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Radiologic Diagnosis and Treatment of Pulmonary Embolism

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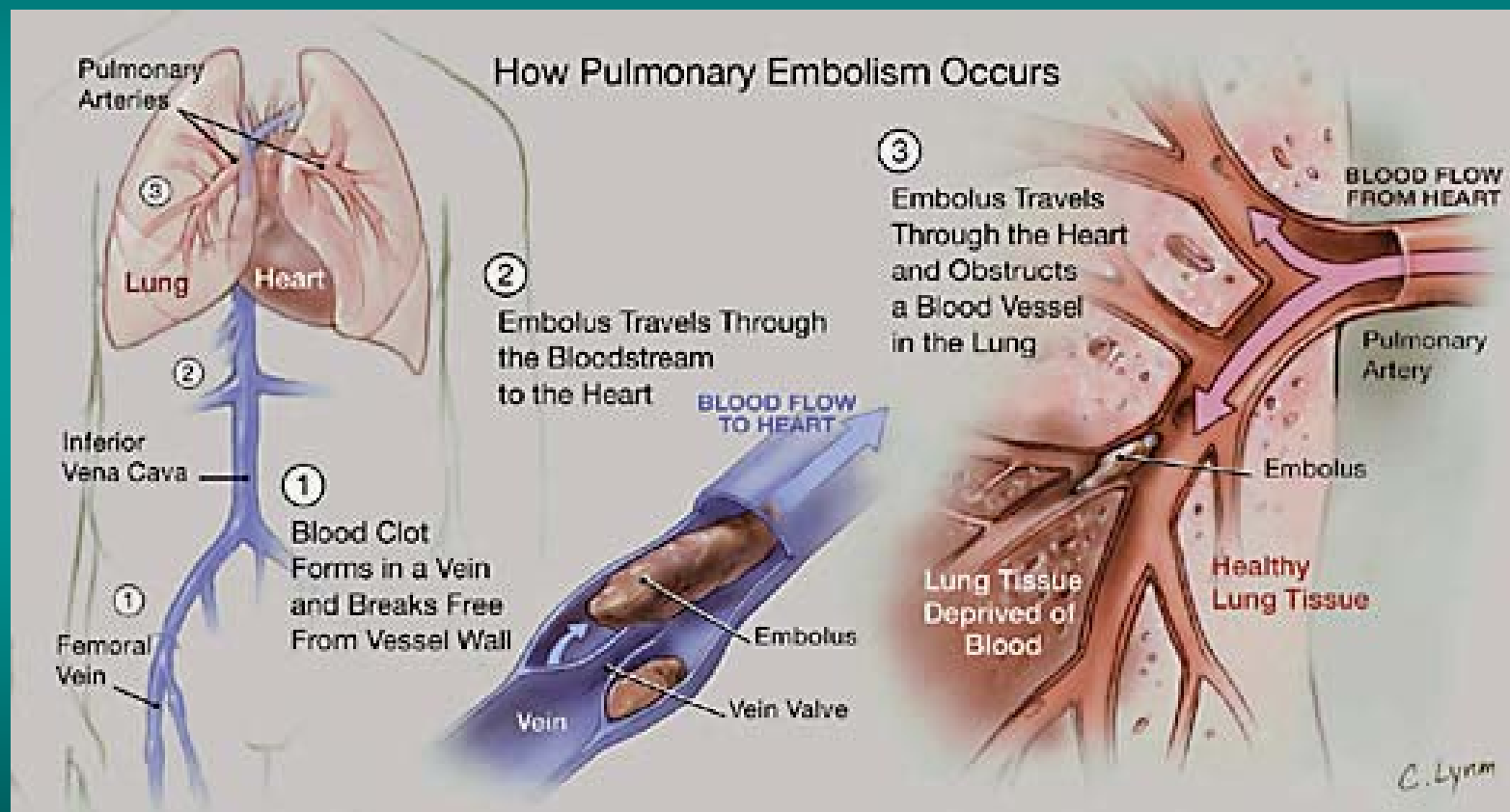


Goals

- Learn diagnostic evaluation steps of pulmonary embolism
- Learn indications, contraindications, and morbidity associated with inferior vena cava filter placement



Pulmonary Embolism





Patient C.L.

- 71 yo male
- presenting with shortness of breath
- after surgical repair of comminuted tibia fracture, caused by high speed motor vehicle accident
- PMH: prostate cancer treated with Brachy therapy 11 years ago



Differential Diagnosis for PE⁵

- Other pulmonary processes (pneumothorax, pneumonia, asthma, pleural effusion, pleurisy)
- Cardiac Processes (Myocardial Infarction, Congestive Heart Failure, Pericarditis, pericardial tamponade, aortic dissection)
- GI (esophageal rupture, gastritis, ulcer)
- Musculoskeletal Diagnoses
- Anxiety disorder with hyperventilation



Common Symptoms of PE⁶

Symptom	Percentage present when PE present	Percentage present when PE not present
Dyspnea (sudden)	78%	29%
Dyspnea (gradual)	6%	20%
Chest Pain (pleuritic)	44%	30%
Chest Pain (substernal)	16%	10%
Fainting	26%	13%
Hemoptysis	9%	5%
Cough	11%	15%
Palpitations	18%	15%



Common Signs of PE⁶

Sign	Percentage present when PE present	Percentage present when PE not present
Tachycardia	78%	23%
Cyanosis	16%	15%
Hypotension	3%	2%
Neck Vein Distension	12%	9%
Leg Swelling (unilateral)	17%	9%
Fever >38°C	7%	21%
Crackles	18%	13%
Pleural Friction Rub	4%	4%



Other Limited Utility Evaluations

- EKG
- Chest Radiographs are abnormal in 69% of PE patients with common findings of elevated hemidiaphragm, atelectasis, or effusions.
- Two other rare findings are Westermark's sign and Hampton's Hump.



Westermark's Sign - Patient A

Focal avascularity in the
right upper lung field.

Sensitivity: 14%

Specificity: 92%¹⁰



A

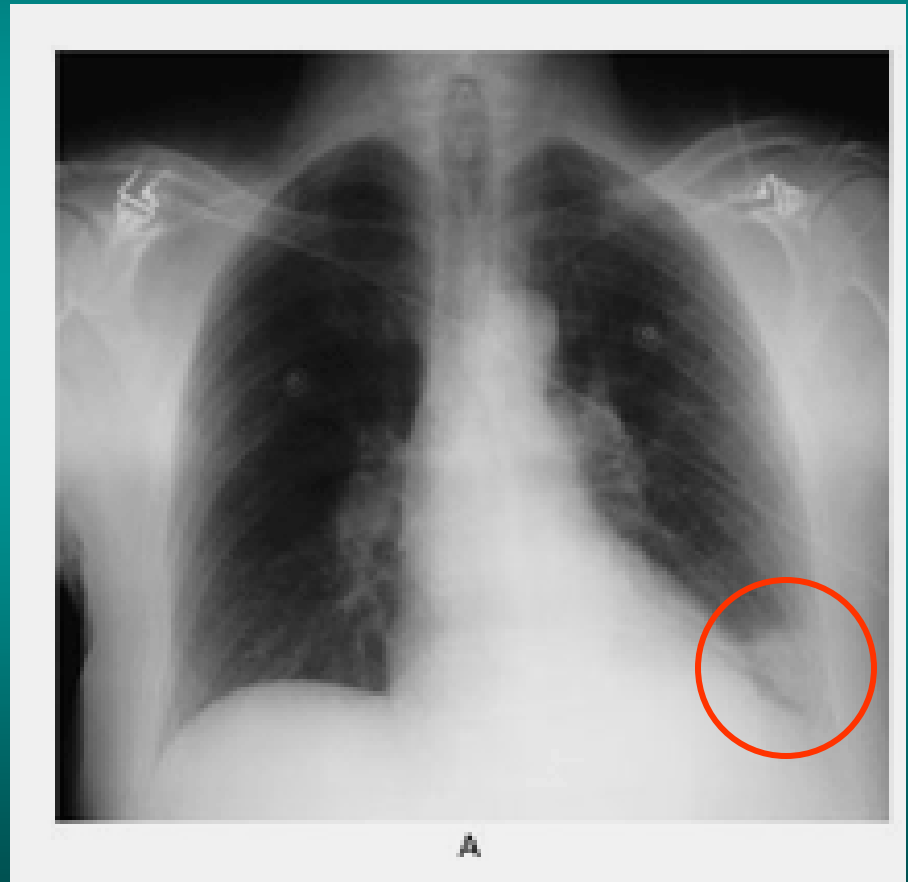


Hampton's Hump - Patient A

A pleural-based, wedge-shaped pulmonary infarction at left lung base

Sensitivity: 22%

Specificity: 82%¹⁰





PE Diagnostics Tools and Tests

- Wells Criteria for estimating clinical probability
- Additional risk factors
- D-Dimer Testing
- Ventilation-Perfusion (VQ) Scanning
- CT Angiography, MR Angiography
- Ultrasonography
- Pulmonary Angiography – the gold standard



Clinical Prediction: Wells Criteria³

- 3.0 pts Clinical signs and symptoms of DVT
 - 3.0 pts Alternative diagnosis deemed less likely than PE
 - 1.5 pts HR > 100bpm
 - 1.5 pts Immobilization or surgery within 4 weeks
 - 1.5 pts Previous DVT or PE
 - 1.0 pt Hemoptysis
 - 1.0 pt Cancer (receiving treatment, or treated within 6 months)
-

Low clinical probability: <2 pts

Intermediate clinical probability: 2-6 pts

High clinical probability: >6 pts



Risk Factors for Venous Thromboembolism³

- Age >40 y
- History of venous thromboembolism
- Surgery requiring >30 min anesthesia
- Prolonged immobilization
- CHF
- Fracture of pelvis, femur, or tibia
- Obesity
- Pregnancy or recent delivery
- Cerebrovascular accident
- Cancer
- IBD
- Obesity
- Estrogen therapy
- Genetic or acquired thrombophilia
 - Antithrombin III deficiency
 - Protein C deficiency
 - Protein S deficiency
 - Prothrombin G20210A mutation
 - Factor V Leiden
 - Anticardiolipin antibody syndrome
 - Lupus anticoagulant

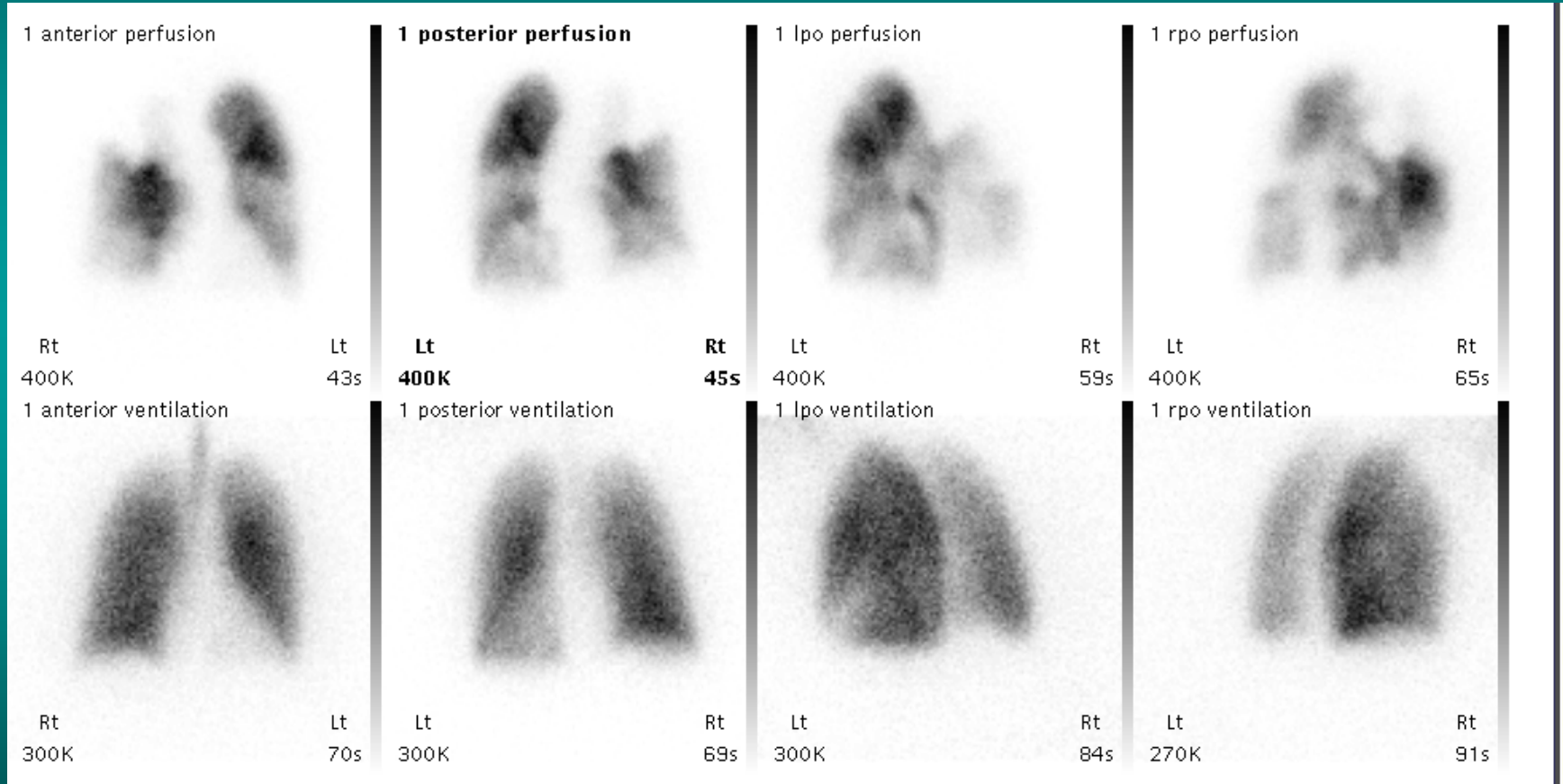


D-Dimer

- Sensitivity: 80-100%² (ELISA)
- Excellent for ruling out PE in low clinical probability patients



Ventilation-Perfusion Scan - Patient B



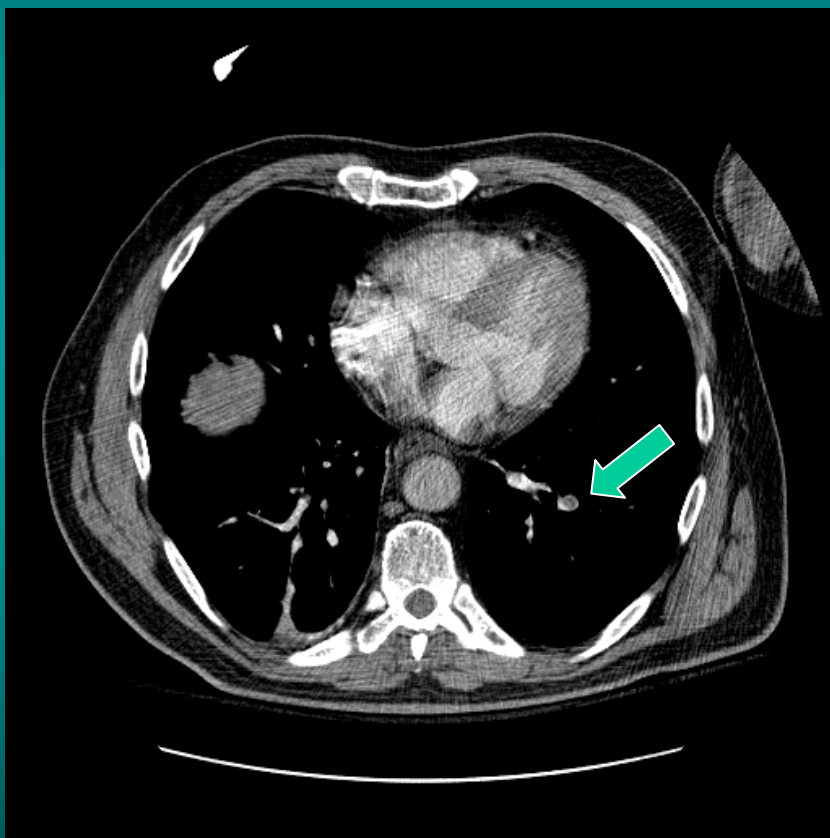


Comparison of Ventilation-Perfusion Scan Category with Angiogram Findings⁸ (PIOPED)

Scan Category	Sensitivity %	Specificity %
High probability	41%	97%
High or intermediate probability	82%	52%
High, intermediate or low probability	98%	10%



Computed Tomography Angiography – Patient CL



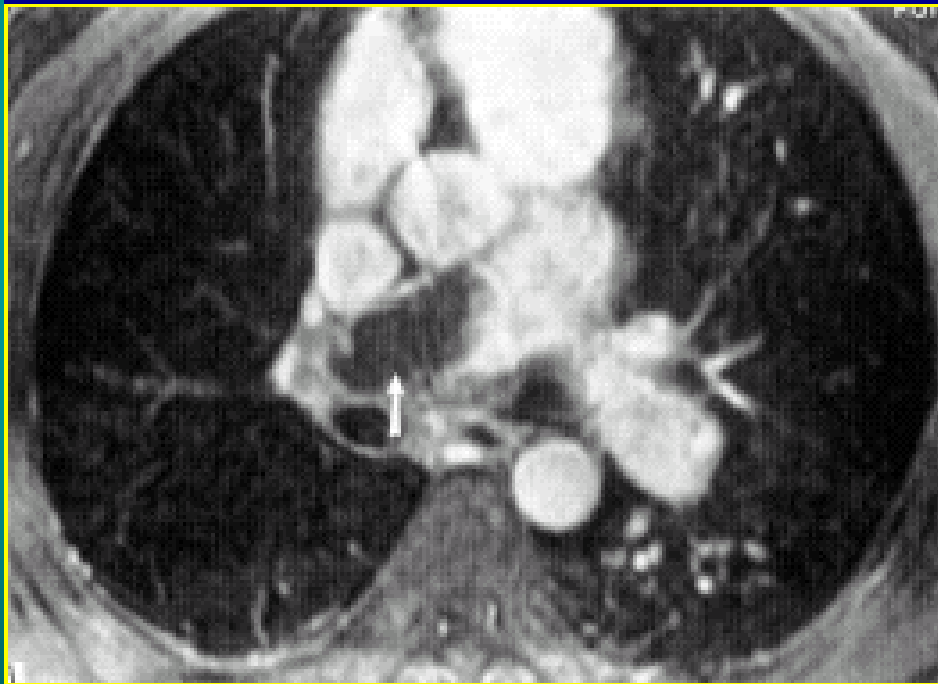
Axial



Coronal



Magnetic Resonance Angiography⁷ – Patient C

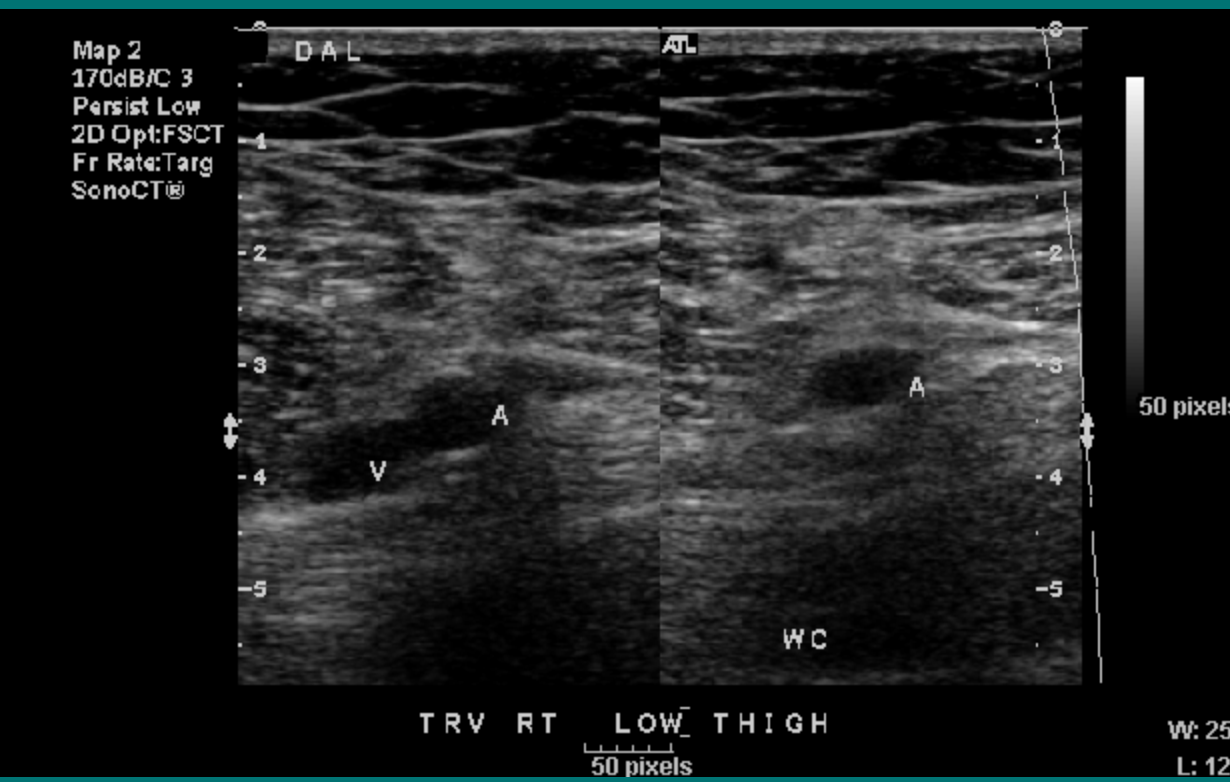


	Angiogram		
MRA	PE+	PE-	Total
PE+	27	2	29
PE-	8	81	89
Total	35	83	118

Oudkerk, *Lancet*, 2002



Ultrasound – Patient CL



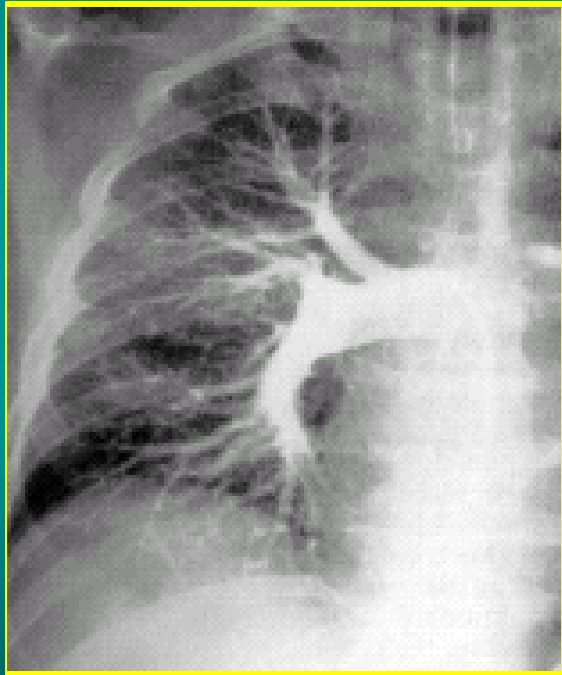
No Compression

Compression



Pulmonary Angiography – Patient D

The Gold Standard -- Expensive – Morbidity



Normal



Lobar Defect

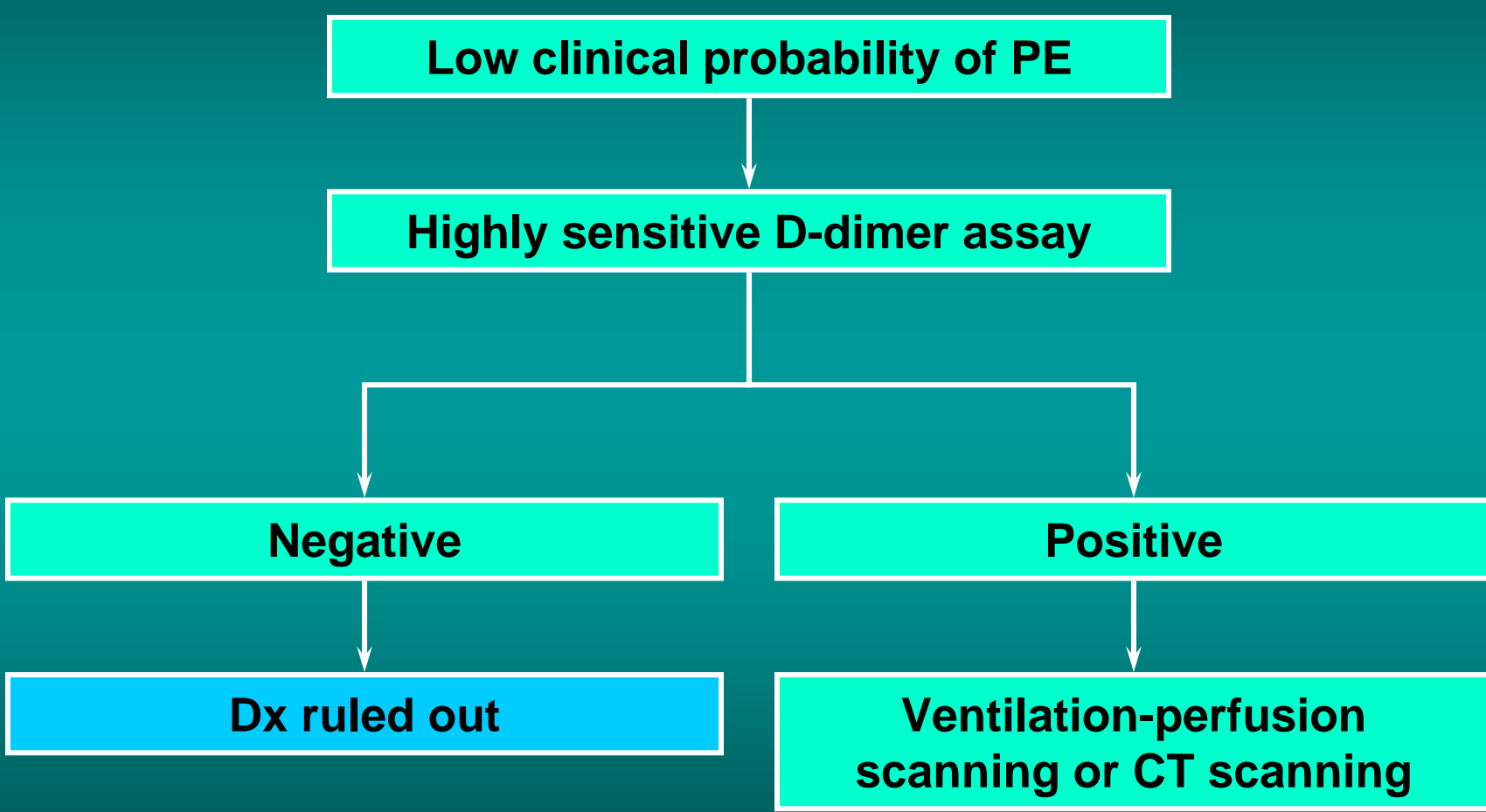


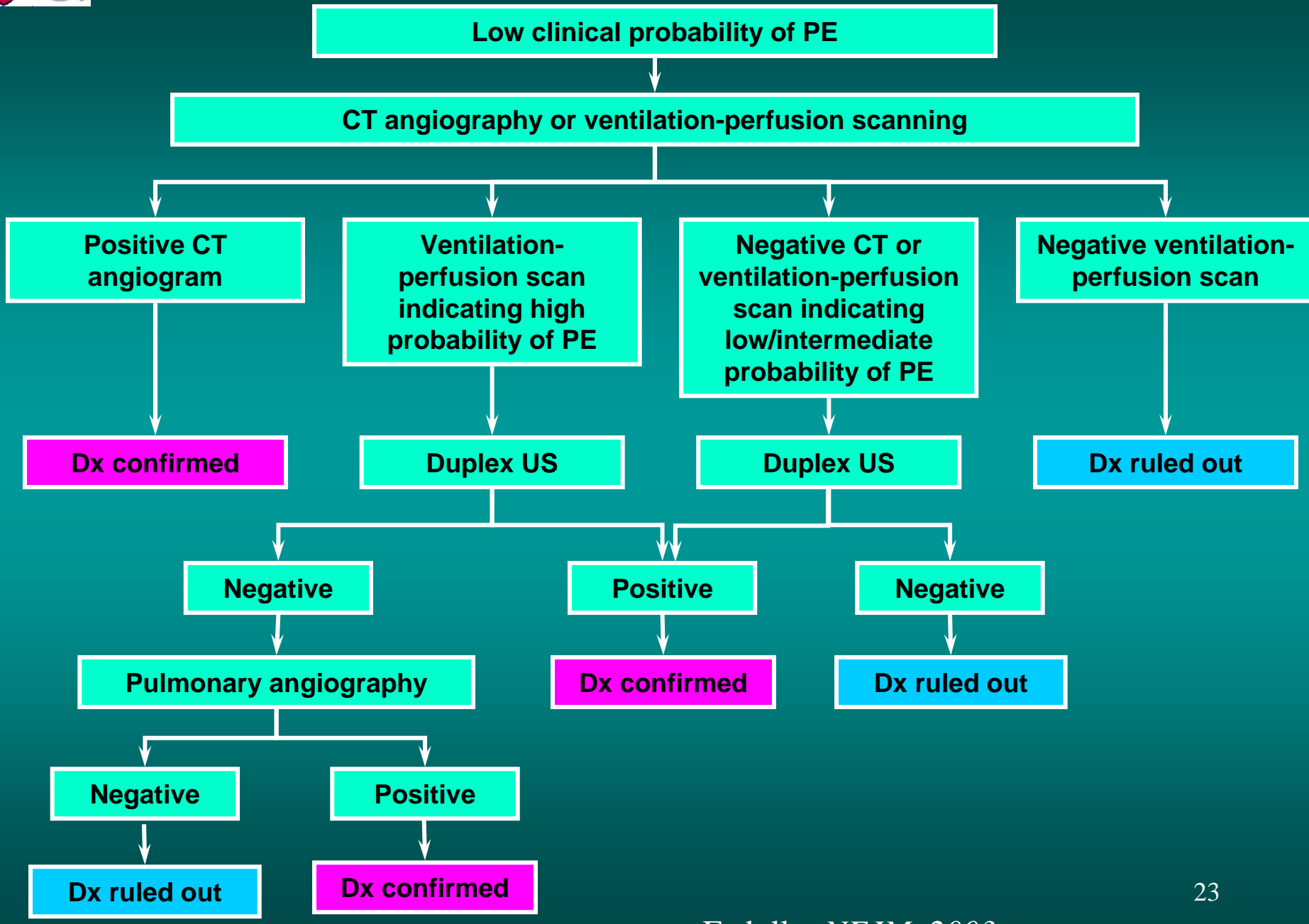
Segmental Defect

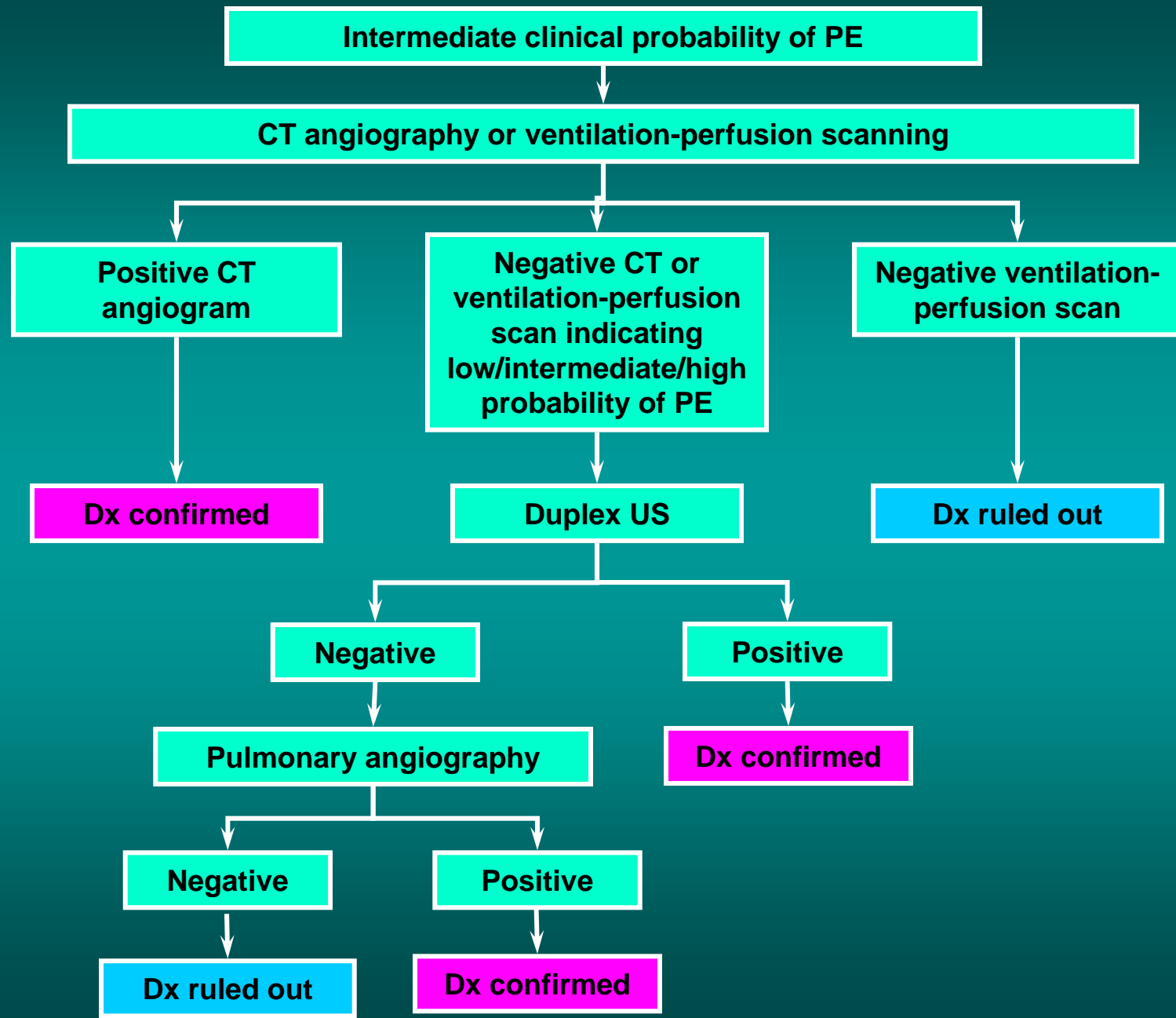


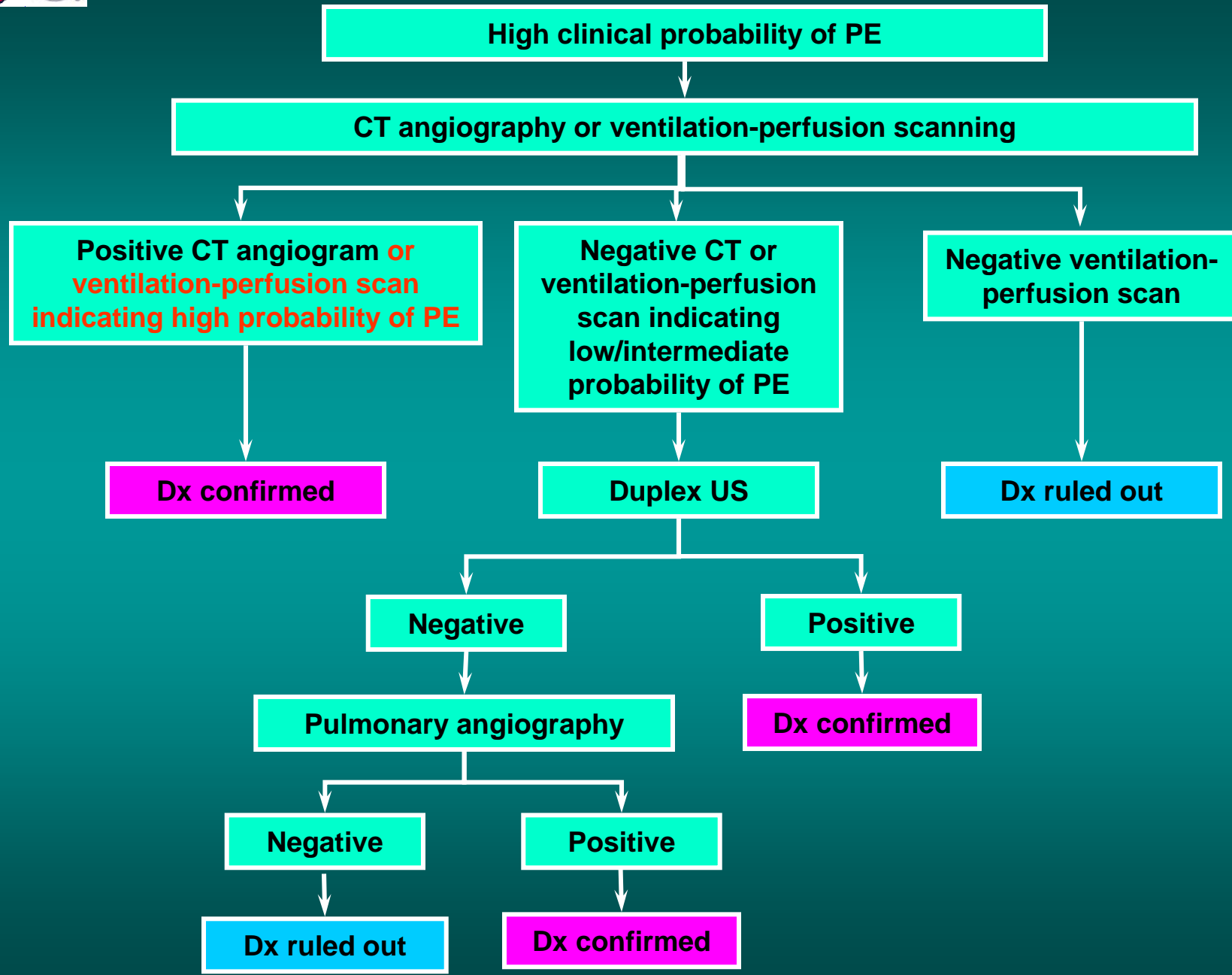
Diagnostic Approaches

- Low clinical probability
- Intermediate clinical probability
- High clinical probability









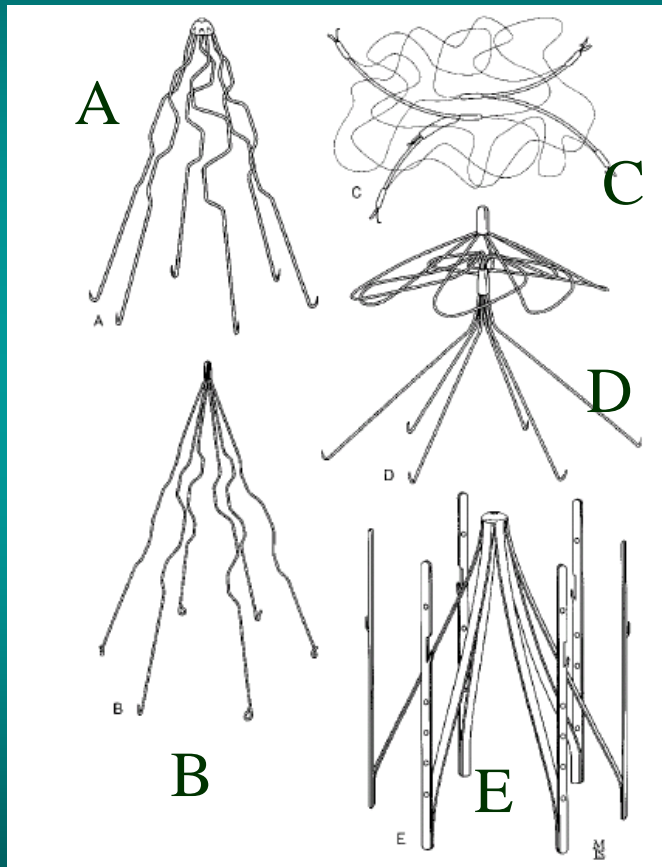


Treatment²

- Unfractionated heparin or Low Molecular Weight Heparin
- Coumadin for 6 months
- Inferior Vena Cava Filter
- Thrombectomy



Inferior Vena Cava (IVC) Filters



Indications

- Contraindication to anticoagulation therapy
- Failure of anticoagulation therapy
- Prophylaxis for patients at high risk for thromboembolic events

Low Morbidity

- Vena Cava thrombosis
- Malpositioning and migration

A. Greenfield, B. Modified Greenfield, C. Bird's Nest, D. Simon nitinol, Vena Tech

Picture Source: Streiff, Blood, 2002



Filters vs. Anticoagulation Therapy²

- Initial significant beneficial effect of filters (<12 days and < 1 year) in prevention of PE
- Counterbalanced after 1 year by increased symptomatic PE and DVT for those with filters
- No long-term difference in mortality



Removable Filters

- Benefits include decreased risk of IVC occlusion and filter migration
- Two week stay
- Nov 2002: FDA approved Recovery filter that can remain as long as needed and then removed.



Conclusions

- Acute pulmonary embolism is a major, preventable cause of death
- Diagnosis is difficult, but combining Wells Criteria with Laboratory and Radiologic tests improves the accuracy of the diagnosis.
- When anticoagulation therapy is contraindicated, IVC filters are indicated for prevention of recurrent PE.



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Image Sources

- Slide 3: Diagram Source: JAMA Patient Page: Pulmonary Embolism
http://www.medem.com/medlb/article_detailb.cfm?article_ID=ZZZDQHMZUIC&sub_cat=575
- Slide 9: Image Source: NEJM: 2001;345 (18): 1311
- Slide 15: Image Source: Plymouth Hospital, UK,
<http://www.derriford.co.uk/nucmed/teaching/images/lungs>
- Slide 17 and 19: Image Source Jim Busch, MD, BI
- Slide 20: Image Source: Wake Forest School of Medicine, Duncan Hite, MD.
<http://intmedweb.wfubmc.edu/download/venous.pdf>
- Slide 27: Diagram Source: Streiff, MB., Vena Cava Filters, A Comprehensive Review, Blood: 2000; 95 (12): 3670.