Pulmonary Embolism

Introduction, Causes, Risk Factors, Diagnosis, Management, Prognosis & Prevention

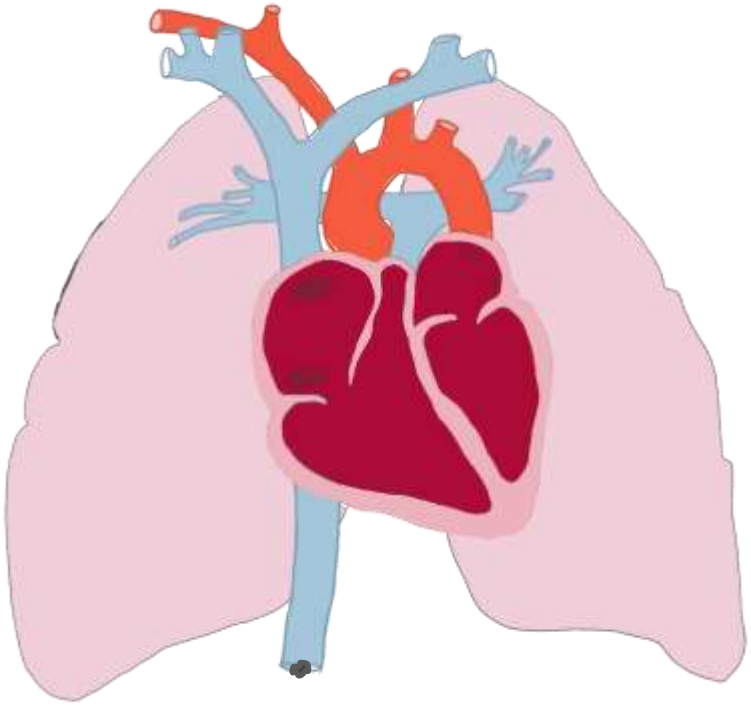
For Easy Navigation between Different Chapters of This Video, Timeline is given in Description & Comment section

Introduction

Definition of Pulmonary Embolism & its Effects

Introduction

When some material from anywhere in the body, passes into the pulmonary circulation, and block blood flow to the lungs → Pulmonary Embolism (PE)



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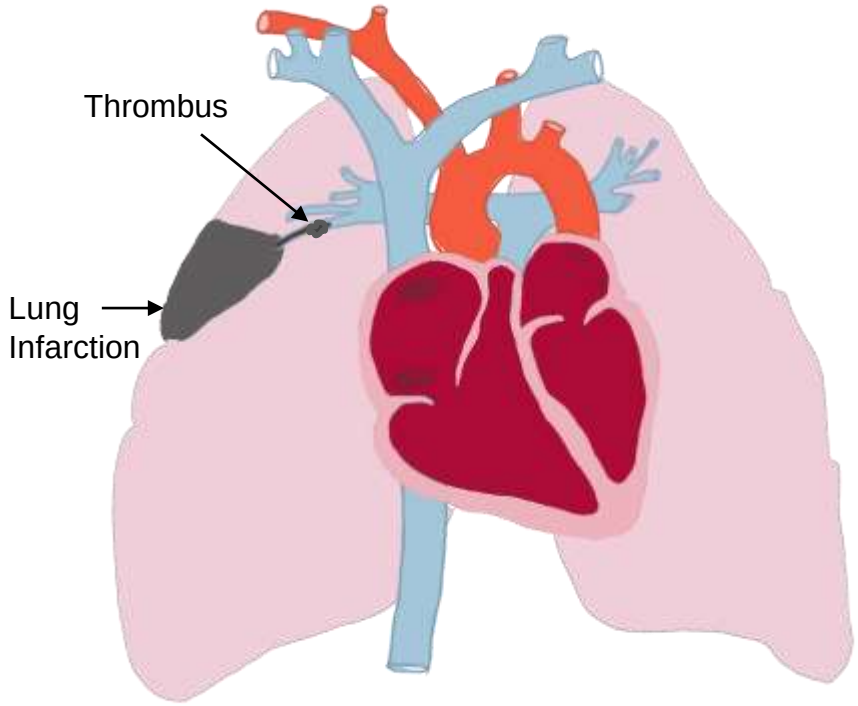


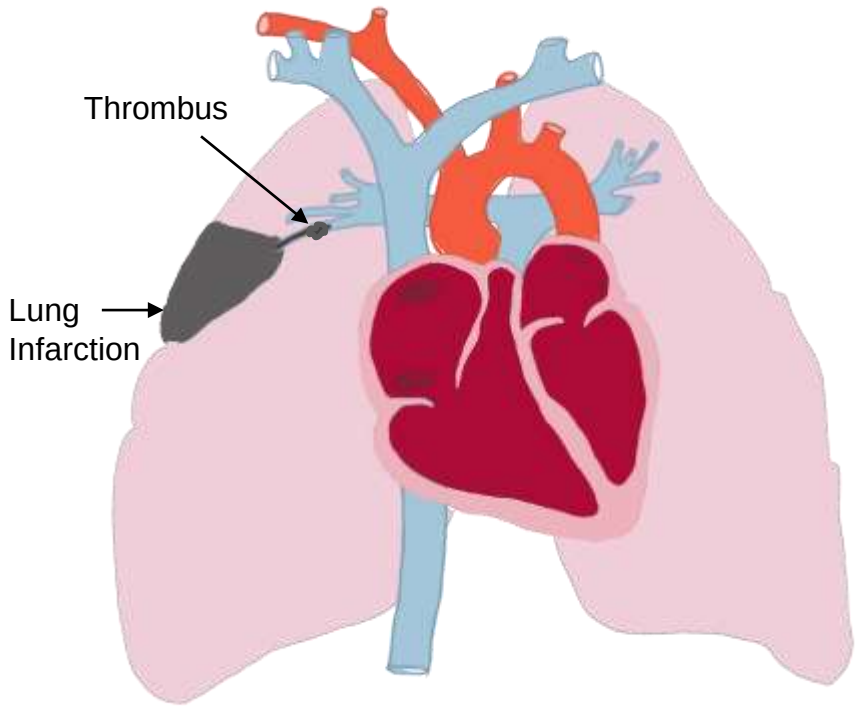
Effects of PE

i. Compromised gas exchange → **Hypoxemia**

ii. ↓ CO & Acute Right Heart Failure → **Cardiogenic Shock**

iii. Pulmonary Infarction & its sequelae

iv. Pulmonary hypertension & Chronic Right Heart Failure

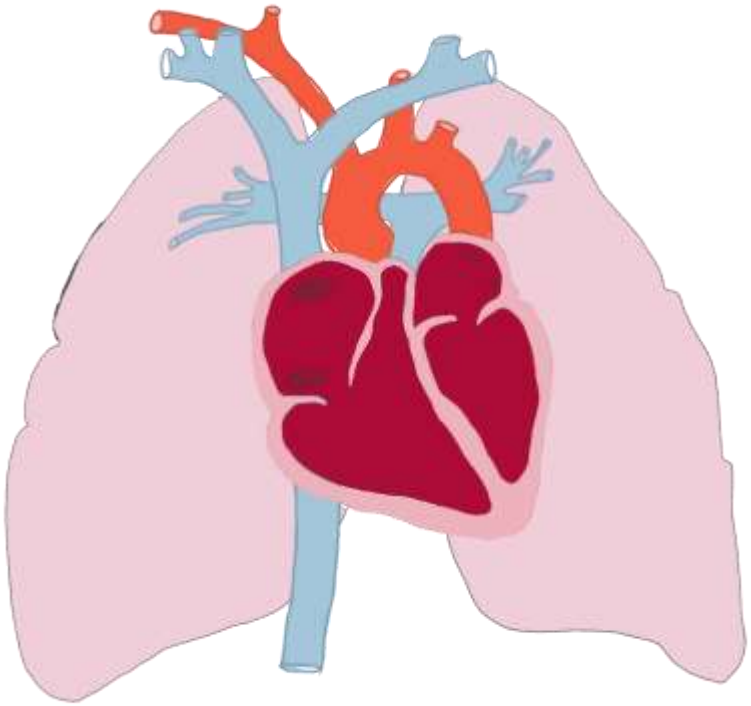


Causes of PE

What is Venous Thromboembolism (VTE)?

Causes

i. **Deep venous thrombus (DVT)** – Legs or Pelvic DVT



Causes

i. **Deep venous thrombus (DVT)** – Legs or Pelvic DVT

ii. **RV Thrombus** – From Post RV Infarct

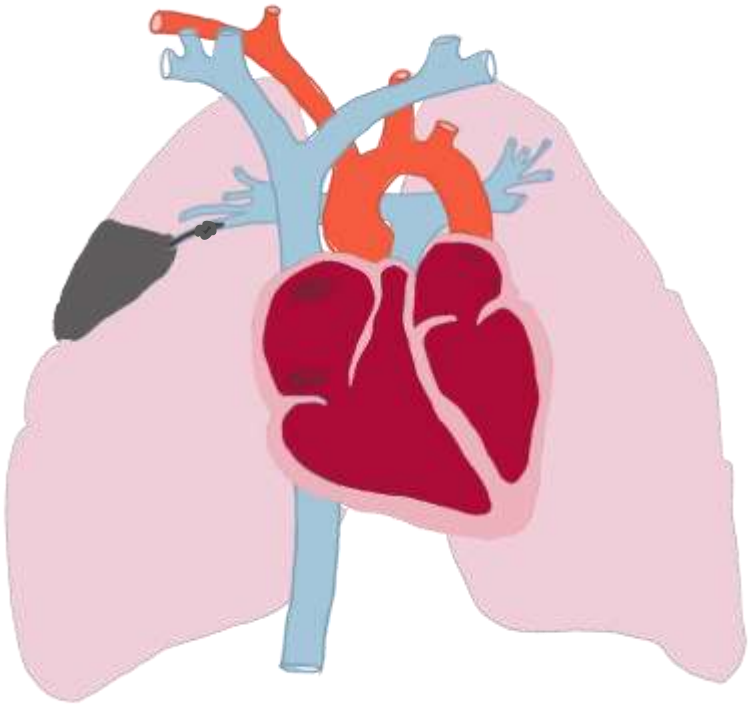
iii. **Septic emboli** – From Tricuspid or Pulmonary valve endocarditis

iv. **Fat embolism** -From long bones fracture

v. **Air** *or* **Amniotic fluid embolism** - Obstetric complication

vi. Neoplastic cells embolism - esp. Choriocarcinoma

vii. Parasites



Causes

i. **Deep venous thrombus (DVT)** – Legs or Pelvic DVT

ii. **RV Thrombus** – From Post RV Infarct

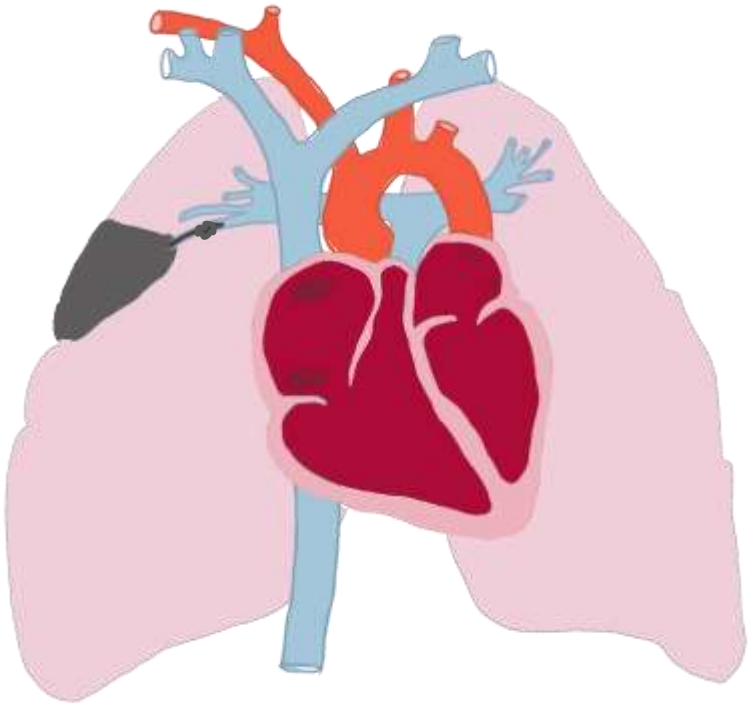
iii. **Septic emboli** – From Tricuspid or Pulmonary valve endocarditis

iv. Thrombosis in deep veins & then embolism is known as **‘Venous Thromboembolism’** or **VTE**
Fat embolism -From long bones fracture

v. **Air** *or* **Amniotic fluid embolism** - Obstetric complication

vi. Neoplastic cells embolism - esp. Choriocarcinoma

vii. Parasites

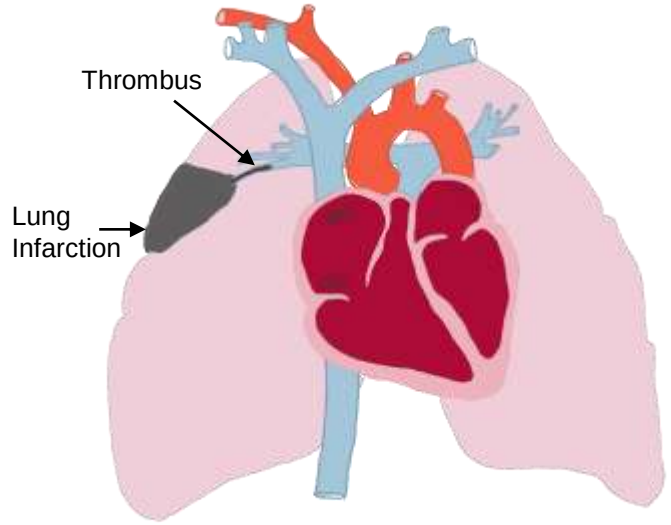


Risk Factor

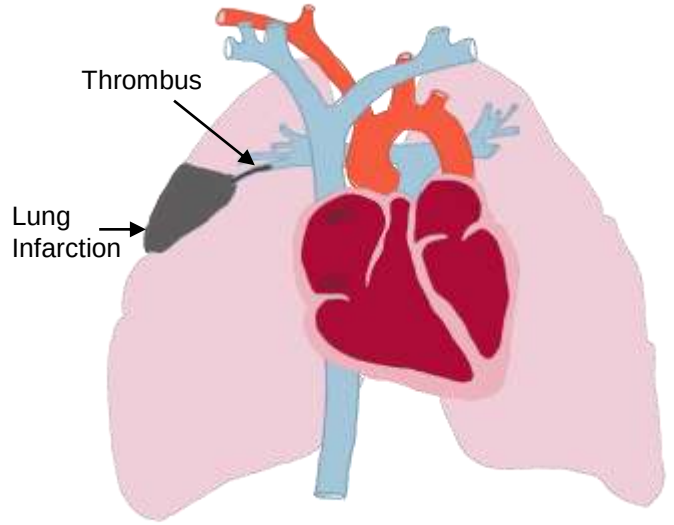
What is *Provoked* VTE and *Unprovoked* VTE?

Risk Factors

- Risk factor(s) found → **'Provoked'** VTE (80 – 90% cases)
- No risk factor found → **'Unprovoked'** VTE

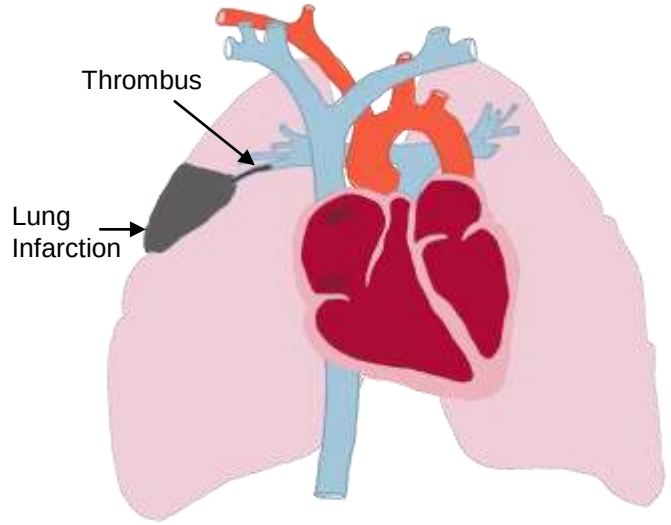


Risk Factors



- Recent major surgery
  - Abdominal/pelvic surgery
  - Hip/knee replacement
- Prolonged bed rest
- Immobility
  - Leg cast
  - Neurological conditions such as stroke, Guillain-Barre syndrome
  - Long-distance travelling > 4 h
- Thrombophilia - Antithrombin, Protein C or S deficiency, and Factor V Leiden, Prothrombin gene G20120 mutation etc
- Malignancy - Chemotherapy increases the risk of VTE compared with cancer alone
- Nephrotic syndrome
- Antiphospholipid antibody syndrome (APLAS)

Risk Factors

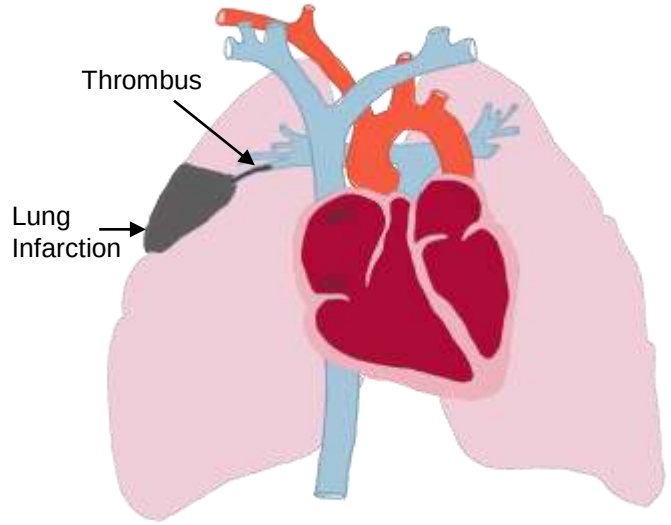


- Myeloproliferative disorders
  - Polycythemia rubra vera (PRV)
  - Essential Thrombocythaemia
  - Myelofibrosis
- Paroxysmal Nocturnal Hemoglobinuria (PNH)
- Active Inflammation - Infection *or* Inflammatory bowel disease (IBD)
- Pregnancy & Postpartum period
- Estrogen-only or combined contraceptive pill
- Hormone replacement therapy
- Previous thromboembolism

Clinical Features

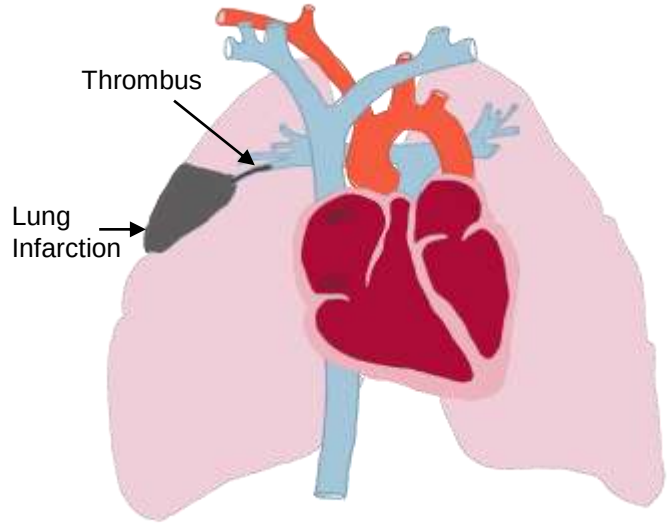
Symptoms & Signs

Clinical Features



- Presentation depends on
  - Onset – *Acute or Chronic*
  - Number, Size & Distribution of emboli
  - Cardiorespiratory reserve – *Any previous cardiopulmonary disease?*
- Small emboli – may be asymptomatic
- Large emboli – may be fatal
- Clinical presentation is anywhere on this spectrum

Clinical Features - Symptoms

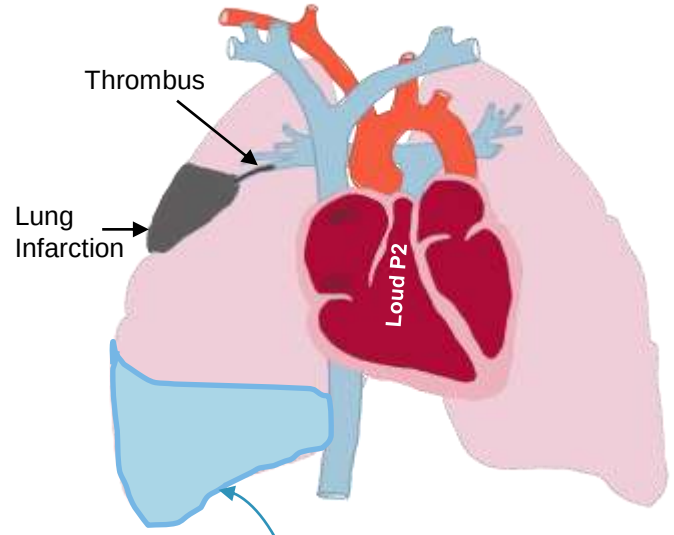


- Acute breathlessness
- Pleuritic chest pain
- Hemoptysis
- Dizziness
- Syncope

  - Current DVT

    - Ask about Risk factors, Past & Family history of thromboembolism

Clinical Features - Signs



Vital Signs

- Tachypnoea
- Tachycardia
- Hypotension
- Atrial fibrillation – *Irregularly irregular pulse*

General Physical

- Cyanosis
- ↑ JVP

Heart

- Right ventricular heave
- Loud P2
- Gallop rhythm

Lungs

- Pleural rub
- Pleural effusion

Look for embolic source *especially DVT*

Assessment & Investigations

Approach to Diagnosis & Making sense of Investigations in PE

Assessment & Investigations

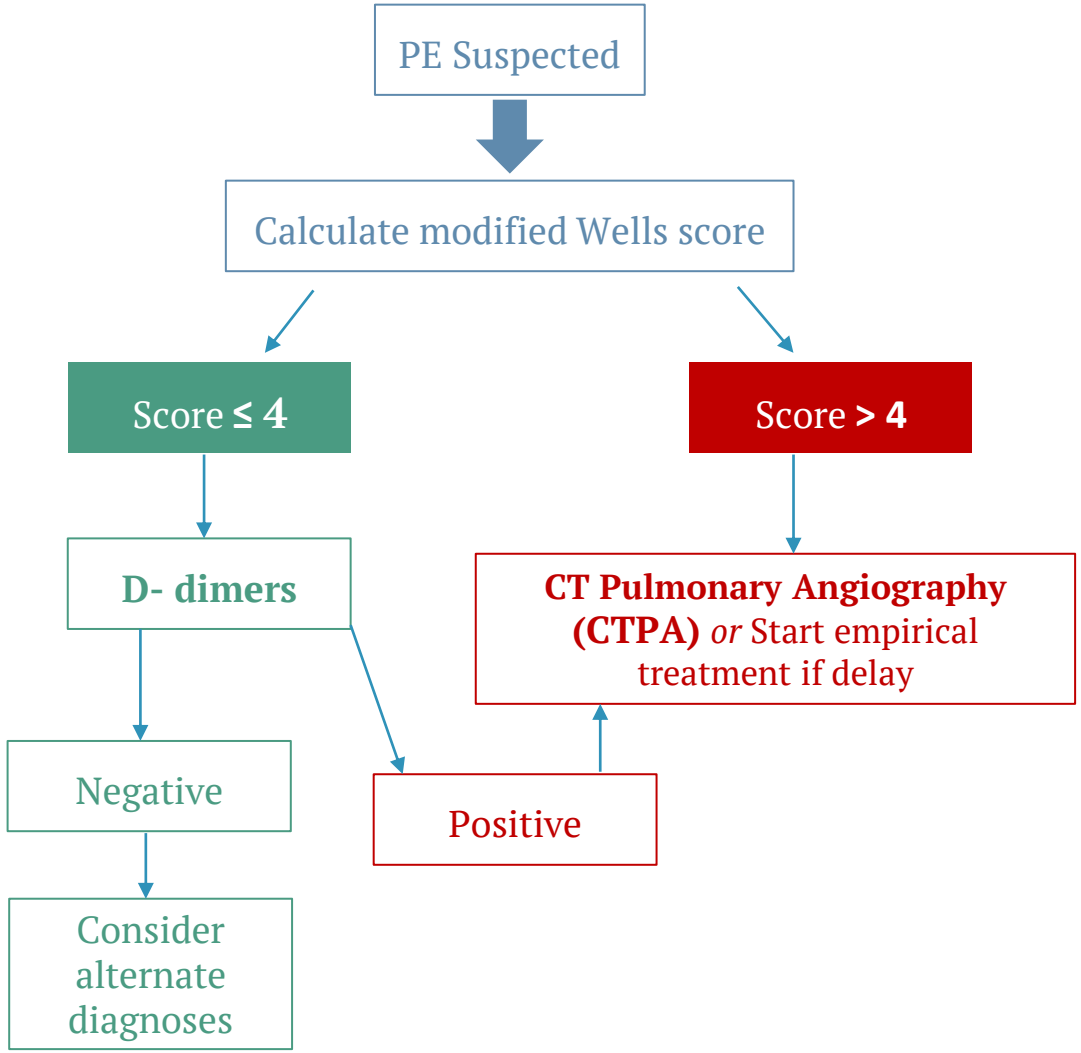
Clinical Scoring → Investigations

Modified Wells Criteria

	Features	*Score*
1.	Clinical signs and symptoms of DVT	- **3**
2.	Heart rate >100 bpm	- **1.5**
3.	Recently bed-ridden for more than 3 days, or if major surgery within last 4 weeks	- **1.5**
4.	Previous DVT or PE history	- **1.5**
5.	Hemoptysis	- **1**
6.	Cancer patient on active treatment/treated in last 6 months/palliative treatment	- **1**
7.	An alternative diagnosis is less likely than PE	- **3**

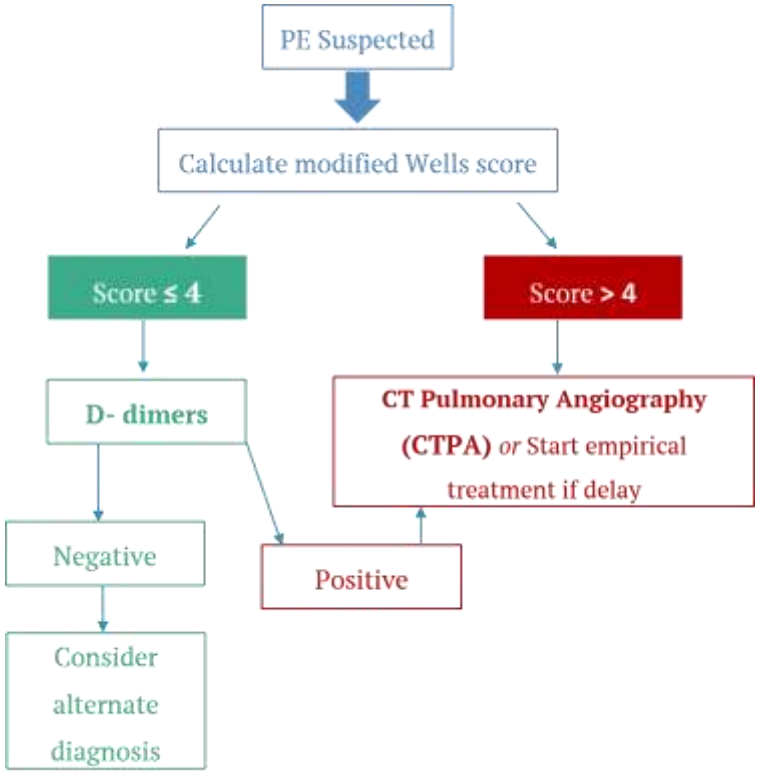
Score **4 or less** - PE **Unlikely**

Score **>4** - PE **Likely**



Assessment & Investigations

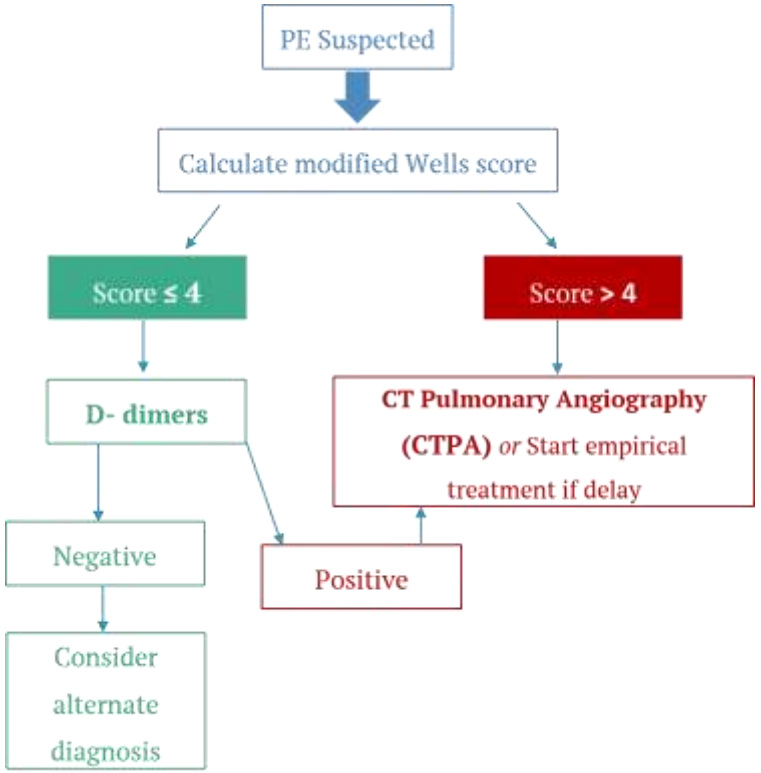
- **V/Q scan** *or* **Ventilation-Perfusion single photon emission computed tomography (V /Q SPECT)**
  - Consider where IV contrast for CTPA contraindicated



Assessment & Investigations

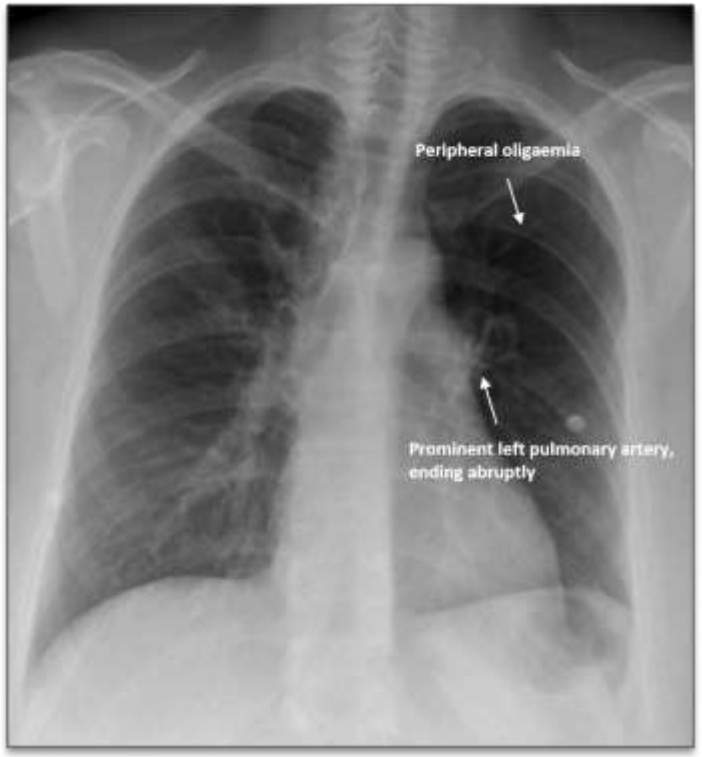
- **V/Q scan** *or* **Ventilation-Perfusion single photon emission computed tomography (V /Q SPECT)**
  - Consider where IV contrast for CTPA contraindicated
- **Full Blood Counts (FBC), Urea & Electrolytes, Clotting profile**
- **Arterial Blood Gases (ABGs)**

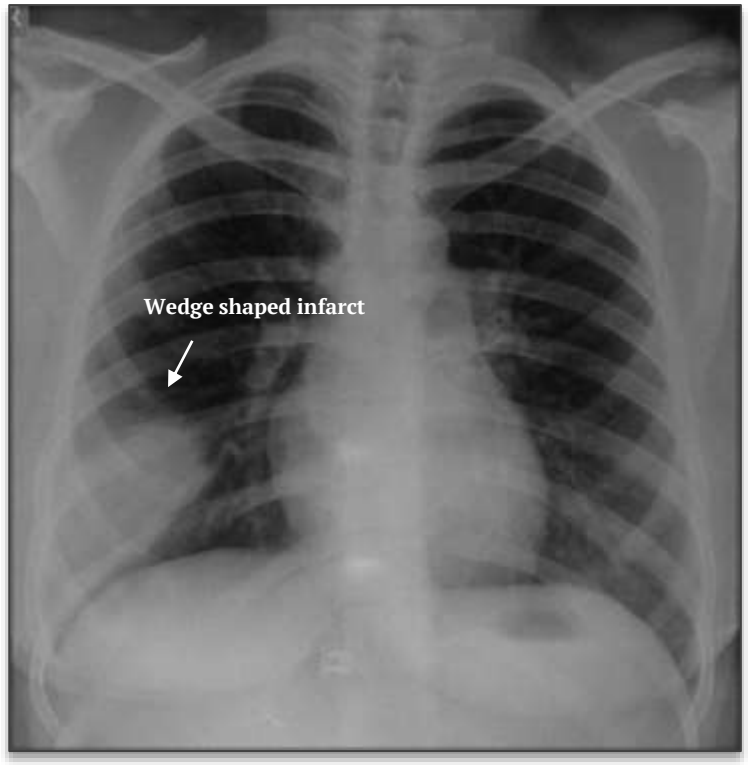
Poor gas exchange	-	↓ paO_2 , ↑ A-a gradient
Hyperventilation	-	↓ $paCO_2$, ↑ pH
Shock in massive PE	-	Metabolic acidosis



Assessment & Investigations

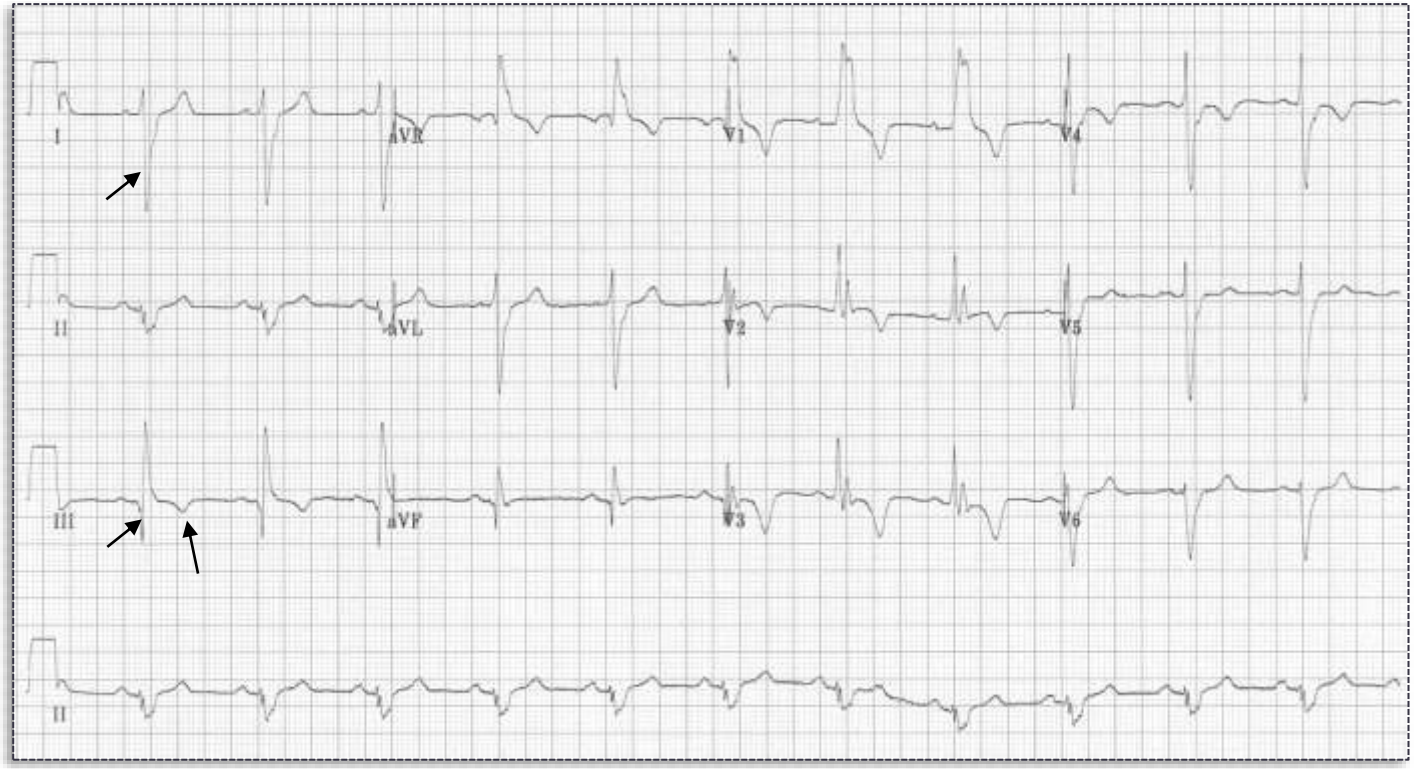
- **Chest X-ray**
  - Normal, or
  - Peripheral oligemia of affected segment
  - Dilated pulmonary artery
  - Linear atelectasis
  - Small pleural effusion
  - Wedge-shaped area of infarction.





Assessment & Investigations

- **ECG**
  - Normal
  - Sinus Tachycardia
  - T-wave inversion – Anterior leads
  - Right Ventricular strain
    - RBBB
    - Right axis deviation
    - Dominant R-wave & Inverted T-waves – V1 – V3
  - $S_IQ_{III}T_{III}$ - Rare
  - AF



Right Axis Deviation (RAD)

RBBB pattern with T-wave inversion V1 –V4 (RV strain)

$S_IQ_{III}T_{III}$ pattern

Assessment & Investigations

- **Color Doppler Ultrasound legs**
  - To exclude DVT
- **Echocardiography**
  - Helps in assessment of right-side of heart in massive PE/circulatory compromise
    - Acute dilatation of right heart
    - Thrombus (embolism in transit)
  - Helps in identifying/excluding important DD – LVF, Aortic dissection & Pericardial tamponade
- **Conventional Pulmonary Angiography**
  - Selected setting, *for catheter-based therapies*

Unprovoked PE

- **Exclude Malignancy**
- Complete Hx & Examination, incl Breasts
- Chest X-Ray, Full blood Count, calcium, Liver Function Tests & Urinalysis.
- >40-years old patient
  - Abdomen-pelvic CT scan
  - Mammography in women.
- **Thrombophilia screening**
- If family hx +ve

Treatment

A Holistic Approach

Treatment

Massive PE / Unstable patient

- **Thrombolysis**
  - Alteplase – 10 mg IV stat over 1 min, 90 mg IVI over 2h
- **Surgical pulmonary embolectomy**
  - Selected patient
  - Carries high mortality
- **Supplemental O_2** – Keep SaO_2 > 90%
- **Shock**
  - IV Fluids/Plasma expanders
  - Vasopressors – Dobutamine, Nor-epinephrine
- **Opiates** – *To relieve pain & distress*
- **External Cardiac Massage** – *in moribund patients*
  - May dislodge or break large central embolus

Stable patient

Low Molecular Weight Heparin (LMWH)

Unfractionated Heparin (UFH)

- If Renal Impairment

- Continue for 5 days

Warfarin

- **Target INR** 2-3
- Overlap with Heparin, as Warfarin initially Prothrombotic
- Stop Warfarin when INR >2 for >24h

Direct-acting oral anticoagulants (DOACs)

(*Apixaban, Rivaroxaban, Edoxaban, Dabigatran)*

- Switch from Heparin – *Unlike Warfarin, No need to overlap*
- Can be used instead of Heparin initially ***but not in*** *massive PE/massive Ileo-femoral DVT, Pregnancy & severe renal impairment*
- Only Apixaban & Rivaroxaban

Treatment

Maintenance Anticoagulation Duration

Initial Duration - 3 – 6 months

Provoked VTE

- Use for **3 months**
- Then, Reassess
- If risk factors persisting - Continue for a finite period

Unprovoked VTE

- **Optimum duration** – *difficult to establish*
  - Several predictors – *Strong predictors are Male gender & +ve D-dimer 1 month after discont of anticoagulation*
  - DASH score, Vienna prediction model
- **Recurrent unprovoked VTE** – Indefinite anticoagulation

Malignancy

- **Use LMWH , Not Warfarin**
- Continue for 6 months or until cure on cancer

Pregnancy

- **LMWH -** continue until delivery *or* end of pregnancy

Treatment

Inferior Vena Cava Filters

Used when

- Anticoagulation is contraindicated
- Suffer massive hemorrhage on anticoagulation
- Recurrent VTE despite anticoagulation

IVC filter should be used only until anticoagulation can be safely initiated

Prognosis

Prognosis

- Immediate mortality greatest in patients with right ventricular dysfunction or cardiogenic shock
- Once anticoagulation is commenced, the risk of mortality rapidly falls
- Recurrence risk - Highest in the first 6–12 months

Prevention

Steps to Prevent VTE in your patient!

Prevention

- VTE risk assessment for all In-patients
- Appropriate prophylaxis, if indicated
  - Prophylactic anticoagulation
  - Mechanical devices - Intermittent pneumatic compression, graduated foot stockings, or mechanical foot pump
- Stop Hormone replacement therapy & OCPs pre-operatively
- Early post-operative mobilization of patient

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