Jefferson
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# CDU Curriculum: Pulmonary Embolism

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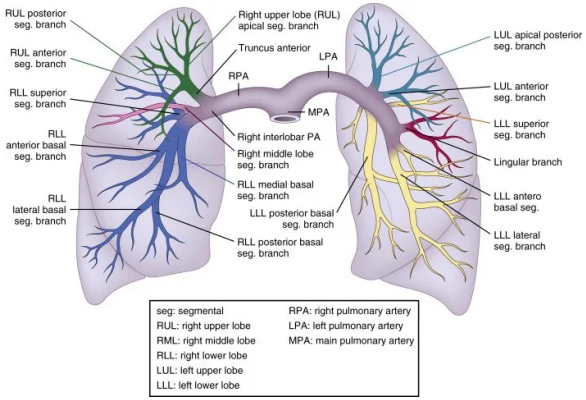
# Epidemiology

- As many as 900,000 people could be affected by DVT/PE each year (1:1,000).
- 60,000 - 100,000 Americans die of DVT/PE.
- 10 – 30% of people die within one month of diagnosis.
- The mortality risk ratio from PE has declined from 138 in 1980s to 36.08 in the 2000-2011.
- About 1/3 of people with DVT/PE will have a recurrence within 10 years.



# Brief ED management, info about diagnostic testing

**Wells criteria and modified Wells criteria: Clinical assessment for pulmonary embolism**

| | |
|---|---|
| ▪ Clinical symptoms of DVT (leg swelling, pain with palpation) | 3.0 |
| ▪ Other diagnosis less likely than pulmonary embolism | 3.0 |
| ▪ Heart rate >100 | 1.5 |
| ▪ Immobilization (≥3 days) or surgery in the previous four weeks | 1.5 |
| ▪ Previous DVT/PE | 1.5 |
| ▪ Hemoptysis | 1.0 |
| ▪ Malignancy | 1.0 |
| **Probability** | **Score** |
| **Traditional clinical probability assessment (Wells criteria)** | |
| High | >6.0 |
| Moderate | 2.0 to 6.0 |
| Low | <2.0 |
| **Simplified clinical probability assessment (Modified Wells criteria)** | |
| PE likely | >4.0 |
| PE unlikely | ≤4.0 |

DVT: deep vein thrombosis; PE: pulmonary embolism.

*Data from van Belle A, Buller 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.*

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## PE Rule-Out Criteria (PERC)

- Clinical criteria only
- Identifies patients whose pre-test probability is below the test threshold

- Age < 50
- Pulse < 100
- SaO2 > 94%
- No unilateral leg swelling
- No hemoptysis
- No recent trauma or surgery
- No prior PE/DVT
- No hormone use

Kline, *J Thromb Haemost*. 2004

Kline, *J Thromb Haemost*. 2008

# Low Risk/Medium Risk

- **If PERC criteria fulfilled and patient is low risk**
  - No further testing required (ACEP Level B)

**If low risk but PERC not fulfilled, or Medium Risk**

- Obtain D- dimer levels
  - </= 500 ng/ml - PE excluded
  - >/= 500 ng/ml - CTPA/Ventilation perfusion scanning

# Validity of PE rule out criteria in Low Probability Patients

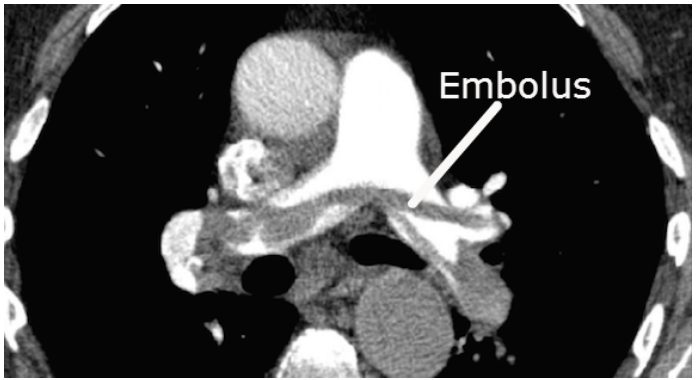
- A Metanalysis in the Emergency Medicine Journal showed that PERC used in low probability patients had a sensitivity of 0.97 (0.96 - 0.98), with a negative likelihood ratio of 0.17 (0.13 - 0.23).[3]

- In one retrospective validation study in the European Journal of Emergency Medicine looking at 940 patients who were deemed PE unlikely by the wells score, 3 patients would have been missed if using PERC while only one missed if using D-dimer.[4]

- In the same study the NPV for PERC rule was 99.1% (95% CI: 97.3-99.8%)
- The NPV for standard D-dimer test was 99.8% (95% CI:99.2-100%).[4]

# Importance of Clinical Tool in Reducing Overuse of CTPA in the ED

- In 152 suspected PE subjects who underwent CTPA[5]
  - 9.2% met PERC, none of whom were diagnosed with PE
  - 110 assigned low risk Wells score, only 38 (35%) of which underwent clinical D-dimer testing. Archived samples showed 22% of these patients would have had negative D-dimers, and all of these patients were PE negative




# PE Classifications Based on Severity

- Massive PE
  - Sustained hypotension not due to other cause
    - SBP <90 mmHg for a period of >15 minutes
    - Substantial drop in SBP (>40mmHg)
  - Pulselessness
  - Shock
    - HR < 40 bpm with signs/symptoms of hypoperfusion
- Intermediate Risk = Sub-massive PE
  - RV dysfunction and/or myocardial necrosis in absence of persistent hypotension or shock
- Low Risk
  - No hemodynamic compromise and no RV strain

## GUIDELINES FOR THE USE OF INTRAVENOUS THROMBOLYTIC THERAPY FOR PULMONARY EMBOLISM

### I. CANDIDATES

A. Use of tPA is reasonable in patients with acute massive PE associated with one or more of the following:
   1. Hypotension (systolic BP < 90 mm Hg for > 15 minutes or requiring inotropic support and not due to another cause such as arrhythmia, hypovolemia, sepsis or left ventricular dysfunction)
   2. Persistent profound bradycardia (HR < 40 bpm with signs or symptoms of shock)
   3. Severe hypoxemia or shock, as indicated by lactic acidosis
   4. Note: tPA may be given up to 14 days after onset of PE symptoms

B. Use of tPA is reasonable in patients with pulselessness/cardiac arrest and a high suspicion of PE

C. Use of tPA can be considered in select patients with acute submassive/intermediate-risk PE associated with one or more of the following:
   1. New hemodynamic instability
   2. Worsening respiratory insufficiency
   3. Severe RV dysfunction
   4. Major myocardial necrosis
   5. High risk of developing hypotension

## ABSOLUTE CONTRAINDICATIONS

Intravenous thrombolytic therapy in the following conditions is contraindicated because of an increased risk of bleeding, which could result in significant disability or death:

A. History of intracranial hemorrhage
B. Ischemic stroke within 3 months
C. Structural intracranial cerebrovascular disease (such as arteriovenous malformation)
D. Suspected aortic dissection
E. Active bleeding or bleeding diathesis
F. Recent surgery encroaching on the spinal canal or brain
G. Recent significant closed-head or facial trauma with radiographic evidence of bony fracture or brain injury

## RELATIVE CONTRAINDICATIONS

In the following conditions, the risks of intravenous thrombolytic therapy may be increased and should be weighed against the anticipated benefits:

A. Severe or uncontrolled hypertension (systolic BP > 180 mm Hg or diastolic BP > 110 mm Hg)
B. Recent major bleeding or internal bleeding (within 2 – 4 weeks)
C. Recent surgery within 10 days or major surgery within 3 weeks
D. Recent invasive procedure
E. Ischemic stroke > 3 months previously
F. Known malignant intracranial neoplasm
G. Current use of anticoagulation [e.g., warfarin (Coumadin®), dabigatran (Pradaxa®), rivaroxaban (Xarelto®), apixaban (Eliquis®), or edoxaban (Savaysa®)]
*(If potential benefit outweighs the risk, use of thrombolytics should be considered and used with caution.)*
H. Traumatic or prolonged cardiopulmonary resuscitation (> 10 minutes)
I. Pericarditis or pericardial fluid
J. Diabetic retinopathy
K. Pregnancy
L. Low body weight (e.g., < 60 kg)
M. Recent noncompressible vascular punctures within 7 days
N. Dementia

# Management

- Initial Therapy: **Oxygen therapy, Hemodynamic support, and Anticoagulation**
  - Oxygen therapy to maintaining SpO2 >90%
  - Hemodynamic support
    - Gentle fluid challenge of 500 ml in select patients
      - Some studies suggest aggressive volume expansion provides little benefit, may worsen RV function in patients with acutely elevated RV afterload and increased pulmonary HTN
  - Vasopressors (Norepinephrine) if needed while awaiting or in parallel with pharmacological, surgical, or interventional reperfusion treatment

# Initial Anticoagulation Management While Awaiting Workup

| Clinical Suspicion | Management |
|---|---|
| Low | Do not treat with anticoagulation while awaiting diagnostic test results |
| Medium | Treat with parenteral anticoagulation if results of diagnostic tests expected to be delayed >/= 4 hours |
| High | Treat with parenteral anticoagulation while awaiting diagnostic test results. |

-According to ACCP 2016 Guidelines

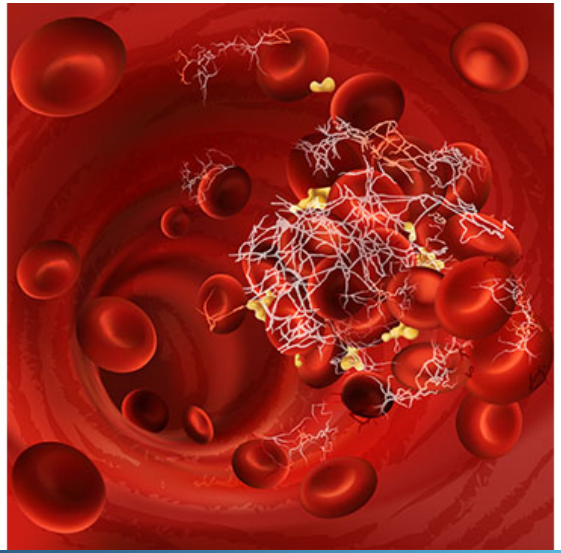
- Also consider patients bleeding risk

-Usually done with subcutaneous weight adjusted LMWH, Fondaparinux, or UFH

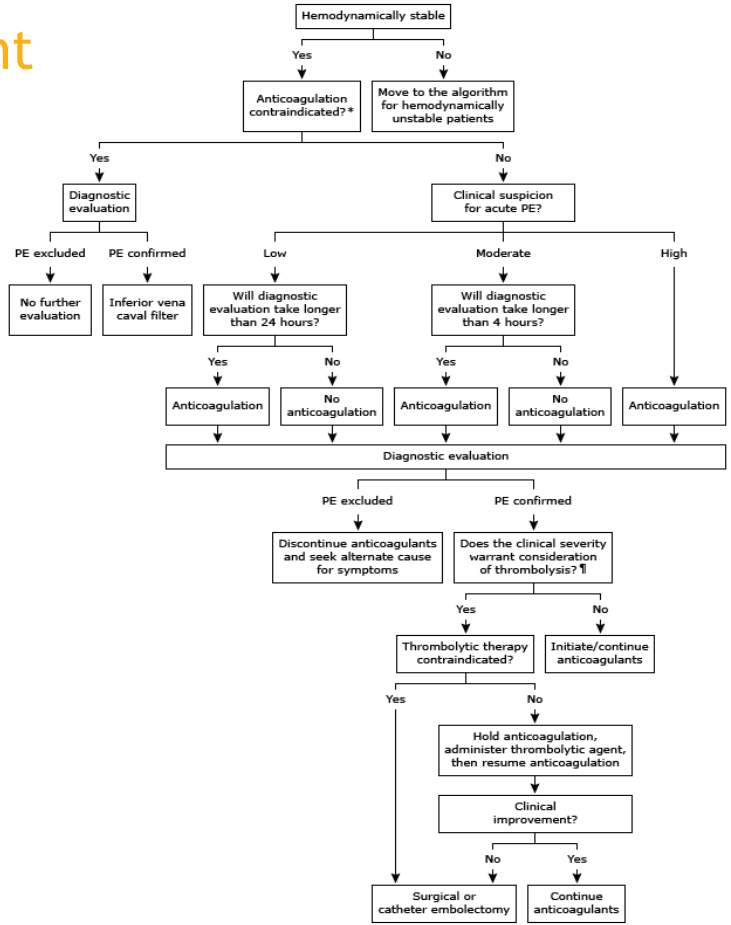
# Assessing Bleeding Risk

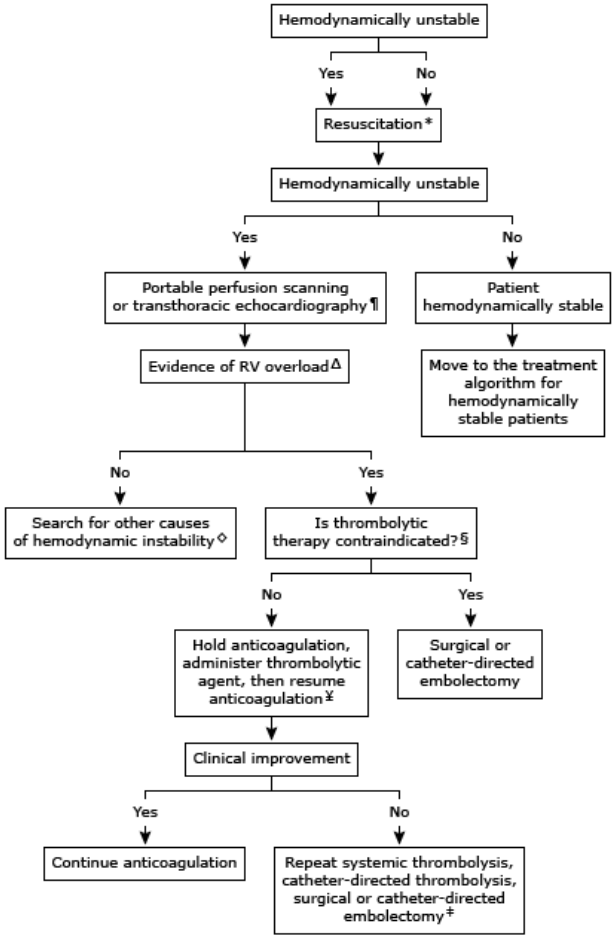
- There is no one single great tool to assess bleeding risk in these patients

- Can use other bleeding risk tools such as:
  - HAS-BLED score (bleeding risk with A-fib anticoagulation)
- Risk Factors for Bleeding
  - Age >65
  - Previous bleeding
  - Cancer
  - Renal/Liver failure
  - DM
  - Previous Stroke
  - Use of other antiplatelets
  - Alcohol Abuse



# Management


Hemodynamically stable
Yes
No
Anticoagulation contraindicated?*
Move to the algorithm for hemodynamically unstable patients
Yes
No
Diagnostic evaluation
Clinical suspicion for acute PE?
PE excluded
PE confirmed
Low
Moderate
High
No further evaluation
Inferior vena caval filter
Will diagnostic evaluation take longer than 24 hours?
Will diagnostic evaluation take longer than 4 hours?
Yes
No
Yes
No
Anticoagulation
No anticoagulation
Anticoagulation
No anticoagulation
Anticoagulation
Diagnostic evaluation
PE excluded
PE confirmed
Discontinue anticoagulants and seek alternate cause for symptoms
Does the clinical severity warrant consideration of thrombolysis?¶
Yes
No
Thrombolytic therapy contraindicated?
Initiate/continue anticoagulants
Yes
No
Hold anticoagulation, administer thrombolytic agent, then resume anticoagulation
Clinical improvement?
No
Yes
Surgical or catheter embolectomy
Continue anticoagulants


Hemodynamically unstable
Yes
No
Resuscitation*
Hemodynamically unstable
Yes
No
Portable perfusion scanning or transthoracic echocardiography¶
Patient hemodynamically stable
Evidence of RV overload Δ
Move to the treatment algorithm for hemodynamically stable patients
No
Yes
Search for other causes of hemodynamic instability◇
Is thrombolytic therapy contraindicated?§
No
Yes
Hold anticoagulation, administer thrombolytic agent, then resume anticoagulation¥
Surgical or catheter-directed embolectomy
Clinical improvement
Yes
No
Continue anticoagulation
Repeat systemic thrombolysis, catheter-directed thrombolysis, surgical or catheter-directed embolectomy‡

# Anticoagulation

- **Initial anticoagulation should be started in patients with symptomatic PE and most patients with subsegmental PE**
  - Enoxaparin – 1mg/kg SC q 12h (first line in most hemodynamically stable patients)
  - Unfractionated Heparin – 80 units/kg bolus then 18 units/kg/hr continuous infusion (no need for renal dosing)
  - Rivaroxaban – 15 mg BID for 3 weeks then 20 mg once daily (if parenteral therapy to be avoided)

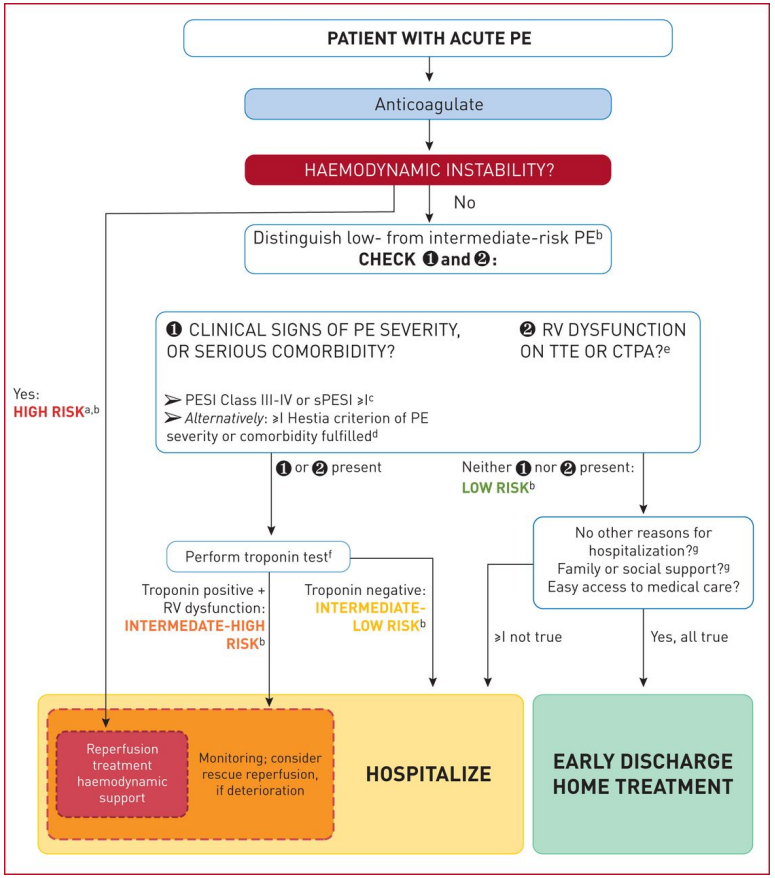
# CDU Pathway

## Inclusion criteria

- Probability of discharge within 24 hours >80%
- Imaging consistent with non-central PE
- sPESI score of zero
- No other contraindications to outpatient anticoagulation.
- JATS consultation notified in ED
  - Evaluation within 12 hours of arrival

| Simplified PESI Score | |
|---|---|
| Age > 80 years | 1 point |
| History of cancer | 1 point |
| History of chronic cardiopulmonary disease | 1 point |
| Heart rate ≥ 110 beats per minute | 1 point |
| Systolic plod pressure < 100 mmHg | 1 point |
| O2 saturation < 90% | 1 point |

**Table 1:** Simplified PESI score.



# Exclusion Criteria

- Meets criteria for inpatient admission
  - Multi-lobar, hypoxia
- sPESI score greater than or equal to 1
- Patient not a candidate for anticoagulation due to bleeding risk
- Elevated troponin
- Right heart strain on imaging
- Multiple co-morbidities
- Renal insufficiency defined as CrCl < 30mL/min
- Inability to care for self
- Pregnancy
- Dementia with no caregiver present for education
- Necessity for heparin gtt
- Probability of discharge home within 24 hours < 80%

# Typical CDU Plan

- Review ED diagnostic tests, lab work, imaging
- Monitor vital signs
- Telemetry
- Labs to include BMP, LFTs, Coags
- TTE to evaluate for R heart strain if necessary
- Initiation of outpatient DOAC regimen per JATS consultation
- Anticoagulation teaching
- Case management insurance verification and case review
- Pharmacy verification
- Home care coordination as needed

# Disposition

- Home if:
  - Observation course completed and stable
  - Stable or improved exam
  - Anticoagulation initiated and teaching completed

# References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- 6.Konstantinides SV et al. ESC guidelines on the diagnosis and management of acute pulmonary embolism. Eur HearJ. 2014;35(43):3033-69

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