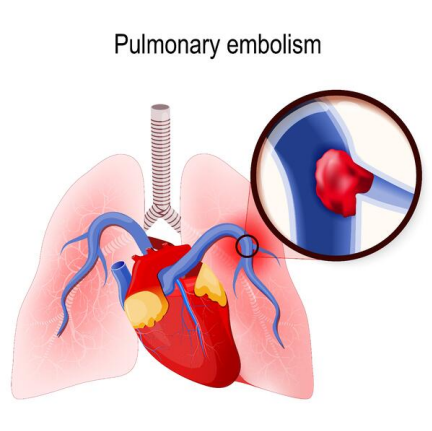
Pulmonary Embolism



-Disruption of the flow of blood in the pulmonary artery due to a thrombus
- Part of a thrombus in the leg (DVT) breaks off and travels to the lungs
- Other causes = air, fat, tumour cells

Causes

- Virchow's Triad: Hypercoagulability, venous stasis, endothelial injury
- Genetic
- Prolonged immobilisation: Bed rest >3 days, >4 hours travel, recent orthopaedic surgery, malignanct, venous catheter, obesity, pregnancy, smoking, oral contraceptive pill
- F# of lower limb
- Hospitalisation for heart failure/atrial fibrillation/flutter within 3 months
- Hip/knee replacement
- Major trauma
- Hx of previous DVT/PE
- Central venous lines
- Chemotherapy
- Heart failure/respiratory failure
- Hormone replacement therapy
- Postpartum period
- Infection (UTI, pneumonia, HIV)
- Cancer (Pancreatic, haemtological, lung, gastric, brain highest risk)

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Types

- **Haemodynamically unstable:** PE that results in hypotension (<90mmHg) or drop of systolic blood pressure of >40mmHg **more likely to die from obstructive shock (severe right ventricular failure)**
- **Haemodynamically stable**: Small can be symptomatic/asymptomatic , mild hypotension stablises with fluid therapy or right ventricle dysfunction

Pathology

- Can be multiple - lower lobes more affected
- Large ones obstruct pulmonary artery, smaller ones block peripheral arteries
- Impaired gas exchange occurs
- Mismatch in ventilation to perfusion ratio - dead space ventilation and hypoxemia
- Serotonin released - vasospasm and pulmonary flow further decreased
- Inflammatory mediators - alteration of lung surfactant - hypocapnia and respiratory alkalosis
- Right ventricular dilation and flattening/bowing of the interventricular septum due to increased PVR
- RBB

Presentation

- Dyspnea
- Pleuritic chest pain (pleural irritation)
- Cough
- Haemoptysis
- Presyncope/syncope
- Arrhymias
- Haemodynamic collapse
- Assess risk factors with Virchows triad
- Tachypnea and Tachycardia
- DVT signs (Calf swelling/redness/warmness), palpable cords, pedal oedema, rales, decreased breath sounds, pulmonary hypertension (elevated neck veins, loud P2, right sided gallop, right ventricular parasternal lift)

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Investigations

- Arterial Blood Gas analysis - Widened alveolar-arterial gradient for oxygen, respiratory alkalosis, hypocapnia
- Brain Natriuretic Peptide (BNP) - RV pressure overload releases B-type natriuretic peptide and N-terminal - proBNP (Blood test)
- Troponin - RV dysfunction
- D-Dimer (ELISA) - thrombotic process (high negative predictive value)
- ECG - usually nonspecific - tachycardia, nonspecific ST and T-wave changes
- Chest X-ray - usually normal/nonspecific, Hamptons hump, Westermark's sign
- Computed Tomographic Pulmonary Angiography (CTPA) -

-Lung Scintigraphy

- Pulmonary Angiography
- MRA - low sensitivity, low availability
- US for DVT

CXR



Left: Hampton's Hump: Dome/wedged shaped opaque
Right: Westermark's sign lucency of the lung on x-ray due to lack of blood in the lung

CPR (Geneva)

- Previous PE/DVT - 3/1
- Heart Rate
- 75-94 BPM - 3/1
- >95 BPM - 5/2
- Surgery/f# within past month - 2/1
- Haemoptysis - 2/1
- Active Cancer - 2/1
- Unilateral lower limb pulses - 3/1
- Pain on lower limb deep palpation and unilateral oedema - 4/1
- Age >65 years - 1/1

Three level score =
Low /0-3/0-1
Intermediate/4-10/2-4
High - >11/>5

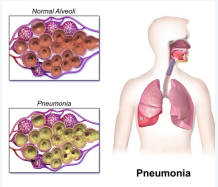
Two level score:
PE unlikely - 0-5/0-2
PE likely - >6/>3

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Management

- **Send to A&E**
- Anticoagulant: Heparin then oral anticoagulant therapy
- Prophylaxis in severe cases

Pneumonia



- Acute inflammation of and around the alveolis and terminal bronchioles - neutrophils
- Oedema and inflammation consolidate the affected lobe
- Can be bacterial/viral/fungal/parasitic

Pathogens

Viral:	Bacterial:
- Respiratory Syncytial Virus (RSV)	- Streptococcus pneumoniae
- Rhinovirus	- Haemophilis influenzae
- Influenza A,B,C (A greatest cause of mortality)	- Staphylococcus aureus
- Human Metapneumovirus (SARS)	- Group A strep
- Parainfluenza 1,2,3,4	- Moraxella catarrhalis
- Human Bocavirus Coronavirus	- Anaerobes and aerobic gram negative bacteria
- Adenovirus	- Legionella
- Enteroviruses	- Mycoplasma pneumoniae
- Varicella-Zoster virus	- Chlamydia pneumoniae
- Hantavirus	- Chlamydia psittaci
- Epstein-Barr (EBV)	
- Human Herpesvirus 6 &7	
- Herpes simplex virus	
- Minimi virus Cytomegalovirus (CMV)	
- Measles	
- MERS (Coronavirus)	
- Metapneumovirus	

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Causes

- Age (Young children/elderly)
- Pregnancy (usually viral)
- Immune compromised
- Chemotherapy/Radiation
- Immunosuppresive medications
- HIV/AIDS
- Inherited diseases :
- Trauma/ Severe burns
- Uncontrolled diabetes
- Malnutrition
- Poverty
- Environmental exposure
- Group living

Presentation

Viral:	**Bacterial:**
- Gradual	- Sudden
- No/lower temperature	- Purulent/bloody sputum
- Hx of immunosuppression	- Temperature (>38C) & increased RR (>18 breaths per minute)
- Hx of HIV	- Exposure to animals, crowds, water, air conditioning , aspiration
- Hx of solid organ/haemtopoietic transplantation	- Tachycardia/Tachypnoea
- Hx of neoplasm	- Chills
- Flu/GI symptoms	- Myalgia/arthralgia
- Tachycardia/Tachypnea	- Fatigue
- Usually affects lungs bilaterally	- Headache
	- Atypical pneumonia presents with GI and altered mental state
	- Pleuretic chest pain

Both: Dull on percussion, chest expansion reduced unilaterally, crackles heard on auscultation (lung bases)

Sputum:
S.pneunomiae: Rust coloured
Pseudomonas , haemophilius: Green
Kiebsella: Red currant jelly
Anaerobes: Foul smelling, bad tasting

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Investigations

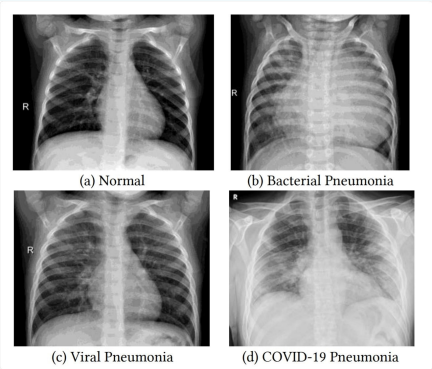
Laboratory:

- ELISA (viral)
- Blood cultures (not sensitive)
- CRP, ESR
- Urine testing
- Sputum culture

Chest X-ray - can differentiate between viral and bacterial pneumonia

- **Chest CT** - if normal chest x-ray and high suspicion of pneumonia (+ve parenchymal defects)

Chest X-ray



Bacterial:

Alveolar infiltrates

Lobar consolidation

Nodular densities

Pleural effusion

Viral:

Interstitial infiltrates - patchy and bilateral

X-ray usually unremarkable

Management

Viral:	**Bacterial:**
Influenza: Oseltamivir/preamivir/zanamivir	Fluoroquinolone/macrolide and beta-lactam
RSV: Ribavirin	Stop smoking
Parainfluenza: Ribavirin	Hydration
HSV: Acyclovir	Chest physical therapy
Adenovirus: Ribavirin	Upright position
Measles: Ribavirin	Nutrition
CMV: Ganciclovir/foscarnet	Bronchodilators
VZ: Acyclovir	Pulse oximetry monitoring

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DDx

- Any other type of pneumonia
- Bronchitis/Bronchiectasis/bronchiolitis
- Sarcoidosis
- Amyloidosis
- Pulmonary oedema/hypertension/embolism/fibrosis
- Hyperreactive airway disease
- Aspiration of a foreign body
- Atelectasis
- Lung abscess
- Respiratory failure

If in children consider: Asthma , Bronchiolitis, Croup, Respiratory distress syndrome, Epiglottitis as DDx

Prognosis

Viral:	Bacterial:
- Depends on virulence of the virus - hantavirus, SARS, MERS worse prognosis	- Age (>60 most at risk)
- Immunocompromised patient - HIV worse prognosis	- Comorbidities
- Comorbidities (COPD, CHF, Diabetes, cancer, haematological dyscrasias increase risk of death and complications)	- Antibiotic resistance of bacteria
- Presence/absence of concomitant bacterial infection	- Type of bacteria - pseudomonas, staphylococcus aureus highest mortality
- Time between diagnosis and treatment	

Complications

Viral:	Bacterial:
- Abscess	- Respiratory failure
- Empyema	- Sepsis/meningitis
- Pleural effusion	- Multiorgan failure
- Sepsis	- Coagulopathy
- Acute respiratory failure	- Exacerbation of preexisting conditions

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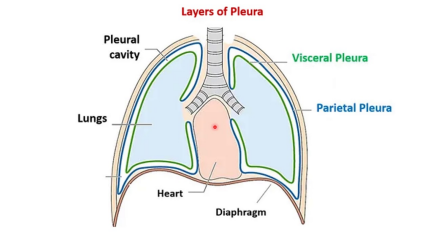
Complications (cont)

- Cardiovascular collapse
- Multiorgan failure
- Lung fibrosis
- Destruction of lung parenchyma
- Necrotising pneumona
- Cavitation
- Empyema
- Lung abscess

Pleurisy

- Localised chest pain
- Inflammation of the pleura
- Can be primary or secondary

Pleural anatomy



Pleural anatomy

- Visceral Pleura:	**- Parietal pleura**
- Surrounds lung tissue	- Lines inner chest wall
- Single mesothelial cells	- Contains stomata which drains pleural fluid to lymphatic capillaries in connective tissue
- No connective tissue	- Innervated by intercostal nerves (sensory) + phrenic nerve
- Supplied by vagus nerve	- Sensitive to pain

- Both are supplied by the bronchial arteries
- Function is to allow frictionless movement between the chest wall and chest, helps expand the lung outwards during inspiration and prevents infection into the lungs
- A space inbetween the visceral and parietal pleura is where the pleural fluid lies (pleural cavity)

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Causes

- **Hyperacute:**
- Pneumothorax
- Acute coronary syndrome
- Pulmonary emboli
- Acute pericarditis
- Chest wall trauma

- **Acute:** Viral and bacterial pneumonia

- **Subacute/Chronic:**
- RA
- Malignancy (Metastases, pleural lymphoma, fibrous tumour, angiosarcoma, pleuropulmonary blastoma, synovial sarcoma, mesothelioma)
- Tuberculosis

Presentation

- Sharp and localised thoracic/shoulder pain
- Exacerbated by coughing, sneezing, chest wall/trunk movement
- Can be dull, achy, burning or "catching"
- Travel hx, alcohol use, tobacco/e-cig/drug use
- +ve Friction rub in inspiration on auscultation (pericardial friction rub heard on both inspiration and expiration)
- Dullness to percussion
- Diminished breath sounds
- Vocal/tactile resonance

Investigations

- If pleurisy left sided **acute coronary syndrome should be ruled out**
- ECG, serum troponin
- Rule out acute pericarditis and aortic dissection
- Blood count, serum protein, albumin, lactate dehydrogenase, serum lipase (if acute pancreatitis suspected)
- Sample of pleural fluid if effusion present (pH, Glucose, cell count, lactate dehydrogenase, bacterial gram stain and cultures)
- Chest x-ray/CT

Management

- Treat underlying cause
- Drainage of the fluid to relieve pressure on the lungs

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DDx

- Acute coronary syndrome
- Aortic dissection
- Pneumothorax
- Pericardial effusion/tamponade
- PE
- Intrathoracic malignancies
- Infection in the lung
- Pericarditis

Pleural Effusion

- Accumulation of fluid between parietal and visceral pleura (pleural cavity)
- Fluid maintained by oncotic and hydrostatic pressure and lymph drainage
- Pleural fluid can build up if one or more of the processes above is disturbed

Causes

- Fluid can be transudate and exudate
- **Exudate if:**
- Fluid protein/serum protein ratio >0.5
- Lactate dehydrogenase(LDH)/serum LDH ratio >0.6
- Serum LDH >2/3 of upper limits of normal
- **Exudate causes:** Pulmonary infections, malignancy, inflammatory disorders (pancreatitis, lupus, RA, post-cardiac injury syndrome, chylothorax, haemothorax, benign asbestos pleural effusion) , PE, drug induced, post-radiotherapy, oesphageal rupture, ovarian hyperstimulation syndrome (increased hydrostatic pressure)
- **Transudates:** Congestive left heart failure, nephrotic syndrome, liver cirrhoris, hypoalbuminemia (disturbance of hydrostatic/oncotic pressure)

Presentation

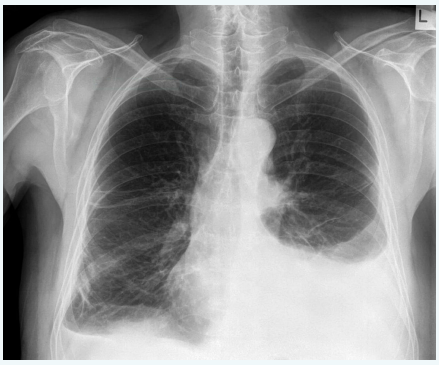
- Usually asymptomatic
- Exertional breathlessness
- Fullness of intercostal spaces
- Dullness on percussion
- Decreased breath sounds on auscultation
- Decreased tactile and vocal fremitus
- Pleural rub
- Look for underlying causes

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Presentation (cont)

- Mediastinal shift (deviated trachea and apex beat)

Investigations



- Chest X-ray : Meniscus sign (fluid located in costophrenic angle) + mediastinal shift towards contralateral chest cavity, displacement of trachea ipsilaterally
- CT if malignancy
- Ultrasound of chest more sensitive
- Fluid analysis (pH, protein, albumin, LDH, glucose, cell count, gram stain, culture, cytology)
- Adenosine Deaminase (ADA) - Tuberculosis

Management

- Addressing underlying cause
- Tube drainage + antibiotics

DDx

- Congestive Heart Failure
- Diaphragm injury/paralysis
- Malignant mesothelioma
- Pneumonia
- Atelectasis

Prognosis

- Depends on the cause
- Malignant causes have very poor prognosis (deceased within 12-24 months)
- Recurrent effusions should be drained
- Large effusions should not be drained too quickly due to the risk of re-expansion pulmonary oedema

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Pneumothorax

- Air accumulates between parietal and visceral pleura
- Can apply pressure onto the lung and cause a collapse

Causes/Risk factors

- Can be sudden/traumatic (blunt/penetrating)

Primary spontaneous causes/Risk factors:

- Smoking
- Tall, thin, young men
- Pregnancy
- Marfan syndrome
- Familial

Secondary spontaneous:

- COPD
- Asthma
- HIV + pneumocystis pneumonia
- Necrotising pneumonia
- Tuberculosis
- Sarcoidosis
- Cystic fibrosis
- Bronchogenic carcinoma
- Idiopathic pulmonary fibrosis
- Severe ARDs
- Langerhans cell histiocytosis
- Lymphangioleiomyomatosis
- Collagen vascular disease
- Cocaine/marijuana
- Thoracic endometriosis

Iatrogenic:

- Pleural/transthoracic lung biopsy
- Central venous catheter insertion
- Tracheostomy
- Intercostal nerve block

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Causes/Risk factors (cont)

- Positive pressure ventilation

Traumatic:

- Penetrating/blunt trauma
- Positive pressure ventilation (barotrauma)
- Percutaneous Tracheostomy
- Spontaneous pneumothorax
- Open pneumothorax

Pathology

- Pressure in the pleural space is negative compared to atmospheric pressure
- Pressure in the thorax changes with pneumothorax
- Surface tension between parietal and visceral pleurae causes the lung to expand outwards when chest wall expands
- Lung usually collapses during elastic recoil
- Air fills the space between the pleurae changing the pressure gradient

Presentation

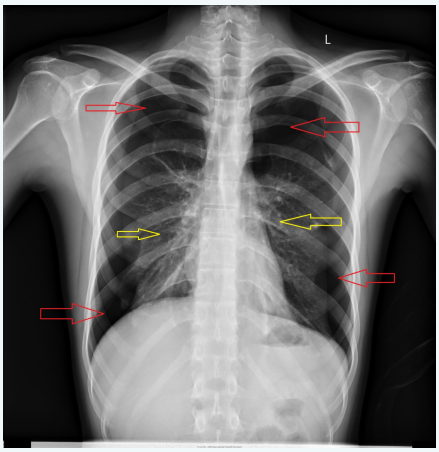
- Can be asymptomatic or minimal symptoms
- Chest pain (pleuritic, sharp, severe, radiating to the ipsilateral shoulder)
- SOB (more severe in spontaneous secondary)
- Can recur on the contralateral side
- Increased respiratory rate
- Asymmetrical lung expansion
- Decreased tactile fremitus
- Hyperresonant on percussion
- Decreased/absent breath sounds
- **Tension pneumothorax:** Tachycardia >134 BPM
- Hypotension
- Jugular venous distension
- Cyanosis
- Respiratory failure
- Cardiac arrest

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DDx

- Aspiration/bacterial/viral pneumonia
- Aortic dissection
- Myocardial infarction
- Pulmonary embolism
- Acute pericarditis
- Oesophageal spasm/rupture
- Rib fracture
- Diaphragm injuries

Investigations



Chest X-ray/US/CT
Red arrows = radiolucent areas of pneumothorax
Yellow arrows = Displaced lung parenchyma

Management

- Refer to GP if primary spontaneous
- **Tension pneumothorax is considered a medical emergency send to A&E**

Prognosis

- Usually resolves on its own
- Can reoccur
- Sponteneous secondary can be more deadly
- COPD and HIV higher mortality
- Tension pneumothorax mortality is high

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