PULMONARY EMBOLISM – THE SILENT KILLER

Max Cosmic, MD, FCCP
CIC Associates
Pulmonary Embolism

- Why all the big fuss?
- Why are the docs fretting on how to diagnose PE?
- Why not put every patient who is short of breath through the proverbial “Donut of Truth”?
Pulmonary Embolism

- What is the true incidence of PE?
- What is the rational approach to confirm or r/o PE, in a suspected case?
- What is the role of D-dimer in the diagnostic work up?
- How helpful are V/Q scans?
- How sensitive are multidetector CT scans in diagnosing PE?
Diagnostic Challenge of PE

- Clinical Presentation: subtle, atypical or obscured by coexisting disease.
- Routinely available lab data — EKG, CXR and ABG — unreliable to confirm or r/o PE.
- No single noninvasive test is sensitive or specific in all patients.
PE

- “There are very few other common lethal diseases for which our diagnostic accuracy is so poor”
Symptoms of PE

- Dyspnea 77% (A-a gradient)
- Tachypnea 70%
- Chest Pain 55% (usually pleuritic)
- Tachycardia 43%
- Cyanosis 18%
- Hemoptysis 13%
- Syncope 10%
- Pleuritic chest pain in absence of dyspnea is common first presentation
- Sudden cardiac arrest with pulseless electrical activity
David Bloom – NBC Reporter

- Travelled with a Mechanized Unit of U.S. Army’s 3rd Infantry Division in its push toward Baghdad in 2003.
- Bloom and crew covered the war on a specially modified M-88 tank recovery vehicle that allowed them to file live reports during the division’s campaign from Kuwait to the outskirts of Baghdad.
David Bloom

- He spent long hours cramped in the Army vehicle. He complained of cramps behind his knee 3 days prior.
- He consulted military doctors and described his symptoms over the phone to overseas physicians. They suspected DVT, and advised him to seek proper medical attention. He ignored their advice, swallowed some aspirins, and kept on working.
David Bloom, 39, of New York

NBC anchor and father of three, died outside of Baghdad while covering the war in Iraq in 2003

April 9 - The Bloom family remembers a father and husband: David was an energetic and talented reporter whose battlefield broadcasts gave millions a soldier’s view of war. David was born in Edina, Minnesota and attended Pitzer College in Claremont, California where he was national debate champion.
Serena Williams
Serena Williams

- The WTA ranked her World No. 1 in singles on six separate occasions.
- She was sidelined by two operations on her right foot after getting cut by glass at a restaurant.
Serena Williams

- She was treated for pulmonary embolism in March 2011.
- Although it may seem like a young, professional athlete would be an unlikely candidate for this condition, the truth is that no one is immune.
LM - 50yr. Old WF

- Lightheadedness and repeated episodes of syncope and sob on exertion - 4 days. No CP, cough or hemoptysis. Nonsmoker. No prior lung problems.
- Had Ca breast – diagnosed 3 yrs. prior and required chemo and XRT. On Tamoxifen. H/o HTN – on Bisoprolol and Lisinopril.
- Father, paternal GM and paternal uncle have had VTE
Physical Examination

- Obese, tachypneic (RR 28) on 4L O2 – Pulse ox 89%. Pulse 87/min. BP 72/50.
- Lungs – clear
- CVS: Heart sounds – normal
- Extremitities – no edema
Labs

- WBC 16.0, Hb 12.7, Hct 39.4, plts 240
- Na 135, K 3.9, Cl 103, Bicarb 15, BUN 25, Creat 1.4.
- S.Lactate 7.1
- CK 273, CKMB 23.9, Troponin I 0.18
- LFT -Normal
2D Echo

- LVEF 65%
- Severe RV dialatation.
- Severely reduced RV systolic function
- Severe RA dialatation
- Markedly elevated RA pressure
- PAS 50 mm Hg
How would you treat??

- Bilateral massive PE
- Hypoxic
- Hypotensive – despite 4L of fluids and started on Levophed
- RV dysfunction.
- Received Enoxaparin – therapeutic dose 1 hour prior.
- Jehova’s Witness
Pulmonary Embolism – The Problem

- True Incidence – Unknown (nonspecific CF and one of the most difficult diagnostic challenges in all of medicine)
- Estimates: 600,000 patients /yr in USA
- Causes or contributes to 50,000 – 200,000 deaths
- PE may be responsible for or at least accompanies up to 15% of in-hospital deaths
- Mortality of PE without treatment: 18-30%
- PE promptly diagnosed and properly treated – subsequent mortality directly due to PE is 2%.
- Few (Probably <2%) subsequently develop PH.
PE

- 10% of symptomatic PE – fatal within 1 hour of symptoms.
- 5-10% of PE have shock at presentation.
- 50% of symptomatic PE involve lobar or main pulmonary artery.
- 20% of symptomatic cases – confined to subsegmental pulmonary arteries.
Clot: Genes meet Environment

Genes

DVT

PE

Environment

e.g. FxV Leiden
Genetic Risk

"Bummer of a Birthmark, Hal"
Acquired Risks for Venous Thromboembolism

- Malignancy
- Surgery
- Trauma
- Travel
- Pregnancy/postpartum
- SLE
- Antiphospholipid antibodies
- Nephrotic syndrome
- Inflammatory bowel disease
- Beçhet syndrome
- Paroxysmal nocturnal hemoglobinuria

- Obesity, Hypertension, Smoking
- Therapy-related: Hormonal agents, Oral contraceptives Hormone replacement, Tamoxifen/raloxifene, Chemo therapy/thalidomide
- Heparin-induced thrombocytopenia
Massive PE

- Hypotension (SBP < 90 mmHg or a drop in SBP of ≥ 40 mmHg from baseline for a period > 15 minutes).
- Suspect anytime when there is hypotension accompanied by an elevated central venous pressure (or neck vein distension) – not explained by AMI, tension pneumothorax, pericardial tamponade, or a new arrhythmia.
- Death often occurs within one to two hours of the event, but remain at risk for 24 to 72 hours.
Saddle PE

- PE that lodges at the bifurcation of the main pulmonary artery into the right and left pulmonary arteries.
- Most saddle PE are submassive.
- In a retrospective study of 546 consecutive patients with PE, 14 (2.6 percent) had a saddle PE.
- Only two of the patients with saddle PE had hypotension.
Saddle Embolism
CXR in PE

- Normal in 40%
- Westermark’s sign: focal oligemia
- Hampton’s hump: peripheral wedge shaped density above the diaphragm.
- Palla’s sign: enlarged right descending pulmonary artery.
Hampton’s Hump
Westermark Sign
Diagnostic Testing
– EKG’s

- EKG
  - Most Common Findings:
    - Tachycardia or nonspecific ST/T-wave changes
    - Acute cor pulmonale or right strain patterns
      - Tall peaked T-waves in lead II (P pulmonale)
      - Right axis deviation
      - RBBB
      - S1-Q3-T3 (occurs in only 20% of PE patients)
A-a Gradient

- Alveolar arterial oxygen gradient
- $148 - 1.2(PaCO_2) - PaO_2$
- Gradient $> 15-20$ is considered abnormal.
- Done at Room air.
ABG on Room Air

- A. 7.32/65/58
- B. 7.30/28/60
- C. 7.48/60/60
- D. 7.48/25/62
D-dimer

- Formed when cross-linked fibrin is lysed by plasmin.
- Highly sensitive but poor specificity.
- Wide variety of D-dimer assays available – varying in sensitivity and specificity.
- Be aware of the limitations and usefulness of D-dimer tests.
- Not valuable in most hospitalized patients.
False Positive D-dimer

- Inflammatory arthritis
- Cancer
- Infection
- Post-op
- Trauma
- Pregnancy
- Myocardial Infarction
- Old age
D-Dimer

- d-dimer testing can be omitted as a diagnostic step in patients who are older than 80 years of age, are hospitalized, or have cancer, as well as in pregnant women, because d-dimer concentrations are frequently (and nonspecifically) elevated in such patients
V/Q Scan - Indications

- Multidetector CT is not available
- Patients with renal failure
- Allergy to contrast dye
V/Q Scans

- Normal perfusion rules out PE, but found only in minority (25%).
- Mismatched perfusion defects - segmental or larger (High probability) – seen in 10% of patients tested.
- 65% of patients with suspected PE have intermediate or low probability lung scans and may require further testing.
Multidetector CT Scan

- Test of choice in most patients suspected with PE.
- 97% sensitivity for detecting emboli in the main pulmonary arteries.
- Multidetector CT delivers a higher dose of radiation to the mother but a lower dose to the fetus than ventilation-perfusion lung scanning.
Acute DVT
Pulmonary Angiogram

- Gold standard for the diagnosis of PE.
- Invasive, associated with risks, requires expertise in performance and interpretation.
- Risks: 0.5% mortality; 0.8% morbidity.
Treatment of PE

- What anticoagulant should I choose? How much? How long?
- Should I administer thrombolytic therapy?
- When should I consider IVC filter?
- Is embolectomy indicated – catheter directed or surgical?
- Coumadin – when to start and how long to continue?
Treatment:

Goals:
- Prevent death from a current embolic event
- Reduce the likelihood of recurrent embolic events
- Minimize the long-term morbidity of the event

Dr. Batizy explaining the CT results

Patient replies: “Uh-huh, when do I get to eat!”
Risk Stratification in PE

- Should be done promptly during hospital admission, since fatal pulmonary embolism generally occurs early after hospital admission.
- Based on clinical features and markers of myocardial dysfunction or injury.
Treatment of PE

- Low molecular weight heparin
- Fondaparinux: once daily - 5 mg for <50 kg (110 lb), 7.5 mg for 50 to 100 kg (220 lb), and 10 mg for > 100 kg.
- IV Unfractionated Heparin: initial bolus dose (80 IU per kilogram or 5000 IU), followed by continuous infusion (usually starting with 18 IU per kilogram per hour) with adjustment to achieve a target activated thromboplastin time that is 1.5 to 2.5 times the normal value, according to validated nomograms.
Treatment of PE

- Treat acutely for at least 5 days.
- LMWH or Fondaparinux preferred.
- Discontinue LMWH or Fondaparinux or Unfractionated heparin if INR therapeutic for 2 consecutive days.
- Start Coumadin on the first day.
Duration of Anticoagulation (Coumadin)

- 3-6 M: First event with reversible or time limited risk factor.
- 6 M: Idiopathic VTE, first event
- 12 M to lifetime: First event with cancer, until resolved; anticardiolipin antibody; antithrombin deficiency. Recurrent event, idiopathic or with thrombophilia.
To Lyse or not to Lyse!!!
Thrombolytic Therapy of PE

- What are the indications?
- What are the proven advantages of thrombolytic therapy?
- Should we use lytics for sub massive PE (normal BP, but with RV dysfunction)?
- What is the optimum time window?
- What are the complications?
RV Function in PE

- RV hypokinesis by echo seen in ~ 40% of patients with PE and normal systemic hypertension.

- Relationship between RV hypokinesis and mortality
  2. Swedish Study (1997): 1 yr. Overall mortality – 15% (126 consecutive pts.) RV dysfunction: x3
Thrombolytics - Facts

- Thrombolytic therapy result in more rapid clot resolution than with heparin.
- Within 5-7 days, both treatments produce similar improvements in pulmonary perfusion as assessed by perfusion scan.
- A meta-analysis of five randomized trials that included patients with shock showed that thrombolysis effectively reduced the risk of death or recurrent pulmonary embolism (9.4%, vs. 19.0% with heparin alone.
- In hemodynamically stable patients, thrombolytics has not been proven to reduce mortality or recurrence.
- In the subset of patients with normal BP and RV dysfunction, thrombolytics may reduce mortality and recurrence (but no consensus).
Optimum Time Window for Thrombolysis

- The greatest benefit: within 48 hours after the onset of symptoms.
- Can be effective in patients who have had symptoms for up to 14 days.
Thrombolysis – Contraindications

Absolute

1. H/o hemorrhagic stroke or stroke of unknown origin.
2. Ischemic stroke in previous 6 months.
3. Central nervous system neoplasms.
4. Major trauma, surgery, or head injury in previous 3 wk.
Thrombolysis – Contraindications Relative

- Transient ischemic attack in previous 6 mo
- Oral anticoagulation
- Pregnancy or first postpartum week
- Noncompressible puncture sites
- Traumatic resuscitation
- Refractory hypertension (systolic pressure >180 mm Hg)
- Advanced liver disease
- Infective endocarditis
- Active peptic ulcer
Pooled data from studies assessing various thrombolytic regimens showed that there was a 13% cumulative rate of major bleeding and a 1.8% rate of intracranial or fatal hemorrhage.
Indication for IVC Filter

- Patients with acute VTE but conventional anticoagulation is contraindicated (recent surgery, hemorrhagic stroke, active bleeding)
- Recurrent thromboembolism despite adequate anticoagulation.
- Chronic recurrent embolism with pulmonary hypertension.
- Patients requiring pulmonary embolectomy or thromboendarterectomy.
Truth about IVC Filter

- No carefully controlled trials on the impact of IVC filter on recurrence rates and mortality from PE.
Should IVC filters be routinely utilized in patients anatomically or hemodynamically massive PE?

Uncertain
Complications – IVC Filter

- Local complications (eg, hematoma) related to the insertion process
- DVT at the site of insertion
- Filter migration
- Filter erosion through the IVC wall
- Filter embolization
- IVC thrombosis/obstruction
- Mortality 3 out of 2557 patients (0.12%)
- Another series of 1765 insertions – major complication rate 0.3%
PE after IVC Filter

Incidence: 2.6 - 5.6%

**Causes**
- Filter migration
- Improper filter deployment
- Thrombus formation proximal to filter
- Inadequate filtration
- Development of collaterals.
Resume anticoagulation as soon as possible after insertion of filter if there is no contra-indication. *(Filter alone is not an effective treatment of VTE!!!).*
An Ounce of Prevention is worth a Pound of Cure!!!
Efficacy & Effectiveness of Thromboprophylaxis

- Highly efficacious at preventing DVT.
- Highly effective at preventing symptomatic VTE and fatal PE.
- Prevention of DVT also prevents PE.
- Cost-effectiveness of prophylaxis repeatedly demonstrated.
Be Aware. Be Proactive. Prophylax.

DVT Awareness + Effective Prophylaxis = Improved Patient Safety
Conclusion

Summary Points

- PE remain a potentially deadly and common event which may present in various ways.

- Don't be fooled if your patient lacks the “classic” signs and symptoms!

- Consider PE in any patient with an unexplainable cause of dyspnea, pleuritic chest pain, or findings of tachycardia, tachypnea, or hypoxemia

- When the probability is low or intermediate, a negative D-dimer test essentially rules out the diagnosis, but a positive result indicates the need for further testing, preferably multidetector CT scanning.

- Anticoagulation therapy should be initiated promptly.
Thank You