



Pulmonary Embolism: An Update in Diagnosis and Treatment

Pulmonary embolism remains an elusive yet potentially devastating diagnosis. What are the risk factors for the development of thromboembolic disease and the most cost-effective approaches to the diagnosis? Are there patients who can be safely excluded from evaluation? Can ventilation/perfusion scan interpretation stand alone diagnostically? How do you follow the patient with calf deep vein thrombosis? When are thrombolytic agents indicated? These issues and the latest diagnostic and therapeutic modalities will be discussed.

- Explain the advantages and disadvantages of cost-effective testing for pulmonary embolus, including blood gas, ventilation/perfusion scanning, transesophageal echocardiography, angiography, Doppler ultrasound, venography, D-dimer, and end-tidal CO₂ measurement.
- Discuss a cost-effective algorithmic approach to the diagnosis of pulmonary embolus or deep vein thrombosis with tests available at your hospital.
- Explain the latest therapeutic modalities, including low-molecular-weight heparin and thrombolytic therapy.

MO-09

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8:00 AM - 9:55 AM

Room # N227

Las Vegas Convention Center

FACULTY

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Notes

**Pulmonary Embolism: An Update in
Diagnosis and Treatment**

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a case

- 50 yr old obese WF c/o Rt. leg pain x 36 hours, similar to her 4 prior DVTs. No longer on coumadin.
- ROS: No chest complaints, but is currently heavily vaginal bleeding.
- Exam: 168/98 101 18 36.7
- Lungs CTA, heart normal
- Rt. thigh tender, with bilat. trace pedal edema
- Pelvic exam: bleeding, o/w normal

case continued...

- While awaiting US tech, she suddenly develops sharp, pleuritic chest pain
- Pulse Ox 94% on RA
- V/Q scan ordered
- GYN consult for EMB
- V/Q scan indeterminate
- LE US + for proximal thigh DVT
- Admit for IV heparin

Notes

Overview

- introduction
- clinical assessment
- pre-test probability
- diagnostic tests
- diagnostic algorithms
- treatment
- summary

Objectives

- At the conclusion of this lecture, the participants will be able to :
 - Use an evidenced-based approach to the clinical evaluation of a patient with possible PE.
 - Apply a Bayesian approach to interpretation of results of clinical tests, and apply the results to the individual patient.
 - Use a cost-effective algorithm for the diagnosis of PE with tests available at your hospital.
 - Discuss the latest and most appropriate therapeutic modalities for PE.

A more typical case

- 31 yr old HF, sudden onset of stabbing, Rt. sided CP while lying in bed.
- Collapsed upon standing up with ?able LOC.
- Now with continued mild CP, radiating to back.
- 3 weeks post-partum, no other PMHx.
- VS: 111/74, 94, 18, 36.2
- Exam: no JVD; lungs clear; heart RRR, no m/r/g; legs no edema or tenderness; all else normal.

Notes

things to consider...

- historical points
- physical exam findings
- risk factors
 - surgery within 12 weeks
 - bedrest for >3 days in past 4 weeks
 - previous DVT or PE
 - LE fracture/immobilization/paralysis in past 12 weeks
 - strong FHx of thromboembolic or hypercoag. state
 - cancer
 - post-partum period

How helpful is the clinical assessment?

HISTORY

- dyspnea (78-84%)
- pleuritic chest pain (59-74%)
- cough (43-50%)
- hemoptysis (28%)
- risk factors (76%)
- syncope (9%)

PHYSICAL EXAM

- tachypnea (73-85%)
- tachycardia (30-58%)
- loud P2 (57%)
- rales (56%)
- signs of DVT (41%)
- shock (10%)

Stein, *Am J Cardiol*, 1981;47:218-223.
 Stein, *Am J Cardiol*, 1991;68:1723-4.

In combination...

- dyspnea, hemoptysis, or pleuritic pain: separately or in combo in 94%
- All 3 in only 22%
- dyspnea or tachypnea in 96%
- dyspnea or tachypnea or DVT in 99%

Stein, *Am J Cardiol*, 1981;47:218-223.

Notes

things to do...

- Basic tests:
 - CXR
 - EKG
 - ABG
 - A-a gradient

Does CXR help?

<u>CXR finding</u>	<u>With PE</u>	<u>Without PE</u>
atelectasis/parenchymal abnormality	69%	58%
pleural effusion	47%	39%
↑ hemidiaphragm	28%	21%
pleural based density	34%	26%

Stein, *Am J Cardiol*, 1991;68:1723-4.

What about the ABG?

Mean PaO₂

- with PE: 70 ± 16
- without PE: 72 ± 18
- 26% of those with PE had PaO₂ ≥ 80 (esp. in those ≤ 40 yrs.*)

A-a gradient ($=150 - 1.25 \times \text{PaCO}_2 - \text{PaO}_2$)

- with PE: 37 ± 17
- without PE: 35 ± 18
- 14% of those with PE had A-a grad. ≤ 20

Stein, *Chest* 1991;100:598-603.
 *Green, *Chest* 1992;101:1507.

Notes

EKG findings...

- Normal EKG most common (70%)
- "Classic findings" of right heart strain ($\leq 6\%$)
RBBB, P pulmonale, RVH, RAD, S₁Q₃T₃
- Nonspecific ST-Tw changes most common abnormality (49%)
- LAD/LASH as common as RAD

Stein, *Chest* 1991;100:598-603.

back to the case...

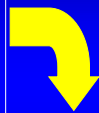
- 31 yr old HF, sudden onset of stabbing, Rt. sided CP while lying in bed.
- Collapsed upon standing up with ?able LOC.
- VS: 111/74, 94, 18, 36.2 and normal phys. Exam
- 3 weeks post-partum, no other risk factors identified

basic tests

- EKG: NSR at 95
- CXR: ?atalectasis at Rt. base
- O₂ sat: 95% on RA

clinical assessment

- risk factors for VTE
- signs and symptoms
- results of basic tests
- likelihood of alternative diagnosis



pre-test probability

- low (unlikely)
- moderate (uncertain)
- high (highly likely)

Notes

How to make this diagnosis?

pulmonary angiography = gold standard

- mortality rate = 0.5%
- major morbidity rate = 1%
- complications more likely to occur in the sickest patients
- inter-observer agreement 92%

PIOPED, JAMA 1990;263:2753-2759

Pre-test probability alone pretty good!

<u>pre-test probability</u>	<u>% with PE</u>	<u>% of cases</u>
low	3.4-9	26
moderate (uncertain)	28	64
high	68-78	10

Wells, Ann Int Med 1998;129:997-1005
 PIOPED, JAMA 1990;263:2753-2759

V/Q scan results defined:

- **normal/near normal** = no perfusion defects seen or ≤ 3 small segmental defects
- **low probability** = 1 moderate sized mismatched defect, or > 3 small segmental defects
- **intermediate (indeterminate) probability** = not high or low
- **high probability** = ≥ 2 large segmental defects, or ≥ 2 moderate and 1 large mismatched segmental defects, or ≥ 4 moderate mismatched segmental defects

PIOPED, JAMA 1990;263:2753-2759

Notes

How good is V/Q alone?

<u>scan category</u>	<u>PE +</u>	<u>PE -</u>	<u>PE ?</u>
high prob.	41%	3%	4%
intermed. prob.	42%	45%	38%
low prob.	16%	41%	50%
normal/near normal	2%	10%	8%
total	251	480	24

PIOPED, JAMA 1990;263:2753-2759

V/Q plus clinical pre-test probability increases predictive value

<u>scan category</u>	<u>high pre-test prob.</u>	<u>uncertain pre-test prob.</u>	<u>low pre-test prob.</u>	<u>all pre-test probs.</u>
high prob.	96%	88%	56%	87%
intermed.	66%	28%	16%	30%
low prob.	40%	16%	4%	14%
normal/near normal	0%	6%	2%	4%
total with PE	68%	30%	9%	28%

PIOPED, JAMA 1990;263:2753-2759

the case again...

- Pre-test probability assessment: uncertain
 - RF: post-partum
 - symptoms: near syncope, stabbing CP
 - signs: pulse 94
 - basic tests: 95% O₂ sat., CXR: ? atelectasis
 - alternative dx: anxiety???
- V/Q scan: low probability
- Now what???

Notes

other tests

- spiral CT
- lower extremity doppler ultrasound
- D-dimer assays

spiral CT

alternative to V/Q scan

- provides additional diagnostic information
- sens. about 90%, spec. >95% for central clots
- sens. down to 63% when include subsegmental clots

supplemental to non-diagnostic V/Q scan

- makes the diagnosis if +
- more testing required if -

Mayo, *Radiology* 1997;205:447-52

lower extremity doppler ultrasound

Operator characteristics of LE US vary with patient's clinical findings:

- asymptomatic for DVT: sensitivity 62%
specificity 75%
- symptomatic for DVT: sensitivity 95%
specificity 96%
- + LE US found in only 5-10% of PE patients with nondiagnostic V/Q scans
- - LE US found in 20% of PE patients with nondiagnostic V/Q scans

Kearon, *Ann Int Med* 1998;129:1044-49

Notes

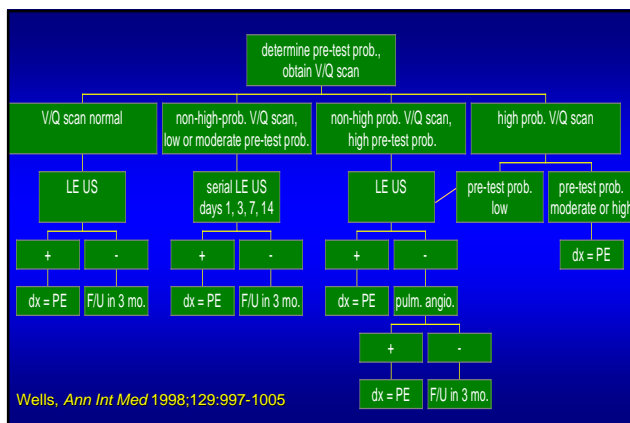
serial LE ultrasound

- small residual distal clots may be missed on initial testing
- still a risk for recurrent VTE, and hence PE within 2 weeks of presentation
- serial testing done on days 3-5, 6-8, and 13-15
- will pick up additional 2% abnormal proximal LE US with serial testing
- treatment of all non-diagnostic V/Q scan patients with abnormal LE US \rightarrow 2% over treatment rate

Kearon, *Ann Int Med* 1998;129:1044-49

D-dimer assays

- **Latex agglutination** - widely available in most hospitals
 - sens. > 90%
 - spec. < 30%
- **ELISA assay** - probably more accurate, not widely available, and takes too long
- **rapid bedside tests**
 - sens. 85-100%
 - spec. 35- 68%



Notes

alternative strategy

	<u>low</u> <u>pre-test</u> <u>prob.</u>	<u>uncertain</u> <u>pre-test</u> <u>prob.</u>	<u>high</u> <u>pre-test</u> <u>prob.</u>
V/Q normal	F/U 3 mo.	F/U 3 mo.	LE US or spiral CT
V/Q indeterminate	LE US or spiral CT	PA	PA
V/Q high prob.	LE US or spiral CT or PA	dx = PE	dx = PE

treatment options

- **goals of treatment:** prevent pulmonary HTN and death, alleviate discomfort, prevent recurrent VTE
- **life-threatening PE:** thrombolytic therapy
consider emergent embolectomy
- **all others:**
 - **IV heparin still standard of care-** weight based dosing at 80U/Kg bolus, then 18U/Kg/hr drip rate
 - once or twice daily SQ **low molecular weight heparin** - fewer complications (bleeding, thrombocytopenia) - looks great for DVT rx; not adequately studied for PE

take-home points

- No sign or symptom or combination can rule in or rule out PE.
- Basic tests used to help clarify a pattern or to look for alternative diagnoses.
- Determination of pre-test probability is key to interpreting V/Q scan (and LE US) results.
- Indeterminate scans always require further work-up.
- Must do further work-up if pre-test prob.and scan results are discordant - even if the scan is "normal."

Notes

more take-home points

- Spiral CT gives the diagnosis if it is positive, but negative doesn't rule it out.
- Negative ELISA D-dimer assay essentially rules out the diagnosis, but this is low frequency event.
- LE US insensitive in the asymptomatic patient, but serial testing maybe useful for finding recurrent VTE.
- Pulmonary angio.= gold standard, and complication rate < 1%.
- Rx. for PE is IV heparin

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