

	CHEST WALL INJURIES		
	Rib Fractures	Flail Chest	Sternal Fracture
Epidemiology	<p>Incidence:</p> <ul style="list-style-type: none"> - Commonly caused by blunt trauma - Significant force required - Commonly adults, usually in elderly <p>Morbidity/Mortality:</p> <ul style="list-style-type: none"> - Depends on location + total number of fractures (mortality associated with underlying pulmonary/cardiovascular injury) - Increased mortality in elderly <p>Consequences:</p> <ul style="list-style-type: none"> - geriatric ribs are brittle and rigid - Number, location of fractures can increase chance for pulmonary and/or cardiovascular injury. <p>Sites:</p> <ul style="list-style-type: none"> - Fracture of ribs 4-9 most common (they are thin + poorly protected) - Fracture of 1st or 2nd rib: <ul style="list-style-type: none"> - Severe force & resultant injuries - 50% mortality rate - Low ribs <ul style="list-style-type: none"> - associated w/liver, spleen injury - Posterior ribs <ul style="list-style-type: none"> - associated w/spleen + kidney injury 	<p>3 or more ribs fracture in 2 or more places, producing a free floating segment of the chest wall.</p> <p>Incidence:</p> <ul style="list-style-type: none"> - Commonly caused by MVCs <ul style="list-style-type: none"> - frontal impact - lateral impact - Falls from heights - Industrial accidents - Assault <p>Morbidity/Mortality:</p> <ul style="list-style-type: none"> - Indicates significant energy transfer - Mortality rates 20-40% due to associated injuries <ul style="list-style-type: none"> - Multi-systems trauma - Pulmonary and cardiac trauma - Additional factors determining mortality: <ul style="list-style-type: none"> - Advanced age - Fracture of 7 or more ribs - Presence of 3 or more associated injuries - Shock - Head injury 	<p>Incidence:</p> <ul style="list-style-type: none"> - 5-8% incidence in blunt chest trauma - indicates significant energy transfer - result from deceleration or compression injuries <ul style="list-style-type: none"> - Impact to dashboard or steering wheel - Direct blow to chest - deceleration from frontal impacts: <ul style="list-style-type: none"> - "cheese slice" of aorta - "paper bag" syndrome (pneumothorax) - Abdominal injuries - Head trauma <p>Morbidity/Mortality:</p> <ul style="list-style-type: none"> - 25-45% mortality - High association w/myocardial or pulmonary injury <ul style="list-style-type: none"> - myocardial contusion - pericardial tamponade - pulmonary contusion
Pathophysiology	<ul style="list-style-type: none"> - Restriction of tidal volume due to pain and splinting - Ventilation/perfusion mismatch - Atelectasis from extended restriction of tidal volume: <ul style="list-style-type: none"> - Higher risk in the elderly - High likelihood development pneumonia - Risk of underlying pulmonary + cardiac injury potential: <ul style="list-style-type: none"> - Multiple rib fractures - Flail segment - Sternal fractures 	<p>Impaired ventilation:</p> <ul style="list-style-type: none"> - Pain - Muscle spasm surrounding the injury - Paradoxical movement of chest <p>Impaired respiration:</p> <ul style="list-style-type: none"> - Underlying pulmonary contusion - Results in: <ul style="list-style-type: none"> - Hypoxia - Elevated PaCO₂ 	<ul style="list-style-type: none"> - Displacement of Sternal fractures are rare - Impairment to ventilation and respiration: <ul style="list-style-type: none"> - restriction of tidal volume due to pain - dependent upon the presence of pulmonary injuries - Reduced cardiac output + further reduction in ventilation/respiration due to underlying injuries
Assessment Findings	<p>Symptoms:</p> <ul style="list-style-type: none"> - Localized pain - Provocation pain: <ul style="list-style-type: none"> - Movement - Deep inspiration - Cough <p>Signs:</p> <ul style="list-style-type: none"> - Patient self-splinting on respiration <p>Palpation</p> <ul style="list-style-type: none"> - Point tenderness - Crepitus or audible crunch - Pain on placement of anteriorposterior pressure - Tenderness to compression of rib cage 	<p>Symptoms:</p> <ul style="list-style-type: none"> - Localized pain - Dyspnea - Pleuritic chest pain <p>Signs:</p> <ul style="list-style-type: none"> - Similar as rib fracture - Self-splinting - ↑HR (tachycardia) - ↑RR (tachypnea)/Respiratory distress/Shallow resp - lung sounds diminished - Unilateral crackles if pulmonary contusion present. - Pain and splinting of affected side - Chest wall contusion (bruising) - Paradoxical chest wall movement <p>Palpation:</p> <ul style="list-style-type: none"> - crepitus in multiple sites of the affected ribs 	<p>Symptoms:</p> <ul style="list-style-type: none"> - localized pain - tenderness over sternum - Pleuritic chest pain - Ischemic organ pain if a myocardial injury is present <p>Signs:</p> <ul style="list-style-type: none"> - ↑RR (tachypnea) + Shallow respiratory effort - ↑HR (tachycardia) may be a sign of shock - ECG changes associated w/myocardial contusion <p>Palpation:</p> <ul style="list-style-type: none"> - Crepitus + point tenderness over sternum - Other rib fractures may be present
Management	<ul style="list-style-type: none"> - High flow O₂ and BMV if needed - ECG - Splinting may decrease pain <ul style="list-style-type: none"> - avoid circumferential splinting - patient self-splinting may be appropriate - Analgesic for pain - Psychological support/communication strategies - Transport considerations: <ul style="list-style-type: none"> - appropriate mode and facility based on injury 	<ul style="list-style-type: none"> - High flow O₂ and BMV if needed - ECG - IV: - restrict fluids unless signs of shock <ul style="list-style-type: none"> - monitor lung sounds - Analgesic for pain - Psychological support/communication strategies - Transport considerations: <ul style="list-style-type: none"> - appropriate mode and facility based on severity of injury 	<ul style="list-style-type: none"> - High flow O₂ and BMV if needed - ECG - IV: - restrict fluids if pulmonary contusion is suspected <ul style="list-style-type: none"> - fluid challenge may be helpful for a myocardial contusion - Analgesic for pain - Psychological support/communication strategies - Transport considerations: <ul style="list-style-type: none"> - appropriate mode and facility based on severity of injury

	PULMONARY INJURIES				
	Simple pneumothorax	Open pneumothorax	Tension pneumothorax	Hemothorax	Pulmonary contusion
Epidemiology	<p>Incident:</p> <ul style="list-style-type: none"> - Nearly 100% in penetrating chest trauma - 10-30% blunt chest trauma <p>Morbidity/mortality:</p> <ul style="list-style-type: none"> - dependent upon extent of involvement - dependent upon presence + severity of associated injuries 	<p>Incident:</p> <ul style="list-style-type: none"> - Penetrating trauma <p>Morbidity/mortality:</p> <ul style="list-style-type: none"> - Death due to profound hypoventilation - Death related to delayed management 	<p>Incident:</p> <ul style="list-style-type: none"> - Penetrating trauma - Blunt trauma <p>Morbidity/mortality:</p> <ul style="list-style-type: none"> - Death due to profound hypoventilation - Death related to delayed management 	<p>Incident:</p> <ul style="list-style-type: none"> - Blunt or penetrating trauma - Frequently caused by rib fractures - High association with pneumothorax - Associated with great vessel/cardiac injury <p>Morbidity/mortality:</p> <ul style="list-style-type: none"> - 50% will die immediately - 25% will live 5 to 10 minutes - 25% may live 30 min or longer 	<p>Incident:</p> <ul style="list-style-type: none"> - Commonly cause by blunt thoracic trauma: <ul style="list-style-type: none"> - commonly associated w/rib fx - rapid deceleration MOI - blast injuries - Penetrating trauma <p>Morbidity/mortality:</p> <ul style="list-style-type: none"> - mortality between 14-20% - commonly missed bcos presence of associated injuries
Pathophysiology	<ul style="list-style-type: none"> - Disruption of pleural space. - Air accumulation in pleural space: <ul style="list-style-type: none"> - compression of lung tissue - ventilation/perfusion mismatch - air accumulation change w/pt position 	<ul style="list-style-type: none"> - deep, open defect in the chest wall <ul style="list-style-type: none"> - air will enter pleural space during Inspiration - air may or may not exit during expiration - ↓breath sounds on affected side - Pleuritic chest pain - collapse/compression of affected area - potential development of pressure within pleural space - Hypoventilation - Hypoxia 	<ul style="list-style-type: none"> - Similar to pneumothorax - Large volume of air trapped in pleural space w/increased pressure in the thoracic cavity: <ul style="list-style-type: none"> - Severe compression lung tissue - Hypoxia - Elevated levels of PaCO₂ - Lung collapses on affected area: <ul style="list-style-type: none"> - Impairment to ventilation - ↓ cardiac output: <ul style="list-style-type: none"> - ↓ preload due to kinking of the vena cava - profound shock may occur fast 	<ul style="list-style-type: none"> - Blood accumulation into the pleural space <ul style="list-style-type: none"> - chest cavity can hold up to 2-3 liters - massive hemothorax indicates a great vessel or cardiac injury - Sources of bleeding: <ul style="list-style-type: none"> - pulmonary contusion - disruption of pulmonary vessels - disruption of chest wall vessels - disruption of intercostal vessels - myocardial rupture - Collapse/compression of affected lung tissue 	<ul style="list-style-type: none"> - Bruised lung – lung impacts chest wall in blunt trauma - Alveoli and capillary rupture: <ul style="list-style-type: none"> - Bleeding into alveoli and interstitial space - Edema - Disruption of respiration: <ul style="list-style-type: none"> - Damaged capillaries and alveolar walls are unavailable for gas exchange: <ul style="list-style-type: none"> - hypoxia - CO₂ retention
Assessment findings	<p>s/s:</p> <ul style="list-style-type: none"> - Dyspnea - Chest pain referred to shoulder or arm on affected site - Respiratory distress - Subcutaneous emphysema - Decreased or absent breath sounds on affected site <p>Vital signs:</p> <ul style="list-style-type: none"> - ↑HR (tachycardia) - ↑RR (tachypnea) - Normal or slightly lowered pulse oximetry readings 	<p>s/s:</p> <ul style="list-style-type: none"> - Dyspnea - Open wounds in the chest wall - Sucking sound on inhalation - bubbling of fluid/blood at the wound - subcutaneous emphysema - Decreased or absent breath sounds on affected site <p>Vital signs:</p> <ul style="list-style-type: none"> - ↑HR (tachycardia) - ↑RR (tachypnea) - respiratory distress - watch for signs of shock 	<p>s/s:</p> <ul style="list-style-type: none"> - Rapid onset respiratory distress - Extreme anxiety or rapidly deteriorating mentation - Cyanosis - Bulging of intercostal muscles - Unilateral ↓/absent breath sounds - Subcutaneous emphysema - Late signs: <ul style="list-style-type: none"> - JVD - Tracheal deviation - decompensated shock <p>Vital signs:</p> <ul style="list-style-type: none"> - ↑HR (tachycardia) - ↑RR (tachypnea) - ↓BP (hypotension) - narrowing pulse pressures 	<p>s/s:</p> <ul style="list-style-type: none"> - Dyspnea - Pleuritic chest pain - Respiratory distress - Decreased or absent breath sounds - Signs of shock may be present - Dullness to percussion <p>Vital signs:</p> <ul style="list-style-type: none"> - ↑HR (tachycardia) - ↑RR (tachypnea) - ↓BP (hypotension) - narrowing pulse pressures 	<p>s/s:</p> <ul style="list-style-type: none"> - Dyspnea - Cough, hemoptysis (coughing blood) - evidence of blunt chest trauma - apprehension - changes in skin color - Dull to percussion - Signs of hypoxia dependent upon size of injury - respiratory distress - lung sounds: <ul style="list-style-type: none"> - crackles in affected lung - ↓ sounds w/reduced tidal volume <p>Vital signs:</p> <ul style="list-style-type: none"> - ↑HR (tachycardia) - ↑RR (tachypnea)
Management	<ul style="list-style-type: none"> - High flow O₂ / BVM - Observe for any potential progression towards a tension pneumothorax. <ul style="list-style-type: none"> - IV - ECG - Psychological support/communication strategies - Transport considerations: <ul style="list-style-type: none"> - appropriate mode and facility based on severity of injury 	<ul style="list-style-type: none"> - High flow O₂ / BVM - Cover open wounds with occlusive dressing - Monitor for development of tension pneumothorax <ul style="list-style-type: none"> - IV - ECG - Psychological support/communication strategies - Transport considerations: <ul style="list-style-type: none"> - appropriate mode and facility based on severity of injury 	<ul style="list-style-type: none"> - High flow O₂ / BVM (high resistance to ventilations due to increased intrathoracic pressure) - ECG - 3 sides occlusive dressing (if this is a progression of an open pneumothorax) - Rapid transport <ul style="list-style-type: none"> - consider ALS intercept for advance airway procedures (needle decompression) - appropriate mode and facility 	<ul style="list-style-type: none"> - High flow O₂ / BVM - IV fluid admin if signs of shock - Treat for respiratory compromise and for shock <ul style="list-style-type: none"> - ECG - Psychological support/communication strategies - Transport considerations: <ul style="list-style-type: none"> - appropriate mode and facility based on severity of injury (Activate trauma system) 	<ul style="list-style-type: none"> - High flow O₂ & assist ventilations dependent - Restrict IV fluids unless signs of shock are present <ul style="list-style-type: none"> - otherwise additional fluid may settle into the damaged area of the lung - frequent chest assessment is necessary w/IV fluid admin. - ECG - Psychological support/communication strategies - Transport considerations: <ul style="list-style-type: none"> - appropriate mode and facility

MYOCARDIAL TRAUMA			
	Myocardial Contusion	Pericardial Tamponade	
Epidemiology	<p>Incidence:</p> <ul style="list-style-type: none"> - 16-76% of blunt trauma - Major deceleration injury <ul style="list-style-type: none"> - Common in frontal impacts: <ul style="list-style-type: none"> - Bent steering wheel and chest tenderness - Direct blows to the chest - High association with sternal fractures <ul style="list-style-type: none"> - right ventricle most likely to be contused (right heart usually injured) - Result of injury <ul style="list-style-type: none"> - conduction system damage - bruising of myocardium (all or some) <p>Morbidity/Mortality: Significant cause of morbidity + mortality in blunt trauma patient.</p>	<p>Incidence:</p> <ul style="list-style-type: none"> - Occurs in less than 2% of chest trauma - Rare in blunt trauma - More common occurs in penetrating trauma - Myocardial rupture 	
Pathophysiology	<ul style="list-style-type: none"> - Rapid deceleration of right atrium and/or ventricle against the sternum - Vascular damage <ul style="list-style-type: none"> - bleeding into the myocardium or pericardium - Injury to contractile and conduction fibers <ul style="list-style-type: none"> - ↓ stroke volume - Complications <ul style="list-style-type: none"> - ↓ cardiac output - conduction disturbances - myocardial ischemia 	<p>Rapid fluid accumulation in the pericardial sac (rapid trauma)</p> <ul style="list-style-type: none"> - compression of myocardium + chambers of the heart: <ul style="list-style-type: none"> - restricting diastolic expansion and - reduces chamber filling - restricts venous return to the right atrium - Results: <ul style="list-style-type: none"> - ↓ stroke volume => ↓ cardiac output - ↓ myocardial perfusion - myocardial infarction may develop - development of shock 	
Assessment Findings	<p>s/s:</p> <ul style="list-style-type: none"> - Chest discomfort - Palpitations - Dyspnea - Signs of chest wall trauma: <ul style="list-style-type: none"> - Multiple rib fractures - Sternal fracture - signs of hypoperfusion - adventitious lung sounds if lung injuries <p>Vital signs:</p> <ul style="list-style-type: none"> - ↑HR (tachycardia) - irregular heart rhythm <p>Clues of a Contusion</p> <ul style="list-style-type: none"> - Bent steering wheel - Chest discomfort - Palpitations - Bruising of chest wall - Persistent tachycardia - ECG changes - ↓ cardiac output 	<ol style="list-style-type: none"> 1. Conduction system damage <ul style="list-style-type: none"> - tachycardia - PVCs - A-fibrillation - PAC - Atrial flutter Other ECG changes 2. Rupture of the myocardial wall <ul style="list-style-type: none"> - Rapid hemorrhage - Pericardial tamponade 3. Myocardial bruising <ul style="list-style-type: none"> - ↓ cardiac output - ECG changes 	<p>s/s:</p> <ul style="list-style-type: none"> - Respiratory distress - Chest discomfort - Open wounds to the chest - Cyanosis <ul style="list-style-type: none"> - Head - Neck - Upper extremities - signs of shock <p>Vital signs:</p> <ul style="list-style-type: none"> - ↑HR (tachycardia) - Narrow pulse pressure (systolic and diastolic get closer and closer to each other) - pulsus paradoxus (pulse becomes weaker as one inhales and stronger as one exhales) - ECG changes <p>30% of tamponades:</p> <ul style="list-style-type: none"> - Muffled heart tones - Neck vein distension (JVD) - Hypotension - Shows a progressive worsening of the condition
Management	<ul style="list-style-type: none"> - High flow O₂ / BVM - IV therapy (fluid boluses in hypoperfusion, tachycardia) - ECG (monitor changes after treatments) - Antidysrhythmic therapy i.e. lidocaine for malignant PVC - Psychological support/communication strategies - Transport considerations: <ul style="list-style-type: none"> - appropriate mode, consider air medical transport - appropriate facility 	<ul style="list-style-type: none"> - High flow O₂ / BVM - IV: fluid challenge - ECG (monitor changes after treatments) - Psychological support/communication strategies - Transport considerations: <ul style="list-style-type: none"> - appropriate mode, consider air medical transport - appropriate facility 	

OTHER THORACIC INJURIES		
	Traumatic Asphyxia	Aortic Dissection
Epidemiology	<p>Incidence:</p> <ul style="list-style-type: none"> - Hangings - Crush injuries, major blunt trauma 	<p>Incidence:</p> <ul style="list-style-type: none"> - Blunt trauma - 15% of all blunt trauma deaths - Caused by significant, rapid deceleration <ul style="list-style-type: none"> - Motor vehicle collisions <ul style="list-style-type: none"> - Frontal impacts - Lateral impacts - Falls <p>Morbidity/Mortality:</p> <ul style="list-style-type: none"> - 85%-95% die instantaneously - Poor survival rates at the hospital
Pathophysiology	<ul style="list-style-type: none"> - Sudden compressional force against the chest: <ul style="list-style-type: none"> - disruption of ventilation - blood return to the heart is prevented - Blood backs up into head and neck - JVD - High back-pressure placed on smaller vessels of the head: <ul style="list-style-type: none"> - rupture capillaries - inability to deliver O₂ or nutrients to cells - blood stagnates and clots - prolonged compression will result in massive decompensation when pressure is relieved: <ul style="list-style-type: none"> - profound hypoxia - circulation of acid and blood clots 	<p>Tear due to effect of high speed deceleration on portions of the aorta at points of relative fixation:</p> <ul style="list-style-type: none"> - Develop of injury is similar to an aortic aneurysm - Rupture of the aorta may occur as pressure continues to build within the walls of the aorta
Assessment Findings	<p>s/s:</p> <ul style="list-style-type: none"> - Dramatic color contrasts of the skin <ul style="list-style-type: none"> - Capillaries break: <ul style="list-style-type: none"> - Permanent cyanosis to head and neck - Swelling or blood in conjunctiva - Skin below neck remains pink - JVD (jugulars engorged w/blood) - ↓BP (hypotension) when pressure released - Building of blood/high pressure in head: <ul style="list-style-type: none"> - Impairment of cellular metabolism - Capillary damage may cause stroke-like effect - Crush injury management: <ul style="list-style-type: none"> - Release of pressure will cause hypotension - Circulation of acid 	<p>s/s:</p> <ul style="list-style-type: none"> - Respiratory distress - Chest discomfort - Open wounds to the chest - Cyanosis <ul style="list-style-type: none"> - Head - Neck - Upper extremities - signs of shock <p>Vital signs:</p> <ul style="list-style-type: none"> - ↑HR (tachycardia) - Narrow pulse pressure (systolic and diastolic get closer and closer to each other) - pulsus paradoxus (pulse becomes weaker as one inhales and stronger as one exhales) - ECG changes <p>30% of tamponades:</p> <ul style="list-style-type: none"> - Muffled heart tones - Neck vein distension - Hypotension - Shows a progressive worsening of the condition
Management	<ul style="list-style-type: none"> - High flow O₂ - Prepare to support ventilations when compressional force is lifted from the patient. <ul style="list-style-type: none"> - potential for rapid decompensation - combitube for unconscious patients - IV large bores - ECG (monitor changes after treatments) - Psychological support/communication strategies - Transport considerations <ul style="list-style-type: none"> - appropriate mode, consider air medical transport - appropriate facility 	<ul style="list-style-type: none"> - High flow O₂ / BVM - IV - Titrate fluid admin to signs of adequate perfusion <ul style="list-style-type: none"> - LOC - Systolic BP of 90mm Hg - ECG (monitor changes after treatments) - Drugs (narcotic analgesics are contraindicated) - Psychological support/communication strategies - Transport considerations <ul style="list-style-type: none"> - appropriate mode, consider air medical transport - appropriate facility