CORE Workshop 17
Cardiac and Cardiovascular

Developed by Stefan Tigges, Travis Henry and Carl R. Fuhrman

Learning Objectives

1. Identify positions of cardiac chambers and heart valves on chest radiographs
2. Propose imaging for chest pain and dyspnea (of suspected cardiac origin)

3. Distinguish cardiogenic and non-cardiogenic pulmonary edema & list CXR findings of CHF
4. Identify and recognize proper position of common devices and catheters used in the ICU on CXR (e.g., intra-aortic balloon pump (IABP) and Swan-Ganz)

5. Compare roles of CT angiography and catheter angiography in suspected coronary artery disease for intermediate and low risk populations
6. Compare radiation doses of cardiac nuclear medicine and CT imaging

7. Propose initial imaging and follow up of a pulsatile abdominal abnormality found on physical exam
8. Recognize abdominal aortic aneurysm on ultrasound
9. Describe surgical and endovascular treatments for abdominal aortic aneurysm

10. Compare advantages of CT angiography vs conventional catheter angiography for lower extremities

Question

What topics were challenging for you in this case?


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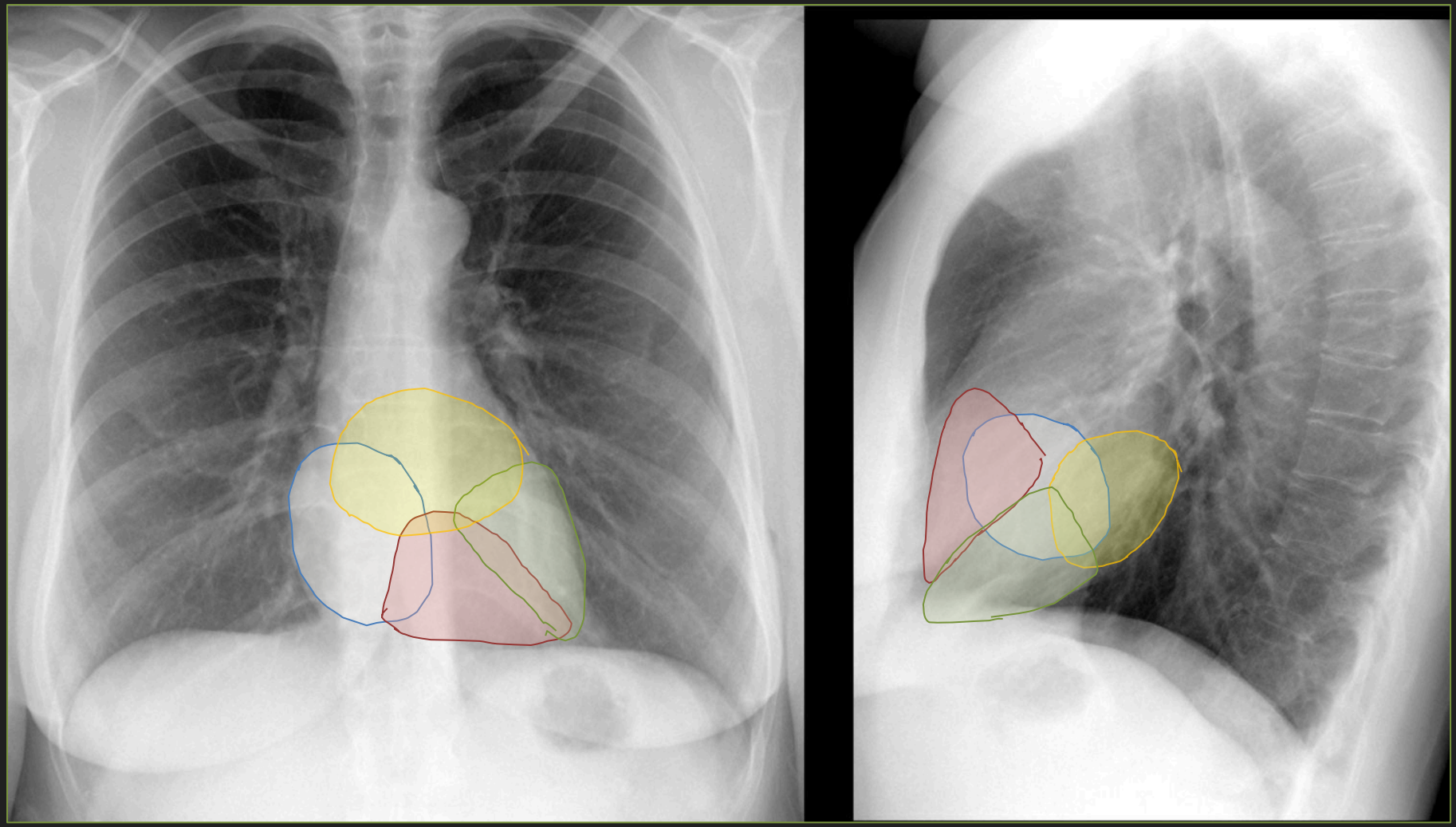

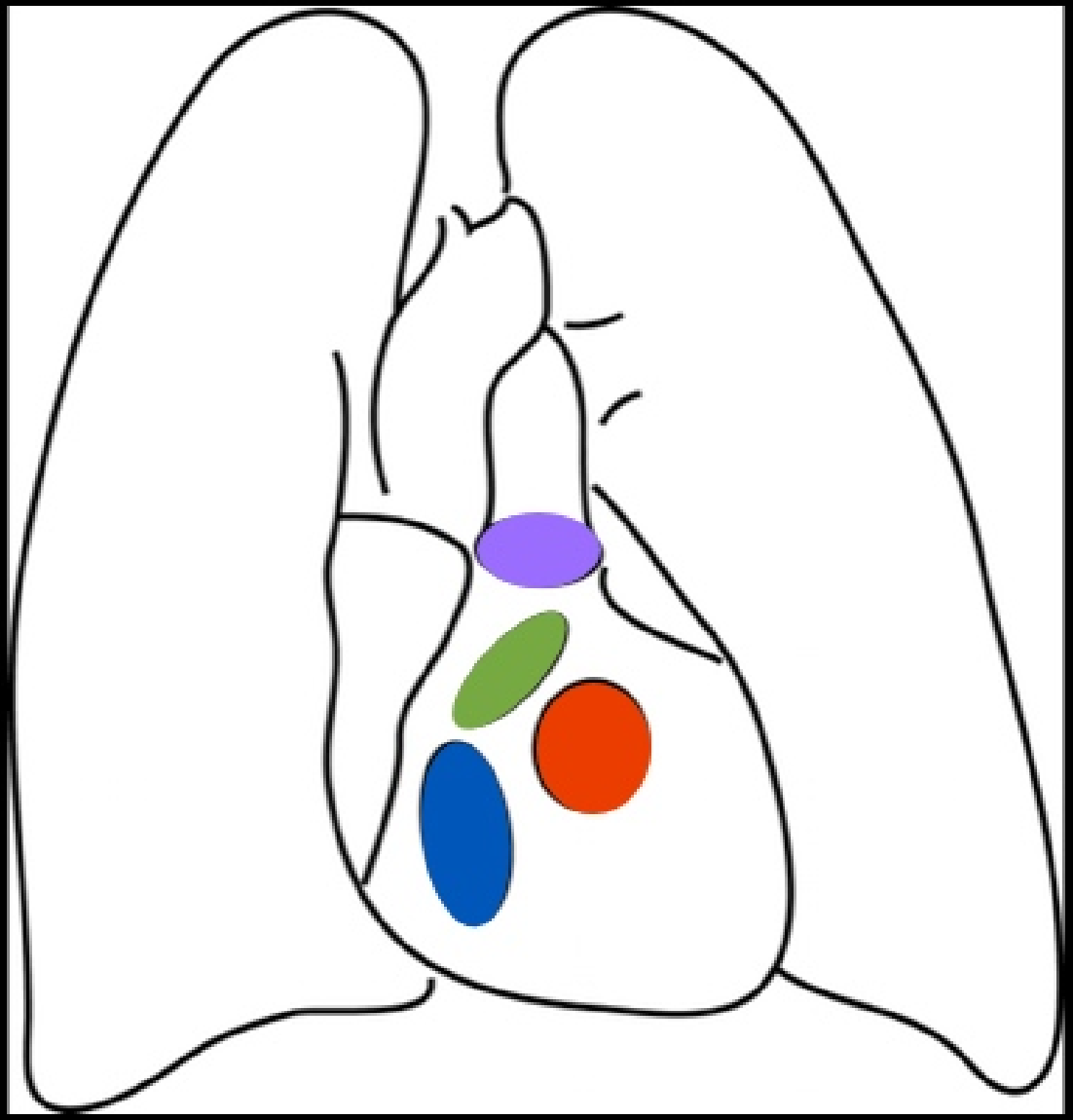

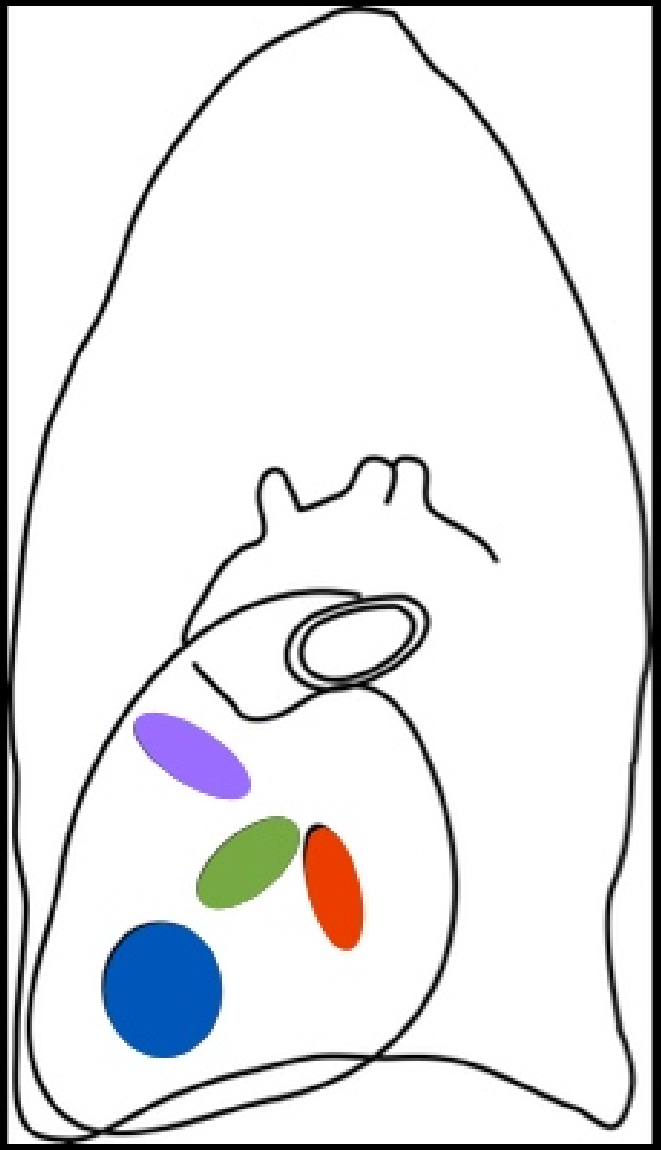

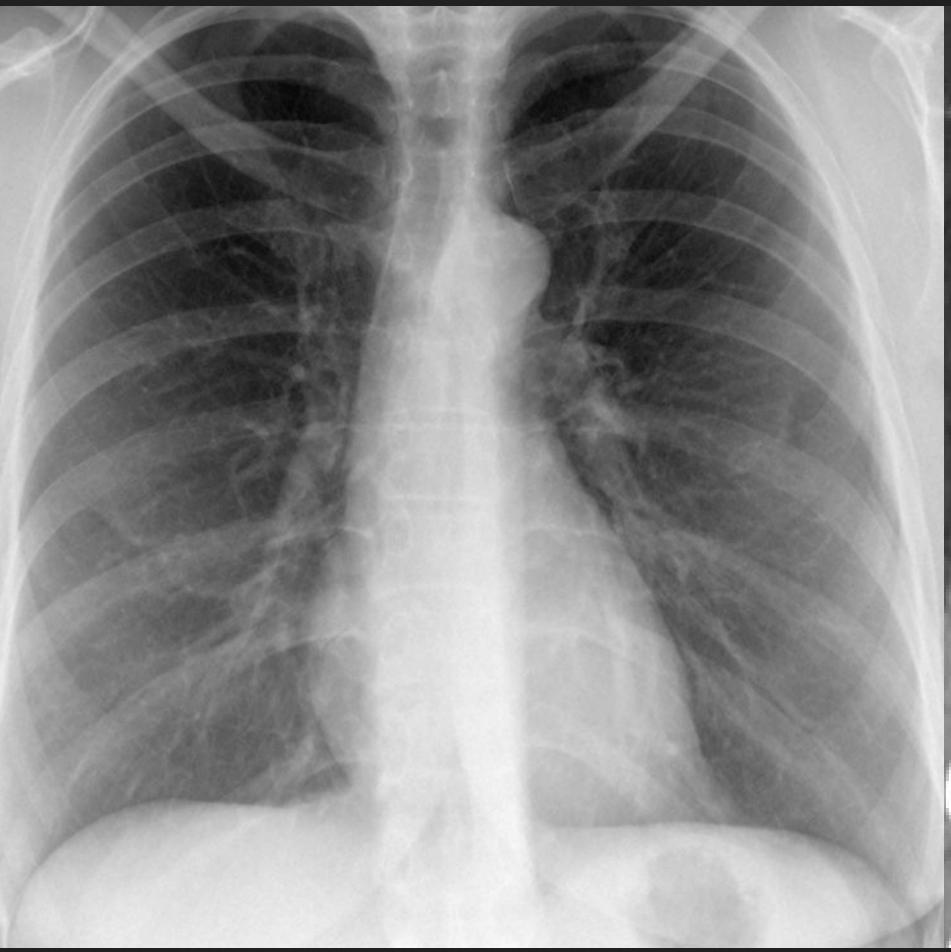

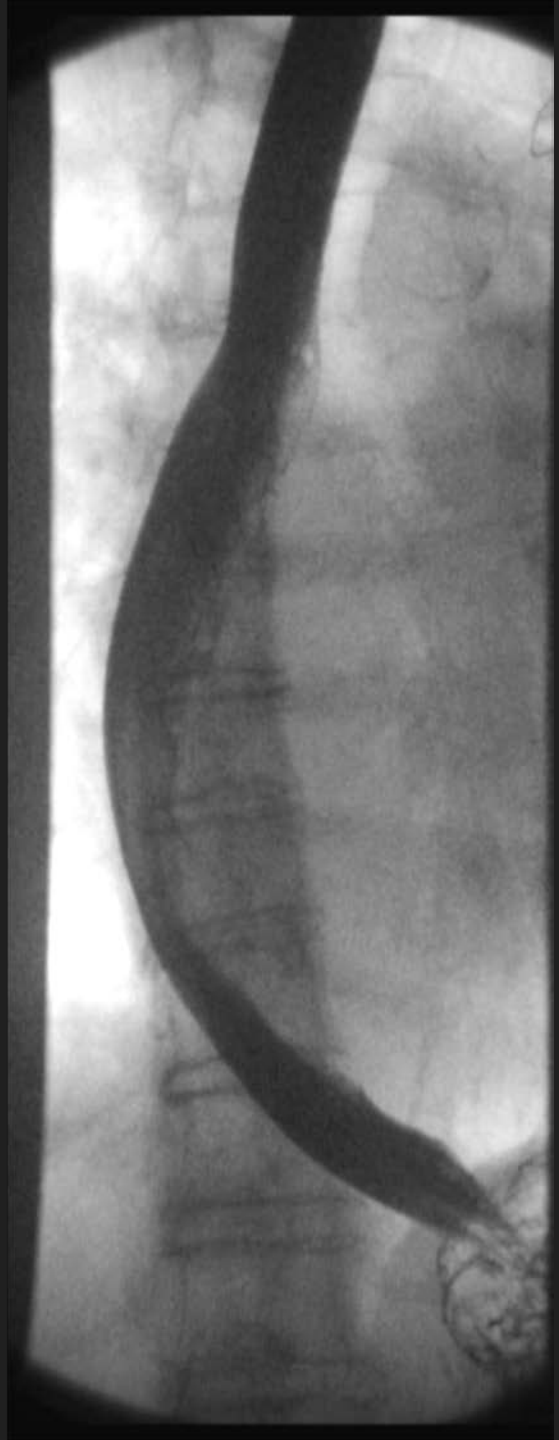

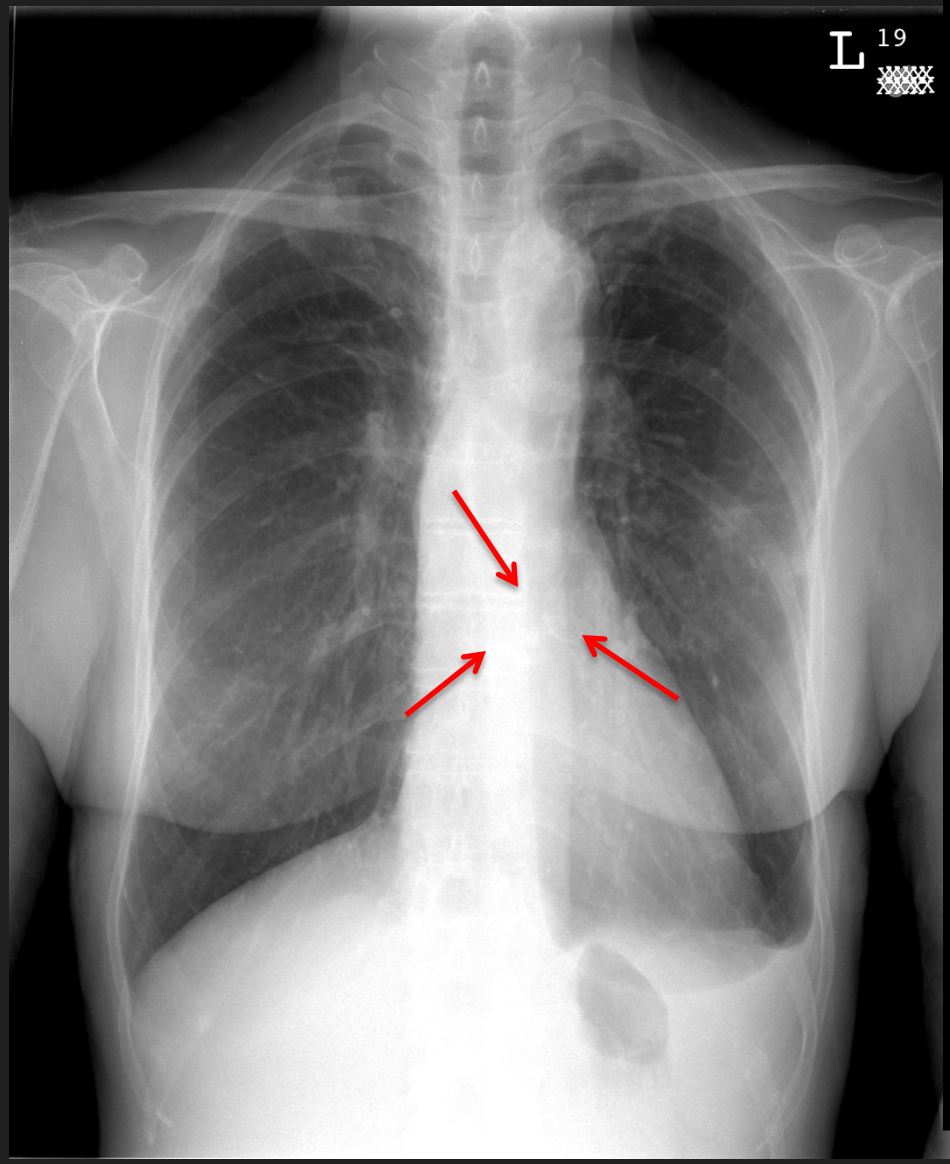
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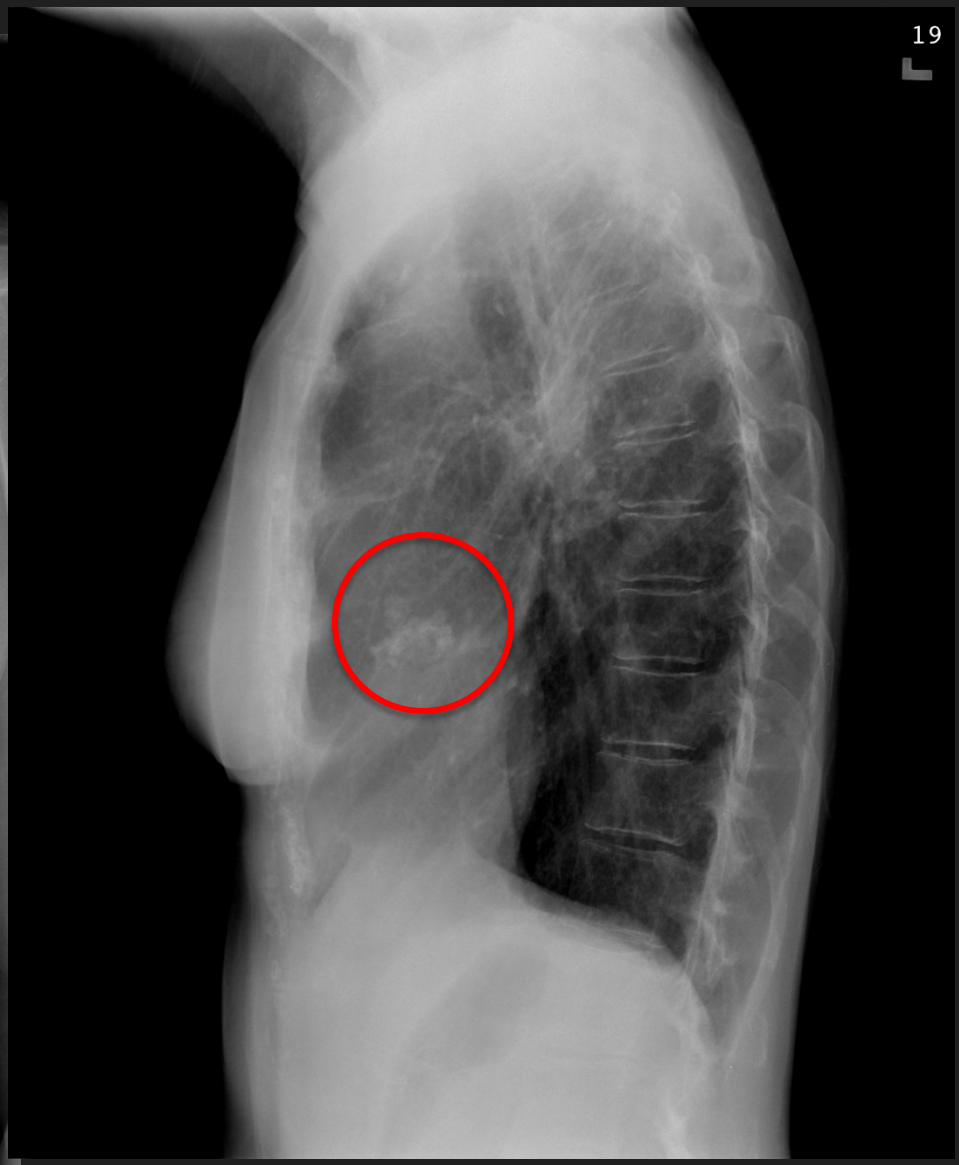
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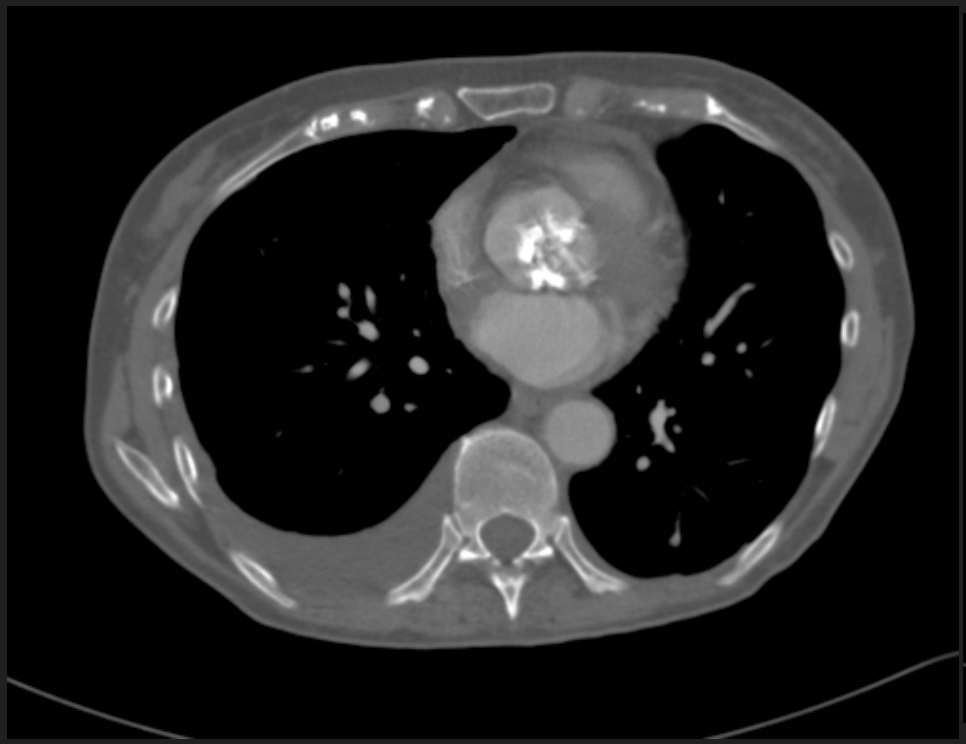

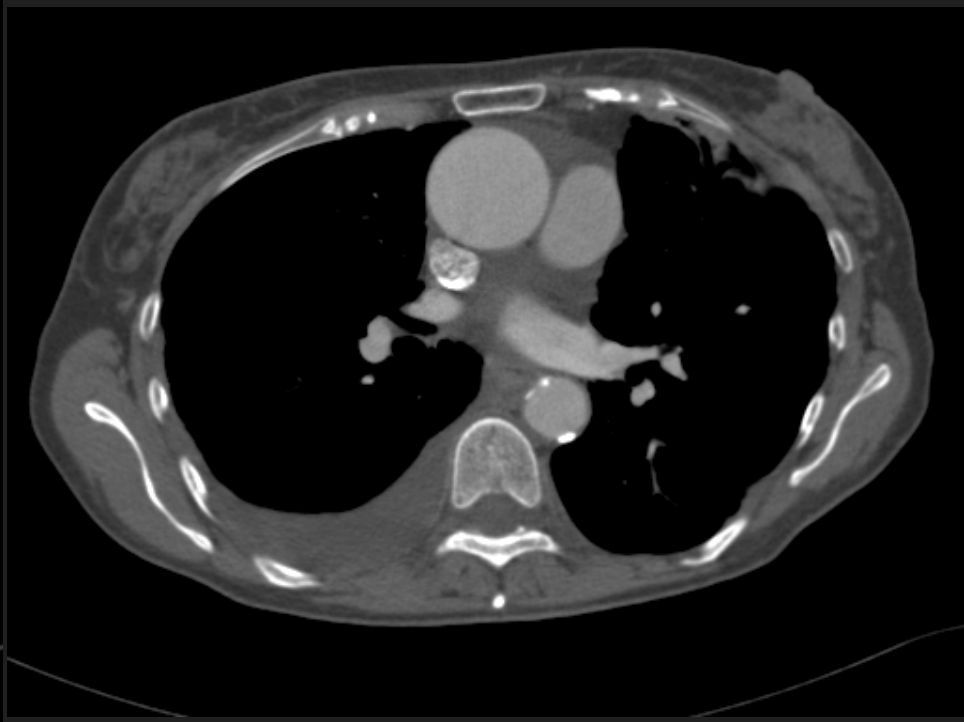

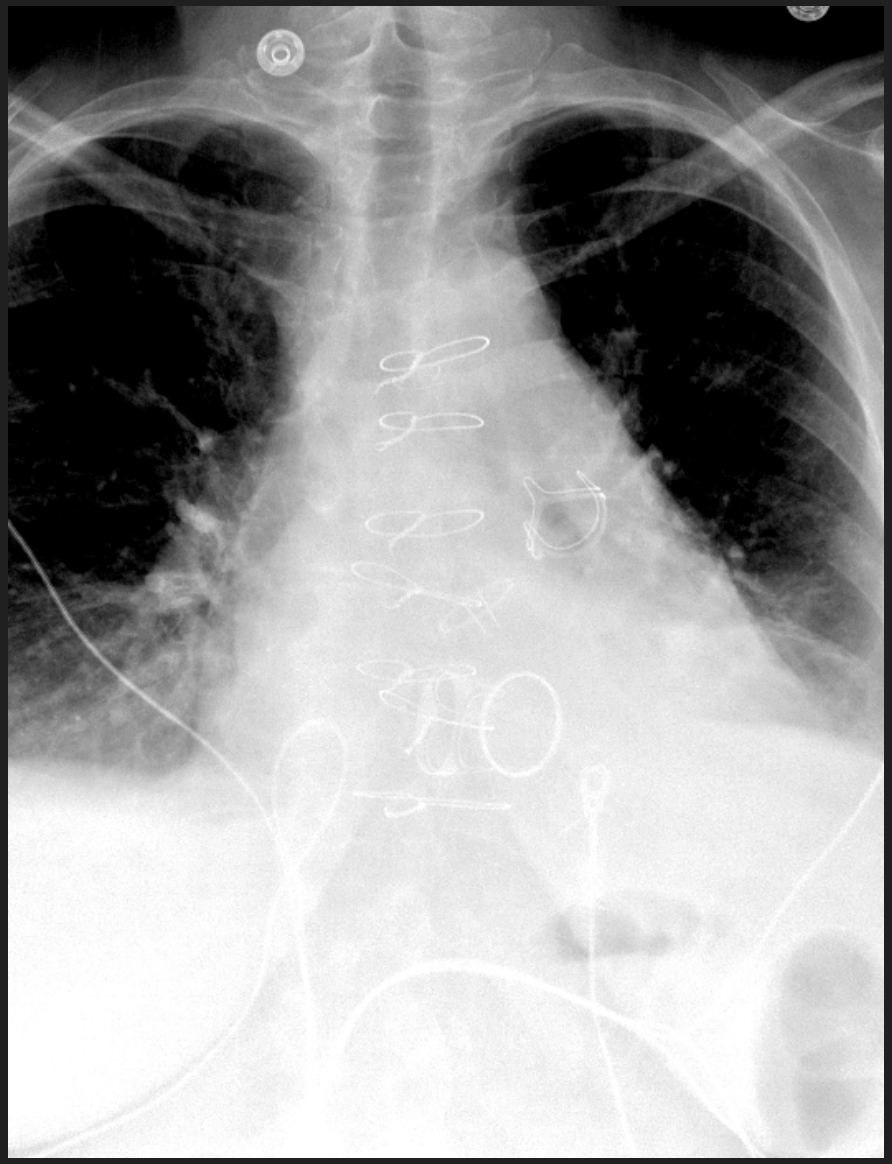

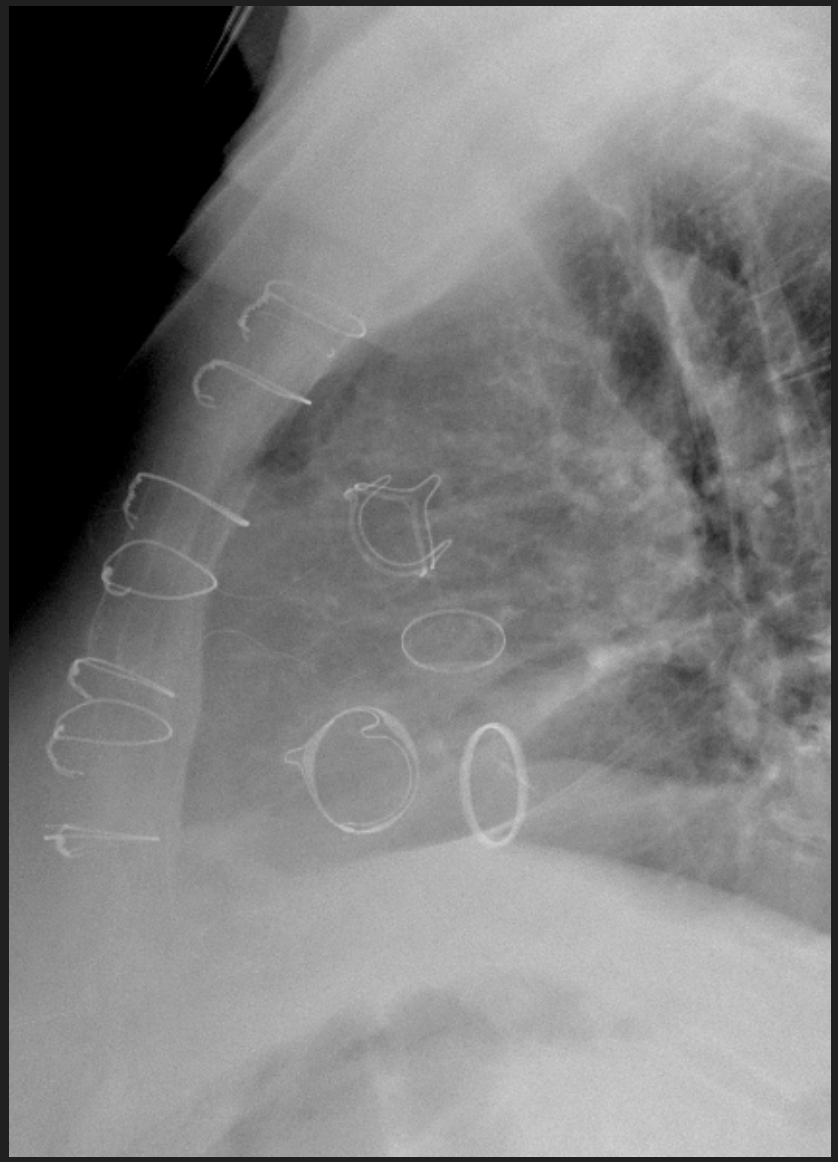

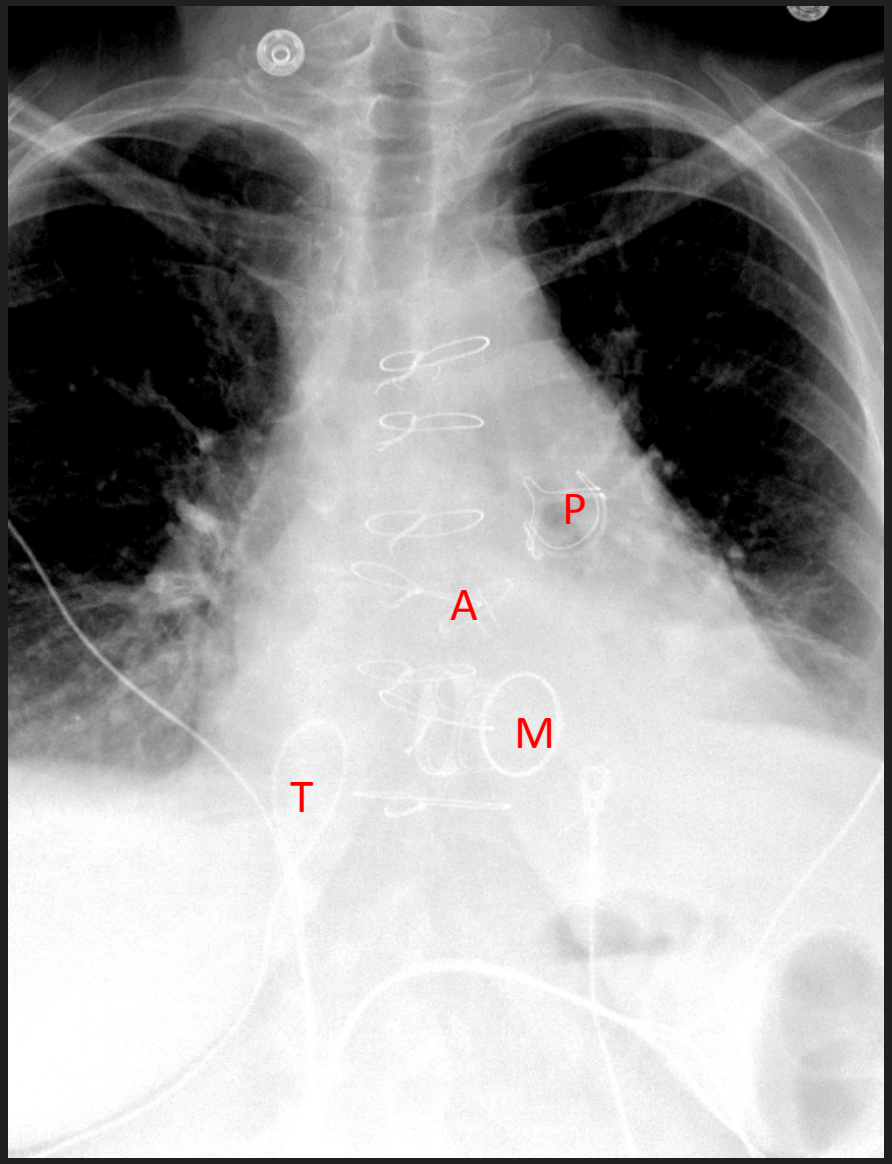
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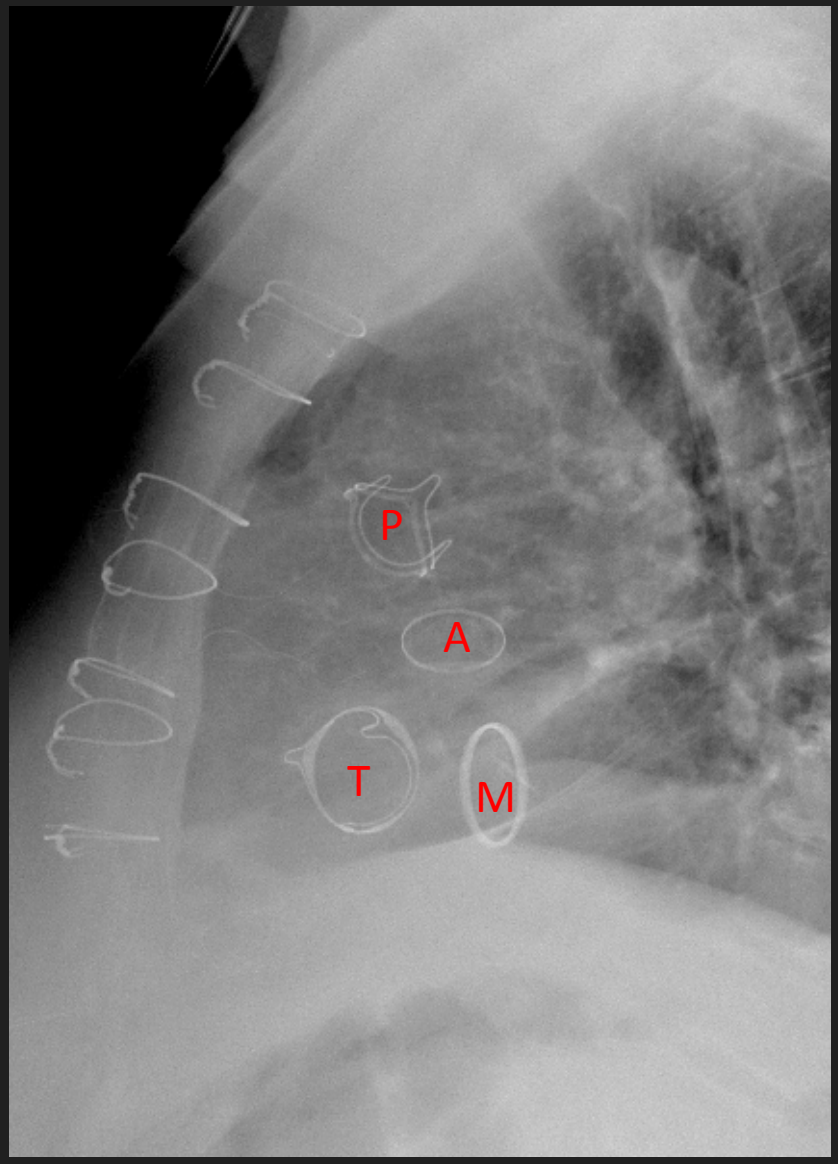
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69 year old man with dyspnea and new severe chest pain

What imaging do you start with?

Date of origin: 1995
Last review date: 2010

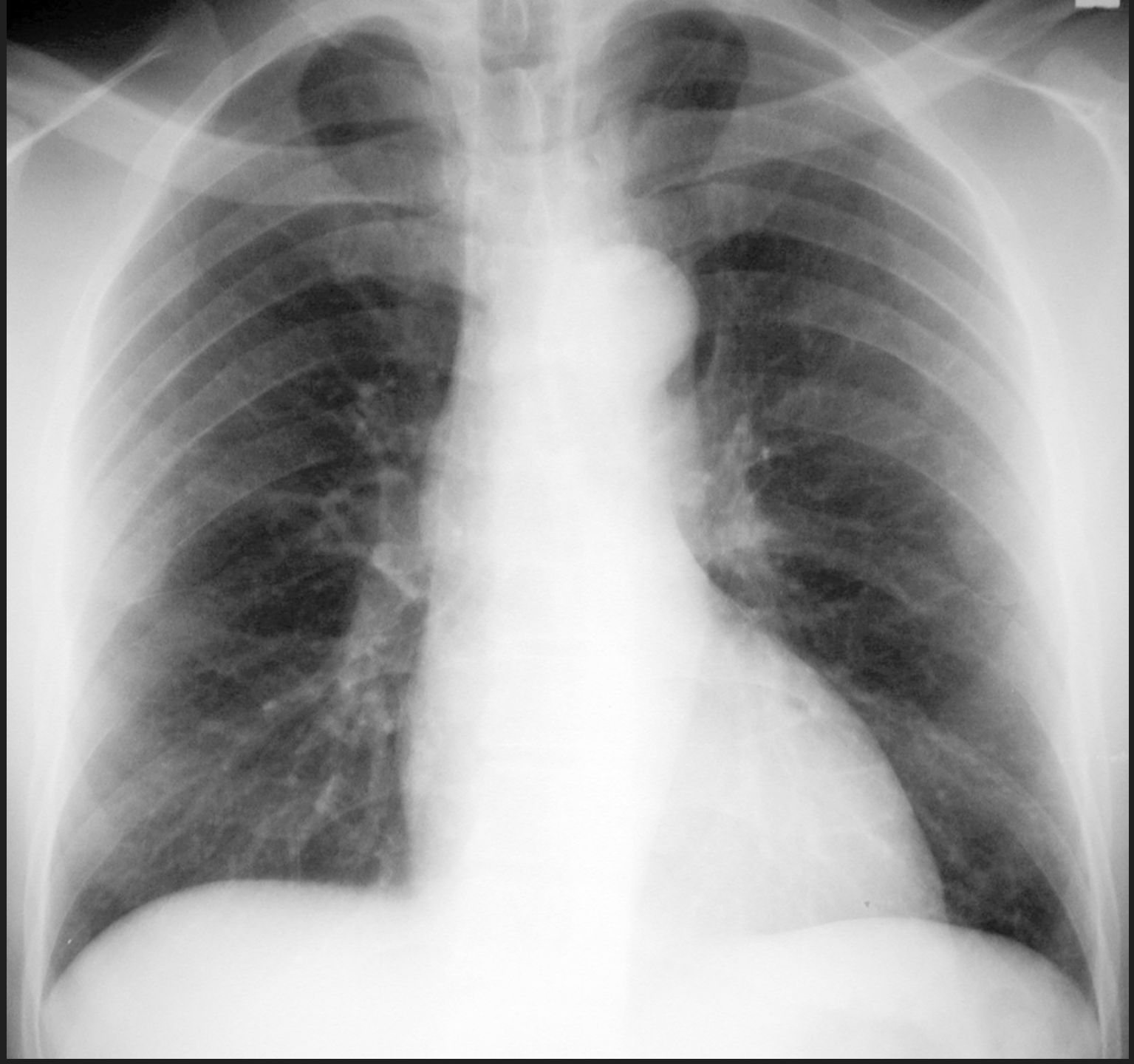
American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Dyspnea — Suspected Cardiac Origin**

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	8		☢
US echocardiography transthoracic resting	8		O
US echocardiography transthoracic stress	7		O
SPECT MPI rest and stress	7		☢☢☢☢
Rb-82 PET heart stress	7		☢☢☢
MRI heart function and morphology without and with contrast	7	See statement regarding contrast in text under "Anticipated Exceptions."	O
MRI heart function and morphology without contrast	6		O
CTA coronary arteries with contrast	6		☢☢☢
CTA chest with contrast	6		☢☢☢
Arteriography coronary with ventriculography	6		☢☢☢
US echocardiography transesophageal	5		O
CT chest without contrast	5		☢☢☢
Radionuclide ventriculography	4		☢☢☢
Tc-99m V/Q scan lung	3		☢☢☢
CT coronary calcium	3		☢☢☢
Arteriography pulmonary	3		☢☢☢☢

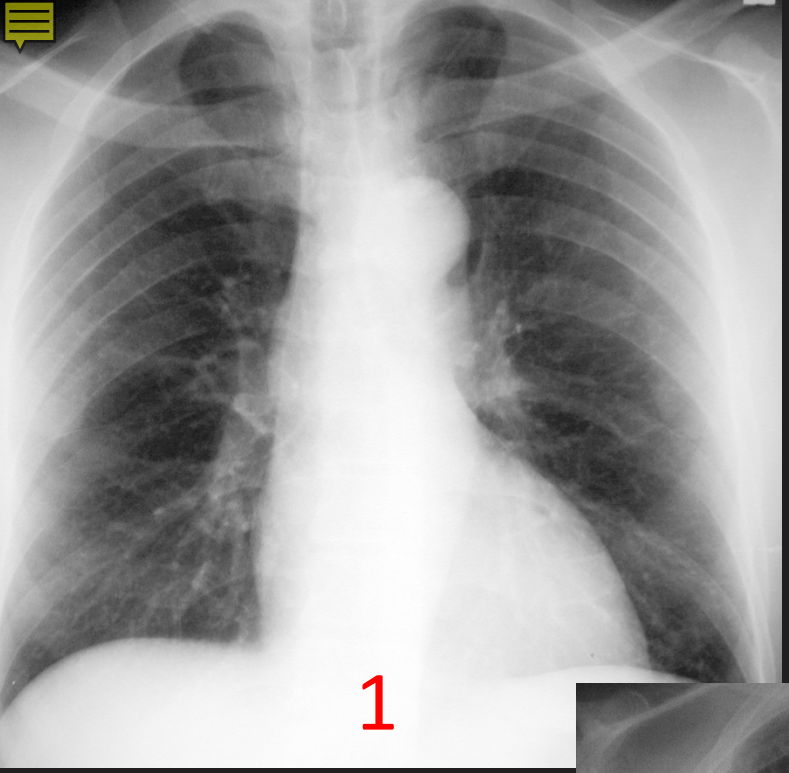
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level



What happens to pulmonary venous pressure in heart failure (CHF)?

In ARDS?
How can we measure it?



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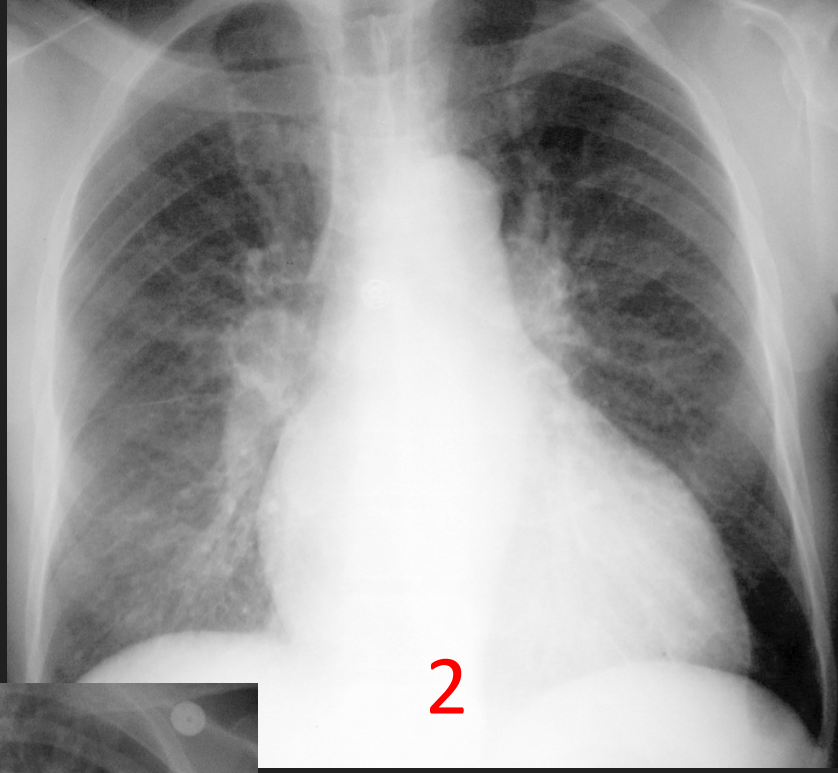

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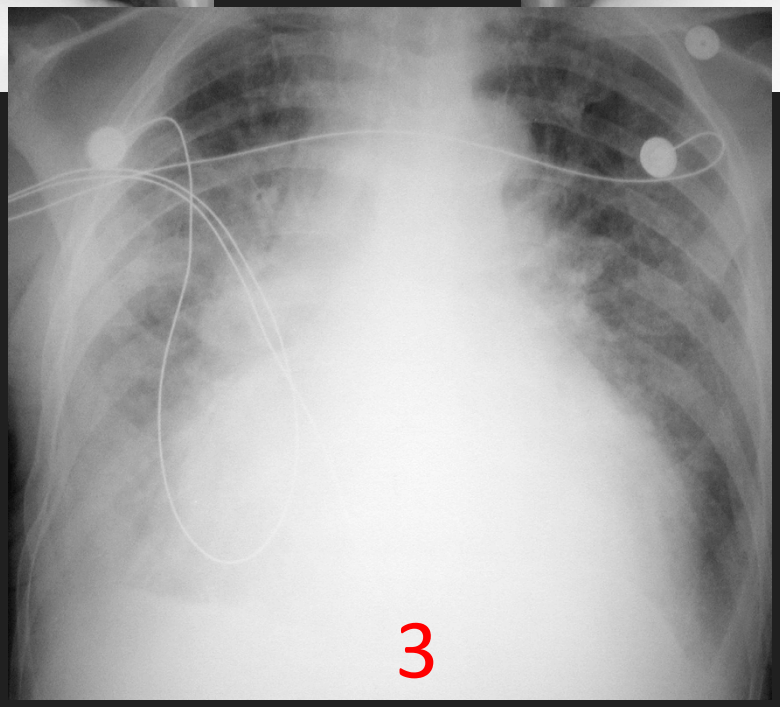

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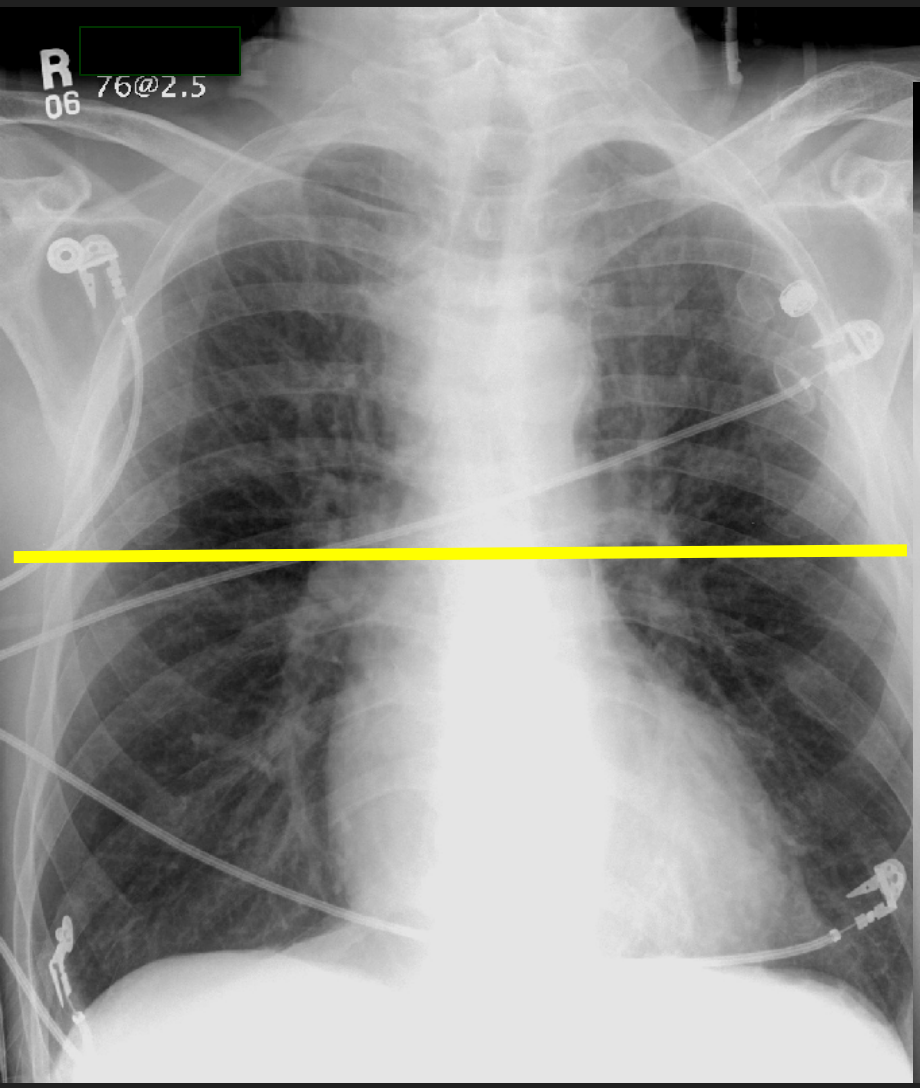
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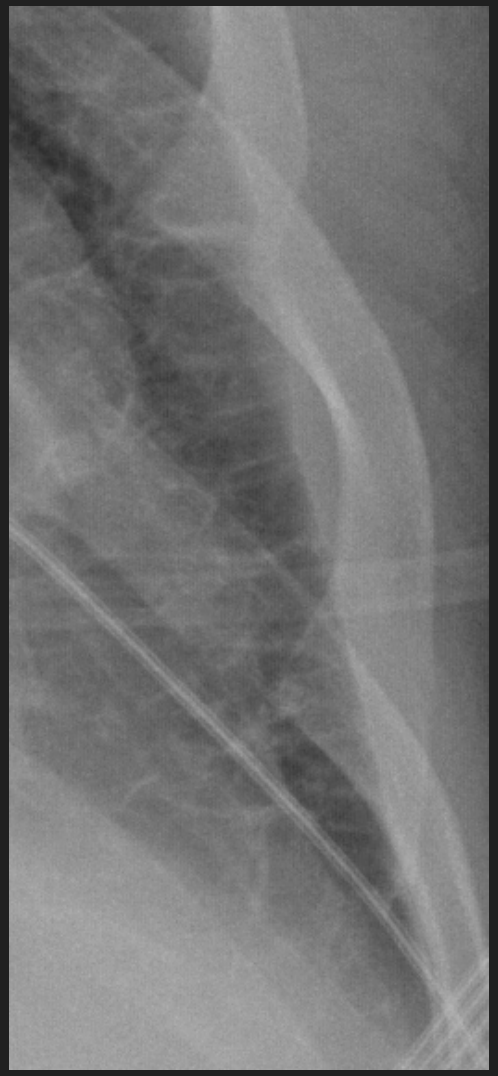
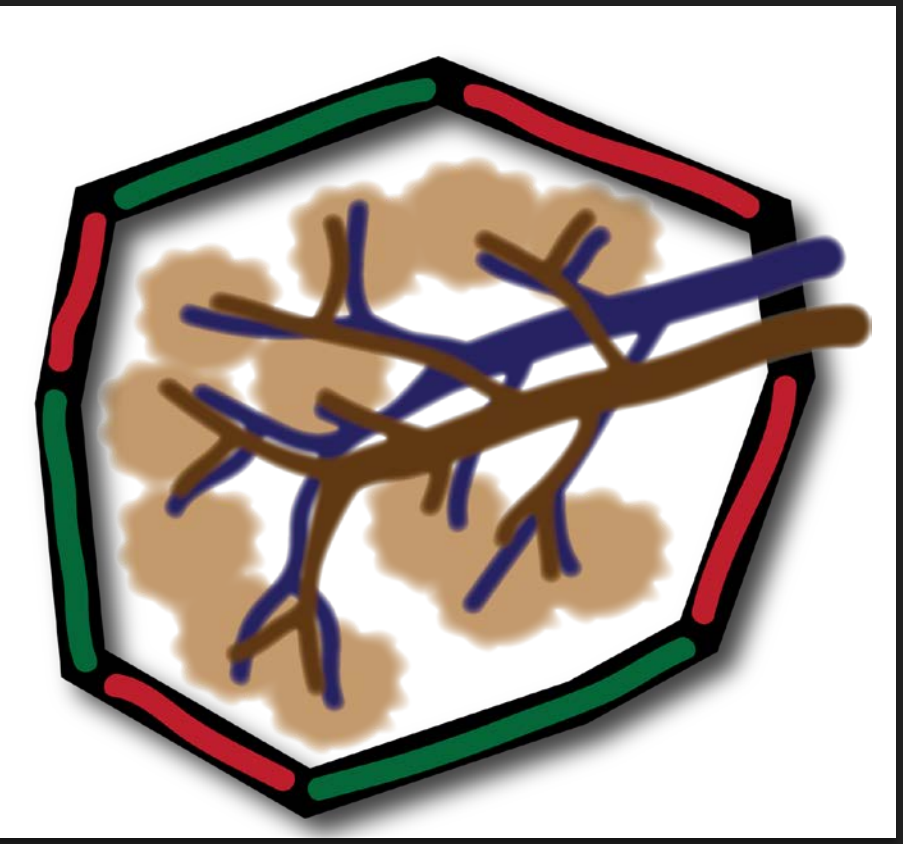
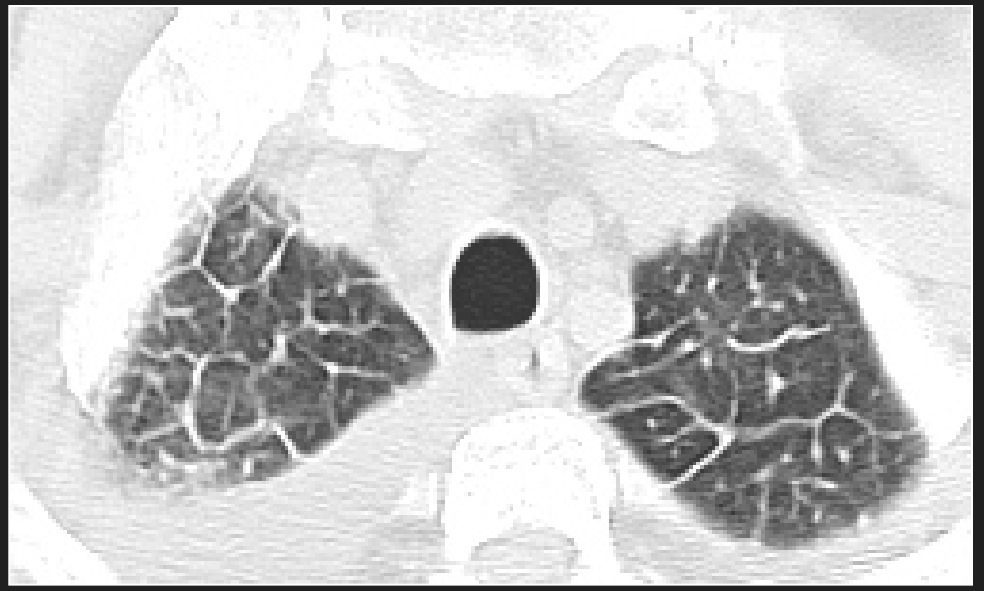
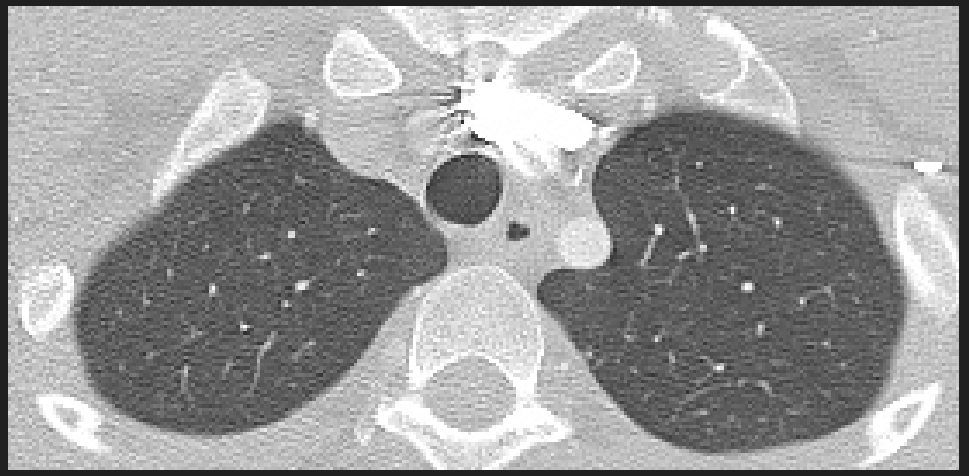
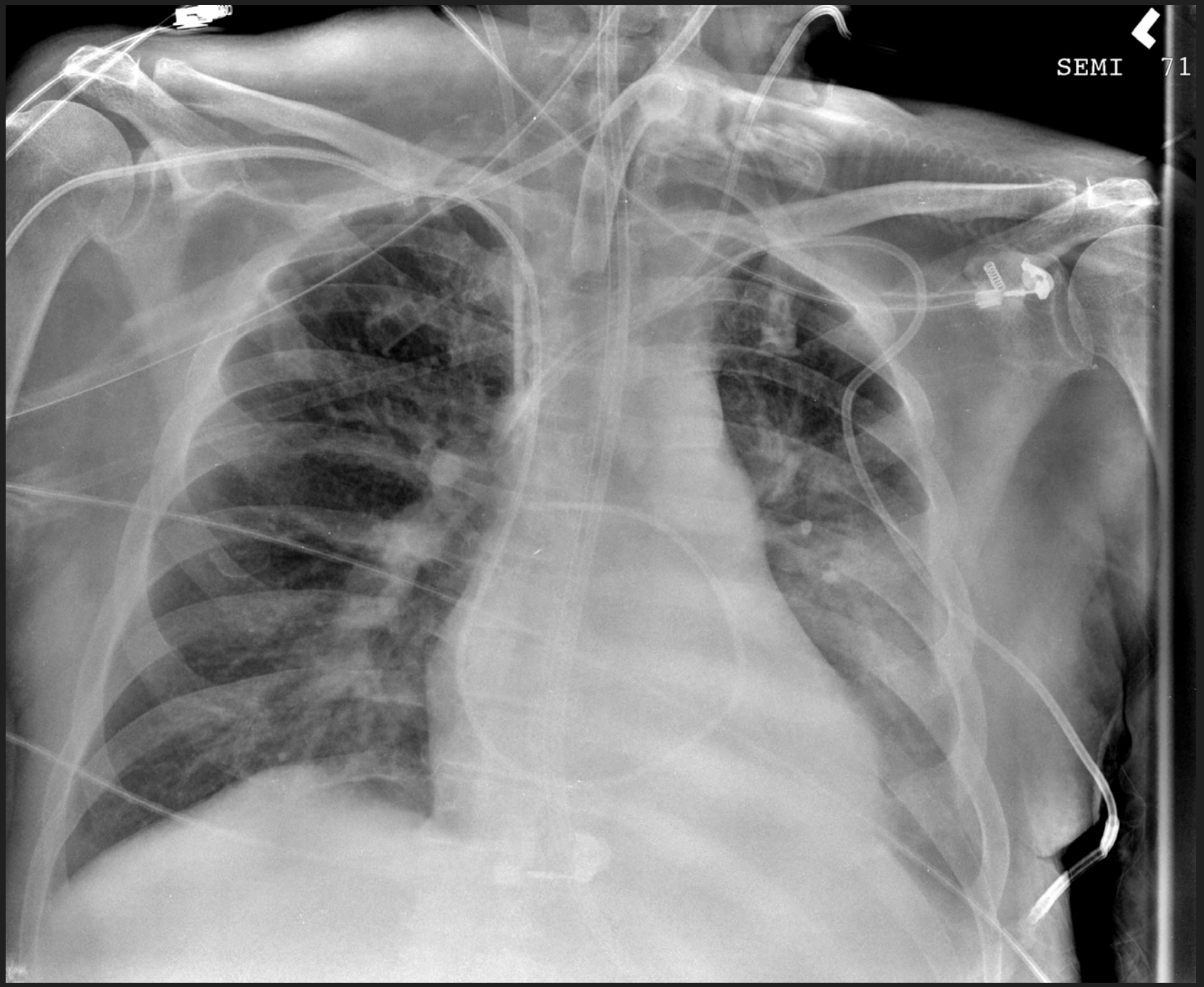


Where do Kerley B lines come from?





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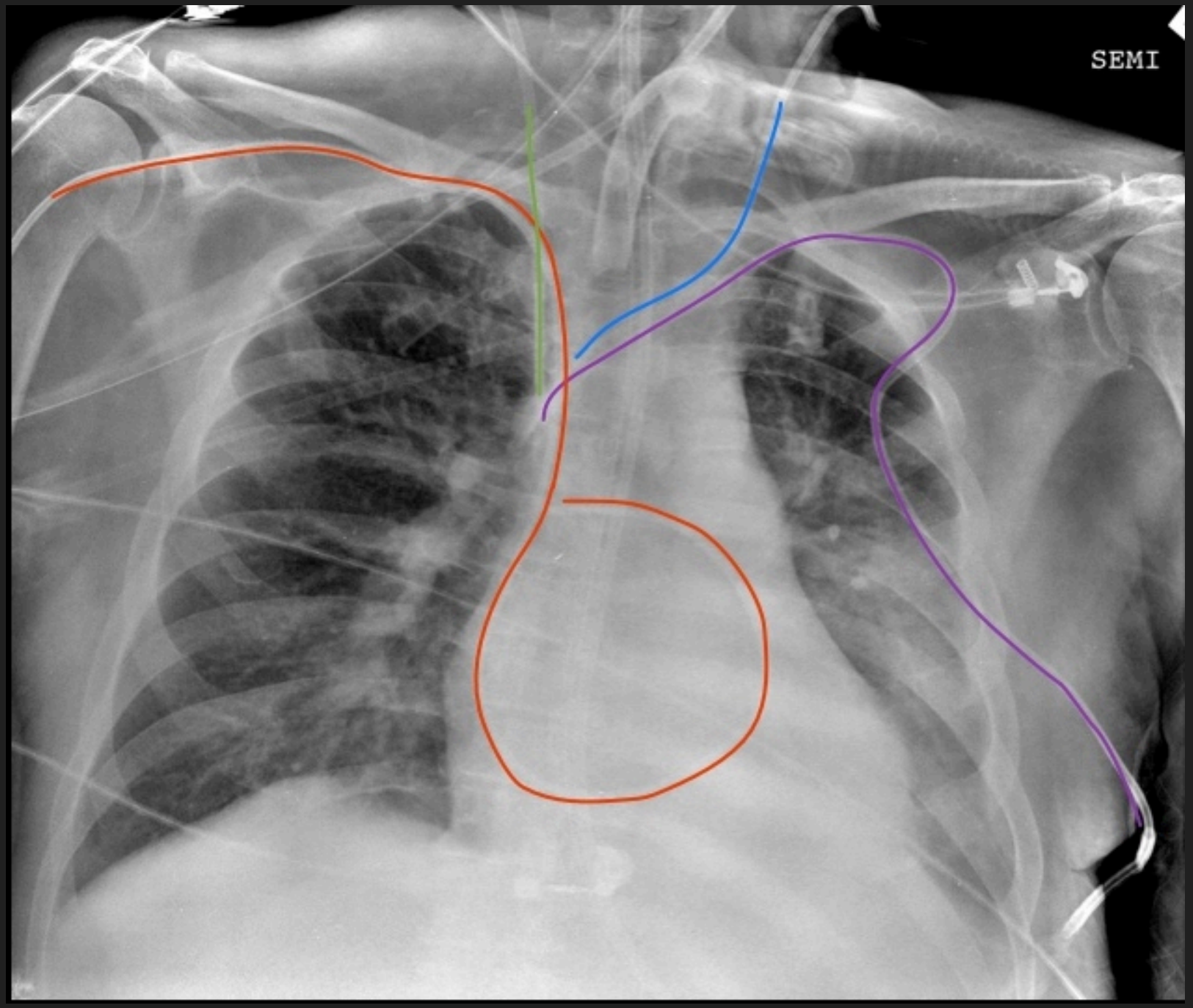
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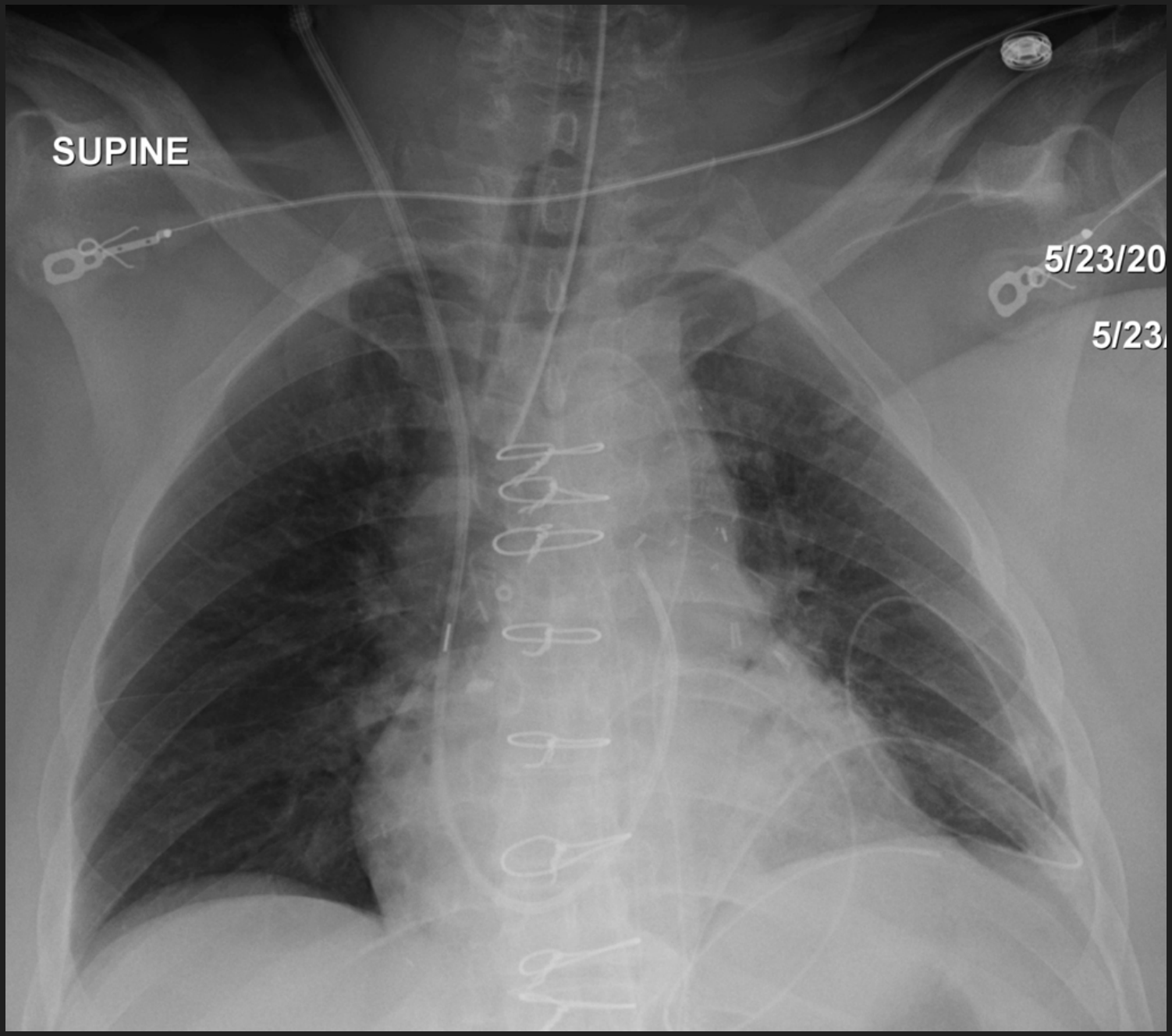
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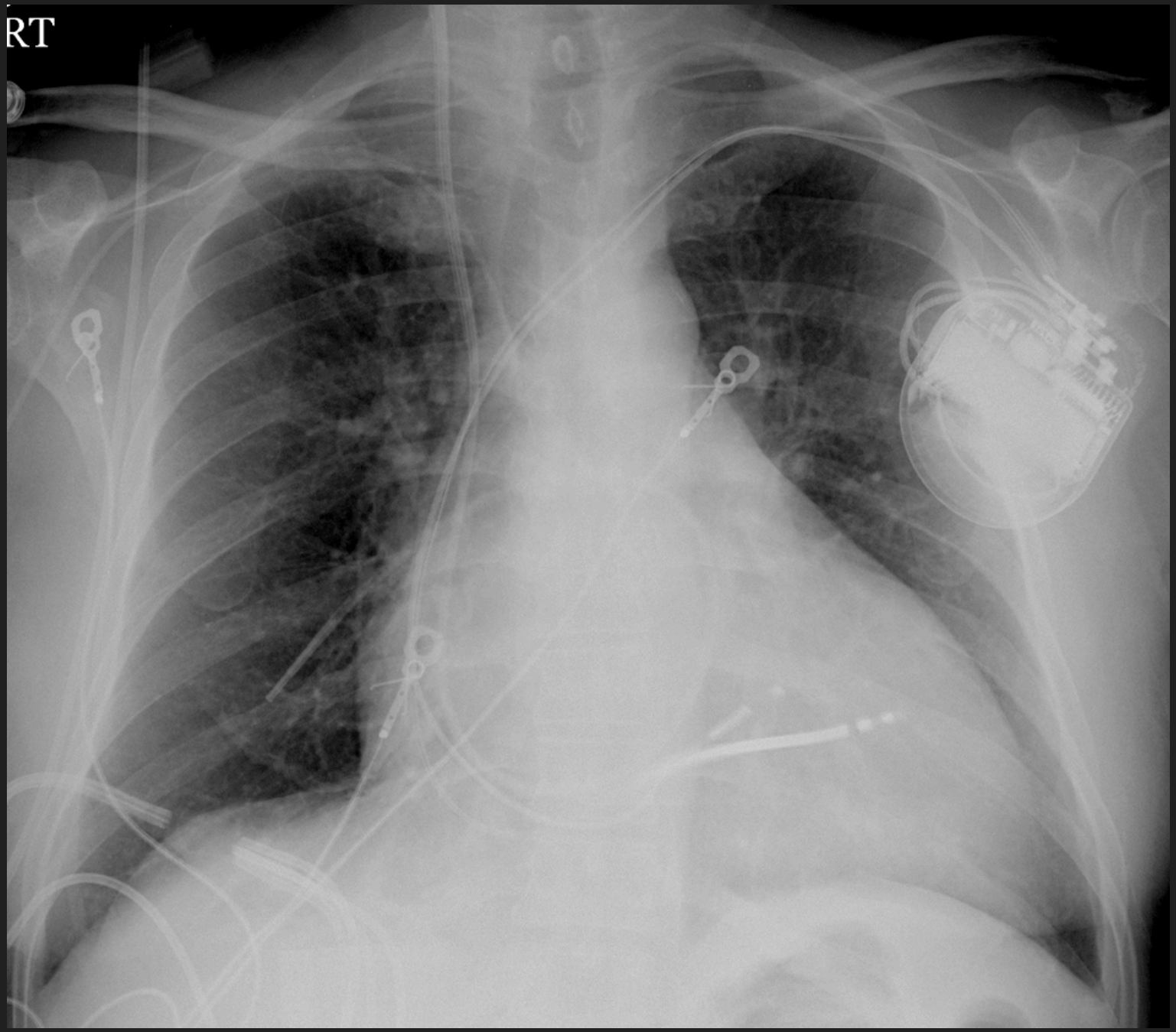
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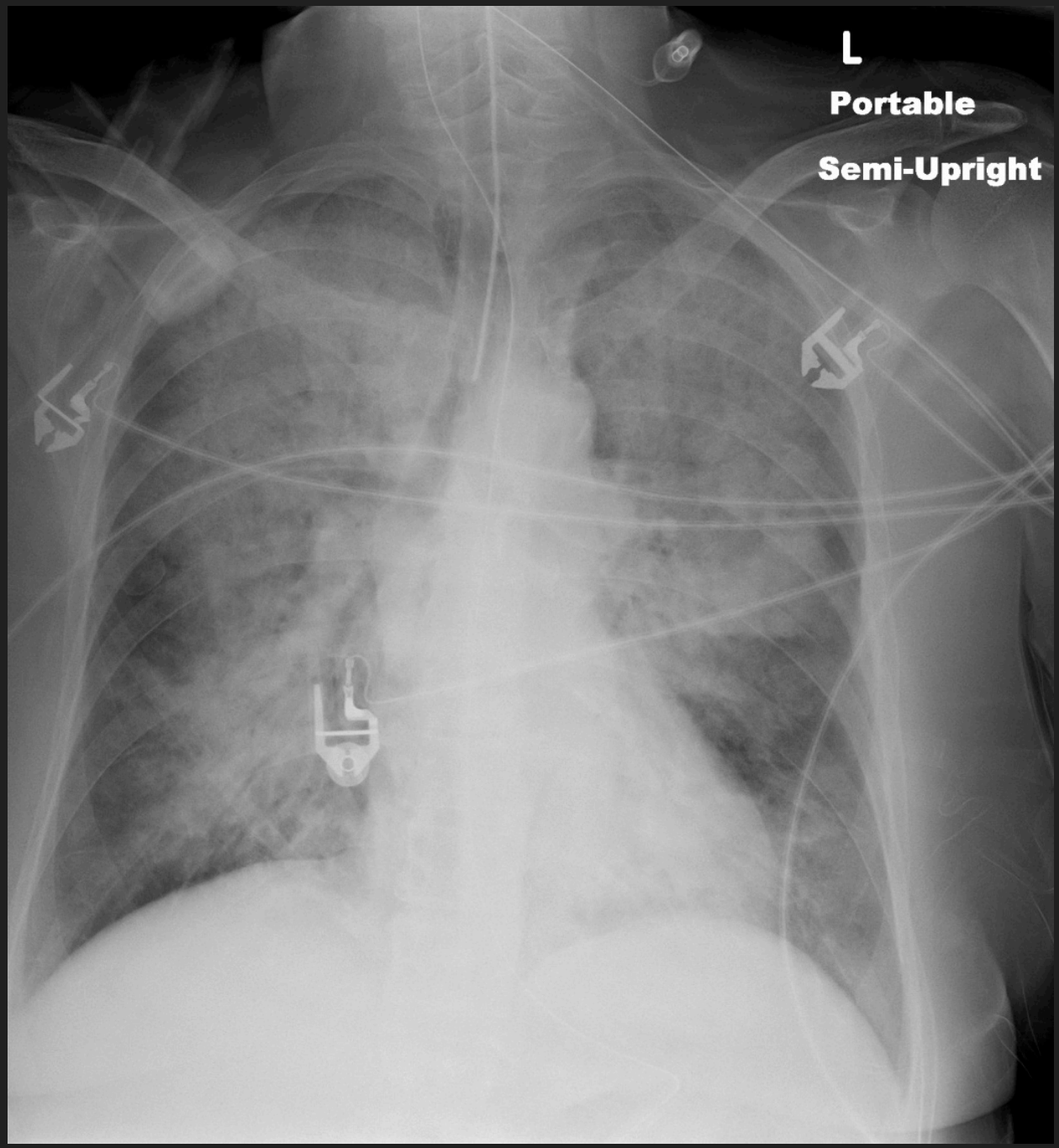
70 year old diabetic woman with severe shortness of breath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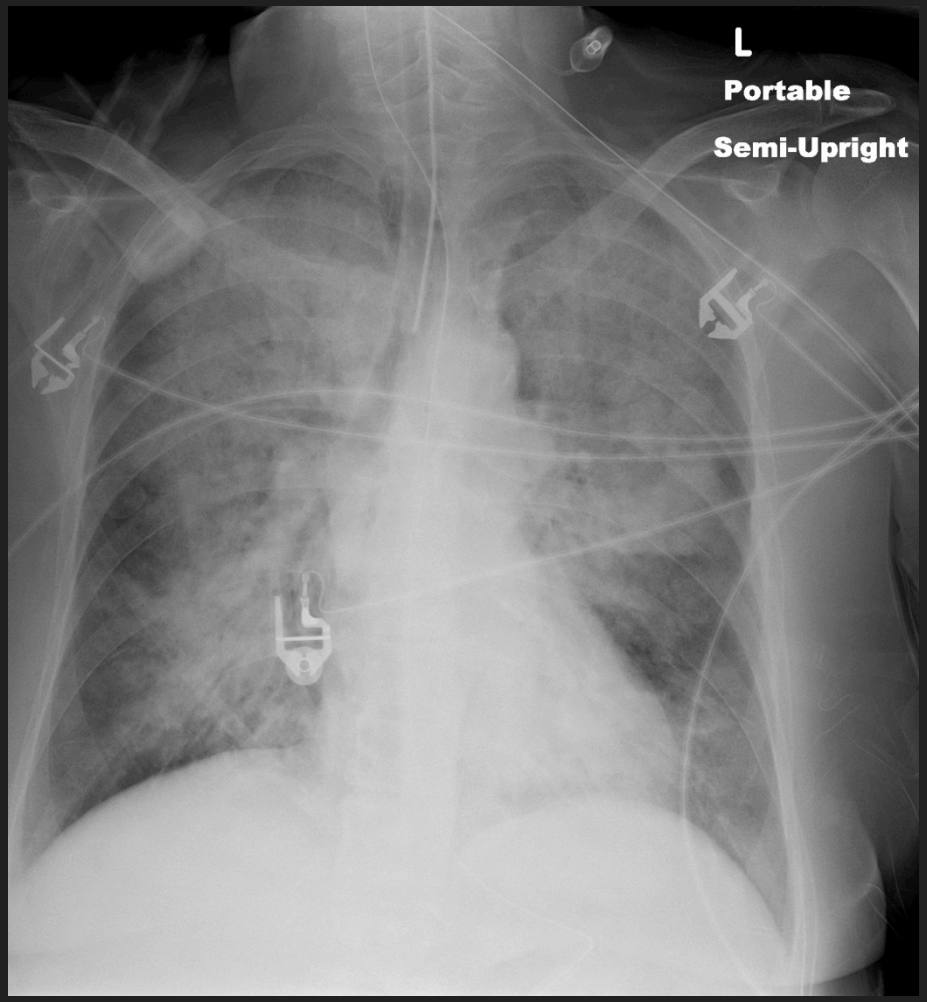
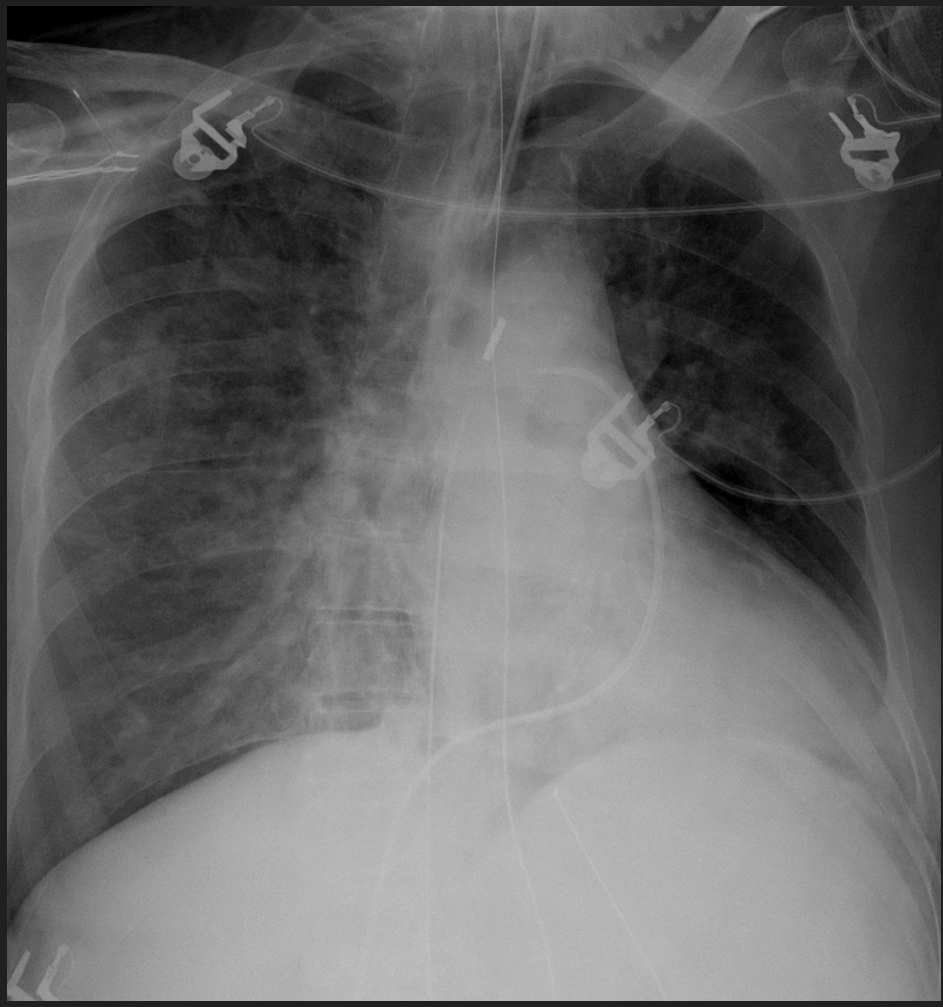
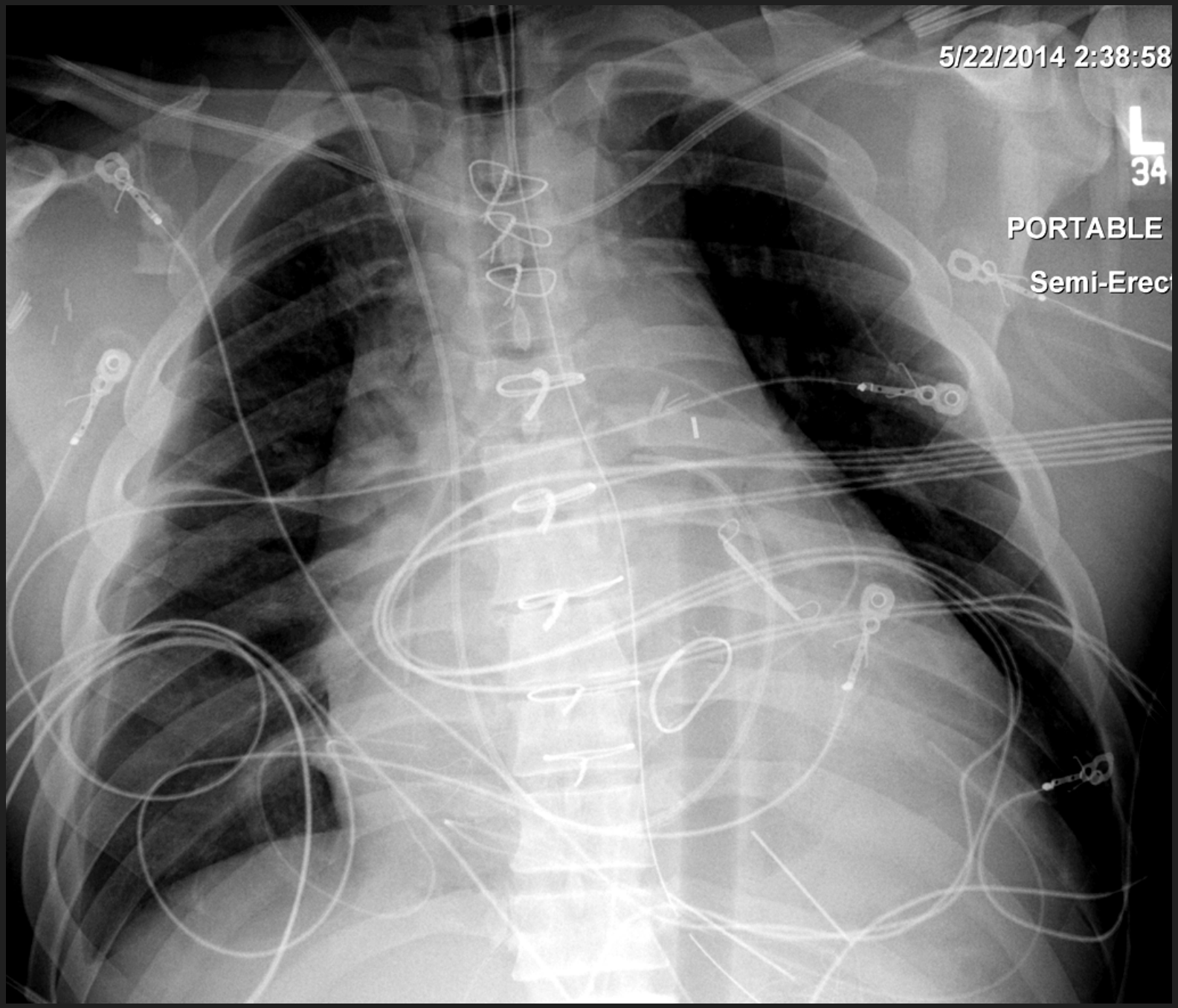
Portable
Semi-Upright

4 hours later



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PORTABLE
Semi-Erect

31 year old male personal fitness trainer has twinges of chest discomfort while playing tennis

Presents to Emergency Dept

How will we evaluate?

His CXR is negative

Date of origin: 1998
Last review date: 2011

American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Acute Nonspecific Chest Pain — Low Probability of Coronary Artery Disease**

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	9		☢
CTA coronary arteries with contrast	7		☢☢☢
CTA chest with contrast	7		☢☢☢
US echocardiography transthoracic resting	7		O
SPECT MPI rest and stress	6		☢☢☢☢
Tc-99m V/Q scan lung	5		☢☢☢
MRA aorta without and with contrast	5	See statement regarding contrast in text under "Anticipated Exceptions."	O
X-ray rib views	5		☢☢☢
MRA chest without and with contrast	5	See statement regarding contrast in text under "Anticipated Exceptions."	O
MRA aorta without contrast	4		O
MRA chest without contrast	4		O
X-ray barium swallow and upper GI series	4		☢☢☢
X-ray thoracic spine	4		☢☢☢
US abdomen	4		O
MRI heart with or without stress without and with contrast	3		O
MRA pulmonary arteries without and with contrast	3		O
MRA coronary arteries without contrast	3		O
MRA coronary arteries without and with contrast	3		O
US echocardiography transthoracic stress	3		O
US echocardiography transesophageal	2		O
MRI heart with or without stress without contrast	2		O
MRA pulmonary arteries without contrast	2		O
Arteriography coronary	1		☢☢☢

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level

62 year old male hypertensive diabetic 2 ppd smoker suffers new onset crushing substernal chest pain and dyspnea

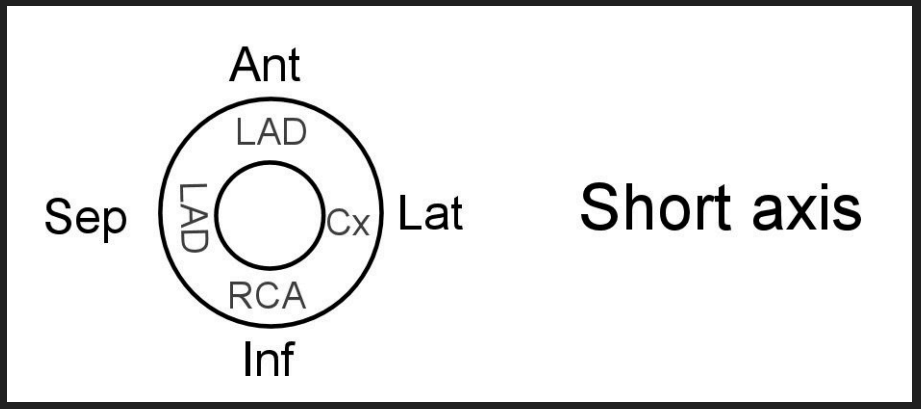
Presents to Emergency Dept

How will we evaluate?

Clinical Condition: **Chest Pain Suggestive of Acute Coronary Syndrome**

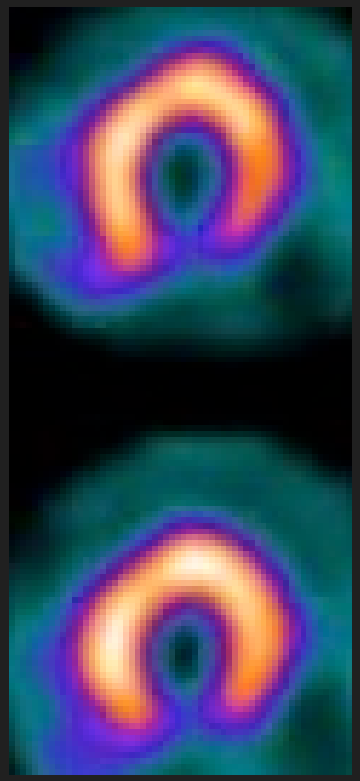
Radiologic Procedure	Rating	Comments	RRL*
SPECT MPI rest and stress	8	This procedure is appropriate for intermediate-to-high likelihood for coronary artery disease. There is abundant literature available on clinical utility.	☢☢☢☢
Arteriography coronary	8	This procedure is the gold standard and is invasive.	☢☢☢
SPECT MPI rest only	7	In the setting of ongoing chest pain, this procedure has a high negative predictive value. Tc-99m is the most commonly used radionuclide agent for this test. RRL may be higher if Thallium (TI-201) used.	☢☢☢
US echocardiography transthoracic stress	7	Consider this procedure when resting echo and cardiac enzymes are normal.	O
US echocardiography transthoracic resting	6	This procedure is primarily used for evaluating wall-motion abnormalities and aortic dissection.	O
CTA coronary arteries with contrast	6	Consider this procedure for those patients with low-to-intermediate likelihood for coronary artery disease, in the absence of cardiac enzyme elevation and ischemic ST changes.	☢☢☢
X-ray chest	5	This procedure is primarily a survey for noncardiac etiologies of chest pain.	☢
CT chest with contrast	5	This procedure is primarily for noncardiac etiologies such as pulmonary embolism and aortic dissection.	☢☢☢
MRI heart function with stress without and with contrast	5	For this procedure there is limited experience in the clinical setting and lack of availability. See statement regarding contrast in text under “Anticipated Exceptions.”	O
MRI heart function with stress without contrast	4	For this procedure there is limited experience in the clinical setting and lack of availability.	O
Rb-82 PET heart stress	4	For this procedure there is lack of widespread use and availability.	☢☢☢

How else besides CXR, CTA, coronary cath can we investigate the heart?

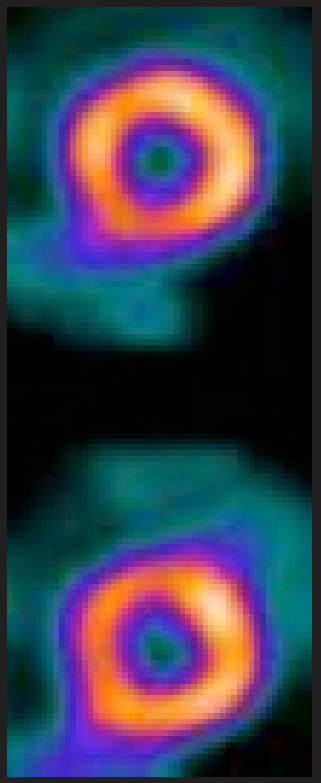


Stress

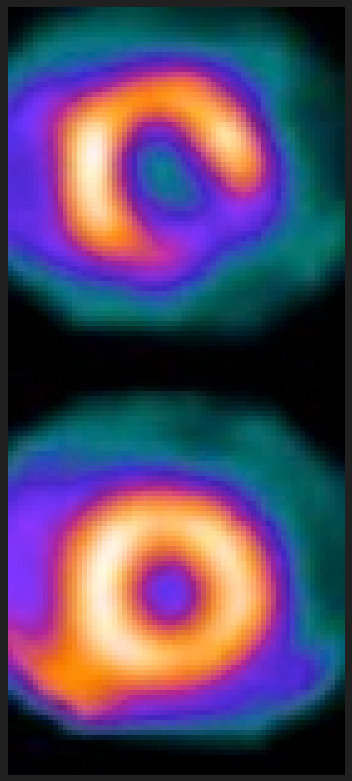
Rest



Patient A



Patient B



Patient C

Radiation Doses of Cardiac Nuclear Medicine & Cardiac CTA for 50 yo man

Exam	Average Dose (mSv)	Added lifetime risk of fatal cancer from examination
Cardiac CTA	16	.0809% (1 in 1236)
Technecium Cardiac Stress	9.4	.0475% (1 in 2104)
Thallium Cardiac Stress	40.7	.2058% (1 in 486)
Whole body PET	14.1	.0713% (1 in 1403)
CT chest/abdomen/pelvis	21	.106% (1 in 942)

www.xrayrisk.com Accessed 11/28/2014

67 year old man with pulsating palpable abdominal mass

How shall we evaluate this?

What clinical questions influence our choice?

Last review date: 2012

American College of Radiology
ACR Appropriateness Criteria®

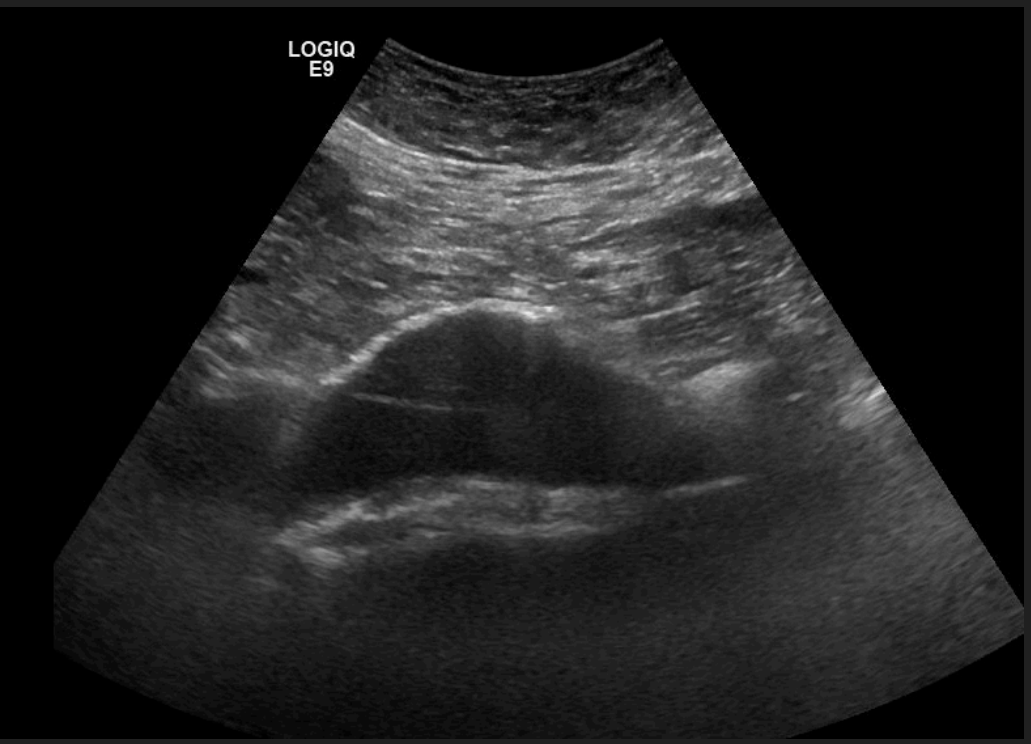
Clinical Condition: **Pulsatile Abdominal Mass, Suspected Abdominal Aortic Aneurysm**

Radiologic Procedure	Rating	Comments	RRL*
US aorta abdomen	9	Initial examination. May be limited by body habitus or acoustic window.	O
CT abdomen without contrast	8	Preferred for symptomatic patients. Suitable for patients in whom US is not useful.	☢☢☢
CTA abdomen with contrast	7	Also enables preinterventional planning.	☢☢☢
MRA abdomen without contrast	6	Alternative to CTA. Unable to detect calcium. Site-specific expertise important.	O
MRA abdomen without and with contrast	6	Alternative to CTA. Unable to detect calcium. Site-specific expertise important. See statement regarding contrast in text under "Anticipated Exceptions."	O
Aortography abdomen	2	Essentially replaced by cross-sectional imaging for diagnostic purposes. May be used for preinterventional planning.	☢☢☢
FDG-PET/CT abdomen	2		☢☢☢☢

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level

Patient A



Patient B

72 year old man with rapidly declining condition (hypotension, tachycardia, severe back pain)

What imaging is needed?

What treatments can be offered?

How do we choose therapy?

Last review date: 2012

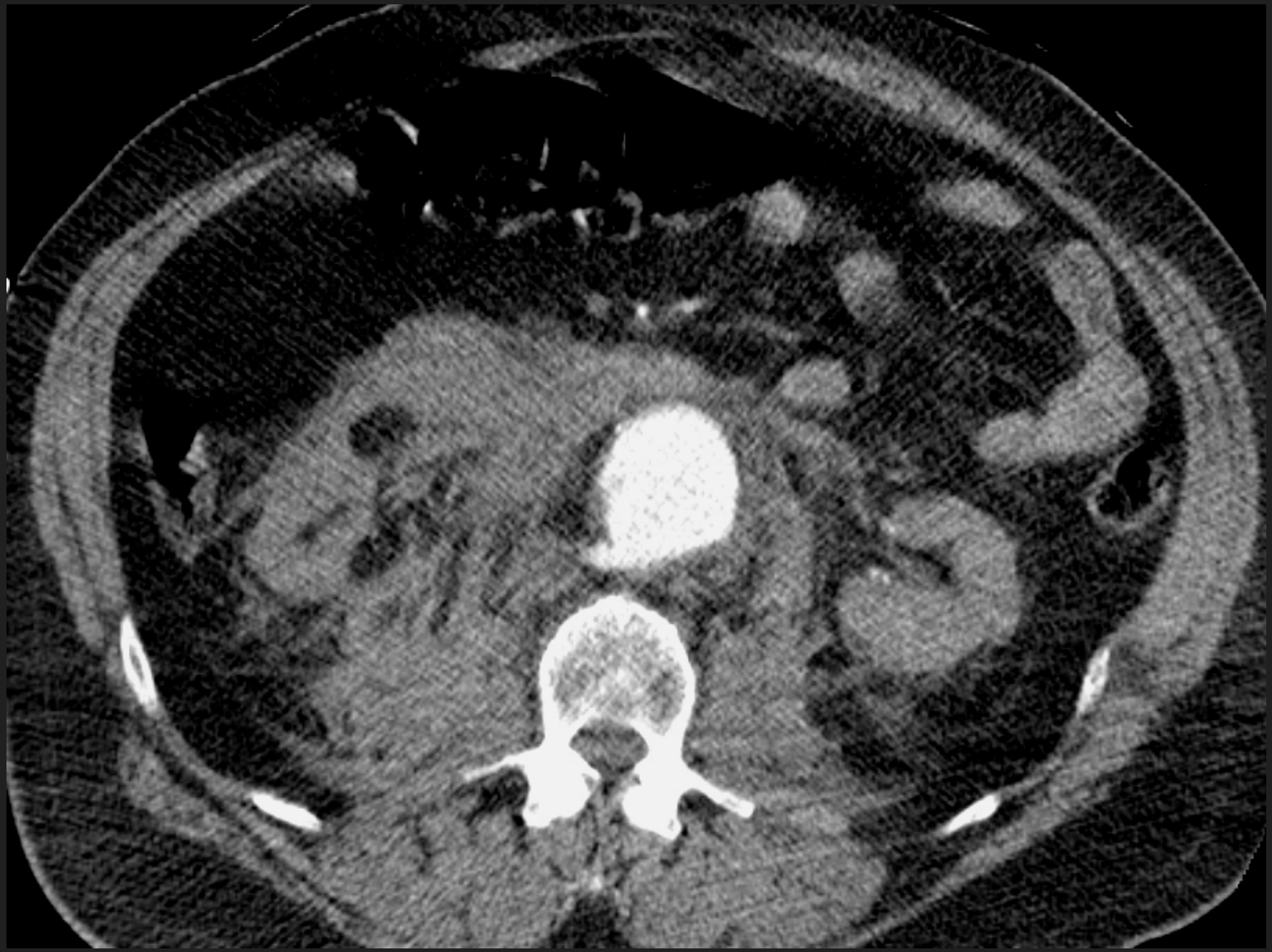
American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Pulsatile Abdominal Mass, Suspected Abdominal Aortic Aneurysm**

Radiologic Procedure	Rating	Comments	RRL*
US aorta abdomen	9	Initial examination. May be limited by body habitus or acoustic window.	O
CT abdomen without contrast	8	Preferred for symptomatic patients. Suitable for patients in whom US is not useful.	☢☢☢
CTA abdomen with contrast	7	Also enables preinterventional planning.	☢☢☢
MRA abdomen without contrast	6	Alternative to CTA. Unable to detect calcium. Site-specific expertise important.	O
MRA abdomen without and with contrast	6	Alternative to CTA. Unable to detect calcium. Site-specific expertise important. See statement regarding contrast in text under "Anticipated Exceptions."	O
Aortography abdomen	2	Essentially replaced by cross-sectional imaging for diagnostic purposes. May be used for preinterventional planning.	☢☢☢
FDG-PET/CT abdomen	2		☢☢☢☢

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level



American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Abdominal Aortic Aneurysm: Interventional Planning and Follow-up**

Variant 1: **Planning for pre-endovascular repair (EVAR) or open repair of AAA.**

Radiologic Procedure	Rating	Comments	RRL*
CTA abdomen and pelvis with contrast	9	For evaluation of known AAA without thoracic aortic involvement. Noncontrast sequence is not necessary for interventional planning.	☢☢☢☢☢
CTA chest abdomen pelvis with contrast	8	Useful for patients with suspected AAA but no prior workup of the thoracic aorta. Study of choice for workup of suprarenal AAA or thoracoabdominal aneurysm.	☢☢☢☢☢
CT abdomen and pelvis without contrast	6	At physician's discretion, chest may not be included. Appropriate for patients with contraindication to iodinated contrast. Occasionally depicts density differences between the blood pool and aortic wall/mural thrombus. Otherwise, further luminal assessment with MRI, US, or DSA would be preferred.	☢☢☢☢
MRA abdomen and pelvis without and with contrast	6	Alternative to CTA in patients with known AAA not involving the thoracic aorta and in whom iodinated contrast is contraindicated. See statement regarding contrast in text under "Anticipated Exceptions."	O
CT chest abdomen pelvis without contrast	5	Appropriate for patients with contraindication to iodinated contrast. Occasionally depicts density differences between the blood pool and aortic wall/mural thrombus. Otherwise, further luminal assessment with MRI, US, or DSA would be preferred.	☢☢☢☢
Digital subtraction angiography (DSA) aorta	5	May be appropriate in select cases, including patients who require pre-operative embolization of branch vessels or those requiring further characterization of the aortic lumen with an alternative	☢☢☢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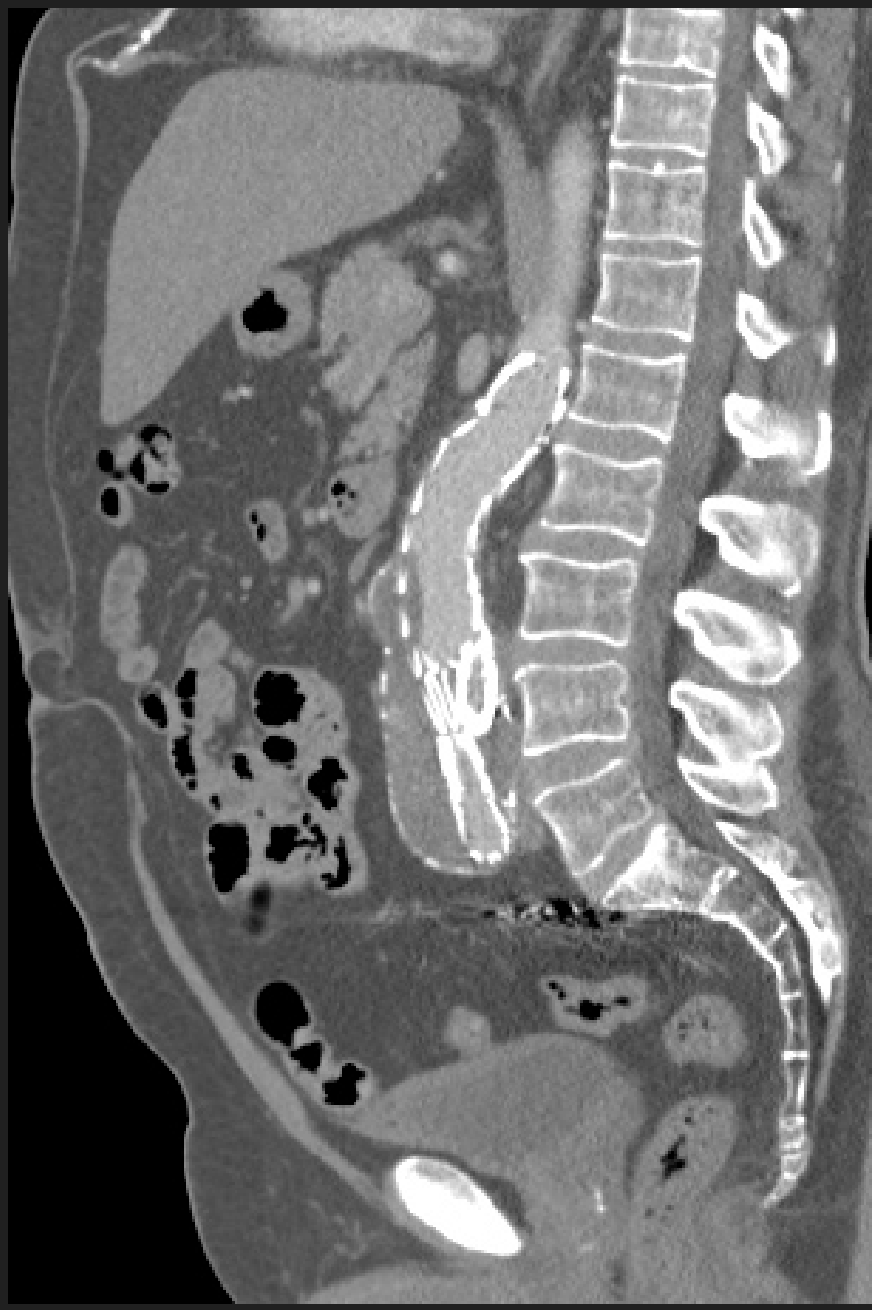


AAA F/U after EVAR *or* open surgery

Variant 2: **Follow-up for post-endovascular repair (EVAR) or open repair of AAA.**

Radiologic Procedure	Rating	Comments	RRL*
CTA abdomen and pelvis with contrast	9	Method of choice.	☢☢☢☢☢
MRA abdomen and pelvis without and with contrast	7	Appropriate alternative to CTA, but less accurate for assessing endograft metallic components. Effectiveness depends on composition of endoprosthesis. 3D contrast-enhanced MRA and time-resolved MRA are highly sensitive to endoleaks. See statement regarding contrast in text under "Anticipated Exceptions."	O
CT abdomen and pelvis without contrast	6	Appropriate for patients with MR-incompatible devices or contraindication to iodinated contrast. Provides temporal information regarding sac morphology with reduced contrast exposure and radiation burden. US is a useful adjunctive tool for endoleak detection.	☢☢☢☢
Digital subtraction angiography (DSA) aorta	6	Selectively useful for characterization and treatment of endoleaks type I and III.	☢☢☢
MRA abdomen and pelvis without contrast	5	Selectively useful for assessment of renal or mesenteric vasculature in patients with contraindication to iodinated contrast.	O
US aorta abdomen with Doppler	5	Important adjunct to noncontrast CT for endoleak detection. May be useful in endoleak characterization.	O
X-ray abdomen and pelvis	4	Provides detailed survey for structural integrity of the metallic components of the endograft but not the nonmetallic components. Particularly useful with tortuous anatomy. However, inadequate as a stand-alone follow-up modality.	☢☢☢

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level

68 year old retired man has calf pain after walking about one block

What diagnoses would you consider?

How might this be evaluated?

Last review date: 2012

American College of Radiology
ACR Appropriateness Criteria®

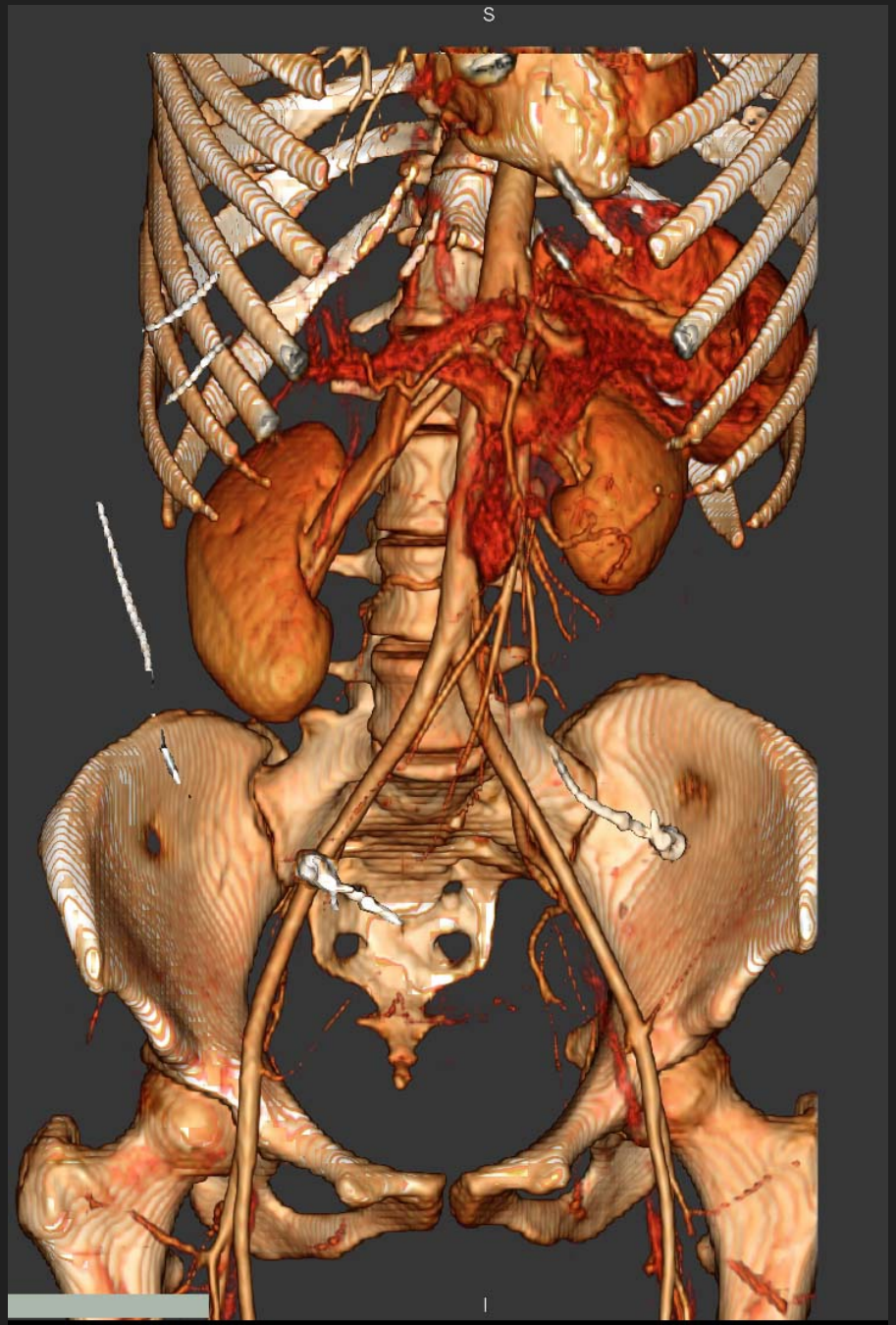
Clinical Condition: **Claudication — Suspected Vascular Etiology**

Radiologic Procedure	Rating	Comments	RRL*
Segmental Doppler pressures and pulse volume recordings	9	Appropriate for screening patients with symptoms and findings suggestive of peripheral vascular disease. Compressibility artifact limits interpretation of pressures, but pulse volume recordings remain interpretable in this setting.	O
MRA lower extremity without and with contrast	8	See statement regarding contrast in text under "Anticipated Exceptions."	O
CTA lower extremity with contrast	8	Test of choice in patients that cannot have MRA.	☢ ☢ ☢
US lower extremity with Doppler	7	Useful in patients with contrast allergy or renal dysfunction.	O
Arteriography lower extremity	7	Indicated only if intervention is planned.	☢ ☢ ☢
MRA lower extremity without contrast	5	Appropriate in patients with contraindications to iodinated and gadolinium-based contrast agents.	O

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level

Normal CTA



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