

PULMONARY EMBOLISM (PE)

(Last updated 07 /23/2019; Reviewed by: S Chandralekha Kruthiventi MD.)

PRESENTING COMPLAINT: Dyspnea (shortness of breath), chest pain, and hemoptysis

FINDINGS

- **A** Check airway
- **B** ↑ RR, increased work of breathing
- **C** ↑ HR, N, or ↓ BP, Circulatory collapse with shock and PEA arrest in severe cases.
- **D** Variable altered (V,P,U,D)*
- **E** Cyanosis, increased sweating, syncope
- **L_{PC}** ↑ D-dimer, CBC, type and crossmatch, baseline PT/APTT, ABG - ↑ pH, respiratory alkalosis-low pAO₂ in severe cases
- **U_{PC}** Unremarkable lung fields, if submassive or massive RV dilatation, McConnell's sign (regional right ventricular akinesia/ hypokinesia); non-compressible femoral vein if DVT

***V** (verbal), **P** (pain), **U** (unconsciousness), **D** (delirious)

U_{PC} (point of care ultrasound) **L_{PC}** (point of care labs)

OTHER HISTORY

- **Pre-disposing conditions**
 - Immobilization, reduced mobility, recent surgery (< 3 months), malignancy, heart failure, obesity, smoking, female, use of oral contraceptives, hormonal therapy, prior history or family history of DVT/PE, air travel, pregnancy, cancer, chronic leg edema
- **Symptoms:** Sudden onset dyspnea/tachypnea, pleuritic pain, cough, chest pain +/-, hemoptysis
- **Signs:** Pleural friction rub, loud pulmonic component of second heart sound, pale skin, JVD +/-, tachycardia, RV S3, signs of deep vein thrombosis (edema, erythema, tenderness in calf, thigh, or arm), often masked by underlying COPD or CHF

DIFFERENTIAL DIAGNOSIS

- Acute coronary syndrome, pneumothorax, aortic dissection, pneumonia, ARDS, atelectasis, amniotic fluid embolism, septic emboli

OTHER INVESTIGATIONS

- **Labs:** D-Dimer, ABG, ↑ Troponin, ↑ BNP
- **Monitoring**
 - **ECG:** nonspecific ECG changes, S1Q3T3, sinus tachycardia, RV strain patterns, RBBB
 - Blood pressure, oxygen saturation

- **Imaging**
 - **ECHO:** direct visualization of free floating thrombus, regional right ventricular dysfunction with right ventricular free -wall akinesia/hypokinesis in the presence of normal apical contractility, McConnell's sign specific for acute PE
 - **CT-PA:** if contraindicated, consider isotope scintigraphy/VQ
 - Venous duplex ultrasound of calf/thigh/arm
 - **Echo:** RV diameter/LV diameter > 0.9 or RV systolic dysfunction indicates at least submassive PE if hemodynamically stable or massive PE if shock
 - **Doppler ultrasonography** of leg to rule out deep vein thrombosis: non-compressible venous segment and USG chest - pleural effusion
 - **Clinical probability**
 - Modified Wells score: PE unlikely (< 2), moderate risk (2-6), high (> 6)
 - Massive PE defined by Systolic blood pressure < 90 mm for at least 15 minutes or requiring vasopressor support, pulselessness or profound bradycardia (heart rate < 40 bpm with shock)
- **Suggested Diagnostic Approach**
 - If PE unlikely per Modified Well's score (< 2) + D-dimer negative, PE ruled out; otherwise, CT-PA and treat based on results
- **Consult:** ECMO, cardiovascular surgery, interventional radiology, pulmonology

THERAPEUTIC INTERVENTIONS

- **Treatment**
 - Oxygen therapy, IV access, ECG monitoring, monitor and treat pain and anxiety, initial bed rest (semi-Fowler's position)
 - If PE intermediate/high probability (e.g. Wells score ≥ 2) and no contraindications, start anticoagulant treatment while waiting for confirmatory tests
 - **IF MASSIVE PE, consider emergent systemic thrombolysis**
 - Low molecular weight heparin (LMWH) or IV unfractionated heparin (UFH) or fondaparinux
 - Monitor APTT if using UFH: goal 60-90 sec
 - Monitor platelet count if high suspicion for HIT: 4 T score, work up and switch to direct thrombin inhibitors
 - Consider one of the following: dabigatran, rivaroxaban, apixaban, edoxaban
- **Massive PE** with consecutive shock, pulselessness or bradycardia, consider:

- Systemic Thrombolysis with tPA
 - If low or acceptable risk of bleeding complications
 - 100 mg over 2 hours (half-dose [50 mg] maybe effective)
- Vasopressors: Norepinephrine, vasopressin +/- dobutamine, epinephrine
- Thrombectomy: If thrombolysis contraindicated, consider surgical or catheter embolectomy
- Intubation and mechanical ventilation if necessary to maintain oxygenation: Risk of cardiac arrest with intubation, minimize induction agents, avoid apnea/acidosis, avoid vigorous positive pressure
- Consider ECMO
- **Submassive PE:** No clear short or long-term benefit of thrombolytic treatment
 - Close monitoring first 24 hours

ONGOING TREATMENT

- **Further Treatment**
 - Interventional/catheter directed thrombolysis and surgical options if persistent instability after fibrinolysis or contraindication to thrombolysis
 - Start oral warfarin overlapping with LMWH/UFH/Fondaparinux therapy (goal INR: 2-3), OR continuing LWMH better outcomes in cancer patients OR dabigatran, rivaroxaban, apixaban, edoxaban
 - Consider IVC filter if lower extremity DVT and contraindication to anticoagulation or if bleeding complications; consider long-term anticoagulation if recurrent DVT

CAUTION

- **Complications :** Bleeding, heparin-induced Thrombocytopenia (HIT), skin necrosis (if starting warfarin without overlapping LMHW/UFH/Fondaparinux), RV failure, chronic thrombotic pulmonary hypertension

REFERENCES & ACKNOWLEDGEMENTS

Acknowledgement: *Linda Bucher, PhD, RN, CEN; Venu Velagapudi, MD*

Benjamin Bonneton, MD -AHA Scientific Statement. Management of Massive and Submassive Pulmonary Embolism, Iliofemoral Deep Vein Thrombosis, and Chronic Thromboembolic Pulmonary Hypertension. *Circulation*. 2011; 123: 1788-1830\ van Belle A, Büller HR, Huisman MV, et al. Effectiveness of Managing Suspected Pulmonary Embolism Using an Algorithm Combining Clinical Probability, D-Dimer Testing, and Computed Tomography. *JAMA* 2006; 295:172.