Emergency Nursing Procedures

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Foreword

THE HASHEMITE KINGDOM OF JORDAN

المملكة الأردنية الهاشمية

MINISTRY OF HEALTH

وزارة الصحة

Jordan’s health care system improved dramatically in the last years and is recognized as one of the most well-structured efficient health systems in the region. Across Jordan, the hospital emergency departments face many challenges due to the increasing number of patients visiting these departments and to the increasing number of casualties resulting from road traffic accidents.

As guardians of our nation’s health, it is of utmost importance that we ensure high quality, efficient and safe emergency health services for all patients. “The Emergency Nursing Procedures” will help to assure this quality of care. It is part of the evidence based clinical procedures series that was developed by the Ministry of Health and is intended for nurses in Jordan working in the public sector.

This integrated and coordinated collection of nursing procedures, when used conscientiously, will enhance the contribution of nurses in providing high quality emergency services to patients. The result of this improvement in quality of care is expected to be the reduction of disability and mortality rates resulting from traumatic and emergency medical conditions.

The information contained in this publication should be disseminated to and used by all nurses, so that patients will benefit from their increased knowledge and skills.

All those who worked so diligently to produce this series, Ministry of Health personnel and their technical counterparts deserve praise and appreciation.

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ACRONYMS

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ABG	Arterial Blood Gas
ACS	Acute Coronary Syndrome
ACTH	Adreno Cortico Tropic Hormone
ADA	American Diabetic Association
ADH	Antidiuretic Hormone
AED	Antiepileptic Drugs
ALT	Alanine Liver Transference
AMI	Acute Myocardial Infarction
ARDS	Acute Respiratory Distress Syndrome
AST	Aspartate Aminotransferase
ATP	Adult Treatment Panel

B

BP	Blood Pressure

C

CAD	Coronary Artery Disease
CBC	Complete Blood Count
CDU	Chest Drainage Unit
CGM	Continuous Glucose Monitoring
CN	Cranial Nerve
CNS	Central Nervous System
CO	Cardiac Output
COPD	Chronic Obstructive Pulmonary Disease
CPAP	Continuous Positive Airway Pressure
CPP	Cerebral Perfusion Pressure
CPR	Cardiopulmonary Resuscitation
CSF	Cerebro Spinal Fluid
CVP	Central Venous Pressure

D

DI	Diabetes Insipidus
DPG	Diphosoglycerate
DUB	Dysfunctional Uterine Bleeding
DVT	Deep Vein Thrombosis

E

ECG	Electro Cardiogram
EEG	Electro Encephalogram
EMG	Electromyelography
ERCP	Endoscopic Retrograde Cholangiopancreatography
ET	Endotracheal

F

FBS	Fasting Blood Sugar
FEF	Forced Expiratory Flow
FEV_1	Forced Expiratory Volume in One Second
FiO_2	Fraction of Inspired O_2
FVC	Forced Vital Capacity

G

GCS	Glasgow Coma Scale
GDM	Gestational Diabetes Mellitus
GI	Gastrointestinal

H

HHNKS	Hyperosmolar Hyperglycemic Nonketonic Syndrome
HRT	Hormone Replacement Therapy

I

ICP	Intracranial Pressure
INR	International Normalized Ratio

L

LOC	Level of Consciousness
LDH	Lactate Dehydrogernase

M

MAP	Mean Arterial Pressure
MRCP	Magnetic Resonance Cholangio Pancreatography
MRI	Magnetic resonance Imaging
MRSA	Methicillin-Resistant Staplyococcus Aureus
MVV	Maximal Voluntary Ventilation

N

NCEP	The National Cholesterol Education Program
NPO	Nothing Per Os
NSAIDs	Non-Steroidal Anti Inflammatory Drugs

O

ORIF	Open Reduction with Internal Fixation

P

$PaCO_2$	Partial Pressure of Carbon Dioxide in Blood
PAP	Positive Airway Pressure
PAWP	Pulmonary Artery Wedge Pressure
PEEP	Positive End Expiratory Pressure
PEFR	Peak Expiratory Flow Rate
PO_2	Partial Pressure in Blood
PSA	Prostate-Specific Antigen
PT	Prothrombine Time
PTH	Parathyroid Hormone
PUVA	Psoralem Ultraviolet A

R

RAS	Reticular Activating System
ROM	Range of Motion
RBGs	Red Blood Corpuscles

S

SCDs	Superior Canal Dehiscence Syndrome
SCI	Spinal Cord Injury
SIADH	Syndrome of Inappropriate Antidiuretic Hormone
SpO_2	Amount of O_2 Attached to Hemoglobin
SvO_2	Venous O_2 Saturation

T

T3	Tri-iodothyronine
T4	Thyroxine
TBG	Thyroxine Binding Globulin
TBI	Traumatic Brain Injury
TBSA	Total Body Surface Area

Tc-DTPA	Technetium-Diethyele Triamine Pentaacetic Acid
TRH	Thyrotropin-Releasing Hormone
TSH	Thyroid-Stimulating Hormone
TSS	Toxic Shock Syndrome
TSI	Thyroid-Stimulating Immunoglobulin
TURP	Trans Urethral Resection of Prostate

U

UTI	Urinary Tract Infection

V

VMA	Vanillylmandelic Acid
VT	Ventricular Tachycardia
V/Q	Ventilation/Perfusion Ration
VC	Vital Capacity

INTRODUCTION

Jordan’s focus has been on developing its human resources potential, essentially by advancing the well being of its citizens. Overall health conditions in Jordan are significantly improved in the last two decades.

The government of Jordan has a priority to improve health services in the country. Accordingly, the Ministry of Health continues to improve its readiness to meet the increasing number of patients visiting the Emergency Department in MOH hospitals.

Across Jordan, emergency medical services face many challenges; mainly the quality of care, workforce, and infrastructure challenges. Due to increasing number of population and increasing emergency casualties due to high incidence of road traffic accidents, the MOH is taking active steps to improve the status of the infrastructure and staff working in the emergency departments.

Health Systems Strengthening II (HSS II), in partnership with Ministry of Health (MOH), will continue to support programs that expand and institutionalize high quality health care services in the Emergency Departments of MOH hospitals.

This publication offers practical, clearly written procedures on the diagnosis and management of the most commonly encountered emergencies at the Emergency Departments. It was designed to meet the needs of emergency department nurses who offer comprehensive and continuous care for their clients.

This publication was intended to serve as a convenient reference, a guide for service delivery, and a tool to support performance improvement.

This publication is going to be used as a resource that allows any nurse to retrieve basic information easily; it is a reference with enough depth to be useful in a clinical setting, to serve as a source of teaching advice for clients. It is also intended to ensure early and appropriate management of life threatening conditions, and to relieve pain and suffering of patients.

CHAPTER 1: CARDIOPULMONARY RESUSCITATION AND AIRWAY MANAGEMENT

THE SIMPLE TRIAGE AND RAPID TREATMENT (START) SYSTEM

This is a widely accepted system developed by a Californian hospital.

It is a simple step-by-step method, employed by the first qualified person who arrives on the disaster scene. Although designed for the pre-hospital setting, it can be used in the hospital as well.

Communication, Documentation, Organization, Reporting to higher levels, is important during a disaster

Definition

Cardiopulmonary resuscitation (CPR) is a technique of basic life support for the purpose of oxygenating the brain and heart until appropriate, definitive medical treatment can restore normal heart and ventilatory action. Management of airway obstruction or cricothyroidotomy may be necessary to open the airway before CPR can be performed.

Indications

- Cardiac arrest:
  - Ventricular fibrillation.
  - Ventricular tachycardia.
  - Asystole.
  - Pulseless electrical activity.
- Respiratory arrest:
  - Drowning.
  - Stroke.
  - Foreign-body airway obstruction.
  - Smoke inhalation.
  - Drug overdose.
  - Electrocution/injury by lightning.
  - Suffocation
  - Accident/injury.
  - Coma.
  - Epiglottitis.

Assessment

- Immediate loss of consciousness.
- Absence of breath sounds or air movement through nose or mouth.
- Absence of a palpable carotid or femoral pulse; pulselessness in large arteries.

Complications

- Post resuscitation distress syndrome (secondary derangements in multiple organs).
- Neurological impairment, and or brain damage.

Equipment

- Arrest board.
- Oral airway.
- Bag and mask device.
- Oxygen.
- Intravenous (I.V) setup.
- Defibrillator.
- Emergency cardiac drugs.
- Cardiac monitor.
- Electrocardiograph machine.
- Intubation equipment.
- Suction.

Procedure

Nursing Action		Rationale	
Responsiveness/airway			
1.	Determine unresponsiveness: tap or gently shake patient while shouting, "Are you okay?"	1.	This will prevent injury from attempted resuscitation on a person who is not unconscious.
Activate emergency medical service.			
1.	Place the patient supine on a firm, flat surface. Kneel at the level of the patient's shoulders. If head or neck trauma is suspected, he should not be moved unless it is absolutely necessary (e.g., at the site of an accident, fire, or other unsafe environment).	1.	This enables the rescuer to perform rescue breathing and chest compression without changing position.

Circulation			
Determine presence or absence of pulse.			
1.	While maintaining head-tilt with one hand on the patient's forehead, palpate the carotid or femoral pulse for no more than 10 seconds. If pulse is not palpable, start external chest compressions.	1.	Cardiac arrest is recognized by pulselessness in the large arteries of the unconscious, breathless patient. If the patient has a palpable pulse, but is not breathing, initiate rescue breathing at rate of 12 times per minute (once every 5 seconds) after two initial breaths.
External Chest Compressions			
This procedure consists of serial, rhythmic applications of pressure over the middle third of the sternum.			
1.	Kneel as close to side of patient's chest as possible. Place the heel of one hand on the middle third of the sternum, The fingers may either be extended or interlaced but must be kept off the chest.	1.	The long axis of the heel of the rescuer's hand should be placed on the long axis of the sternum so that the main force of the compression is on the sternum, thereby decreasing the chance of rib fracture.
2.	While keeping your arms straight, elbows locked, and shoulders positioned directly over your hands, quickly and forcefully depress the middle third of the patient's sternum straight down one-third the depth of the chest.		
3.	Release the external chest compression completely and allow the chest to return to its normal position after each compression. The time allowed for release should equal the time required for compression. Do not lift your hands from the patient's chest or change position.	3.	Release of the external chest compression allows blood flow into the heart.
4.	For cardiopulmonary resuscitation (CPR) performed by one rescuer, do 30 compressions at a rate of 100 per minute and then perform two ventilations; reevaluate the patient. After four cycles of 30 compressions and two breaths each, check the pulse; check again every few minutes thereafter. Minimize interruptions of chest compressions.	4.	Rescue breathing and external chest compressions must be combined. Check for return of carotid pulse. If absent, resume CPR with two ventilations followed by compressions. For CPR performed by health professionals, mouth-to-mask ventilation is an acceptable alternative to rescue breathing.
5.	For CPR performed by two rescuers, the compression rate is 100 per minute. The compression-ventilation ratio is 30:2. Once an advanced airway is in place, the compressing rescuer should give continuous chest compressions at a rate of 100 without pauses for ventilation. The rescuer delivering ventilation provides 8 to 10 breaths per minute.		
Open the Airway			
1.	*Head-tilt/chin-lift maneuver:* Place one hand on the patient's forehead and apply firm backward pressure with the palm to tilt the head back. Then, place the fingers of the other hand under the bony part of the lower jaw near the chin and lift up to bring the jaw forward and the teeth almost to occlusion.	1.	In the absence of sufficient muscle tone, the tongue or epiglottis will obstruct the pharynx and larynx. This supports the jaw and helps tilt the head back.

2.	*Jaw-thrust maneuver:* Grasp the angles of the patient's lower jaw, lifting with both hands, one on each side; displacing the mandible forward, while tilting the head backward.		2.	The jaw-thrust technique without head tilt is the safest method for opening the airway in the presence of suspected neck injury.
Breathing				
1.	Place ear over patient's mouth and nose while observing the chest, *look* for the chest to rise and fall, *listen* for air escaping during exhalation, and *feel* for the flow of air.		1.	To determine presence or absence of spontaneous breathing.
2.	Perform rescue breathing by mouth-to-mouth, using a ventilation barrier device. While keeping the patient's airway open, pinch the nostrils closed using the thumb and index finger of the hand you have placed on his forehead. Take a deep breath, open your mouth wide, and place it around the outside edge of the patient's mouth to create an airtight seal. Ventilate the patient with two full breaths (each lasting 1 second), taking a breath after each ventilation. If the initial ventilation attempt is unsuccessful, reposition the patient's head and repeat rescue breathing.		2.	This prevents air from escaping from the patient's nose. Adequate ventilation is indicated by seeing the chest rise and fall, feeling the air escape during ventilation, and hearing the air escape during exhalation.
Usage of Special Resuscitation Equipment				
1.	While resuscitation proceeds, simultaneous efforts are made to obtain and use special resuscitation equipment to manage breathing and circulation and provide definitive care.		1.	Definitive care includes defibrillation, pharmacotherapy for dysrhythmias and acid-base disturbances, and ongoing monitoring and skilled care in an intensive care unit.
2.	Utilize the automated external defibrillator (AED) as soon as possible. Special circumstances affecting use of AEDs include:		2.	The American Heart Association supports the use of AEDs in public places as well as medical centers.
	a.	AEDs should not be used on children younger than age 8.	a.	The default energy level of AEDs is too high for children younger than age 8.
	b.	The victim should not be lying in water when using an AED. Make sure the patient's chest is dry before attaching the AED.	b.	Using an AED when patients are wet or lying in water may result in burns and shocks to the rescuer.
	c.	Do not place the AED electrode directly over an implanted pacemaker.	c.	Placing an AED pad directly over an implanted pacemaker may reduce the effectiveness of the defibrillation.
	d.	Remove any transdermal medication patches from the patient before using the AED.	d.	Placing an AED pad over a transdermal medication patch may make the defibrillation less effective and cause a burn.

3.	The four basic steps used in AED operation are:		3.	The directions provided for operation of the AED were provided by the device manufacturer.	
	a.	Turn the power on.			
	b.	Attach the AED pads to the patient's chest, using the diagrams on the pads to show you exactly where to place them.			
	c.	Analyze the patient's rhythm by pushing the button on the AED labeled ANALYZES. During this time, no one should touch the patient.		c.	Touching the patient could create artifact and interfere with analysis.
	d.	Charge the AED and deliver the shock if indicated by the AED. Make sure that no one is touching the patient. Push the shock button; the AED will provide visual and voice prompts to tell you what to do.		d.	If the machine delivered a shock, anyone touching the patient would feel it.

NURSING ALERT

The patient who has been resuscitated is at risk for another episode of cardiac arrest.

CHAPTER 2: RESPIRATORY FUNCTION

Definition

The major function of the pulmonary system (lungs and pulmonary circulation) is to deliver oxygen (O_2) to body cells and remove carbon dioxide (CO_2) from the cells (**gas exchange).** The adequacy of oxygenation and ventilation is measured by partial pressure of arterial oxygen (PaO_2) and partial pressure of arterial carbon dioxide ($PaCO_2$). The pulmonary system also functions as a blood reservoir for the left ventricle when the body needs to boost cardiac output; as a protector for the systemic circulation by filtering debris/particles; as a fluid regulator so water can be kept away from the alveoli; and as a provider of metabolic functions such as surfactant production and endocrine functions.

Assessment

Subjective Data:

Dyspnea, Cough, Chest Pain, Haemoptysis

- Explore the patient's symptoms through characterization and history taking to help anticipate needs and plan care.

Objective Data:

Inspection, Palpation, Percussion, Auscultation

Key Observations

- What are the respiratory rate, depth, and pattern? Are accessory muscles being used? Is the patient breathing through the mouth or pursing lips during exhalation? Is sputum being raised, and what is its appearance and odor?
- Is there an increase in the anterior to posterior chest diameter, suggesting air trapping?
- Is there obvious orthopnea or splinting?
- Is there clubbing of the fingers, associated with bronchiectasis, lung abscess, empyema, cystic fibrosis, pulmonary neoplasm, and various other disorders?
- Is there central cyanosis indicating possible hypoxemia or cardiac disease? Are mucous membranes and nail beds pink?
- Are there signs of tracheal deviation, as seen with pneumothorax?
- Are the jugular veins distended? Is there peripheral edema or other signs of cardiac dysfunction?
- Does palpation of the chest cause pain? Is chest expansion symmetrical? Any change in tactile fremitus?
- Is percussion of lung fields resonant bilaterally? Is diaphragmatic excursion equal bilaterally?
- Are breath sounds present and equal bilaterally? Are the lung fields clear or are there rhonchi, wheezing, crackles, stridor, or pleural friction rub? Does auscultation reveal ego phony, bronchophony, or whispered pectoriloquy?

DIAGNOSTIC TESTS

Laboratory Studies

Arterial Blood Gas Analysis

Description

- A measurement of O_2, CO_2, and the pH of the blood that provides a means of assessing the adequacy of ventilation ($PaCO_2$), metabolic status (pH), and oxygenation (PaO_2).
- Allows assessment of body's acid-base (pH) status, indicating if acidosis or alkalosis is present, whether acidosis or alkalosis is respiratory or metabolic in origin, and whether it is compensated or uncompensated.
- Used for diagnostic evaluation and evaluation of the patient's response to clinical interventions (oxygen therapy, mechanical ventilation, etc.).

Nursing and Patient Care Considerations

- Blood can be obtained from any artery, but is usually drawn from the radial, brachial, or femoral site. It can be drawn directly by arterial puncture or accessed by way of indwelling arterial catheter. Determine facility policy for qualifications for Arterial blood gases (ABG) sampling and the site of arterial puncture.
- If the radial artery is used, an Allen test must be performed before the puncture to determine if collateral circulation is present.
- Arterial puncture should not be performed through a lesion, or distal to a surgical shunt, or in area where peripheral vascular disease or infection is present.
- Coagulopathy or medium- to high-dose anticoagulation therapy may be a relative contraindication for arterial puncture.
- Results may be affected by recent changes in oxygen therapy, suctioning, or positioning.
- Interpret ABG values by looking at trends for the patient as well as the following normal values:
  - PaO_2—partial pressure of arterial oxygen (80 - 100 mm Hg).
  - $PaCO_2$—partial pressure of arterial carbon dioxide (35 - 45 mm Hg).
  - SaO_2—arterial oxygen saturation (> 95%).
  - PH—hydrogen ion concentration, or degree of acid-base balance (7.35 - 7.45); bicarbonate (HCO_3-) ion primarily a metabolic buffer—22 to 26 mEq/L.

Nursing and Patient Care Considerations

- Observe and record the total amount of fluid withdrawn, nature of fluid, and its color and viscosity.
- Prepare a sample of the fluid and ensure it is transported to the laboratory.
- A chest X-ray may be done before or after the fluid is withdrawn.
- Patients should not cough, breathe deeply, or move while fluid is being withdrawn.

- Instruct patients to inform the provider immediately if sharp chest pain or shortness of breath occurs.

RADIOLOGY AND IMAGING

Chest X-Ray

Description

- Normal pulmonary tissue is radiolucent and appears black on film. Thus, densities produced by tumors, foreign bodies, and infiltrates can be detected as lighter or white images.
- Commonly, two views (posterior-anterior and lateral) are taken.
- This test shows the position of normal structures, displacement, and presence of abnormal shadows. It may reveal pathology in the lungs in the absence of symptoms.

Computed Tomography Scan (CT scan)

Description

- Cross-sectional X-rays of the lungs are taken from many different angles and processed through a computer to create three-dimensional images. This three-dimensional imaging provides more complete diagnostic information than the two-dimensional X-ray.
- It may be used to define pulmonary nodules, pulmonary abnormalities, or to demonstrate mediastinal abnormalities and hilar adenopathy.

Magnetic Resonance Imaging (MRI)

Description

- Non-invasive procedure that uses a powerful magnetic field, radio waves, and a computer to produce detailed pictures of organs, soft tissue, bone, and other internal structures.

Bronchoscopy

Description

- The direct inspection and observation of the upper and lower respiratory tract through fiber-optic (flexible) or rigid bronchoscope as a means of diagnosing and managing inflammatory, infectious, and malignant diseases of the airway and lungs.
- Flexible fiber-optic bronchoscope allows for more patient comfort and better visualization of smaller airways, including nasal passages.
- Rigid bronchoscopy, often performed under general anesthesia with adequate sedation and muscle relaxants, may be combined with flexible bronchoscopy for better access to distal airways.

Diagnostic and therapeutic indications include:

- Bleeding or hemorrhage.
- Foreign body extraction.
- Deeper biopsy specimen collection than can be obtained fiber-optically.
- Dilation of tracheal or bronchial strictures.
- Relief of airway obstruction.
- Insertion of stents.
- Tracheo bronchial laser therapy or other mechanical tumor ablation.

> ***NURSING ALERT***
> *After bronchoscopy, be alert for complications, such as pneumothorax, dysrhythmias, laryngospasm, and bronchospasm.*

Pulse Oximetry

Description

- Non-invasive monitoring that provides an estimate of arterial oxyhemoglobin saturation by using selected wavelengths of light to determine the saturation of oxyhemoglobin. Oximeters function by passing a light beam through a vascular bed, such as the finger or earlobe, to determine the amount of light absorbed by oxygenated (red) and deoxygenated (blue) blood.
- Calculates the amount of arterial blood that is saturated with oxygen (SaO_2) and displays this as a percentage.
- Only provides and indication of oxygenation, not ventilation.
- Indications include:
  - Monitor adequacy of oxygen saturation; quantify response to therapy.
  - Monitor unstable patient who may experience sudden changes in blood oxygen level.
  - Evaluation of the need for home oxygen therapy.
  - Determine supplemental oxygen needs at rest, with exercise, and during sleep.
  - Allows the provider to follow the patient's oxygenation trends and the need to decrease the number of ABG samples.
- The oxyhemoglobin dissociation curve allows for the correlation between SaO_2 and PaO_2:
  - Increased body temperature, acidosis, and increased phosphates (2, 3-DPG) cause a shift in the curve to the right, thus increasing the ability of hemoglobin to release oxygen to the tissues.
  - Decreased temperature, decreased 2, 3-DPG, and alkalosis cause a shift to the left; causing hemoglobin to hold on to oxygen, reducing the amount of oxygen being released to the tissues.

- Increased bilirubin, increased carboxyhemoglobin, low perfusion, or SaO_2 less than 80%, may alter light absorption and interfere with results.

> ***NURSING ALERT***
> *There is a potential error in SaO_2 readings of ±2% that can increase to greater than 2% if the patient's SpO_2 drops below 80%. Oximeter relies on the differences in light absorption to determine SaO_2. At lower saturations, oxygenated hemoglobin appears bluer in color and is less easily distinguished from deoxygenated hemoglobin. ABG analysis should be used in this situation.*

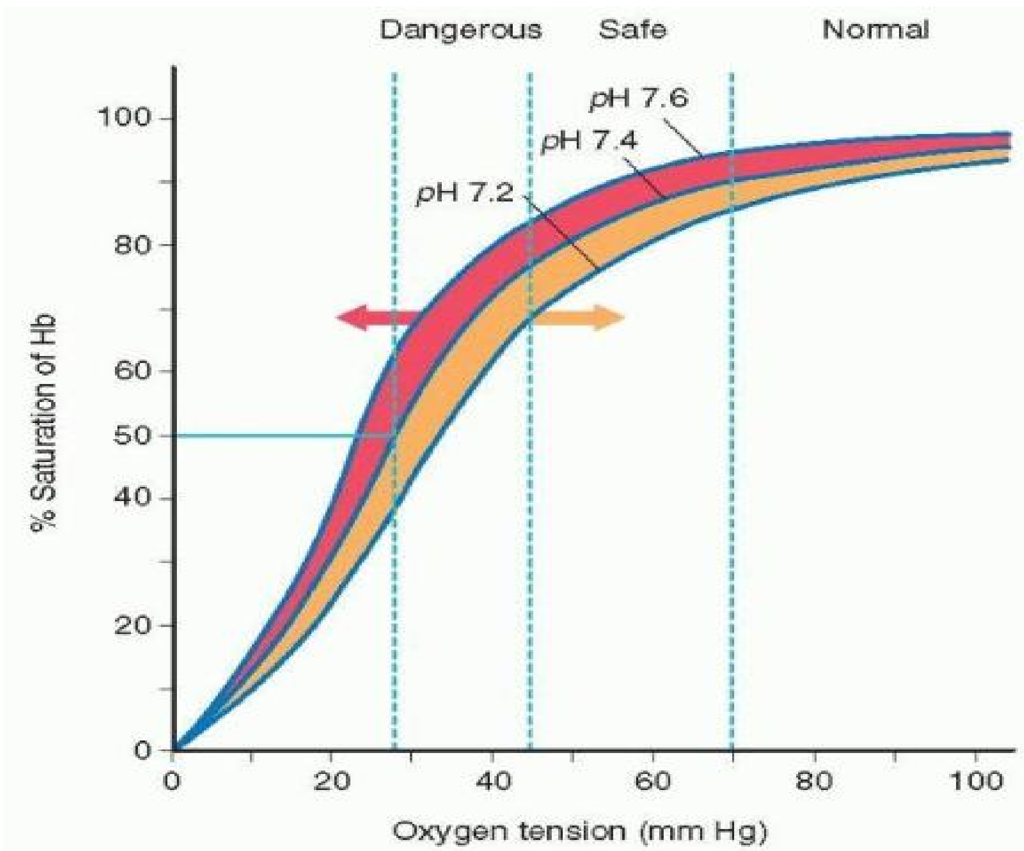

FIGURE 1: The oxyhemoglobin dissociation curve shows the relation between the partial pressure of oxygen and the oxygen saturation. At pressures greater than 60 mm Hg, the curve is essentially flat with blood oxygen content not changing with increases in the oxygen partial pressure. As oxygen partial pressures decrease in the slope of the curve, the oxygen is unloaded to peripheral tissue as the hemoglobin's affinity decreases. The curve is shifted to the right by an increase in temperature, 2, 3-DPG, or $PaCO_2$, or a decrease in pH, and to the left by the opposite of these conditions (Lippincot Manual of Nursing Procedures).

Nursing and Patient Care Considerations

- Assess patient's hemoglobin. SaO_2 may not correlate well with PaO_2 if hemoglobin is not within normal limits.
- Remove patient's nail polish, it can affect the ability of the sensor to correctly determine oxygen saturation, particularly polish with blue or dark colors.
- Correlate oximetry with ABG values and then use for single reading or trending of oxygenation (Oximetry does not monitor $PaCO_2$).
- Displayed heart rate (Oxymeter) should correlate with patient's heart rate.
- To improve the quality of the signal, hold the patient’s finger dependent and motionless (motion may alter results), and cover the finger sensor to occlude ambient light.
- Assess the site of oximetry monitoring for perfusion on a regular basis, because a pressure ulcer may occur from prolonged application of the probe. Rotate probe every two hours.
- Device limitations include motion artifact, abnormal hemoglobin (carboxyhemoglobin and methemoglobin), I.V. dye, the exposure of the probe to ambient light, low perfusion states, skin pigmentation, nail polish or nail coverings, and nail deformities such as severe clubbing.
- Document inspired oxygen or supplemental oxygen and the type of oxygen delivery device.
- Accuracy can be affected by decreased peripheral perfusion, ambient light, I.V. dyes, nail polish, deeply pigmented skin, cold extremities, hypothermia, patients in sickle cell crisis, jaundice, severe anemia, and use of antibiotics such as sulfas. In patients with COPD, oxygen saturation levels may remain unchanged, even though CO_2 levels may be rising as the patient becomes acidotic. Pulse oximetry will not detect this deterioration.
- Contraindicated for monitoring patients who have high levels of arterial carboxyhemoglobin, such as victims of fire.

GENERAL PROCEDURES AND TREATMENT MODALITIES

ARTIFICIAL AIRWAY MANAGEMENT

Indications

- Airway management may be indicated in patients with:
  - Loss of consciousness.
  - Facial or oral trauma.
  - Aspiration
  - Tumors.
  - Infection.
  - Copious respiratory secretions.
  - Respiratory distress.
  - The need for mechanical ventilation.

Types of Airways

- **Oropharyngeal airway—**curved plastic device inserted through the mouth and positioned in the posterior pharynx to move the tongue away from the palate and open the airway.
  - Usually for short-term use in the unconscious patient or may be used along with an oral ET tube.
  - Not used if recent oral trauma, surgery, or if loose teeth are present.
  - Does not protect against aspiration.
- **Nasopharyngeal airway (nasal trumpet)—**soft rubber or plastic tube inserted through nose into posterior pharynx:
  - Facilitates frequent nasopharyngeal suctioning.
  - Use extreme caution with patients on anticoagulants or bleeding disorders.
  - Select the size that is slightly smaller than the diameter of nostril, and slightly longer than the distance from the patient's tip of the nose to the earlobe.
  - Check the nasal mucosa for irritation or ulceration, and the clean airway with hydrogen peroxide and water.
- **Laryngeal mask airway—**composed of a tube with a cuffed mask like projection at the distal end; inserted through the mouth into the pharynx; seals the larynx and leaves distal opening of tube just above the glottis:
  - Easier placement than a ET tube, because visualization of the vocal cords is not necessary.
  - Provides ventilation and oxygenation comparable to that achieved with an ET tube.
  - Cannot prevent aspiration, because it does not separate the GI tract from the respiratory tract.
  - May cause laryngospasm and bronchospasm.

- **Combitube—**double-lumen tube with pharyngeal lumen and tracheo esophageal lumen; pharyngeal lumen has a blocked distal end and perforations at pharyngeal level; tracheo esophageal lumen has open upper and lower end; large oropharyngeal balloon serves to seal the mouth and nose; distal cuff seals the esophagus or trachea.
- **Endo Tracheal Tube—**flexible tube inserted through the mouth or nose and into the trachea beyond the vocal cords that acts as an artificial airway.
  - Maintains a patent airway.
  - Allows for deep tracheal suction and removal of secretions.
  - Permits mechanical ventilation.
  - Inflated balloon seals off trachea so aspiration from the GI tract cannot occur.
  - Generally easy to insert in an emergency, but maintaining placement is more difficult; not for long-term use.
- **Tracheostomy tube**—firm, curved artificial airway inserted directly into the trachea at the level of the second or third tracheal ring through a surgically made incision.
  - Permits mechanical ventilation and facilitates secretion removal.
  - Can be for long-term use.
  - Bypasses upper airway defenses, increasing susceptibility to infection.
  - Allows the patient to eat and swallow.

> ***NURSING ALERT***
> *Position the patient on their side and suction the oral cavity frequently to prevent aspiration of oral secretions or vomitus when an oral airway is in place.*
> *Nasopharyngeal airways may obstruct sinus drainage and produce acute sinusitis. Be alert to fever and facial pain.*

Endotracheal Tube Insertion

- Orotracheal insertion is technically easier, because it is done under direct visualization. Disadvantages are increased oral secretions, decreased patient comfort, difficulty with tube stabilization, and inability of patient to use lip movement as a communication means.
- NT insertion may be more comfortable to the patient and is easier to stabilize. Disadvantages are that blind insertion is required; possible development of pressure necrosis of the nasal airway, sinusitis, and otitis media.
- Tube types vary according to length and inner diameter, type of cuff, and number of lumens.
- Usual sizes for adults are 6- 9.0 mm.
- Most cuffs are high volume, low pressure, with self-sealing inflation valves, or the cuff may be made of foam rubber (Fome-Cuff).
- Most tubes have a single lumen; however, dual-lumen tubes may be used to ventilate each lung independently.

- May be contraindicated when the glottis is obscured by vomitus, bleeding, foreign body, trauma, cervical spine injury or deformity.

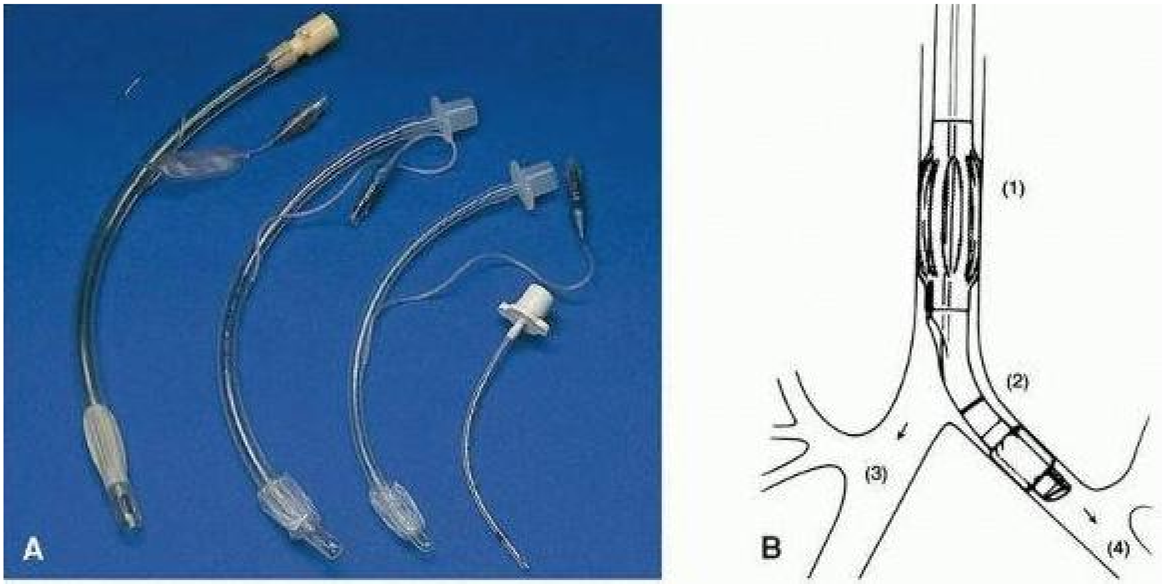

FIGURE 2: (A) Endotracheal tubes: single-lumen and double-lumen endotracheal tube. When the double-lumen tube is used (B), two cuffs are inflated. One cuff (1) is positioned in the trachea and the second cuff (2) in the left main stem bronchus. After inflation, air flows through an opening below the tracheal cuff (3) to the right lung and through an opening below the bronchial cuff (4) to the left lung. This permits differential ventilation of both lungs, lavage of one lung, or selective inflation of either lung during thoracic surgery. Marshall, B.E., Longnecker, D.E., and Fairley, H.B. (Eds.) (1988). Anesthesia for thoracic procedures. Boston: Blackwell Scientific Publications.

Tracheostomy Tube Insertion

Types:

- Tube types vary according to presence of inner cannula, and the presence and type of cuff:
  - Tubes with high-volume, low-pressure cuffs with self-sealing inflation valves; with or without inner cannula.
  - Fenestrated tube.
  - Foam-filled cuffs (Fome-Cuff).
  - Speaking tracheostomy tube.
  - Tracheal button or Passy-Muir valve.
  - Silver tube (rarely used).
    Vary according to length and inner diameter in millimeters. Usual sizes for an adult are 5-8.
  - Tracheostomy is usually planned, either as an adjunct to therapy for respiratory dysfunction or for longer-term airway management when ET intubation has been used for more than 14 days.

- May be done at the bedside in an emergency when other means of creating an airway have failed.

Cuffless: nonfenestrated (left) and fenestrated (right). Tracheostomy plug to allow breathing through upper airway is also shown.

Cuffed: fenestrated (left) and nonfenestrated (right) with inner cannula and obturator for insertion. Percutaneous tracheostomy inducer (bottom).

Speaking valve.

FIGURE 3: Types of tracheostomy tubes. (Courtesy of Mallinckrodt Medical, St. Louis, Mo.)

INDICATIONS FOR ENDOTRACHEAL OR TRACHEOSTOMY TUBE INSERTION

- Acute respiratory failure, central nervous system (CNS) depression, neuromuscular disease, pulmonary disease, or chest wall injury.
- Upper airway obstruction (tumor, inflammation, foreign body, or laryngeal spasm).
- Anticipated upper airway obstruction from edema or soft tissue swelling due to head and neck trauma, some postoperative head and neck procedures involving the airway, facial or airway burns, and decreased level of consciousness (LOC).
- Need for airway protection (vomiting, bleeding, or altered mental status).
- Aspiration prophylaxis.
- Fracture of the cervical vertebrae with spinal cord injury; requiring ventilatory assistance.

COMPLICATIONS OF ENDOTRACHEAL OR TRACHEOSTOMY TUBE INSERTION

- Laryngeal or tracheal injury:
  - Sore throat, hoarse voice.
  - Glottis edema.

    - Trauma (damage to teeth or mucous membranes, perforation or laceration of pharynx, larynx, or trachea).
    - Aspiration.
    - Laryngospasm, bronchospasm.
    - Ulceration or necrosis of tracheal mucosa.
    - Vocal cord ulceration, granuloma, or polyps.
    - Vocal cord paralysis.
    - Postextubation tracheal stenosis.
    - Tracheal dilation.
    - Formation of tracheal-esophageal fistula.
    - Formation of tracheal-arterial fistula.
    - Innominate artery erosion.
- Pulmonary infection and sepsis.
- Dependence on artificial airway.

NURSING ALERT
Avoid the use of petroleum jelly to lubricate the nares, because it is flammable and may clog the openings of the cannula. Use saline spray or water-based gel.

NURSING ALERT
Monitor functioning of mask to ensure that side ports of mask do not get blocked. This could lead to the patients inability to exhale and may lead to suffocation.

NURSING ALERT

- *CPAP is used when patients have not responded to attempts to increase PaO_2 with other types of masks.*
- *The patient will require frequent assessments to detect changes in their LOC, respiratory and cardiovascular status.*
- *If the patient's LOC decreases or ABGs deteriorate, intubation may be necessary.*

NURSING ALERT

- *Make sure that a good seal is maintained between the face and mask so that the volume delivered through bag compression is not lost.*
- *Airways are not appropriate in a conscious patient or patients with a gag reflex because stimulation of the oropharynx could cause vomiting and aspiration. Short nasal pumps can be used in conscious patients with a gag reflex.*
- *All Joint Commission-accredited hospitals must be smoke free; however, other health care facilities and homes where oxygen is used may allow smoking. Make sure that no smoking is permitted where oxygen is used.*

MECHANICAL VENTILATION

The mechanical ventilator device functions as a substitute for the bellows action of the thoracic cage and diaphragm. The mechanical ventilator can maintain ventilation automatically for prolonged periods. It is indicated when the patient is unable to maintain safe levels of oxygen or CO_2 by spontaneous breathing, even with the assistance of other oxygen delivery devices.

Clinical Indications

- Mechanical Failure of Ventilation.
- Disorders of Pulmonary Gas Exchange.

Types of Ventilators

- Negative Pressure Ventilators.
- Positive Pressure Ventilators.

During mechanical inspiration, air is actively delivered to the patient's lungs under positive pressure. Exhalation is passive. Mechanical ventilation requires the use of a cuffed artificial airway.

Nursing Assessment and Interventions

- Monitor for complications:
  - Airway aspiration, decreased clearance of secretions, ventilator-acquired pneumonia, tracheal damage, or laryngeal edema.
  - Impaired gas exchange.
  - Ineffective breathing pattern.
  - ET tube kinking, cuff failure, or mainstem intubation.
  - Sinusitis.
  - Pulmonary infection.

  - Barotrauma (pneumothorax, tension pneumothorax, subcutaneous emphysema, or pneumomediastinum).
  - Decreased cardiac output.
  - Atelectasis.
  - Alteration in GI function (stress ulcers, gastric distention, or paralytic ileus).
  - Alteration in renal function.
  - Alteration in cognitive-perceptual status.
- Suction the patient as indicated:
  - When secretions can be seen, or sounds resulting from secretions are heard with or without the use of a stethoscope.
  - After chest physiotherapy.
  - After bronchodilator treatments.
  - Increased peak airway pressure in mechanically ventilated patients that is not due to the artificial airway or ventilator tubing being kinked, the patient biting the tube, the patient's coughing or struggling against the ventilator, or a pneumothorax.
- Provide routine care for a patient on the mechanical ventilator, including: provide regular oral care to prevent ventilator-associated pneumonia. Provide humidity and repositioning to mobilize secretions.
- Assist with the weaning process, when indicated (patient gradually assumes responsibility for regulating and performing own ventilations):
  - Patient must have acceptable ABG values, no evidence of acute pulmonary pathology, and must be hemodynamically stable:
  - Obtain serial ABGs and/or oximetry readings, as indicated.
  - Monitor very closely for change in pulse, BP, anxiety, and increased rate of respirations.
  - The patient is awake and cooperative and displays optimal respiratory drive.
- Once weaning is successful, extubate and provide alternate means of oxygen.
- Extubation will be considered when the pulmonary function parameters of VT, VC, and negative inspiratory pressure are adequate, indicating strong respiratory muscle function.

NURSING ALERT:

For patients in a severe compromised respiratory state or who are unstable homodynamically, consider the use of a specialty bed with kinetic therapy.

DRUG ALERT:

Never administer paralyzing agents until the patient is intubated and on mechanical ventilation. Sedatives should be prescribed in conjunction with paralyzing agents, because the patient may not be able to move but can still have awareness of his surroundings and inability to move.

CHEST DRAINAGE

Definition

Placement of a chest tube in the pleural space.

Indications for Chest Tube Use

Indication	Accumulating Substance
Pneumothorax	Air
Hemothorax	Blood
Pleural effusion	Fluid
Chylothorax	Lymphatic fluid
Empyema	Pus

It is necessary to keep the pleural space evacuated postoperatively and to maintain negative pressure within this potential space. Therefore, during or immediately after thoracic surgery, chest tubes/catheters are positioned strategically in the pleural space, sutured to the skin, and connected to a drainage apparatus to remove the residual air and fluid from the pleural or mediastinal space. This assists in the reexpansion of remaining lung tissue.

Sites for chest tube placement are

- Pneumothorax (air)—second or third interspace along midclavicular or anterior axillary line.
- Hemothorax (fluid)—fifth - seventh lateral interspace in the midaxillary line.
- Chest drainage can also be used to treat spontaneous pneumothorax, hemothorax, or both (caused by trauma).

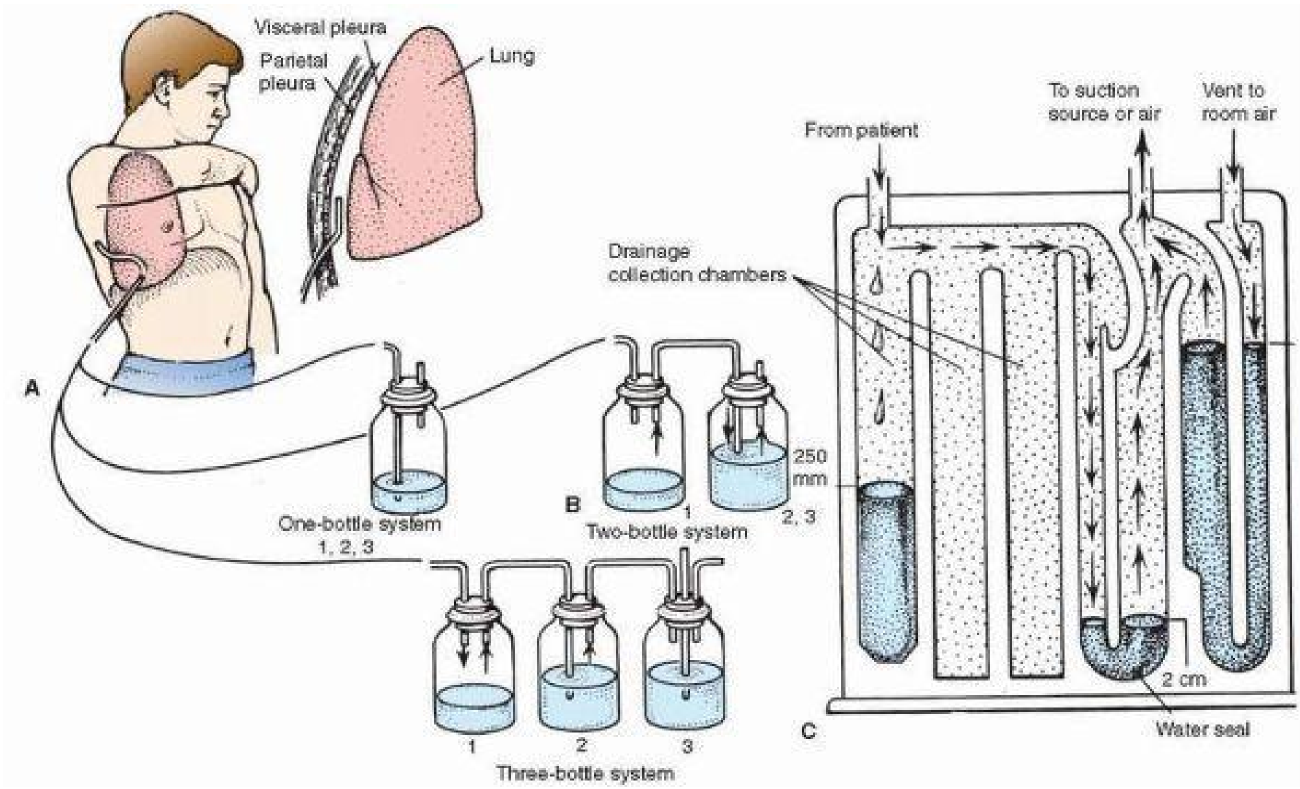

FIGURE 4: Chest drainage systems. (A) Strategic placement of a chest catheter in the pleural space. (B) Three types of mechanical drainage systems. A Pleur-vac operating system: (1) the collection chamber, (2) the water-seal chamber, and (3) the suction control chamber. The Pleurevac is a single unit with all three bottles identified as chambers (Lippincot Manual of Nursing Procedures).

> ***NURSING ALERT***
> *When the motor or the wall vacuum is turned off, the drainage system should be open to the atmosphere so that intrapleural air can escape from the system. This can be done by detaching the tubing from the suction port to provide a vent.*

> ***NURSING ALERT***
> *Milking and stripping of chest tubes to maintain patency is no longer recommended. This practice has been found to cause significant increases in intrapleural pressures and damage to the pleural tissue. New chest tubes contain a nonthrombogenic coating, thus decreasing the potential for clotting. If it is necessary to help the drainage move through the tubing, apply a gentle squeeze-and-release motion to small segments of the chest tube between your fingers.*

> ***NURSING ALERT***
> *Clamping of chest tubes is no longer recommended due to the increased danger of tension pneumothorax from rapid accumulation of air in the pleural space. Clamp only momentarily to change the drainage system. Check for leaks to assess the patient's tolerance for removal of the chest tube (perhaps up to 24 hours).*

Chest Drainage Unit (CDU)

Types	Description	Indications for use
Standard CDU	Drainage of pleural cavity for air or any type of fluid with or without use. Up to 2,000 ml capacity.	Following surgery that impacts the continuity of suction of the thoracic cavity (e.g., thoracic, cardiac, esophageal surgery).
	Replaced when full.	Pneumothorax.
		Hemothorax.
		Pleural effusion.
		Pleurodesis.
Smaller Portable CDU	Drainage without the use of suction.	For ambulatory patients.
	Dry seal system that prevents air leaks.	Home care.
	No lung reexpansion occurs.	Chronic conditions.
	500 ml maximum drainage.	
	Emptied when used in home.	
Indwelling Pleural Catheter	Small size chest tube or pigtail catheter (smaller than standard 14F).	Pneumothorax. Chronic drainage of fluid.
	Can be irrigated if occluded by health care provider.	Not for trauma or blood. Can be used for pleurodesis.
	Less traumatic.	
Heimlich Valve	One-way flutter valve.	Evacuates air from the pleural space.
	Removes air as the patient exhales. Opens when the pleural space pressure is greater than atmospheric pressure and closes when the reverse occurs.	Used for emergency transport, home care, and long-term care units.

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CHAPTER 3: RESPIRATORY FAILURE

Types:

Acute Respiratory Failure

- Characterized by hypoxemia (PaO2 less than 50 mm Hg) and/or hypercapnia (PaCO2 greater than 50 mm Hg) and acidosis (pH less than 7.35).
- Occurs rapidly, usually over minutes, sometimes it develops over hours or days.

Chronic Respiratory Failure

- Characterized by hypoxemia (decreased PaO2) and/or hypercapnia (increased PaCO2) with a normal pH (7.35 to 7.45).
- Occurs over a period of days to months to years; allowing for activation of compensatory mechanisms, including bicarbonate retention with normalization of pH.

Combined Acute on top of Chronic Respiratory Failure

- A condition characterized by an abrupt increase in the degree of hypoxemia and/or hypercapnia in patients with preexisting chronic respiratory failure.
- The condition may occur after an acute upper respiratory infection, pneumonia, respiratory exacerbation, or without obvious cause.
- Extent of deterioration is best assessed by comparing the patient's present ABG levels with previous ABG levels (patient baseline).

Clinical Manifestations

- Hypoxemia—restlessness, agitation, dyspnea, disorientation, confusion, delirium, and/or loss of consciousness.
- Hypercapnia—headache, somnolence, dizziness, and/or confusion.
- Tachypnea initially; then, when no longer able to compensate, bradypnea.
- Accessory muscle use.
- Asynchronous respiration.

> ***NURSING ALERT***
> *Avoid administration of fraction of inspired oxygen (FiO_2) of 100% for COPD patients because you may depress the respiratory center drive. For COPD patients, the drive to breathe may be hypoxemia.*

NURSING ALERT
Note changes suggesting increased work of breathing (dyspnea, tachypnea, diaphoresis, intercostal muscle retraction, fatigue) or pulmonary edema (fine, coarse crackles or rales, frothy pink sputum).

NURSING ALERT
Obtain ABG levels whenever the history, or signs and symptoms, suggest the patient is at risk for developing respiratory failure. Initial and subsequent values should be recorded so comparisons can be made over time. The need for ABG analysis can be decreased by using an oximeter to continuously monitor oxygen saturation (SaO_2). Correlate oximeter values with ABG values and then use oximeter for trending. Be aware that oximetry does not measure $PaCO_2$ and pH, which are important determinants of respiratory acidosis.

Complications

- Oxygen toxicity if prolonged high FiO2 required.
- Barotrauma from mechanical ventilation intervention.

Nursing Assessment

- Assess breath sounds.
  - Diminished or absent sounds suggest inability to ventilate the lungs sufficiently to prevent atelectasis.
  - Crackles may indicate ineffective airway clearance and/or fluid in the lungs.
  - Wheezing indicates narrowed airways and bronchospasm.
  - Rhonchi and crackles suggest ineffective secretion clearance.
- Assess level of consciousness (LOC) and ability to tolerate increased work of breathing.
  - Confusion, lethargy, rapid shallow breathing, abdominal paradox (inward movement of abdominal wall during inspiration), and intercostal retractions suggest inability to maintain adequate minute ventilation.
- Assess for signs of hypoxemia and hypercapnia.
  - Analyze ABG and compare with previous values.
  - If the patient cannot maintain minute ventilation sufficient to prevent CO_2 retention, pH will fall.
  - Mechanical ventilation or non-invasive ventilation may be needed if pH falls to 7.30 or below.
- Determine vital capacity (VC) and respiratory rate and compare with values indicating need for mechanical ventilation:
  - VC < 15 mL/kg.

- Respiratory rate > 30 breaths/minute.
- Negative inspiratory force < -15 to -25 cm H_2O.
- Refractory hypoxia.

ASPIRATION PNEUMONIA

Definition

Aspiration is the inhalation of oropharyngeal secretions and/or stomach contents into the lungs. It may produce an acute form of pneumonia.

Nursing Assessment

- Assess for airway obstruction.
- Assess for risk factors for aspiration.
- Assess for development of fever, foul-smelling sputum, and development of congestion.

Nursing Interventions

- Be on guard constantly, and monitor patients at risk as described earlier.
- Elevate head of bed for debilitated patients, for those receiving tube feedings, and for those with neurological or motor diseases of the esophagus.
- Place patients with impaired cough and/or gag reflexes in an upright position.
- Make sure NG tube is patent.
- Give tube feedings slowly, with patient sitting up in bed. Check for tube feeding residuals.
- Check position of tube in stomach before feeding.
- Check the seal of a tracheostomy or ET tube cuff before feeding.
- Keep the patient in a fasting state before anesthesia (at least 8 hours).
- Feed patients with impaired swallowing slowly, and make sure that no food is retained in their mouth after feeding.
- Determine hemodynamic status
- Blood pressure (BP), heart rate, pulmonary wedge pressure, cardiac output, and SvO_2 should be compared with previous values. If the patient is mechanically ventilated with positive end-expiratory pressure (PEEP), venous return may be limited, resulting in decreased cardiac output.

> ***NURSING ALERT***
> *Morbidity and mortality rate of aspiration pneumonia remain high even with optimum treatment. Prevention is the key to the problem.*

Nursing Diagnoses

- Impaired Gas Exchange related to inadequate respiratory center activity or chest wall movement, airway obstruction, and/or fluid in lungs.
- Ineffective Airway Clearance related to increased or tenacious secretions.

NURSING INTERVENTIONS

Maintaining Airway Patency

- Administer medications to increase alveolar ventilation—bronchodilators to reduce bronchospasm, corticosteroids to reduce airway inflammation.
- Teach slow, pursed-lip breathing to reduce airway obstruction and improve oxygen levels. Chest physiotherapy may be considered to remove mucus.
- Suction patient, as needed, to assist with removal of secretions.
- If the patient becomes increasingly lethargic, cannot cough or expectorate secretions, cannot cooperate with therapy, or if pH falls below 7.30, despite use of the above therapy; report and prepare to assist with intubation and initiation of mechanical ventilation.

Improving Gas Exchange

- Administer oxygen to maintain PaO_2 of 60 mm Hg or SaO_2 greater than 90%, using devices that provide increased oxygen concentrations (aerosol mask, partial rebreathing mask, and non rebreathing mask).
- Administer antibiotics, cardiac medications, and diuretics as ordered for underlying disorder.
- Monitor fluid balance by intake and output measurement, daily weight, and direct measurement of pulmonary capillary wedge pressure to detect presence of hypovolemia or hypervolemia.
- Provide measures to prevent atelectasis and promote chest expansion and secretion clearance, as ordered (incentive spirometer, nebulization, head of bed elevation of 30 degrees, frequent turning, encourage mobility when clinically stable).
- Monitor adequacy of alveolar ventilation by frequent measurement of SpO_2, ABG levels, respiratory rate, and VC.
- Compare monitored values with criteria indicating need for mechanical ventilation (see section titled “Nursing Assessment”). Report and prepare to assist with noninvasive ventilation or intubation, and initiation of mechanical ventilation, if indicated.
- Use extreme caution in administering sedatives and opioids to patients at risk for respiratory compromise.

This information should serve as general guidelines only. Each patient situation presents a unique set of clinical factors and requires nursing judgment to guide care, which may include additional or alternative measures and approaches.

PULMONARY EMBOLISM

Definition

Pulmonary embolism refers to the obstruction of one or more pulmonary arteries by a thrombus (or thrombi) usually originating in the deep veins of the legs, the right side of the heart, or rarely, an upper extremity; which becomes dislodged and is carried to the pulmonary vasculature.
Pulmonary infarction refers to necrosis of lung tissue that can result from interference with blood supply.

> ***NURSING ALERT***
> *Be aware of high-risk patients for pulmonary embolism—immobilization, trauma to pelvis (especially surgical) and lower extremities (especially hip fracture), obesity, history of thromboembolic disease, varicose veins, pregnancy, heart failure, myocardial infarction (MI), malignant disease, postoperative patients, and/or elderly patients.*

> ***NURSING ALERT***
> *Have a high index of suspicion for pulmonary embolus if there is a subtle or significant deterioration in the patient's condition and unexplained cardiovascular and pulmonary findings.*

> ***NURSING ALERT***
> *Massive pulmonary embolism is a medical emergency; the patient's condition tends to deteriorate rapidly. There is a profound decrease in cardiac output, with an accompanying increase in right ventricular pressure.*

Emergency Management

For massive pulmonary embolism, the goal is to stabilize cardio respiratory status.

- Oxygen is administered to relieve hypoxemia, respiratory distress, cyanosis, and to dilate pulmonary vasculature.
- An infusion is started to open an I.V. route for drugs and fluids.
- Vasopressors, inotropic agents such as dopamine (Intropin), and antidysrhythmic agents may be indicated to support circulation if the patient is unstable.
- ECG is monitored continuously for findings suggestive of right-sided heart failure, which may have a rapid onset. Changes may include sinus tachycardia, Q waves, late T-wave inversion, S wave in lead I, right bundle-branch block, right axis deviation, atrial fibrillation, and T-wave changes.
- Small doses of I.V. morphine may be given to relieve anxiety, alleviate chest discomfort (which improves ventilation), and ease adaptation to mechanical ventilator, if this is necessary.

- Pulmonary angiography, thoracic imaging, hemodynamic measurements, ABG analysis, and other studies are carried out.

> ***ALERT***
> *Consider the patient's age in dosing of anticoagulation therapy. Elderly patients will usually need a decreased dosing regimen.*

NURSING ASSESSMENT

- Take nursing history with emphasis on onset and severity of dyspnea and nature of chest pain.
- Examine the patient's legs carefully. Assess for swelling of leg, duskiness, warmth, pain on pressure over gastrocnemius muscle, pain on dorsiflexion of the foot (positive Homan's sign), which indicate thrombophlebitis as source.
- Monitor respiratory rate—may be accelerated out of proportion to degree of fever and tachycardia.
- Observe rate of inspiration to expiration.
- Percuss for resonance or dullness.
- Auscultate for friction rub, crackles, rhonchi, and wheezing.
- Auscultate heart; listen for splitting of second heart sound.
- Evaluate results of PT/PTT tests and INR for patients on anticoagulants and report results that are outside of therapeutic range; anticipate a dosage change.

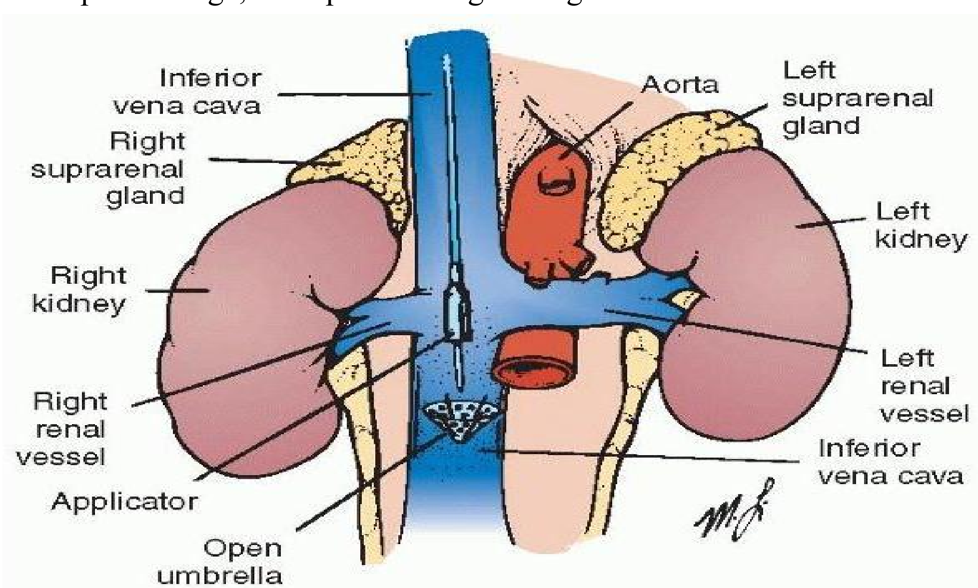

FIGURE 5: Insertion of umbrella filter in inferior vena cava to prevent pulmonary embolism. Filter (compressed within an applicator catheter) is inserted through an incision in the right internal jugular vein. The applicator is withdrawn when the filter fixes itself to the wall of the inferior vena cava after ejection from the applicator (Lippincot Manual of Nursing Procedures).

NURSING DIAGNOSES

- Ineffective Breathing Pattern related to acute increase in alveolar dead airspace and possible changes in lung mechanics from embolism.
- Ineffective Tissue Perfusion (Pulmonary) related to decreased blood circulation.
- Acute Pain (pleuritic) related to congestion, possible pleural effusion, and possible lung infarction.
- Anxiety related to dyspnea, pain, and seriousness of condition.
- Risk for Injury related to altered hemodynamic factors and anticoagulant therapy.

NURSING INTERVENTIONS

- Correcting Breathing Pattern:
  - Assess for hypoxia, dyspnea, headache, restlessness, apprehension, pallor, cyanosis, and/or behavioral changes.
  - Monitor vital signs, Electro cardio gram (ECG), oximetry, and ABG levels for adequacy of oxygenation.
  - Monitor patient's response to I.V. fluids/vasopressors.
  - Monitor oxygen therapy—used to relieve hypoxemia.
  - Prepare patient for assisted ventilation when hypoxemia does not respond to supplemental oxygen. Hypoxemia is due to abnormalities of V/Q mismatch.
- Improving Tissue Perfusion:
  - Closely monitor for shock—decreasing blood pressure (BP), tachycardia, cool and clammy skin.
  - Monitor prescribed medications given to preserve right-sided heart filling pressure and increase BP.
  - Maintain patient on bed rest during acute phase to reduce oxygen demands and risk of bleeding.
  - Monitor urinary output hourly; there may be reduced renal perfusion and decreased glomerular filtration.
  - Antiembolism compression stockings should provide a compression of 30 to 40 mm Hg.
- Relieving Pain
  - Watch patient for signs of discomfort and pain.
  - Ascertain if pain worsens with deep breathing and coughing; auscultate for friction rub.
  - Give morphine (Duramorph), as prescribed, and monitor for pain relief and signs of respiratory depression.
  - Position: slightly elevate the head of the bed (unless contraindicated by shock), and with chest splinted for deep breathing and coughing.

  - Evaluate patient for signs of hypoxia thoroughly when patient exhibits new-onset anxiety, restlessness, and before administering as-needed sedatives. Consider physician evaluation when these signs are present, especially if accompanied by cyanotic nail beds, circumoral pallor or cyanosis, and increased respiratory rate.
- Reducing Anxiety:
  - Correct dyspnea and relieve physical discomfort.
  - Explain diagnostic procedures and the patient's role; correct misconceptions.
  - Listen to the patient's concerns; attentive listening relieves anxiety and reduces emotional distress.
  - Speak calmly and slowly.
  - Do everything possible to enhance the patient's sense of control.

INTERVENING FOR COMPLICATIONS

- Monitor for shock from low cardiac output secondary to resistance to right-sided heart outflow, or to myocardial dysfunction due to ischemia.
- Assess for skin color changes, particularly nail beds, lips, ear lobes, and mucous membranes.
- Monitor BP, pulse, and SpO_2.
- Measure urine output.
- Monitor I.V. infusion of vasopressor or other prescribed agents.
- Bleeding—related to anticoagulant or thrombolytic therapy.

ASSESS PATIENT FOR BLEEDING; MAJOR BLEEDING MAY OCCUR FROM THE GI TRACT, BRAIN, LUNGS, NOSE, AND GENITOURINARY (GU) TRACT.

- Perform stool guaiac test to detect occult blood loss.
- Monitor platelet count to detect heparin-induced thrombocytopenia.
- Minimize risk of bleeding by performing essential ABG analysis on upper extremities; apply digital compression at puncture site for 30 minutes; apply pressure dressing to previously involved sites; check site for oozing.
- Maintain patient on strict bed rest during thrombolytic therapy; avoid unnecessary handling.
- Discontinue infusion in the event of uncontrolled bleeding.
- Notify health care provider on call immediately for change in LOC, inability to follow commands, a change in sensation, inability to move limbs, and poor response to questions with clear articulation. Intracranial bleed may necessitate discontinuation of anticoagulation promptly, to avert massive neurological catastrophe.

PLEURAL EFFUSION

Definition

Pleural effusion refers to a collection of fluid in the pleural space. It is almost always secondary to other diseases.

NURSING ASSESSMENT

- Obtain history of previous pulmonary condition.
- Assess patient for dyspnea and tachypnea.
- Auscultate and percuss the lungs for abnormalities.

NURSING DIAGNOSIS

- Ineffective breathing pattern related to collection of fluid in pleural space.

NURSING INTERVENTIONS

- Maintaining Normal Breathing Pattern
  - Institute treatments to resolve the underlying cause as ordered.
  - Assist with thoracentesis, if indicated.
  - Maintain chest drainage as needed.
  - Provide care after pleurodesis.
  - Monitor for excessive pain from the sclerosing agent, which may cause hypoventilation.
  - Administer prescribed analgesic.
  - Assist patient undergoing instillation of intrapleural lidocaine, if pain relief is not forthcoming.
  - Administer oxygen as indicated by dyspnea and hypoxemia.
  - Observe patient's breathing pattern, oxygen saturation, and other vital signs, for evidence of improvement or deterioration.
- Patient Education and Health Maintenance
  - Instruct patient to seek early intervention for unusual shortness of breath, especially if he has underlying chronic lung disease.

TRAUMATIC DISORDERS

PNEUMOTHORAX

Definition

A pneumothorax is air in the pleural space occurring spontaneously or from trauma.

In patients with chest trauma, it is usually the result of a laceration to the lung parenchyma, tracheobronchial tree, or esophagus. The patient's clinical status depends on the rate of air leakage and size of wound. Pneumothorax is classified as:

- Spontaneous pneumothorax:
  - Sudden onset of air in the pleural space with deflation of the affected lung in the absence of trauma.
- Tension pneumothorax:
  - Buildup of air under pressure in the pleural space, interfering with filling of both the heart and lungs.
- Open pneumothorax (sucking chest wound).
  - Implies an opening in the chest wall large enough to allow air to pass freely in and out of thoracic cavity with each attempted respiration.

Diagnostic Evaluation

- Chest X-ray confirms presence of air in pleural space.

Complications

- Acute respiratory failure.
- Cardiovascular collapse with tension pneumothorax.

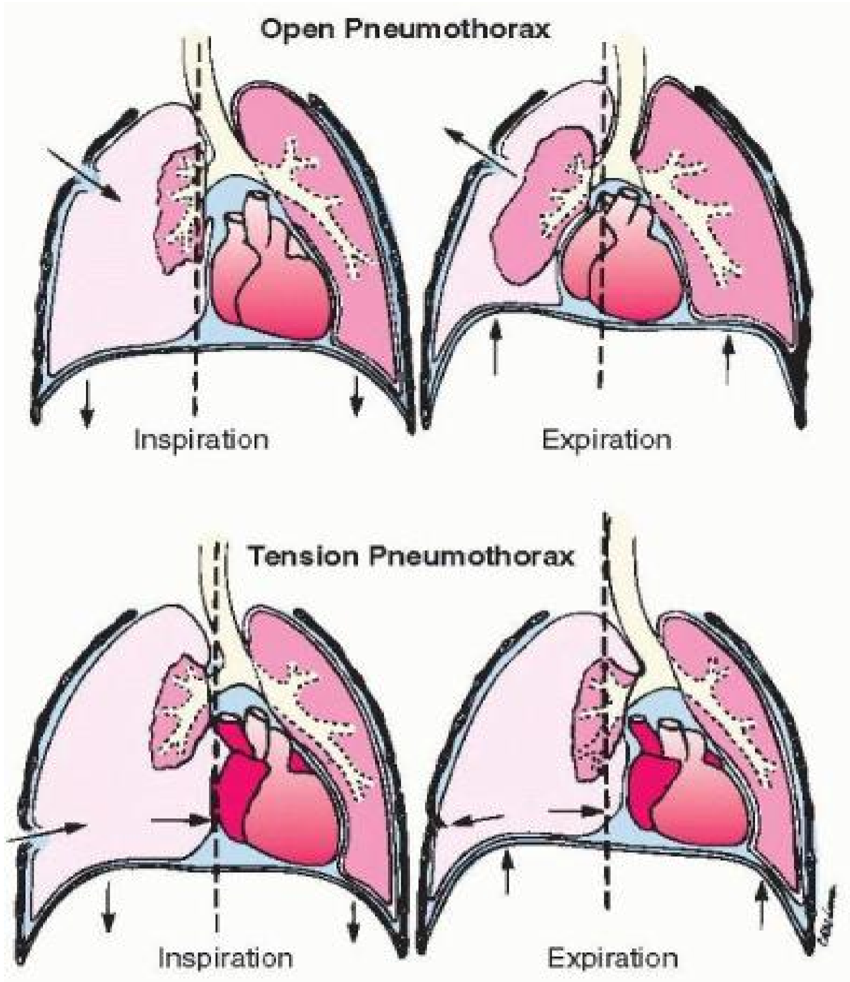

FIGURE 6: Open pneumothorax and tension pneumothorax. In open pneumothorax, air enters the chest during inspiration and exits during expiration. There may be slight inflation of the affected lung due to a decrease in pressure as air moves out of the chest. In tension pneumothorax, air can enter but not leave the chest. As the pressure in the chest increases, the heart and great vessels are compressed and the mediastinal structures are shifted toward the opposite side of the chest. The trachea is pushed from its normal midline position toward the opposite side of the chest, and the unaffected lung is compressed (Lippincot Manual of Nursing Procedures).

MANAGEMENT

Spontaneous Pneumothorax

- Treatment is generally nonoperative for a non-extensive pneumothorax.
- Observe and allow for spontaneous resolution for minor (less than 50% collapse) pneumothorax in otherwise healthy person.

- Needle aspiration or chest tube drainage may be necessary to achieve reexpansion of collapsed lung, in a major pneumothorax (greater than 50% collapse).
- Surgical intervention by pleurodesis or thoracotomy with resection of apical blebs is advised for patients with recurrent spontaneous pneumothorax.

Tension Pneumothorax

- Immediate decompression to prevent cardiovascular collapse by thoracentesis or chest tube insertion allowing for air escape.
- Chest tube drainage with underwater-seal suction to allow for full lung expansion and healing.

Open Pneumothorax

- Close the chest wound immediately to restore adequate ventilation and respiration.
- Patient is instructed to inhale and exhale gently against a closed glottis (Valsalva maneuver) as a pressure dressing (paraffin gauze secured with elastic adhesive) is applied. This maneuver helps to expand the collapsed lung.
- A chest tube is inserted, and water-seal drainage set up, to permit evacuation of fluid/air and to produce re-expansion of the lung.
- Surgical intervention may be necessary to repair trauma.

NURSING ASSESSMENT

- Obtain history for chronic respiratory disease, trauma, and onset of symptoms.
- Inspect chest for reduced mobility and tracheal deviation.
- Auscultate chest for diminished breath sounds and percuss for hyperresonance.

NURSING DIAGNOSES

- Ineffective breathing pattern related to air in the pleural space.
- Impaired gas exchange related to atelectasis and collapse of lung.

NURSING INTERVENTIONS

Achieving Effective Breathing Pattern

- Provide emergency care as indicated.
- Apply paraffin gauze to sucking chest wounds.
- Assist with emergency thoracentesis or thoracostomy.
- Be prepared to perform cardiopulmonary resuscitation or administer medications if cardiovascular collapse occurs.
- Maintain patent airway; suction as needed.
- Position patient upright if condition permits, this allows for greater chest expansion.

- Maintain patency of chest tubes.
- Assist patient to splint chest while turning or coughing, and administer pain medications as needed.

Resolving Impaired Gas Exchange

- Encourage patient to use the incentive spirometer.
- Monitor oximetry and ABG levels to determine oxygenation.
- Provide oxygen as needed.

Patient Education and Health Maintenance

- Instruct patient to continue using the incentive spirometer at home.
- For patients with spontaneous pneumothorax, there is an increased risk for recurrence; therefore, encourage these patients to immediately report sudden dyspnea.

Evaluation: Expected Outcomes:

- Breath sounds equal bilaterally; less dyspneic.
- ABG levels improved.

CHEST INJURIES

Definition

Chest injuries are potentially life-threatening because of the immediate disturbances of cardio respiratory physiology and hemorrhage; and later developments of infection, damaged lung, and thoracic cage.

Traumatic chest injuries include

- Rib fracture.
- Hemothorax.
- Flail chest.
- Pulmonary contusion and cardiac tamponade.

> ***Nursing Alert***
> *Patients with chest trauma may have injuries to multiple organ systems. The patient should be examined for intra-abdominal injuries, which must be treated aggressively.*

Clinical Manifestations

Rib Fracture

- Most common chest injury.
- May interfere with ventilation and may lacerate underlying lung.
- Causes pain at fracture site; painful, shallow respirations; localized tenderness and crepitus (crackling) over fracture site.

Hemothorax

- Blood in pleural space as a result of penetrating or blunt chest trauma.
- Accompanies a high percentage of chest injuries.
- Can result in hidden blood loss.
- Patient may be asymptomatic, dyspneic, apprehensive, or in shock.

Flail Chest

- Loss of chest wall stability as a result of multiple rib fractures, or combined rib and sternum fractures.
- When this occurs, one portion of the chest has lost its bony connection to the rest of the rib cage.
- During respiration, the detached part of the chest will be pulled in on inspiration and blown out on expiration (paradoxical movement).
- Normal mechanics of breathing are impaired, which seriously jeopardizes ventilation, causing dyspnea and cyanosis.
- Generally associated with other serious chest injuries; lung contusion, lung laceration, with diffuse alveolar damage.

Pulmonary Contusion

- Bruise of the lung parenchyma that results in leakage of blood and edema into the alveolar and interstitial spaces of the lung.
- May not be fully developed for 24 to 72 hours.
- Signs and symptoms include:
  - Tachypnea, tachycardia.
  - Crackles on auscultation.
  - Pleuritic chest pain.
  - Copious secretions.
  - Cough—constant, loose, or rattling.

Cardiac Tamponade

- Compression of the heart as a result of accumulation of fluid within the pericardial space.

- Caused by penetrating injuries, metastasis, and other disorders.
- Signs and symptoms include:
    - Falling BP.
    - Distended jugular veins, elevated central venous pressure (CVP).
    - Muffled heart sounds.
    - Pulsus paradoxus (audible BP fluctuation with respiration).
    - Dyspnea, cyanosis, or shock.

> ***NURSING ALERT***
> *A rapidly developing tamponade interferes with ventricular filling and causes impairment of circulation. Thus, there is a reduced cardiac output and poor venous return to the heart. Cardiac collapse can result. In the patient with hypovolemia caused by associated injuries, the CVP may not rise, thus masking the signs of cardiac tamponade.*

MANAGEMENT AND NURSING INTERVENTIONS

The goal is to restore normal cardio respiratory function as quickly as possible. This is accomplished by performing effective resuscitation while simultaneously assessing the patient, restoring chest wall integrity, and reexpanding the lung. The order of priority is determined by the clinical status of the patient.

Rib Fracture

- Give analgesics (usually non opioids) to assist in effective coughing and deep breathing.
- Encourage deep breathing with strong inspiration; give local support to injured area by splinting with hands.
- Assist with intercostal nerve block to relieve pain so coughing and deep breathing may be accomplished. An intercostal nerve block is the injection of a local anesthetic into the area around the intercostal nerves to relieve pain temporarily after rib fractures, chest wall injury, or thoracotomy.
- For multiple rib fractures, epidural anesthesia may be used.

Hemothorax

- Assist with thoracentesis to aspirate blood from pleural space, if being done before a chest tube insertion.
- Assist with chest tube insertion and set up drainage system for complete and continuous removal of blood and air.
- Auscultate lungs and monitor for relief of dyspnea.
- Monitor amount of blood loss in drainage.
- Replace volume with I.V. fluids or blood products.

- Trauma patients with pulmonary contusion and flail chest should receive adequate I.V. fluids to maintain adequate tissue perfusion. Once adequately resuscitated, unnecessary fluid administration should be meticulously avoided. A pulmonary artery catheter may be useful to avoid fluid overload.
- The use of optimal analgesia and aggressive chest physiotherapy should be applied to minimize the likelihood of respiratory failure and ensuing ventilatory support. Epidural catheter anesthesia is the preferred mode of analgesia delivery in severe flail chest injury.
- Patients may require non-invasive positive pressure ventilation or mechanical ventilation. Positive end-expiratory pressure/continuous positive airway pressures (PEEP/CPAP) should be included in the ventilatory regimen.
- Steroids should not be used in therapy for pulmonary contusion.
- Diuretics may be used in hydrostatic fluid overload, as evidenced by elevated pulmonary capillary wedge pressures in hemodynamically stable patients, or in known concurrent heart failure.
- Surgical fixation may be considered in severe unilateral flail chest, or in patients requiring mechanical ventilation when thoracotomy is otherwise required.

Flail Chest

- Stabilize the flail portion of the chest as directed.
- Thoracic epidural analgesia may be used for some patients to relieve pain and improve ventilation.
- If respiratory failure is present, prepare for immediate ET intubation and mechanical ventilation—treats underlying pulmonary contusion and serves to stabilize the thoracic cage for healing of fractures, improves alveolar ventilation, and restores thoracic cage stability and intrathoracic volume by decreasing work of breathing.
- Prepare for operative stabilization of chest wall in select patients.

Pulmonary Contusion

For moderate lung contusion

- Employ mechanical ventilation to keep lungs inflated.
- Administer diuretics to reduce edema.
- Correct metabolic acidosis with I.V. sodium bicarbonate.
- Use PAP monitoring.
- Monitor for development of pneumonia.

Cardiac Tamponade

For penetrating injuries

- Assist with pericardiocentesis to provide emergency relief and improve hemodynamic function, until surgery can be undertaken.
- Prepare for emergency thoracotomy to control bleeding and to repair cardiac injury.

Additional Responsibilities

- Secure and support the airway as indicated.
- Prepare for tracheostomy, if indicated.
- Tracheostomy helps to clear tracheobronchial tree, helps the patient breathe with less effort, decreases the amount of dead airspace in the respiratory tree and helps reduce paradoxical motion.
- When used with mechanical ventilation provides a closed system and stabilizes the chest.
- Secure one or more I.V. lines for fluid replacement, and obtain blood for baseline studies, such as hemoglobin level and hematocrit.
- Monitor serial CVP readings to prevent hypovolemia and circulatory overload.
- Monitor ABG/SpO2 results to determine need for supplemental oxygen and/or mechanical ventilation.
- Obtain urinary output hourly to evaluate tissue perfusion.
- Continue to monitor thoracic drainage to provide information about rate of blood loss, whether bleeding has stopped, and to indicate if surgical intervention is necessary.
- Institute ECG monitoring for early detection and treatment of cardiac dysrhythmias (dysrhythmias are a frequent cause of death in chest trauma).
- Maintain ongoing surveillance for complications such as:
    - Aspiration.
    - Atelectasis.
    - Pneumonia.
    - Mediastinal/subcutaneous emphysema.
    - Respiratory failure.

Patient Education and Health Maintenance

- Instruct patient about proper splinting techniques.
- Make sure patient is aware of the importance of seatbelt use to reduce serious chest injuries caused by automobile accidents.
- Teach patient to report signs of complications—increasing dyspnea, fever, cough.

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CHAPTER 4: CARDIOVASCULAR FUNCTION AND THERAPY

ASSESSMENT

Common Manifestations of Heart Disease

- Chest pain (the most common manifestation).
- Shortness of breath.
- Palpitations.
- Weakness.
- Fatigue.
- Dizziness.
- Syncope.
- GI complaints.

> ***DRUG ALERT***
> *Note that patients taking beta-adrenergic blockers may not exhibit a compensatory increase in heart rate when changing to a upright position.*

> ***NURSING ALERT***
> *Elderly, diabetic, and female patients may not present with typical symptoms of Acute Coronary Syndrome (ACS). Consider the diagnosis of ACS in these patients when they present with other complaints, such as back pain, nausea, fatigue, dyspnea, jaw pain, shortness of breath, and right arm pain (without chest pain).*

DIAGNOSTIC TESTS

- Cardiovascular function and disease are evaluated by:
- Blood tests.
- Ultrasound techniques.
- Fluoroscopy and nuclear imaging studies.
- Electro cardio gram ECG.

LABORATORY STUDIES

Cardiac damage or disease is indicated by CK, CKMD, Triponin and Myoglobin**.**

Table 1: Cardiac Markers—Normal Values, Rise, Peak, Advantages and Disadvantages

Enzyme	Rise (Hrs)	Peak (Hrs)	Normalization	Advantages	Disadvantages
CK (Creatine Kinase)	3-12	10-36	3-4 days	• Rises fairly early	• Lacks cardiac specificity. Increases only after severe damage.
CK-MB	3-8	9-30	2-3 days	• Can detect reinfarction • Low cost	• Lacks cardiac specificity. • False-positive results. • Increases only after severe damage.
CK Isoforms	2-6	6-12	1 day	• Highly sensitive in early stages of acute myocardial infarction (AMI)	• Elevates slowl. • Lacks cardiac specificity. • False-positive results.
TnT (TroponinT)	3-12	12-96	5-14 days	• Cardiac specific and sensitivity in late AMI	• Low sensitivity in early AMI. • Inability to diagnose subsequent myocardial infarction (MIs)
TnI (TroponinI)	3-12	12-24	5-10 days	• Cardiac specific and sensitivity in late AMI	• Low sensitivity in early AMI. • Inability to diagnose subsequent MIs.
Myoglobin	1-4	6-12	1 day	• Extremely sensitive • Shows in blood before CK-MB	• Low cardiac specificity. • Not beneficial in late AMIs. • False-positive results.

Nursing and Patient Care Considerations

- Make sure that enzymes are drawn in a serial pattern, usually on admission and every 6 to 24 hours until three samples are obtained; enzyme activity is then correlated with the extent of heart muscle damage.
- Maintain standard precautions while obtaining blood specimens, and properly dispose of all equipment.

- Advise the patient that results will be discussed by the physician or primary care provider.

> ***NURSING ALERT***
> *Greater peaks in enzyme activity and the length of time an enzyme remains at its peak level are correlated with serious damage to the heart muscle and, thus, a poorer prognosis.*

ELECTROCARDIOGRAM

- Despite its limited sensitivity and specificity, the 12-lead ECG is still the standard for the evaluation of myocardial ischemia.
- Electrical activity is generated by the cells of the heart as ions are exchanged across cell membranes.
- Electrodes that are capable of conducting electrical activity from the heart to the ECG machine are placed at strategic positions on the patient's extremities and chest precordium.
- The electrical energy sensed is then converted to a graphic display by the ECG machine. This display is referred to as the ECG.
- Each ECG lead consists of a positive and negative pole; each lead also has an axis that represents the direction in which current flows.
- Each lead takes a different view of the heart; therefore, the tracing will be different with each view obtained.
- The direction in which electrical current flows determines how the waveform will appear.
- There are three sets of leads:

  Standard limb or bipolar leads (I, II, III) utilize three electrodes; these leads form a triangle known as Einthoven's Triangle.

  Augmented unipolar leads (AVR, AVL, AVF).

  Precordial unipolar leads (V1, V2, V3, V4, V5, V6).

- A heart contraction is represented on the ECG graph paper by the designated P wave, QRS complex, and T waves.
  The P wave is the first positive deflection and represents atrial depolarization or atrial contraction.
- The PR interval represents the time it takes for the electrical impulse to travel from the sinoatrial node to the AV node and down the bundle of His to the right and left bundle branches.
- The Q wave is the first negative deflection after the P wave; the R wave is the first positive deflection after the P wave.
- The S wave is the negative deflection after the R wave.
- The QRS waveform is generally regarded as a unit and represents ventricular depolarization. Atrial repolarization (relaxation) occurs during the QRS complex, but cannot be seen.

- The T wave follows the S wave and is joined to the QRS complex by the ST segment.
- The ST segment represents ventricular repolarization or relaxation. The point that represents the end of the QRS complex and the beginning of the ST segment is known as the J point.
- The T wave represents the return of ions to the appropriate side of the cell membrane. This signifies relaxation of the muscle fibers and is referred to as repolarization of the ventricles.
- The QT interval is the time between the Q wave and the T wave; it represents ventricular depolarization (contraction) and repolarization (relaxation).

Indications

- The ECG is a useful tool in the diagnosis of conditions that may cause aberrations in the electrical activity of the heart. Examples of these conditions include:
  - MI and other types of Coronary artery disease (CAD), such as angina.
  - Cardiac dysrhythmias.
  - Cardiac enlargement.
  - Electrolyte disturbances (calcium, potassium, magnesium, and phosphorous).
  - Inflammatory diseases of the heart.
  - Effects on the heart by drugs, such as antiarrhythmics and tricyclic antidepressants.
  - Despite its many advantages, however, the ECG also has several shortcomings:
  - Fifty percent of all patients with AMI have no ECG changes.
  - A patient may have a normal ECG, present pain-free, and still have significant risk for myocardial ischemia.
  - Several disease processes can mimic that of an AMI, including left bundle-branch blocks, ventricular paced rhythms, and left ventricular hypertrophy.

ECG LEADS AND NORMAL WAVEFORM INTERPRETATION

- The normal amplitude of the P wave is 3 mm or less; the normal duration of the P wave is 0.04 to 0.11 second.
- The PR interval is measured from the upstroke of the P wave to the QR junction and is normally between 0.12 and 0.20 seconds. There is a built-in delay in time at the AV node, this allows for adequate ventricular filling to maintain normal stroke volume.
- The QRS complex contains separate waves and segments, which should be evaluated separately. A normal QRS complex should be between 0.06 and 0.10 seconds.
- The Q wave, or first downward stroke after the P wave, is usually less than 3 mm in depth. A Q wave of significant deflection is not normally present in the healthy heart. A pathologic Q wave usually indicates a completed MI.
- The R wave is the first positive deflection after the P wave, normally 5 to 10 mm in height. Increases and decreases in amplitude become significant in certain disease states. Ventricular hypertrophy produces very high R waves because the hypertrophied muscle requires a stronger electrical current to depolarize.

- The ST segment begins at the end of the S wave, the first negative deflection after the R wave, and terminates at the upstroke of the T wave.
- The T wave represents the repolarization of myocardial fibers or provides the resting state of myocardial work; the T wave should always be present.
- Normally, the T wave should not exceed a 5-mm amplitude in all leads except the precordial (V1 to V6) leads, where it may be as high as 10 mm.
- The P, Q, R, S, and T waves all appear differently depending on which lead you are viewing.

Nursing and Patient Care Considerations

- Perform the ECG or begin continuous ECG monitoring as indicated.
- Provide privacy, and ask the patient to undress, exposing the chest, wrists, and ankles. Assist with draping as appropriate.
- Place the leads on the chest and extremities as labeled, using self-adhesive electrodes, water-soluble gel or other conductive material.
- To avoid artifact, instruct the patient to lie still, avoiding movement, coughing, or talking, while ECG is recording.
- Make sure the ECG machine is plugged in and grounded, and operate according to manufacturer's directions.
- If continuous cardiac monitoring is being done, advice the patient on the parameters of mobility as movement may trigger alarms and false readings.
- Interpret the rhythm strip. Develop a systematic approach to assist in accurate interpretation.
- Determine the rhythm—Is it regular, irregular, regularly irregular, or irregularly irregular? Use calipers, count blocks between QRS complexes, or measure the distance between R waves to determine regularity.
- Determine the rate—Is it fast, slow, or normal?
- A gross determination of rate can be accomplished by counting the number of QRS complexes within a 6-second time interval (use the superior margin of ECG paper) and multiplying the complexes by a factor of 10.
- Note: This method is accurate only for rhythms that are occurring at normal intervals and should not be used for determining rate in irregular rhythms. Irregular rhythms are always counted for 1 full minute for accuracy.
- Another means of obtaining the patient's rate is to divide the number of large 5-square blocks between each two QRS complexes into 300. Five large 5-square blocks represent 1 minute on the ECG paper.
- Evaluate the P wave—Are P waves present? Is there a P for every QRS complex? If there is not a P for every QRS, do the P waves have a normal configuration?
- Measure and evaluate the PR interval.
- Evaluate the QRS complex—Measure the QRS complex and examine its configuration.

- Evaluate the ST segment—A elevated ST segment heralds a pattern of injury and usually occurs as an initial change in acute MI. ST depression occurs in ischemic states. Calcium and potassium changes also affect the ST segment.
- Evaluate the T wave—Are T waves present? Do all T waves have a normal shape? Could a P wave be hidden in the T wave, indicating a junctional rhythm or third-degree heart block? Is it positively or negatively deflected (inverted T waves indicate ischemia) or peaked (indicative of hyperkalemia)?
- Evaluate the QT interval—it should be less than one-half the R-R interval. Prolonged QT interval may indicate digoxin toxicity, long-term quinidine (Quinaglute) or procainamide (Pronestyl) therapy, or hypomagnesaemia.

RADIOLOGY AND IMAGING

Chest X-ray

- The chest X-ray is a noninvasive tool used to visualize internal structures, such as the heart, lungs, soft tissues, and bones.
- Most chest X-rays are taken while the patient is inhaling so that the lungs are fully expanded. However, some chest X-rays are taken while the patient exhales to facilitate accurate imaging; conditions that require imaging during exhalation include small pneumothorax and air trapping that occurs with emphysema.
- Several types of chest X-rays can be used to assess heart size, contour, and position; other types reveal cardiac and pericardial calcification, as well as, physiologic alterations in pulmonary circulation.

Cardiac MRI

Magnetic resonance imaging (MRI) is used to evaluate diseased heart muscle. It is possible that this technology will eventually replace cardiac catheterization. In addition, recent reports have demonstrated the safety of MRI in patients with permanent pacemakers and implantable cardioverter-defibrillators.

- Nursing and Patient Care Considerations:
  - Inform the patient that the test is noninvasive.
  - Provide written information about the test, if available.
  - Explain that the patient will be lying in one position for a long period.
  - Screen the patient for claustrophobia and anxiety; these can be reduced through premedication with an anti-anxiety agent.

Doppler Ultrasound

Doppler ultrasound can be used to evaluate arterial and peripheral venous patency as well as valvular competence.

- Nursing and Patient Care Considerations:
  - Inform the patient that the test is noninvasive.
  - The test takes about five to ten minutes, and no special preparation is necessary.
  - Explain that a cuff will be applied to patient's leg; the cuff will be inflated and deflated in a manner similar to that of blood pressure measurement and that the purpose of the test is to detect arterial patency.

GENERAL PROCEDURES AND TREATMENT MODALITIES

Hemodynamic Monitoring

Hemodynamic monitoring is the assessment of the patient's circulatory status; it includes measurements of:

- Heart rate (HR).
- Intra-arterial pressure.
- Cardiac output (CO).
- Central venous pressure (CVP).
- Pulmonary artery wedge (PAP) pressure and blood volume.

The primary purpose is the early detection, identification, and treatment of life-threatening conditions, such as heart failure, cardiac tamponade, and all types of shock (septic, cardiogenic, neurogenic, and anaphylactic).

Cardiac Output (CO)

CO is the amount (volume) of blood ejected by the left ventricle into the aorta in one minute. Normal CO is 4 to 8 L/minute.

Signs of low CO include:

- Changes in mental status.
- An increase in HR.
- Shortness of breath.
- Cyanosis or duskiness of buccal mucosa, nail beds, and earlobes.
- Falling blood pressure.
- Low urine output.
- Cool, moist skin.

Central Venous Pressure Monitoring

Refers to the measurement of right atrial pressure or the pressure of the great veins within the thorax (normal range: 5 to10 cm H_2O or 2 to 8 mm Hg).

- Right-sided cardiac function is assessed through the evaluation of CVP.

- Left-sided heart function is less accurately reflected by the evaluation of CVP, but may be useful in assessing chronic right- and left-sided heart failure and differentiating right and left ventricular infarctions.
- Requires the threading of a catheter into a large central vein (subclavian, internal or external jugular, median basilic or femoral). The catheter tip is then positioned in the right atrium, upper portion of the superior vena cava, or the inferior vena cava (femoral approach only).
- Purposes of CVP catheter and monitoring include:
  - To serve as a guide for fluid replacement.
  - To monitor pressures in the right atrium and central veins.
  - To administer blood products, total parenteral nutrition, and drug therapy contraindicated for peripheral infusion.
  - To obtain venous access when peripheral vein sites are inadequate.
  - To insert a temporary pacemaker.
  - To obtain central venous blood samples.

NURSING ALERT

Transport the patient to other parts of facility with a portable ECG monitor and nurse. Patients with temporary pacemakers should never be placed in unmonitored areas.

Defibrillation and Cardioversion

Concepts

- Defibrillation is the use of electrical energy, delivered over a brief period, to temporarily depolarize the heart. When it repolarizes, it has a better chance of resuming normal activity. See Procedure Guidelines 12-5, pages 361 and 362.
- Synchronized cardio version is the use of electrical energy that is synchronized to the QRS complex so as not to hit the T wave during the cardiac cycle, which may cause ventricular fibrillation.
- A defibrillator is an instrument that delivers an electric shock to the heart to convert the dysrhythmias to normal sinus rhythm (defibrillators are not used to convert other abnormal and rapid cardiac rhythms). There are several types of defibrillators:
- Direct current defibrillators contain a transformer, an alternating-current-direct-current converter, a capacitor to store direct current, a charge switch, and a discharge switch to the electrodes to complete the circuit.
- Portable defibrillators have a battery as a power source and must be plugged in at all times when not in use.

- Automatic external defibrillator (AED) may be used inside the facility or in the community to deliver electric shock to the heart before trained personnel arrive with a manual defibrillator. AEDs are accurate to be used by less trained individuals because the device has a detection system that analyzes the person's rhythm, detects the presence of ventricular fibrillation or tachycardia, and instructs the operator to discharge a shock.

Indications

- Defibrillation:
  - Ventricular fibrillation.
  - Ventricular tachycardia without a pulse.
- Synchronized cardio version:
  - Atrial fibrillation.
  - Atrial flutter.
  - Supraventricular tachycardia.
  - Ventricular tachycardia with a pulse.

> ***NURSING ALERT***
> *Paddles should be placed at least 5 inches (12.7 cm) away from a pacemaker to prevent damage to pacemaker circuitry.*

> ***NURSING ALERT***
> *If ventricular fibrillation develops, turn the synchronizer off, adjust energy settings, and proceed with defibrillation.*

MAINTAINING ADEQUATE CARDIAC OUTPUT

- Monitor vital signs frequently until stable.
- Evaluate incision site for evidence of bleeding or hematoma.
- Evaluate urine output.
- Be alert for dysrhythmias postoperatively (manipulation of heart and swelling may induce dysrhythmias 24 to 48 hours after implant).
- Monitor for changes in blood pressure as a sudden drop may indicate cardiac tamponade.
- Carefully evaluate all complaints of chest pain (noncardiac pain may be due to lead fracture or dislodgement; pain may be noted along wire pathways).
- Auscultate heart sounds every four hours for presence of friction rub or muffled heart sounds.

PERICARDIOCENTESIS

Pericardiocentesis is an invasive procedure, which involves the puncture of the pericardial sac to aspirate fluid. The pericardium typically contains 10 to 50 mL of sterile fluid. Excessive fluid within the pericardial sac can cause compression of the heart chambers, resulting in an acute decrease in CO (cardiac tamponade). Fluid accumulation (pericardial effusion) can occur rapidly (acute) or slowly (sub acute). The amount of excess fluid the pericardium is able to accommodate is individually based on the ability of the pericardium to stretch. Once the stretch has been maximized, intra pericardial pressure rises, possibly causing circulatory compromise.

Types of Pericardial Effusion

Acute Pericardial Effusion: A rapid increase of fluid into the pericardial space (as little as 200 mL); this causes a marked rise in intra pericardial pressure. Emergency intervention is required to prevent severe circulatory compromise.

Sub acute Pericardial Effusion: slow accumulation of fluid into the pericardial sac over weeks or months; this causes the pericardium to stretch and accommodate up to 2 L of fluid without severe increases in intra pericardial pressure.

Both of these situations require intervention to remove the pericardial fluid. Pericardiocentesis is frequently performed in the cardiac catheterization laboratory under fluoroscopy or assisted by echo cardio graphic imaging. In the case of severely decompensated cardiac tamponade, Pericardiocentesis can be safely performed at the bedside with echocardiography.

Nursing support of the patient undergoing Pericardiocentesis

Purposes

- To remove fluid from the pericardial sac caused by:
  - Infection.
  - Malignant neoplasm or lymphoma.
  - Trauma (blunt or penetrating wounds or from cardiac surgery/procedure).
  - Drug reactions.
  - Radiation.
  - MI.
- To obtain fluid for diagnosis.
- To instill certain therapeutic drugs.

Sites for Pericardiocentesis

- Subxiphoid Needle inserted in the angle between the left costal margin and xiphoid.
- Near cardiac apex, ¾ inch (2 cm) inside left border of cardiac dullness.
- To the left of the fifth or sixth interspace at the sternal margin.
- Right side of the fourth intercostal space just inside the border of dullness.

RADIOLOGY AND IMAGING

Chest X-ray

- The chest X-ray is a noninvasive tool used to visualize internal structures, such as the heart, lungs, soft tissues, and bones.
- Most chest X-rays are taken while the patient is inhaling so that the lungs are fully expanded. However, some chest X-rays are taken while the patient exhales to facilitate accurate imaging; conditions that require imaging during exhalation include small pneumothorax and air trapping that occurs with emphysema.
- Several types of chest X-rays can be used to assess heart size, contour, and position; other types reveal cardiac and pericardial calcification as well as physiologic alterations in pulmonary circulation.

Echocardiography (Ultrasound Cardiography)

- Echocardiography is used to visualize and assess cardiac function, structure, and hemodynamic abnormalities. It is the most commonly used noninvasive cardiac imaging tool.
- It records high-frequency sound vibrations that are sent into the heart through the chest wall. The cardiac structures return the echoes derived from the ultrasound. The motions of the echoes are traced on an oscilloscope and recorded on film, CD, or DVD.
- Clinical usefulness includes demonstration of valvular and other structural deformities, detection of pericardial effusion, evaluation of prosthetic valve function, and diagnosis of cardiac tumors, asymmetric thickening of the interventricular septum, cardiomegaly (heart enlargement), clots, vegetations on valves, and wall motion abnormalities.
- Types include two-dimensional (2-D), M-mode, and Doppler mode. The methods are complementary and are commonly used in conjunction.
- 2-D echocardiography—provides a wider view of the heart and its structures because it involves a planar ultrasound beam.
- M-mode—utilizes a single ultrasound beam and provides a narrow segmental view.
- Doppler mode—evaluates pressures and blood flow across the valves; also assesses for atrial and ventricular septal defects.

Nursing and Patient Care Considerations

- Advice the patient that traditional echocardiography is noninvasive and that no preparation is necessary.
- Position the patient on his left side, if tolerated, to bring the heart closer to the chest wall.
- Assist the patient to clean chest of transducer gel after the test.

Cardiac MRI

- Magnetic resonance imaging (MRI) is used to evaluate diseased heart muscle. It is possible that this technology will eventually replace cardiac catheterization. In addition, recent reports have demonstrated the safety of MRI in patients with permanent pacemakers and implantable cardioverter-defibrillators.

Doppler Ultrasound

- Doppler ultrasound can be used to evaluate arterial and peripheral venous patency, as well as, valvular competence.

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CHAPTER 5: NEUROLOGICAL DISORDERS

ASSESSMENT

A baseline neurological assessment is needed to detect changes in a patient's neurological function and includes a patient history, general physical examination, and thorough neurological examination. An important principle underlying the neurological assessment is maximum stimulation for maximum response. Common manifestations of neurological dysfunction include motor, sensory, autonomic, and cognitive deficits. By exploring these symptoms, obtaining a pertinent history, and performing a thorough neurological examination, the clinician will gain an understanding of the underlying disorder and be able to plan care for patients with neurological disorders.
It is important that the clinician document finding using appropriate terminology. Clinically, the patient should be assessed on both the right and left sides of the body, to compare and contrast asymmetrical findings.

DIAGNOSTIC TESTS

- Radiology and Imaging.
- Computed Tomography Scan.
- Magnetic Resonance Imaging.

GENERAL PROCEDURES AND TREATMENT MODALITIES

Nursing management of the patient with an altered state of consciousness

Unconsciousness or loss of consciousness (LOC) is a condition in which there is a depression of cerebral function ranging from stupor to coma. Coma results from a impairment in both the arousal and the awareness of consciousness. The arousal of consciousness is mediated by the reticular activating system (RAS) in the brain stem, while the awareness component is mediated by cortical activity within the cerebral hemispheres.
Both arousal and awareness are assessed when using the Glasgow Coma Scale (GCS) as a measure of LOC.

Table 2: Glasgow Coma Scale

Parameter	Finding	Score
Eye opening	Spontaneously	4
	To speech	3
	To pain	2
	Do not open	1
Best verbal response	Oriented	5
	Confused	4
	Inappropriate speech	3
	Incomprehensible sounds	2
	No verbalization	1

Best motor response	Obeys command	6
	Localizes pain	5
	Withdraws from pain	4
	Abnormal flexion	3
	Abnormal extension	2
	No motor response	1
Interpretation: Best score = 15; worst score = 3; 7 or less generally indicates coma; changes from baseline are most important.		

When using the GCS, coma may be defined as no eye opening on stimulation, absence of comprehensible speech, and failure to obey commands. The GCS is designed to provide a rapid assessment of LOC and does not provide a means to monitor or localize neurological dysfunction. Facility generated neurological assessment tools may be used in combination with the GCS to assess, monitor and trend neurological function.

An altered state of consciousness may be caused by many factors, including: hypoxemia, trauma, neoplasms, vascular, degenerative, and infectious disorders; as well as a variety of metabolic disorders and structural neurological lesions. A patient's diagnostic evaluation and management depends on the underlying cause, overall intracranial dynamics, age, comorbidities, and general state of health.

Nursing Assessment

- Assess eye opening (level of responsiveness):
  - Eye opening = arousal.
  - Tracking = awareness.
- Assess neurological function using the GCS. The GCS addresses eye opening, verbal responses, and motor responses. Painful stimuli include applying pressure against the nail bed, trapezius/axillary pinch, or sternal rub. Use the least amount of stimuli for the best response.
- Assess cognitive function:
  - Orientation:
    - Person, place, and time.
    - Proper response to questions such as: Where are you? Why are you here?
    - General information—national and local current events.
    - Speech—aphasia and other problems.
    - Fluent aphasia (motor/Broca's)—inability to express self.
    - Non-fluent aphasia (sensory/Wernicke's)—inability to understand the spoken language.
    - Global aphasia—inability to speak or understand spoken language.
    - Other aphasia syndromes—amnesia, conduction.
    - Other alterations include:
      - Confabulation—fluent, nonsensical speech.
      - Preservation—continuation of thought process with inability to change train of thought without direction or repetition.

- Assess motor function—voluntary versus reflexive:
  - Voluntary movement
  - Normal complex movement—strength and symmetry in the upper extremities (UE), pronator drift proximally and grip strength distally; in the lower extremities (LE), leg lifts proximally and dorsi/plantar flexion distally.
  - Localization—ability to determine location of stimuli; patient localizes area of painful stimuli.
  - Withdrawal—abduction of the upper extremity; moving away from the stimuli.
  - Reflexive movement:
    - Abnormal flexor posturing (decorticate)—dysfunction of corticospinal tracts above the brainstem. Abnormal flexion of the UE with adduction of the UE, internal rotation of the upper extremity, wrist and extension, internal rotation and plantar flexion of the LE.
    - Abnormal extension posturing (decerebrate)—dysfunction of vestibulospinal tract and the RAS of the upper brain stem. Abnormal extension, hyperpronation, and adduction of the UE and wrist flexion; abnormal extension and internal rotation of the LE with plantar flexion of the feet and toes.
    - Mixed posturing—varied extensor and flexor tone in UE.
    - Flaccid—medullary compression with complete loss of motor tone.
- Test cranial nerve (CN) reflexes to assess for brain stem dysfunction:
  - Assess pupil size, symmetry, and reaction to light.
  - Assess extra ocular movements (CN 3, 4, 6) and reflex eye movements elicited by head turning (oculocephalic response). This should not be performed on patients with suspected cervical spine injury, patients in a cervical collar, or patients known to have cervical spine injuries.
  - The oculovestibular (caloric) response (CN 3, 4, 6, 8) is tested by medical staff when the patient is comatose and the oculocephalic response is absent, as a determination of brain death.
  - Assess CN 5, 7 together to evaluate facial pain, blink, eye closure, and grimace.
  - Assess CN 9, 10, 12 to evaluate gag, swallowing reflex, tongue protrusion, and patient's ability to handle own secretions.
- Assess respiratory rate and pattern (ex. normal, Kussmaul, Cheyne-Stokes, apneic).
- Assess deep tendon reflexes; evaluate tone for spasticity, rigidity, and paratonia (abnormal resistance increasing throughout flexion and extension, indicating frontal lobe dysfunction).
- Examine head for signs of trauma; and mouth, nose, and ears for evidence of edema, blood, and CSF (may indicate basilar skull fracture).
- Monitor any change in neurological status over time, and report changes to health care provider as indicated.

> ***NURSING ALERT***
> *A critical indicator of neurological function is the LOC. A change in GCS of two or more points may be significant. If patient demonstrates deterioration, as evidenced by a change in neurological examination, notify the health care provider without delay. Reevaluate the neurological status more often than required by orders, based on nursing judgment.*

NURSING DIAGNOSES

- Decreased Intracranial Adaptive Capacity
- Ineffective airway clearance related to upper airway obstruction by tongue and soft tissues; inability to clear respiratory secretions.
- Risk for imbalanced fluid volume related to inability to ingest fluids and dehydration from osmotic therapy (when used to reduce intracranial pressure).
- Impaired oral mucous membranes related to mouth breathing, absence of pharyngeal reflex, and inability to ingest fluid.
- Risk for impaired skin integrity related to immobility or restlessness.
- Impaired tissue integrity of the cornea related to diminished/absent corneal reflex.
- Hyperthermia related to infectious process; damage to hypothalamic center.
- Impaired urinary elimination related to unconscious state.
- Bowel incontinence related to unconscious state.

NURSING INTERVENTIONS

- Minimizing Secondary Brain Injury:
  - Monitor for change in neurological status, decreased LOC, and onset of cranial nerve deficits.
  - Identify emerging trends in neurological function, and communicate findings to medical staff.
  - Monitor response to pharmacologic therapy, including drug levels, as indicated.
  - Monitor laboratory data: Cerebro spinal fluid (CSF) cultures and Gram's stain (if applicable); communicate findings to the medical staff.
  - Assess neurological drains/dressings for patency, security, and characteristics of drainage.
  - Institute measures to minimize risk for increased intracranial pressure (ICP), cerebral edema, seizures, or neurovascular compromise.
  - Adjust care to reduce risk of increasing ICP: body positioning in a neutral position (head aligned with shoulders) without flexing head, reduce hip flexion, distribute care throughout 24-hour period sufficiently for ICP to return to baseline.
  - Monitor temperature status, maintaining normothermia.
- Maintaining an Effective Airway:
  - Position patient to prevent the tongue from obstructing the airway, encourage drainage of respiratory secretions, and promote adequate exchange of oxygen and carbon dioxide.

    - Keep the airway free from secretions with suctioning. In the absence of cough and swallowing reflexes, secretions rapidly accumulate in the posterior pharynx and upper trachea and can lead to respiratory complications (e.x., aspiration).
        - Insert oral airway if tongue is paralyzed or is obstructing the airway. An obstructed airway increases ICP. This is considered a short-term measure.
        - Prepare for insertion of cuffed endotracheal tube to protect the airway from aspiration and to allow efficient removal of tracheobronchial secretions.
        - Use oxygen therapy as prescribed to deliver oxygenated blood to the central service system (CNS).
        - Before suctioning, pretreat with sedative, opioid, or endotracheal lidocaine (if indicated).
- Attaining and Maintaining Fluid and Electrolyte Balance:
    - Monitor prescribed I.V. fluids carefully, maintaining euvolemia and minimizing large volumes of “free water,” which may aggravate cerebral edema.
    - Maintain hydration and enhance nutritional status with the use of enteral or parenteral fluids.
    - Measure urine output and specific gravity.
    - Evaluate pulses (radial, carotid, apical, and pedal); measure BP; these parameters are a measure of circulatory adequacy/inadequacy.
    - Maintain circulation; support the BP and treat life-threatening cardiac dysrhythmias.
- Maintaining Healthy Oral Mucous Membranes.
- Maintaining Skin Integrity.
- Maintaining Corneal Integrity.
- Reducing Fever.
- Promoting Urinary Elimination.
- Promoting Bowel Function.

Evaluation: Expected Outcomes

- Neurological status remains at baseline or improved.
- Maintains clear airway; coughs up secretions.
- Absence of the signs of dehydration.
- Intact, pink mucous membranes.
- No skin breakdown or erythema.
- Absence of trauma to the cornea.
- Core temperature within normal limits.
- Absence of urinary tract infection (UTI); maintenance of normal bladder emptying.
- Bowel movement on regular basis in response to bowel regimen.

NURSING MANAGEMENT OF THE PATIENT WITH INCREASED INTRACRANIAL PRESSURE (ICP)

ICP is the pressure exerted by the contents inside the cranial vault—the brain tissue (gray and white matter), CSF, and the blood volume. Increased ICP is defined as CSF pressure greater than 15 mm Hg.

Nursing Assessment

- Change in level of consciousness (loc):
  Caused by increased cerebral pressure.
- Changes in vital signs:
  Caused by pressure on brain stem.
- Hyperthermia followed by hypothermia.

> ***NURSING ALERT***
> *Watch for Cushing's triad—bradycardia, hypertension (with widening pulse pressure), and irregular respirations; this is classic symptomatology related to uncompromised increased ICP and is considered a neurological medical emergency*

> ***NURSING ALERT***
> *Respiratory irregularities may not be apparent if patient is mechanically ventilated.*
> *Pupillary Changes.*
> *Extra ocular Movements.*

- Other changes:
  - Headache.
  - Papilledema.
  - Subtle changes, such as restlessness, headache, forced breathing, purposeless movements, and mental cloudiness.
  - Motor and sensory dysfunctions (proximal muscle weakness, presence of pronator drift).
  - Contra lateral hemi paresis progressing to complete hemiplegia.
  - Speech impairment (nonfluent, fluent, or global aphasia) when dominant hemisphere involved.
  - Seizure activity: focal or generalized.
  - Decreased brain stem function (cranial nerve deficits, such as loss of corneal reflex, gag reflex, and ability to swallow).
  - Pathologic reflexes: Babinski, grasp, chewing, sucking.

Nursing Diagnosis

Decreased Intracranial Adaptive Capacity.

Nursing Interventions

The goal of nursing intervention is to decrease intracranial pressure.

- Establish and maintain the patient's airway, breathing, and circulation.
- Promote normal PCO_2. Hyperventilation is not recommended for prophylactic treatment of increased ICP as cerebral circulation is reduced by 50% the first 24 hours after injury. Hyperventilation causes cerebral vasoconstriction and decreases cerebral blood flow to decrease ICP; this can potentiate secondary injury to the brain. Hyperventilation should be used only after all other treatment options have been exhausted or in an acute crisis.
- Avoid hypoxia. Decreased PO_2 (less than 60) causes cerebral vasodilatation, thus increasing ICP.
- Maintain cerebral perfusion pressure (CPP) greater than 60. CPP is determined by subtracting the ICP from the mean arterial pressure (MAP): CPP = MAP - ICP.
- Administer mannitol, an osmotic diuretic, if ordered. Dosing: 0.25 to 1 gm/kg. Osmotic diuretics act by establishing an osmotic gradient across the blood-brain barrier that depletes the intracellular and extra cellular fluid volume within the brain and throughout the body. Mannitol will be ineffective if the blood-brain barrier is not intact.
- Administer hypertonic saline (2% or 3%), if ordered. It creates an osmotic gradient that pulls extra fluid from the brain with an intact blood-brain barrier, lowers ICP, improves cerebral blood flow by reducing viscosity, and improves oxygen carrying capacity. Saline (23.4%) is used as a bolus to treat acute increases in ICP in conjunction with or in place of mannitol.
- Insert an indwelling urinary catheter for management of diuresis.
- Administer corticosteroids, such as dexamethasone (Decadron), as ordered, to reduce vasogenic edema associated with brain tumors. Corticosteroids are not recommended in the treatment of cytoxic (intracellular) cerebral edema related to trauma or stroke.
- Maintain balanced fluids and electrolytes. Watch for increased or decreased serum sodium due to the following conditions that may occur with increased ICP:
    - Diabetes insipidus (DI) results from the absence of antidiuretic hormone (ADH); this is reflected by increased urine output with elevation of serum osmolarity and sodium.
    - The syndrome of inappropriate antidiuretic hormone (SIADH) results from the secretion of ADH in the absence of changes in serum osmolality. This is reflected by a decreased urine output with a decreased serum sodium and increased free water.
- Cerebral salt wasting is associated with abnormal release of aldosterone resulting in increased elimination of sodum and decreased interstitial volume.
- Monitor effects of neuromuscular paralyzing agents, such as pancuronium (Pavulon) (Dormicium); anesthetic agents, such as propofol (Diprivan); and sedatives, such as midazolam (Versed). These medications may be given along with mechanical ventilation to prevent sudden changes in ICP due to coughing, straining, or "fighting" the ventilator. Short-acting medications are preferred to allow for intermittent neurological assessment.

- High-dose barbiturates, such as pentobarbital (Nembutal), may be used in patients with intractable increased ICP (Note: not recommended unless all other treatments failed).
- High-dose barbiturates induce a comatose state and suppress brain metabolism, which, reduces cerebral blood flow and ICP. Only pupillary response is assessed.
- Be alert to the high level of nursing support required. All responses to environmental and noxious stimuli (suctioning, turning) are abolished, as well as, all protective reflexes.
- The cough or gag reflex will be absent and the patient will be unable to protect their airway, increasing susceptibility to pneumonia.
- Monitor ICP, arterial pressure, and serum barbiturate levels as indicated. Perform continuous EEG monitoring to document burst suppression (suppression of cortical activity) and ensure adequate dosing of barbiturates, if used.
- Monitor temperature because barbiturate coma causes hypothermia.
- Diminished GI motility and high risk for ileus.
- Maintain normothermia and treat fever aggressively. Fever increases cerebral blood flow and cerebral blood volume; acute increases in ICP occur with fever spikes. Cerebral temperature is 4 to 5 degrees higher then body core temperature; therefore, small increases in body core temperature can create drastic increases in the core temperature of the brain. Induced mild hypothermia (32° to 35° C) is currently being utilized in some facilities; however, results of research are inconclusive. Hypothermia is felt to be neuroprotective because it lowers metabolic needs, reduces intracellular acidosis, decreases the influx of intracellular calcium, and reduces the production of oxygen free radicals. Infection is a common complication of ICP and in the presence of fever, an infectious workup should be completed.
- Avoid positions or activities that may increase ICP. Keep the head and shoulders in alignment; neck flexion or rotation increases ICP by impeding venous return. Keep the head of bed elevated 30 degrees to reduce jugular venous pressure and decrease ICP:
  - Minimize suctioning, keep procedure less than 15 seconds, and, if ordered, instill lidocaine via endotracheal (ET) tube before suctioning. Coughing and suctioning are associated with increased intrathoracic pressure, which is associated with ICP spikes. Inject 5 to 10 mL of lidocaine into the ET tube before suctioning to dampen the cough response.
  - Minimize other stimuli, such as alarms, television, radio, and bedside conversations, which may precipitously increase ICP (stimuli that create elevation in ICP are patient dependent).
- Avoid hyperglycemia. Treat with sliding scale insulin or insulin drip as ordered.
- Initiate treatment modalities, as ordered, for sustained increased ICP (above 20 mm Hg persisting 15 minutes or more or if there is a significant shift in pressure).
- Pretreat prior to known activities that raise ICP, and avoid taking pressure readings immediately after a procedure. Allow patient to rest for approximately 5 minutes.
- Record ICP readings every hour, and correlate them with significant clinical events or treatments (suctioning, turning).

> ***NURSING ALERT***
> *Increased ICP is a true life-threatening medical emergency that requires immediate recognition and prompt therapeutic intervention.*

CEREBROVASCULAR ACCIDENT (STROKE, BRAIN ATTACK)

Definition

Stroke, cerebrovascular accident (CVA), or brain attack is the onset and persistence of neurological dysfunction lasting longer than 24 hours and resulting from disruption of blood supply to the brain and indicates infarction rather than ischemia. Strokes are classified as **ischemic** (more than 70% of strokes) or **hemorrhagic** (associated with greater morbidity and mortality). About 14% of strokes in the United States are of cardiac origin. About 60% of hemorrhagic strokes are the result of hypertension. Stroke is the leading cause of long-term disability and the third leading cause of death in the United States, with an annual incidence of 700,000.

> ***NURSING ALERT***
> *Early detection of warning signs promotes early diagnosis and intervention aimed at lessening stroke mortality and morbidity.*

HEMORRHAGIC STROKE

Nursing Assessment

- Maintain neurological flow sheet.
- Assess for voluntary or involuntary movements, tone of muscles, and presence of deep tendon reflexes (reflex return signals the end of the flaccid period and the return of muscle tone).
- Also assess mental status, cranial nerve function, and sensation/proprioception.
- Monitor bowel and bladder function/control.
- Monitor effectiveness of anticoagulation therapy.
- Frequently assess the patient's level of function and psychosocial response to condition.
- Assess for skin breakdown, contractures, and other complications of immobility.

> ***DRUG ALERT***
> *Oral anticoagulants are adjusted to maintain an INR at 2 to 3 to prevent stroke associated with atrial fibrillation. Monitor for potential complications of intracranial and subdural hemorrhage. Report INRs that are elevated to reduce the risk of bleeding or decreased levels to adjust therapy to be more effective.*

Nursing Diagnoses

- Risk for injury related to neurological deficits.
- Impaired physical mobility related to motor deficits.
- Disturbed thought processes related to brain injury.
- Impaired verbal communication related to brain injury.
- Self-care deficit: bathing, dressing, toileting; related to hemi paresis/paralysis.
- Imbalanced nutrition: less than body requirements related to impaired self-feeding, chewing, swallowing.
- Impaired urinary elimination related to motor/sensory deficits
- Disabled family coping related to catastrophic illness, cognitive and behavioral sequelae of stroke, and care giving burden.

> ***NURSING ALERT***
> *Use of clinical pathways maximizes stroke patient outcomes. Case management models of care foster interdisciplinary utilization, timeliness of referrals, patient education, patient satisfaction, and efficient use of health care resources. The specific role of the nurse in stroke recovery integrates therapeutic aspects of coordinating, maintaining, and training.*

Nursing Interventions

- Preventing fall and Other Injuries:
  - Maintain bed rest during the acute phase (24 to 48 hours after onset of stroke) with the head of bed slightly elevated and side rails in place.
  - Administer oxygen, as ordered, during acute phase to maximize cerebral oxygenation.
  - Frequently assess respiratory status, vital signs, heart rate and rhythm, and urine output to maintain and support vital functions.
  - When patient becomes more alert after acute phase, maintain frequent vigilance and interactions aimed at orienting, assessing, and meeting the needs of the patient.
  - Try to allay confusion and agitation with calm reassurance and presence.
  - Assess the patient for fall risk.
- Preventing Complications of Immobility

Interventions to improve functional recovery require active participation of the patient and repetitive training. Functional demand and intensive training are believed to trigger CNS reorganization — responsible for late functional recovery after stroke.

- Maintain functional position of all extremities.
- Apply a trochanter roll from the crest of the ilium to the midthigh to prevent external rotation of the hip.

- Place a pillow in the axilla of the affected side when there is limited external rotation to keep the arm away from chest and prevent adduction of the affected shoulder.
- Place the affected upper extremity slightly flexed on pillow supports with each joint positioned higher than the preceding one to prevent edema and resultant fibrosis; alternate elbow extension.
- Place the hand in slight supination with fingers slightly flexion.
- Avoid excessive pressure on the ball of foot after spasticity develops.
- Do not allow the top bedding to pull the affected foot into plantar flexion; may use tennis shoes in bed.
- Place the patient in a prone position for 15 to 30 minutes daily, and avoid sitting up in a chair for long periods; to prevent knee and hip flexion contractures.
- Encourage neutral positioning of affected limbs to promote relaxation. Limit abnormal increases in muscular tone to enhance functional recovery (reflex-inhibiting positioning).
- “Forced use” is an experimental treatment designed to overcome nonuse of the hemi paretic upper extremity in regaining functional use of the affected arm with selected chronic hemi paretic patients.
- “Constraint-induced movement therapy” restricts the contra lateral upper extremity in effort to force use of the affected arm:
    - Apply splints and braces, as indicated, to support flaccid extremities or on spastic extremities to decrease stretch stimulation and reduce spasticity.
- Volar splint to support functional position of wrist.
- Sling to prevent shoulder subluxation of the flaccid arm.
- High-top sneaker for ankle and foot support:
    - Exercise the affected extremities passively through ROM four to five times daily, this maintains joint mobility and enhances circulation; encourage active ROM exercise as able.
    - Teach the patient to move the affected extremity with the unaffected extremity.
    - Assist with ambulation, as needed, with the help of physical therapy (as indicated).
- Check for orthostatic hypotension when dangling and standing.
- Gradually position the patient from a reclining position to sitting; dangle their legs at the bedside before transferring out of bed or ambulating; assess sitting balance in bed.
- Assess the patient for excessive exertion.
- Have the patient wear walking or tennis shoes.
- Assess standing balance, and have the patient practice standing.
- Help the patient begin ambulating as soon as standing balance is achieved; ensure safety with a patient waist belt.
- Provide rest periods, the patient will tire easily.
- Facilitating Communication.
- Attaining Bladder Control.
- Promoting Adequate Oral Intake.

- Strengthening Family Coping.
- Community and Home Care Considerations.
- Patient Education and Health Maintenance.

Evaluation: Expected Outcomes

- No falls, vital signs stable.
- Maintains body alignment, no contractures.
- Oriented to person, place, and time.
- Communicates appropriately.
- Brushes teeth, puts on shirt and pants independently.
- Feeds self two-thirds of meal.
- Voids on commode at 2-hour intervals.
- Family seeks help and assistance from others.

TRAUMA

Traumatic brain injury

Definition

Traumatic brain injury (TBI), also known as head injury, is the disruption of normal brain function due to trauma-related injury. TBI produces compromised neurological function, resulting in focal or diffuse symptoms. Falls are the most common etiology of injury, followed by motor vehicle accidents. TBI is the leading cause of trauma-related deaths and accounts for 40% of trauma-related injuries. The goal of treatment is to prevent secondary brain injury by providing supportive care

Types:

- Concussion—transient interruption in brain activity; no structural injury noted on radiographs.
- Cerebral contusion—bruising of the brain with associated swelling. Coup injury is the site of initial trauma; the contra coup injury is the site of rebound injury. Temporal and frontal lobes are common sites.
- Intracerebral hematoma—bleeding into the brain tissue commonly associated with edema.
- Epidural hematoma—blood between the inner table of the skull and dura. Frequently associated with injury or laceration of the middle meningeal artery secondary to a temporal bone fracture. Arterial bleed is commonly associated with a lucid interval, followed by unresponsiveness.
- Subdural hematoma—blood between the dura and arachnoid caused by venous bleeding; commonly associated with contusion, or intracerebral hematoma.
- Diffuse axonal injury (DAI) or shear injury —axonal tears within the white matter of the brain. Frequently occurs within the corpus callosum or brain stem and at the frontal/temporal poles. Associated with prolonged coma.

Classification

- **Mild** (GCS 13 – 15), with loss of consciousness up to 15 minutes.
- **Moderate** (GCS 9 – 12), with loss of consciousness for up to 6 hours.
- **Severe** (GCS 3 to 8), with loss of consciousness greater than 6 hours.

Associated Injuries: (Extra-cranial Trauma)

- Facial trauma and skull fractures—occur in 20% of major TBI. The temporal skull is thinnest; frontal or occipital are the thickest:
  - Linear fracture—fracture through the entire thickness of bone that runs in a straight linear pattern.
  - Basilar skull fracture of the anterior fossa results in contusions around the eyes (raccoon eyes) and rhinorrhea.
  - Basilar skull fracture of the posterior fossa results in contusions around the ears (Battle sign) and otorrhea.
  - Depressed fracture—displacement of fracture past the inner table of the skull; risk of dural tear, CSF leak, and intracranial injury; may be closed or open.
  - Facial fractures—orbital (LeForte I-II), mandible, zygoma, maxillary, or nasal fractures.
- Vascular injuries—vertebral or carotid artery dissection.
- Spine fracture with or without spinal cord injury (SCI).
- Soft tissue injuries.

Nursing Assessment

- Monitor for signs of increased ICP—altered LOC, abnormal pupil responses, vomiting, increased pulse pressure, bradycardia, and hyperthermia.
- Monitor for signs of sympathetic storming—altered LOC, diaphoresis, tachycardia, tachypnea, hypertension, hyperthermia, agitation, and dystonia. Sympathetic storming is generally seen in severe TBI (GCS 3 - 8) or minimally responsive patients.
- Monitor cardiac status for hypotension and arrhythmias (bradycardia, elevated T waves, premature ventricular contractions, premature atrial contractions, and sinus arrhythmias)—common and frequently asymptomatic. Tachycardia with hypotension is indicative of hypovolemia; the patient should be evaluated for additional source of blood loss.
- Be alert for Diabetes Insipidus (DI)—excessive urine output, dilute urine (specific gravity less than 1.005), and hypernatremia.
- Be alert for hyponatremia and assess etiology (SIADH or cerebral salt wasting).
- Monitor laboratory findings and report abnormal values:
  - Abnormal PTT, PT, and fibrinogen levels indicating coagulopathy.
  - Electrolyte imbalance—alterations in serum potassium (hypokalemia) and sodium (hypernatremia/hyponatremia) levels are common.
  - Anemia—related to additional trauma or may be dilutional.

  - Elevated WBC count—indicating infection related to trauma or invasive procedures.
  - Hypoxia or hypercarbia.
- Perform cranial nerve, motor, sensory, and reflex assessment.
- Assess for behavior that warrants potential for injury to self or others.

> ***NURSING ALERT***
> *Regard every patient who has a brain injury as having a potential spinal cord injury. Cervical collar and spine precautions should be maintained until spinal fracture has been ruled out. A significant number of patients are under the influence of alcohol at the time of injury, which may mask the nature and severity of the injury.*

Nursing Diagnoses

- Ineffective tissue perfusion (cerebral) related to increased ICP.
- Ineffective breathing pattern related to increased ICP or brain stem injury.
- Imbalanced nutrition: less than body requirements related to compromised neurological function and stress of injury.
- Disturbed thought processes related to physiology of brain injury.
- Risk for injury related to altered thought processes.
- Compromised family coping related to unpredictability of outcome.

Nursing Interventions

Maintaining Adequate Cerebral Perfusion:

- Maintain a patent airway.
- Monitor ICP, as ordered.
- Monitor cerebral oxygenation, temperature, or neurochemicals, as ordered.
- Provide oxygen therapy to maintain Pa_{O2} above 100 and carbon dioxide within normal range.
- Maintain SBP above 90 to enhance cerebral perfusion. Administer the treatment for arrhythmias if patient is symptomatic. Evaluate for additional source of blood loss if the patient is tachycardic and hypotensive.
- Monitor LOC, cranial nerve function, and motor and sensory function as per GCS or neurological flow sheet,. Identify emerging trends in neurological function, and communicate findings to medical staff.
- If a patient has severe TBI, monitor for signs of sympathetic storming (abnormal stress response) and identify triggers and effective treatment modalities. Institute nursing measures that have been found to be helpful, such as maintaining normothermia, pre treating before known triggers, applying cool compress to the forehead, and providing relaxing music.

- Monitor response to pharmacologic therapy, including antiepileptic drugs (AED) levels, as directed.
- Monitor laboratory data, CSF cultures, and Gram stains, if applicable, and institute prompt antibiotic therapy as directed.
- Monitor for hypernatremia and administer fluid replacements, as directed. If due to Diabetes Insipidus DI, administer pitressin replacement therapy.
- Monitor for hyponatremia and administer oral or I.V. salt replacement as directed. Administer 250 to 500 mL 3% saline solution over 3 to 5 hours.
- Monitor coagulation panel and replace clotting factors at room temperature as directed.
- Assess dressings and drainage tubes after surgery for patency, security, and characteristics of drainage.
- Institute measures to minimize increased ICP, ischemic changes, cerebral edema, seizures, or neurovascular compromise. This is done by careful positioning; to avoid flexing head, reducing hip flexion (can reduce venous drainage, causing congestion); and spreading out care evenly over 24-hour period.

> ***NURSING ALERT***
> *Sympathetic storming places the patient at high risk for secondary brain injury, cardiac abnormalities, weight loss, skin breakdown, and infection. Be alert to triggers (suctioning, turning, hyperthermia, infection, auditory stimuli), and treat promptly to control symptoms.*

> ***NURSING ALERT***
> *Severe states of hypernatremia and hyponatremia can cause further neurological compromise (seizures, nausea, confusion, irritability/agitation, and coma). Close monitoring of laboratory values is indicated to evaluate trends and maintain normal range. Hypernatremia and hyponatremia should not be reversed quickly, because the rapid change can create rebound cerebral edema and be detrimental to the patient.*

Maintaining Respiration:

- Monitor respiratory rate, depth, and pattern of respirations; report any abnormal pattern, such as Cheyne-Stokes respirations or periods of apnea.
- Assist with intubation and ventilatory assistance, if needed.
- Obtain frequent ABG values to maintain PaO_2 greater than 100 mm Hg and $PaCO_2$ 35 to 45 mm Hg.
- The use of positive end-expiratory pressure (PEEP) in the care of critically ill patients after TBI remains controversial. PEEP (5 to 10 cm) is felt to be physiological and not detrimental; however, excessive PEEP can create increases in intrathoracic pressure, diminish venous drainage, reduce mean arterial pressure (MAP), and increase ICP.

- Turn the patient every 2 hours, and assist with coughing and deep breathing.
- Suction the patient as needed; however, hyperventilate the patient before suctioning to prevent hypoxia.

Meeting Nutritional Needs:

- Begin nutritional support as soon as possible after a head injury; provide 140% of energy requirements (100% in paralyzed patient), with 15% in the form of protein. Administer H_2-blocking agents to prevent gastric ulceration and hemorrhage from gastric acid hyper secretion.
  - Enteric feedings can be initiated once bowel sounds have returned; continuous or intermittent:
    - Elevate the head of the bed after feedings.
    - Check residuals to prevent aspiration.
    - Monitor for diarrhea.
  - I.V. hyper alimentation—for patients unable to tolerate nasogastric feedings.
  - Oral feeding—started when adequate swallowing mechanism is demonstrated.
- Consult with dietitian to provide the increased calories and nitrogen requirement resulting from the metabolic changes of brain injury.
- Monitor glucose levels frequently, utilizing finger stick samples and glucometer. Insulin (I.V. drip/sliding scale) may be required to regulate serum glucose levels within a normal range to avoid hyperglycemia, which elevates lactate levels and worsens the effects of secondary brain injury.
- Consult speech therapist for bedside or radiographic swallow study before initiation of oral foods. Recognize that any patient with coma is at risk for swallowing difficulties. Assessment of swallowing function decreases risk of aspiration. Speech therapy is essential for retraining and developing adaptive techniques.

NURSING ALERT
Caloric needs of the head-injured patient increase by 100% to 200%. Consult your dietitian to institute nutritional support within the first 2 to 3 days after injury to support the recovery process. Weight loss is generally in the form of muscle loss and can be as much as 25 to 30 lb (11.3 to 13.6 kg).

Promoting Cognitive Function

Preventing Injury:

- Instruct the family regarding the behavioral phases of recovery from brain injury, such as restlessness and combativeness.
- Investigate for physical sources of restlessness, such as uncomfortable position, signs of UTI, or pressure ulcer development.
- Reassure the patient and family during periods of agitation and irrational behavior.
- Pad side rails, and wrap hands in mitts if patient is agitated. Maintain constant vigilance, and avoid restraints if possible.

- Keep environmental stimuli to a minimum to avoid confusion and agitation.
- Provide adequate light if patient is hallucinating.
- Avoid sedatives to avoid medication-induced confusion and altered states of cognition.

Strengthening Family Coping:

- Consult with social worker or psychologist to assist the family in adjusting to patient's permanent neurological deficits.
- Help the family assist the patient to recognize current progress and not focus on limitation.

TABLE 3: American Academy of Neurology Guidelines for Sports-Related Concussion

Severity	**Recommendations**
Grade 1	
Transient confusion without loss of consciousness and resolution of symptoms within 15 minutes	• Removal from game and only returned to the game if remains asymptomatic after 15 minutes • If second grade 1 concussion occurs, removal from sports activity until asymptomatic for 1 week
Grade 2	
Transient confusion without loss of consciousness and symptoms persisting longer than 15 minutes	• Removal from sporting event and further workup if symptoms do not resolve in 1 week. • No sporting activity for 1 week. If grade 2 occurs after a grade 1 concussion, removal from sporting event and no sporting activities for 2 weeks
Grade 3	
Loss of consciousness	• Removal from sporting event. Return to sporting activities if asymptomatic for 1 week (brief loss of consciousness) • Return to sporting activities if asymptomatic for 2 weeks (prolonged loss of consciousness) Unconsciousness with neurological findings should be transported to nearest emergency for full evaluation. • Removal from sporting activity for 1 year and discouraged from future participation in contact sports if any structural findings on computed tomography scan or magnetic resonance imaging.

Evaluation: Expected Outcomes

- No signs of increased ICP.
- Respirations: Less than24 breaths/minute, regular.

- Tube feedings tolerated well without residual.
- Oriented to person, place, and time.
- Less agitated; side rails maintained.
- Family reports using respite care.

SPINAL CORD INJURY

Definition

Spinal cord injury (SCI) is a traumatic injury to the spinal cord that may vary from a mild cord concussion with transient numbness to immediate and complete tetraplegia. The most common sites are the cervical areas C_5, C_6, and C_7, and the junction of the thoracic and lumbar vertebrae, T_{12} and L_1. Injury to the spinal cord may result in loss of function below the level of cord injury. SCI requires comprehensive and specialized care.

Table 4: Incomplete Spinal Cord Clinical Syndromes

Syndrome	Affected Site	Deficit	Preservation
Central cord	Central cervical spinal cord	More motor deficit in upper extremities than lower extremities caused by medial damage of corticospinal tract.	Sacral sensory; lower extremities have better motor function than upper extremities due to lateral sparing of corticospinal tract.
Brown-Sequard	Hemi section of spinal cord	Ipsilateral motor function and fine touch, vibration, and proprioception (posterior tract); contra lateral sensory function pain and temperature (spinothalamic tract).	Ipsilateral sensory function of pain and temperature (spinothalamic tract); contra lateral motor function, fine touch, vibration, and proprioception (posterior tract).
Anterior cord	Main anterior spinal artery of anterior spinal cord affecting anterior two-thirds of spinal cord	Variable motor deficit; variable sensory deficit of pain and temperature (spinothalamic tract).	Posterior one-third of spinal cord (posterior spinal artery); sensory function of proprioception, light touch, vibration (posterior tract).
Conus medullaris	Conus and lumbar nerve roots in spinal cord	Variable motor deficit; bowel, bladder, and lower extremity reflexes (flaccid).	Lesions of proximal conus may be reflexic (e.g., butocavernosa, micturition).
Cauda equina	Lumbosacral nerve roots in spinal cord (distal from conus medullaris)	Variable motor deficit; bowel, bladder, and lower extremity reflexes (flaccid).	Lesions proximal to level of injury may be reflexic (e.g., bulbocavernosa, micturition).

Nursing Assessment

- Assess cardiopulmonary status and vital signs to help determine degree of autonomic dysfunction, especially in patients with tetraplegia.
- Determine LOC and cognitive function indicating TBI or other pathology.
- Perform frequent motor and sensory assessments of the trunk and extremities. The extent of the deficits may increase due to edema and hemorrhage. Later, increasing neurological deficits and pain may indicate development of syringomyelia.
- Note signs and symptoms of spinal shock, such as flaccid paralysis, urine retention, absent reflexes.
- Assess bowel and bladder function.
- Assess quality, location, and severity of pain.
- Perform psychosocial assessment to evaluate motivation, support network, financial, or other problems.
- Assess for indicators of powerlessness, including verbal expression of no control over the situation, depression, nonparticipation, dependence on others, or passivity.

Nursing Diagnoses

- Ineffective breathing pattern related to paralysis of respiratory muscles or diaphragm.
- Impaired physical mobility related to motor dysfunction.
- Risk for impaired skin integrity related to immobility and sensory deficit.
- Urinary retention related to neurogenic bladder.
- Constipation or bowel incontinence related to neurogenic bowel.
- Risk for injury related to autonomic dysreflexia and orthostatic hypotension.
- Powerlessness related to loss of function, long rehabilitation, and depression.
- Sexual dysfunction related to erectile dysfunction and fertility changes.
- Chronic pain related to neurogenic changes.

Nursing Interventions

Attaining an Adequate Breathing Pattern:

- For patients with high-level lesions, continuously monitor respirations and maintain a patent airway. Be prepared to intubate if respiratory fatigue or arrest occurs.
- Frequently assess cough and vital capacity. Teach effective coughing; if patient is able.
- Provide adequate fluids and humidification of inspired air to loosen secretions.
- Suction as needed; observe vagal response (bradycardia—should be temporary).
- When appropriate, implement chest physiotherapy regimen to assist with pulmonary drainage and prevent infection.
- Monitor results of ABG values, chest X-ray, and sputum cultures.

- Tape halo wrench to body jacket or halo traction in the event the jacket must be removed for basic or advanced life support or respiratory distress.

Assisted Coughing

Many patients with tetraplegia have an impairment of the diaphragmatic and intercostal muscles. The result is a weak or ineffective cough. To increase the mechanical effectiveness of the patient's cough, perform or teach the assisted cough techniques:

- Place the patient in supine, low semi-Fowler's position.
- Place the heels of your hands on the costophrenic angle of the patient's rib cage.
- With the patient's head turned away, ask the patient to hyperventilate and exhale once or twice. Allow your hands to move with the patient.
- During the next breath, ask the patient to take a deep breath and cough while exhaling.
- As the patient coughs, thrust your hands down and in (inferiorly and medially) to add power to the diaphragm during exhalation.
- Allow one or two normal breaths, and repeat the procedure.

> ***NURSING ALERT***
> *Incorrect hand placement may cause injury to the internal organs, ribs, and xiphoid process.*

Promoting Mobility:

- Place the patient on a firm kinetic turning bed until spinal cord stabilization occurs. After stabilization, turn every two hours on a pressure reduction surface, ensuring good alignment.
- Logroll the patient with unstable spinal cord injury (SCI).
- Perform range of motion (ROM) exercises to prevent contractures and maintain rehabilitation potential.
- Monitor BP with position changes for patients with lesions above the midthoracic area to prevent orthostatic hypotension.
- Encourage physical therapy and practicing of exercises as tolerated. Functional electrical stimulation may facilitate independent standing and ambulation.
- Encourage weight-bearing activity to prevent osteoporosis and risk of kidney stones.

Protecting Skin Integrity.

Promoting Urinary Elimination.

Promoting Bowel Elimination.

NURSING ALERT
Never attempt to reposition the patient by grasping a halo or any other stabilization device. This may result in severe damage to the brain, head, or vertebra

DRUG ALERT
Caution should be exercised for patients with SCI who are taking tricyclic antidepressants because of autonomic dysfunction. SCI patients are more vulnerable to anticholinergic adverse effects and orthostatic hypotension. In addition, numerous potential drug reactions are associated with monoamine oxidase inhibitors and SCI.

Reducing Pain:

- Assess pain using consistent pain scale. Report changes from baseline or new location or type of pain.
- Manage neurogenic pain with pharmacologic agents as directed.
- Help the patient assess the effects of nonpharmacologic treatment such as acupuncture.

Evaluation: Expected Outcomes

- Respirations adequate, ABG values within normal limits.
- Repositioning hourly, no orthostatic changes
- No evidence of pressure ulcers or deep vein thrombosis (DVT).
- Reflex (or areflexic) voiding without retention.
- Bowel evacuation controlled.
- No episodes of autonomic dysreflexia.
- Verbalizes feeling of control over condition.
- Patient and partner exploring sexuality and sexual options.
- Reports pain at or lower than 2 to 3 level on a scale of 1 to 10.

SEIZURE DISORDERS

Definition

Seizures are defined as a sudden alteration in normal brain activity that causes distinct changes in behavior and body function. Seizures are thought to result from disturbances in the cells of the brain that cause cells to give off abnormal, recurrent, uncontrolled electrical discharges.

Emergency Management of Status Epilepticus

Status epilepticus (acute, prolonged, repetitive seizure activity) is a series of generalized seizures without return to consciousness between attacks. The term has been broadened to include continuous clinical and/or electrical seizures lasting at least five minutes, even without impairment of consciousness. Status epilepticus is considered a serious neurological emergency. It has high mortality and morbidity (permanent brain damage, severe neurological deficits). Factors that precipitate status epilepticus in patients with preexisting seizure disorder include: medication withdrawal, fever, metabolic or environmental stresses, alcohol or drug withdrawal, and sleep deprivation.

Nursing Interventions

- Establish airway, and maintain blood pressure (BP).
- Obtain blood studies for glucose, blood urea nitrogen, electrolytes, and anticonvulsant drug levels to determine metabolic abnormalities and serve as a guide for maintenance of biochemical homeostasis.
- Administer oxygen—there is some respiratory depression associated with each seizure, which may produce venous congestion and hypoxia of brain.
- Establish I.V. lines, and keep them patent for blood sampling, drug administration, and infusion of fluids.
- Administer I.V. anticonvulsant (lorazepam [Ativan], phenytoin [Panutin]), diazepam [Valium]) slowly to ensure effective brain tissue and serum concentrations.
  - Give additional anticonvulsants as directed—effects of lorazepam are of short duration.
  - Anticonvulsant drug levels should be monitored regularly.
- Monitor the patient continuously; depression of respiration and BP induced by drug therapy may be delayed.
- Use mechanical ventilation as needed.
- If initial treatment is unsuccessful, general anesthesia may be required
- Assist with search for precipitating factors:
  - Monitor vital and neurological signs on a continuous basis.
  - Use electroencephalographic monitoring to determine nature and abolition (after diazepam administration) of epileptic activity.

  - Determine (from family member) if there is a history of epilepsy, alcohol/drug use, trauma, or recent infection.

Diagnostic Evaluation

- Electro encephalogram (EEG) with or without video monitoring—locates epileptic focus, spread, intensity, and duration; helps classify seizure type.
- magnetic resonance imaging (MRI), CT scan—to identify the lesion that may be the cause of the seizure.
- SPECT or PET scans—additional tests to identify seizure foci.
- Neuropsychological studies—to evaluate for behavioral disturbances.
- Serum laboratory studies or lumbar puncture—to evaluate for infectious, hormonal, or metabolic etiology.

Management

- Pharmacotherapy—AED selected according to seizure type.
- Biofeedback—useful in the patient with reliable auras.
- Surgery—resective and palliative operations (temporal lobectomy, extra temporal resection, corpus callosotomy, or hemispherectomy).
- Vagal nerve stimulation.

Complications

- Status epilepticus.
- Injuries due to falls, especially head injuries.

Nursing Assessment

- Obtain seizure history, including prodromal signs and symptoms, seizure behavior, postictal state, and history of status epilepticus.
- Document the following about seizure activity:
  - Circumstances before attack, such as visual, auditory, olfactory, or tactile stimuli; emotional or psychological disturbances; sleep; hyperventilation.
  - Description of movement, including where movement or stiffness started; type of movement and parts involved; progression of movement; and whether the beginning of the seizure was witnessed.
  - Position of the eyes and head; size of pupils.
  - Presence of automatisms, such as lip smacking or repeated swallowing.
  - Incontinence of urine or feces.
  - Duration of each phase of the attack.
  - Presence of unconsciousness and its duration.

  - Behavior after attack, including inability to speak, any weakness or paralysis (Todd's paralysis), or sleepiness.
  - Investigate the psychosocial effect of seizures.
  - Obtain history of drug or alcohol abuse.
  - Assess compliance and medication-taking strategies.

> ***DRUG ALERT***
> *Nonadherence to medication regimen as well as toxicity of antiepileptic medications can increase seizure frequency. Obtain drug levels before implementing medication changes.*

Nursing Diagnoses

- Ineffective tissue perfusion (cerebral) related to seizure activity.
- Risk for injury related to seizure activity.
- Ineffective coping related to psychosocial and economic consequences of epilepsy.

Nursing Interventions

- Maintaining Cerebral Tissue Perfusion:
  - Maintain a patent airway until the patient is fully awake after a seizure.
  - Provide oxygen during the seizure if color change occurs.
  - Stress the importance of taking medications regularly.
  - Monitor serum levels for therapeutic range of medications.
  - Monitor the patient for toxic adverse effects of medications.
  - Monitor platelet and liver functions for toxicity due to medications.
- Preventing Injury:
  - Provide a safe environment by padding side rails and removing room clutter.
  - Place the bed in the lowest position.
  - Do not restrain the patient during a seizure.
  - Do not put anything in the patient's mouth during a seizure.
  - Place the patient on his side during a seizure to prevent aspiration.
  - Protect the patient's head during a seizure. If seizure occurs while ambulating or from a chair, cradle their head or provide cushion/support for protection against head injury.
  - Stay with the patient who is ambulating or who is in a confused state during/after a seizure.
  - Provide a helmet to the patient who frequently falls during a seizure.
  - Manage the patient in status epilepticus.

Evaluation: Expected Outcomes

- Takes medication as ordered, drug level within normal range.
- No injuries observed.
- Reports using support services and stress management techniques.

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CHAPTER 6: GASTROINTESTINAL (GI) DISORDERS

Introduction

The Gastrointestinal (GI) system comprises the alimentary canal and its accessory organs, beginning at the mouth; extending through the pharynx, esophagus, stomach, small intestine, colon, rectum, and anal canal; and ending at the anus.

The GI system is responsible for the following essential body functions:

- Ingestion and propulsion of food.
- Mechanical and chemical digestion of food.
- Synthesis of nutrients, such as vitamin K.
- Absorption of nutrients into the bloodstream.
- The storage and elimination of non digestible waste products from the body through feces.

ASSESSMENT

A comprehensive health history should be obtained to elicit subjective data related to major manifestations of GI problems. Common manifestations include nutritional problems, abdominal pain, indigestion, nausea and vomiting, diarrhea, constipation, change in bowel habits, weight loss, and dysphasia.

STANDARDS OF CARE GUIDELINES

- When caring for a patient after abdominal surgery or with any type of GI disorder:
- Make sure that adequate bowel sounds are present before allowing anything by mouth. Periodically reassess for bowel sounds, bloating, nausea, vomiting, and abdominal distension or tenderness.
- Monitor food intake and fluid intake and output as indicated.
- Periodically monitor weight, and watch for trends in weight loss or weight gain.
- Assess stools for frequency, consistency, color, and amount.
- Promptly report increases in pain, fever, nausea and vomiting, bloating, change in stools, and signs of wound infection to health care provider.
- Monitor the complete blood count, electrolytes, albumin, and protein as directed.
- This information serves as a general guideline only. Each patient situation presents a unique set of clinical factors and requires nursing judgment to guide care, which may include additional or alternative measures and approaches.

Nutritional Problems

Assessment

- What is your typical 24-hour food intake?
- What is your usual weight?

- Has there been a recent weight gain or loss? If a recent weight change, how many pounds?
- How is your appetite?

History

- Any history of eating disorders?
- Any personal or family history of ulcer disease, GI cancer, or inflammatory bowel disease.
- What symptoms is the patient suffering from: obesity, abdominal pain, indigestion (dyspepsia), nausea, vomiting, diarrhea, constipation, or dysphagia.

Physical examination

- Inspection of the abdomen.
- Auscultation of all four abdominal quadrants.
- Percussion for tympani or dullness.
- Light and deep palpation.

> ***NURSING ALERT***
> *Auscultation should be performed before percussion and palpation, which may stimulate bowel sounds. Deep palpation in noted areas of tenderness or pain should be performed last.*

Key Findings

- Tenting of the skin when the skin is rolled between thumb and index finger. Tenting may indicate dehydration.
- Mouth lesions, missing teeth, swollen or bleeding gums may contribute to weight loss and nutritional deficiencies.
- Body weight may indicate obesity or such problems as anorexia nervosa or malignancy.
- A palpable mass may indicate an enlarged organ, inflammation, malignancy, or hernia.
- Rebound tenderness, guarding, and rigidity may indicate appendicitis, cholecystitis, peritonitis, pancreatitis, or duodenal ulcer.
- Protuberant or bulging abdomen or flanks can indicate ascites. Two physical assessment skills that may help to confirm the presence of ascites are testing for shifting dullness and testing for a fluid wave.
- Distention and absence of bowel sounds may indicate intestinal obstruction.
- Characteristics of stool.
- The appearance of blood in stool may be characteristic of its source:
- Upper GI bleeding—tarry black (Melina).
- Lower GI bleeding—bright red blood.

- Lower rectal or anal bleeding—blood streaking on surface of stool or on toilet paper.
- Other characteristics of stool may indicate a particular GI problem.
- Bulky, greasy, foamy, foul smelling, gray with silvery sheen—steatorrhea (fatty stool).
- Light gray "clay-colored" (due to absence of bile pigments, acholic)—biliary obstruction.
- Mucus or pus visible—chronic ulcerative colitis, shigellosis.
- Small, dry, rocky-hard masses—constipation, obstruction.
- Marble-size stool pellets—irritable bowel syndrome.

DIAGNOSTIC TESTS

Laboratory tests

- Stool testing for blood (Hem occult).
- A variety of blood tests, such as hematocrit and hemoglobin for monitoring GI bleeding.

Radiology and imaging studies

- Barium meal and small-bowel Series.
- Barium enema.
- Ultrasound.

> ***NURSING ALERT***
> *If a barium enema and upper GI series are both ordered, the upper GI series is done last so that barium traveling down the digestive tract does not interfere with the results of the barium enema.*

Endoscopic procedures

- Capsule endoscopy.
- Esophagogastroduodenoscopy.

Instruments passed through the scope can be used to perform a biopsy or cytological study, remove polyps or foreign bodies, control bleeding, or open strictures.

> ***NURSING ALERT***
> *Capsule endoscopy is contraindicated for patients with small bowel obstruction, dysphagia, fistulas, severe delayed gastric emptying, gastrectomy with gastrojejunostomy, or GI stricture. There is a risk of trapping the capsule, delayed passage, or impaired peristalsis. Pacemakers or implanted defibrillators may alter the quality and quantity of study information.*

GENERAL PROCEDURES AND TREATMENT MODALITIES

Relieving Constipation and Fecal Impaction

Definition

Enema: a common procedure to relieve constipation or evacuate the lower bowel through the installation of a solution into the rectum and sigmoid colon.

Purposes of Enema Administration

- Bowel preparation for diagnostic tests or surgery to empty the bowel of fecal content.
- Delivery of medication into the colon (such as enemas containing steroids to treat ulcerative proctitis or a Kayexalate enema to decrease the serum potassium level).
- To soften the stool (oil-retention enemas).
- To relieve gas (tidal, milk and molasses, or Fleet's enemas).
- To promote defecation and evacuate feces from the colon for patients with constipation or an impaction.

> ***NURSING ALERT***
> *Enemas should not be given routinely to treat constipation because they disrupt normal defecation reflexes, and the patient becomes dependent.*

NASOGASTRIC AND NASOINTESTINAL INTUBATION

Definition

- Nasogastric (NG) intubation refers to the insertion of a tube through the nasopharynx into the stomach.
- Nasointestinal intubation is performed by inserting a small-bore, weighted tube that is carried by way of peristalsis into the duodenum or jejunum.
- It is primarily used for administering feedings and maintaining nutritional intake.

Purposes of Nasogastric Intubation

- Remove fluids and gas from stomach (decompression).
- Prevent or relieve nausea and vomiting after surgery or traumatic events by decompressing the stomach.
- Determine the amount of pressure and motor activity in the GI tract (diagnostic studies).
- Irrigate the stomach (lavage) for active bleeding or poisoning.
- Treat mechanical obstruction.
- Administer medications and feeding (gavage) directly into the GI tract.

- Obtain a specimen of gastric contents for laboratory studies when pyloric or intestinal obstruction is suspected.

Nursing and Patient Care Considerations

- If the patient is unconscious, advance the tube between respirations to make sure it does not enter the trachea.
- You will need to stroke the unconscious patient's neck to facilitate passage of the tube down the esophagus.
- Watch for cyanosis while passing the tube in an unconscious patient. Cyanosis indicates the tube has entered the trachea.
- If patient has a nasal condition that prevents insertion through the nose, the tube is passed through the mouth.
- Remove dentures, slide the distal end of the tube over the tongue, and proceed the same way as a nasal intubation.
- Make sure to coil the end of the tube and direct it downward at the pharynx.
- Pain or vomiting after the tube is inserted indicates tube obstruction or incorrect placement.
- If the NG tube is not draining, the nurse should reposition the tube by advancing or withdrawing it slightly (with a physician's order). After repositioning, always check for placement.
- Recognize complications (when the tube is in for prolonged periods): nasal erosion, sinusitis, esophagitis, esophagotracheal fistula, gastric ulceration, pulmonary and oral infections.
- Extended-use NG tubes are made of flexible, soft, plastic material with manufacturer's recommendations that may include leaving the tube in place for up to 30 days before changing the tube.
- Assess the color, consistency, and odor of gastric contents. Coffee ground-like contents may indicate GI bleeding. Report findings immediately.
- The tube should be irrigated before and after medication administration through the tube. When possible, medications should be given in liquid form.
- Clamp the tube for 30 to 45 minutes to ensure medication absorption before reconnecting to suction, if ordered.
- Check GI function by auscultation for bowel sounds on a regular basis after the tube has been clamped for 30 minutes.

> ***NURSING ALERT***
> *Patient risk factors for malpositioned tubes include craniofacial trauma, reduced cough and gag reflexes, confusion, presence of Endotracheal tube, decreased consciousness, and noncooperation at insertion.*

> ***NURSING ALERT*** *Never place the end of the tube in water while checking placement. If the tube is in the trachea, the patient could aspirate.*

ESOPHAGEAL TRAUMA AND PERFORATIONS

Definition

Esophageal trauma or perforations are injuries to the esophagus caused by external or internal insult.

Etiology

External

Stab or bullet wounds, crush injuries, or blunt trauma.

Internal

Swallowed foreign objects (coins, pins, bones, dental appliances, caustic poisons).

Spontaneous or post emetic rupture

Usually in the presence of underlying esophageal disease (reflux, hiatus hernia).
Mallory-Weiss syndrome.

Nonpenetrating mucosal tear at the gastro esophageal junction.

Caused by an increase in transabdominal pressure from lifting, vomiting, or retching. Alcoholism is a predisposing condition.

Nursing Assessment

Assess the following to determine status of patient:

- Vital signs.
- Respiratory status.
- Bleeding.
- Ability to swallow—choking, gagging.
- Monitor the patient for hypovolemic shock.

Nursing Diagnoses

- Deficient fluid volume related to blood loss from injury.
- Imbalanced nutrition: less than body requirements related to esophageal injury.
- Ineffective breathing pattern related to pain and trauma.
- Acute pain related to injury.

Nursing Interventions

- Maintaining Fluid Volume:
  - Administer I.V. fluids and blood transfusion for volume replacement, if indicated.
  - Monitor intake and output. Urine output should be greater than 30 mL/hour.

  - Monitor laboratory results (electrolytes, hemoglobin, and hematocrit), and report abnormal findings.
- Maintaining Nutritional Status:
  - Monitor daily weights and skin turgor.
  - Administer parenteral hyper alimentation as prescribed—to prevent gastric reflux into the esophagus, which may occur with enteral feedings.
  - Encourage progression of diet through NG, esophagostomy, or oral feedings when esophagoscopy or esophagogram reveals healing of the esophagus.
  - Continue to monitor intake and output.
- Maintaining Respiratory Function:
  - Auscultate the lungs and trachea for stridor, crackles, or wheezes. Assess respiratory rate, depth, use of accessory muscles, and skin color.
  - Position the patient in semi-Fowler's position to facilitate breathing and reduce neck edema.
  - Monitor vital signs frequently for signs and symptoms of shock and infection.
  - Administer oxygen as prescribed.
  - Have emergency airway equipment at bedside.
- Reducing Pain:
  - Administer analgesics as prescribed—I.V. analgesia may be required to control pain and allow the esophagus to rest.
  - Provide reassurance and support.
  - Assess and record pain relief.
  - Evaluate for symptoms that may indicate spillage of digestive contents into the mediastinum, pleura, or abdominal cavity—sudden onset of acute pain.

Patient Education and Health Maintenance

- Instruct the patient on the indications and adverse effects of analgesics.
- Inform the patient on the signs and symptoms to report about possible complications: increases in severity or nature of pain; difficulty breathing or swallowing.
- Teach the patient about tests or surgical procedures that may be performed.

Evaluation, Expected outcomes

- Urine output greater than 30 mL/hour; electrolytes stable.
- No further weight loss, tolerating parenteral feedings well.
- Lungs clear, respirations unlabored.
- States pain decreased to level of 2 or 3 on 0 to 10 scale.

GASTRO-DUODENAL DISORDERS

GASTROINTESTINAL BLEEDING

Definition

GI bleeding is not just a gastro duodenal disorder but may occur anywhere along the alimentary tract. Bleeding is a symptom of an upper or lower GI disorder. It may be obvious in emesis or stool, or it may be occult (hidden).

Etiology

- Trauma anywhere along the GI tract.
- Erosions or ulcers.
- Rupture of an enlarged vein such as a varicosity (esophageal or gastric varices).
- Inflammation, such as esophagitis (caused by acid or bile), gastritis, inflammatory bowel disease (chronic ulcerative colitis, Crohn's disease), and bacterial infection.
- Alcohol and drugs (aspirin-containing compounds, NSAIDs, anticoagulants, corticosteroids).
- Diverticular disease.
- Cancers.
- Vascular lesions or disorders, such as bowel ischemia, aortoenteric fistula, arteriovenous malformations.
- Mallory-Weiss tear.
- Anal disorders, such as hemorrhoids or fissures.

Characteristics of Blood.

- Bright red: vomited from high in esophagus (hematemesis); passed from rectum or distal colon (coating stool).
- Dark red: higher up in colon and small intestine; mixed with stool.
- Shades of black ("coffee ground"): vomited from esophagus, stomach, and duodenum.
- Tarry stool (Melina): occurs in patient who accumulates excessive blood in the stomach.

Management

- Based on Etiology
- If aspirin or NSAIDs are the cause, discontinue medication and treat bleeding.
- If an ulcer is the cause, assess medications, dietary and lifestyle modifications, and for the presence of Helicobacter pylori.
- Therapeutic endoscopic procedure (cautery, injection).
- Surgery may be indicated for cancers, inflammatory diseases, and vascular disorders.

Emergency Intervention

- Patient remains on nothing per os (NPO) status.
- I.V. lines and oxygen therapy initiated.
- If life-threatening bleeding occurs, treat shock; administer blood replacement, intra-arterial vasopressin or embolization.
- Surgical therapy, if indicated.

Nasogastric Intubation

- A nasogastric (NG) tube should be in place for most patients with acute or upper GI bleeding.
- If the aspirate continues to be bloody after 2 to 3 L of tap water lavage, the patient may have an active bleed requiring more emergent intervention or endoscopic therapy.
- Other Measures:
  - Electro coagulation using a heater probe.
  - Injection of sclerosant or epinephrine.
  - Endoscopy used in conjunction with management measures, as well as, diagnostic evaluation.
  - Pharmacotherapy depends on cause; can include histamine blockers—as either continuous I.V. (preferred) or bolus infusion to block the acid-secreting action of histamine—or I.V. pantoprozole (Protonix). Intra-arterial vasopressin can be used to slow or stop active bleeding from the diverticulum or vascular ectasia.
  - Surgery is indicated when more conservative measures fail.

> ***NURSING ALERT***
> *Because of the action of topical thrombin, it is used only on the surface of bleeding tissue and is never injected into the blood vessels, where intravascular clotting could occur.*

Nursing Assessment

- Obtain history regarding:
  - Change in bowel patterns or hemorrhoids.
  - Change in color of stools (dark black, red, or streaked with blood).
  - Alcohol consumption.
  - Medications, such as aspirin, NSAIDs, antibiotics, anticoagulants, or corticosteroids.
  - Hematemesis.
  - Other medical conditions.
- Evaluate for presence of abdominal pain or tenderness.
- Monitor vital signs and laboratory tests for changes that indicate bleeding (hemoglobin, hematocrit, platelet count, coagulation studies).
- Test for occult blood, if indicated.

Nursing Diagnoses

- Deficient fluid volume related to blood loss.
- Imbalanced nutrition: less than body requirements related to nausea, vomiting, and diarrhea.

Nursing Interventions

- Attaining Normal Fluid Volume.
- Maintain NG tube and NPO status to rest the GI tract and evaluate bleeding.
- Monitor intake and output, as ordered, to evaluate fluid status.
- Monitor vital signs as ordered.
- Observe for changes indicating shock, such as tachycardia, hypotension, increased respirations, decreased urine output, and change in mental status.
- Administer I.V. fluids and blood products, as ordered, to maintain volume.
- Attaining Balanced Nutritional Status.
- Weigh daily to monitor caloric status.
- Administer I.V. fluids, TPN, if ordered, to promote hydration and nutrition while on oral restrictions.
- Begin liquids when the patient is no longer NPO. Advance diet as tolerated. Diet should be high-calorie, high-protein. Frequent, small feedings may be indicated.
- Offer snacks; high-protein supplements.

Patient Education and Health Maintenance

- Discuss the cause and treatment of GI bleeding with patient.
- Instruct the patient regarding signs and symptoms of GI bleeding: melena, emesis that is bright red or “coffee ground” color, rectal bleeding, weakness, fatigue, or shortness of breath.
- Instruct the patient on how to test stool or emesis for occult blood, if applicable.

Evaluation

Expected Outcomes:

- Intake and output equal, vital signs stable.
- Tolerates small feedings, weight stable.

INTESTINAL CONDITIONS

INTESTINAL OBSTRUCTION

Definition

Intestinal obstruction is an interruption in the normal flow of intestinal contents along the intestinal tract. The block may occur in the small or large intestine, may be complete or incomplete, may be mechanical or paralytic, and may or may not compromise the vascular supply. Obstruction most frequently occurs in the young and the old.

Etiology

- Mechanical obstruction

  A physical block of intestinal contents without disturbing blood supply of the bowel. High small-bowel (jejunal) or low small-bowel (ileal) obstruction occurs four times more frequently than colonic obstruction. Causes include:
  - **Extrinsic**—adhesions from surgery, hernia, wound dehiscence, masses, or volvulus (twisted loop of intestine). Up to 70% of small bowel obstructions are caused by adhesions.
  - **Intrinsic**—hematoma, tumor, intussusceptions (telescoping of intestinal wall into itself), stricture or stenosis, congenital (atresia/imperforate anus), trauma, or inflammatory diseases (Crohn's, diverticulitis, ulcerative colitis).
    - Intraluminal—foreign body, fecal or barium impaction, polyp, gallstones, and meconium in infants:
    - In postoperative patients, approximately 90% of mechanical obstructions are due to adhesions.
    - In nonsurgical patients, hernia (most often inguinal) is the most common cause of mechanical obstruction.
- Paralytic (adynamic, neurogenic) ileus
  - Peristalsis is ineffective (diminished motor activity perhaps because of toxic or traumatic disturbance of the autonomic nervous system).
  - There is no physical obstruction and no interrupted blood supply.
  - Disappears spontaneously after 2 to 3 days.
  - Causes include:
    - Spinal cord injuries; vertebral fractures.
    - Postoperatively after any abdominal surgery.
    - Peritonitis, pneumonia.
    - Wound dehiscence (breakdown).
    - GI tract surgery.
    - Strangulation—obstruction compromises blood supply, leading to gangrene of the intestinal wall. Caused by prolonged mechanical obstruction.

Diagnostic Evaluation

- Fecal material aspiration from NG tube.
- Abdominal and chest X-rays. May show presence and location of small or large intestinal distention, gas or fluid.
- "Bird beak" lesion in colonic volvulus.

Foreign body visualization

- Contrast studies.
- Barium enema may diagnose colon obstruction or intussusceptions.
- Ileus may be identified by oral barium or Gastrografin.
- Laboratory tests:
  - May show decreased sodium, potassium, and chloride levels due to vomiting.
  - Elevated WBC counts due to inflammation; marked increase with necrosis, strangulation, or peritonitis.
  - Serum amylase may be elevated from irritation of the pancreas by the bowel loop.
  - Flexible sigmoidoscopy or colonoscopy may identify the source of the obstruction such as tumor or stricture.

Nursing Assessment

- Assess the nature and location of the patient's pain, the presence or absence of distention, flatus, defecation, emesis, or obstipation.
- Listen for high-pitched bowel sounds, peristaltic rushes, or absence of bowel sounds.
- Assess vital signs.
- Fluid collects in dependent bowel loops.
- Peristalsis is too weak to push fluid "uphill."
- Obstruction primarily occurs in the large bowel.
- Conduct frequent checks of the patient's level of responsiveness; decreasing responsiveness may offer a clue to an increasing electrolyte imbalance or impending shock.

> ***ALERT***
> *Watch for air-fluid lock syndrome in elderly patients, who typically remain in the recumbent position for extended periods.*

Nursing Diagnoses

- Acute pain related to obstruction, distention, and strangulation.
- Risk for deficient fluid volume related to impaired fluid intake, vomiting, and diarrhea from intestinal obstruction.

Diarrhea related to obstruction

- Ineffective breathing pattern related to abdominal distention, interfering with normal lung expansion.
- Risk for injury related to complications and severity of illness.
- Fear related to life-threatening symptoms of intestinal obstruction.

Nursing Interventions

- Achieving pain relief.
- Maintaining normal bowel elimination.

Evaluation: Expected Outcomes

- Maintains position of comfort, states pain decreased to 3 or 4 level on 0-to-10 scale.
- Urine output greater than 30 mL/hour; vital signs stable.
- Passed flatus and small, formed brown stool that is negative occult blood.
- Respirations equal to or less than 24 breaths per minute that are unlabored with head of bed elevated 45 degrees.
- Alert, lucid, vital signs stable, abdomen firm but not rigid.
- Appears relaxed and reports feeling better.

APPENDICITIS

Definition

Appendicitis is inflammation of the vermiform appendix caused by an obstruction of the intestinal lumen from infection, stricture, fecal mass, foreign body, or tumor.

Nursing Assessment

- Obtain history for location and extent of pain.
- Auscultate for presence of bowel sounds; peristalsis may be absent or diminished.
- Palpation of the abdomen; assesses for tenderness anywhere in the right lower quadrant, but usually localized over McBurney's point (midway line between umbilicus and iliac crest on the right side). Assess for rebound tenderness in the right lower quadrant, as well as, referred rebound pain when palpating the left lower quadrant.
- Assess for positive psoas sign by having the patient attempt to raise the right thigh against the pressure of your hand placed over the right knee. Inflammation of the psoas muscle in acute appendicitis will increase abdominal pain with this maneuver.
- Assess for positive obturator sign by flexing the patient's right hip and knee and rotating the leg internally. Hypogastric pain with this maneuver indicates inflammation of the obturator muscle.

Nursing Diagnoses

- Acute pain related to inflamed appendix.
- Risk for infection related to perforation.

Nursing Interventions

- Relieving Pain:
  - Monitor pain level, including: location, intensity, and pattern.
  - Assist the patient into comfortable positions, such as semi-Fowler's and knees up.
  - Restrict activity that may aggravate pain, such as coughing and ambulation.
  - Apply an ice bag to abdomen for comfort.
  - Give antiemetics and analgesics, as ordered, and evaluate response.
  - Avoid indiscriminate palpation of the abdomen to avoid increasing the patient's discomfort.

> ***ALERT***
> *Do not give analgesics/antipyretics to mask fever, and do not administer cathartics because they may cause rupture.*

Evaluation: Expected Outcomes

- Verbalizes decreased pain to 2 or 3 level on 0-to-10 scale with positioning and analgesics.
- Afebrile; no abdominal rigidity or distention.

PERITONITIS

Definition

Peritonitis is a generalized or localized inflammation of the peritoneum, the membrane lining the abdominal cavity and covering visceral organs.

Nursing Assessment

- Ascertain bowel function by assessing for abdominal distention and tenderness, guarding, rebound tenderness, hypoactive or absent bowel sounds.
- Observe for signs of shock—tachycardia and hypotension.
- Monitor vital signs, ABG levels, CBC, electrolytes, and central venous pressure to monitor hemodynamic status and assess for complications.

Nursing Diagnoses

- Acute pain related to peritoneal inflammation.
- Deficient fluid volume related to vomiting and interstitial fluid shift.

- Imbalanced nutrition: less than body requirements related to GI symptomatology.

Nursing Interventions

- Achieving Pain Relief
- Place the patient in semi-Fowler's position before surgery for less painful breathing.
- After surgery, place the patient in Fowler's position to promote drainage by gravity.
- Provide analgesics as prescribed.
- Maintaining Fluid and Electrolyte Volume
- Keep the patient NPO to reduce peristalsis.
- Provide I.V. fluids to establish adequate fluid intake and to promote adequate urine output, as prescribed.
- Record accurately intake and output, including the measurement of vomitus and NG drainage.
- Minimize nausea, vomiting, and distention by useing NG suction and antiemetics.
- Monitor for signs of hypovolemia: dry mucous membranes, oliguria, postural hypotension, tachycardia, and diminished skin turgor.

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CHAPTER 7: HEPATIC, BILIARY, AND PANCREATIC DISORDERS

Assessment

The liver, gallbladder and its bile ducts, and the pancreas are called accessory glands in the GI system. Their function is to aid in digestion through the delivery of bile and enzymes to the small intestine. The liver plays additional roles in detoxification of chemicals and synthesis and storage of important nutrients. The pancreas also functions as an endocrine gland. Major liver, biliary, and pancreatic problems can be differentiated by clinical manifestations and thorough history taking and physical examination.

Common Manifestations

- Jaundice—any yellow color of sclera and skin, pruritus, dark tea-colored urine, light gray or clay-colored (acoholic) stool.
- Any dyspepsia, anorexia, nausea, vomiting, right upper quadrant or epigastric pain, or pain radiating to the back or shoulder blade. Question the patient about the relationship of the pain to eating or to position.
- Has there been recent fatigue, malaise, loss of vigor and strength, easy bruising, or weight loss?
- Any fever, chills, headache, myalgias, arthralgias, or photophobia?
- Any steatorrhea—stools that are loose, greasy, foamy, orange, foul smelling, and that float?

Diagnostic Tests

LABORATORY TESTS (SEE TABLE BELOW)

Table 5: Liver Diagnostic Studies

Test And Purpose	Normal	Nursing Considerations
Bile Formation and Secretion		
Serum Bilirubin		
Measures Bilirubin in the blood; this determines the ability of the liver to take up, conjugate, and excrete Bilirubin. Bilirubin is a product of the breakdown of hemoglobin.		
Direct (conjugated)—soluble in water.	0-0.3 mg/dL	• Abnormal in biliary and liver disease, clinically causing jaundice.
Indirect (unconjugated)—insoluble in	0-1 mg/dL	• Abnormal in hemolysis

water.		and in functional disorders of uptake or conjugation.
Total serum Bilirubin	0.1-1.2 mg/dL	• Used as screening test for liver or biliary dysfunction.
Urine Bilirubin		
Not normally found in urine, but if direct serum Bilirubin is elevated, some spills into the urine.	None (0)	• Tea-colored urine. When specimen is shaken, yellow tinted foam can be observed. Confirm with Ictotest tablet or dipstick.
		• If phenazopyridine (Pyridium) is being taken, there may be a false-positive Bilirubin result (mark laboratory slip if this medication is being taken).
Urobilinogen		
Formed in the small intestine by bacteria that react with Bilirubin. Related to the amount of Bilirubin excreted into bile.	Urine Urobilinogen < 1 mg in 2-hour specimen or 0.5-4 mg/dL in 24-hour specimen. Fecal Urobilinogen 50-300 mg/24 hours.	• Urine specimen is collected over 24 hours or the two-hour period after lunch. • Place the specimen in dark brown container and send it to the laboratory immediately; or refrigerate to prevent decomposition. If the patient is receiving antimicrobials, mark the laboratory slip, because the production of Urobilinogen can be falsely reduced.
Protein Studies		

Albumin and Globulin ***Measurement***		
Is of greater significance than total protein measurement.		• As one increases, the other decreases.
Albumin—produced by liver cells.	3.5-5.5 g/dL	• Albumin ↓ (decrease) in cirrhosis and chronic hepatitis.
Globulin—produced in lymph nodes, spleen, bone marrow and Kupffer's cells of liver.	2.5-5.9 g/dL	• Globulin ↑ (increase) in cirrhosis, chronic obstructive jaundice, and viral hepatitis.
Coagulation		
Prothrombin Time (PT)		
Prothrombin and other clotting factors are manufactured in the liver; its rate is influenced by the supply of vitamin K.	100% of control 9.6-12.5 seconds	• PT may be prolonged in liver disease, demonstrated by a non-refractory response to vitamin K. It may also be prolonged in malabsorption of fat and fat-soluble vitamins, in which case it will return to normal with vitamin K.
International Normalized Ratio (INR)	0.8-1.2	
Fat Metabolism		
Cholesterol		
It is possible to measure lipid metabolism by determining serum cholesterol levels.	140-200 mg/dL	• Serum cholesterol level is decreased in parenchymal liver disease.
		• Serum lipid level is increased in biliary obstruction.
Liver Detoxification		
Serum Alkaline Phosphatase		

Because bile disposes this enzyme, any impairment of liver cell excretory function will cause an elevation. In cholestasis or obstruction, increased synthesis of the enzyme causes very high levels in blood.	30-120 IU/L	• Elevated to more than three times normal levels in obstructive jaundice, intrahepatic cholestasis, liver metastasis, or granulomas. Also elevated in osteoblastic diseases, Paget's disease, and hyperparathyroidism.
Enzyme Production		
These enzymes are found in high concentration in the liver as well as some other tissues. Liver injury results in enzyme release into the blood.		
Aspartate aminotransferase (AST)	0-37 IU/L	• An elevation in these enzymes indicates liver cell damage. Some drugs such as opioids may also cause a rise in AST and ALT.
Alanine aminotransferase (ALT)	0-40 IU/L	
Lactate dehydrogenase (LDH)	105-333 IU/L	• LDH is found in the liver, heart, kidney, muscle, and blood cells.
Gamma glutamyl transpeptidase (GGT)	0-51 IU/L	• GGT is also found in the kidneys, pancreas, and bile ducts; but is most sensitive to alcohol-induced liver damage.
Ammonia (serum)	0-32 mmol/L	• Ammonia levels rise when the liver is unable to convert ammonia to urea.

RADIOLOGY AND IMAGING

- Ultrasonography.
- Hepatobiliary Scan.
- Endoscopic Retrograde Cholangiopancreatography (ERCP).

BLEEDING ESOPHAGEAL VARICES

Definition

Esophageal varices are dilated tortuous veins usually found in the sub mucosa of the lower esophagus; however, they may develop higher in the esophagus or extend into the stomach.

Diagnostic Evaluation

- Upper GI endoscopy for patients with a suspected upper GI source of bleeding.
- Hemoglobin may be decreasing (due to bleeding) and liver function tests can be elevated.

ADDITIONAL NURSING RESPONSIBILITIES

- Maintain constant vigilance while balloons are inflated in the patient.
- Keep balloon pressures at required level to control bleeding (clamps help to maintain pressure).
- Observe and record vital signs; monitor color and amount of NG lavage fluid (subtracting lavage input) for evidence of bleeding.
- Be alert for chest pain, this may indicate injury or rupture of esophagus.
- Irrigate suction tube as prescribed; observe and record nature and color of aspirated material.
- Keep the head of the bed elevated to avoid gastric regurgitation, and to diminish nausea and a sensation of gagging.
- Maintain nutritional and electrolyte levels parenterally.
- Maintain NG suction, or suction to esophageal suction port, to aspirate any collected saliva.

> ***NURSING ALERT***
> *Note nature of breathing; if counterweight pulls the tube into oropharynx, the patient may be asphyxiated*

> ***NURSING ALERT***
> *Keep scissors taped to the head of the bed. In the event of acute respiratory distress, use the scissors to cut across tubing (to deflate both balloons) and remove tubing.*
>
> *Note: This procedure should be reserved for patients who are known, without a doubt, to be bleeding from esophageal varices and in whom all forms of conservative therapy have failed.*

Complications

- Exsanguination or recurrent hemorrhage.
- Portal systemic encephalopathy.

Nursing Assessment

- Monitor vital signs and respiratory function.
- Assess LOC and impending signs of liver failure.

Nursing Diagnoses

- Ineffective tissue perfusion related to GI bleeding.
- Risk for aspiration related to GI bleeding and intubation.
- Anxiety related to fear of unknown procedures and consequences of GI bleeding.

Nursing Interventions

- Maintaining Adequate Tissue Perfusion:
  - Assess BP, heart rate, skin condition, and urine output for signs of hypovolemia and shock.
  - Monitor the patient frequently during vasopressin infusion for complications including: hypertension, bradycardia, abdominal cramps, chest pain, or water intoxication.
  - Observe the patient for straining, gagging, or vomiting; these increase pressure in the portal system and increase risk of further bleeding.
  - Check all GI secretions and feces for occult and frank blood.
  - Monitor infusion of blood products.
  - Administer vitamin K.
- Preventing Aspiration:
  - Assess respirations and monitor oxygen saturation of blood.
  - Note and report occurrence of obstructed airway or ruptured esophagus from the esophageal balloon, which include: changes in skin color, respirations, breath sounds, LOC, or vital signs; chest pain.
  - Check location and inflation of esophageal balloon; maintain traction on tubes if applicable.
  - Have scissors readily available. Cut tubing and remove esophageal balloon immediately if patient develops acute respiratory distress.
  - Keep the head of the bed elevated to avoid gastric regurgitation and aspiration of gastric contents.
  - When using the Sengstaken-Blakemore esophageal balloon tube, ensure removal of secretions above the esophageal balloon: position NG tube in the esophagus for suctioning purposes; provide intermittent Oropharyngeal suctioning.
  - Inspect nares for skin irritation; clean and lubricate frequently to prevent bleeding.

Evaluation: Expected Outcomes

- BP stable; urine output adequate.
- Airway maintained without aspiration.
- Cooperates and indicates understanding of treatment.

CHOLECYSTITIS

- Acute cholecystitis, an acute inflammation of the gallbladder, is most commonly caused by gallstone obstruction.
- Secondary bacterial infection may occur and progress to Empyema (purulent effusion of the gallbladder).
- Acalculous cholecystitis is acute gallbladder inflammation without obstruction by gallstones. It generally occurs after major surgical procedures, severe trauma, or burns.
- Chronic cholecystitis occurs when the gallbladder becomes thickened, rigid, fibrotic and functions poorly. Results from repeated attacks of cholecystitis, calculi, or chronic irritation.

CHOLEDOCHOLITHIASIS

- Small gallstones can pass from the gallbladder into the common bile duct and proceed to the duodenum. More commonly they remain in the common bile duct and can cause obstruction, resulting in jaundice and pruritus.
- Common bile duct stones are frequently associated with infected bile and can lead to cholangitis (inflammation/infection in the biliary system).
- A typical clinical picture includes biliary pain in the upper abdomen, jaundice, chills and fever, mild hepatomegaly, abdominal tenderness with rebound tenderness.

Nursing Assessment

- Obtain history and demographic data that may indicate risk factors for biliary disease.
- Assess patient's pain for location, description, intensity, relieving and exacerbating factors.
- Assess for signs of dehydration: dry mucous membranes, poor skin turgor, low urine output with elevated specific gravity.
- Assess sclera and skin for jaundice.
- Monitor temperature and white blood cells (WBC) count for indications of infection.

Nursing Diagnoses

- Acute pain related to biliary colic or stone obstruction.
- Deficient fluid volume related to nausea and vomiting and decreased intake.

Nursing Interventions

- Relieving Pain:
  - Assess pain location, severity, and characteristics.
  - Administer medications.
  - Assist in attaining position of comfort.
  - Restoring Normal Fluid Volume
  - Administer I.V. fluids and electrolytes as prescribed.

  - Administer antiemetic, as prescribed, to decrease nausea and vomiting.
  - Maintain NG decompression, if needed.
  - Begin food and fluids, as tolerated, after acute symptoms subside or postoperatively.
  - Observe and record amount of biliary tube drainage, if applicable.
- Encourage follow-up as indicated.

Evaluation: Expected Outcomes

- Verbalizes reduced pain level.
- Tolerates oral fluids and solid food; adequate urine output.

PANCREATIC DISORDERS

The pancreas secretes pancreatic enzymes, including amylase and lipase, through the pancreatic duct when stimulated by cholecystokinin and secretin to aid in digestion of carbohydrates and fat in the small intestine. The pancreas also secretes hormones, such as insulin and glucagon, which help to regulate and maintain normal serum glucose.

ACUTE PANCREATITIS

Acute pancreatitis is an inflammation of the pancreas, ranging from mild edema to extensive hemorrhage, resulting from various insults to the pancreas. It is defined by a discrete episode of abdominal pain and serum enzymes elevations. The structure and function of the pancreas usually returns to normal after an acute attack. Chronic pancreatitis occurs when there is persistent cellular damage to the pancreas.

Nursing Assessment

- Obtain history of gallbladder disease, alcohol use, or precipitating factors.
- Assess GI distress, including nausea and vomiting, diarrhea, and passage of stools containing fat.
- Assess characteristics of abdominal pain.
- Assess nutritional and fluid status.
- Assess respiratory rate, pattern and breath sounds.

Nursing Diagnoses

Acute Pain related to disease process

  - Deficient fluid volume related to vomiting, self-restricted intake, fever, and fluid shifts.
  - Ineffective breathing pattern related to severe pain and pulmonary complications.

Nursing Interventions

- Control pain.
- Restore adequate fluid balance.

- Improve respiratory function.

Patient Education and Health Maintenance

Evaluation: Expected Outcomes

- Verbalizes reduced pain level.
- BP stable; urine output adequate.
- Respirations unlabored; breath sounds clear.

Table 6: Acute versus Chronic Pancreatitis: Comparing Findings

	Acute Pancreatitis	Chronic Pancreatitis
Definition	• Inflammation that leads to swelling of the pancreas. • Auto digestion—enzymes normally secreted by the pancreas become activated inside the pancreas and start to digest the pancreatic tissue.	• Associated with widespread scarring and destruction of pancreatic tissue. • Affects men more than women.
Etiology	• Gallstones passing through the common bile duct • Alcohol abuse. • Viral infection, hereditary conditions, traumatic injury, certain medications (especially estrogens, corticosteroids, thiazide diuretics, and azathioprine), pancreatic or common bile duct surgical procedures, or ERCP. ▪ Underlying pancreatic tumor. ▪ Hypercalcemia. ▪ Hyperlipidemia. ▪ Idiopathic.	• Alcohol abuse (70% of patients). • Hereditary pancreatitis. • Ductal destruction (from trauma, stones, tumors). • Tropical pancreatitis. • Systemic diseases (cystic fibrosis, systemic lupus erythematosus, or hyperparathyroidism). • Congenital conditions such as pancreas divisum. • Hypercalcemia. • Hyperlipidemia. • Idiopathic.
Symptoms	• Sudden attack of constant, severe upper abdominal pain that may radiate to the back. • Pain that is sudden and steady. • Pain that may be aggravated by walking or lying down and relieved by sitting or leaning forward (proning).	• Constant, dull mid- to upper-abdominal pain; may also have back pain. • Pain that worsens with eating food or drinking alcohol; lessens with sitting or leaning forward (proning).

	• Other possible symptoms: nausea, vomiting, diarrhea, bloating, fever, diaphoresis, and jaundice.	• As the disease progresses, attacks of pain will last longer and occur more frequently. • May have nausea, vomiting and possibly weight loss.
Course	• Mild disease in 85% of patients with rapid recovery within a few days of onset of illness.	• Destruction of pancreatic tissue that slowly progresses to chronic inflammatory damage.
Diagnosis	• Medical history. • Serum amylase and lipase. • Serum triglycerides. • Ultrasound, CT scan, and MRI.	• Medical history. • Liver function tests. • Fecal elastase test. • Abdominal X-ray that may revealcalcium deposits in the pancreas. • Imaging studies, such as ultrasound, CT scan, endoscopic retrograde cholangiopancreatography (ERCP), EUS, and MRI/MRCP. • CEA and CA 19-9 to assess for pancreatic cancer.
Treatment	• Depends on the severity; as acute pancreatitis may be mild, moderate, or severe. • I.V. fluids. • Pain medication. • NPO. • Surgery for such complications as necrosis, infection, and bleeding.	• Pain management. • Nutritional support and diet modification with smaller, frequent, low-fat meals. • Pancreatic enzymes. • Diabetes control. • Pancreatic duct drainage procedures or excision of damage of all or part of the pancreas. • Alcohol abstinence.
Complications	• Severe acute pancreatitis may lead to: ▪ Multiple organ system failure, such as lung, liver, kidney, and heart failure. ▪ Infected pancreatic necrosis. ▪ Pancreatic abscess. ▪ Pseudo cysts. ▪ Pancreatic fistula.	• Malnutrition from poor absorption of nutrients, especially fats. • Frequent bowel movements that are loose, greasy, and foul smelling (steatorrhea). • Insulin-dependent diabetes. • Increased risk of pancreatic cancer.

	▪ Pancreatic ascites. ▪ Damage to surrounding organs, such as small bowel, colon, and duodenum (due to inflammation).	• Pseudo cyst. • Bleeding from the stomach. • Increased risk of blood clots. • Possible bouts of acute pancreatitis.
Prognosis	• Usually, patients can fully recover without recurrence, if cause is removed.	• Can maintain quality of life with supportive care and adherence to medical regimen

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CHAPTER 8: DIABETES MELLITUS

Classification

Type 1 Diabetes Mellitus

- Type 1 diabetes mellitus was formerly known as insulin dependent diabetes mellitus and juvenile diabetes mellitus.
- Little or no endogenous insulin, requiring injections of insulin to control diabetes and prevent ketoacidosis.
- Five to ten percent of all diabetic patients have type 1 diabetes.

Etiology: *autoimmune, viral, and certain histocompatibility antigens, as well as, a unknown genetic component.*

Usual *presentation includes a rapid onset of classic symptoms which include: polydipsia, polyphagia, polyuria, and weight loss.*

- Most commonly seen in patients under the age of 30, but it can be seen in older adults.

Type 2 Diabetes Mellitus

- Type 2 diabetes mellitus was formerly known as non-insulin dependent diabetes mellitus or adult onset diabetes mellitus.
- Caused by a combination of insulin resistance and relative insulin deficiency—some individuals have predominantly insulin resistance, whereas others have predominantly deficient insulin secretion, with little insulin resistance.
- Approximately 90% to 95% of diabetic patients have type 2 diabetes.

Etiology: strong hereditary component commonly associated with obesity.

Usual presentation occurs slowly and insidiously, with symptoms of fatigue, weight gain, poor wound healing, and recurrent infection.

- Found primarily in adults over the age of 30; however, it may be seen in younger adults and adolescents who are overweight.
- Patients with this type of diabetes, but they are treated with insulin, are still referred to as type 2 diabetics.

Prediabetes

- A new category adopted by the American Diabetes Association (ADA) in 1997 and redefined in 2003.
- Prediabetes is an abnormality in glucose values, an is an intermediate value between normal and overt diabetes.
- Impaired Fasting Glucose: Occurs when fasting blood glucose is greater than or equal to 100mg/dL, but less than 126 mg/dL.

- Impaired Glucose Tolerance
- Defined a blood glucose measurement on a glucose tolerance test greater than or equal to 140 mg/dL but less than 200mg/dL in the two-hour sample.
- Asymptomatic; it can progress to type 2 diabetes or remain unchanged.
- May be a risk factor for the development of hypertension, coronary heart disease, and hyperlipidemias.

Gestational Diabetes Mellitus

- Gestational diabetes mellitus (GDM) is defined as a carbohydrate intolerance occurring during pregnancy.
- Occurs in approximately seven percent of pregnancies and usually disappears after delivery.
- Women with GDM are at higher risk for type 2 diabetes later in life. They should be rescreened for diabetes six weeks postpartum (to be sure that fasting glucose returns to normal) and continue to be followed and screened every one to two years.
- GDM is associated with increased risk of fetal morbidity.
- Screening for GDM for all pregnant women other than those at lowest risk (under age 25, of normal body weight, have no family history of diabetes, are not a member of an ethnic group with high prevalence of diabetes) should occur between the 24th and 28th weeks of gestation.

Diabetes Associated with Other Conditions

- Certain drugs can decrease insulin activity resulting in hyperglycemia, these include: corticosteroids, thiazide diuretics, estrogen, and phenytoin.
- Disease states affecting the pancreas or insulin receptors, these include: pancreatitis, cancer of the pancreas, Cushing's disease or syndrome, acromegaly, pheochromocytoma, muscular dystrophy, and Huntington's chorea.

Diagnostic tests

Laboratory Tests

Laboratory tests are taken to diagnose the disease, as well as, measure and monitor the patient’s short- and long-term glucose control.

Blood Glucose

- Description:

Fasting blood sugar (FBS): *drawn after at least an 8-hour fast, to evaluate circulating amounts of glucose.*

Postprandial test: *drawn usually 2 hours after a well-balanced meal, to evaluate glucose metabolism. Random glucose: drawn at any time, (nonfasting).*

NURSING AND PATIENT CARE CONSIDERATIONS

- For fasting glucose, make sure that patient has maintained an eight-hour fast overnight; sips of water are allowed.
- Advise the patient to refrain from smoking before the glucose sampling; this may affect the test results.
- For postprandial test, advise the patient that no food should be eaten during the two-hour testing interval.
- For random blood glucose, note the time and content of the last meal.
- Interpret the patient's blood values as diagnostic for diabetes mellitus if:
  - The patient's FBS is greater than or equal to 126 mg/dL on two occasions.
  - The patient's random blood sugar is greater than or equal to 200 mg/dL in the presence of classic diabetic symptoms (polyuria, polydipsia, polyphagia, and weight loss).
  - The patient's fasting blood glucose result is greater than or equal to 100 mg/dL; this demands close follow-up and repeat monitoring every one to two years.

> ***NURSING ALERT***
> *Capillary blood glucose values obtained by finger stick sample tend to be higher than values in venous samples.*

GENERAL PROCEDURES AND TREATMENT MODALITIES

Blood Glucose Monitoring

Accurate determination of capillary blood glucose assists patients in the control and daily management of diabetes mellitus. Blood glucose monitoring helps evaluate the effectiveness of medication; reflects glucose excursion after meals; assesses glucose response to exercise regimen; and assists in the evaluation of episodes of hypoglycemia and hyperglycemia to determine appropriate treatment.

Procedure

- The most appropriate schedule for glucose monitoring is determined by the patient and health care provider.
- Medication regimens and meal timing are considered when setting the monitoring schedule.
- Scheduling of glucose tests should reflect cost effectiveness for the patient.
- Glucose monitoring should be increased during times of stress including illness, or when changes in therapy are prescribed.
- Patients with type 2 diabetes controlled with oral hypoglycemic agents or a single injection of intermediate acting insulin may test their glucose levels before breakfast and before supper, or at bedtime (twice-per-day monitoring).
- Patients with type 1 diabetes using a multiple-dose insulin regimen may test before meals and at bedtime, occasionally adding a 2 to 3 AM test (four to six times daily monitoring).

- Alternate site testing has been recommended by some clinicians for patients who complain of painful fingers and for individuals such as musicians, who use their fingertips for occupational activities. However, testing in such sites as the forearm, palm, thigh, and calf have been proved to be less accurate.
- If an alternate testing site is used, the area should be rubbed until it is warm (before testing).
- Do not use an alternate site when:
  - glucose levels are rapidly changing (postprandial, hypoglycemia, reaction to exercise/activity).
  - Accuracy is critical (hypoglycemia is suspected, before exercise, or before driving).
  - Check with the glucometer manufacturer to see if it is approved for alternate site testing.
  - Continuous glucose monitoring (CGM) is a supplemental tool for use in selected patients, such as type 1 diabetics with frequent hypoglycemia. Finger stick glucose is required at least twice daily to calibrate the device. CGM data require confirmation with finger stick glucose before any action is taken (i.e. treatment of hypoglycemia or hyperglycemia).

Table 7: Insulin Onset, Peak, and Duration

Insulin Products Available in the United States			
TYPE	**ONSET**	**PEAK**	**DURATION**
Immediate/Rapid-Acting			
Novo Log (aspart)	5-15 minutes	30-90 minutes	< 5 hours
Apidra (glulisine)			
Humalog (lispro)			
Fast/Short-Acting			
Humulin Regular (R)	30-60 minutes	2-3 hours	5-8 hours
Novolin Regular (R)			
Intermediate-Acting/Basal			
Insulin Isophane	2-4 hours	4-10 hours	10-16 hours
Suspension (NPH)			
Humulin N			
Novolin N			
Long-Acting/Basal			
Levemir (detemir) Once or twice daily	3-8 hours	None	15-13 hours
Lantus (glargine)	2-4 hours	None	20-24 hours
Pre-Mixed Insulin			

Insulin Products Available in the United States			
TYPE	**ONSET**	**PEAK**	**DURATION**
Non-NPH Suspensions	≤ 15 minutes	½-4 hours	16-24 hours
Novo Log Mix 70/30			
Humalog Mix 75/25			
Humalog Mix 50/50			
NPH and Regular Suspensions	30 minutes	2-12 hours	18-24 hours
Novolin 70/30			
Humulin 70/30			
Humulin 50/50			

PATIENT EDUCATION AND HEALTH MAINTENANCE

- Ongoing education of the patient should include advanced skills and rationales for treatment, prevention, and management of complications.
- Education should focus on lifestyle management issues including: sick-day management, exercise adjustments, travel preparations, foot care guidelines, intensive insulin management, and dietary considerations for dining out.
- For additional information and support, refer to the drug manufacturers' Web sites for special programs for diabetics and to agencies, such as ADA, www.diabetes.org; and American Dietetic Association, www.eatright.org.

PATIENT EDUCATION GUIDELINES

Diabetes Sick-Day Guidelines

- Never omit insulin dosage. Check with the health care provider about oral medication. For instance, Glucophage should be withheld if vomiting or in danger of becoming dehydrated.
- Take at least the usual dosage of insulin.
- Keep regular insulin on hand for supplemental doses as prescribed by health care provider.
- Monitor blood glucose and urine ketones every 2-4 hours.
- Whenever blood glucose is > 240 mg/dL, test urine ketones.
- Record all test results.
- Drink plenty of fluids; six to eight ounces of fluid every hour is recommended.
- If unable to eat, drink fluids that contain carbohydrates (e.g. fruit juices, regular soda).
- Contact the health care provider if the illness becomes severe or unmanageable.
- Fever, nausea, vomiting, and diarrhea increase the risk of dehydration.
- Signs and symptoms of infection—redness, swelling, drainage—need immediate attention.

- Large amount of urine ketones or other signs and symptoms of diabetic ketoacidosis: call health care provider immediately.

Evaluation: Expected Outcomes

- Maintains ideal body weight with a body mass index less than 25.
- Demonstrates self-injection of insulin with minimal fear.
- Hypoglycemia is identified and treated appropriately.
- Exercises daily.
- Verbalizes appropriate use and action of oral hypoglycemic agents.
- No skin breakdown.
- Verbalizes initial strategies for coping with diabetes.

DIABETIC KETOACIDOSIS

DKA is an acute complication of diabetes mellitus (usually type 1 diabetes) characterized by hyperglycemia, ketonuria, acidosis, and dehydration.

Clinical Manifestations

Early

- Polydipsia, polyuria.
- Fatigue, malaise, or drowsiness.
- Anorexia, nausea, or vomiting.
- Abdominal pain or muscle cramps.

Late

- Kussmaul's respirations (deep respirations).
- Fruity, sweet-smelling breath.
- Hypotension and weak pulse.
- Stupor and coma.

Diagnostic Evaluation

- Serum glucose level is usually elevated over 300 mg/dL; may be as high as 1,000 mg/dL.
- Serum and urine ketone bodies are present.
- Serum bicarbonate and pH are decreased due to metabolic acidosis, and partial pressure of carbon dioxide is decreased as a respiratory compensation mechanism.
- Serum sodium and potassium levels may be low, normal, or high due to fluid shifts and dehydration, despite total body depletion.
- BUN, creatinine, hemoglobin, and hematocrit are elevated due to dehydration.

- Urine glucose is present in high concentration and specific gravity is increased, reflecting osmotic diuresis and dehydration.

> ***NURSING ALERT***
> Severity of DKA cannot be determined by serum glucose levels; acidosis may be prominent with glucose level of 200 mg/dL or less.

Nursing Assessment

- Assess skin for dehydration—poor turgor, flushing, or dry mucous membranes.
- Observe for cardiac changes reflecting dehydration, metabolic acidosis, and electrolyte imbalance—hypotension; tachycardia; weak pulse; electrocardiographic changes, including elevated P wave, flattened T wave or inverted, prolonged QT interval.
- Assess respiratory status—Kussmaul's respirations, acetone breath characteristic of metabolic acidosis.
- Perform GI assessment—nausea, vomiting, extreme thirst, abdominal bloating and cramping, or diarrhea.
- Determine GU symptoms—nocturia or polyuria.
- Observe for neurologic signs—crying, restlessness, twitching, tremors, drowsiness, lethargy, headache, or decreased reflexes.
- Interview the family or significant others regarding precipitating DKA events, patient self-care management before hospitalization, and unusual events that may have precipitated episode (e.g. chest pain, trauma, illness).

Nursing Diagnoses

- Deficient fluid volume related to hyperglycemia.
- Ineffective therapeutic regimen management related to the patient’s failure to increase insulin during illness.

Nursing Interventions

Restoring Fluid and Electrolyte Balance.

- Assess BP and heart rate frequently and depending on patient's condition; assess skin turgor and temperature.
- Monitor intake and output every hour.
- Replace fluids, as ordered, through peripheral I.V. line.
- Monitor urine specific gravity to assess fluid changes.
- Monitor blood glucose frequently.
- Assess for symptoms of hypokalemia—fatigue, anorexia, nausea, vomiting, muscle weakness, decreased bowel sounds, paresthesia, arrhythmias, flat T waves, or ST-segment depression.

- Administer replacement electrolytes and insulin as ordered. Flush the entire I.V. infusion set with a solution containing insulin and discard the first 50 mL because plastic bags and tubing may absorb some insulin and the initial solution may contain decreased concentration of insulin.
- Monitor serum glucose, bicarbonate, and pH levels periodically.
- Provide reassurance about improvement of condition and that correction of fluid imbalance will help reduce discomfort.

Preventing Further Episodes of DKA

- Review precipitating events and causes of DKA with patients.
- Assist patients in identifying warning signs and symptoms of DKA.
- Instruct patients about sick-day guidelines.
- Patient Education and Health Maintenance
- Make sure that patient and caretakers can demonstrate drawing up and administering insulin in the proper dose, blood glucose monitoring, and urine ketone testing.
- Make sure that patient and caretakers know whom to notify in the event of hyperglycemia, stressful situations, or if symptoms of DKA present.

Evaluation: Expected Outcomes

- BP and heart rate are stable; glucose and bicarbonate levels are improving.
- Verbalizes sick-day guidelines correctly.

NURSING ALERT

Electrolyte levels may not reflect the total body deficit of potassium (primarily) and sodium (to a lesser extent) due to compartment shifts and fluid volume loss. Replacement is necessary despite normal to high values.

DRUG ALERT

Interruption in insulin administration may result in reaccumulation of ketone bodies and worsening acidosis. Glucose will normalize before acidosis resolves, so I.V. insulin is continued until bicarbonate levels normalize and subcutaneous insulin takes effect and the patient starts eating.

HYPEROSMOLAR HYPERGLYCEMIC NONKETOTIC SYNDROME (HHNKS)

Is an acute complication of diabetes mellitus (particularly type 2 diabetes) characterized by hyperglycemia, dehydration, and hyperosmolarity, but little or no ketosis.

Diagnostic Evaluation

- Serum glucose and osmolality are greatly elevated.
- Serum and urine ketone bodies are minimal to absent.
- Serum sodium and potassium levels may be elevated, depending on degree of dehydration, despite total body losses.
- Bun and creatinine may be elevated due to dehydration.
- Urine specific gravity is elevated due to dehydration.

Management

- Correct fluid and electrolyte imbalances with I.V. fluids.
- Provide insulin via I.V. drip to lower plasma glucose.
- Evaluate complications; such as stupor, seizures, or shock; and treat appropriately.
- Identify and treat underlying illnesses or events that precipitated HHNKS.

Complications

- Extremely rapid infusions of I.V. fluids can cause cerebral edema and death.
- HHNKS is a medical emergency that, if not treated properly, can cause death.
- Patients who become comatose will need nasogastric (NG) tubes to prevent aspiration.

Nursing Assessment

- Assess level of consciousness (LOC).
- Assess for dehydration—poor turgor, flushing, or dry mucous membranes.
- Assess cardiovascular status for shock—rapid, thready pulse, cool extremities, hypotension, or electrocardiogram changes.
- Interview the family or significant others regarding precipitating HHNKS events.
- Evaluate the patient's self-care regimen before hospitalization.
- Determine events, treatments, or drugs that may have caused the event.

Nursing Diagnoses

- Deficient fluid volume related to severe dehydration.
- Risk for aspiration related to reduced LOC and vomiting.

Nursing Interventions

Restoring Fluid Balance

- Assess the patient for increasing signs and symptoms of dehydration, hyperglycemia, or electrolyte imbalance.
- Institute fluid replacement therapy, as ordered (usually normal or half-strength saline initially), maintaining patent I.V. line.
- Assess the patient for signs and symptoms of fluid overload and cerebral edema as I.V. therapy progresses.
- Administer regular insulin I.V., as ordered, and add dextrose to the I.V. infusion as blood glucose falls below 300 mg/dL, to prevent hypoglycemia.
- Monitor hydration status by monitoring hourly intake and output and urine specific gravity.

Preventing Aspiration

- Assess patient's LOC and ability to handle oral secretions.
- Cough and gag reflex.
- Ability to swallow.
- Properly position the patient to reduce possibility of aspiration.
- Elevate the head of the bed, unless contraindicated.
- If nausea is present, use the side-lying position.
- Suction as frequently as needed to maintain a patent airway.
- Withhold oral intake until the patient is no longer in danger of aspiration.
- Insert an NG tube, as indicated, for gastric decompression.
- Monitor the respiratory rate and breath sounds for signs of aspiration pneumonia.
- Provide mouth care to maintain adequate mucosal hydration.

Patient Education and Health Maintenance

- Advise the patient and family that it may take three to five days for symptoms to resolve.
- Instruct the patient and family about the signs and symptoms of hyperglycemia and the use of sick-day guidelines.
- Explain possible causes of HHNKS.
- Review changes in the patient’s medications, activity, meal plans, or glucose monitoring for home care. It may not be necessary to continue insulin therapy following HHNKS; many patients can be treated with diet and oral agents.

Evaluation: Expected Outcomes.

- BP stable, dehydration resolved.
- No evidence of aspiration.

METABOLIC SYNDROME

Metabolic syndrome (also known as syndrome X, insulin resistance syndrome, and dysmetabolic syndrome) has been used to characterize a state of insulin resistance believed to be a major contributing factor to the development of a variety of significant health problems.

The National Cholesterol Education Program (NCEP) Adult Treatment Panel (ATP) III criteria for metabolic syndrome—three or more of the following:

Abdominal obesity: waist circumference > 102 cm (> 40″) in men; > 88 cm (> 35″) in women.

- Hypertriglyceridemia: ≥ 150 mg/dL.
- Low HDL cholesterol: < 40 mg/dL in men and < 50 mg/dL in women.
- Elevated BP: ≥ 130/85 mm Hg.
- Elevated fasting glucose: ≥ 110 mg/dL.

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CHAPTER 9: RENAL AND URINARY DISORDERS

Assessment

Subjective data include characterization of symptoms, history of present illness, past medical and surgical history, demographic data, and lifestyle factors. Malfunctions of the urinary tract may be caused by disorders of the kidneys, ureters, or bladder; surrounding structures; or disorders of other body systems.

- Changes in Micturition (Voiding).
- Changes in amount or color of urine.

Common Manifestations

Hematuria—blood in the urine is considered a serious sign and requires evaluation.

- May be gross (visible by color change) or microscopic: microscopic hematuria is the presence of red blood cells (RBCs) in urine, which can be seen only under a microscope; urine appears normal.

Color of bloody urine depends on several factors including:

- The amount of blood present
- Anatomical source of the bleeding.
- *Dark, rusty urine indicates bleeding from the upper urinary tract.*
- *Bright red bloody urine indicates lower urinary tract bleeding.*

Causes

- Hematuria may be due to a systemic cause, such as blood dyscrasias, anticoagulant therapy, or extreme exercise.
- Painless hematuria may indicate neoplasm in the urinary tract.
- Hematuria is common in patients with urinary tract stone disease and may also be seen in renal tuberculosis, polycystic disease of kidneys, acute pyelonephritis, thrombosis and embolism involving the renal artery or vein, and trauma to the kidneys or urinary tract.

Polyuria—large volume of urine voided in a given time:

- Volume is out of proportion to usual voiding pattern and fluid intake.
- Demonstrated in diabetes mellitus, diabetes Insipidus, chronic renal disease, and with the use of diuretics.

Oliguria—small volume of urine: Output between 100 and 500 mL/24 hours:

- May result from acute renal failure, shock, dehydration, or fluid and electrolyte imbalance.
- Anuria—absence of urine output; Output less than 50 mL/24 hours. Indicates serious renal dysfunction requiring immediate medical intervention.

STANDARDS OF CARE GUIDELINES

Symptoms Related to Irritation of the Lower Urinary Tract.

Dysuria—*painful or difficult urination*

Burning sensation seen in a wide variety of inflammatory and infectious urinary tract conditions.

Frequency—*voiding occurs more frequently than usual when compared with patient's usual pattern or with a generally accepted norm of once every 3 to 6 hours.*

- Determine if habits governing fluid intake have been altered—it is essential to know normal voiding pattern to evaluate frequency.
- Increasing frequency can result from a variety of conditions, such as infection and diseases of the urinary tract, metabolic disease, hypertension, or certain medications (diuretics).

Urgency—*strong desire to urinate that is difficult to postpone.*

- Due to inflammatory conditions of the bladder, prostate, or urethra; acute or chronic bacterial infections; neurogenic voiding dysfunctions; chronic prostitutes or bladder outlet obstruction in men; overactive bladder; and urogenital atrophy in postmenopausal women.

Nocturia—*urination at night, which interrupts sleep.*

- Causes include urologic conditions affecting bladder function, poor bladder emptying, bladder outlet obstruction, or overactive bladder.
- Metabolic causes include decreased renal concentrating ability or heart failure, hyperglycemia, and the increased urine production at rest that occurs with aging.

Strangury—*slow and painful urination; only small amounts of urine voided. Wrenching sensation at end of urination produced by spasmodic muscular contraction of the urethra and bladder.*

- Blood staining may be noted.
- Seen in numerous urological conditions, including severe cystitis, interstitial cystitis, urinary calculus, and bladder cancer.

Symptoms Related to Obstruction of the Lower Urinary Tract

Weak stream—*decreased force of urine stream when compared to usual stream of urine when voiding.*

Hesitancy—*undue delay and difficulty in initiating voiding. May indicate compression of urethra, outlet obstruction, and neurogenic bladder.*

Terminal dribbling—*prolonged dribbling of urine from the meatus after urination is complete. May be caused by bladder outlet obstruction.*

Incomplete emptying—*feeling that the bladder is still full even after urination. Indicates either urinary retention, overactive bladder, or a condition that prevents the bladder from emptying well; may lead to infection.*

Urinary retention*—inability to void.*

Involuntary Voiding

Urinary incontinence—*involuntary loss of urine; may be due to pathologic, anatomical, or physiologic factors affecting the urinary tract.*

Nocturnal Enuresis—*involuntary voiding during sleep. May be physiologic during early childhood; thereafter, it may be functional or symptomatic of obstructive or neurogenic disease (usually of lower urinary tract) or dysfunctional voiding.*

Urinary Tract Pain

Genitourinary (GU) pain is not always present in renal disease, but it is generally seen in the more acute conditions of the urinary tract.

- **Kidney pain—**may be felt as a dull ache in the costovertebral angle; or may be a sharp, colicky pain felt in the flank area that radiates to the groin or testicle. The severity of the pain is related to how quickly distention of the renal capsule develops.
- **Ureteral pain—**felt in the back and/or abdomen can radiate to groin, urethra, penis, scrotum, or testicle.
- **Bladder pain (lower abdominal pain or pain over the suprapubic area)—**may be due to bladder infection, over-distended bladder, or bladder spasms.
- **Urethral pain—**from irritation of the bladder neck, from foreign body in the canal, or from urethritis due to infection or trauma; pain increases when voiding.
- **Pain in the scrotal area—**due to inflammatory swelling of epididymis or testicle, torsion of the testicle, or scrotal infection.
- **Testicular pain—**due to injury, mumps, orchitis, torsion of spermatic cord, testes, or testes appendix.
- **Perineal or rectal discomfort—**due to acute or chronic prostatitis, prostatic abscess, or trauma.
- **Back and leg pain—**may be due to cancer of the prostate with metastases to bone.
- **Pain in the glans penis—**usually from prostatitis; penile shaft pain results from urethral problems; may also be referred pain from Ureteral calculus.

Related Symptoms

- GI symptoms related to urologic conditions include nausea, vomiting, diarrhea, abdominal discomfort, paralytic ileus, and GI hemorrhage with uremia. Occurs with urologic conditions because the GI and urinary tracts have common autonomic and sensory innervations and because of renointestinal reflexes.
- Fever and chills may also occur with infectious processes.

Objective Data

Objective data should focus on physical examination of the abdomen and the genitalia. Complete body system assessment may be indicated in some conditions such as renal failure.

Diagnostic Tests

Laboratory Studies

Blood and urinary excretion tests for renal function, prostate-specific antigen (PSA), and urinalysis.

Tests of Renal Function: (See table 1 below).

Table 8: Tests of Renal Function

There is no single test for renal function. The rate of change of renal function is more important than the result of a single test.		
Test	**Purpose/Rationale**	**Test Protocol**
Renal concentration test: • Specific gravity • Osmolality of urine	• Tests the body's ability to concentrate solutes in the urine. • Concentration ability is lost early in kidney disease; hence, this test detects early defects in renal function.	• Fluids may be withheld for 12-24 hours to evaluate the concentrating ability of the tubules under controlled conditions. Specific gravity measurements of urine are taken at specific times to determine urine concentration.
Creatinine clearance	• Provides a reasonable approximation of glomerular filtration rate. • Measures the volume of blood cleared of creatinine in one minute. • Most sensitive indication of early renal disease. Useful to follow the progress of the patient's renal status.	• Collect all urine over a 24-hour period. • Draw one sample of blood within the sampling period.

Serum creatinine	• A test of renal function reflecting the balance between production and filtration by the renal glomerulus. • Most sensitive test of renal function.	• Obtain a sample of blood serum.
Serum urea nitrogen (blood urea nitrogen [BUN])	• Serves as index of renal excretory capacity. • Serum urea nitrogen depends on the body's urea production and on urine flow (Urea is the nitrogenous end-product of protein metabolism). • Affected by protein intake and tissue breakdown.	• Obtain a sample of blood serum.
Protein	• Random specimen may be affected by dietary protein intake. Proteinuria >150 mg/24 hours may indicate renal disease.	• Collect all urine over a 24-hour period.
Micro albumin/creatinine ratio	• Sensitive test for the subsequent development of Proteinuria; > 30 mcg/mg creatinine predicts early nephropathy.	• Collect a random urine specimen.
Urine casts	• Mucoproteins and other substances present in renal inflammation; help to identify the type of renal disease (e.g., red cell casts present in glomerulonephritis, fatty casts in nephrotic syndrome, white cell casts in pyelonephritis). • Renal function may be within normal limits until about 50% of renal function has been lost. • Prostate-Specific Antigen (PSA) •	• Collect a random urine specimen.

Nursing and Patient Care Considerations

- No patient preparation is necessary.
- Current or recent UTI causes an artificial elevation of PSA.

- Clinical laboratories may differ slightly in methods used for determining PSA; patients having serial PSA should be sent to the same laboratory.

  Urine analysis

  - Appearance:
    - **Odor—**normal urine has a faint aromatic odor.
    - **Color—**shows degree of concentration and depends on amount voided. Normal urine is clear.
    - **PH of urine—**reflects the ability of kidney to maintain normal hydrogen ion concentration in plasma and extracellular fluid; indicates acidity or alkalinity of urine.
    - **Specific gravity—**reflects the kidney's ability to concentrate or dilutes urine; may reflect degree of hydration or dehydration.
    - **Osmolality—**indication of the amount of active particles in urine (number of particles per unit volume of water). It is similar to specific gravity, but is considered a more precise test; it is also easy—only one to two mL of urine is required. Average value is 300 to 1,090 mOsm/kg for females; 390 to 1,090 mOsm/kg for males.

Nursing and Patient Care Considerations

- Freshly voided urine provides the best results for routine urinalysis; some tests may require first morning specimen.
- Obtain sample of about 30 mL.
- Urine culture and sensitivity tests are typically performed using the same specimen obtained for urinalysis; therefore, use clean-catch or catheterization techniques.
- Patients with urinary diversions, especially ileal conduit diversions, require special techniques to obtain urine that is not contaminated with bacteria from the intestinal diversion.

RADIOLOGY AND IMAGING

These tests include simple X-rays, X-rays with contrast media, ultrasound, nuclear scans, and imaging through computed tomography (CT) scanning and magnetic resonance imaging (MRI).

- X-ray: of the kidneys, ureters, and bladder.
- Intravenous Pyelogram (intravenous urogram).
- Retrograde Pyelography.
- Cystourethrogram.
- Renal angiography.
- Renal scans
- Ultrasound.
- Computed tomography scanning (CT).
- Magnetic resonance imaging (MRI).

OTHER TESTS

- Cystoscopy.
- Urodynamic.

GENERAL PROCEDURES AND TREATMENT MODALITIES

Catheterization

Definition

Catheterization may be done to relieve acute or chronic urinary retention, to drain urine preoperatively and postoperatively, to determine the amount of residual urine after voiding, or to determine accurate measurement of urinary drainage in critically ill patients.

> ***Alert***
> *Replace catheters as often as possible, at least once per month.*

URINARY DISORDERS

Lower Urinary Tract Infections

A UTI is caused by the presence of pathogenic microorganisms in the urinary tract with or without signs and symptoms. Lower UTIs may predominate at the bladder (cystitis) or urethra (urethritis). Bacteriuria refers to the presence of bacteria in the urine (10^3 bacteria/mL of urine or greater generally indicates infection).

- In asymptomatic Bacteriuria, organisms are found in urine, but patient has no symptoms.
- Recurrent UTIs may indicate the following:
  - Relapse—recurrent infection with an organism that has been isolated during a prior infection.
  - Reinfection—recurrent infection with an organism distinct from previous infecting organism.

Clinical Manifestations

- Dysuria, frequency, urgency, nocturia.
- Suprapubic pain and discomfort.
- Microscopic or gross Hematuria.

Diagnostic Evaluation

- Urine dipstick may react positively for blood, white blood cells (WBCs), and nitrates indicating infection.
- Urine microscopy shows red blood corpuscles (RBCs) and many WBCs per field without epithelial cells.
- Urine culture is used to detect presence of bacteria and for antimicrobial sensitivity testing.
- Patients with indwelling catheters may have asymptomatic bacterial colonization of the urine without UTI. In these patients, UTI is diagnosed and treated only when symptoms are present.

> ***NURSING ALERT***
> *Urinalysis showing many epithelial cells is likely contaminated by vaginal secretions in women and is therefore inaccurate in indicating infection. Urine culture may be reported as contaminated as well. Obtaining a clean-catch, midstream specimen is essential for accurate results, and catheterization may be necessary in some patients.*

Nursing Assessment

- Determine if the patient has a history of UTIs in childhood, during pregnancy, or has had recurrent infections.
- Question about voiding habits, personal hygiene practices, and methods of contraception (use of diaphragm or spermicides is associated with development of cystitis).

- Ask if the patient has any associated symptoms of vaginal discharge, itching, or irritation—Dysuria may be prominent symptom of vaginitis or infection from a sexually transmitted pathogen, rather than UTI.
- Examine for suprapubic tenderness, as well as abdominal tenderness, guarding, rebound, or masses that may indicate more serious process.

Nursing Diagnoses

- Acute pain related to inflammation of the bladder mucosa.
- Deficient knowledge related to prevention of recurrent UTI.

Nursing Interventions

- Relieving pain.
- Increasing understanding and practice of preventive measures.
- Patient education and health maintenance.

Evaluation: Expected Outcomes

- Verbalizes relief of symptoms.
- Verbalizes self-care measures to prevent recurrence.

INTERSTITIAL CYSTITIS

Nursing Assessment

- Assess voiding patterns including frequency, nocturia, and urgency (a voiding diary is helpful). Determine if the symptoms increase in relation to certain foods, menstrual cycle, or sexual intercourse.
- Assess the level of pain using a scale of 1 to 10; determine if pain increases during or after voiding and if bladder spasms occur. Some practitioners may use a symptom questionnaire such as the O'Leary-Sent Interstitial Cystitis Symptom and Problem Indices or the Pelvic Pain and Urgency/Frequency questionnaire.
- Perform abdominal examination and assist with pelvic examination, if indicated, to rule out gynecologic causes and to identify location of pain on palpation.
- Assess impact on relationships and quality of life.

Nursing Diagnoses

- Chronic pain related to disease process.
- Impaired urinary elimination related to frequency, urgency, dysuria, and nocturia.
- Ineffective coping related to interruption of lifestyle and chronic, unrelenting symptoms.

Nursing Interventions

- Controlling pain.
- Improving urinary elimination.

INJURIES TO THE KIDNEY

Trauma to abdomen, flank, or back may produce renal injury. Suspicion is high in a patient with multiple injuries.

Types and physiologic effects of renal injuries:

- Contusion.
- Laceration.
- Rupture.
- Pedicle injury.

> ***NURSING ALERT***
> *If there is a history consistent with renal injury and the patient presents in shock, suspect a renal pedicle injury. This is a hemorrhagic emergency, requiring immediate treatment of shock and preparation for surgery.*

Nursing Assessment

- Obtain history of traumatic event and any history of renal disease.
- Inspect for any abrasions, lacerations, or entrance and exit wounds to the upper abdomen or lower thorax.
- Monitor BP and pulse to assess for bleeding and impending shock; perirenal hemorrhage may cause rapid Exsanguination.
- Assess for the presence and the degree of Hematuria.

> ***NURSING ALERT***
> *Watch for any sudden change in patient's condition—drop in BP, increasing flank or abdominal pain and tenderness, or palpable mass in flank. May indicate hemorrhage, which requires surgical intervention.*

Nursing Diagnoses

- Ineffective (renal) tissue perfusion related to injury.
- Impaired urinary elimination related to injury.
- Acute pain related to injury.

Nursing Interventions

- Restoring and maintaining renal perfusion.
- Preserving urinary elimination.
- Controlling pain.
- Patient education and health maintenance.

Evaluation: Expected Outcomes

- Vital signs stable.
- Serial urine clears.
- Reports decreased pain.

INJURIES TO THE BLADDER AND URETHRA

Definition

Injuries to the bladder and urethra commonly occur along with pelvic fracture or may be due to surgical interventions.

Diagnosis

- Retrograde urethrogram—to detect rupture of urethra.
- Cystogram—to detect and localize perforation/rupture of bladder.
- Plain film of abdomen—may show associated pelvic fracture.
- Abdominal CT with contrast—best study to evaluate extent of kidney injury.
- Excretory urogram—to survey the kidneys and ureters for injury.

> ***NURSING ALERT***
> *If ruptured urethra is suspected, do not catheterize because doing so may complete a partial urethral rupture. Urethrogram must be done first to determine patency of urethra.*

BLADDER INJURY

- Treatment instituted for shock and hemorrhage.
- Surgical intervention carried out for intraperitoneal bladder rupture. Extravasated blood and urine will first be drained and urine diverted with suprapubic Cystostomy or indwelling catheter.
- Small extra peritoneal bladder ruptures will heal spontaneously with indwelling suprapubic or urethral catheter drainage.
- Large extra peritoneal bladder ruptures are repaired surgically.

URETHRAL INJURY

- Immediate repair—urethra is manipulated into its correct anatomical position with reanastomosis after evacuation of hematoma.
- Delayed repair—suprapubic Cystostomy drainage for 6 to 12 weeks allows the urethra to realign itself while hematoma and edema resolve; then surgical reanastomosis.
- Two-stage urethroplasty—reconstruction of the urethra occurs in two separate surgeries with urinary elimination diverted until final procedure.

Nursing Assessment

- Obtain vital signs; assess for evidence of shock.
- Obtain detailed history of injury, if possible.
- Inspect urinary meatus for evidence of bleeding.
- Perform physical examination for symptoms of bladder rupture; dullness to palpation; rebound tenderness or rigidity.

Nursing Diagnoses

- Risk for deficient fluid volume related to trauma and resulting hemorrhage.
- Impaired urinary elimination related to disruption of intact lower urinary tract.
- Acute pain related to traumatic injury.
- Fear related to traumatic injury and uncertain prognosis.

Nursing Interventions

- Stabilizing circulatory volume.
- Facilitating urinary elimination.
- Controlling pain.
- Relieving fear.
- Patient education and health maintenance.

Evaluation: Expected Outcomes

- Vital signs stable.
- Adequate urine output by way of catheter.
- Verbalizes relief of pain.
- Verbalizes reduction in fear.

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CHAPTER 10: MUSCULOSKELETAL DISORDERS

Assessment

Subjective Data

History of injury, description of symptoms, and associated personal health and family history can give clues to the underlying problem and appropriate care for that problem.

Fractures, Strains, Sprains

Common Manifestations

- Pain.
- Limited Range of Motion.
- Associated Symptoms.

History

- Mechanism of Injury.
- Medical History.
- Social History.

Objective Data

Inspection- Palpation-and Measurement.
Always compare with contra lateral side (one side of the body to the other).

MUSCULOSKELETAL SYSTEM

Skeletal Component

- Note deviation from normal structure: bony deformities, length discrepancies, alignment, symmetry, and amputations.
- Identify abnormal motion and crepitus (grating sensation), as found with fractures.

Joint Component

- Identify swelling that may be due to inflammation or effusion.
- Note deformity associated with contractures or dislocations.
- Evaluate stability, which may be altered.
- Estimate active and passive range of motion (ROM).

Muscle Component

- Inspect for size and contour of muscles.
- Assess coordination of movement.
- Palpate for muscle tone.
- Estimate strength through cursory evaluation (i.e., handshake) or scaled criteria (ie, 0 = no palpable contraction; 5 = normal ROM against gravity with full resistance).
- Measure girth to note increases due to swelling or bleeding into the muscle or decreases due to atrophy (difference of more than 1 cm is significant).
- Identify abnormal clonus (rhythmic contraction and relaxation) or fasciculation (contraction of isolated muscle fibers).

Neurovascular Component

- Assess circulatory status of involved extremities by noting skin color and temperature, peripheral pulses, capillary refill response, pain, and edema.
- Assess neurologic status of involved extremities by the patient's ability to move distal muscles and description of sensation (e.g., paresthesia).
- Test reflexes of extremities.
- Compare to uninjured/unaffected extremity.

Skin Component

- Inspect traumatic injuries (e.g., cuts, bruises).
- Assess chronic conditions (e.g., dermatitis, stasis ulcers).
- Note hair distribution and nail condition.
- Inspect for Heberden's or Bouchard's nodes.
- Assess for warmth or coolness of skin.

DIAGNOSTIC TESTS

Radiologic and Imaging Studies

X-Rays

- Bone: to determine bone density, texture, integrity, erosion, or changes in bone relationships.
- Cortex: to detect any widening, narrowing, or irregularity.
- Medullary cavity: to detect any alteration in density.
- Involved joint: to show fluid, irregularity, spur formation, narrowing, or changes in joint contour.
- Tomogram: special X-ray technique for detailed view of bone.

Nursing and Patient Care Considerations

- Tell the patient that proper positioning is important to obtain a good X-ray, so cooperation is essential.
- Advise the patient to remove all jewelry, clothing with zippers or snaps, change from pockets, or other items that may interfere with X-ray.
- Medicate for pain prior to X-ray, as needed.

CT Scans

Narrow beam of X-ray that scans body areas in successive layers to evaluate disease, bone structure, joint abnormalities, and trauma (fractures).

> ***NURSING ALERT***
> *Patients with metal implants or valves, metal braces, or pacemakers are unable to undergo MRI.*

STANDARDS OF CARE GUIDELINES

Caring for a Patient with Musculoskeletal Trauma, Surgery, Casting, or Immobilization
When caring for a patient with musculoskeletal trauma, surgery, casting, or immobilization; provide the following care as indicated:

- Check neurovascular status of involved extremities.
- Palpate for intact and equal pulses bilaterally.
- Palpate for proper warmth of the skin.
- Check for brisk capillary refill.
- Test sensation to light touch and pain.
- Observe for unusual or increased swelling.
- Ensure that patient can move affected parts.
- Ensure proper positioning for comfort and alignment.
- Determine pressure points and take precautions to prevent pressure sores.
- Medicate to control pain, particularly before movement, procedures, and physical therapy.
- Provide diversional activities and emotional support during long immobilizations.
- Always document assessments and interventions meticulously, realizing that a patient may be involved in Workers' Compensation claim or litigation due to accident and that records will be essential to patient's future well-being.

This information should serve as a general guideline only. Each patient situation presents a unique set of clinical factors and requires nursing judgment to guide care, which may include additional or alterative measures and approaches.

GENERAL PROCEDURES AND TREATMENT MODALITIES

Casts

A cast is an immobilizing device made up of layers of plaster or fiberglass (water-activated polyurethane resin) bandages molded to the body part that it encases.
Purposes:

- To immobilize and hold bone fragments in reduction.
- To apply uniform compression of soft tissues.
- To permit early mobilization.
- To correct and prevent deformities.
- To support and stabilize weak joints.

TYPES OF CASTS

Short-arm Cast

Extends from below the elbow to the proximal palmar crease.

Gauntlet Cast

Extends from below the elbow to the proximal palmar crease, including the thumb (thumb spica).

Long-arm Cast

Extends from upper level of axillary fold to proximal palmar crease; elbow usually immobilized at a right angle.

Short-leg Cast

Extends from below the knee to the base of the toes.

Long-leg Cast

Extends from the upper thigh to the base of the toes; the foot is at a right angle, in a neutral position.

Body Cast

Encircles the trunk stabilizing the spine.

Spica Cast

Incorporates the trunk and one or more extremities.

Shoulder Spica cast—a body jacket that encloses trunk, shoulder, and elbow.

Hip-Spica cast—encloses trunk and a lower extremity.

- Single hip-Spica—extends from the nipple line to include the pelvis and one thigh.
- Double hip-Spica—extends from the nipple line or upper abdomen to include the pelvis and both thighs and lower legs.
- One-and-a-half hip-Spica—extends from the upper abdomen, includes one entire leg, and extends to the knee of the other.

Cast-brace

External support about a fracture that is constructed with hinges to permit early motion of joints, early mobilization, and independence.

- Cast bracing is based on the concept that some weight-bearing is physiologic, and will promote the formation of bone and contain fluid within a tight compartment that compresses soft tissues; providing a distribution of forces across the fracture site.
- Cast-brace is applied after initial edema and pain have subsided and there is evidence of fracture stability.

Cylinder Cast

This cast can be used for the upper or lower extremities. Used for fracture or dislocation of the knee (lower extremity), or elbow dislocation (upper extremity).

Nursing Assessment

- Assess neurovascular status of the extremity with a cast for signs of compromise:
  - Pain (pain out of proportion to injury is an indication for compartment syndrome).
  - Swelling.
  - Discoloration—pale or blue.
  - Cool skin distal to injury.
  - Tingling or numbness (paresthesia).
  - Pain on passive extension (muscle stretch).
  - Slow capillary refill; diminished or absent pulse.
  - Paralysis.
- Assess skin integrity of casted extremity. Be alert for:
  - Severe initial pain over bony prominences; this is a warning symptom of an impending pressure ulcer. Pain increases when ulceration occurs.
  - Odor.

  - Drainage on cast.
  - Carefully assess for positioning and potential pressure sites of the casted extremity.
  - Lower extremity—heel, malleoli, dorsum of foot, head of fibula, and anterior surface of patella.
  - Upper extremity—medial epicondyle of humerus and ulnar styloid.
  - Plaster jackets or body Spica casts—sacrum, anterior and superior iliac spines, and vertebral borders of scapulae.
- Assess cardiovascular, respiratory, and GI systems for possible complications of immobility.
- Assess psychological reaction to illness, cast, and immobility.

> ***NURSING ALERT***
> *Do not ignore the complaint of pain of the patient in a cast; suspect compartment syndrome or a pressure ulcer. Notify health care provider if symptoms persist. Cast may have to be split or removed.*

Nursing Diagnoses

- Ineffective tissue perfusion (extremity) related to swelling and constrictive bandage or cast.
- Impaired physical mobility related to condition and casting.
- Risk for injury related to potential complications.

Nursing Interventions

Maintaining Adequate Tissue Perfusion:

- Elevate the extremity on a cloth-covered pillow above the level of the heart. Keep the patient's heels off the mattress.
- Avoid resting the cast on hard surfaces or sharp edges that can cause denting or flattening of the cast and consequent pressure sores.
- Handle a moist cast with the palms of hands.
- Turn the patient every two hours while the cast dries.
- Assess the patient's neurovascular status hourly during the first 24 hours, then less frequently as their condition warrants and swelling resolves.
- If symptoms of neurovascular compromise occur:
  - Notify the health care provider immediately.
  - Bivalve the cast—split cast on each side over its full length into two halves.
  - Cut the underlying padding—blood-soaked padding may shrink and cause constriction of circulation.
  - Spread cast sufficiently to relieve constriction.

- If symptoms of pressure area occur, cast may be "windowed" (hole cut in it) so the skin at the pain point can be examined and treated. The window must be replaced so the tissue does not swell and cause additional pressure problems at window edge.

Minimizing the Effects of Immobility:

- Encourage the patient to move as normally as possible.
- Encourage compliance with prescribed exercises to avoid muscle atrophy and loss of strength.
  - Active ROM for every joint that is not immobilized at regular and frequent intervals.
  - Isometric exercises for the muscles of the casted extremity. Instruct patient to alternately contract and relax muscles without moving affected part.
- Reposition and turn the patient frequently.
- Avoid pressure behind the knees, which reduces venous return and predisposes the patient to thromboembolism.
- Use Antiembolism stockings and sequential compression devices (SCD) as indicated.
- Administer prophylactic anticoagulants as prescribed.
- Encourage deep-breathing exercises and coughing at regular intervals to prevent atelectasis and pneumonia.
- Observe for symptoms of cast syndrome—nausea, vomiting, abdominal distention, abdominal pain, and decreased bowel sounds.
- Encourage patient to drink liberal quantities of fluid—to avoid urinary infection and calculi secondary to immobility.

> ***NURSING ALERT***
> *People at high risk for pulmonary emboli include older adults and persons with previous thromboembolism, obesity, heart failure, or multiple trauma. These patients require prophylaxis against thromboembolism.*

> ***NURSING ALERT***
> *Cast syndrome (superior mesenteric artery syndrome) is a rare sequela of body cast application, yet it is a potentially fatal complication. It is important to teach patients about this syndrome because this can develop as late as several weeks after cast application.*

SPECIFIC CARE FOR PATIENT IN SPICA OR BODY CAST

Positioning

- Place a bed board under the mattress for uniform support of the body.
- Support the curves of the cast with cloth-covered flexible pillows, this prevents cracking and flat spots while the cast is drying:

  - Place three pillows crosswise on the bed for body casts.
  - Place one pillow crosswise at the waist and two pillows lengthwise for affected leg, for Spica cast. If both legs are involved, use two additional pillows.
- Encourage the patient to maintain physiologic position by:
  - Using the overhead trapeze.
  - Placing their good (uncasted) foot flat on the bed and pushing down while lifting himself/ herself up on the trapeze.
  - Avoiding twisting motions.
  - Avoiding positions that produce pressure on the groin, back, chest, and abdomen.

Turning

- Move the patient to the side of the bed using a steady, even pulling motion.
- Place pillows along the other side of the bed—one for the chest and two (lengthwise) for the legs.
- Instruct the patient to place arms at their side or their above head.
- Turn the patient as a unit. Avoid twisting the patient in the cast.
- Turn the patient toward the leg not encased in plaster or toward the unoperated side, if both legs are in plaster:
  - One nurse stands at other side of bed to receive the patient's shoulders.
  - The second nurse supports the leg in plaster, while the third nurse supports the patient's back as he/she is turned.
  - Turn the patient in a body cast to a prone position twice daily, this provides postural drainage of bronchial tree and relieves pressure on the back.
- Keep the cast level by elevating the lumbar sacral area with a small pillow when the head of the bed is elevated.

> ***NURSING ALERT***
> *Do not grasp cross bar of spica cast to move the patient. The purpose of the bar is to maintain the integrity of the cast.*

Hygienic Care

- Provide hygienic care of the patient.
- Protect the cast from soiling:
  - Cover the perineum with a towel and apply spray (lacquertype) to perineal area of cast. Tuck a 4-inch (10-cm) strip of thin polyethylene sheeting under the perineal area of cast and tape it to the cast exterior. Replace when soiling occurs.
  - Clean the outside of soiled cast with a mild powdered cleanser and a slightly dampened or dry clean cloth, pat dry completely, only when necessary.
- Roll the patient onto fracture bedpan; use small pillow in the lumbosacral area for support.

Skin Care

- Inspect skin for signs of irritation:
  - Around cast edge.
  - Under cast—pull skin taut and inspect under cast, using a flashlight for illumination.
- Reach up under the cast, and massage accessible skin.
- Protect the toes from bedding pressure.

Skin Irritation

- Advice the patient to prevent skin irritation at the cast edge by padding edges of the cast with moleskin, or "petaling" cast edges with strips of adhesive tape.

Neurovascular Status

- Instruct the patient to check neurovascular status and to control swelling:
  - Watch for signs and symptoms of circulatory disturbance, including blueness or paleness of fingernails or toenails accompanied by pain and tightness, numbness, cold or tingling sensations.
  - Elevate the affected extremity, and wiggle their fingers or toes.
  - Apply ice bags as prescribed (one-third to one-half full) to each side of the cast, making sure they do not make indentations in the plaster.
  - Call the health care provider promptly if excessive swelling, paresthesia, persistent pain, pain on passive stretch, or paralysis occurs.
- Instruct the patient to alternate ambulation with periods of elevation to the cast when seated. Encourage the patient to lie down several times daily with cast elevated.

Cast Care

- Advise the patient to avoid getting the cast wet, especially the padding under cast. Dampness causes skin breakdown because the plaster cast becomes soft.
- Warn against covering a leg cast with plastic or rubber boots, because this causes condensation and wetting of the cast.
- Instruct the patient to avoid weight bearing or stress on the plaster cast for 24 hours.
- Instruct the patient to report to health care provider if the cast cracks or breaks; they should not to try to fix it.
- Teach the patient how to clean the cast:
  - Remove surface soil with a slightly damp cloth.
  - Rub soiled areas with household scouring powder.
  - Wipe off residual moisture.

TRACTION

Traction is the force applied in a specific direction. To apply the force needed to overcome the natural force or pull of muscle groups, a system of ropes, pulleys, and weights is used.

Purposes of Traction

- To reduce and immobilize fracture.
- To regain normal length and alignment of an injured extremity.
- To lessen or eliminate muscle spasm.
- To prevent deformity.
- To give the patient freedom for "in-bed" activities.
- To reduce pain.

Types of Traction

- Skin Traction.
- Skeletal Traction.

> ***NURSING ALERT***
> *Traction is not accomplished if the knot in the rope or the footplate is touching the pulley or the foot of the bed or if the weights are resting on the floor. Never remove the weights when repositioning the patient who is in skeletal traction because this will interrupt the line of pull and cause the patient considerable pain.*

Nursing Diagnoses

- Impaired physical mobility related to traction therapy and underlying pathology.
- Risk for impaired skin integrity related to pressure on soft tissues.
- Risk for infection related to bacterial invasion at skeletal traction site.
- Ineffective tissue perfusion: peripheral related to injury or traction therapy.

Nursing Interventions

Minimizing the Effects of Immobility:

- Encourage active exercise of uninvolved muscles and joints to maintain strength and function. Dorsiflex the feet hourly to avoid development of footdrop and aid in venous return.
- Encourage deep breathing hourly to facilitate expansion of lungs and movement of respiratory secretions.
- Auscultate lung fields twice per day.
- Encourage fluid intake of 2,000 to 2,500 mL daily.
- Provide a balanced high-fiber diet rich in protein; avoid excessive calcium intake.

- Establish bowel routine through use of diet and stool softeners, laxatives, and enemas, as prescribed.
- Prevent pressure on the calf, and evaluate twice daily for the development of thrombophlebitis.
- Check traction apparatus at repeated intervals. The traction must be continuous to be effective, unless prescribed as intermittent, as with pelvic traction:
  - With running traction, the patient may not be turned without disrupting the line of pull.
  - With balanced suspension traction, the patient may be elevated, turned slightly, and moved as desired.
- Use SCDs and compression stockings as indicated.
- Administer prophylactic anticoagulants as prescribed.

> ***NURSING ALERT***
> *Every complaint of the patient in traction should be investigated immediately to prevent injury.*

Maintaining Skin Integrity:

- Examine bony prominences frequently for evidence of pressure or friction irritation.
- Observe for skin irritation around the traction bandage.
- Observe for pressure at traction-skin contact points.
- Report complaint of burning sensation under traction.
- Relieve pressure without disrupting traction effectiveness.
- Make sure that linens and clothing are wrinkle-free:
  - Use lambs' wool pads, heel and elbow protectors, and special mattresses as needed.
- Special care must be given to the patient’s back every two hours, because the patient maintains a supine position:
  - Have the patient use the trapeze to pull himself up and relieve back pressure.
  - Provide backrubs.

Avoiding Infection at Pin Sites

- Monitor vital signs for fever or tachycardia.
- Watch for signs of infection, especially around the pin tract:
  - The pin should be immobile in the bone, and the skin surrounding the wound should be dry. Small amounts of serous fluid oozing from pin site may occur.
  - If infection is suspected, Percuss gently over the tibia; this may elicit pain if infection is developing.
  - Assess for other signs of infection: Heat, redness, and fever.
- If directed, clean the pin tract with sterile applicators and prescribed solution or ointment (ie, normal saline, sterile water, chlorhexidine). This clears drainage at the entrance of tract and around the pin, because plugging at this site can predispose bacterial invasion of the tract and bone.

Promoting Tissue Perfusion

- Assess motor and sensory function of specific nerves that might be compromised.
  - Peroneal nerve: have the patient point their great toe toward their nose; check their sensation on the dorsum of the foot; presence of footdrop.
  - Radial nerve: Have the patient extend their thumb; check sensation in web between their thumb and index finger.
  - Median nerve: Have the patient touch their thumb and middle finger together; check their sensation of their index finger.
- Determine adequacy of circulation (e.g., color, temperature, motion, capillary refill of peripheral fingers or toes):
  - With Buck's traction, inspect the foot for circulatory difficulties within a few minutes and then periodically after the elastic bandage has been applied.
- Report promptly if change in neurovascular status is identified.

Evaluation: Expected Outcomes

- Exercises as instructed; deep breaths hourly; fluid intake 2,000 to 2,500 mL/24 hours.
- No signs of skin breakdown under traction bandage or over bony prominences.
- No drainage, redness, or odor at pin site.
- No motor or sensory impairment; good capillary refill, color, and warmth of the extremity.

STRAIN

- Hemorrhage into the muscle.
- Swelling.
- Tenderness.
- Pain with isometric contraction.
- May be associated spasm.

SPRAIN

- Rapid swelling, due to extravasation of blood within injured tissues.
- Pain on passive movement of the joint.
- Increasing pain during the first few hours due to continued swelling.

Management (Strain & Sprain)

- X-ray may be done to rule out fracture.
- Immobilize with a splint, elastic wrap, or compression dressing to support painful structures and control swelling.
- Apply ice while swelling is present.

- Analgesics usually include nonsteroidal anti-inflammatory drugs (NSAIDs).
- Severe sprains may require surgical repair or cast immobilization.

Nursing Interventions and Patient Education

- Elevate the affected part to reduce swelling. Maintain splint or immobilization as prescribed.
- Apply cold compresses for the first several days (15 to 20 minutes at a time every few hours), to produce vasoconstriction, decrease edema, and reduce discomfort (do not apply ice directly to skin). Ice may be needed for up to a week to control acute swelling.
- Assess neurovascular status of contused extremity every one to four hours as the patient's condition indicates.
- Instruct the patient on the use of pain medication, as prescribed.
- Ensure correct use of crutches or other mobility aids, with or without weight bearing, as prescribed.
- Educate the patient on the need to rest the injured part for about a month, to allow for healing.
- Teach the patient to resume activities gradually.
- Teach the patient to avoid excessive exercise of the injured part.
- Teach the patient to avoid re injury by “warming up” before exercise and stretching tendons and muscles before and after exercise.
- Complementary methods, such as acupuncture, biofeedback, and imagery, may contribute to healing by reducing anxiety and pain.

> ***NURSING ALERT***
> *Teach patients to use PRICE at home for minor injuries: Protection—of the affected part from injury; Rest—to promote healing; Ice—to control swelling (do not use heat until acute swelling is relieved); Compression—with an elastic wrap or splint to control swelling and prevent stiffness, can be removed at night; Elevation —above the level of the heart to reduce swelling.*

TRAUMATIC JOINT DISLOCATION

Definition

Dislocation of a joint occurs when the surfaces of the bones forming the joint are no longer in anatomic contact. This is a medical emergency because of associated disruption of surrounding blood and nerve supplies. Shoulders, fingers, and elbows are the most commonly dislocated joints. Mechanism of injury can be anterior, posterior (most common), lateral, or a medial force.

Clinical Manifestations

- Pain.
- Deformity.

- Change in the length of the extremity.
- Loss of normal movement.
- X-ray confirmation of dislocation without associated fracture.

Management

- Immobilize part while the patient is transported to emergency department, X-ray department, or clinical unit.
- Secure reduction of dislocation (bring displaced parts into normal position) as soon as possible, to prevent circulatory or nerve impairments; usually performed under anesthesia.
- Stabilize reduction until joint structures are healed to prevent permanently unstable joint or aseptic necrosis of bone.

Nursing Interventions and Patient Education

- Assess the neurovascular status of the extremity before and after dislocation reduction.
- Administer or teach self-administration of pain medications such as NSAIDs.
- Ensure proper use of immobilization device(s) after reduction.
- Review instructions for activity restrictions and the need for PT and follow-up.

FRACTURES

Definition

A fracture is a break in the continuity of bone. A fracture occurs when the stress placed on a bone is greater than the bone can absorb. Muscles, blood vessels, nerves, tendons, joints, and other organs may be injured when a fracture occurs.

Types of Fractures

- **Complete:** Involves the entire cross section of the bone, usually displaced (abnormal position).
- **Incomplete:** Involves a portion of the cross section of the bone or may be longitudinal.
- **Closed (simple):** Skin not broken.
- **Open (compound):** Skin broken, leading directly to fracture:
  - **Grade I:** Minimal soft tissue injury.
  - **Grade II:** Laceration greater than one cm without extensive soft tissue flaps.
  - **Grade III:** Extensive soft tissue injury, including skin, muscle, neurovascular structure, with crush injuries.
- **Pathologic:** Through an area of diseased bone (osteoporosis, bone cyst, bone tumor, bony metastasis).

Patterns of Fracture

- **Greenstick:** One side of the bone is broken and the other side is bent.
- **Transverse:** Straight across the bone.
- **Oblique:** At an angle across the bone.
- **Spiral:** Twists around the shaft of the bone.
- **Comminuted:** Bone splintered into more than three fragments.
- **Depressed:** Fragments are driven inward (seen in fractures of the skull and facial bones).
- **Compression:** Bone collapses in on itself (seen in vertebral fractures).
- **Avulsion:** Fragment of bone pulled off by an attached ligament or tendon.
- **Impacted:** Fragment of bone wedged into other bone fragments.
- **Fracture-dislocation:** Fracture complicated by the bone being out of the joint.
- **Other:** Described according to anatomic location; epiphyseal (end of large bones containing growth plate), supracondylar (above the articular prominence of a bone), midshaft, or intra-articular.

Physical Findings

- Pain at injury site.
- Swelling.
- Tenderness.
- False motion and crepitus (grating sensation).
- Deformity.
- Loss of function.
- Ecchymosis.
- Paresthesia.

Altered Neurovascular Status

- Injured muscle, blood vessels, and nerves.
- Compression of structures resulting in ischemia.
- Findings:
  - Progressive uncontrollable pain.
  - Pain on passive movement.
  - Altered sensations (paresthesia).
  - Loss of active motion.
  - Diminished capillary refill response or diminished distal pulse.
  - Pallor.

Shock

- Bone is very vascular.
- Overt hemorrhage through an open wound.
- Covert hemorrhage into soft tissues (especially with femoral fracture) or body cavity, as with pelvic fracture.
- May be fatal if not detected.

Diagnostic Evaluation

- X-ray and other imaging studies to determine bone integrity.
- Blood studies (complete blood count (CBC), electrolytes) with blood loss and extensive muscle damage; may show a decreased hemoglobin level and hematocrit.
- Arthroscopy to detect joint involvement.
- Angiography if associated with blood vessel injury.
- Nerve conduction and electromyogram studies to detect nerve injury.

Management

Emergency management

Principles of Management:

- Factors influencing choice of management include:
  - Type, location, and severity of the fracture.
  - Soft tissue damage.
  - Age and health status of the patient, including type and extent of other injuries.
- Goals include:
  - To regain and maintain correct position and alignment.
  - To regain the function of the involved part.
  - To return the patient to usual activities in the shortest time and at the least expense.
- The management process is a three-step process:
  - Reduction: setting the bone; refers to restoration of the fracture fragments into anatomic position and alignment.
  - Immobilization: maintains reduction until bone healing occurs.
  - Rehabilitation: regaining normal function of the affected part.

Approaches to Management

- Closed reduction.
- Traction.
- Open reduction with internal fixation (ORIF).
- Endoprosthetic replacement.
- External fixation device.

Table 9: Fractures of Specific Sites

Site and Mechanism	Management	Nursing Considerations
Clavicle		
Fall on the shoulder	• Closed reduction and immobilization with clavicular strap (figure-eight bandage), or sling. • Open reduction with internal fixation (ORIF) for marked displacement, severely comminuted fracture, and extensive soft tissue injury.	• Pad axilla to prevent nerve damage from pressure of the immobilizer. • Assess neurovascular status of the arm. ▪ Teach the patient exercises for the elbow, wrist, and fingers. • Teach shoulder exercises through a full range of motion (ROM) as prescribed.
Proximal humerus		
Fall on outstretched arm; osteoporosis is predisposing factor.	• Many remain in alignment and are supported by a sling and swathe or Velpeau bandage for comfort. • If displaced, treated with reduction under X-ray control, open reduction, or replacement of humeral head with a prosthesis.	• Place a soft pad under the axilla to prevent skin maceration. Encourage shoulder ROM exercises after specified period of immobilization to prevent frozen shoulder. • Instruct the patient to lean forward and allow the affected arm to abduct and rotate.
Shaft of humerus		
Direct fall, blow to arm, or auto injury. Damage to radial nerve may occur.	• Immobilize with a sling and swathe, splint, or hanging cast. A hanging cast is applied for its weight to correct displaced fractures with shortening of the humeral shaft.	• The hanging cast must remain unsupported to maintain traction. Teach the patient to avoid supporting their elbow in their lap or arm on a pillow.

	• ORIF for associated vascular injury or pathologic fracture, followed by support in a sling.	▪ The patient should sleep in upright position to maintain 24-hour traction. • Encourage the patient to exercise their fingers immediately after cast application. • Teach pendulum exercises of arm, as prescribed, to prevent a frozen shoulder.
Elbow and forearm		
Fall on the elbow, outstretched hand, or direct blow (sideswipe injury).	• Treatment depends on specific characteristics of fracture—ORIF, arthroplasty, external fixation, or casting. • A closed drainage system may be used to decrease hematoma formation and swelling.	• Assess the neurovascular status of the forearm and hand. If radial pulse weakens or disappears, report finding immediately to prevent irreversible ischemia. • Elevate arm to control edema. • Encourage finger and shoulder exercises.
Wrist		
Colles' fracture is common (½ to 1 inch [1.2 to 2.5 cm] above the wrist with dorsal displacement of lower fragment); caused by fall on outstretched palm; commonly associated with osteoporosis.	• Closed reduction with splint or cast support. • Percutaneous pins and external fixator or plaster cast.	• Elevate the arm above the level of the heart for 48 hours after reduction to promote venous and lymphatic return and reduce swelling. Watch for swelling of the fingers and check for constricting bandages or cast. • Teach finger exercises to reduce swelling and stiffness.

		▪ Hold the hand above the level of the heart. ▪ Move fingers from full extension to flexion. ▪ Hold and release. ▪ Repeat at least 10 times every half hour, when awake, for as long as the swelling persists. • Encourage daily-prescribed exercises to restore full extension and supination.
Hand		
Caused by numerous injuries	• Splinting for undisplaced finger fractures. • Debridement, irrigation, and Kirchner wire fixation for open fractures. Reconstructive surgery may be necessary for complex injuries.	• Provide aggressive care and encouragement with rehabilitation plan to regain maximal function of the hand.
Hip (Proximal Femur)		
Occur frequently in older adults, women with osteoporosis, and with certain fall types. • Types: • Intracapsular—femoral neck within joint capsule. • Extra capsular—femoral neck between greater and lesser trochanter (intertrochanteric) or of femoral shaft. Subtrochanteric—of femur just below level of lesser trochanter.	• Hip fracture is identified by shortening and external rotation of affected leg; pain in the hip or knee; and the inability to move the affected leg. • Immobilization with Buck's extension traction should be performed, until surgery.Surgery as soon as medically stable; choice depends on location, character, and patient factors.	• Provide constant monitoring and nursing care to reduce the risk of complications, such as pneumonia, thrombo-phlebitis, fat emboli, dislocation of prosthesis, infection, and pressure sores. • Administer aspirin, warfarin, subcutaneous heparin, or low - molecular - weight heparin asordered.

	▪ Internal fixation with nail, nail-plate combination, multiple pins, screws, or sliding nails. ▪ Femoral prosthetic replacement. ▪ Total hip replacement.	Use sequential compression devices, as ordered. • Provide meticulous skin care to prevent breakdown. ▪ Use trapeze for the patient to assist with position changes. ▪ Use a special bed or mattress, as indicated. ▪ Inspect heels daily and use heel protection measures. • Prevent UTI by increasing fluids, limiting the use of indwelling catheters, and encouraging frequent voiding. Keep the affected leg in abduction and neutral rotation. Teach quadriceps setting exercises to prevent muscle atrophy of the affected leg.
Femoral Shaft		
	• Closed reduction and stabilization with skeletal traction. Thomas leg splint with Pearson attachment; followed by use of orthosis (cast-brace) to allow weight bearing. • Open reduction with hardware or with bone grafting may be necessary.External fixator may be used.	• Marked concealed blood loss may occur; watch for signs of shock initially and anemia later. • Examine the skin under the ring of the Thomas splint for signs of pressure.

Knee		
Direct blow to the knee area; may involve the distal shaft of femur (supracondylar), articular surfaces, or patella.	• Closed reduction and immobilization through casting, traction, braces, or splints. • ORIF The goal is to preserve knee mobility.	• Elevate the extremity by raising the foot gatch of the bed. Evaluate for effusion; report and loosen pressure dressings if pain is severe, and prepare for joint aspiration. • Teach quadriceps setting exercises and limited weight bearing, as prescribed.
Tibia and Fibula/Ankle		
Distal tibia or fibula, malleoli, or talus fractures generally result from forceful twisting of the ankle and commonly associated with ligament disruption. There is a high incidence of open fractures of the tibial shaft because the tibia lies superficially beneath the skin.	• Closed reduction and toe-to-groin cast for closed fractures, later replaced by short leg cast or orthosis. • ORIF may be necessary for some closed fractures. External fixator for open fractures.	• Elevate the lower leg to control edema. Avoid a dependent position of the extremity for prolonged periods. Prepare the patient for a long immobilization period, as union is slow (12-16 weeks, longer for open and comminuted fractures). • Prepare the patient for a stiff ankle joint following immobilization.
Foot Metatarsal fracture due to crush injuries of the foot.	• Immobilization with cast, splint, or strapping.	• Encourage partial weight bearing as allowed. • Elevate the foot to control edema.
Thoracic and Lumbar Spine		
Trauma from falls, contact sports, or auto accidents, or excessive loading may cause fracture of vertebral body, lamina, spinous and transverse processes; usually stable compression fractures	• Suspected with pain that is worsened by movement and coughing and radiates to extremities, abdomen, or intercostal muscles;	• Use log roll technique to change positions. Monitor bowel and bladder dysfunction, as paralytic ileus and bladder

	and presence of sensory and motor deficits • Bed rest on firm mattress and pain relief followed by progressive ambulation and back strengthening to treat stable fractures; takes about 6 weeks to heal • ORIF with Harrington rod, body cast, or laminectomy with spinal fusion may be necessary for unstable or displaced fractures	distention may occur with nerve root injury • Assist patient to ambulate when pain subsides, no neurologic deficit exists, and X-rays reveal no displacement Teach proper body mechanics and back preservation techniques Encourage weight reduction • Teach patient with osteoporosis the importance of safety measures to avoid falls
Pelvis		
Sacrum, Ilium, pubic, ischium, and coccyx fractures may occur from auto accidents, crush injuries, and falls. Most are stable fractures that do not involve the pelvic ring and have minimal displacement.	• Emergency management to treat multiple trauma, shock from intraperitoneal hemorrhage and injury to internal organs is necessary. • Bed rest for several days followed by progressive weight bearing for stable fractures. • Prolonged bed rest, external fixation, ORIF, skeletal traction, or pelvic sling are options for unstable fractures.	• Monitor and support vital functions, as indicated. ▪ Observe urine output for blood, indicating genitourinary injury. • Do not attempt to insert a urethral catheter until patency of urethra is known; incidence of urethral injury in males is high with anterior fractures. • Assist the patient being treated in pelvic sling. ▪ Fold sling back over buttocks to enable the patient to use the bedpan. ▪ Reach under the sling to give skin care; line the sling with sheepskin. ▪ Loosen sling only as directed.

Complications

Complications Associated with Immobility:

- Muscle atrophy: loss of muscle strength and endurance.
- Loss of ROM due to joint contracture.
- Pressure sores at bony prominences from immobilization device.
- Diminished respiratory, cardiovascular, and GI function; resulting in possible pooling of respiratory secretions, orthostatic hypotension, ileus, anorexia, and constipation.
- Psychosocial compromise resulting in feelings of isolation and depression.

Other Acute Complications:

- Venous stasis and thromboembolism, particularly with fractures of the hip and lower extremities.
- Neurovascular compromise.
- Infection, especially with open fractures.
- Shock due to significant hemorrhage related to trauma or as a postoperative complication.
- Pulmonary emboli.

Fat Emboli Syndrome

- Associated with embolization of marrow or tissue fat or platelets and free fatty acids to the pulmonary capillaries, producing rapid onset of symptoms.
- Clinical manifestations:
  - Respiratory distress: tachypnea, hypoxemia, crackles, wheezes, acute pulmonary edema, or interstitial pneumonitis.
  - Mental disturbances: irritability, restlessness, confusion, disorientation, stupor, coma due to systemic embolization, and severe hypoxia.
  - Fever.
  - Petechiae in buccal membranes: hard palate, conjunctival sacs, chest, or anterior axillary folds: due to occlusion of capillaries.

> ***NURSING ALERT***
> *Restlessness, confusion, irritability, and disorientation may be the first signs of fat embolism syndrome. Confirm hypoxia with arterial blood gas (ABG) analysis. Young adults (ages 20 to 30), and older adults (ages 60 to 70), with multiple fractures or fractures of long bones or pelvis, are particularly susceptible to development of fat emboli.*

Bone Union Problems

- Delayed union (takes longer to heal than average for a specific type of fracture).
- Nonunion (fractured bone fails to unite).
- Malunion (union occurs but is faulty—misaligned).

Nursing Assessment

- Ask the patient how the fracture occurred; the mechanism of injury is important in determining possible associated injuries.
- Ask the patient to describe the location, character, and intensity of the pain; helps to determine possible sources of discomfort.
- Ask the patient to describe their sensations in the injured extremity: to aid in evaluation of neurovascular status.
- Observe patient's ability to change position: to assess functional mobility.
- Note patient's emotional status and behavior: indicators of ability to cope with stress of injury.
- Assess patient's support system; identify current and potential sources of support, assistance, and care giving.
- Review findings on past and present health status: to aid in formulating care plan.
- Conduct physical examination:
  - Examine skin for lacerations, abrasions, Ecchymosis, edema, and temperature.
  - Auscultate lungs to establish a baseline assessment of their respiratory function.
  - Assess pulses and BP; assess peripheral tissue perfusion, especially in the injured extremity, to establish circulatory status baseline.
  - Determine neurologic status (sensations and movement) of the extremities distal to injury.
  - Note length, alignment, and immobilization of the injured extremity.
  - Evaluate behavior and cognitive functioning of the patient to determine their ability to participate in care planning and patient education activities.

> ***NURSING ALERT***
> *Change in patient’s behavior or cerebral functioning may be an early indicator of cerebral anoxia from shock, or pulmonary/fat emboli.*

Nursing Diagnoses

- Risk for deficient fluid volume related to hemorrhage and shock.
- Impaired gas exchange related to immobility and potential pulmonary emboli or fat emboli.
- Risk for peripheral neurovascular dysfunction.
- Risk for injury related to thromboembolism.
- Acute or chronic pain related to injury.

- Risk for infection related to open fracture or surgical intervention.
- Bathing or hygiene self-care deficit related to immobility.
- Impaired physical mobility related to injury/treatment modality.
- Risk for disuse syndrome related to injury and immobilization.
- Risk for post trauma syndrome related to the cause of injury.

Nursing Interventions

- Evaluate for hemorrhage and shock.
- Monitoring for impaired gas exchange.
- Preventing neurovascular compromise.
- Relieving pain.
- Monitoring for development of infection.
- Promoting \adequate hygiene.
- Promoting physical mobility.
- Preventing disuse syndrome.
- Minimizing the psychological effects of trauma.
- Community and home care considerations.
- Patient education and health maintenance.
- Evaluation: expected outcomes.

> ***NURSING ALERT***
> *Meperidine (Demerol) may cause toxicity as it breaks down into the metabolite normeperidine, which has a 15- to 20-hour half-life, especially in patients with impaired renal function or elderly patients.*

> ***NURSING ALERT***
> *Monitoring the neurovascular integrity of the injured extremity is essential. Development of compartment syndrome (increased tissue pressure causing hypoxemia) leads to permanent loss of function in 6 to 8 hours. This situation must be identified and managed promptly.*

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CHAPTER 11: DERMATOLOGIC DISORDERS

General Overview

Description of skin lesions

Dermatologic conditions are usually described by the types of lesions that appear on the skin, their shape, and configuration.

Primary Lesions

- ***Macule***—flat, circumscribed discoloration of skin; may have any size or shape.
- ***Papule***—solid, elevated lesion less than 1 cm wide.
- ***Nodule***—raised, solid lesion larger than 1 cm wide.
- ***Vesicle***—circumscribed elevated lesion less than 1 cm, containing fluid.
- ***Bulla***—a vesicle or blister larger than 1 cm wide.
- ***Pustule***—circumscribed raised lesion that contains pus; may form as a result of purulent changes in a vesicle.
- ***Wheal***—elevation of the skin that lasts less than 24 hours, caused by edema of the dermis; may be surrounded by erythema or blanching.
- ***Plaque***—solid, elevated lesion on the skin or mucous membrane, larger than 1 cm in diameter. Psoriasis is commonly manifested as plaques on the skin; leukoplakia is an example of plaques on mucous membranes.
- ***Cyst***—soft or firm mass in the skin, filled with semisolid or with liquid material contained in a sac.
- ***Petechiae***—circumscribed deposits of blood or blood pigment less than 1 cm wide.
- ***Purpura***—circumscribed deposits of blood or blood pigment greater than 1 cm wide.

Secondary Lesions

- ***Scale***—heaped-up, horny layer of dead epidermis; may develop as a result of inflammatory changes.
- ***Crust***—covering formed by the drying of serum, blood, or pus on the skin.
- ***Excoriation***—linear scratch marks or traumatized areas of skin.
- ***Fissure***—cracks in the skin, usually from marked drying and long-standing inflammation.
- ***Ulcer***—lesion formed by local destruction of the epidermis and by part or all of the underlying dermis.
- ***Lichenification***—thickening of skin accompanied by accentuation of skin markings.
- ***Scar***—new formation of connective tissue that replaces the loss of substance in the dermis as a result of injury or disease.
- ***Atrophy***—diminution in size or in loss of skin cells that causes thinning of the skin.

- ***Keloid*—**hypertrophic scar that is larger than the original lesion or injury.

Assessment

History

By obtaining a detailed history of a rash or other complaints related to dermatologic conditions, you will understand characteristics of the problem and their effects on the patient, which will help in care planning. A through historical evaluation should include the characteristics of the rash; associated factors, including alleviating or aggravating factors; and personal medical history (including medications).

Physical Examination

- Focus your examination on the skin, hair, and nails. Some dermatologic conditions affect other body systems; perform a general physical exam as indicated.
- Ask the patient to show you the area of concern and examine the skin surface under good lighting. You may have to examine the entire skin if the condition is generalized.
- Note the distribution and configuration of skin lesions. Compare right and left sides of the body.
- Note the shape, border, texture, and surface of the lesions.
- Palpate the lesions for texture, warmth, and tenderness.
- Use a metric ruler to determine size of the lesions, this serves as a baseline for comparison with subsequent measurements.
- Examine the scalp, nails, and oral mucosa.
- Perform diascopy—gently press a glass slide or Lucite rule over a skin lesion to detect blanching (caused by dilated blood vessels).
- Use a Wood's light to inspect for fluorescent changes with some fungal infections. Clean skin prior to examination because some ointments, soaps, or deodorant may fluoresce.
- For dark-skinned patients, look for black, purple, or gray lesions; palpate carefully to determine if a rash is present.

DRESSINGS FOR SKIN CONDITIONS

Open Wet Dressings

Indications

- Bacterial infections that require drainage.
- Inflammatory and pruritic conditions.
- Oozing and crusting conditions.

Nursing and Patient Care Considerations

- Apply dressings to the affected area, or teach the patient to apply and moisten (to the point of slight dripping) a dressing; remoisten as necessary.

- Use warm tap water if warming is desired.
- Application may be from 5 to15 minutes three to four times per day, unless otherwise indicated.
- Keep the patient warm and do not treat more than one-third of body at a time, because open wet dressings can cause chilling and hypothermia.
- Teach patients to prevent burns by measuring the temperature of dressing solution with a bath thermometer or by testing tap water on their wrist before applying a compress. Advise them not use microwave ovens to warm dressings, because uneven heating can occur.

Occlusive Dressing

An occlusive dressing is formed by an airtight plastic or vinyl film applied over medicated areas of skin (usually with corticosteroids) to enhance absorption of medication and to promote moisture retention.

Indications

- Skin conditions with thick scaling, such as psoriasis (on feet), eczema, and lichen simplex chronicus.

Nursing and Patient Care Considerations

- Wash area and pat the area dry.
- Apply medications while the skin is still moist.
- Cover with plastic wrap, vinyl gloves, or a plastic bag.
- Seal the occlusive devise with paper tape at the edges, or cover with other dressings, such as coban, to hold everything in place.
- Do not apply dressing occlusion to ulcerated or abraded skin; removal is recommended within 12 to 24 hours. High-potency steroids are for short-term use only.

> ***DRUG ALERT***
> *Excessive use of occlusive dressings that contain corticosteroids may cause skin atrophy, striae, telangiectasia, folliculitis, nonhealing ulceration, erythema, and systemic absorption of corticosteroids.*

Nursing and Patient Care Considerations

- Apply a dry gauze dressing using clean technique (sterile technique is indicated for open wounds).
- Wrap extremities with elastic or cotton-rolled bandages, or apply tape.
- Alternative dressing materials can be used for home care; such as disposable or white cotton gloves for the hands, cotton socks for the feet; sheets or towels for large areas; disposable diapers or towels folded in a diaper fashion for the groin; washcloths for the axilla; cotton T-shirt or cotton pajamas for the trunk; turban or plastic shower cap for the scalp; or a mask made from gauze for the face, with holes cut for the eyes, mouth, and nose.

DERMATOLOGIC DISORDERS

Cellulitis

Cellulitis is a diffuse inflammation of the deep dermal and subcutaneous tissues that results from an infectious process.

Etiology

Caused by infection with group a beta-hemolytic streptococci, Staphylococcus aureus, Haemophilus influenza, or other organisms.

Usually results from a break in skin that may be as simple as athlete's foot.

Infection can spread rapidly through the lymphatic system.

> ***NURSING ALERT***
> *Methicillin-resistant S. aureus (MRSA) is a significant problem in the community. It is resistant to previously effective anti-staphylococcal antibiotics and may be fatal.*

Clinical Manifestations

- Tender, warm, erythematous, and swollen area that is poorly demarcated.
- Tender, warm, erythematous streak that extends proximally from the area, indicating lymph vessel involvement.
- Possible fluctuant abscess or purulent drainage.
- Possible fever, chills, headache, malaise.

Diagnostic Evaluation

- Gram stain and culture of drainage.
- Blood cultures.

NURSING ASSESSMENT

- Obtain history of skin trauma, needle stick, insect bite, or wound.
- Observe for expanding borders and lymphatic streaking; palpate for fluctuance of abscess formation.
- Watch for signs of antibiotic sensitivity—shortness of breath, urticaria, angioedema, maculopapular rash, or severe skin reaction, such as erythema multiforme or toxic epidermal necrolysis.
- Assess for patient and caretaker ability to provide care at home, keep affected area clean, and adhere to medication prescribed.

NURSING DIAGNOSES

- Risk for impaired skin integrity related to infectious process.
- Acute pain related to inflammation of subcutaneous tissue.

NURSING INTERVENTIONS

- Protecting Skin Integrity:
  - Administer, or teach patient to administer, antibiotics as prescribed; teach dosage schedule and adverse effects.
  - Maintain I.V. infusion or venous access to administer I.V. antibiotics, if indicated.
  - Elevate affected extremity to promote drainage from the area and reduce the swelling.
  - Prepare the patient for surgical drainage and debridement, if necessary.
- Relieving Pain:
  - Encourage the patient to assume a comfortable position; and immobilize of the affected area (if necessary).
  - Administer, or teach the patient to administer, analgesics as prescribed; monitor for adverse effects.
  - Use bed cradle to relieve pressure from overlying bed covers.

Patient Education and Health Maintenance

- Make sure that the patient understands the dosage schedule of antibiotics and the importance of complying with therapy to prevent complications.
- Advise patients to notify their health care providers immediately if condition worsens; hospitalization may be necessary.
- Outpatient-treated cellulitis should be observed within 48 hours of starting antibiotics to determine efficacy.
- Teach patients with impaired circulation or impaired sensation, highlighting how they should perform proper skin care and how to inspect skin for trauma.

Evaluation: Expected Outcomes

- Skin is normal color and temperature, nontender, nonswollen, and intact.
- Actively moves extremity; verbalizes no pain.

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CHAPTER 12: BURNS

Etiology

Burns are a form of traumatic injury caused by:

- Thermal.
- Electrical.
- Chemical.
- Radioactive agents.

Inhalation injury and associated pulmonary complications are a significant factor in mortality and morbidity from burn injury (50% to 60% of fire deaths are secondary to inhalation injury).

Classification

- **Partial-thickness burn injuries** involve the epidermis and upper portions of the dermis. Some of the dermal appendages remain, from which the wound can spontaneously reepithelialize.
- **Full-thickness injuries** all layers of the skin and sometimes underlying tissues are destroyed. At the core is the burn injury. There is then a zone of coagulation surrounded by a zone of stasis, surrounded by erythema very similar to a bull's eye pattern; the burn is the center. Grafting is usually required to close the wound.

Assessment and Diagnostic Evaluation

As with all trauma victims, a primary and secondary trauma survey should be performed. This assessment should include assessments of the patient’s airway, breathing, and circulation (ABC’s), as well as vital signs. Other assessment parameters can be performed that are specific to the burn injury; and should focus on the extent and severity of the burn and inhalation injury.

Severity of Burns

Severity of burns is determined by:

- **Depth:** first, second (partial-thickness), third degree (full thickness).

  Burn depth is directly related to the temperature of the burning agent and the duration of contact with body tissue:

  - **Below 44.4° C**, no local damage occurs unless exposure is for a protracted period.
  - **At 48.9° C,** it takes 5 minutes' exposure to create a full-thickness burn.
  - **At 51.7° C,** the time requirement is 2 minutes, and at (60° C) only 6 seconds required.
  - **At 70.6° C,** it takes 1 second to create a full-thickness burn in a healthy adult—less time or temperature in children or the elderly.

- **Extent:** percentage of Total Body Surface Area (TBSA).

  Extent of Body Surface Burned. Determination is based on the use of standardized

- Estimation tools, such as:

  - "Rule of nines"
  - Lund and Browder chart or the (rule of the palm). The patient's palm (including the fingers) is approximately 1% of the TBSA burned. The Lund and Browder chart is the most accurate. Calculation of the percentage of TBSA burned serves as a guide for fluid therapy. Full fluid resuscitation is necessary for partial- or full-thickness burns of 20% TBSA or greater.
  - Anatomic location: burns affecting hands, feet, face, and/or the perineum require specialized care.
  - Circumferential burns also require special attention, possibly escharotomy.
- **Age:** the very young and very old have a poor prognosis; the prognosis alters for adults after age 45.
- **Area of the body burned:** face, hands, feet, perineum, and circumferential burns require special care.
- **Medical history** including concomitant injuries and illness.

Restrictive pulmonary complications can occur because of the tourniquet effect of edema seen with circumferential chest burns. Lung compliance and alveolar gas exchange can also be decreased because of ARDS.

Table 10: Assessment of Burn Injury

Extent or Degree	Assessment Of Extent	Reparative Process
First Degree	• Pink to red; slight edema, which subsides quickly. • Pain may last up to 48 hours; relieved by cooling. • Sunburn is a typical example.	• In about 5 days, epidermis peels and the burn heals spontaneously. • Itching and pink skin persist for about 1 week. • No scarring. • If burn does not become infected, it • Heals spontaneously within 10-14 days.
Second Degree (Partial thickness)	**Superficial:** • Pink or red; blisters (vesicles) form; weeping, edematous, and elastic. • Superficial layers of skin are destroyed; wound moist and painful. • Hair does not pull out easily.	• Takes several weeks to heal. Scarring may occur.

	Deep dermal: • Mottled white and red; edematous reddened areas that blanch on pressure. • May be yellowish but soft and elastic—may or may not be sensitive to touch; sensitive to cold air. • Hair pulls out easily.	• Takes several weeks to heal. • Scarring may occur.
Third Degree (Full thickness)	• Destruction of epithelial cells—epidermis and dermis destroyed. • Reddened areas do not blanch with pressure. • Not painful; inelastic; coloration varies from waxy white to brown; leathery devitalized tissue is called eschar. • Destruction of epithelium, fat, muscles, and bone.	• Eschar must be removed. • Granulation tissue forms to nearest epithelium from wound margins or support graft. For areas larger than 1¼ to 2 inches (3 to 5 cm), grafting is required. • Expect scarring and loss of skin function. Area requires debridement, formation of granulation tissue, and grafting.

Depth of Burn and Triage Criteria

- It may be difficult to differentiate between second- and third-degree wounds initially.
- If the areas appear wet and are particularly sensate, then a second-degree (partial-thickness) injury is likely.
- If the burn area is less painful or insensate, the hairs are easily pulled out, and the area appears dry and is firm to touch, then it is most likely a third degree (full-thickness) burn.
- Reassess daily for the first few days, because second-degree burns can convert or progress to a third-degree injury.

Burn Center Referral Criteria

- Partial-thickness burns of greater than 10% TBSA.
- Involvement of face, hands, feet, genitalia.
- Third-degree burns.
- Electrical burns.
- Chemical burns.
- Inhalation injury.
- Preexisting medical conditions that could complicate management.
- Concomitant trauma where the burn injury poses the greatest risk.

- Burned children, when initial treatment facilities lack qualified staff and equipment.
- Patients who require special social, emotional, or rehabilitative intervention.

INHALATION INJURY

- Inhalation injuries may be located in the upper airway (supraglottic), and may occur within minutes or hours. Inhalation injuries in the lower airways may cause acute respiratory distress syndrome (ARDS), which can occur in as little as 4 hours. Thermal injury can be seen in the lower airway with steam or drug activity, such as freebasing. ARDS is most simply described as pulmonary edema of noncardiac origin. It may also be seen in children.
- Carbon monoxide is a colorless, odorless, tasteless, nonirritating gas produced from incomplete combustion of carbon-containing materials.
- Affinity of hemoglobin for carbon monoxide is **200 times** greater than for oxygen.
- Toxicity depends on:
  - The concentration of carbon monoxide in the inspired air.
  - The amount (time) of exposure.

Table 11: Signs and Symptoms of Toxicity from Carbon Monoxide

Co Blood Level	Manifestations
0%-10%	• None. • Smokers may have 10% carbon monoxide level or greater.
10%-20%	• Headache, vision disturbance, angina in patients with cardiovascular disease, and slowed mental function.
20%-40%	• Tight feeling in head, rapid fatigue from muscular effort, decreased muscular coordination, confusion, irritability, ataxia, nausea, vomiting, increased pulse rate, decreased blood pressure, and dysrhythmias.
40%-60%	• Pulmonary and cardiac dysfunction, collapse, coma, and convulsions.
60%	• Commonly fatal.

- **Sulfur dioxide** and **nitrous oxide** are toxic agents inhaled in soot. In the presence of water, they form corrosive acids and alkalis that are extremely toxic.
- Toxic fumes from burning plastic are more dangerous than smoke.
- Noxious gases include hydrogen cyanide, hydrochloric acid, sulfuric acid, halogens, and perhaps phosgene.

Assessment for Inhalation Injury

- The provider should have a high index of suspicion for a inhalation injury, if the burn victim was burned in a closed area.

- Evaluate all patients in closed-space fires for symptoms of carbon monoxide poisoning, which include: headache, visual changes, confusion, irritability, decreased judgment, nausea, ataxia, and collapse.
- Question the patient about types of objects that were burning, including: type of carpet, vinyl articles, and synthetics.
- With the increasing use of synthetics, toxicity from aldehydes, cyanide, and other substances is increasing and must be considered.
- Observe for upper body burns erythema or blistering of lips, buccal mucosa or pharynx, singed nasal hair, soot in oropharynx, dark gray or black sputum.
- Listen for hoarseness and crackles. Increasing hoarseness, stridor, and drooling are indicators of increasing need for intubation.
- Obtain arterial blood gases (ABGs), carboxyhemoglobin levels, and spirometry.
- Direct visualization of the vocal cords may be necessary. Further visualization may be accomplished through bronchoscopy, if necessary.
- A chest X-ray should be obtained as a baseline.

TREATMENT

Management of the acute burn injury includes homodynamic stabilization, metabolic support, and wound debridement. Burn treatment utilizes topical antibacterial therapy, biologic dressings, and finally wound closure. Prevention and treatment of complications (including infection and pulmonary damage), and rehabilitation are also of major importance. The patient will also require physical and occupational therapy, psychiatric, and nutritional support.

NURSING MANAGEMENT OF THE BURN PATIENT

Nursing Assessment

Obtain a thorough history, including:

- Causative agent—hot water, chemical, gasoline, flame, tar, radiation PUVA light, etc.
- Duration of exposure.
- Circumstances of injury, including whether the burn occurred in a closed or open space, accidental or intentional, or self-inflicted.
- Age.
- Initial treatment, including first aid, emergency care (including fluids, intubation, etc.), or care rendered in another facility (emergency department, etc.).
- Pre-existing medical problems, such as heart disease, human immunodeficiency virus, drug abuse, diabetes, ulcers, alcoholism, chronic obstructive pulmonary disease (COPD), epilepsy, psychosis, hepatitis B, C, or D.
- Current medications.
- Concomitant injuries (e.g., from fall, explosions, assaults).

- Evidence of inhalation injury.
- Allergies.
- Tetanus immunization status.
- Height and weight.
- Perform ongoing assessment of the patient's hemodynamic and respiratory status, condition of wounds, and signs of infection.

Nursing Diagnoses

- Impaired gas exchange related to inhalation injury.
- Ineffective breathing pattern related to circumferential chest burn, upper airway obstruction, or ARDS.
- Decreased cardiac output related to fluid shifts and hypovolemic shock.
- Ineffective tissue perfusion: Peripheral related to edema and circumferential burns.
- Risk for imbalanced fluid volume related to fluid resuscitation and subsequent mobilization (3 to 5 days post burn).
- Impaired skin integrity related to burn injury and surgical interventions (donor sites).
- Impaired urinary elimination related to indwelling catheter.
- Ineffective thermoregulation related to loss of skin microcirculatory regulation and hypothalamic response.
- Risk for infection related to loss of skin barrier and altered immune response.
- Impaired physical mobility related to edema, pain, skin and joint contractures.
- Imbalanced nutrition: less than body requirements, related to hyper metabolic response to the burn injury.
- Risk for injury related to decreased gastric motility and stress response.
- Acute pain related to injured nerves in burn wound and skin tightness.
- Ineffective coping related to fear and anxiety.
- Disturbed body image related to cosmetic and functional sequelae of burn wound.

Nursing Interventions

Achieving Adequate Oxygenation and Respiratory Function

- Provide humidified 100% oxygen until carbon monoxide level is known. (Caution: Adjust oxygen flow rate for patient with COPD as prescribed). If the patient is stable, try to get the initial ABG on room air.
- Assess for signs of hypoxemia (anxiousness, tachypnea, tachycardia), and differentiate this from pain.
- Suspect respiratory injury if burn occurred in an enclosed space.

- Observe for and report erythema or blistering of buccal mucosa; singed nasal hairs; burns of lips, face, or neck; increasing hoarseness.
- Monitor respiratory rate, depth, rhythm, and cough.
- Auscultate chest and note breath sounds.
- Note character and amount of respiratory secretions. Report carbonaceous sputum, or the presence of tracheal tissue.
- Observe for signs of inadequate ventilation and begin serial monitoring of ABG levels and oxygen saturation.
- Provide mechanical ventilation, continuous positive airway pressure, or positive end-expiratory pressure if requested.
- Keep intubation equipment nearby, and be alert for signs of respiratory obstruction.

  In mild inhalation injury:
- Provide humidification of inspired air.
- Encourage coughing and deep breathing.
- Promote clearance of secretions through chest physical therapy.

In moderate to severe inhalation injury:

- Initiate more frequent bronchial suctioning.
- Closely monitor vital signs, urine output, and ABG levels.
- Administer bronchodilator treatments as ordered.
- For additional respiratory problems, it may be necessary to intubate the patient and place them on mechanical ventilation.

Maintaining Adequate Tidal Volume and Unrestricted Chest Movement

- Observe rate and quality of breathing; report if respiratory distress as indicated by progressively rapid and/or shallow breathing.
- Assess tidal volume; report decreasing volume to health care provider.
- Encourage deep breathing and incentive spirometry (may use sigh control on ventilator as needed).
- Place patient in semi-Fowler's position to permit maximal chest excursions, if there are no contraindications such as hypotension or trauma.
- Make sure that chest dressings are not constricting.
- Prepare the patient for escharotomy and assist as indicated.

Supporting Cardiac Output

- Position the patient to increase venous return.
- Give fluids as prescribed.
- Monitor vital signs hourly, including apical pulse, respirations, central venous pressure, pulmonary artery pressures, and urine output.

- Determine cardiac output as requested.
- Monitor sensorium.
- Document all observations, and particularly note trends in vital sign changes.

Promoting Peripheral Circulation

- Remove all jewelry and clothing.
- Elevate extremities.
- Monitor peripheral pulses hourly. Use Doppler as necessary.
- Prepare the patient for escharotomy if circulation is impaired.
- Monitor tissue pressure.

Facilitating Fluid Balance

- Titrate fluid intake as tolerated. The initial resuscitation formula is only a base.
- Maintain accurate intake and output records.
- Weigh the patient daily.
- Monitor results of serum potassium and other electrolytes.
- Be alert to signs of fluid overload and heart failure, especially during initial fluid resuscitation and immediately afterward, when fluid mobilization is occurring.
- Administer diuretics as ordered.

Protecting and Reestablishing Skin Integrity

- Cleanse wounds and change dressings twice daily. Use an antimicrobial solution or mild soap and water. Dry gently. This may be done in the hydrotherapy tank, bathtub, shower, or at the bedside.
- Perform debridement of dead tissue at this time. May use gauze, scissors, or forceps as appropriate. Try to limit debridement time to 20 to 30 minutes depending on the patient's tolerance. Additional analgesia may be necessary.
- Apply topical bacteriostatic agents as directed. Cream or ointment is applied 1/8-inch (3-mm) thick.
- Dress wounds, as appropriate; using conventional burn pads, gauze rolls, or any combination. Dressings may be held in place, as necessary, with gauze rolls or netting.
- For grafted areas, use extreme caution in removing dressings; observe for and report serous or sanguineous blebs or purulent drainage. Redress grafted areas according to facility protocol.
- Observe all wounds daily and document wound status on the patient's record.
- Promote healing of donor sites by:
  - Preventing contamination of donor sites that are clean wounds.
  - Opening to air for drying postoperatively, if gauze or impregnated gauze dressing is used. If exudate occurs after the first 24 hours, swab the area for culture and apply an antimicrobial topical cream. If the culture is positive, treatment will be in accord with sensitivities.

- o Following health care provider's or manufacturer's instructions for care of sites dressed with synthetic materials.
- o Allowing dressing to peel off spontaneously.
- o Cleanse healing donor sites with mild soap and water when dressings are removed; lubricating site(s) twice daily and as needed.

Preventing Urinary Infection

- Maintain closed urinary drainage system and ensure patency. Use a catheter impregnated with an antimicrobial agent whenever possible.
- Frequently observe color, clarity, and amount of urine.
- Empty drainage bag frequently.
- Provide catheter care by washing the catheter with soap and water.
- Encourage removal of catheter and use of urinal, bedpan, or commode as soon as frequent urine output determinations are not required.

Promoting Stable Body Temperature

- Be efficient in care; do not expose wounds unnecessarily.
- Maintain warm ambient temperatures.
- Use radiant warmers, warming blankets, or adjustment of the bed temperature to keep the patient warm.
- Obtain urine, sputum, and blood cultures for temperatures above (38.9° C) rectally (core temperature), or if chills are present.
- Provide a dry top layer for wet dressings to reduce evaporative heat loss.
- Warm wound cleansing and dressing solutions to body temperature.
- Use blankets when transporting patients to other areas of the hospital.
- Administer antipyretics as prescribed.

Avoiding Wound and Systemic Infection

- Wash hands with a antibacterial cleansing agent before and after all patient contact.
- Use barrier garments—isolation gown or plastic apron—for all care requiring contact with the patient or the patient's bed.
- Cover hair and wear a mask when wounds are exposed or when performing a sterile procedure.
- Use sterile examination gloves for all dressing changes, and for all care involving patient contact.
- Maintain proper concentration of topical antibacterial agents used in wound care.
- Be alert for reservoirs of infection and sources of cross contamination in equipment; monitor trends in infection based on the assignment of personnel.
- Check history of tetanus immunization and provide passive or active tetanus prophylaxis as prescribed.

- Change I.V. tubing and lines according to Centers for Disease Control and Prevention recommendations.
- Administer antibiotics, as prescribed, and be alert for toxic effects and incompatibilities.
- Assess wounds daily for local signs of infection—swelling and redness around wound edges, purulent drainage, discoloration, loss of grafts.
- Be alert for early signs of septicemia; including changes in mentation, tachypnea, and decreased peristalsis as well as later signs; such as increased pulse, decreased blood pressure (BP), increased or decreased urine output, facial flushing, increased and later decreased temperatures, increasing hyperglycemia, and malaise. Report changes to the health care provider promptly.
- Promote optimal personal hygiene for the patient, including daily cleansing of unburned areas, meticulous care of teeth and mouth, shampooing of hair every other day, shaving of hair in or near burned areas, and meticulous care of I.V. and urinary catheter sites.
- Inspect skin carefully for signs of pressure and breakdown.
- Observe for and report signs of thrombophlebitis or catheter-induced infections.
- Prevent atelectasis and pneumonia through chest physical therapy, postural drainage, meticulous pulmonary technique, and, if indicated, tracheostomy care.

> ***NURSING ALERT***
> *Although pseudomonas has been and continues to be a danger to the burn patient, hospital-acquired MRSA is now another serious threat. Staple antibiotics, such as vancomycin and gentamycin, are not effective. Now, linezolid, clindamycin, sulfamethoxazole-trimethoprim, and even mupirocin ointment are being used to combat MSRA—not only in the hospital setting, but in most burn clinics as well.*

Generally:

- **Burns less than 10%** TBSA, a well-balanced diet with high protein intake is necessary.
- **Burns 10% - 20%** TBSA, a high-protein, high-calorie diet is ordered.
- **Burns 20% - 30%** TBSA, supplementary enteral nutrition is necessary.
- **Burns 30% - 40%** TBSA, TPN may be implemented. When the patient is ready for oral fluids, observe tolerance. If there are no problems, advance the diet as tolerated.
- Provide nasogastric (NG) tube feedings, as prescribed, using caution to prevent aspiration by checking tube placement before each feeding and checking the amount of gastric aspirate.
- Administer I.V. hyper alimentation and fat emulsions as prescribed, utilizing usual nursing precautions.
- Keep a record of caloric intake.
- Encourage the patient to feed themselves.
- Supplement meals with between-meal high-protein, high-calorie snacks, such as milkshakes or foods brought from home according to patient's preference.

Preventing Paralytic Ileus and Stress Ulcer

- Keep the patient on NPO status until bowel sounds resume.
- Assess bowel sounds every 2 to 4 hours while acutely ill (decreased peristalsis may be an early sign of septicemia).
- Decompress stomach with an NG tube on low intermittent suction until bowel sounds resume.
- Recent practice now encourages small amounts of tube feedings, 5 to 10 mL/hour, immediately following the initial injury to help preserve the function of the gut and prevent paralytic ileus or stress ulcer.
- Check the amount and pH of gastric drainage or aspirate and report changes.
- Administer histamine-2 blockers and antacids as prescribed. This will help prevent or diminish the occurrence of stress (Curling's) ulcers.
- Heed complaints of nausea while intubated by checking for abdominal distention, tube placement, and residual aspirate.
- Provide mouth care every 4 hours while intubated.
- Test stools for occult bleeding.

Reducing Pain

- Assess for pain periodically; do not wait for complaints of pain to intervene. Common opioids used include morphine, fentanyl, hydromorphone, propofol, oral agents such as oxycodone, and long-acting continuous-release oral agents. These can be enterally or orally administered by I.V. drip, patient-controlled analgesia (PCA).
- Determine previous experience with pain, the patient's response, and coping mechanisms.
- Offer analgesics before wound care or before particularly painful treatments. Analgesia given orally should be administered 30 to 45 minutes before the procedure. Ketamine I.V. is now more commonly used than before. It is also becoming more popular to use conscious sedation for dressing changes.
- Change the patient's position when possible, supporting extremities with pillows.
- Reduce anxiety by utilizing sensory-oriented explanations of procedures.
- Teach relaxation techniques, such as imagery, breathing exercises, and progressive muscle relaxation, to help the patient cope with pain.
- Allow the patient to make choices regarding care whenever possible, thus allowing some measure of input and control in care.

  Greater emphasis is now focusing on pain management both from an inpatient and an outpatient perspective. Mid-range analgesics are often used rather than just morphine. Medication dosages are being increased if the patient is on a ventilator. It is not always possible to make a conscious patient completely pain-free, but increased comfort is the goal.

> ***NURSING ALERT***
> *Check with your state board of nursing and facility policy to determine requirements for administering conscious sedation. Requirements may dictate that an anesthesiologist be in attendance or that the nurse be trained in intubation and airway management.*

Evaluation: Expected Outcomes

- Carboxyhemoglobin below 10.
- ABG levels within normal limits.
- Respiratory rate between 12 - 28 breaths/minute.
- Tidal volume within normal limits.
- Pulse 110 to 120 mm Hg or below, BP stable.
- Peripheral pulses strong.
- Weight stable, no edema, lungs clear.
- Wounds clean and granulating.
- Catheter patent, urine clear and quantity sufficient.
- Temperature normal to low-grade fever, no chills.
- No signs of infection.
- Normal ROM achieved and performing ADLs independently.
- Less than 5% weight loss from baseline.
- No gastric distention, aspirate and stool Hemoccult negative.

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CHAPTER 13: PROCEDURE GUIDELINES

PROCEDURE 1: ASSISTING WITH ARTERIAL PUNCTURE FOR BLOOD GAS ANALYSIS

Equipment

- Commercially available blood gas kit, or:
  - 2- or 3-mL syringe.
  - 23G or 25G needle.
  - 0.5 mL sodium heparin (1:1,000).
  - Stopper or cap.
  - Xylocaine.
  - Sterile antiseptic solution.
  - Cup or plastic bag with crushed ice.
  - Gloves.
  - Goggles.
  - Draw sheet.
  - Roll towel.

	Nursing Action		Rationale
Preparatory phase			
1.	Record the patient's inspired oxygen concentration.	1.	Changes in inspired oxygen concentration alter the change in PaO_2. Degrees of hypoxemia cannot be assessed without knowing the inspired oxygen concentration.
2.	Take the patient's temperature.	2.	May be considered when results are evaluated. Hyperthermia and hypothermia influence oxygen release from hemoglobin.
If not using a commercially available blood gas kit			
3.	Heparinize the 2-mL syringe.	3.	
	a. Withdraw heparin into the syringe to wet the plunger and fill dead space in the needle.		a. This action coats the interior of the syringe with heparin to prevent blood from clotting.
	b. Hold syringe in an upright position and expel excess heparin and air bubbles.		b. Air in the syringe may affect measurement of PaO_2; heparin in

Nursing Action			Rationale		
					the syringe may affect measurement of the pH. Heparin left in the syringe can decrease the pH.
Performance phase (By physician, or by nurse or respiratory therapist with special instruction)					
1.	Verify correct patient; perform hand hygiene.				
2.	Put on gloves and goggles.				
3.	Palpate the radial, brachial, or femoral artery.		3.	The radial artery of the nondominant side is the preferred site of puncture, but is contraindicated if a fistula or shunt for dialysis exists. Arterial puncture is performed on areas where a good pulse is palpable.	
4.	If puncturing the radial artery, perform the **Allen test.**		4.	The **Allen test** is a simple method for assessing collateral circulation in the hand. Ensures circulation if radial artery thrombosis occurs (post procedure).	
In the conscious patient					
	a.	Obliterate the radial and ulnar pulses simultaneously by pressing on both blood vessels at the wrist.		a.	Impedes arterial blood flow into the hand.
	b.	Ask the patient to clench and unclench his fist until blanching of the skin occurs.		b.	Forces blood from the hand.
	c.	Release pressure on ulnar artery (while still compressing radial artery). Watch for return of skin color within 15 seconds.		c.	Documents that the ulnar artery alone is capable of supplying blood to the hand, because radial artery is still occluded.
Note: If the ulnar does not have sufficient blood flow to supply the entire hand, the radial artery should not be used.					
In the unconscious patient					
	a.	Obliterate the radial and ulnar pulses simultaneously at the wrist.			
	b.	Elevate the patient's hand above the heart and squeeze or compress his hand until blanching occurs.			
	c.	Lower the patient's hand while still compressing the radial artery (release pressure on ulnar artery) and watch for the return of skin color.			
5.	For the radial site, turn palm up and mildly hyperextend the wrist, placing a small towel roll under the patient's wrist.		5.	To make the artery more accessible.	

Nursing Action		Rationale	
6.	Feel along the course of the radial artery and palpate for maximum pulsation with the middle and index fingers. Prepare the skin with germicide; allowing it to dry completely. The skin and subcutaneous tissues may be infiltrated with a local anesthetic agent (Xylocaine).	6.	The wrist should be stabilized to allow for better control of the needle.
7.	The needle is introduced at a 45- to 60-degree angle to the skin surface and is advanced into the artery. Once the artery is punctured, arterial pressure will push up the hub of the syringe and a pulsating flow of blood will fill the syringe.	7.	The arterial pressure will cause the syringe to be filled within a few seconds; about 2 mL will accumulate and the flow into the syringe will stop.
Technique of arterial puncture for blood gas analysis			
8.	After blood is obtained, withdraw the needle and apply firm pressure over the puncture with a dry sponge.	8.	Significant bleeding can occur because of pressure in the artery.
9.	Remove air bubbles from syringe and needle. Use safety syringe system for closure.	9.	Proper closure of the needle prevents room air from mixing with the blood specimen.
10.	Place the capped syringe in the container of ice. Label as per facility policy.	10.	Icing the syringe will prevent a clinically significant loss of oxygen.
11.	Maintain firm pressure on the puncture site for 5 minutes. If the patient is on anticoagulant medication, apply direct pressure over puncture site for 10 to 15 minutes and then apply a firm pressure dressing.	11.	Firm pressure on the puncture site prevents further bleeding and hematoma formation.
12.	For patients requiring serial monitoring of arterial blood, an arterial catheter (connected to a flush solution of heparinized saline) is inserted into the radial or femoral artery.	12.	All connections must be tight to avoid disconnection and rapid blood loss. The arterial line also allows for direct blood pressure (BP) monitoring in the critically ill patient.
Follow-up phase			
1.	Send the labeled, iced specimen to the laboratory immediately.	1.	Blood gas analysis should be done as soon as possible because PaO_2 and pH can change rapidly.
2.	Palpate the pulse (distal to the puncture site), inspect the puncture site, and assess for a cold hand, numbness, tingling, or discoloration.	2.	Hematoma and arterial thrombosis are complications following this procedure.

Nursing Action		Rationale	
3.	Change the ventilator settings, inspired oxygen concentration or type and setting of respiratory therapy equipment if indicated by the results.	3.	The PaO_2 results will determine whether to maintain, increase, or decrease the FiO_2. The PaO_2 and pH results will detect if any changes are needed in tidal volume or rate of patient's ventilator.

PROCEDURE 2: ASSISTING THE PATIENT UNDERGOING THORACENTESIS

Equipment

- Thoracentesis tray (if available), or:
  - Syringes: 5-, 20-, 50-mL.
  - Needles: 22G, 26G, or 16G (3 inches long).
  - Three-way stopcock and tubing.
  - Hemostat (Artery forceps).
  - Biopsy needle.
  - Antiseptic solution.
  - Local anesthetic (such as Xylocaine 1%).
  - Sterile gauze pads (4″ × 4″ and 2″ × 2″).
  - Sterile towels and drape.
  - Sterile specimen containers.
  - Sterile gloves.
  - Overhead table and chair.

	Nursing Action		Rationale
	Preparatory phase		
1.	Determine in advance if a chest X-ray or other tests have been prescribed and completed. These should be available at the bedside.	1.	Localization of pleural fluid is accomplished by physical examination, chest X-ray, ultrasound localization, or fluoroscopic localization.
	Technique of thoracentesis		
2.	Check if the consent form has been explained and signed.	2.	Invasive procedures require the patient’s documented informed consent.
3.	Determine if the patient is allergic to the local anesthetic agent. Give sedation if prescribed.		
4.	Inform the patient about the procedure and indicate how the patient can be helpful. Explain:	4.	An explanation helps orient the patient to the procedure, assists with coping, and provides an opportunity to ask questions and verbalize anxiety.
	a. The nature of the procedure.		
	b. The importance of remaining immobile and of not talking or coughing.		
	c. Pressure sensations to be experienced.		

Nursing Action		Rationale	
	d. That no discomfort is anticipated after the procedure.		
5.	Assist the patient to obtain a comfortable position with adequate supports. If possible, place the patient upright and help the patient maintain this position during the procedure.	5.	The upright position ensures that the diaphragm is most dependent and facilitates the removal of fluid that usually localizes at the base of the chest. A comfortable position helps the patient to relax.
Positioning the patient for a thoracentesis. The nurse assists the patient to one of three positions and offers comfort and support throughout the procedure. ***(A)*** *Sitting on the edge of the bed with head and arms on and over the bed table. (B) Straddling a chair with arms and head resting on the back of the chair. (C) Lying on unaffected side with the bed elevated 30 to 45 degrees.*			
6.	Support and reassure the patient during the procedure.	6.	Sudden and unexpected movement by the patient can cause trauma to the visceral pleura with resultant trauma to the lung. A local anesthetic inhibits nerve conduction and is used to prevent pain during the procedure.
	a. Prepare the patient for sensations of cold from skin germicide and for pressure and sting from infiltration of local anesthetic agent.		
	b. Encourage the patient to refrain from coughing, talking, or moving.		
	c. Be prepared to monitor the patient's condition throughout the procedure.		
	Performance phase		
1.	Expose the site to be aspirated. If fluid is in the pleural cavity, the thoracentesis site is determined by the chest X-ray and physical findings, with attention to the site of maximal dullness on percussion. If air is in the pleural cavity, the thoracentesis site is usually in the second or third intercostal space in the midclavicular line.	1.	Fluid usually settles in the lower pleural cavity Air raises in the thorax because the density of air is much less than the density of liquid.
2.	Perform hand hygiene and put on personal protective equipment.	2.	To protect the patient and nurse.
3.	The procedure is done under aseptic conditions. After the skin is cleaned, the health care provider slowly injects a local anesthetic with a small-gauge needle into the intercostal space.	3.	An intradermal wheal is raised slowly; rapid intradermal injection causes pain. The parietal pleura are very sensitive and should be well infiltrated with anesthetic before the thoracentesis needle is passed through it.

	Nursing Action		Rationale
4.	Ultrasound or direct physical examination is used to guide needle placement.	4.	To prevent pneumothorax.
5.	The thoracentesis needle is advanced with the syringe attached. When the pleural space is reached, suction may be applied with the syringe.		
	a. A 20-mL or 50-mL syringe with a three-way adapter (stopcock) is attached to the needle. (One end of the adapter is attached to the needle and the other to the tubing leading to a receptacle that receives the fluid being aspirated.)	a.	When a larger quantity of fluid is withdrawn, a three-way adapter serves to keep air from entering the pleural cavity. The amount of fluid removed depends on clinical status of the patient and absence of complications during the procedure.
	b. If a considerable quantity of fluid is to be removed, the needle is held in place on the chest wall with a small hemostat.	b.	The hemostat steadies the needle on the chest wall and prevents too deep a penetration of pleural space. Sudden pleuritic pain or shoulder pain may indicate that the visceral or diaphragmatic pleura are being irritated by the needle point.
	c. A pleural biopsy may be performed.		
6.	After the needle is withdrawn, pressure is applied over the puncture site and a small sterile dressing is fixed in place.	6.	This is done to prevent air entry into pleural space.
	Follow-up phase		
1.	Place the patient on bed rest. A chest X-ray is usually obtained after thoracentesis.	1.	Chest X-ray verifies that there is no pneumothorax.
2.	Record vital signs every 15 minutes for 1 hour.	2.	To assess for complications.
3.	Administer oxygen, as directed, if the patient has cardio respiratory disease.	3.	Pulmonary gas exchange may worsen after thoracentesis in patients with cardio respiratory disease.
4.	Record the total amount of fluid withdrawn and the nature of the fluid, its color, and viscosity. If prescribed, prepare samples of fluid for laboratory evaluation (usually bacteriology, cell count and differential, determinations of protein,	4.	The fluid may be clear, serous, bloody, or purulent.

Nursing Action		Rationale	
	glucose, lactate dehydrogenase, and specific gravity). A small amount of heparin may be needed for several of the specimen containers to prevent coagulation. A specimen container with preservative may be needed if a pleural biopsy is obtained.		
5.	Evaluate the patient at intervals for increasing respirations, faintness, vertigo, tightness in the chest, uncontrollable cough, blood-tinged mucus, and rapid pulse and signs of hypoxemia.	5.	Pneumothorax, tension pneumothorax, hemothorax, subcutaneous emphysema, or pyogenic infection may result from a thoracentesis.
6.	Encourage deep breaths to expand the lungs.		

PROCEDURE 3: ENDOTRACHEAL INTUBATION

Equipment

- Laryngoscope with curved or straight blade and working light source (check batteries and bulb regularly).
- Endotracheal (ET) tube with low-pressure cuff and adapter to connect tube to ventilator or resuscitation bag.
- Stylet to guide the ET tube.
- Oral airway (assorted sizes) or bite block to keep patient from biting into and occluding the ET tube.
- Adhesive tape or tube fixation system.
- Sterile anesthetic lubricant jelly (water-soluble).
- 10-mL syringe.
- Suction source.
- Suction catheter and tonsil suction.
- Resuscitation bag and mask connected to oxygen source.
- Sterile towel.
- Gloves.
- Face shield.
- End tidal CO2 detector.

Procedure

Nursing Action		Rationale	
Preparatory phase			
1.	Assess the patient's heart rate, level of consciousness, and respiratory status.	1.	Provides a baseline to estimate the patient's tolerance of the procedure.
Performance phase			
1.	Remove the patient's dental bridgework and plates.	1.	May interfere with insertion. Not easily removed from the patient once intubated.
2.	Remove the headboard from the bed (optional).	2.	To provide room to stand behind patient's head.
3.	Prepare equipment.		
	a. Ensure function of resuscitation bag with mask and suction.	a.	The patient may require ventilatory assistance during procedure. Suction should be functional because gagging and emesis may occur during the procedure.

Nursing Action			Rationale	
	b.	Assemble the laryngoscope. Make sure the light bulb is tightly attached and functional.		
	c.	Select an ET tube of the appropriate size (6-9 mm for the average adult).		
	d.	Place the ET tube on a sterile towel.	d.	Although the tube will pass through the contaminated mouth or nose, the airway below the vocal cords is sterile, and efforts must be made to prevent iatrogenic contamination of the distal end of the tube and cuff. The proximal end of the tube may be handled because it will reside in the upper airway.
	e.	Inflate the cuff to make sure it assumes a symmetrical shape and holds volume without leakage. Then deflate maximally.	e.	Malfunction of the cuff must be determined before tube placement occurs.
	f.	Lubricate the distal end of the tube liberally with the sterile anesthetic water-soluble jelly.	f.	Aids in insertion.
	g.	Insert the stylet into the tube (if oral intubation is planned). Nasal intubation does not employ use of the stylet.	g.	Stiffens the soft tube, allowing it to be more easily directed into the trachea.
4.	Aspirate the stomach contents if an NG tube is in place.		4.	To reduce risk of aspiration.
5.	If time allows, inform the patient of the impending inability to talk and discuss alternative means of communication.			
6.	If the patient is confused, consider requesting an order for soft wrist restraints.		6.	Restraint of the confused patient may be necessary to promote patient safety and maintain sterile technique.
7.	Put on gloves and face shield.		7.	Prevents contact with patient's oral secretions.
8.	During oral intubation if cervical spine is not injured, place patient's head in a “sniffing” position (extended at the junction of the neck and thorax and flexed at the junction of the spine and skull).		8.	Upper airway is open maximally in this position.
9.	Spray the back of the patient's throat with anesthetic spray.		9.	Will decrease gagging.
10.	Ventilate and oxygenate the patient with the resuscitation bag and mask before intubation.		10.	Preoxygenation decreases the likelihood of cardiac dysrhythmias or respiratory distress secondary to hypoxemia.

Nursing Action		Rationale	
11.	Hold the handle of the laryngoscope in the left hand and hold the patient's mouth open with the right hand by placing crossed fingers on the teeth.	11.	Leverage is improved by crossing the thumb and index fingers when opening the patient's mouth (scissor-twist technique).
12.	Insert the curved blade of the laryngoscope along the right side of the tongue, push the tongue to the left, and use the right thumb and index finger to pull patient's lower lip away from lower teeth.	12.	Rolling the lip away from teeth prevents injury by being caught between the teeth and the blade.
13.	Lift the laryngoscope forward (toward ceiling) to expose the epiglottis.	13.	Do not use teeth as a fulcrum; this could lead to dental damage.
14.	Lift the laryngoscope upward and forward at a 45-degree angle to expose the glottis and visualize the vocal cords.	14.	This stretches the hypo epiglottis ligament, folding the epiglottis upward and exposing the glottis.
15.	As the epiglottis is lifted forward (toward ceiling), the vertical opening of the larynx between the vocal cords will come into view.	15.	Do not use the wrist. Use the shoulder and arm to lift the epiglottis.
Endotracheal intubation. ***(A)*** *The primary glottis landmarks for tracheal intubation as visualized with proper placement of the laryngoscope.* ***(B)*** *Positioning the ET tube.*			
16.	Once the vocal cords are visualized, insert the tube into the right corner of the mouth and pass the tube while keeping vocal cords in constant view.	16.	Make sure you do not insert the tube into the esophagus; the esophageal mucosa is pink and the opening is horizontal rather than vertical.
17.	Gently push the tube through the triangular space formed by the vocal cords and the back wall of trachea.	17.	If the vocal cords are in spasm (closed), wait a few seconds before passing tube.
18.	Stop insertion just after the tube cuff has disappeared from view beyond the cords.	18.	Advancing the tube further may lead to its entry into a main stem bronchus (usually the right bronchus) causing collapse of the unventilated lung.
19.	Withdraw laryngoscope while holding ET tube in place. Disassemble mask from resuscitation bag, attach bag to ET tube, and ventilate the patient.		
20.	Inflate the cuff with the minimal amount of air required to occlude the trachea.	20.	Listen over the cuff area with a stethoscope. Occlusion occurs when no air leak is heard during ventilator inspiration or compression of the resuscitation bag.

Nursing Action		Rationale	
21.	Insert a bite block if necessary.	21.	This keeps the patient from biting down on the tube and obstructing the airway.
22.	Ascertain expansion of both sides of the chest by observation and auscultation of breath sounds.	22.	Observation and auscultation help in determining that tube remains in position and has not slipped into the right main stem bronchus.
23.	Auscultate over epigastrium.	23.	To confirm no air movement in stomach.
24.	Use a capnometer.	24.	To confirm consistent exhalation of CO_2.
25.	Record the distance from proximal end of tube to the point where the tube reaches the teeth.	25.	Later, this will allow for detection of tube position change.
26.	Secure the tube to the patient's face with adhesive tape or apply a commercially available ET tube stabilization device.	26.	The tube must be fixed securely to ensure that it will not dislodge. Dislodgement of a tube with an inflated cuff may result in damage to the vocal cords.
27.	Obtain a chest X-ray to verify tube position.		
28.	Document and monitor tube distance from lips to the end of ET tube.	28.	Assures correct placement of the tube.
Follow-up phase			
1.	Record tube type and size, cuff pressure, and patient tolerance of the procedure. Auscultate breath sounds every two hours, or if signs and symptoms of respiratory distress occur. Assess ABGs after intubation (if requested by the health care provider).	1.	ABGs may be prescribed to ensure adequacy of ventilation and oxygenation. Tube displacement may result in extubation (cuff above vocal cords), tube touching carina (causing paroxysmal coughing), or intubation of a main stem bronchus (resulting in collapse of the unventilated lung).
2.	Measure cuff pressure with manometer; adjust pressure. Make adjustment in tube placement on the basis of the chest X-ray results.	2.	The tube may be advanced or removed several centimeters for proper placement based on the chest X-ray results.

PROCEDURE 4: ASSISTING WITH TRACHEOSTOMY INSERTION

Equipment

- Tracheostomy tube (sizes 6 - 9 mm for most adults).
- Sterile instruments: hemostat, scalpel and blade, forceps, suture material, and scissors.
- Sterile gown, drapes, and gloves.
- Cap and face shield.
- Antiseptic prep solution.
- Gauze pads.
- Shave prep kit.
- Sedation.
- Local anesthetic and syringe.
- Resuscitation bag and mask with oxygen source.
- Suction source and catheters.
- Syringe for cuff inflation.
- Respiratory support available for post tracheostomy (mechanical ventilation, tracheal oxygen mask, CPAP, and T-piece).

Procedure

	Nursing Action		Rationale
	Performance phase		
1.	Explain the procedure to the patient. Discuss a communication system with the patient.	1.	Apprehension about inability to talk is usually a major concern of the tracheotomies patient.
2.	Obtain consent for operative procedure.		
3.	Shave neck region.	3.	Hair and beard may harbor microorganisms. If the beard is to be removed, inform the patient or family.
4.	Assemble equipment. Using aseptic technique, inflate tracheostomy cuff and evaluate for symmetry and volume leakage. Deflate maximally.	4.	Ensures that the cuff is functional before tube insertion.
5.	Position the patient (in a supine position with head extended and a support under the shoulders).	5.	This position brings the trachea forward.

Nursing Action		Rationale	
6.	Obtain an order for and apply soft wrist restraints if the patient is confused.	6.	Restraint of the confused patient may be necessary to ensure patient safety and preservation of aseptic technique.
7.	Give medication, if ordered.	7.	Sedation may be needed.
8.	Position the light source.		
9.	Assist with antiseptic prep.		
10.	Assist with gowning and gloving.		
11.	Assist with sterile draping.		
12.	Put on face shield.	12.	Spraying of blood or airway secretions may occur during this procedure.
	Tracheostomy tube placement.		
13.	During the procedure, monitor the patient's vital signs, suction as necessary, give medication as prescribed, and be prepared to administer emergency care.	13.	Bradycardia may result from vagal stimulation due to tracheal manipulation, or hypoxemia. Hypoxemia may also cause cardiac irritability.
14.	Immediately after the tube is inserted, inflate the cuff. The chest should be auscultated for the presence of bilateral breath sounds.	14.	Ensures ventilation of both lungs.
15.	Secure the tracheostomy tube with twill tapes or other securing device and apply dressing.		
16.	Apply appropriate respiratory assistive device (mechanical ventilation, tracheostomy, oxygen mask, CPAP, and T-piece adapter).		
17.	Check the tracheostomy tube cuff pressure.	17.	Excessive cuff pressure may cause tracheal damage.
18.	“Tie sutures” or “stay sutures” of silk may have been placed through either side of the tracheal cartilage at the incision and brought out through the wound. Each is to be taped to the skin at a 45-degree angle laterally to the sternum.	18.	Should the tracheostomy tube become dislodged, the stay sutures may be grasped and used to spread the tracheal cartilage apart, facilitating placement of the new tube.

Nursing Action		Rationale	
Follow-up phase			
1.	Assess vital signs and breath sounds; note tube size used; physician performing procedure; type, dose, and route of medications given.	1.	Provides baseline.
2.	Obtain chest X-ray.	2.	Documents proper tube placement.
3.	Assess and chart the condition of the stoma:		
a.	Bleeding	a.	Some bleeding around the stoma site is not unusual for the first few hours. Monitor and inform the physician of any increase in bleeding occurs. Clean the site aseptically when necessary. Do not change the tracheostomy ties for the first 24 hours, because accidental dislodgement of the tube could result when the ties are loose, and tube reinsertion through the as-yet-unformed stoma may be difficult or impossible to accomplish.
b.	Swelling		
c.	Subcutaneous air	c.	When positive pressure respiratory assistive devices are used (mechanical ventilation, CPAP) before the wound is healed, air may be forced into the subcutaneous fat layer. This can be seen as an enlargement of the neck and facial tissues and felt as crepitus or "cracking" when the skin is depressed. Report immediately.
4.	An extra tube, obturator, and hemostat should be kept at the bedside. In the event of tube dislodgement, reinsertion of a new tube may be necessary. For emergency tube insertion:	4.	The hemostat will open the airway and allow ventilation in the spontaneously breathing patient. Avoid inserting the tube horizontally, because the tube may be forced against the back wall of the trachea.
a.	Spread the wound with a hemostat or stay sutures.		
b.	Insert replacement tube (containing the obturator) at an angle.		
c.	Point cannula downward and insert the tube maximally.		
d.	Remove the obturator.		

PROCEDURE 5: NASOTRACHEAL SUCTIONING

Equipment

Assemble the following equipment or obtain a prepackaged kit:

- Disposable suction catheter (preferably soft rubber).
- Sterile towel.
- Sterile disposable gloves.
- Sterile water.
- Anesthetic water-soluble lubricant jelly.
- Suction source at -80 to -120 mm Hg.
- Resuscitation bag with face mask. Connect 100% O2 source with flow of 10 L/minute.
- Oximeter.

Procedure

Nursing Action			Rationale		
Preparatory phase					
1.	Verify correct patient. Auscultate breath sounds, monitor heart rate, respiratory rate, color, and ease of respirations. If the patient is on the monitor, continue monitoring heart rate or arterial BP. Discontinue the suctioning and apply oxygen if the heart rate decreases by 20 beats/minute or increases by 40 beats/minute, if BP increases, or if cardiac dysrhythmia is noted.		1.	NT suctioning should not be routinely performed. It is indicated when other methods to remove secretions from airway have failed. Suctioning may cause the occurrence of:	
				a.	Hypoxemia—Initially resulting in tachycardia and increased BP, and later causing cardiac ectopy, bradycardia, hypotension, and cyanosis.
				b.	Vagal stimulation resulting in bradycardia.
Performance phase					
1.	Make sure that the suction apparatus is functional. Place suction tubing within easy reach.		1.	The procedure must be done aseptically because the catheter will be entering the trachea below the level of the vocal cords, and introduction of bacteria is contraindicated.	
2.	Inform and instruct the patient about the procedure.		2.	A thorough explanation will decrease patient anxiety and promote patient cooperation.	
	a.	At a certain interval, the patient will be requested to cough to open the lung passage so the catheter will go into the			

Nursing Action			Rationale	
		lungs and not into the stomach. The patient will also be encouraged to try not to swallow because this will also cause the catheter to enter the stomach.		
	b.	The postoperative patient can splint the wound to make the coughing produced by NT suctioning less painful.		
3.	Place the patient in a semi-Fowler's or sitting position if possible.		3.	NT suctioning should follow chest physical therapy, postural drainage, or ultrasonic nebulization therapy. The patient should not be suctioned after eating or after a tube feeding is given (unless absolutely necessary) to decrease the possibility of emesis and aspiration.
4.	Monitor oxygen saturation via oximetry and heart rate during suctioning.			
5.	Place a sterile towel across the patient's chest. Squeeze a small amount of sterile anesthetic water-soluble lubricant jelly onto the towel.			
6.	Open the sterile pack containing curved-tipped suction catheter.			
7.	Aseptically glove both hands. Designate one hand (usually the dominant one) as “sterile” and the other hand as “contaminated.”		7.	The “contaminated” hand must also be gloved to ensure that organisms in the sputum do not come in contact with the nurse's hand, possibly resulting in infection of the nurse.
8.	Grasp the sterile catheter with the sterile hand.			
9.	Lubricate catheter with the anesthetic jelly and pass the catheter into the nostril and back into the pharynx.		9.	If obstruction is met, do not force the catheter. Remove it and try the other nostril.
10.	Pass the catheter into the trachea. To do this, ask the patient to cough or say “ahh.” If the patient is incapable of either, try to advance the catheter on inspiration. Asking the patient to stick out their tongue, or hold their tongue extended with a gauze pad (helps to open their airway). If a protracted amount of time is needed to position the catheter in the trachea, stop and oxygenate the patient with a face mask or the resuscitation bag-mask unit at intervals. If three attempts to place the catheter are unsuccessful, request assistance.		10.	These maneuvers may aid in opening the glottis and allowing the passage of the catheter into the trachea. To evaluate proper placement, listen at the catheter end for air, or feel for air movement against the cheek. An increase in intensity of breath sounds or more air movement against the cheek indicates nearness to the larynx. Gagging or sudden lessening of sound means the catheter is in the hypo pharynx. Draw back and advance again. The presence of the catheter in the trachea is indicated by:
a. Sudden paroxysms of coughing.				

Nursing Action		Rationale	
b. Movement of air through the catheter.			
c. Vigorous bubbling of air when the distal end of the suction catheter is placed in a cup of sterile water.			
d. Inability of the patient to speak.			
11.	Specific positioning of catheter for deep bronchial suctioning:	11.	Turning the patient's head to one side elevates the bronchial passage on the opposite side, making catheter insertion easier. Suctioning of a particular lung segment may be of value in patients with unilateral pneumonia, atelectasis, or collapse.
	a. For left bronchial suctioning, turn the patient's head to the extreme right, chin up.		
	b. For right bronchial suctioning, turn the patient's head to the extreme left, chin up.		
	Note: The value of turning the head as an aid to entering the right or left main stem bronchi is not accepted by all clinicians.		
12.	Never apply suction until catheter is in the trachea. Once the correct position is ascertained, apply suction and gently rotate catheter while pulling it slightly upward. Do not remove catheter from the trachea.	12.	Because entry into the trachea is often difficult, less change in arterial oxygen may be caused by leaving the catheter in the trachea than by repeated insertion attempts.
13.	Disconnect the catheter from the suctioning source after 5 to 10 seconds. Apply oxygen by placing a face mask over the patient's nose, mouth, and catheter, and instruct the patient to breathe deeply.	13.	Be sure adequate time is allowed to reoxygenate the patient as oxygen is removed, as well as secretions, during suctioning.
14.	Reconnect the suction source. Repeat as necessary.	14.	No more than three to four suction passes should be made per suction episode.
15.	During the last suction pass, remove the catheter completely while applying suction and rotating the catheter gently. Apply oxygen when the catheter is removed.	15.	Never leave the catheter in the trachea after the suction procedure is concluded, because the epiglottis is splinted open and aspiration may occur.
		Placement of nasotracheal catheter for suctioning the tracheobronchial tree.	
Follow-up phase			
1.	Dispose of disposable equipment. Auscultate breath sounds.		

Nursing Action		Rationale	
2.	Measure the heart rate, BP, respiratory rate, and oxygen saturation. Record the patient's tolerance of the procedure, type and amount of secretions removed, and complications.	2.	To assess for hypoxemia, trauma, or other complications.
3.	Report any patient procedure intolerance (changes in vital signs, bleeding, laryngospasm, and upper airway noise).		

PROCEDURE 6: ADMINISTERING OXYGEN BY NASAL CANNULA

Equipment

- Oxygen source.
- Plastic nasal cannula with connecting tubing (disposable).
- Humidifier filled with sterile water.
- Flow meter.
- NO SMOKING signs.

Procedure

<table>
<tr><th colspan="2">Nursing Action</th><th colspan="3">Rationale</th></tr>
<tr><td colspan="5">Preparatory phase</td></tr>
<tr><td>1.</td><td>Verify correct patient. Determine current vital signs, LOC, and most recent ABG.</td><td>1.</td><td colspan="2">Provides a baseline for future assessment. Nasal cannula oxygen administration is often used for patients prone to CO_2 retention. Oxygen may depress the hypoxic drive of these patients (evidenced by a decreased respiratory rate, altered mental status, and further $PaCO_2$ elevation).</td></tr>
<tr><td>2.</td><td>Assess risk of CO_2 retention with oxygen administration</td><td>2.</td><td colspan="2">If $PaCO_2$ is decreased or normal, the patient is not experiencing CO_2 retention and can use oxygen without fear of the above consequences.</td></tr>
<tr><td colspan="5">Performance phase</td></tr>
<tr><td>1.</td><td>Post NO SMOKING signs on the patient's door and in view of the patient and visitors.</td><td>1.</td><td colspan="2">Oxygen use increases the risk of fire hazard.</td></tr>
<tr><td>2.</td><td colspan="4">Show the nasal cannula to the patient and explain the procedure.</td></tr>
<tr><td>3.</td><td>Make sure the humidifier is filled to the appropriate mark.</td><td>3.</td><td colspan="2">Humidification may not be ordered if the flow rate is less than 4 L/minute.</td></tr>
<tr><td>4.</td><td colspan="4">Attach the connecting tube from the nasal cannula to the humidifier outlet.</td></tr>
<tr><td>5.</td><td>Set the flow rate at the prescribed liters per minute. Feel to determine if oxygen is flowing through the tips of the cannula.</td><td>5.</td><td colspan="2">Because a nasal cannula is a low-flow system (patient's tidal volume supplies part of the inspired gas), oxygen concentration will vary, depending on the patient's respiratory rate and tidal volume. Approximate oxygen concentrations delivered are:</td></tr>
<tr><td></td><td></td><td></td><td>1 L = 24% to 25%</td><td>2 L = 27% to 29%</td></tr>
<tr><td></td><td></td><td></td><td>3 L = 30% to 33%</td><td>4 L = 33% to 37%</td></tr>
<tr><td></td><td></td><td></td><td>5 L = 36% to 41%</td><td>6 L = 39% to 45%</td></tr>
</table>

Nursing Action		Rationale	
6.	Place the tips of the cannula in the patient's nose and adjust straps around ears for snug, comfortable fit.	6.	Inspect skin behind the ears periodically for irritation or breakdown. Ears may need to be padded where the cannula sits.
Administering oxygen by nasal cannula. Patient's inspiration consists of a mixture of supplemental oxygen supplied via the nasal cannula and room air. Oxygen concentration is variable and depends on the patient's tidal volume and ventilatory pattern.			
Follow-up phase			
1.	Record the flow rate used and immediate patient response.	1.	Note the patient's tolerance of treatment. Report any intolerance noted.
2.	Assess the patient's condition, ABG or SaO_2 and the functioning of the equipment at regular intervals.	2.	Depression of hypoxic drive is most likely to occur within the first hours of oxygen use. Monitoring of SaO_2 with oximetry can be substituted for ABGs if the patient is not retaining CO_2.
3.	Determine the patient’s comfort with oxygen use.	3.	Flow rates in excess of 4 L/minute may cause irritation to the nasal and pharyngeal mucosa.

PROCEDURE 7: ADMINISTERING OXYGEN BY SIMPLE FACE MASK WITH OR WITHOUT AEROSOL

Equipment

- Oxygen source.
- Humidifier bottle with distilled water, if high humidity is desired for simple face mask.
- Simple face mask or plastic aerosol mask.
- Large-bore tubing for aerosol or small-bore tubing for simple face mask.
- Flow meter.
- Nebulizer for aerosol.
- NO SMOKING signs.

Procedure

	Nursing Action		Rationale
	Preparatory phase		
1.	Verify correct patient. Determine current vital signs, LOC, and SaO_2 or ABG, if patient is at risk for CO_2 retention.	1.	Because the nebulizer face mask is a low-flow system (patient's tidal volume may supply part of inspired gas), oxygen concentration will vary depending on the patient's respiratory rate and rhythm. Oxygen delivery may be inadequate for tachypneic patients (flow does not meet peak inspiratory demand) or excessive for patients with slow respirations.
2.	Assess viscosity and volume of sputum produced.	2.	Aerosol is given to assist in mobilizing retained secretions.
	Performance phase		
1.	Post NO SMOKING signs on the patient's door and in view of the patient and visitors.	1.	Oxygen use increases the risk of fire hazard.
2.	Show the mask to the patient and explain the procedure.		
3.	Make sure the humidifier or nebulizer is filled to the appropriate mark.	3.	If the humidifier bottle is not sufficiently full, less moisture will be delivered.
4.	Attach the large-bore tubing from the mask to the humidifier in the heating element, if used.		

Nursing Action		Rationale	
5.	Set desired oxygen concentration and plug in the heating element, if used.	5.	The inspired oxygen concentration is determined by the humidifier setting. Usual concentrations are 35% to 50%.
6.	If the patient is tachypneic and concentration of 50% oxygen or greater is desired, two humidifiers and flow meters should be yoked together.	6.	The aerosol mask is a low-flow system. Yoking two humidifiers together doubles the humidifier flow, but does not change the inspired oxygen concentration.
7.	Adjust the flow rate until the desired mist is produced (usually 10 to 12 L/minute).	7.	This ensures that the patient is receiving flow sufficient to meet inspiratory demand and maintains a constant accurate concentration of oxygen.
8.	Apply the mask to the patient's face and adjust the straps so the mask fits securely. Dry the patient's face around mask every two hours.	8.	Reduces moisture accumulation under the mask. Massage of the face stimulates circulation and reduces pressure over the area.
9.	Drain the tubing frequently by emptying condensate into a separate receptacle, not into the humidifier. If a heating element is used, the tubing will have to be drained more often.	9.	The tubing must be kept free of condensate. Condensate that is allowed to accumulate in the delivery tube will block flow and alter oxygen concentration. If condensate is emptied into the humidifier, bacteria may be aerosolized into the lungs.
10.	If a heating element is used, check the temperature. The humidifier bottle should be warm, not hot, to touch.	10.	Excessive temperatures can cause airway burns; patients with elevated temperatures should be humidified with an unheated device.
For a simple face mask, oxygen concentration varies with patient's tidal volume and respiratory rate.			
Follow-up phase			
1.	Record FiO_2 and immediate patient response. Note the patient's tolerance of treatment. Notify the physician if intolerance occurs.		
2.	Assess the patient's condition and the functioning of equipment at regular intervals.	2.	Assess the patient for change in mental status, diaphoresis, changes in blood pressure, and increasing heart and respiratory rates.
3.	If the patient's condition changes, assess SaO_2 or ABG.	3.	If the patient has a high minute ventilation or VE, flow from the mask may not be sufficient to meet inspiratory

Nursing Action		Rationale	
			needs without pulling in room air. Room air will dilute the oxygen provided and lower the inspired oxygen concentration, resulting in hypoxemia. A change in the mask or delivery system may be indicated.
4.	Record changes in volume and tenacity of sputum produced.	4.	Indicates effectiveness of humidification.

PROCEDURE 8: ADMINISTERING OXYGEN BY VENTURI MASK (HIGH AIR FLOW OXYGEN ENTRAINMENT SYSTEM)

Equipment

- Oxygen source.
- Flow meter.
- Venturi mask for correct concentration (24%, 28%, 31%, 35%, 40%, 50%) or correct concentration adapter if interchangeable color-coded adapters are used.
- NO SMOKING signs.
- If high humidity desired.
- Compressed air source and flow meter.
- Humidifier with distilled water.
- Large-bore tubing.

Procedure

	Nursing Action		Rationale
	Preparatory phase		
1.	Verify correct patient. Determine current vital signs, LOC, and most recent ABG.	1.	Provides a baseline for future assessment. Venturi masks are used for patients prone to CO_2 retention. Oxygen may depress the hypoxic drive of these patients (evidenced by a decreased respiratory rate, altered mental status, and further $PaCO_2$ elevation).
2.	Assess risk of CO_2 retention with oxygen administration.	2.	Risk is greater if the patient is experiencing an exacerbation of illness.
	Performance phase		
1.	Post NO SMOKING signs on the door of the patient's room and in view of the patient and visitors.	1.	Oxygen use increases the risk of fire hazard.
2.	Show the Venturi mask to the patient and explain the procedure.		
3.	Connect the mask by lightweight tubing to the oxygen source.		
4.	Turn on the oxygen flow meter and adjust itto the prescribed rate (usually indicated on the mask). Check to see that oxygen is flowing out the vent holes in the mask.	4.	To ensure the correct air/oxygen mix, oxygen must be set at the prescribed flow rate. Prescribed flow rates differ for different oxygen concentrations.

Nursing Action			Rationale	
				Usually this information is printed on the mask or interchangeable color-coded source.
5.	Place the Venturi mask over the patient's nose and mouth and under the chin. Adjust elastic strap.			
6.	Check to make sure holes for air entry are not obstructed by the patient's bedding.		6.	Proper mask function depends on the mixing of sufficient amount of air and oxygen.
7.	If aerosol nebulizer used:		7.	When a Venturi mask is used with an aerosol, an oxygen source is required. The compressed air source provides air for the air/oxygen mix. Excessive oxygen would be inspired if both tubings were connected to an oxygen source.
	a.	Connect the humidifier to a compressed air source.		
	b.	Attach the large-bore tubing to the humidifier, and connect the tubing to the fitting, for high humidity at the base of the Venturi mask.		
Venturi mask: Constant high concentrations of oxygen can be delivered.				
Follow-up phase				
1.	Record flow rate used and immediate patient response. Note the patient's tolerance of treatment. Report if intolerance occurs.		1.	Depression of hypoxic drive is most likely to occur within the first hours of oxygen use.
2.	If CO_2 retention is present, assess ABG every 30 minutes for 1 to 2 hours or until the PaO_2 is greater than 50 mm Hg and the $PaCO_2$ is no longer increasing. Monitor pH. Report if the pH decreases below the initial assessment value.		2.	A modest (5 to 10 mm Hg) increase in $PaCO_2$ may occur after initiation therapy. A decreasing pH indicates failure of compensatory mechanisms. Mechanical ventilation may be required.
3.	Determine patient comfort with oxygen use.		3.	Venturi masks are best tolerated for relatively short periods because of their size and appearance. They also must be removed for eating and drinking. With improvement in patient condition, a nasal cannula may often be substituted.

PROCEDURE 9: ADMINISTERING OXYGEN BY PARTIAL REBREATHING OR NONREBREATHING MASK

Equipment

- Oxygen source.
- Plastic face mask with reservoir bag and tubing.
- Humidifier with distilled water.
- Flow meter.
- No smoking signs.

Procedure

Nursing Action		Rationale	
	Preparatory phase		
1.	Verify correct patient. Determine current vital signs and LOC.	1.	Provides a baseline for evaluating patient response. Typically used for short-term support of patients who require a high inspired oxygen concentration?
2.	Determine most recent SaO_2 or ABG.	2.	Allows objective evaluation of patient response.
	Performance phase		
1.	Post NO SMOKING signs on the patient's door and in view of the patient and visitors.	1.	Oxygen use increases the risk of fire hazard.
2.	Attach tubing to the flow meter.		
3.	Show the mask to the patient and explain the procedure.		
4.	Flush the reservoir bag with oxygen to inflate the bag and adjust flow meter to 6 to 10 L/minute.	4.	Bag serves as a reservoir, holding oxygen for patient inspiration.
5.	Place the mask on the patient's face.	5.	Make sure the mask fits snugly, because there must be an airtight seal between the mask and the patient's face.
6.	Adjust liter flow so the rebreathing bag will not collapse during the inspiratory cycle, even during deep inspiration.	6.	With a well-fitting rebreathing bag adjusted so the patient's inhalation does not deflate the bag, inspired oxygen concentration of 60% to 90% can be achieved. Some patients may require flow rates higher than 10 L/minute to ensure that the bag does not collapse on inspiration.

Nursing Action		Rationale	
7.	Stay with the patient for a time to make the patient comfortable and observe reactions.		
8.	Remove mask periodically (if the patient's condition permits) to dry the face around the mask. Apply water-based lotion to skin and massage the patient's face around the mask.	8.	These actions reduce moisture accumulation under the mask. Massage of the face stimulates circulation and reduces pressure over the area.
			Partial rebreathing mask. 100% oxygen fills the bag, but the concentration delivered varies with respiration. Nonrebreathing mask is similar to the partial rebreathing mask, with the addition of a one-way valve that prevents expired air from entering bag and one-way flaps over exhalation ports.
	Follow-up phase		
1.	Record flow rate and immediate patient response. Note the patient's tolerance of treatment. Report if intolerance occurs.		
2.	Observe the patient for change of condition. Assess equipment for malfunctioning and low water level in humidifier.	2.	Assess the patient for change in mental status, diaphoresis, change in BP, and increasing heart and respiratory rates.

PROCEDURE 10: ADMINISTERING OXYGEN BY CONTINUOUS POSITIVE AIRWAY PRESSURE MASK

Equipment

- O2 blender.
- Flow meter.
- Continuous positive airway pressure (CPAP) mask.
- Valve for prescribed PEEP (2.5, 5, 7.5, 10 cm H2O).
- Nebulizer with distilled water.
- Large-bore tubing.
- NG tube (if ordered).
- Sealing pad to accommodate NG tube.
- NO SMOKING signs.

Procedure

	Nursing Action		Rationale
	Preparatory phase		
1.	Verify correct patient. Assess the patient's LOC and gag reflex.	1.	CPAP mask may lead to aspiration unless the patient is breathing spontaneously and is able to protect their airway.
2.	Determine current ABGs.	2.	Documents that the patient meets the criteria for mask use (normal or increased $PaCO_2$ and provides baseline to evaluate whether therapy results in CO_2 retention).
	Performance phase		
1.	Post NO SMOKING signs on the patient's door and in view of the patient and visitors.	1.	O_2 use increases the risk of fire hazard.
2.	Show the mask to the patient and explain the procedure.		
3.	Insert NG tube if ordered.	3.	With CPAP, the patient may swallow air, causing gastric distention or emesis. Prophylactic NG suction diminishes this risk.
	Note: Some clinicians do not believe an NG tube is needed.		
4.	Attach NG tube adapter.	4.	Use of the adapter may decrease air leak around the mask.

Nursing Action		Rationale	
5.	Set the desired concentration of O_2 blender and adjust flow rate so it is sufficient to meet the patient's inspiratory demand.	5.	O_2 blenders are devices that mix air and O_2 using a proportioning valve. Concentrations of 21% to 100% may be delivered, depending on the model. Because the patient will be receiving all minute ventilation from this "closed system," it is essential that the flow rate be adequate to meet changes in the patient's breathing pattern.
		Administering oxygen by face mask with continuous positive airway pressure (CPAP).	
6.	Place the mask on the patient's face, adjust the head strap, and inflate the mask cushion to ensure a tight seal.	6.	To maintain CPAP, an airtight seal is required. Head straps and the inflatable cushion help to ensure that difficult areas, such as the nose and chin, are sealed with greater comfort to the patient.
7.	Organize care to remove the mask as infrequently as possible.	7.	If the mask is removed (for coughing, suctioning), CPAP is not maintained and inspired O_2 concentrations will drop.
	Follow-up phase		
1.	Assess ABGs, hemodynamic status, and LOC frequently.	1.	Provides objective documentation of patient response. CPAP may increase work of breathing, resulting in patient tiring and inability to maintain ventilation without intubation. CPAP may also decrease venous return (PEEP effect), resulting in decreased cardiac output.
2.	Immediately report any increase in $PaCO_2$.	2.	An increase in $PaCO_2$ suggests hypoventilation, resulting from tiring of the patient or inadequate alveolar ventilation. The need for intubation and mechanical ventilation should be evaluated.
3.	Assess patency of NG tube at frequent intervals.	3.	May become obstructed, causing gastric distention.
4.	Assess patient comfort and functioning of the equipment frequently.	4.	Tight fit of the mask may predispose the skin tp breakdown. The system may develop leaks, resulting in air escaping between the patient's face and mask.

Nursing Action		Rationale	
5.	Record the patient's response. With improvement, O_2 therapy without positive airway pressure can be substituted. With deterioration, intubation and mechanical ventilation may be required. Note the patient's tolerance of treatment. Report if intolerance occurs.	5.	Face mask CPAP is usually continued only for short periods (72 hours) because of patient tiring and the necessity to remove the mask for suctioning and coughing.
	Note: CPAP may be used as a therapy for sleep apnea during the time the patient sleeps. A nasal CPAP mask is typically used.		

PROCEDURE 11: ADMINISTERING OXYGEN BY WAY OF ENDOTRACHEAL AND TRACHEOSTOMY TUBES WITH A T-PIECE (BRIGGS) ADAPTER

Equipment

- Oxygen.
- O2 blender.
- Flow meter.
- Nebulizer with sterile water (heating element may be used as described in aerosol masks).
- Large-bore tubing.
- T-piece and reservoir tubing.
- No smoking signs.

Procedure

Nursing Action		Rationale	
	Preparatory phase		
1.	Verify the correct patient. Assess the patient's SaO_2, hemodynamic status, and LOC frequently. If patient condition changes, assess ABGs.	1.	Provides a baseline to assess response.
2.	Assess viscosity and volume of sputum produced.	2.	Aerosol is given to assist in mobilizing retained secretions.
	Performance phase		
1.	Post NO SMOKING signs on the patient's door and in view of the patient and visitors.	1.	O_2 use increases the risk of fire hazard.
2.	Show the T-tube to the patient and explain the procedure.		
3.	Make sure the humidifier is filled to the appropriate mark.	3.	If humidifier is not sufficiently full, fewer aerosols will be delivered.
4.	Attach the large-bore tubing from the T-tube to the humidifier outlet.		
5.	Set desired O_2 concentration of O_2 blender or humidifier bottle and plug in the heating element, if used.	5.	O_2 blenders are devices that mix air and O_2 using a proportioning valve. Concentrations of 21% to 100% may be delivered at flows of 2 to 100 L/minute, depending on the model.

Nursing Action		Rationale	
			Used when precise control is required.
6.	Adjust the flow rate until the desired mist is produced and meets the patient's inspiratory demand.	6.	The aerosol mist in the reservoir tubing attached to the T-tube should not be completely withdrawn on patient inspiration. If mist is withdrawn (does not extend from reservoir tubing) on inspiration, room air may be inspired and O_2 concentration decreased.
7.	Drain the tubing frequently by emptying condensate into a separate receptacle, not into the humidifier. If a heating element is used, the tubing will have to be drained more often.	7.	The tubing must be kept free of condensate. Condensate allowed to accumulate in the delivery tube will block flow and alter O_2 concentration. If condensate is emptied into the humidifier, bacteria may be aerosolized into the lungs.
8.	If a heating element is used, check the temperature. The humidifier bottle should be warm, not hot, to touch.	8.	Excessive temperatures can cause airway burns; patients with elevated temperatures will be better humidified with an unheated device.
		Administering oxygen via endotracheal tube with a T-piece adapter. A T-piece adapter is attached to the endotracheal tube and large-bore tubing, which serves as a source of oxygen and humidity.	
	Follow-up phase		
1.	Record FiO_2 and immediate patient response. Note patient's tolerance of treatment. Report if intolerance occurs.		
2.	Assess the patient's condition and the functioning of equipment at regular intervals.	2.	Assess the patient for change in mental status, diaphoresis, perspiration, changes in BP, and increasing heart and respiratory rates.
3.	If the patient's condition changes, assess SaO_2 or ABGs and vital signs. Note changes suggesting increased work of breathing (diaphoresis, intercostal muscle retraction).	3.	If the patient is being weaned, return to the ventilator if changes suggest the patient’s inability to tolerate spontaneous ventilation.
4.	Record changes in volume and tenacity of sputum produced.	4.	Indicates effectiveness of humidification therapy.

PROCEDURE 12: ADMINISTERING OXYGEN BY MANUAL RESUSCITATION BAG (AMBO BAG)

Equipment

- O2 source.
- Resuscitation bag and mask.
- Reservoir tubing or reservoir bag.
- O2 connecting tubing.
- Nipple adapter to attach flow meter to connecting tubing.
- Flow meter.
- Gloves.
- Face shield.

Procedure

Nursing Action			Rationale		
	Preparatory phase				
1.	In cardiopulmonary arrest:		1.		
	a.	Follow steps to establish that a cardiopulmonary arrest has occurred.		a.	These steps are: establish unresponsiveness; call for help; position the patient on a firm, flat surface; open the mouth and remove vomitus or debris, if visible; assess presence of respirations with the airway open; if apneic, ventilate; palpate the carotid pulse; if absent, deliver chest compressions.
	b.	Use caution not to injure or increase injury to the cervical spine when opening the airway.		b.	If cervical spine injury is a possibility, the modified jaw thrust should be used. In other situations, the head-tilt or chin-lift method can be used. These maneuvers lift the tongue off the back of the throat and, in some situations, may be all that is needed to restore breathing.
2.	In suctioning or transport situations, assess the patient's heart rate, level of consciousness (LOC), and respiratory status.		2.	Provides a baseline to stimulate patient's tolerance of procedure.	

Nursing Action		Rationale	
	Performance phase		
1.	Attach connecting tubing from the flow meter and nipple adapter to the resuscitation bag.	1.	A humidifier bottle is not used, because the high flow rates of oxygen required would force water into the tubing and clog it.
2.	Turn flow meter to "flush" position.	2.	A high flow rate or "flush" position is necessary to meet the minute ventilation of the patient.
3.	Attach reservoir tubing or reservoir bag to resuscitation bag.	3.	A high inspired O_2 concentration is required. Without a reservoir, inspired O_2 concentration will be low (28% to 56%), because inspired gas will be air/O_2 mix. With a reservoir, manual resuscitation bags can achieve a FiO_2 of greater than 96% at a flow rate of 15 L/minute.
4.	Put on face shield and gloves.		
	***Cardiopulmonary* arrest**		
1.	If respirations are absent after the airway is open, insert an Oropharyngeal airway and ventilate twice with slow, full breaths of 1 to 1 ½ seconds each. Allow 2 seconds between breaths.	1.	The airway helps prevent obstruction from prolapsed tongue in an unconscious patient. If ventilation is difficult, confirm that the airway is unobstructed.
2.	Breaths will have to be quickly interposed between cardiac compressions. If the patient needs only respiratory assistance, watch for chest expansion and listen with the stethoscope to ensure adequate ventilation.	2.	Squeeze resuscitation bag with sufficient force and at the rate necessary to maintain adequate minute ventilation.
3.	A rate of approximately 10 to 12 breaths/minute is used, unless the patient is being given external cardiac compressions.	3.	Continue squeezing the bag at appropriate intervals until CPR is no longer required.
	Preoxygenation and suctioning		
1.	If hyperinflation is being used with suctioning, ventilate the patient before and after each suctioning pass (including after the last suction pass).	1.	Hyperinflation before suctioning helps prevent hypoxemia. Hyperinflation after suctioning replaces O_2 removed during the procedure and helps to prevent atelectasis.

Nursing Action		Rationale	
			The larger tidal volumes may also assist in mobilizing secretions and promote surfactant secretion.
	Transport		
1.	If hyperinflation is used in transport, suction the patient before disconnection for transport; monitor heart and respiratory rates and LOC during procedure.	1.	Establishes a patent airway before the patient is moved. Provides information for assessing tolerance of transport.
2.	Ventilate at rate of 12 - 15 breaths/minute.		
	Follow-up phase		
1.	In cardiopulmonary arrest, verify return of spontaneous pulse and respirations. Initiate further support as needed.	1.	Establishes the patient's need for definitive therapy (drugs, defibrillation, and intensive care).
2.	In suctioning or transport, return to previous support. Note patient tolerance of procedure.	2.	Note SaO_2, heart rate, rate and ease of respirations, arterial BP (if monitored), and LOC. Report if intolerance occurs.

PROCEDURE 13: MANAGING THE PATIENT REQUIRING MECHANICAL VENTILATION

Equipment

- Artificial airway (endotracheal “ET” tube or tracheostomy).
- Manual self-inflating resuscitation bag.
- Pulse oximetry.
- Suction equipment.
- Mechanical ventilator.
- Ventilation circuitry.
- Humidifier.

See manufacturer's directions for specific machine.

Procedure

Nursing Action			Rationale	
Preparatory phase				
1.	Obtain baseline samples for blood gas determinations (pH, PaO_2, $PaCO_2$, HCO_3^-) and chest X-ray.		1.	Baseline measurements serve as a guide in determining the progress of therapy.
Performance phase				
1.	Give a brief explanation to the patient and family.		1.	Emphasize that mechanical ventilation is a temporary measure. The patient should be prepared psychologically for weaning at the time the ventilator is first used.
2.	Premedicate as needed.		2.	To promote cooperation through mild sedation.
3.	Establish the airway by means of a cuffed ET or tracheostomy tube		3.	A closed system between the ventilator and patient's lower airway is necessary for positive pressure ventilation.
4.	Prepare the ventilator (respiratory therapist does this in many facilities).		4.	To have all equipment and settings in place before applying them to the patient.
	a.	Set up desired circuitry.		
	b.	Connect oxygen and compressed air source.		
	c.	Turn on power.		

Nursing Action			**Rationale**		
	d.	Set V_T (usually 6 to 8 mL/kg body weight "Morton").		d.	Adjusted according to pH and $PaCO_2$.
	e.	Set oxygen concentration.			
	f.	Set ventilator sensitivity.		e.	Adjusted according to PaO_2.
	g.	Set rate at 12 - 14 breaths/minute (variable).			
				g.	This setting approximates normal ventilation. The machines' settings are subject to change according to the patient's condition and response, and the ventilator type being used.
	h.	Set inspiratory-expiratory (I: E) times (varies depending on the ventilator). Adjust flow rate (velocity of gas flow during inspiration). Usually set at 40 to 60 L/minute. Depends on rate and V_T.		h.	The slower the flow, the lower the peak airway pressure will result from a set volume delivery. This results in a lower intrathoracic pressure and less impedance of venous return. However, a flow that is too low for the rate selected may result in inverse I: E ratios.
	i.	Select mode of ventilation.			
	j.	Check machine function—measure V_T, rate, I: E ratio, analyze oxygen, check all alarms.		j.	Ensures safe function.
5.	Couple the patient's airway to the ventilator.		5.	Make sure all connections are secure. Prevent ventilator tubing from "pulling" on artificial airway, possibly resulting in tube dislodgement or tracheal damage.	
6.	Assess patient for adequate chest movement and rate. Note peak airway pressure and PEEP.		6.	Ensures proper function of equipment.	
7.	Set airway pressure alarms according to patient's baseline:		7.		
	a.	High pressure alarm		a.	High airway pressure is set at 10 to 15 cm H_2O above peak inspiratory pressure. An alarm sounds if airway pressure selected is exceeded. Alarm activation indicates decreased lung compliance (worsening pulmonary

Nursing Action			Rationale		
					disease); decreased lung volume (such as pneumothorax, tension pneumothorax, hemothorax, pleural effusion); increased airway resistance (secretions, coughing, bronchospasm, breathing out of phase with the ventilator); loss of patency of airway (mucus plug, airway spasm, biting or kinking of tube).
	b.	Low pressure alarm		b.	Low airway pressure alarm set at 5 to 10 cm H_2O below peak inspiratory pressure. Alarm activation indicates inability to build up airway pressure because of disconnection or leak, and changing compliance and resistance.
8.	Assess frequently for change in respiratory status by evaluation of ABGs, pulse oximetry, spontaneous rate, use of accessory muscles, breath sounds, and vital signs. Other means of assessing are through the use of exhaled carbon dioxide. If change is noted, notify appropriate personnel.				
9.	Monitor and troubleshoot alarm conditions. Ensure appropriate ventilation at all times.		9.	Priority is placed for the ventilation and oxygenation of the patient. In alarm conditions that cannot be immediately corrected, disconnect the patient from mechanical ventilation and manually ventilate with resuscitation bag.	
10.	Check for secure stabilization of artificial airway.		10.	Reduces risk of inadvertent extubation.	
11.	Positioning:		11.		
	a.	Turn the patient from side to side every two hours or more frequently if possible. Consider kinetic therapy as early intervention to improve outcome.		a.	For patients on long-term ventilation, this may result in sleep deprivation. Follow a turning schedule best suited to a particular patient's condition. Repositioning may improve secretion clearance and reduce atelectasis.
	b.	Lateral turns are desirable; from right semi prone to left semi prone.			

Nursing Action			Rationale		
	c.	Sit the patient upright at regular intervals if possible.		c.	Upright posture increases lung compliance.
	d.	Consider prone positioning to improve oxygenation.		d.	Proning has been shown to have some beneficial effects or the improvement of oxygenation in certain populations, such as patients with ARDS.
12.	Carry out passive range-of-motion exercises of all extremities for patients unable to do so.		12.	To prevent contractures.	
13.	Assess for the need of suctioning at least every two hours.		13.	Patients with artificial airways on mechanical ventilation are unable to clear secretions on their own. Suctioning may help to clear secretions and stimulate the cough reflex.	
14.	Assess breath sounds every two hours:		14.		
	a.	Listen with a stethoscope to the chest in all lobes bilaterally.		a.	Auscultation of the chest is a means of assessing airway patency and ventilatory distribution. It also confirms the proper placement of the ET or tracheostomy tube.
14.	b.	Determine whether breath sounds are present or absent, normal or abnormal, and whether a change has occurred.			
	c.	Observe the patient's diaphragmatic excursions and use of accessory muscles of respiration.			
15.	Humidification.		15.	Humidity may improve secretion mobilization.	
	a.	Check the water level in the humidification reservoir to ensure that the patient is never ventilated with dry gas. Empty the water that condenses in the delivery and exhalation tubing into a separate receptacle, not into the humidifier. Always wash hands before and after emptying fluid from ventilator circuitry. Humidification may also be achieved using a moisture enhancer.		a.	Water condensing in the inspiratory tubing may cause increased resistance to gas flow. This may result in increased peak airway pressures. Warm, moist tubing is a perfect breeding area for bacteria. If this water is allowed to enter the humidifier, bacteria may be aerosolized into the lungs. Emptying the tubing also prevents introduction of water into the patient's airways.

Nursing Action			Rationale		
16.	Assess airway pressures at frequent intervals.		16.	Monitor for changes in compliance, or onset of conditions that may cause airway pressure to increase or decrease.	
17.	Measures delivered VT and analyzes the oxygen concentration every four hours or more frequently, if indicated (respiratory therapist performs this in most facilities).		17.	To ensure that the patient is receiving the appropriate ventilatory assistance.	
18.	Monitor the patient's cardiovascular function. Assess for abnormalities.		18.		
	a.	Monitor pulse rate and arterial BP; intra-arterial pressure monitoring may be carried out.		a.	Arterial catheterization for intra-arterial pressure monitoring also provides access for ABG samples.
	b.	Use pulmonary artery catheter to monitor pulmonary capillary wedge pressure (PCWP), mixed venous oxygen saturation (SvO_2), and cardiac output (CO).		b.	Intermittent and continuous positive pressure ventilation may increase the PAP and decrease cardiac output.
19.	Provide mouth care every one-to-four hours and assess for the development of ET tube pressure areas.				
	a.	Monitor for systemic signs and symptoms of pulmonary infection (pulmonary physical examination findings, increased heart rate, increased temperature, and increased WBC count).		a.	For comfort and reduced risk of infection.
20.	Evaluate the need for sedation or muscle relaxants.		20.	Sedatives may be prescribed to decrease anxiety, or to relax the patient to prevent "competing" with the ventilator. At times, pharmacologically induced paralysis may be necessary to permit mechanical ventilation.	
21.	Use "ventilator bundle" protocol, as directed, to prevent ventilator-associated complications.		21.	To reduce the risk of aspiration, peptic ulcer, and deep vein prophylaxis; and to reduce sedation that may interfere with assessment.	
	a.	Elevate the head of the bed to between 30 and 45 degrees.			
	b.	Daily "sedative interruption" and daily assessment of readiness to extubate.			
	c.	Peptic ulcer disease prophylaxis.			

Nursing Action			Rationale		
	d.	Deep vein thrombosis prophylaxis (unless contraindicated).			
22.	Report intake and output precisely and obtain an accurate daily weight to monitor fluid balance.		22.	Positive fluid balance resulting in increase in body weight and interstitial pulmonary edema is a frequent problem in patients requiring mechanical ventilation. Prevention requires early recognition of fluid accumulation. An average adult who is dependent on parenteral nutrition can be expected to lose 12 lb (0.25 kg) per day; therefore, constant body weight indicates positive fluid balance.	
23.	Monitor nutritional status.		23.	Patients on mechanical ventilation require inflation of artificial airway cuffs at all times. Patients with tracheostomy tubes may eat, if capable, or may require enteral feeding tubes or parenteral nourishment. Patients with ET tubes are to receive nothing by mouth (the tube splints the epiglottis open) and must be entirely tube fed or parenterally nourished.	
24.	Monitor GI function.		24.	Mechanically ventilated patients are at risk for development of stress ulcers.	
	a.	Test all stools and gastric drainage for occult blood (if part of facility protocol).		a.	Stress may cause some patients requiring mechanical ventilation to develop GI bleeding.
25.	Provide for care and communication needs of patient with an artificial airway.				
26.	Provide psychological support.		26.	Mechanical ventilation may result in sleep deprivation and loss of touch with surroundings and reality.	
	a.	Assist with communication.			
	b.	Orient to environment and function of mechanical ventilator.			
	c.	Ensure that the patient has adequate rest and sleep.			

Nursing Action		Rationale	
	Follow-up phase		
1.	Maintain a flow sheet to record ventilation patterns, ABGs, venous chemical determinations, hemoglobin and hematocrit, status of fluid balance, weight, and assessment of the patient's condition. Notify appropriate personnel of changes in the patient's condition.	1.	Establishes means of assessing effectiveness and progress of treatment.
2.	Change ventilator circuitry per facility protocol; assess ventilator's function every four hours, or more frequently if problem occurs.	2.	Prevents contamination of lower airways.

PROCEDURE 14: ASSISTING WITH CHEST TUBE INSERTION

Equipment

- Tube thoracostomy tray.
- Syringes.
- Needles/trocar.
- Basins/skin antiseptic.
- Sponges.
- Scalpel, sterile drape, and gloves.
- Two large clamps.
- Suture material.
- Local anesthetic.
- Chest tube (appropriate size); connector.
- Cap, mask, gloves, gown, and drapes.
- Chest drainage system-connecting tubes and tubing, collection bottles or commercial system, and vacuum pump (if required).
- Sterile water.

Procedure

Nursing Action		Rationale	
	Preparatory phase		
1.	Assess patient for pneumothorax, hemothorax, and presence of respiratory distress.		
2.	Obtain a chest X-ray. Other means of localization of pleural fluid include ultrasound or fluoroscopic localization.	2.	To evaluate extent of lung collapse or amount of bleeding in pleural space.
3.	Obtain informed consent.		
4.	Verify right patient and right location/procedure.		
5.	Premedicate if indicated.		
6.	Assemble drainage system.		
7.	Reassure the patient and explain the steps of the procedure. Tell the patient to expect a needle prick and a sensation of slight pressure during	7.	The patient can cope by remaining immobile and doing relaxed breathing during tube insertion.

Nursing Action		Rationale	
	infiltration anesthesia.		
8.	Position the patient as for an intercostal nerve block or according to physician preference.	8.	The tube insertion site depends on the substance to be drained, the patient's mobility, and the presence of coexisting conditions.
	Performance phase		
Needle or intracath technique			
1.	Using universal precautions, the skin is prepared, anesthetized, and draped, using local anesthetic with a short 25G needle and using aseptic technique. A larger needle is used to infiltrate the subcutaneous tissue, intercostal muscles, and parietal pleura.	1.	The area is anesthetized to make tube insertion and manipulation relatively painless. Use of universal precautions and aseptic technique prevent contamination of chest tube. Patient may feel pressure while the tube is inserted.
2.	An exploratory needle is inserted.	2.	To puncture the pleura and determine the presence of air or blood in the pleural cavity.
3.	The IntraCath catheter is inserted through the needle into the pleural space. The needle is removed, and the catheter is pushed several centimeters into the pleural space.		
4.	The catheter is taped to the skin; may be sutured to the chest wall and covered with a dressing.	4.	To prevent it from being dislodged out of the chest during patient movement or lung expansion. The chest tube clamp is removed once the chest tube is attached to the system.
5.	The catheter is attached to a connector/tubing and attached to a drainage system (underwater-seal or commercial system) and all connections taped.	5.	All connections are taped to prevent disconnection.
Trocar technique for chest tube insertion			
Using universal precautions and aseptic technique, a trocar catheter is used for the insertion of a large-bore tube for removal of a moderate to large amount of air leak or for the evacuation of serous effusion.			
1.	A small incision is made over the prepared, anesthetized site. Blunt dissection (with a hemostat) through the muscle planes in the interspace to the parietal pleura is performed.	1.	To admit the diameter of the chest tube.

Nursing Action		Rationale	
2.	The trocar is directed into the pleural space, the cannula is removed, and a chest tube is inserted into the pleural space and connected to a drainage system.	2.	There is a trocar catheter available equipped with an indwelling pointed rod for ease of insertion.
Hemostat technique using a large-bore chest tube			
Using universal precautions and aseptic technique, a large bore chest tube is used to drain blood or thick effusions from the pleural space.			
1.	Using universal precautions, aseptic technique, and after skin preparation and anesthetic infiltration, an incision is made through the skin and subcutaneous tissue.	1.	The skin incision is usually made one interspace below proposed site of penetration of the intercostal muscles and pleura.
2.	A curved hemostat is inserted into the pleural cavity and the tissue is spread with the clamp.	2.	To make a tissue tract for the chest tube.
3.	The tract is explored with an examining finger.	3.	Digital examination helps confirm the presence of the tract and penetration of the pleural cavity.
4.	The tube is held by the hemostat and directed through the opening up over the ribs and into the pleural cavity.		
5.	The clamp is withdrawn and the chest tube is connected to a chest drainage system.	5.	The chest tube has multiple openings at the proximal end for drainage of air or blood.
6.	The tube is sutured in place and covered with a sterile dressing.	6.	Prevents dislodgment.
7.	Catheter is attached to a connector/tube and to the system. All connections are taped.	7.	Clamps are removed from the chest tube once connected to the drainage system. Chest tubes open to air at the time of insertion will result in a pneumothorax.
Chest tube (tube thoracostomy) inserted via hemostat technique.			
Follow-up phase			
1.	Observe the drainage system for blood and air. Observe for fluctuation in the tube on respiration.	1.	If a hemothorax is draining through a thoracostomy tube into a bottle containing sterile normal saline, the blood is available for auto transfusion.

Nursing Action		Rationale	
2.	Secure a follow-up chest X-ray.	2.	To confirm correct chest tube placement and reexpansion of the lung.
3.	Assess for bleeding, infection, leakage of air and fluid around the tube.	3.	With too rapid removal of fluid, a vasovagal response may occur with resulting hypotension. Continued use of petroleum gauzes or ointment can irritate the skin.
4.	Maintain integrity of the chest drainage system.	4.	Chest tube malposition is the most common complication.

PROCEDURE 15: MANAGING THE PATIENT UNDER WATER-SEAL CHEST DRAINAGE

Equipment

- Closed chest drainage system.
- Holder for the drainage system (if needed) connector for emergency use.
- Vacuum motor.
- Sterile connector for emergency use (i.e., sterile water).

Procedure

Nursing Action			Rationale	
Performance phase				
1.	Attach the chest tube from the pleural space (the patient) to the collecting/drainage tubing and water-seal drainage system. Add sterile water to water-seal chambers, as needed. Adjust suction until bubbling is seen or set gauge as directed. Keep drainage system below the level of the chest.		1.	Water-seal drainage provides for the escape of air and fluid into a drainage bottle. The water acts as a seal and keeps the air from being drawn back into the pleural space. Vigorous bubbling is not indicated.
2.	Check the tube connections periodically. Tape if necessary.		2.	Tube connections are checked to ensure tight fit, patency of the tubes, and to prevent backflow of drainage or air.
	a.	The tube should be as straight as possible and coiled below the level of chest without dependent loops.		
	b.	Do not let the patient lie on the collecting/tubing drainage.		
3.	Mark the original fluid level with tape on the outside of the drainage system. Mark hourly and daily increments (date and time) at the drainage level.		3.	This marking will show the amount of fluid loss and how fast fluid is collecting in the drainage bottle. It serves as a basis for blood replacement, if the fluid is blood. Grossly bloody drainage will appear in the bottle in the immediate postoperative period and, if excessive, may necessitate reoperation. Drainage usually declines progressively after the first 24 hours.

Nursing Action		Rationale	
4.	Assess patient's clinical status at least once per shift. Observe and report immediately signs of rapid/ shallow breathing, cyanosis, pressure in the chest, subcutaneous emphysema, or symptoms of hemorrhage.	4.	Removal of 1,000 to 1,200 mL of pleural fluid at one time can result in hypotension and rebound pleural effusion. Report to the physician immediately. More frequent monitoring is required at the initiation of therapy and when warranted by patient's condition. Many clinical conditions may cause these signs and symptoms, including tension pneumothorax, mediastinal shift, hemorrhage, severe incisional pain, pulmonary embolus, and cardiac tamponade. Surgical intervention may be necessary.
5.	Make sure the tubing does not loop or interfere with the movements of the patient.	5.	Fluid collecting in the dependent segment of the tubing will decrease the negative pressure applied to the catheter. Kinking, looping, or pressure on the drainage tubing can produce back pressure, thus possibly forcing drainage back into the pleural space or impeding drainage from the pleural space.
6.	Encourage the patient to assume a position of comfort. Encourage good body alignment. When the patient is in a lateral position, place a rolled towel under the tubing to protect it from the weight of the patient's body. Encourage the patient to change position frequently.	6.	The patient's position should be changed frequently to promote drainage and to prevent postural deformity and contractures. Proper positioning helps breathing and promotes better air exchange. Pain medication may be indicated to enhance comfort and deep breathing.
7.	Put the arm and shoulder of the affected side through ROM exercises several times daily. Some pain medication may be necessary.	7.	Exercise helps to avoid ankylosis of the shoulder and assists in lessening postoperative pain and discomfort.
8.	Make sure there is fluctuation (“tidaling”) of the fluid level in the drainage system.	8.	Fluctuation of the water level in the tube shows that there is effective communication between the pleural space and the drainage system; provides a valuable indication of the patency of the drainage system, and is a gauge of intrapleural pressure.
9.	Fluctuations of fluid in the tubing will stop when:		
	a. The lung has reexpanded.		

Nursing Action			Rationale	
	b.	The tubing is obstructed by blood clots or fibrin.		
	c.	A dependent loop develops.		
10.	Watch for leaks of air in the drainage system as indicated by constant bubbling in the water-seal bottle.		10.	Leaking and trapping of air in the pleural space can result in tension pneumothorax.
	a.	Report excessive bubbling in the water-seal change immediately.		
11.	Encourage the patient to breathe deeply and cough at frequent intervals. If there are signs of incisional pain, adequate pain medication is indicated.		11.	Deep breathing and coughing help to raise the intrapleural pressure, this allows emptying of any accumulation in the pleural space and removes secretions from the tracheobronchial tree so the lung expands.
12.	If the patient has to be transported to another area, place the drainage system below the chest level (as close to the floor as possible).		12.	The drainage apparatus must be kept at a level lower than the patient's chest to prevent backflow of fluid into the pleural space.
13.	If the tube becomes disconnected, cut off the contaminated tips of the chest tube and tubing, insert a sterile connector in the chest tube and tubing, and reattach to the drainage system. Otherwise, do not clamp the chest tube during transport.			
14.	When assisting with removal of the tube:		14.	The chest tube is removed as directed when the lung is reexpanded (usually 24 hours to several days). Signs of reinflation include little or no drainage, absence of air leak, no noted respiratory distress, and no fluctuations in fluid in water-seal chamber, no residual air or fluid in chest X-ray. During the tube removal, avoid a large sudden inspiratory effort, which may produce a pneumothorax.
	a.	Administer pain medication 30 minutes before removal of chest tube.		
	b.	Instruct the patient to perform a gentle Valsalva maneuver or to breathe quietly.		
	c.	The chest tube is clamped and removed.		
	d.	Simultaneously, a small bandage is applied and made airtight with petroleum gauze covered by 4″ × 4″ gauze and thoroughly covered and sealed with tape.		

Nursing Action		Rationale	
Follow-up phase			
1.	Monitor the patient's pulmonary status for signs and symptoms of decompensation. Observe insertion site for signs of infection and changes in drainage.	1.	Patient could have reformation of pneumothorax after removal as well as infection at injection site.

PROCEDURE 16: MANUAL CENTRAL VENOUS PRESSURE (CVP) MONITORING

Equipment

- Venous pressure tray.
- Cut down tray
- Infusion solution/infusion set with CVP manometer (electronic CVP monitoring does not use a manometer.).
- I.V. pole.
- Arm board (for antecubital insertion).
- Sterile dressing and tape.
- Gowns, masks, caps, and sterile gloves.
- Heparin flush system and pressure bag (if transducer to be used).
- ECG monitors.
- Carpenter's level (for establishing zero point).

> ***NURSING ALERT***
> *A CVP line is a potential source of septicemia.*

Procedure

	Nursing Action		Rationale
	Preparatory phase (By nurse)		
1.	Assemble equipment according to the manufacturer's directions. Evaluate the patient's prothrombin time, partial thromboplastin time, and complete blood count.	1.	To assess for coagulopathies or anemia.
2.	Explain the procedure to the patient and ensure that informed consent is obtained.	2.	Procedure is similar to an I.V., and the patient may move in the bed as desired after passage of catheter.
a.	Explain to patient how to perform the Valsalva maneuver.	a.	The Valsalva maneuver performed during catheter insertion and removal decreases risk of air emboli.
b.	Ensure that the patient was NPO six hours before insertion.		

Nursing Action		Rationale	
3.	Position patient appropriately.	3.	Provides for maximum visibility of veins.
a.	Place in supine position.	a.	
i.	Arm vein—extend arm and secure on arm board.		
ii.	Jugular veins—place patient in Trendelenburg's position. Place a small rolled towel under shoulders (subclavian approach).	ii.	Trendelenburg's position reduces the risk of air emboli. Anatomic access and clinical status of the patient are considered in site selection.
4.	Flush I.V. infusion set and manometer (measuring device) or prepare heparin flush for use with transducer. Secure all connections to prevent air emboli and bleeding.	4.	
a.	Attach manometer to I.V. pole. The zero point of the manometer should be on a level with the patient's right atrium.	a.	The level of the right atrium is at the fourth intercostal space midaxillary line.
b.	Calibrate/zero transducer and level port with patient's right atrium.	b.	Mark midaxillary line with indelible ink for subsequent readings to ensure consistency of the zero level.
5.	Institute electrocardiogram monitoring.	5.	Dysrhythmias may be noted during insertion as catheter is advanced.
Insertion Phase (By physician)			
1.	Physician puts on gown, cap, and mask.	1.	CVP insertion is a sterile procedure.
2.	The CVP site is surgically cleaned. The physician introduces the CVP catheter percutaneously or by direct venous cut down.	2.	Patient may be asked to perform the Valsalva maneuver to protect against risk of air embolus.
3.	Assist the patient in remaining motionless during insertion.		
4.	Monitor for dysrhythmias, tachypnea, and tachycardia as the catheter is threaded into the great vein or right atrium.	4.	These are signs of pneumothorax or arterial puncture.
5.	Connect primed I.V. tubing/heparin flush system to catheter and allow I.V. solution to flow at a minimum rate to keep vein open (25 mL maximum).	5.	Catheter placement must be verified before hypertonic or blood products can be administered.

Nursing Action		Rationale	
6.	The catheter should be sutured in place.	6.	Prevents inadvertent catheter advancement or dislodgement.
7.	Place a sterile occlusive dressing over site.		
8.	Obtain a chest X-ray.	8.	Verifies correct catheter position and absence of pneumothorax.
To Measure CVP			
1.	Place the patient in a comfortable position.	1.	This baseline position is used for subsequent readings.
2.	Position the zero point of the manometer at the level of the right atrium (see accompanying figure).	2.	To eliminate the effect of hydrostatic pressure on the transducer.
3.	Turn the stopcock so the I.V. solution flows into the manometer, filling to about the 0- to 25-cm level. Then turn stopcock so the manometer solution flows into patient.	3.	To eliminate the effects of atmospheric pressure.
4.	Observe the fall in the height of the column of fluid in manometer. Record the level at which the solution stabilizes or stops moving downward. This is CVP. Record CVP and the position of the patient.	4.	The column of fluid will fall until it meets equal pressure. The CVP reading is reflected by the height of a column of fluid in the manometer when there is open communication between the catheter and the manometer. The fluid in the manometer will fluctuate slightly with the patient's respirations. This confirms that the CVP line is not obstructed by clotted blood.
5.	CVP catheter may be connected to a transducer and an electrical monitor with either digital or calibrated CVP wave readout.		
6.	CVP may range from 5 to 12 cm H^2O (absolute numeric values have not been agreed on) or 2 to 6 mm Hg. All values should be determined at the end of expiration.	6.	A change in CVP is a more useful indication of adequacy of venous blood volume and alterations of cardiovascular function. The management of the patient is not based on one reading, but on repeated serial readings in correlation with patient's clinical status.
7.	Assess the patient's clinical condition. Frequent changes in measurements (interpreted within the	7.	CVP is interpreted by considering the patient's entire clinical picture: hourly

Nursing Action			Rationale		
	context of the clinical situation) will serve as a guide to detect whether the heart can handle its fluid load and whether hypovolemic or hypervolemia is present.			urine output, heart rate, blood pressure, and cardiac output measurements.	
				a.	CVP near zero indicates that the patient is hypovolemic (verified if rapid I.V. infusion causes patient to improve).
				b.	CVP above 15 to 20 cm H_2O may be due to either hypervolemia or poor cardiac contractility.
8.	Turn the stopcock again to allow the I.V. solution to flow from solution bottle into the patient's veins. Use an I.V. pump, and monitor the infusion at least hourly.			8.	When readings are not being made, I.V. flow bypasses the manometer but keeps line open; flow should be controlled to prevent fluid overload.
Follow-up Phase					
1.	Prevent and observe for complications.		1	Patient's complaints of new or different pain or shortness of breath must be assessed closely; may indicate development of complications.	
	a.	*From catheter insertion:* Pneumothorax, hemothorax, air embolism, hematoma, and cardiac tamponade.	a.	Signs and symptoms of air embolism include severe shortness of breath, hypotension, hypoxia, rumbling murmur, and cardiac arrest.	
	b.	*From indwelling catheter:* Infection, air embolism, and central venous thrombosis.			
2.	Make sure the cap is secure on the end of the CVP monitor and all clamps are closed when not in use.		2.	Prevents air from entering system, thereby reducing risk of air embolus.	
3.	If air embolism is suspected, immediately place patient in left lateral Trendelenburg's position and administer oxygen.		3.	Air bubbles will be prevented from moving into the lungs and will be absorbed in 10 to 15 minutes in the right ventricular outflow tract.	
4.	Carry out ongoing nursing surveillance of the insertion site and maintain aseptic technique.		4.		

Nursing Action			Rationale	
a.	Inspect entry site twice daily for signs of local inflammation and phlebitis. Remove the catheter immediately if there are signs of infection.		a.	Local infection could spread rapidly through systemic circulation.
b.	Make sure sutures are intact.		b.	If catheter dislodges into right atrium, dysrhythmias may result.
c.	Change dressings as prescribed.			
d.	Label to show date and time of change.			
e.	Send the catheter tip for bacteriologic culture when it is removed.		e.	To detect bacterial colonization.
5.	When discontinued, remove central line.		5.	
	a.	Position patient flat with head down.	a.	Prevents air from entering blood vessel.
	b.	Remove dressing and sutures.		
	c.	Have patient take a deep breath and hold it while catheter is gently pulled out.	c.	Prevents air emboli by creating positive chest pressure.
	d.	Apply pressure at catheter site and apply dressing.	d.	To prevent bleeding.

PROCEDURE 17: DIRECT CURRENT DEFIBRILLATION FOR VENTRICULAR FIBRILLATION

Equipment

- Direct current defibrillator with paddles or multifunctional defibrillator pads.
- Highly conductive multipurpose electrolyte gel.

Procedure

Nursing Action			Rationale	
Performance Phase				
MONITORED PATIENT				
1.	If ventricular fibrillation is witnessed, precordial thump may be considered.		1.	To minimize cerebral ischemia and potentially restart cardiac rhythm.
2.	Immediately implement cardiopulmonary resuscitation (CPR) until defibrillator is available.		2.	CPR is essential before and after defibrillation to ensure blood supply to the cerebral and coronary arteries.
Unmonitored patient				
1.	Expose anterior chest and move jewelry and transdermal patches away from area.		1.	Jewelry may interfere with electrical current and cause serious burns.
2.	Immediately implement CPR until defibrillator is available. If response time is greater or equal to five minutes, perform two minutes of CPR prior to defibrillation.		2.	To provide oxygenated blood supply to the cerebral and coronary arteries.
3.	Apply multifunctional defibrillator pads or paddles with conductive gel to patient's bare chest.		3.	Multipurpose electrolyte gel provides better conduction than paddles alone. Do not allow gel to be spread across the chest because this may cause severe burns to the patient's chest and may divert the current from traveling to the heart.
4.	Apply paddles or multifunctional pads.		4.	The paddles/pads are placed so that the electrical current flows through as much of the myocardium as possible.
	a.	Anterolateral position: Apply one paddle/pad to just the right of the sternum below the clavicle and the other paddle/pad to just the left of the		

Nursing Action			Rationale		
		cardiac apex (see accompanying figure, page 362).			
	b.	Anteroposterior position: Apply anterior pad over left apex and posterior pad under the infrascapular region.	b.		In this method, the current directly traverses the heart.
5.	Remove oxygen from immediate area.		5.	Prevents danger of fire or explosion.	
6.	Turn on defibrillator to the prescribed setting. The American Heart Association recommends that initial defibrillation should be 200 joules for biphasic or 360 joules for monophasic.		6.	Biphasic is preferred over monophasic. Means that the machine delivers current that flows in one direction for a specified duration then reverses the current to flow in the other direction. Significantly lower energy levels are required with biphasic defibrillators.	
7.	***For paddles:***		7.		
	a.	Grasp the paddles only by the insulated handles.		a.	To prevent getting shocked.
	b.	Charge the paddles. Once paddles are charged, give the command “ALL CLEAR.” Look around quickly to make sure everyone is clear from the patient and bed.		b.	If a person touches the bed, he may get shocked when the patient is defibrillated.
	c.	Push the discharge buttons located on both of the handles of the paddles while simultaneously exerting 25 lb of pressure to each of the paddles.		c.	If good skin contact is not maintained, the electrical current may take the path of least resistance and arc from one paddle to the other.
8.	For multifunctional pads:		8.	Multifunctional pads provide hands-free defibrillation.	
	a.	Press the charge button on the defibrillator machine. Once the charge is reached, give the command “ALL CLEAR.” Look around quickly to make sure everyone is clear from the patient and bed.			
	b.	Push the shock button on the defibrillator machine.			
9.	Resume CPR immediately after defibrillation.		9.	To oxygenate the patient and restore circulation.	

Nursing Action		Rationale	
	Follow-up Phase		
1.	After the patient is defibrillated and rhythm is restored, antiarrhythmics are usually given to prevent recurrent episodes.	1.	Any resultant arrhythmia may require appropriate drug intervention.
2.	Continue with intensive monitoring and care.	2.	The patient may remain in an unstable condition.

PROCEDURE 18: SYNCHRONIZED CARDIO VERSION

Equipment

- Direct current defibrillator with paddles or multifunctional pads.
- Highly conductive multipurpose electrolyte gel.

Procedure

Nursing Action			Rationale	
1.	If the procedure is elective, it is advisable to have the patient ingest nothing by mouth for 12 hours before the cardio version. Make sure to have working suction equipment available.		1.	During sedation or the procedure, the patient may vomit and aspirate if the stomach is full.
	a.	Reassure the patient and make sure that informed consent has been obtained.		
	b.	Make sure the patient has not been taking digoxin and that serum potassium level is normal.	b.	Low potassium levels may precipitate post-shock dysrhythmias.
2.	Make sure an I.V. line is secure.		2.	An I.V. line is necessary for administration of emergency medications and sedation.
3.	Obtain a 12-lead electrocardiogram (ECG) before and after cardio version with the ECG machine.		3.	An ECG is taken to ensure that the patient has not had a recent myocardial infarction or converted back to sinus rhythm prior to the cardio version.
4.	Make sure oxygen is readily available.		4.	May be needed if arrhythmias occur after cardio version.
5.	Placement of paddles or multifunctional pads:			
	a.	Anterolateral position: Apply one paddle/pad immediately to the right of the sternum below the clavicle, and the other paddle/pad just immediately to the left of the cardiac apex.		
	b.	Anterior position: Apply anterior pad over left apex and posterior pad under the infrascapular region.		
6.	Turn the machine to the synchronize mode. Look for the marking above the R wave on the machine. Set to the appropriate joules.		6.	If the electrical discharge hits the T wave, ventricular fibrillation may occur.

Nursing Action			Rationale		
	a.	Charge the machine. Then give the command "ALL CLEAR." Look around quickly to make sure everyone is clear from the patient and bed.		a.	To avoid touching patient and receiving shock.
	b.	Push the shock button. The discharge may be delayed because it is resynchronizing with the R wave before discharging the electrical energy.			
7.	If repeat cardio version is needed, check if the machine is still in the synchronized mode. Some machines reset to defibrillation mode.				
8.	A short-acting sedative and, possibly, an analgesic may be given.		8.	This helps produce amnesia concerning the cardio version.	
9.	Monitor the ECG after conversion occurs. Blood pressure should be recorded every 15 minutes for 1 hour or according to facility policy.		9.	The patient may revert to previous dysrhythmias after conversion.	

PROCEDURE 19: AUTOMATED EXTERNAL DEFIBRILLATOR

Equipment

- Automatic external defibrillator (AED).
- Defibrillator pads.

Procedure

Nursing Action		Rationale	
1.	Assess unresponsiveness and pulselessness.		
2.	Position the patient in the supine position.		
3.	Start cardiopulmonary resuscitation (CPR) while automated external defibrillator (AED) is being applied.	3.	Early restoration of oxygenation and perfusion is imperative in enhancing the resuscitative effort.
4.	Place pads in the Anterolateral position. Apply one paddle/pad immediately to the right of the sternum below the clavicle and the other paddle/pad immediately to the left of the cardiac apex.	4.	Anterior placement is preferred, because attempting anterior-posterior pad placement may delay treatment.
5.	Turn on AED.		
6.	Follow audio and/or visual instructions from the AED.	6.	The AED will analyze the rhythm in 5 to 15 seconds and determine the need for defibrillation. It will then let the operator know how to proceed.
7.	Suspend CPR or any movement of the patient during the analysis.	7.	External movement will impair the AED's accuracy in analyzing the rhythm.
8.	If, after analyzing the rhythm, a shock is advised, the AED will instruct the operator to prepare for a shock. It will charge the unit, give the warning to “STAND CLEAR” and then deliver the shock or prompt the operator to push the shock button.		
9.	After the first shock, resume CPR for two minutes before reanalyzing the rhythm per American Heart Association guidelines.	9.	To provide oxygenation to the patient.

Nursing Action		Rationale	
10.	If no shock is indicated, continue CPR for two minutes, then allow the AED to analyze the rhythm. Proceed as above if a shock is now indicated. If a shock is still not indicated, continue CPR and reanalyze the rhythm every two minutes.	10.	A shock will only be delivered if ventricular fibrillation or tachycardia is present.
11.	If the patient regains a pulse, continue to support ventilations. Keep AED pads attached and the unit on in case the patient again loses consciousness.		

PROCEDURE 20: ASSISTING THE PATIENT UNDERGOING PERICARDIOCENTESIS

Equipment

- Pericardiocentesis tray.
- Intracath set.
- Skin antiseptic.
- 1% to 2% xylocaine.
- Sterile gloves.
- Electrocardiograph (ECG) for monitoring purposes.
- Sterile ground wire to be connected between pericardial needle and V lead of ECG (use alligator clip type connectors).
- Equipment for cardiopulmonary resuscitation.

Procedure

Nursing Action		Rationale	
Preparatory Phase			
1.	Sedate the patient as prescribed.	1.	To reduce anxiety of the patient. Depending on sedatives used, may provide amnesic effect.
2.	Establish venous access.	2.	This preserves a route for I.V. therapy in an emergency.
3.	Place the patient in a comfortable position with the head of the bed or treatment table raised to a 45-degree angle.	3.	This position makes it easier to insert needle into pericardial sac.
4.	Apply the limb leads of the ECG to the patient.	4.	The patient is monitored during the procedure by ECG for arrhythmias, increased heart rate, and decreased heart rate.
5.	Have defibrillator available for immediate use.	5.	In the event that the patient needs to be shocked from an arrhythmia.
6.	Have pacemaker available for immediate use.	6.	In the event the patient becomes bradycardic.
7.	Open the tray using aseptic technique.		

Nursing Action		Rationale		
	Performance Phase (By physician)			
1.	The site is prepared with skin antiseptic; the area is draped with sterile towels and injected with anesthetic.	1.	To cleanse and disinfect the area for pericardial needle insertion.	
2.	The pericardial aspiration needle is attached to a 50-mL syringe by a three-way stopcock. Lead V (precordial lead wire) of the ECG is attached to the hub of the aspirating needle by a sterile wire and alligator clips or clamp.	2.	There is danger of laceration of myocardium/coronary artery and of cardiac dysrhythmias.	
3.	The needle is advanced slowly until fluid is obtained.	3.	Fluid is generally aspirated at a depth of 1 to 1½ inches (2.5 to 4 cm).	
4.	When the pericardial sac has been entered, a hemostat is clamped to the needle at the chest wall just where it penetrates the skin. Pericardial fluid is aspirated slowly.	4.	This prevents movement of the needle and further penetration while fluid is being removed. Aspirated fluid may be cloudy, clear, or bloody.	
5.	Monitor the patient's ECG, blood pressure, and venous pressure constantly.	5.	a.	The ST segment rises if the point of the needle contacts the ventricle; there may be ventricular ectopic beats.
			b.	The PR segment is elevated when the needle touches the atrium.
			c.	Large, erratic QRS complexes indicate penetration of the myocardium.
6.	If a large amount of fluid is present, a polyethylene catheter may be inserted through a needle (an Intracath) and left in the pericardial sac. The catheter may be connected to a drainage bag or capped.	6.	An indwelling catheter left in the pericardial space permits further slow drainage of fluid and prevents recurrence of cardiac tamponade.	
7.	Watch for the presence of bloody fluid. If blood accumulates rapidly, an immediate thoracotomy and cardiorrhaphy (suturing of heart muscle) may be indicated.	7.	Bloody pericardial fluid may be due to trauma. Bloody pericardial effusion fluid does not readily clot, whereas blood obtained from inadvertent puncture of one of the heart chambers does clot.	

	Nursing Action		Rationale
	Follow-up phase		
1.	Monitor patient closely.	1.	After Pericardiocentesis, careful monitoring of blood pressure, venous pressure, and heart sounds will be necessary to indicate possible recurrence of tamponade; repeated aspiration is then necessary.
	a. Watch for rising venous pressure and falling arterial pressure.		
	b. Auscultate the area over the heart.		
2.	Prepare for surgical drainage of pericardium if:	2.	In the presence of these signs, the patient is probably experiencing cardiac tamponade.
	a. Pericardial fluid repeatedly accumulates.		
	b. Aspiration is unsuccessful.		
	c. Complications develop.		
3.	Listen for a decrease in intensity of heart sounds.	3.	Indicates cardiac tamponade. Requires immediate intervention.
4.	Assess for complications, including:	4.	
	a. Inadvertent puncture of heart chamber.		
	b. Dysrhythmias.		
	c. Puncture of lung, stomach, or liver.		
	d. Laceration of coronary artery or myocardium.		

PROCEDURE 21: ADMINISTERING AN ENEMA

Equipment

- Prepackaged enema or enema container.
- Disposable gloves.
- Water-soluble jelly.
- Waterproof pad.
- Bath blanket.
- Bedpan or commode.
- Washcloth and towel.
- Basin.
- Toilet tissue.

Procedure

Nursing Action		Rationale	
	Preparatory phase		
1.	Assess the patient's bowel habits (last bowel movement, laxative usage, bowel patterns) and physical condition (hemorrhoids, mobility, external sphincter control).	1.	Enemas should not be given if there is a suspicion of appendicitis or bowel obstruction.
2.	Provide for privacy, and explain procedure to patient.	2.	Provides comfort.
	Performance phase		
1.	Wash hands.	1.	Promotes hygiene.
2.	Place patient on left side with right knee flexed (Sims' position). Place waterproof pad underneath patient, and cover the patient with a bath blanket.	2.	Allows for enema solution to flow by gravity along the natural curve of the sigmoid colon and rectum.
3.	Place bedpan or bedside commode in position for patient (who cannot ambulate to the toilet or who may have difficulty with sphincter control).	3.	Allows for easy accessibility.
4.	Remove plastic cover over tubing, and lubricate tip of enema tubing 3-4 inches (7.5-10 cm) unless prepackaged (tip is already lubricated). Even pre-packaged enemas may need more lubricant.	4.	Prevents trauma and eases application.

Nursing Action		Rationale	
5.	Apply disposable gloves.	5.	Standard precautions.
6.	Separate buttocks and locate rectum.		
7.	Instruct patient that you will be inserting tubing and to take slow, deep breaths.	7.	Allows for patient relaxation and readiness.
8.	Insert tubing 3-4 inches for adult patients.	8.	Prevents tissue trauma of the rectum.
9.	Slowly instill the solution using a clamp and adjust the height of the container to regulate flow rate (if using an enema bag and tubing). For high enemas, raise enema container 12-18 inches (30.5-45.5 cm) above anus; for low enemas, 12 inches. If using a prepackaged enema, slowly squeeze the container until all solution is instilled.	9.	Rapid infusion can cause colon distention and cramping. If the container is elevated over 12-18 inches, and the controller on the tubing is not regulated, this can contribute progressively rapid enema infusions.
10.	Lower the container or clamp the tubing if patient complains of cramping.	10.	Allows fluid time to disperse.
11.	Withdraw rectal tubing after all enema solution has been instilled or until clear (usually not more than three enemas).	11.	"Until clear" means until results do not contain fecal matter and are clear.
12.	Instruct patient to hold the solution as long as possible, this may cause a feeling of distention.	12.	Promotes better results.
13.	Discard supplies in the appropriate trash receptacle.	13.	Maintains hygiene and minimizes patient embarrassment.
14.	Assist the patient on the bedpan, bedside commode, or toilet when the urge to defecate occurs.	14.	Prompt action will prevent soiling.
15.	Observe enema return for amount and fecal content. Instruct patient not to flush the toilet until the nurse has seen the results.	15.	If the enema has not had sufficient time to absorb, results may be mostly clear with little fecal material.
	Follow-up phase		
1.	Document the type of enema given, volume, and results on the appropriate chart forms.	1.	For continuity of care.
2.	Assess and document the presence or absence of abdominal distention after enema was given.	2.	Relief of abdominal distention indicates success of gas relief.
3.	Assist the patient with washing perineum and rectal areas, if indicated; the patient may also need a clean gown or linen change.	3.	Fecal soiling may result, especially in bedridden patients.

PROCEDURE 22: NASOGASTRIC INTUBATION

Equipment

- Nasogastric (NG) tube—usually single-lumen Levin or double-lumen Salem sump tube.
- Water-soluble lubricant.
- Suction equipment if ordered.
- Clamp for tubing.
- Towel, tissues, and emesis basin.
- Glass of water and straw.
- Tincture benzoate.
- Hypoallergenic tape: 12 inch and 1 inch.
- Bio-occlusive transparent dressing.
- Irrigating set with 20-mL syringe or a 50-mL catheter-tip syringe.
- Stethoscope.
- Tongue blade.
- Penlight.
- Disposable gloves.
- Normal saline.

Procedure

Nursing Action		Rationale	
Preparatory phase			
1.	Ask if the patient has ever had nasal surgery, trauma, a deviated septum, or bleeding disorder.	1.	Nasogastric tubes may be contraindicated in patients with nasopharyngeal or esophageal obstruction, severe uncontrolled Coagulopathy, or severe maxillofacial trauma.
2.	Explain the procedure to the patient, and tell how mouth breathing, panting, and swallowing will help in passing the tube.	2.	Improves comfort and compliance.
3.	Place the patient in a sitting or high-Fowler's position; place a towel across their chest.	3.	Facilitates passage of tube into the esophagus.

Nursing Action			Rationale	
4.	Determine with the patient what sign he might use, such as raising the index finger, to indicate “wait a few moments” because of gagging or discomfort.		4.	Provides a method of communication, which is reassuring to the patient.
5.	Remove dentures; place emesis basin and tissues within the patient's reach.		5.	Dentures may become loose and interfere with tube insertion.
6.	Inspect the tube for defects; look for partially closed holes or rough edges.		6.	Irrigation and suction may be affected by a defective tube.
7.	Place rubber tubing in ice-chilled water for a few minutes to make the tube firmer. Plastic tubing may already be firm enough; if too stiff, dip in warm water.		7.	A firm tube that is not too rigid will pass easiest, without causing trauma.
8.	Determine the length of the tube needed to reach the stomach		8.	To prevent coiling of tube in stomach or tube ending in esophagus.
9.	Have the patient blow their nose to clear the nostrils.		9.	To facilitate passage through the nose.
10.	Inspect the nostrils with a penlight, observing for any obstruction. Occlude each nostril, and have the patient breathe.		10.	This will help determine which nostril is more patent.
11.	Wash your hands. Put on disposable gloves.		11.	To protect nurse from patient's secretions.
12.	Measure the patient's NEX (nose, earlobe, xiphoid), and mark the tube appropriately. Some tubes may be premarked to indicate length, but this may not correlate exactly with the measurement obtained.		12.	The measurement will help ensure that the end of tube reaches the stomach.
	a.	The distance from the nose to the earlobe is the first mark on the tube. This measurement represents the distance to the nasal pharynx.		
	b.	When the tube reaches the xiphoid process (tip of the breast bone) a second mark is made on the tube. This measurement represents the length required to reach the stomach.		

Nursing Action		Rationale	
Performance phase			
1.	Coil the first 3-4 inches (7.5-10 cm) of the tube around your fingers.	1.	This curves tubing and facilitates tube passage.
Obtaining the NEX measurement.			
2.	Lubricate the coiled portion of the tube with water-soluble lubricant. Avoid occluding the tube's holes with lubricant.	2.	Lubrication reduces friction between the mucous membranes and tube, and prevents injury to the nasal passages. Using a water-soluble lubricant prevents oil aspiration pneumonia if the tube accidentally slips into trachea.
3.	Tilt back the patient's head before inserting tube into nostril, and gently pass tube into the posterior nasopharynx, directing downward and backward toward the ear.	3.	The passage of the tube is facilitated by following the natural contours of the body. The slower the advancement of the tube at this point, the less likelihood of putting pressure on the turbinates, which could cause pain and bleeding.
4.	When tube reaches the pharynx, the patient may gag; allow patient to rest for a few moments.	4.	Gag reflex is triggered by the presence of the tube.
5.	Have the patient tilt head slightly forward. Offer several sips of water through a straw, or permit patient to suck on ice chips, unless contraindicated. Advance tube as patient swallows.	5.	Flexed head position partially occludes the airway, and the tube is less likely to enter trachea. Swallowing closes the epiglottis over the trachea and facilitates passage of tube into the esophagus. Actually, when the tube passes the cricopharyngeal sphincter into the esophagus, it can be slowly and steadily advanced even if the patient does not swallow.
6.	Gently rotate the tube 180 degrees to redirect the curve.	6.	This prevents the tube from entering the patient's mouth.
7.	Continue to advance tube gently each time the patient swallows.	7.	Facilitates forward movement.
8.	If obstruction appears to prevent the tube from passing, do not use force. Rotating tube gently may help. If unsuccessful, remove the tube and try the other nostril.	8.	Avoid discomfort and trauma to the patient.
9.	If there are signs of distress such as gasping, coughing, or cyanosis, immediately remove tube.	9.	The tube may have entered the trachea.

Nursing Action			Rationale	
10.	Continue to advance the tube when the patient swallows, until the tape mark reaches the patient's nostril.		10.	This is the reference point where the tube was measured.
11.	To check whether the tube is in the stomach:		11.	
	a.	Ask the patient to talk.	a.	If the patient cannot talk, the tube may be coiled in throat or passed through vocal cords.
	b.	Use the tongue blade and penlight to examine the patient's mouth—especially an unconscious patient.	b.	If the patient is choking or has difficulty breathing, the tube has probably entered the trachea.
	c.	Attach a syringe to the end of the NG tube. Place a stethoscope over the left upper quadrant of the abdomen, and inject 10 to 20 cc of air while auscultation the abdomen.	c.	Air can be detected by a "whooshing" sound entering the stomach rather than the bronchus. If belching occurs, the tube is probably in the esophagus.
	d.	Obtain aspirate with 30- to 60-mL syringe. If stomach contents cannot be aspirated, reposition the patient and repeat air insufflations. Attempt to aspirate again.	d.	If aspirate obtained, check for gastric placement indicators: ph ≤ 5 and gastric fluid characteristics of grassy green, clear and colorless, or brown.
	e.	X-rays may be done to confirm tube placement.	e.	Consider X-ray confirmation of tube placement in patients with risk factors for malpositioning of tubes.
12.	After the tube is passed and the correct placement is confirmed, attach the tube to suction or clamp the tube.		12.	Clamping can be done using a clamp, plastic plug, or folding the tube over and slipping the bend into the tube end.
13.	Apply tincture benzoate to the area where the tape is placed.		13.	This helps make the tube adhere, especially with diaphoretic patients.
14.	Anchor tube with:		14.	Prevents the patient's vision from being disturbed; prevents tubing from rubbing against nasal mucosa. This will ensure tape security. Do not tape to the tube to the patient's forehead; this could cause necrosis of the nostril.
	a.	Hypoallergenic tape; split lengthwise and only halfway, attach unsplit end of tape to nose, and cross split ends around tubing. Apply another piece of tape to bridge of nose.		
	b.	Bio-occlusive transparent dressing where it exits the nose.		

Nursing Action			Rationale	
15.	Anchor the tubing to the patient's gown. Use a rubber band to make a slipknot to anchor the tubing to the patient's gown. Secure the rubber band to the patient's gown using a safety pin.		15.	To permit mobility of patient. This prevents tugging on the tube when the patient moves.
16.	Clamp the tube until the purpose for inserting the tube takes place.			
17.	Attach the larger lumen of the Salem sump tube to suction equipment if ordered. Low continuous suction or high intermittent suction may be used with the Salem sump tube. If the Levin tube is used, low intermittent suction is recommended.		17.	To prevent gastric mucosal damage, if a vacuum forms and the tube adheres to the gastric wall.
Follow-up phase				
1.	Assure the patient that discomfort will lessen with time.			
2.	Irrigate the tube at regular intervals (every 2 hours unless otherwise indicated) with small volumes of prescribed fluid.		2.	To ensure the tube patency.
	a.	If the tube is a Salem sump, it will require periodic placing of 10 to 20 cc of air through the vent port (blue port or smaller lumen). Do not instill water into the vent, and, if the vent is draining fluid, instill air to clear it.		
	b.	Check the Salem sump tube patency by placing the vent port next to your ear.	b.	A soft hissing sound is heard if the tube is patent. If the port hangs downward and the tube backs up, stomach contents will spill over the patient.
3.	Cleanse nares and provide mouth care every shift.		3.	Promotes patient comfort and decreases risk of infection.
4.	Apply petroleum jelly to nostrils, as needed, and assess for skin irritation or breakdown.		4.	To keep tissue soft and prevent crusting and skin breakdown.

Nursing Action		Rationale	
5.	Keep head of bed elevated at least 30 degrees.	5.	To minimize gastro esophageal reflux.
6.	Record the time, type, and size of tube inserted. Document placement checks after each assessment, along with amount, color, and consistency of drainage.	6.	To ensure proper tube placement at all times, and assist in evaluation of tube effectiveness.

PROCEDURE 23: NASOGASTRIC TUBE REMOVAL

Equipment

- Towel.
- Disposable gloves.
- Lip pomade.
- Mouth hygiene materials.

Procedure

	Nursing Action		Rationale
	Preparatory phase		
1.	Make sure that gastric or small bowel drainage is not excessive in volume.	1.	Tube may not be discontinued unless drainage is minimal, bowel sounds are present, and patient is passing flatus.
2.	Make sure, by auscultation, that audible peristalsis is present.		
3.	Determine whether the patient is passing flatus; this indicates peristalsis.		
4.	Verify the health care provider's order for removal.		
	Performance phase		
1.	Place a towel across the patient's chest, and inform him that the tube is to be withdrawn.	1.	No doubt, the patient will be happy to have progressed to this stage.
2.	Apply disposable gloves.	2.	Provides protection from contaminated body fluids.
3.	Turn off suction; disconnect and clamp tube.	3.	Prevents fluids from leaking from tube.
4.	Remove the tape from the patient's nose.		
5.	Instruct the patient to take a deep breath and hold it.	5.	This maneuver closes the epiglottis.
6.	Slowly, but evenly, withdraw tubing and cover it with a towel as it emerges (as the tube reaches the nasopharynx, you can pull quickly.)	6.	Covering the tubing helps dispel patient's nausea.
7.	Provide the patient with materials for oral care and lubricant for nasal dryness.	7.	Mouthwash and a nasal lubricant will be appreciated by the patient.
8.	Dispose of equipment in appropriate receptacle.		

Nursing Action		Rationale	
9.	Document time of tube removal and the patient's reaction.		
10.	Document tube removal including the color, consistency, and amount of drainage in the suction canister.	10.	For continuity of care.
11.	Continue to monitor the patient for signs of GI difficulties.	11.	Recurrence of nausea or vomiting may require reinsertion of nasogastric tubing. Changes in vital signs may suggest infection.

PROCEDURE 24: USING BALLOON TAMPONADE TO CONTROL ESOPHAGEAL BLEEDING (SENGSTAKEN-BLAKEMORE TUBE METHOD, MINNESOTA TUBE METHOD)

Equipment

- Esophageal balloon (Sengstaken-Blakemore or Minnesota).
- Basin with cracked ice.
- Clamps for tubing.
- Water-soluble lubricant.
- Syringe (50 mL with catheter tip).
- Towel and emesis basin.
- Glass of water and straw.
- Adhesive tape.
- Large scissors (for emergency deflation).
- Manometer (to measure balloon pressure).

Procedure

	Nursing Action		Rationale
	Preparatory phase		
1.	Explain the procedure, provide support, and reassure patient that bleeding will be controlled.	1.	Should allay fear and anxiety.
2.	Advise the patient to breathe through the mouth and swallow periodically.	2.	Assists with passing of the tube.
3.	Elevate the head of the bed slightly, unless patient is in shock.	3.	Elevating the head may worsen shock.
	Esophageal varices and their treatment by a compressing balloon tube (Sengstaken-Blakemore). (A) Dilated veins of the lower esophagus. (B) The tube is in place in the stomach and the lower esophagus, but is not inflated. (C) Inflation of the tube causing compression of the veins. It may be necessary to pass an additional tube through the other nostril to aspirate. Note: The Minnesota four-lumen esophagogastric tamponade tube has an additional outlet for aspiration of the esophagus.		
	Performance phase		
1.	Check balloons by trial inflation to detect leaks.	1.	This is best done under water, because it is easier to see escaping air bubbles.

Nursing Action			Rationale		
2.	Chill the tube, then lubricate it before the physician passes it via mouth or nose (preferable).		2.	Chilling makes the tube more firm and lubrication lessens friction.	
3.	Provide the patient with a few sips of water.		3.	This will help pass the tube more easily.	
4.	After the tube has entered the stomach, verify its placement by irrigating the gastric tube with air while auscultating over the stomach.		4.	It is imperative that the tube is in the stomach so that the gastric tube is not inflated in the esophagus.	
5.	After obtaining an X-ray film of the lower chest and upper abdomen to verify placement in the stomach, inflate gastric balloon (200-250 mL) with air; gently pull tube back to seat balloon against gastro esophageal junction.		5.	This is to exert force against the cardia.	
6.	Clamp gastric balloon; mark tube location at nares.		6.	This prevents air leakage and tube migration. The mark on the tube allows easy visualization of movement of the tube.	
7.	Apply gentle traction to the balloon tube and secure it with a foam rubber cube at the nares		7.	This prevents the tube from migrating with peristalsis and assists in exerting proper pressure.	
8.	Attach Y-connector to esophageal balloon opening. Attach syringe to one arm of the Y-connector and manometer to the other. Inflate esophageal balloon to 25-35 mm Hg. Clamp esophageal balloon.		8.	Maintains enough pressure to tamponade bleeding, while preventing esophageal necrosis.	
9.	Apply suction to gastric aspiration opening. Irrigate at least hourly.		9.	Suctioning and irrigating the tube can remove old blood from the stomach and prevent hepatic encephalopathy; allows monitoring of bleeding status.	
10.	[If using Sengstaken-Blakemore tube] Insert a nasogastric (NG) tube, positioning it above the esophageal balloon and attach to suction.		10.	Suctions saliva accumulated above the esophageal balloon, which may be aspirated, and checks for bleeding above the esophageal balloon.	
11.	[If using a Minnesota tube] Attach fourth port, esophageal suction port, to suction.		11.	Removes esophageal secretions.	
	a.	Label each port.		a.	Prevents accidental deflation or irrigation.

Nursing Action			Rationale		
	b.	Tape scissors to head of bed.		b.	Airway occlusion may occur if the esophageal balloon is pulled into the hypo pharynx. If this occurs, the esophageal balloon tube must be cut and removed immediately.

PROCEDURE 25: BLOOD GLUCOSE MONITORING TECHNIQUE

Equipment

- Blood glucose meter.
- Test strip.
- Disposable gloves.
- Lancet/lancing device.
- Alcohol wipes.
- 2″ × 2″ gauze or clean tissue.
- Cotton ball.

Procedure

<table>
<tr><th colspan="2">Nursing Action</th><th colspan="2">Rationale</th></tr>
<tr><td>1.</td><td>Prepare the finger to be lanced by having the patient wash hands in warm water and soap. Dry thoroughly. For convenience, an alcohol wipe may be used to cleanse the finger. Alcohol must dry thoroughly before finger is lanced.</td><td>1.</td><td>Washing in warm water will increase the blood flow to the finger and remove superficial contaminants that could cause erroneous readings.</td></tr>
<tr><td>2.</td><td>Don disposable gloves.</td><td>2.</td><td>Complies with Centers for Disease Control and Prevention standards for blood-borne pathogens.</td></tr>
<tr><td>3.</td><td>Turn on the glucose meter. Prepare the meter by validating the proper calibration with the strips to be used (this usually involves matching a code number on the strip bottle to the code registered on the meter).</td><td>3.</td><td>Errors in glucose readings can result from miscalibrated or improperly coded meters.</td></tr>
<tr><td>4.</td><td colspan="3">The meter will indicate its readiness by displaying a message or symbol. Some meters require that the glucose test strip be inserted at this time.</td></tr>
<tr><td>5.</td><td>Prick the patient's finger lateral to the fingertip using lancet/lancing device, obtaining a large, hanging drop of blood. Most inaccurate blood glucose readings result from insufficient blood samples.</td><td>5.</td><td>This avoids the most sensitive area of the fingertip.</td></tr>
</table>

Nursing Action		Rationale	
6.	Apply the blood carefully to the strip test area (varies by glucose meter model).	6.	Some glucose meters require that the test area be covered completely for accurate results. Others use only a small drop of blood inserted at the side of the test strip.
Obtaining blood from a finger using a lancet device		Applying drop of blood to test strip	
7.	Completing the test	7.	
a.	The blood remains on the strip as the meter processes the result.	a.	Processing time varies between meters, but the meter will be programmed to display the results at the appropriate time.
8.	The lanced finger is covered with gauze or a tissue until bleeding subsides. If necessary, an adhesive bandage is then applied.		

PROCEDURE 26: TEACHING SELF-INJECTION OF INSULIN

Equipment

- Prescribed bottle of insulin.
- Disposable insulin syringe and needle or insulin pen injection device with insulin cartridge.
- Cotton ball and alcohol or alcohol wipe.

Procedure

	Nursing Action		Rationale
	To inject insulin		
1.	Give the patient the syringe or insulin pen device containing the prescribed dose of insulin.		
2.	Have patient select a clean area of subcutaneous tissue.	2.	Preparation with alcohol is not necessary.
3.	Instruct the patient to hold the syringe as he would a pencil.	3.	Helps to accurately target the injection site.
4.	Show the patient how to select an area of skin from the anterior thigh and form a skin fold by picking up subcutaneous tissue between the thumb and forefinger (if the patient is thin).	4.	Pinching a skin fold and injecting at 45 degrees is recommended for thin people; injecting at 90 degrees into taut skin is recommended for heavier people. Avoid pinching the skin tightly to avoid trauma.
5.	Select areas in the upper arm, abdomen, and upper buttocks for injection after patient becomes proficient with needle insertion.	5.	The skin is loose and there is more subcutaneous fat in these areas. Systematic rotation of sites will keep the skin supple and favor uniform absorption of insulin. Use the same body part for each time of day, this ensures consistent absorption.
Rotate sites within each body part, and use the same body part for the same injection each time each day. Absorption is quicker from the abdomen and arms than the thighs and buttocks. Exercising a body part will hasten insulin absorption, so exercise should be consistent.			
6.	Assist the patient to insert the needle with a quick thrust to the hub at a 45- to 90-degree angle to the skin surface.	6.	The needle is inserted into deep subcutaneous tissue.
7.	Instruct the patient to release the “pinched” skin and inject the insulin with slow, consistent pressure.	7.	The insulin is injected into the subcutaneous tissue and the risk of bruising is reduced.

Nursing Action		Rationale	
8.	Have the patient count to 5 and then withdraw the needle in the same direction it was inserted.	8.	Allows time for the insulin to absorb into the tissue and prevents it from "leaking out" when the needle is removed.
To load the syringe			
1.	If the insulin is a suspension (NPH), gently shake, rotate, or roll the insulin bottle to mix well.	1.	Vigorous shaking may result in air bubbles, so rotating or rolling is preferred.
2.	Do not instruct the patient to wipe off the top of the vial with alcohol; instead, make sure that the vial is stored in its original carton and is kept clean.	2.	Wiping with alcohol is not necessary, since the risk of infection is small.
3.	Inject approximately the same volume of air into the insulin vial as the volume of insulin to be withdrawn.	3.	Air is injected into the vial to keep its contents under slightly positive pressure and to make it easier to withdraw the insulin.
4.	If a insulin pen device is being used, follow the manufacturer's instructions for dialing the dosage and changing cartridges.		
To fill a syringe with long- and short-acting insulin mixture			
1.	Inject air equal to the number of units to be injected into each vial. Use the same sequence each time, for example, always NPH insulin first.	1.	Creates positive pressure in the vial, so that insulin can be withdrawn from each vial without mixing.
2.	After injecting air into the second vial, keep the needle in vial and withdraw the prescribed amount of that type of insulin, then withdraw the needle.	2.	There is no real benefit to withdrawing either type of insulin first, as the risk of mixing insulin in the second vial is minimal. It is more important not to switch vials and draw up the wrong dose, so the sequence should always be the same.
3.	Withdraw the prescribed amount of insulin from the second vial.	3.	Positive pressure already exists in the first vial, therefore insulin withdrawal will be easier.

PROCEDURE 27: TECHNIQUE FOR OBTAINING CLEAN-CATCH MIDSTREAM VOIDED SPECIMEN

A clean-catch midstream specimen is the most clinically effective method of securing a voided specimen for urinalysis. Because it is not a simple procedure, it requires thorough patient education as well as active assistance of the female patient.

Equipment

- Antiseptic solution or liquid soap solution.
- Sterile water.
- 4″ × 4″ gauze pads.
- Disposable gloves for nurse assisting female patient.
- Sterile specimen container.

Procedure

	Nursing Action		Rationale
	Male patient		
1.	Instruct patient to expose glans and cleanse area around the meatus. Wash area with mild antiseptic solution or liquid soap. Rinse thoroughly. If uncircumcised, retract foreskin.	1.	The urethral orifice is colonized by bacteria. Urine readily becomes contaminated during voiding. Rinse antiseptic solution or soap solution thoroughly because these agents can inhibit bacterial growth in a urine culture.
2.	Allow the initial urinary flow to escape.	2.	The first portion of urine washes out the urethra and contains debris.
3.	Collect the midstream urine specimen in a sterile container.	3.	The midstream sample reflects the status of the bladder.
4.	Avoid collecting the last few drops of urine.	4.	Prostatic secretions may be introduced into urine at the end of the urinary stream in men.
	Female patient *Obtaining a clean-catch midstream urine specimen in the female patient. (**A**) Instruct the patient to hold the labia apart and wash from (high up) front toward the back with a gauze soaked in soap. (**B**) The collection cup is held so that it does not touch the body, and the sample is obtained only while the patient is voiding with the labia held apart. Note: If the nurse is assisting the patient, gloves are worn.*		
1.	Ask patient to separate her labia to expose the urethral orifice. If no one is available to assist the patient, she may sit backward on the toilet seat facing the water tank or sit on (straddle) the wide part of the bedpan.	1.	Keeping the labia separated prevents labial or vaginal contamination of the urine specimen. By straddling the toilet seat or bedpan, patient's labia are spread apart for cleansing.

Nursing Action			Rationale		
2.	Clean the area around the urinary meatus with pads soaked with antiseptic/soap solution. Rinse thoroughly.		2.	The urethral orifice is colonized by bacteria. Urine readily becomes contaminated during voiding.	
	a.	Wipe the perineum from the front to the back.		a.	To avoid contamination from the anus.
	b.	Do not use pads more than once.			
3.	While patient keeps the labia separated:		3.	This helps wash away urethral contaminants.	
4.	Allow initial urinary flow to drain into bedpan (toilet) and then catch the midstream specimen in a sterile container, making sure that the container does not come in contact with the genitalia.		4.	The first portion of urine washes out the urethra. Have the patient remove the container from the stream while she is still voiding.	
	Follow-up phase				
1.	Send specimen to laboratory immediately.		1.	A culture should be performed as soon as possible to avoid multiplication of urinary bacteria and lysis of cells.	

PROCEDURE 28: CATHETERIZATION OF THE URINARY BLADDER

Equipment

- Sterile gloves.
- Disposable sterile catheter set with single-use packet of lubricant.
- Antiseptic solution for periurethral cleaning (sterile).
- Sterile container for culture.
- Gloves, drape, pads.
- Bath blanket or sheet for draping.
- Standing lamp (preferred) or flashlight.
- Selection of catheter size.
- Use the smallest catheter capable of providing adequate drainage.

Procedure

Nursing Action		Rationale	
	Female patient		
	Preparatory phase		
1.	Wash hands. Put patient at ease.	1.	Patient will feel reassured if the procedure is explained and if she is handled gently and considerately.
2.	Open catheter tray using aseptic technique. Place waste receptacle in accessible place.	2.	Catheterization requires the same aseptic precautions as a surgical procedure. The principal danger of catheterization is urinary tract infection, which is associated with increased morbidity and longer, more costly hospitalization.
3.	Place patient in a supine position with knees bent, hips flexed, and feet resting on bed about 2 feet (0.6 m) apart. Drape the patient.	3.	Position should allow visualization of the vulva.
4.	Direct light for visualization of genital area.		
5.	Position moisture-proof pad under patient's buttocks.	5.	To absorb urine if necessary.
6.	Put on sterile gloves.	6.	To prevent bacterial contamination.

Nursing Action			Rationale		
	Performance phase *Catheterization of urinary bladder in the female patient.*				
1.	Separate labia minora so urethral meatus is visualized; one hand is to maintain separation of the labia until catheterization is finished.		1.	This maneuver helps prevent labial contamination of the catheter.	
2.	Clean around the urethral meatus with a povidone-iodine solution, unless patient is allergic to iodine—in which case, clean with soap and water.		2.	Bacteria that normally colonize the distal urethra may be introduced into the bladder during or immediately after catheter insertion. Inadequate preparation of the urethral meatus is a major cause of infection.	
	a.	Manipulate cleaning pads or cotton balls with forceps, cleaning with downward strokes from anterior to posterior.		a.	To prevent introducing bacteria from the perineum into the urethra.
	b.	Dispose of cotton pad after each use.			
	c.	If patient is sensitive to iodine, benzalkonium chloride or other cleaning agent is used.			
3.	Introduce well-lubricated catheter 2-3 inches (5-7.5 cm) into urethral meatus using strict aseptic technique.		3.	A well-lubricated catheter reduces friction and trauma to the meatus. The female urethra is a relatively short canal, measuring 1¼-1½ inches (3-4 cm) in length.	
	a.	Avoid contaminating surface of catheter.			
	b.	Make sure that catheter is not too large or too tight at urethral meatus.		b.	Too large a catheter may cause painful distention of the meatus and cause damage to the uroepithelium.
4.	Allow some bladder urine to flow through catheter before collecting a specimen.		4.	To obtain representative bladder sample.	
	Male patient				
	Preparatory phase				
1.	Lubricate the catheter well with lubricant or prescribed topical anesthetic.		1.	A well-lubricated catheter prevents urethral trauma (decreasing the opportunity for bacterial invasion).	
2.	Wash off glans penis around urinary meatus with an iodophor solution (Betadine) using forceps to hold cleaning pads. Keep the foreskin retracted.		2.	Clean urethral meatus from tip to foreskin with downward stroke on one side. Discard pad. Repeat as required.	

Nursing Action		Rationale	
	Maintain sterility of dominant hand.		
3.	Grasp shaft of penis (with nondominant hand) and elevate it. Apply gentle traction to penis while catheter is passed.	3.	This maneuver straightens the penile urethra and facilitates catheterization. Maintaining a grasp of the penis prevents contamination and retraction of penis.
4.	Using sterile gloves, insert the catheter into the urethra; advance the catheter 6-10 inches (15-25 cm) until urine flows.	4.	The male urethra is a canal extending from the bladder to the end of the glans penis. The length varies within wide limits; the average length is about 8 inches (20 cm).
5.	If resistance is felt at the external sphincter, slightly increase the traction on the penis and apply steady, gentle pressure on the catheter. Ask patient to strain gently (as if passing urine) to help relax sphincter.	5.	Some resistance may be due to spasm of external sphincter. Inability to pass the catheter may mean that a urethral stricture or other form of urethral pathology exists. The urethra may have to be dilated through instrumentation (sound) by an urologist.
6.	When urine begins to flow, advance the catheter another 1 inch (2.5 cm).	6.	Advancing the catheter ensures its position in the bladder.
7.	Replace (or reposition) the foreskin.	7.	Paraphimosis (retraction and constriction of the foreskin behind the glans penis), secondary to catheterization, may occur if the foreskin is not replaced.
	Follow-up phase		
1.	Remove catheter gently when urine ceases to flow.	1.	Minimizing trauma to the urethra and time the catheter is in contact with the urethral mucosa will minimize chance of infection.
2.	Dry area; make patient comfortable.		
3.	Send specimen to laboratory as indicated.		
4.	Record time, procedure, amount, and appearance of urine.		

PROCEDURE 29: ASSISTING THE PATIENT UNDERGOING SUPRAPUBIC BLADDER DRAINAGE (CYSTOSTOMY)

Equipment

- Sterile suprapubic drainage system package (disposable).
- Skin germicide for suprapubic skin preparation; sterile gloves.
- Local anesthetic agent if needed.

Procedure

	Nursing Action		Rationale
	Preparatory phase		
1.	Place patient in a supine position with one pillow under their head.	1.	Allows access to the suprapubic area but reduces muscle tension.
2.	Expose the abdomen.		
	Performance phase (By physician)		
1.	The bladder is distended with 300-500 mL sterile saline in a urethral catheter, which is removed, or patient is given fluids (PO or I.V.) before the procedure.	1.	Distention of the bladder makes the bladder easier to locate by the suprapubic route.
2.	The suprapubic area is surgically prepared. After the skin is dried, the needle entry point is located.	2.	The needle entry point is in the midline, ¾ to 1¼ inches (2-3 cm) above the symphysis pubis and directly over the palpable bladder.
3.	The skin and subcutaneous tissues are infiltrated with local anesthesia.	3.	An adequate level of local anesthesia is achieved to facilitate catheter introduction.
4.	A small incision may be made.		
5.	The catheter is introduced via a guide wire, needle, or cannula through the incision and advanced in a slightly caudal direction.	5.	Entrance into the bladder is usually felt and can be verified by free flow of urine.
6.	The catheter is advanced until the flange is against the skin where it is secured with tape, a body seal system, or sutures.	6.	Another method is to advance a long needle into the bladder until urine flow verifies the needle is in the bladder.
7.	The catheter is connected to a sterile drainage system.	7.	Aseptic technique is used in the area around the Cystostomy tube.
8.	Secure drainage tubing to lateral abdomen with tape.	8.	Prevents undue tension on the catheter.

Nursing Action			Rationale		
9.	If the catheter is not draining properly, withdraw the catheter 1 inch (2.5 cm) at a time until urine begins to flow. Do not dislodge catheter from bladder.		9.	Catheter tip may be pinned against the wall of the bladder.	
10.	The drainage is maintained continuously for several days.				
11.	If a "trial of voiding" is requested, the catheter is clamped for 4 hours.		11.	Usually, patients will void earlier after surgery with suprapubic drainage than with indwelling catheters.	
	a.	Have patient attempt to void while the catheter is clamped.			
	b.	After patient voids, unclamp the catheter and measure residual urine.		b.	To determine the effectiveness of voiding.
	c.	Usually, if the amount of residual urine is less than 100 mL on two separate occasions (AM and PM), the catheter may be removed.			
	d.	If the patient complains of pain or discomfort, or if the residual urine is over the prescribed amount, the catheter is usually left open.		d.	To facilitate urinary drainage and prevent infection due to urinary stasis.
12.	When the catheter is removed, a sterile dressing is placed over the site. Usually the tract will close within 48 hours.		12.	Suprapubic drainage is considered more comfortable than an indwelling urethral catheter. It allows greater patient mobility, and there is less risk of bladder infection.	
13.	Monitor for complications.		13.	Complications of this procedure: inadvertent peritoneal and bowel damage, leakage around catheter, kinking of catheter, Hematuria, or abdominal wall abscess.	

PROCEDURE 30: APPLICATION OF A CAST

Equipment

- Plaster or synthetic bandages in desired widths.
- Stockinet (tubular knitted material).
- Cast padding (roll padding).
- Splints (for reinforcement).
- Cotton, polyester, or polyurethane foam padding for bony prominences*.
- Cast knives, scissors. Polyethylene sheeting or newspaper—to protect floor.
- Disposable gloves—to protect hands of operator.
- Large, plastic-lined pail of water at room temperature— (21° - 24° C) or as recommended by cast material manufacturer.
- Cast finishing hand cream for synthetic cast, as needed.

Procedure

Nursing Action		Rationale	
	Preparatory phase		
1.	Spread polyethylene sheeting or newspaper on floor.	1.	To contain mess.
2.	Explain to the patient that there will be a feeling of warmth as the plaster is applied.	2.	Heat is produced by an endothermic reaction causing crystallization as the plaster sets. The reaction of water with plaster of Paris liberates heat.
3.	Apply stockinet and roll cast padding on the extremity or part to be immobilized.	3.	Padding is used to pad the sharp cast margins for patient comfort and to prevent pressure areas, minimize circulatory problems, and facilitate cast removal. It is applied from the distal to the proximal end of the extremity. When too much padding is used, it may shift and produce pressure areas under the cast.
	a. Apply roll padding as smoothly and snugly as possible so each turn overlaps the preceding turn by one-half the width of the roll.		
	b. Extra pieces of padding may be placed over bony prominences: olecranon process, malleoli, patella, or ulnar protuberance.		
4.	While keeping the thumb under the forward edge of the bandage, submerge the plaster bandage vertically in water (room	4.	Water that is too warm will accelerate setting time, may cause a burn, and may result in excessive plaster loss by loosening the adhesive

Nursing Action		Rationale	
	temperature) for a minute or so, or until bubbles cease to rise. Check directions on synthetic cast materials.		agents that bond the plaster to the fabric.
5.	Expel excess water by squeezing (not wringing) toward the center of the bandage; hand bandage to operator with free end hanging loose.	5.	Cast will dry more quickly (thus will acquire maximum strength sooner) if a well-squeezed plaster bandage is used. Maximum strength is achieved by synthetic casts through chemical reaction in about 30 minutes.
	Performance phase (By operator)		
1.	Starting at the distal end, roll the bandage gently and evenly on the extremity overlapping the preceding turn by one-half the width of the roll.	1.	Roll inward toward the patient's body for ease of control.
2.	Keep bandage moving and in constant contact with surface of extremity. Smooth and rub down successive layers or turns of each bandage into layers below with the thumbs and thenar eminences (mound on the palm) in circumferential and longitudinal directions.	2.	This keeps the cast uniformly thick. Rubbing the plaster as it is applied will form a smooth, solid, and well-fused cast. Avoid indenting the cast with the fingertips because this may produce pressure sores on underlying skin. Handle fresh casts with palms.
3.	Take tucks in the lower border of the bandage by lifting the bandage off the surface (without tension) and overlapping it in a V-shaped fashion.	3.	Tucking the bandage helps to contour the cast to the changing circumference of the extremity. Do not twist or reverse the bandage to change its direction because this produces sharp cutting edges.
4.	Trim the cast to size with a sharp knife. Fold stockinet over edges of cast and anchor with cast material.	4.	Stockinet produces smooth, comfortable edges on the cast. Do not pull too vigorously on the stockinet because this may cause pressure on bony prominences.
5.	Finish synthetic cast with cast hand cream as indicated.	5.	Smoothes rough exterior surface.
6.	Ask the patient if there is any discomfort or pain.	6.	If a patient complains of pain, it may be due to manipulation of the fracture during setting; pain should subside rapidly. If it persists, the cast and encircling dressings are split to avoid constriction, circulatory problems, and pressure sores.

Nursing Action		Rationale	
	Follow-up phase		
1.	Support the cast with the palm of the hand while moving the patient. Avoid indentations from tips of fingers.	1.	Finger indentation on a fresh cast can produce pressure sores.
2.	Expose the cast to warm, circulating, dry air. Or, blow air over the cast with a circulating fan to increase the evaporation of water.	2.	Avoid covering the cast when it is drying because this delays drying time. Usually the plaster cast will reach its maximum temperature 5 to 15 minutes after it is applied and will then cool rapidly. The ultimate plaster cast strength is obtained after the cast is dry (up to 48 hours, depending on outside temperature and humidity). The synthetic cast reaches maximum strength within 30 minutes, regardless of outside conditions.
3.	Clean equipment and store ready for next use.		

PROCEDURE 31: REMOVAL OF A CAST

Equipment

- Cast cutter: an electric saw with circular blade that oscillates and is connected to a vacuum collector.
- Cast spreader.
- Plaster knife.
- Scissors.
- Felt-tip pen.

Procedure

	Nursing Action		Rationale
	Preparatory phase		
1.	Describe to the patient how and where the cast cutter will be used and the expected sensations.	1.	Reassures the patient that the cutter produces vibrations but not pain.
2.	Determine whether the cast is padded.	2.	An electric plaster cast cutter should not be used on unpadded casts.
3.	Determine where the cut will be made. Mark the area to be cut with a felt pen.	3.	The line should be in front of the lateral malleolus and behind the medial malleolus on a lower extremity cast. An upper extremity cast is usually split along the ulnar or flexor surface.
	Performance phase		
1.	Inform the patient to shield eyes.	1.	Plaster dust may be irritating to the eyes.
2.	Grasp the electric cutter as illustrated.		
3.	The operator should rest their thumb on the cast.	3.	The thumb serves as a depth gauge and acts as a guard in front of the blade.
4.	Turn on the electric cutter. Push the blade firmly and gently through the cast while holding the thumb against the cast to steady the blade while cutting through the cast.		***Operating a cast cutter.***
5.	As the blade cuts through the plaster, a sudden lack of resistance is felt; plaster will "give" (or "dip") when the cut is completed.		
6.	Lift the cutting blade up a degree (but not out of the cutting groove) and advance the blade at a slightly higher or lower level.		

Nursing Action		Rationale	
	The cast is cut by a series of alternating pressure and linear movements along the line of the cut.		
7.	Avoid drawing the cutting blade along the extremity in a single motion.	7.	This will cut the skin. If saw blade is in contact with padding too long, the patient will feel burning sensation on the skin from rapidly oscillating blade.
8.	Cut the cast on both sides. Then rock the anterior portion of the cast over the posterior portion.	8.	This maneuver allows the operator to determine if the cast is completely cut.
9.	Insert the blades of the cast spreader in the cut trough. Separate the two halves with the spreader at several sites along the cast split. Separate the cast with the hands.		
10.	Cut through the padding and stockinet with scissors, keeping the scissor blade that is closest to the skin parallel to the skin.	10.	Use bandage scissors; place the flat blade closest to the skin.
11.	Lift the extremity carefully out of the posterior portion of the cast. Support the extremity so it is maintained in the same position as when in the cast.	11.	When the support of the cast has been removed, stresses and strain are placed on parts that have been at rest.
After removal of cast			
1.	Clean the skin gently with mild soap and water. Blot dry. Apply a skin cream.	1.	Explain to the patient that the skin will be scaly and the extremity will appear “thin” from disuse. Reassure him that it will take a few weeks to regain normal appearance and function.
2.	Emphasize the importance of continuing the prescribed exercises, reporting for physical therapy, and so forth.	2.	Exercises are necessary to redevelop and increase strength and function. Pain and stiffness may be expected after cast removal.

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