

#### FACULTY OF NURSING SCIENCES

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# CHEST INJURIES

General Objective

Students will be able to describe the aetiology, pathophysiology, clinical manifestations, diagnostic measures and management of patients (adults including elderly) with the disorder asthma

#### **General Objective**

#### Specific Objectives

\*Students will be able to get introduced to the topic chest injuries

\*Students will be able to define chest injuries

\*Students will be able to enumerate predisposing factors of chest injuries

\*Students will be able to discuss the pathophysiology of chest injuries

\*Students will be able to describe the clinical manifestations of chest injuries

\*Students will be able to describe the diagnostic tests of chest injuries \*Students will be able to discuss the medical management of

patient with chest injuries

\*Students will be able to describe the nursing management of

patient with chest injuries

# Chest trauma, introduction

- Major chest trauma may occur alone or in combination with multiple other injuries.
- Chest trauma is classified as either blunt or penetrating.
- Blunt chest trauma results from sudden compression or positive pressure inflicted to the chest wall.
- Penetrating trauma occurs when a foreign object penetrates the chest wall.

## Blunt trauma

- Blunt Trauma is more common than penetrating trauma
- It is often difficult to identify the extent of the damage because the symptoms
  may be generalized and vague.
- In addition, patients may not seek immediate medical attention, which may complicate the problem.

# Pathophysiology

• The most common causes of blunt chest trauma are motor vehicle crashes (trauma from steering wheel, seat belt), falls, and bicycle crashes (trauma from handlebars).



## Pathophysiology,contd...

- Mechanisms of blunt chest trauma include
- acceleration (moving object hitting the chest or patient being thrown into an object),
- deceleration (sudden decrease in rate of speed or velocity, such as a motor vehicle crash),
- · shearing (stretching forces to areas of the chest causing tears,

ruptures, or dissections), and

· compression (direct blow to the chest, such as a crush i



## Pathophysiology, contd...

 Injuries to the chest are often life-threatening and result in one or more of the following pathologic states:

- Hypoxemia from disruption of the airway; injury to the lung parenchyma, rib cage, and respiratory musculature; massive hemorrhage; collapsed lung; and pneumothorax
- Hypovolemia from massive fluid loss from the great vessels, cardiac rupture, or hemothorax
- Cardiac failure from cardiac tamponade, cardiac contusion, or increased intrathoracic pressure, result in impaired ventilation and perfusion leading to acute renal failure, hypovolemic shock, and death.



# Assessment and diagnostic findings

- Time is critical in treating chest trauma. Therefore, it is essential to assess the patient immediately to determine the following:
- time elapsed since injury occurred,
- mechanism of injury,
- · level of responsiveness,
- · specific injuries,
- · estimated blood loss,

# Assessment and diagnostic findings

- recent drug or alcohol use, and
- prehospital treatment. Initial assessment of thoracic injuries includes assessment for airway obstruction, tension pneumothorax, open pneumothorax, massive hemothorax, flail chest, and cardiac tamponade. These injuries are life- threatening and require immediate treatment. Secondary assessment includes assessment for simple pneumothorax, hemothorax, pulmonary contusion, traumatic aortic rupture, tracheobronchial disruption, esophageal perforation, traumatic diaphragmatic injury, and penetrating wounds to the mediastinum. Although listed as secondary, these injuries may be life-threatening as well.

Initial assessment of thoracic injuries includes assessment for

- · airway obstruction,
- tension pneumothorax,
- open pneumothorax,
- massive hemothorax,
- flail chest, and
- cardiac tamponade.
- These injuries are life-threatening and require immediate treatment.

Secondary assessment includes assessment for

- simple pneumothorax,
- · hemothorax,
- pulmonary contusion,
- traumatic aortic rupture,
- tracheobronchial disruption,
- · esophageal perforation,
- traumatic diaphragmatic injury, and
- penetrating wounds to the mediastinum.

Although listed as secondary, these injuries may be life-threatening as well.

- The physical examination includes inspection of the airway, thorax, neck veins, and breathing difficulty.
- Specifics include assessing the rate and depth of breathing for abnormalities such as stridor, cyanosis, nasal flaring, use of accessory muscles, drooling, and overt trauma to the face, mouth, or neck.
- The chest is assessed for symmetric movement, symmetry of breath sounds, open chest wounds, entrance or exit wounds, impaled objects, tracheal shift, distended neck veins, subcutaneous emphysema, and paradoxical chest wall motion.

- In addition, the chest wall is assessed for bruising, petechiae, lacerations, and burns.
- The vital signs and skin color are assessed for signs of shock.
- The thorax is palpated for tenderness and crepitus, and the position of the trachea is also assessed.

The initial diagnostic workup includes a

- chest x-ray,
- CT scan,
- complete blood count,
- clotting studies,
- type and crossmatch,

- · electrolytes,
- oxygen saturation,
- arterial blood gas analysis, and
- ECG.

The patient is completely undressed to avoid missing additional injuries that may complicate care.

# Medical management

Goal is to evaluate the patient's condition and to initiate

aggressive resuscitation.

- An airway is immediately established with oxygen or with intubation/ ventilatory support.
- Re-establish fluid volume and negative intrapleural pressure.
- Drain intrapleural fluid and blood.
  - Strategies to restore and maintain cardiopulmonary function include

# Medical management

- Ensure an adequate airway and ventilation
- Stabilize and reestablish chest wall integrity
- Occlude any opening into the chest (open pneumothorax) and
- Drain or remove any air or fluid from the thorax to relieve

pneumothorax, hemothorax, or cardiac tamponade.

• Patient are taken immediately to the operating room for corrective surgery

# General Objective

Students will be able to describe the aetiology,

pathophysiology, clinical manifestations, diagnostic

measures and management of

patients (adults including elderly) with the disorder sternal and rib fractures

#### **General Objective**

#### Specific Objectives

\*Students will be able to get introduced to the topic sternal and rib fractures

\*Students will be able to define sternal and rib fractures

\*Students will be able to enumerate predisposing factors of sternal

and rib fractures

\*Students will be able to discuss the pathophysiology of sternal and rib fractures

 $^{\ast}\mbox{Students}$  will be able to describe the clinical manifestations of sternal

and rib fractures

\*Students will be able to describe the diagnostic tests of sternal and rib fractures

\*Students will be able to discuss the medical management of

patient with sternal and rib fractures

# Sternal and rib fractures, introduction

- □ Sternal fractures are most common in motor vehicle crashes with a direct blow to the sternum via the steering wheel.
- □ Rib fractures are the most common type of chest trauma, occurring in more than 60% of patients admitted with blunt chest injury.
- □ Most rib fractures are benign and are treated conservatively.
- □ Fractures of the first three ribs are rare but can result in a high mortality rate because they are associated with laceration of the subclavian artery or vein.
- □ The fifth through ninth ribs are the most common sites of fractures.

### Clinical manifestations

- □ Severe pain, point tenderness, and
- □ Muscle spasm over the area of the fracture that are aggravated by coughing, deep breathing, and movement.
- □ The area around the fracture may be bruised.
- □ To reduce the pain, the patient splints the chest by breathing in a shallow manner and avoids sighs, deep breaths, coughing, and movement.
- □ This reluctance to move or breathe deeply results in diminished ventilation, atelectasis (collapse of unaerated alveoli), pneumonitis, and hypoxemia. Respiratory insufficiency and failure can be the outcomes of such a cycle.

# Assessment and diagnostic findings

- □ The patient must be closely evaluated for underlying cardiac injuries.
- A crackling, grating sound in the thorax (subcutaneous crepitus) may be detected with auscultation.
- The diagnostic workup may include a chest x-ray, rib films of a specific area
- □ ECG
- Continuous pulse oximetry and
- Arterial blood gas analysis

# Medical management

- Management is directed toward relieving pain, avoiding excessive activity, and treating any associated injuries.
- Surgical fixation is rarely necessary unless fragments are grossly displaced and pose a potential for further injury.
- □ The goals of treatment for rib fractures are to control pain and to detect and treat the injury.
- □ Sedation is used to relieve pain and to allow deep breathing and coughing.
- □ symptoms of associated injuries.

# Medical management

- Alternative strategies to relieve pain include an intercostal nerve block and ice over the fracture site.
- A chest binder may be used as supportive treatment to provide stability to the chest wall and may decrease pain.
- Most rib fractures heal in 3 to 6 weeks. The patient is monitored closely for signs and

#### **General Objective**

Students will be able to describe the aetiology, pathophysiology, clinical manifestations, diagnostic measures and management of patients (adults including elderly) with the disorder Flail Chest

#### **General Objective**

#### Specific Objectives

\*Students will be able to get introduced to the topic flail chest

\*Students will be able to define sternal and flail chest

\*Students will be able to enumerate predisposing factors of flail chest

\*Students will be able to discuss the pathophysiology of flail chest

\*Students will be able to describe the clinical manifestations of flail chest

\*Students will be able to describe the diagnostic tests of flail chest

\*Students will be able to discuss the medical management of patient with flail chest

## Flail chest

- Is a complication of blunt chest trauma from a steering wheel injury.
- It usually occurs when three or more adjacent ribs resulting in free-floating rib segments.
- It may occur as a combination fracture of ribs and costal cartilages or sternum and results in chest wall instability, causing respiratory impairment and usually severe respiratory distress.



## Medical Management

- Supportive management includes providing ventilatory support, clearing secretions from the lungs, and controlling pain.
- □ Specific Management
- If only a small segment of the chest is involved, the objectives are to clear the airway through positioning, coughing, deep breathing, and suctioning to aid in the expansion of the lung, and to relieve pain by intercostal nerve blocks, high thoracic epidural blocks, or cautious use of IV opioids.
- □ required

# Medical Management

- For mild to moderate flail chest injuries, monitor fluid intake and fluid replacement and relieve chest pain. Pulmonary physiotherapy focusing on lung volume expansion, and secretion management techniques are performed.
- □ For severe flail chest injuries, endotracheal intubation and mechanical ventilation are

#### Medical Management, contd...

- Treatment modality requires endotracheal intubation and ventilator support.
- Rarely surgery may be required to more quickly stabilize the flail segment.
- Regardless of the type of treatment, the patient is carefully monitored by serial chest x- rays, arterial blood gas analysis, pulse oximetry, and bedside pulmonary function monitoring.
- For pain management patient-controlled analgesia, intercostal nerve blocks, epidural analgesia, and intrapleural administration of opioids may be used to relieve or manage thoracic pain

# General Objective

Students will be able to describe the aetiology, pathophysiology, clinical manifestations, diagnostic measures and management of patients (adults including elderly) with the disorder pulmonary contusion

#### **General Objective**

#### Specific Objectives

\*Students will be able to get introduced to the topic pulmonary contusion

\*Students will be able to define pulmonary contusion

\*Students will be able to enumerate predisposing factors of pulmonary contusion

 $^{\ast}\mbox{Students}$  will be able to discuss the pathophysiology of pulmonary contusion

\*Students will be able to describe the clinical manifestations of

pulmonary contusion

\*Students will be able to describe the diagnostic tests of pulmonary contusion

\*Students will be able to discuss the medical management of

patient with pulmonary contusion

### PULMONARY CONTUSION, Introduction

Pulmonary contusion is a common thoracic injury and is frequently associated with flail chest. It is defined as damage to the lung tissues resulting in hemorrhage and localized edema. It is associated with chest trauma when there is rapid compression and decompression to the chest wall (ie, blunt trauma). Pulmonary contusion represents a spectrum of lung injury

characterized by the development of infiltrates and various degrees of respiratory dysfunction and sometimes respiratory failure.

# PULMONARY CONTUSION, Introduction

It is often cited as the most common potentially life-threatening chest injury; however, mortality is often attributed to other associated injuries.

A contusion is sustained in 30% to 70% of patients who experience blunt force trauma.

Pulmonary contusion may not be evident initially on examination but develops in the posttraumatic period; it may involve a small portion of one lung, a massive section of a lung, one entire lung, or both lungs.

## Pathophysiology

The primary pathologic defect is an abnormal accumulation of fluid in the interstitial and

intra-alveolar spaces.

- It is thought that injury to the lung parenchyma and its capillary network results in a leakage of serum protein and plasma.
- The leaking serum protein exerts an osmotic pressure that enhances loss of fluid from the capillaries. Blood, edema, and cellular debris (from cellular response to injury) enter the lung and accumulate in the bronchioles and alveoli, where they interfere with gas exchange.

# Pathophysiology

 An increase in pulmonary vascular resistance and pulmonary artery pressure

occurs.

• The patient has hypoxemia and carbon dioxide retention. Occasionally, a contused lung occurs on the other side of the point of body impact; this is called a contrecoup contusion.

# **Clinical Manifestations**

The clinical manifestations vary from decreased breath sounds

Tachypnea

Tachycardia

chest pain

Hypoxemia and blood-tinged secretions

# Clinical Manifestations

to

more severe tachypnea,

Tachycardia

Crackles frank

bleeding

severe hypoxemia (cyanosis), and respiratory acidosis.

# Assessment and diagnostic findings

- The efficiency of gas exchange is determined by pulse oximetry and
- arterial blood gas measurements.
- The initial chest x-ray may show no changes; changes may not appear for 1 or 2 days after the injury and appear as pulmonary infiltrates on chest x-ray

# Medical management

- Treatment priorities include maintaining the airway, providing adequate oxygenation, and controlling pain.
- In mild pulmonary contusion, adequate hydration via IV fluids and oral intake is important to mobilize secretions. Closely monitor to avoid hypervolemia
- Volume expansion techniques, postural drainage, physiotherapy including coughing, and endotracheal suctioning are used to remove the secretions.

# Medical management

- Pain is managed by intercostal nerve blocks or by opioids via patient controlled analgesia or other methods.
- Antimicrobial therapy is administered because lung is susceptible to infection.
- Supplemental oxygen is usually given by mask or cannula for 24 to 36 hours.

#### Medical management, contd...

- In patients with moderate pulmonary contusions, bronchoscopy may be required to remove secretions.
- Intubation and mechanical ventilation with PEEP may also be necessary to maintain the pressure and keep the lungs inflated.
   Diuretics may be administered to reduce edema.

#### Medical management, contd...

- A nasogastric tube is inserted to relieve gastrointestinal distention.
- In patients with severe contusion aggressive treatment with
   endotracheal intubation and ventilatory support, diuretics, and

fluid restriction may be necessary.

Colloids and crystalloid solutions may be used to treat hypovolemia.

General Objective

Students will be able to describe the aetiology, pathophysiology, clinical manifestations, diagnostic measures and management of patients (adults including elderly) with the disorder penetrating trauma

## General Objective

#### Specific Objectives

\*Students will be able to get introduced to the topic penetrating trauma

\*Students will be able to define penetrating trauma

 $\ensuremath{^*Students}$  will be able to enumerate predisposing factors of penetrating trauma

\*Students will be able to discuss the pathophysiology of penetrating trauma

\*Students will be able to describe the clinical manifestations of penetrating trauma

\*Students will be able to describe the diagnostic tests of penetrating trauma \*Students will be able to discuss the medical management of

patient with penetrating trauma

# Penetrating trauma, introduction

- Gunshot and Stab Wounds Gunshot and stab wounds are the most common causes of penetrating chest trauma.
- These wounds are classified according to their velocity.
- Stab wounds are low-velocity trauma because the weapon destroys a small area around the wound. Knives and switchblades cause most stab wounds.
- The appearance of the external wound may be very deceptive, because pneumothorax, hemothorax, lung contusion, and cardiac tamponade, and continuing hemorrhage, can occur from any small wound

#### Penetrating trauma, classification

- Gunshot wounds may be classified as low, medium, or high velocity. The factors that determine the velocity and resulting extent of damage include the distance from which the gun was fired, the caliber of the gun, and the construction and size of the bullet.
- A bullet can cause damage at the site of penetration and along its pathway, and a gunshot wound to the chest can produce a variety of pathophysiologic changes.
- The bullet may ricochet off bony structures and damage the chest organs and great vessels. If the diaphragm is involved in a gunshot wound or a stab wound, injury to the chest cavity must be considered.

## Diagnosis

- The diagnostic workup includes a chest x-ray, chemistry profile, arterial blood gas analysis, pulse oximetry, and ECG.
- The patient's blood is typed and cross-matched in case blood transfusion. After checking peripheral pulses, a large-bore IV line is inserted. An indwelling catheter is inserted to monitor urinary output.
- A nasogastric tube is inserted and connected to low suction to prevent aspiration, and decompress the gastrointestinal tract.

# Medical Management

- The objective is to restore and maintain cardiopulmonary function.
- After an adequate airway is ensured and ventilation is established, examination for shock and intrathoracic and intra-abdominal injuries is necessary.
- There is a high risk for associated intra-abdominal injuries with stab wounds below the level of the fifth anterior intercostal space.
   Death can result from exsanguinating hemorrhage or intraabdominal sepsis.

#### Medical management, contd..

- Shock is treated simultaneously with colloid solutions, crystalloids, or blood, as indicated by the patient's condition.
- A chest tube is inserted to achieve rapid and continuing reexpansion of the lungs.
- The insertion of the chest tube frequently results in a complete evacuation of the blood and air.
- The chest tube also allows early recognition of continuing intrathoracic bleeding, which would make surgical exploration necessary.
- If the patient has a penetrating wound of the heart or great vessels, the esophagus, or the tracheobronchial tree, surgical intervention is required.

# General Objective

Students will be able to describe the aetiology, pathophysiology, clinical manifestations, diagnostic measures and management of patients (adults including elderly) with the disorder penumothorax

#### **General Objective**

#### Specific Objectives

\*Students will be able to get introduced to the topic penumothorax

\*Students will be able to define penumothorax

\*Students will be able to enumerate predisposing factors of penumothorax

\*Students will be able to discuss the pathophysiology of penumothorax

\*Students will be able to describe the clinical manifestations of penumothorax

\*Students will be able to describe the diagnostic tests of penumothorax \*Students will be able to discuss the medical management of

patient with penumothorax

#### Pneumothorax, introduction

- The pleural space is exposed to positive atmospheric pressure.
- Normally the pressure in the pleural space is negative or subatmospheric; this negative pressure is required to maintain lung inflation.
- When either pleura is breached, air enters the pleural space, and the lung or a portion of it collapses.

# Types of pneumothorax

Simple, traumatic, and tension pneumothorax.

1. Simple Pneumothorax

A simple, or spontaneous, pneumothorax occurs when air enters the pleural space through a breach of either the parietal or visceral pleura.

- air enters through the rupture of a bleb or a bronchopleural fistula.
- may occur in a healthy person in the absence of trauma due to rupture of an air- filled bleb, or blister, on the surface of the lung,
- may be associated with diffuse interstitial lung disease / emphysema.

#### Types of pneumothorax, contd..

#### 2. Traumatic Pneumothorax

- Causes
- occurs when air escapes from a laceration in the lung and enters pleura
- from a wound in the chest wall
- may result from blunt trauma (eg, rib fractures)
- penetrating chest or abdominal trauma (eg, stab or gunshot wounds),
- or diaphragmatic tears
- inadvertently punctured invasive thoracic procedures (ie, thoracentesis, transbronchial lung biopsy, subclavian line puncture)
- In barotrauma from mechanical ventilation

# Types of pneumothorax, contd...

- Open pneumothorax is one form of traumatic pneumothorax.
   It occurs when a wound in the chest wall is large enough to allow air to pass freely in respiration.
- Because the rush of air through the wound in the chest wall produces a sucking sound, such injuries are termed sucking chest wounds.
- In such patients, the lung collapses, along with mediastinum shift toward the uninjured side with each inspiration and in the opposite direction with expiration. This is termed mediastinal flutter or swing

# 3. Tension pneumothorax



#### 3. Tension pneumothorax

- A tension pneumothorax occurs when air is drawn into the pleural space from a lacerated lung or through a small opening or wound in the chest wall.
- the air that enters the chest cavity with each inspiration is trapped; it cannot be expelled during expiration through the air passages or the opening in the chest wall.
- With each breath, tension (positive pressure) is increased within the affected pleural space. This causes the lung to collapse and mediastinal shift occurs.
- Both respiration and circulatory function are compromised causing decreased cardiac output and impairment of peripheral circulation.
- In extreme cases, the pulse may be undetectable—this is known as pulseless electrical activity.

## **Clinical Manifestations**

Pain is usually sudden and may be pleuritic.

Minimal respiratory distress with slight chest discomfort and

tachypnoea with a small simple or uncomplicated pneumothorax.

If the pneumothorax is large and the lung collapses totally, acute respiratory distress occurs.

#### Assessment and diagnostic measures

- Nurse assesses tracheal alignment, expansion of the chest, breath sounds, and percussion of the chest.
- In a simple pneumothorax, the trachea is midline, expansion of the chest is decreased. Breath sounds may be diminished, and percussion of the chest may reveal normal sounds or hyperresonance
- In a tension pneumothorax, the trachea is shifted away from the affected side, chest expansion may be decreased or fixed in a hyper expansion state, breath sounds are diminished or absent, and percussion to the affected side is hyper resonant.
- The clinical picture is one of air hunger, agitation, increasing hypoxemia, central cyanosis, hypotension, tachycardia, and profuse diaphoresis.

# Medical Management

- Medical management of pneumothorax depends on its cause and severity.
- The goal of treatment is to evacuate the air or blood from the pleural space.
- A small chest tube (28 Fr) is inserted near the second intercostal space;
- This space is used because it is the thinnest part of the chest wall, minimizes the danger of contacting the thoracic nerve

## Medical Management, contd..

- If haemothorax, a large-diameter chest tube (32 Fr or greater) is inserted, in the fourth or fifth intercostal space at the midaxillary line.
- Once the chest tube is inserted and 20 mm Hg suction is applied effective decompression of the pleural cavity (drainage of blood or air) occurs.
- If an excessive amount of blood enters the chest tube an autotransfusion may be needed.
- In such an emergency, anything (a towel, a handkerchief, or the heel of the hand) may be used that is large enough to fill the chest wound.
- If pt is conscious instruct to inhale and strain against a closed glottis to reexpand the lung and eject the air from the thorax.
- · In the hospital, the opening is plugged by sealing it with petrolatum gauze

# Nursing diagnoses

- Ineffective airway clearance related to tracheo bronchial
  - secretions secondary to chest trauma
- · Activity intolerance related to impaired respiratory function
- Risk for deficient fluid volume related to fever and a rapid respiratory rate
- Imbalanced nutrition: less than body requirements
- Deficient knowledge about the treatment regimen and preventive health measures

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