Pathogenesis of PE, Risk Stratification, and Management

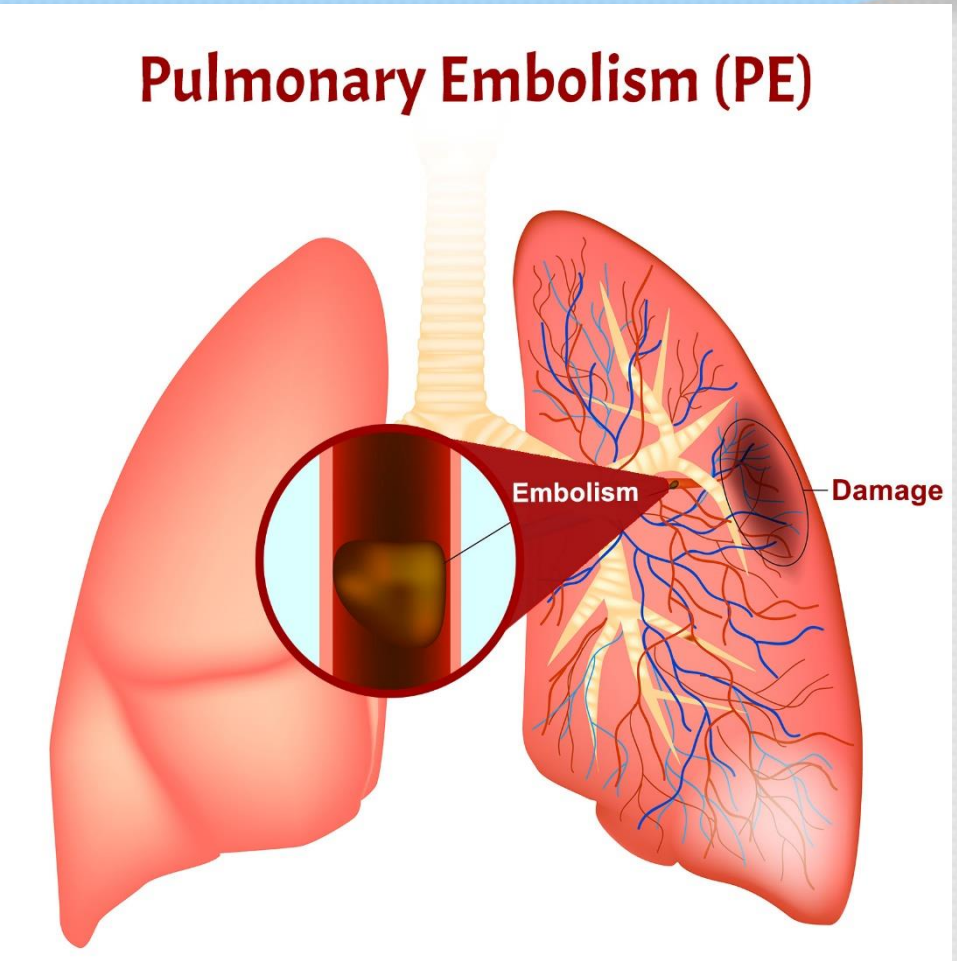
Anushka Bhate

Rajan Memorial Lecture 2022

January 9, 2022

Introduction to Pulmonary Embolism

- Pulmonary embolism is when a clot gets dislodged, travels to the lungs, and blocks an artery in the lungs. This blocks blood flow to the lungs.
- Life-threatening condition
- Can affect anyone



https://apsfa.org/pulmonary-embolism/

Epidemiology

- VTE is second most common cardiovascular disorder after heart attacks
  - More frequent than strokes
  - 1 to 5 cases out of 1000 people annually
  - Age dependent:
    - 1/100,000 annually in children
    - 1/1000 annually in adults
    - 1/100 annually in elderly
- Approximately 60,000-100,000 Americans die of PE each year
  - Approximately 900,000 Americans are affected by PE each year

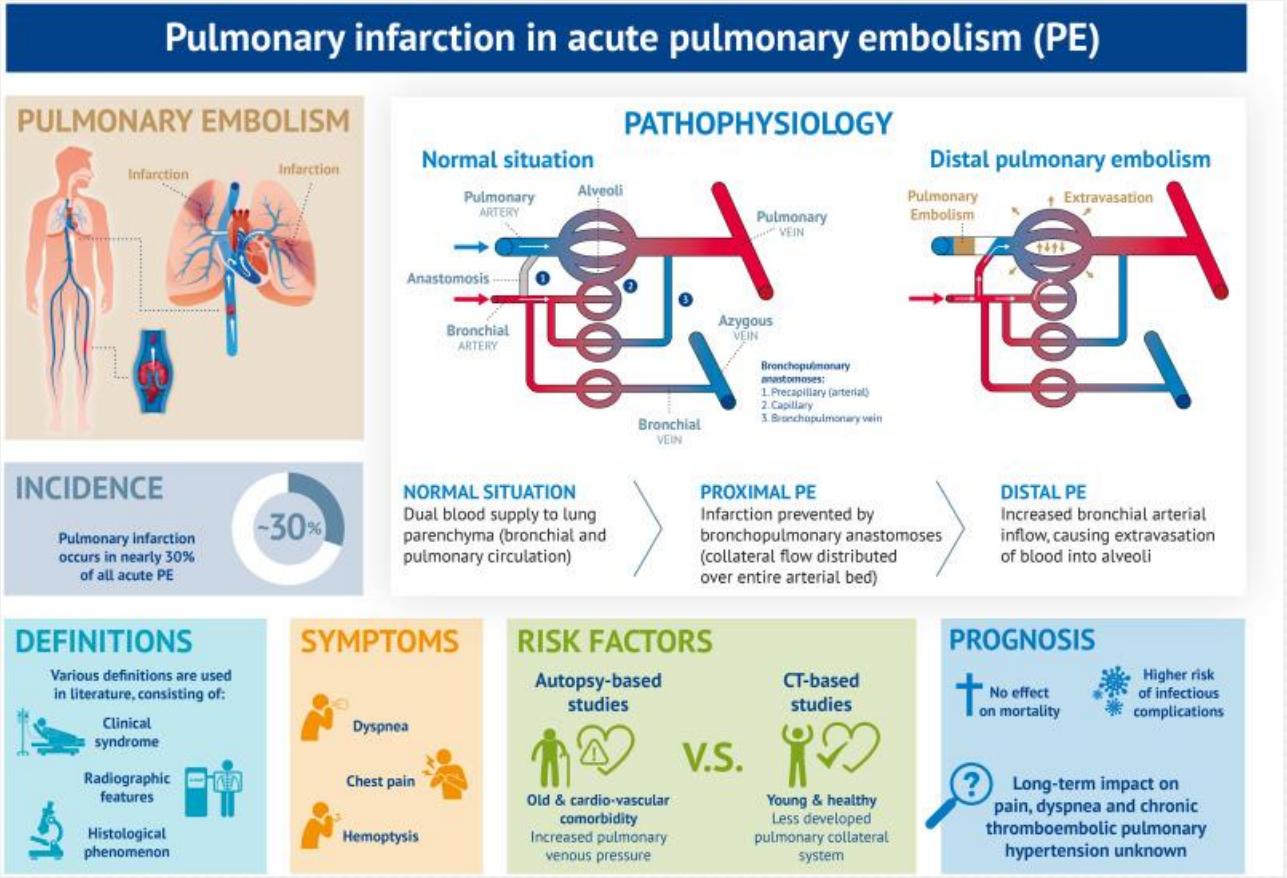
Hypercoagulability and Increased Risk for PE

- Hypercoagulability (thrombophilia)- Increased tendency of blood to clot
- If you are bleeding, your body forms a clot to maintain hemostasis
  - This is a healthy and normal response
  - This process is called coagulation
- However, sometimes people's bodies might form clots when they are not bleeding or have exaggerated coagulation.
  - This is called hypercoagulability.
  - Different hypercoagulable states and thrombophilic diseases cause hypercoagulability

Pathophysiology

- Clot breaks off and embolizes into pulmonary circulation
- Impaired gas exchange since blood cannot reach the lungs through the blocked vessels -> can lead to low O2 saturation
- If lungs cannot get enough blood flow -> pulmonary infarction
- Since pulmonary vessels are blocked -> leads to increased resistance that the right ventricle must pump against -> can cause acute right heart failure
- Right ventricular failure is the primary cause of death in PE

Pathophysiology (continued…)



https://www.thrombosisresearch.com/article/S0049-3848(21)00126-2/fulltext

Risk Stratification

- Shock and right ventricular dysfunction confer a poor prognosis and predict mortality in patients with PE
- Patients who have PE and coexisting DVT are also at increased risk for death
- Several prognostic models have been designed, the Pulmonary Embolism Severity Index (PESI) and the simplified PESI (sPESI) are the most commonly used
- PESI score predicts 30-day mortality in patients with an established diagnosis of PE

Risk Stratification (continued…)

Original and simplified Pulmonary Embolism Severity Index (Parameter- original version/simplified version)

- Age-1 point (if age >80 years)
- Male sex- +10 points/0 points
- Cancer- +30 points/1 point
- Chronic heart failure- +10 points/1 point
- Chronic pulmonary disease- +10 points/1 point
- Pulse rate ≥110 b.p.m- +20 points/1 point
- Systolic BP <100 mmHg- +30 points/1 point
- Respiratory rate >30 breaths per min- +20 points/ 0 points
- Temperature <36°C- +20 points/ 0 points
- Altered mental status- +60 points/ 0 points
- Arterial O2 saturation <90%- +20 points/1 point

Risk Stratification (continued…)

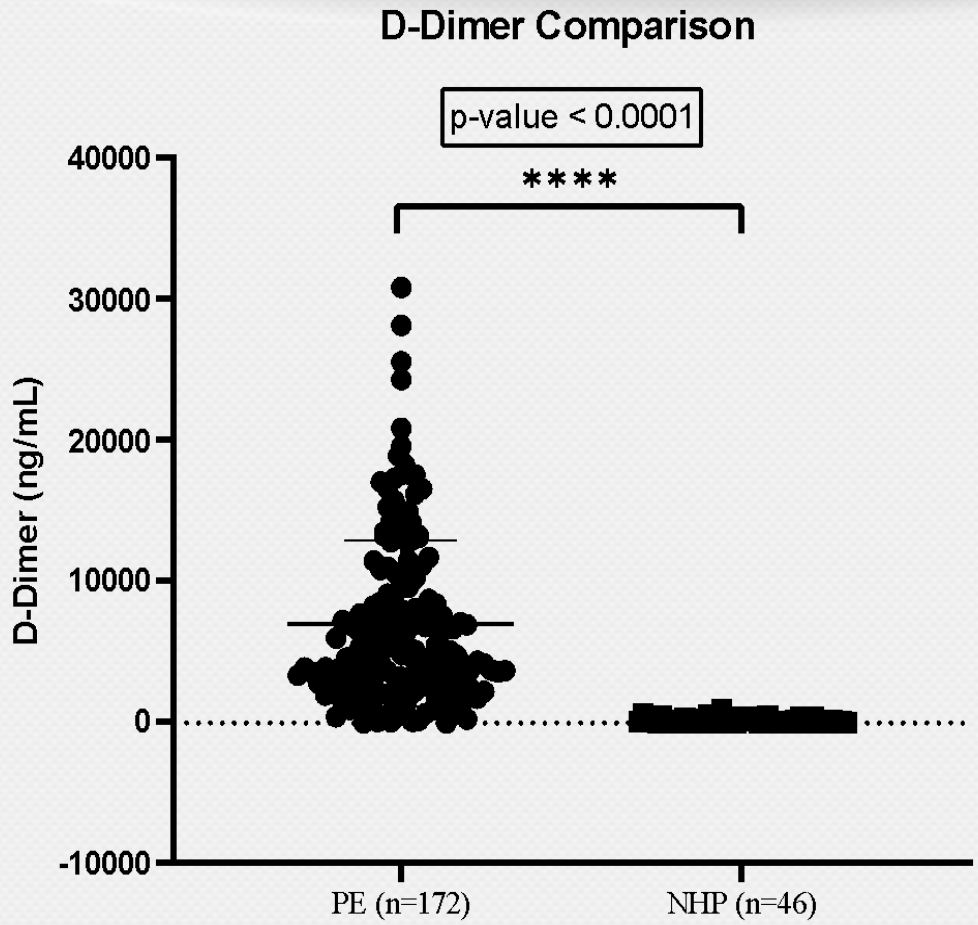
Risk stratification in PESI

- Class I: Points less than or equal to 65; low 30-day risk of mortality from 1 to 6%
- Class II: Points 66–85; low mortality risk from 1.7 to 3.5%
- Class III: Points 86–105; moderate mortality risk from 3.2 to 7.1%
- Class IV: Points 106–125; high mortality risk from 4.0 to 11.4%.
- Class V: Points more than 125; very high mortality risk from 10.0 to 24.5%.

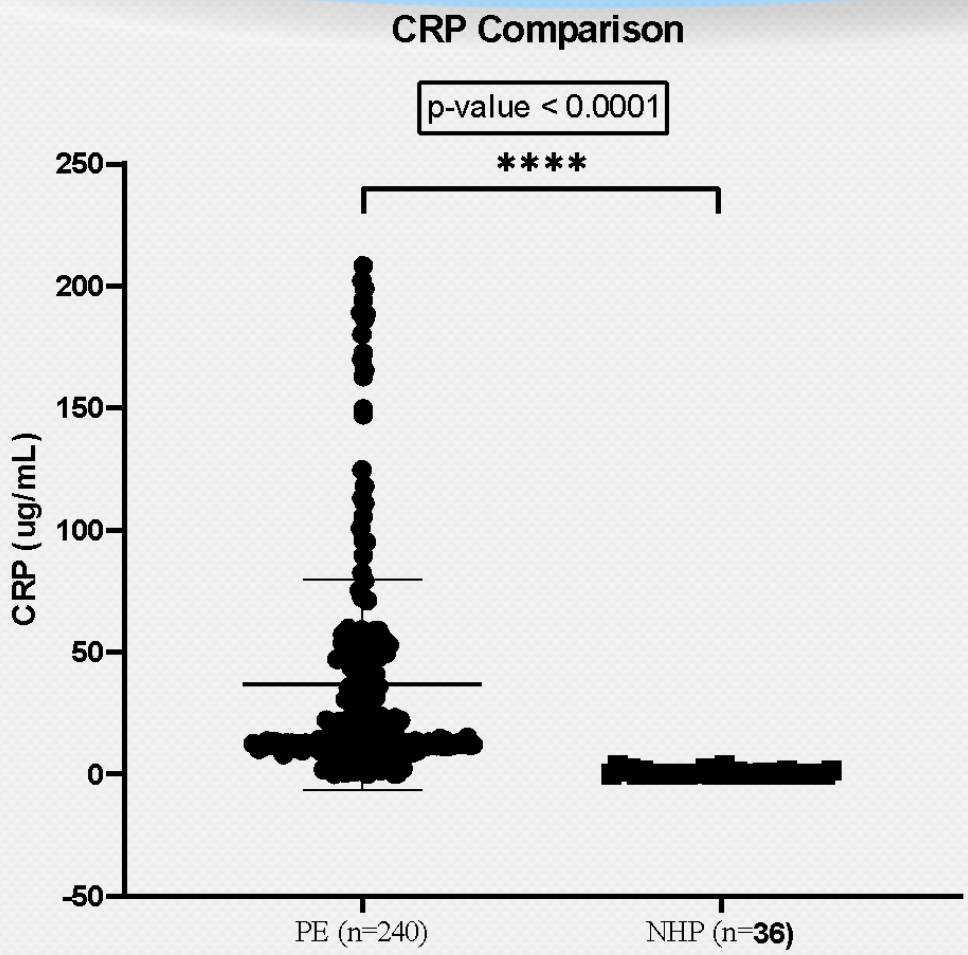
Risk stratification in sPESI

- If 0 points then 30-day mortality risk 1.0%
- If 1 or more points then 30-day mortality risk 10.9%

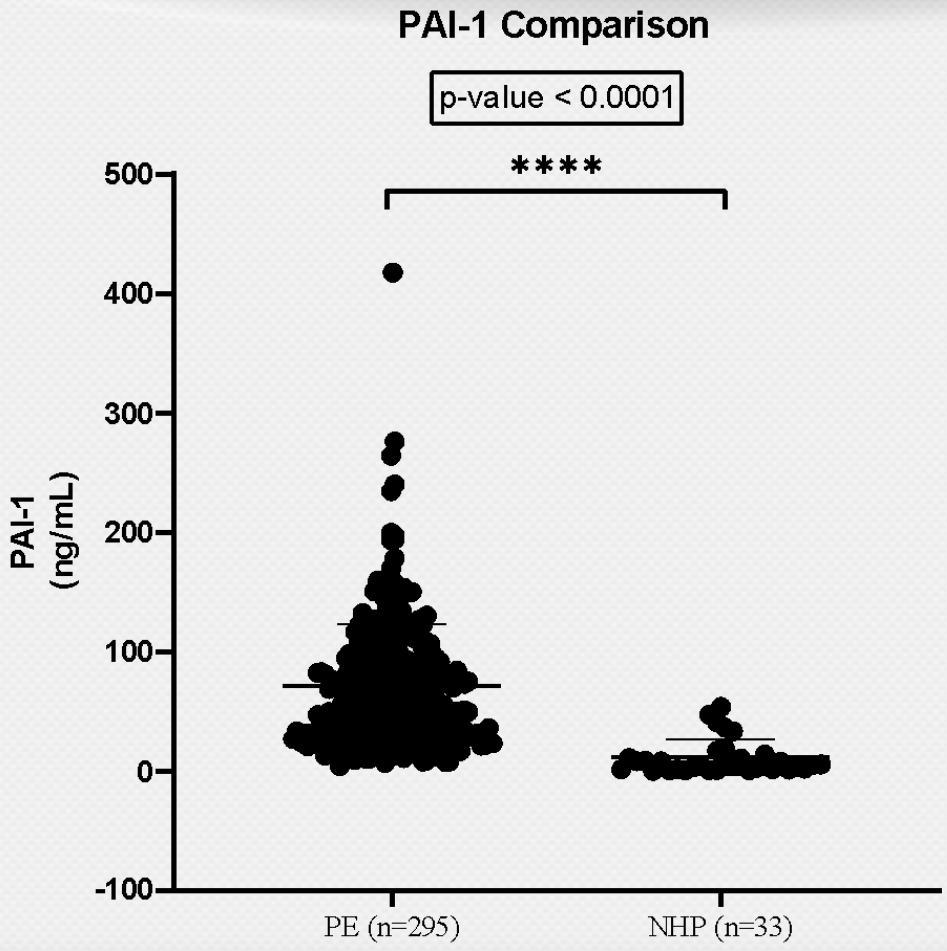
D-Dimer Patient Data Analysis



CRP Patient Data Analysis



PAI-1



Conclusion

- All 3 biomarkers, D-dimer, CRP, and PAI-1, had p-values < 0.0001
  - These p-values were < α = 0.05, indicating statistically significant difference between the levels in PE patients vs. NHP
- PE patients had higher levels of D-dimer, CRP, and PAI-1, likely due to these biomarkers' relation to thrombosis and inflammation.
- The levels of thrombo-inflammatory biomarkers (D-dimer, CRP, and PAI-1) in PE patients show statistically significant elevation.
- Outliers did not affect overall conclusion made of the data.
- Upregulation of these three biomarkers could be an indication of PE.
- More research needs to be conducted using greater sample sizes to determine if a potential future diagnosis of patients with PE can be done using thrombo-inflammatory biomarkers.

Acknowledgements

I would like to thank Dr. Fareed, Dr. Bulent, Dr. Siddiqui, Dr. Laddu, my parents, and the GTF team for giving me this amazing opportunity and for supporting me.

Thank You