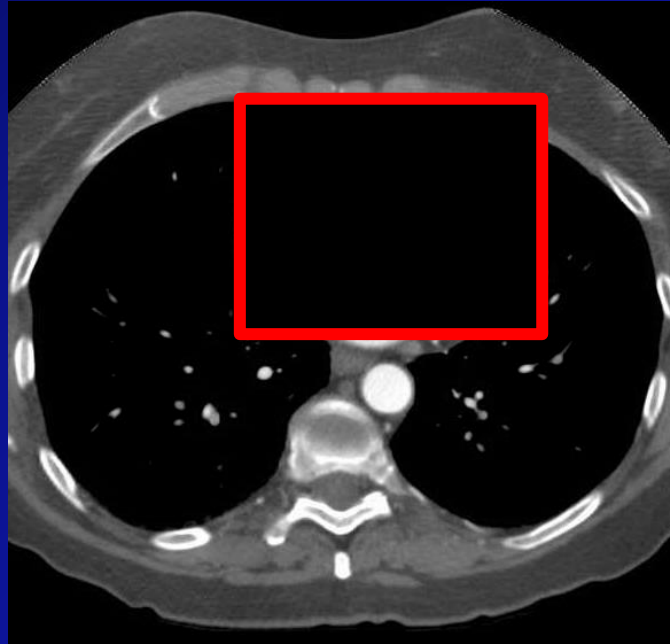


Making the Black Box of the Heart More Transparent!



Presented by Dominique DaBreo MD FRCPC
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For Elena Pena MD
NASCI Annual Meeting September 14-17, 2019

Disclosure

- Bayer AG – speaker honorarium
- HeartFlow Inc. – consultant fee

Introduction

- Non-gated chest CT common imaging test
- Heart is included in its field of view
- New technology (high temporal and spatial resolution) decreases cardiac motion with increased detection of cardiac findings

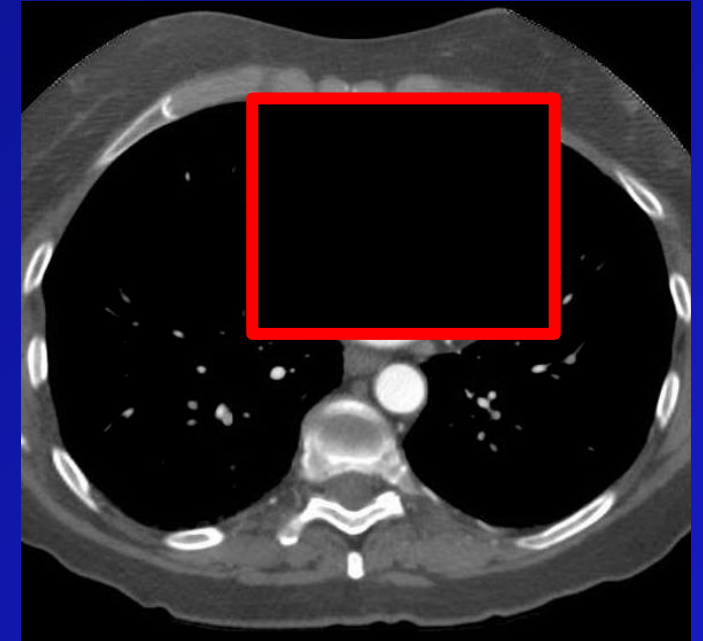
Pertinent reportable incidental cardiac findings on chest CT without electrocardiography gating: review of 268 consecutive cases

Garry Choy¹, Patric Kröpiß, Axel Scherer², Ahmed H El-Sherief¹, Jonathan Chung¹, Carlos A Rojas¹ and Suhny Abbara¹

- 268 chest CT reviewed for reportable cardiac findings by two radiologists
- 61% reportable cardiac findings - 22% not mentioned in radiology report
- ✓ Incidental cardiac findings are common but usually not reported

Introduction

- ✓ Heart often regarded as a “black-box” on chest CT
- ✓ Cardiovascular and pulmonary diseases may overlap in their presentation
- ✓ Cardiac/pericardial diseases may alter patient’s clinical course

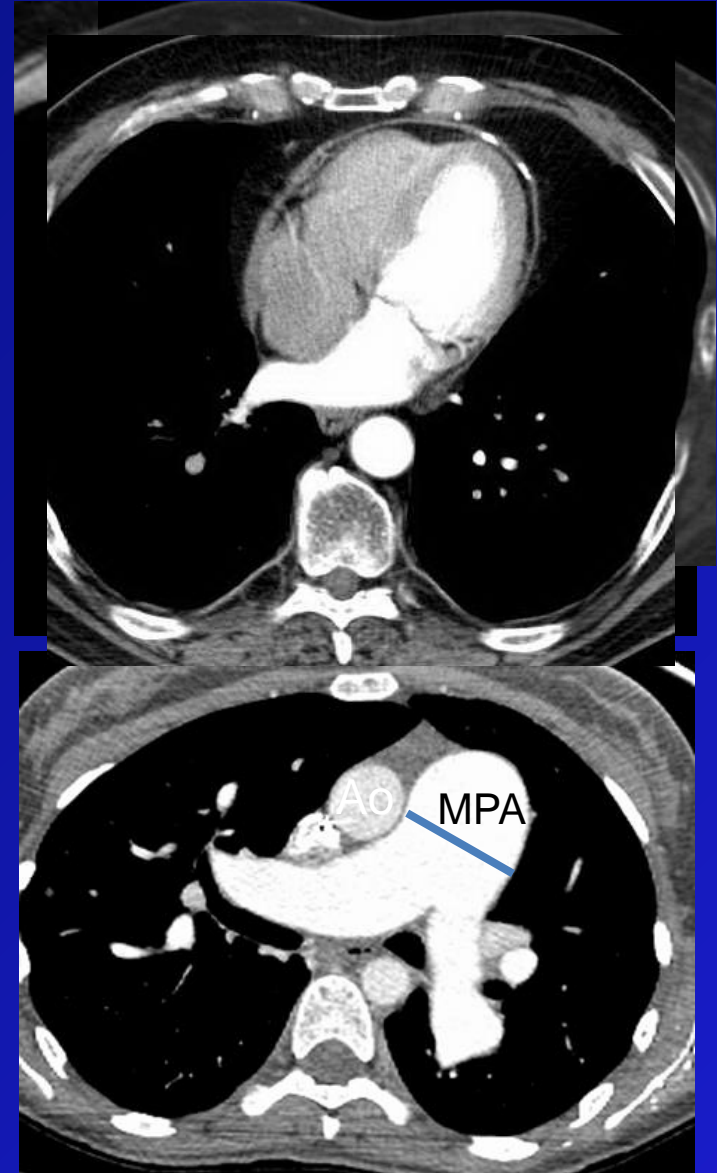


Objectives

- ✓ Learn a stepwise approach to the examine the heart on CT chest
- ✓ Review **clinically significant** cardiac findings through cases
- ✓ Tips and Take Home Messages

Normal References

- RV myocardium $< 4\text{mm}$
- Pericardium $< 4\text{ mm}$
- Pulmonary Artery $< 29\text{ mm}$
 - PA/Ao diameter ratio ≤ 1



Chambers

Right ventricular enlargement

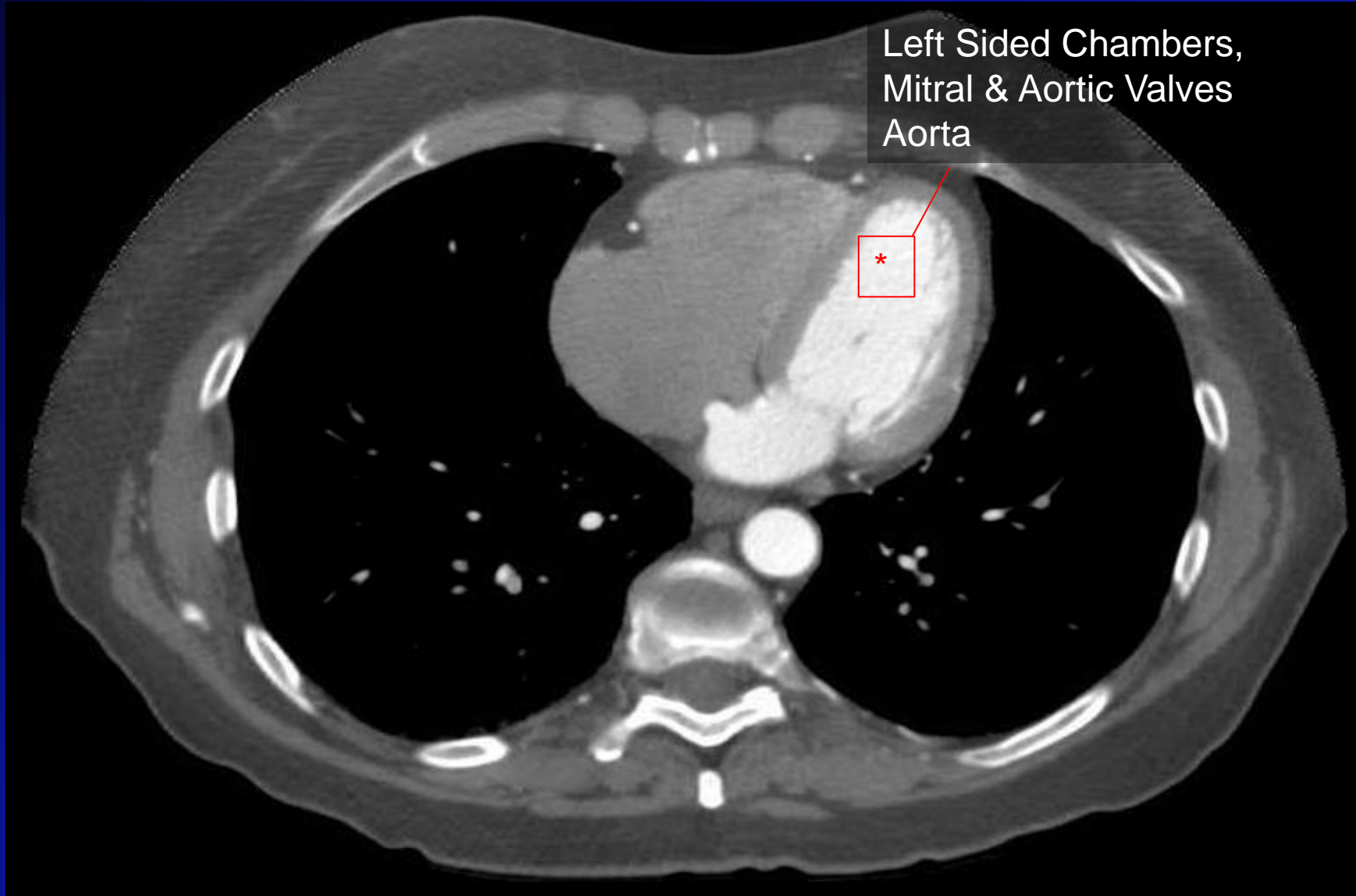
- RV displaces inferiorly (below the level of the LV on axial)
- RV/LV ratio >1
- Left ventricular enlargement > 5.6 cm
 - Sens 78%, Spec 100%
- Left atrial enlargement > 4.5 cm
 - Sens 53%, Spec 94%
- Atria smaller than ventricles
 - Valvular or congenital disease



¹ Kathiria N et al. J Comput Assist Tomogr 2015; 39:794.

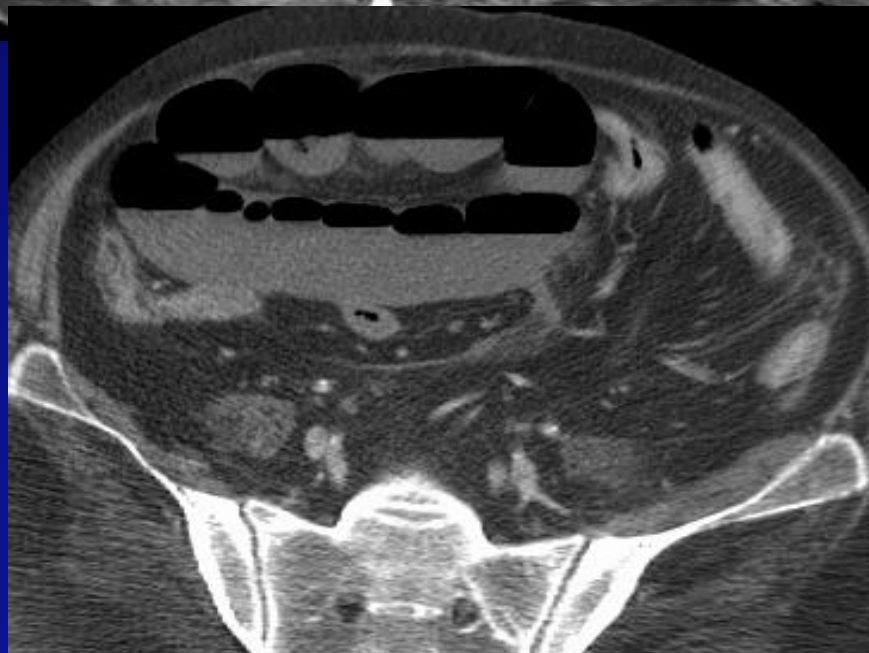
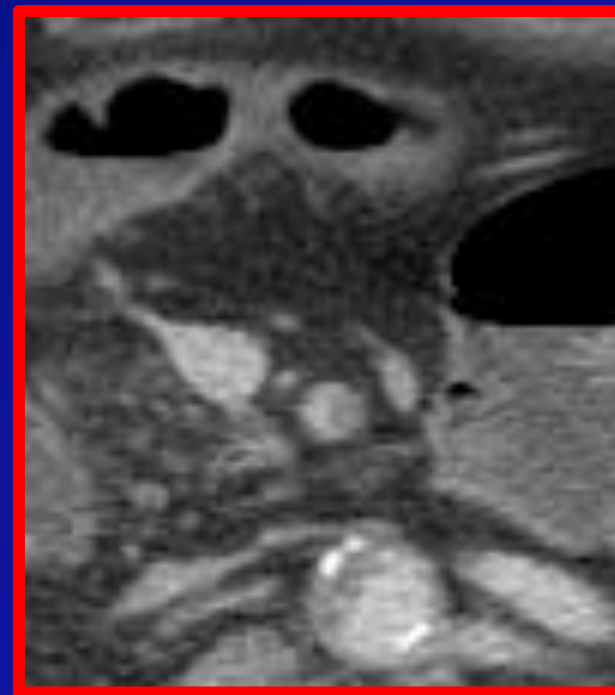
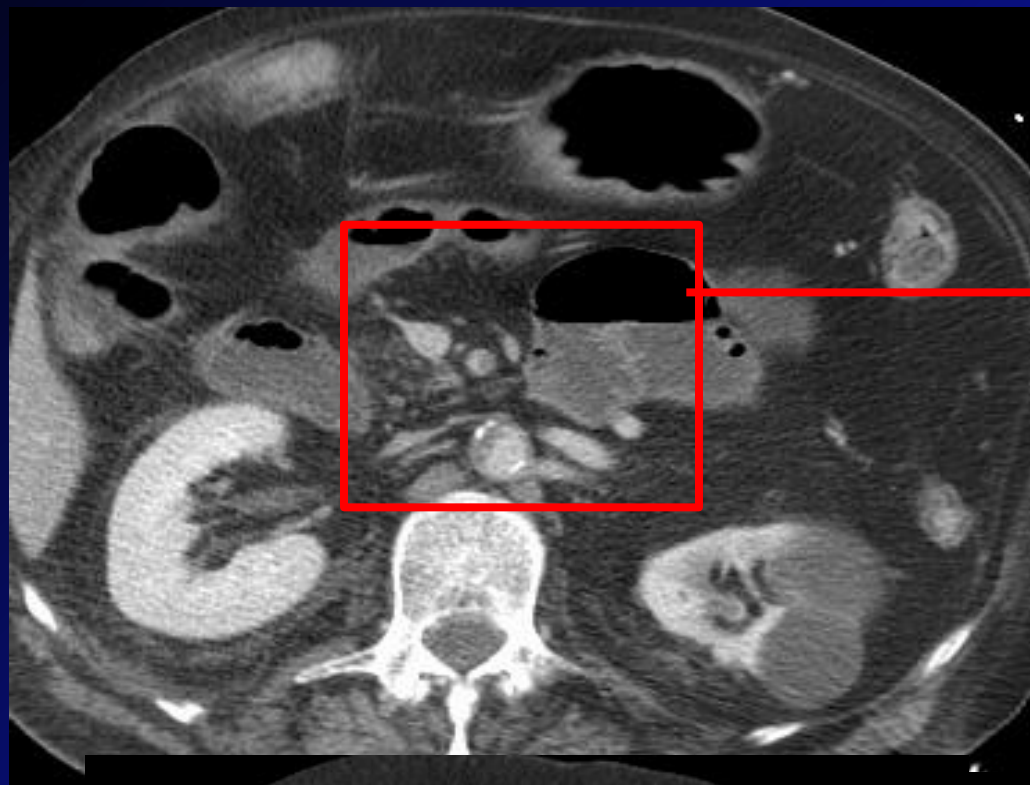
² Huckleberry et al. J Thor Imaging 2012; 27: 354

Stepwise Approach to Examine Heart



Case 1

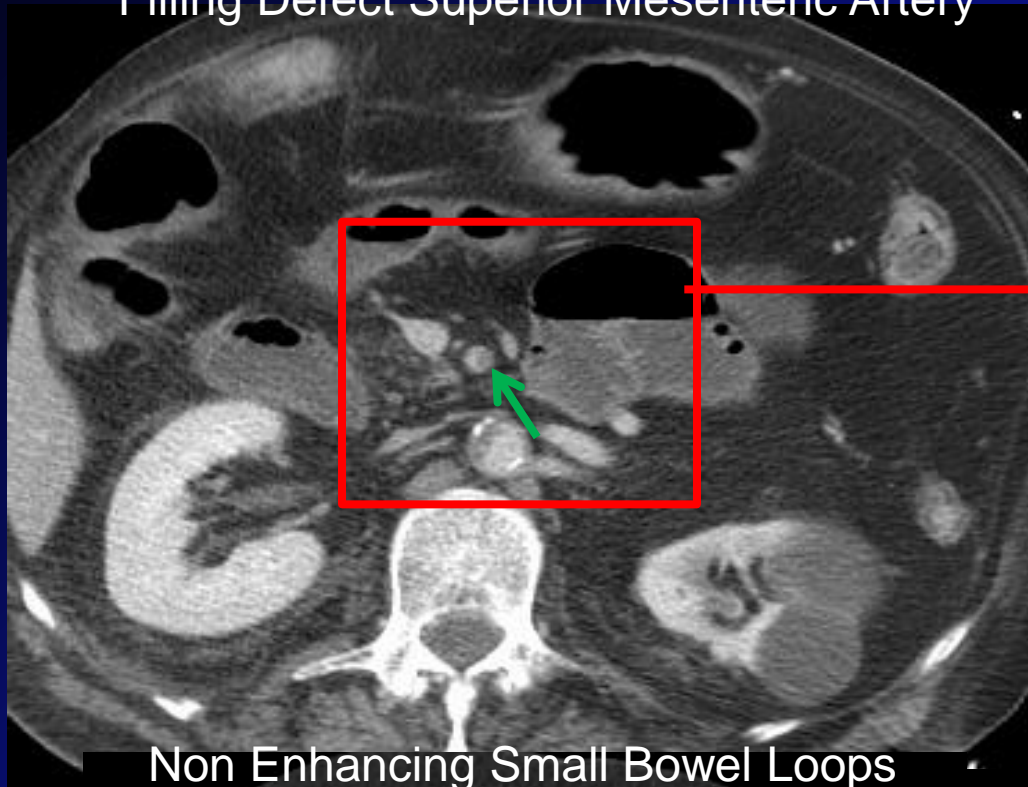
- 56-year-old male with abdominal pain
- Rule out bowel ischemia



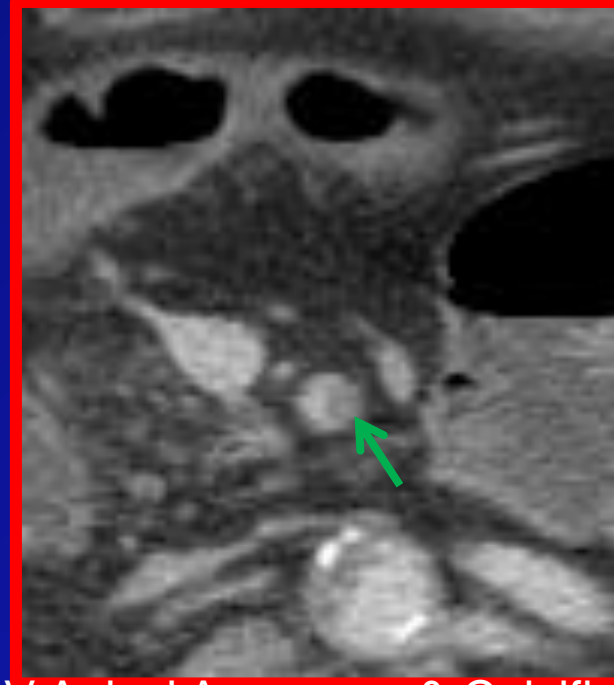
Case 1 - What is the most likely diagnosis?

1. Small bowel obstruction
2. Small bowel ischemia due to heart failure
3. Small bowel ischemia due to prior myocardial infarction
4. Small bowel ischemia due to SMA embolism from LV thrombus

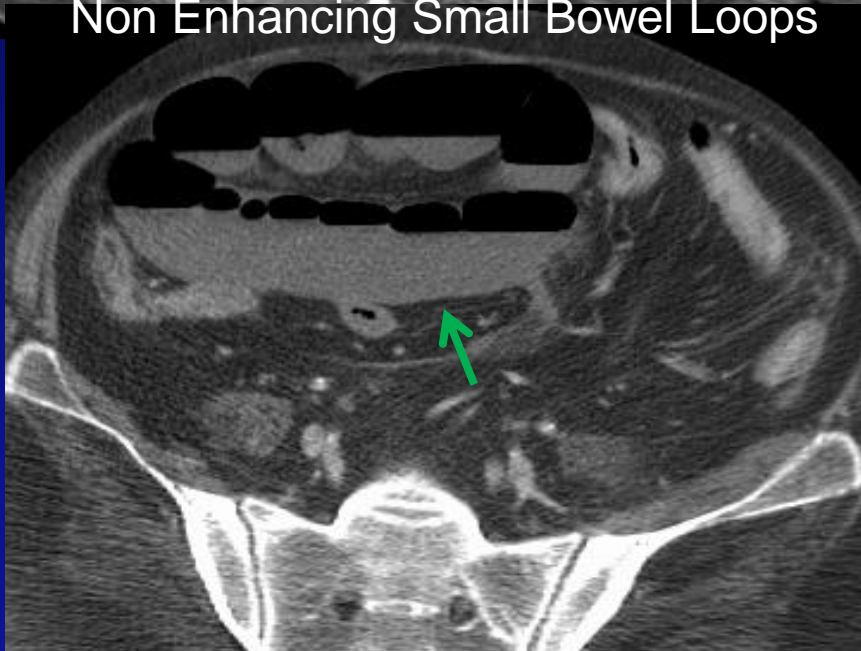
Filling Defect Superior Mesenteric Artery



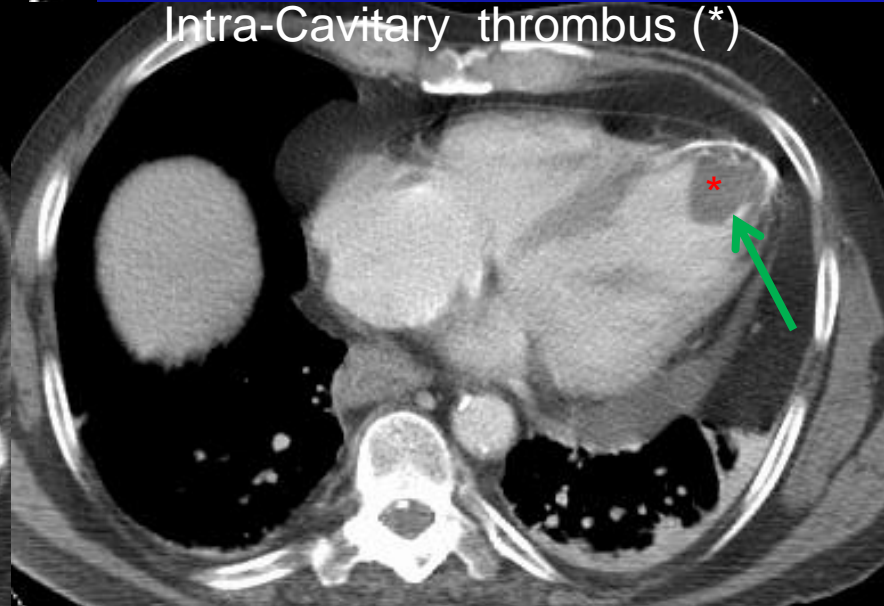
Filling Defect Superior Mesenteric Artery



Non Enhancing Small Bowel Loops

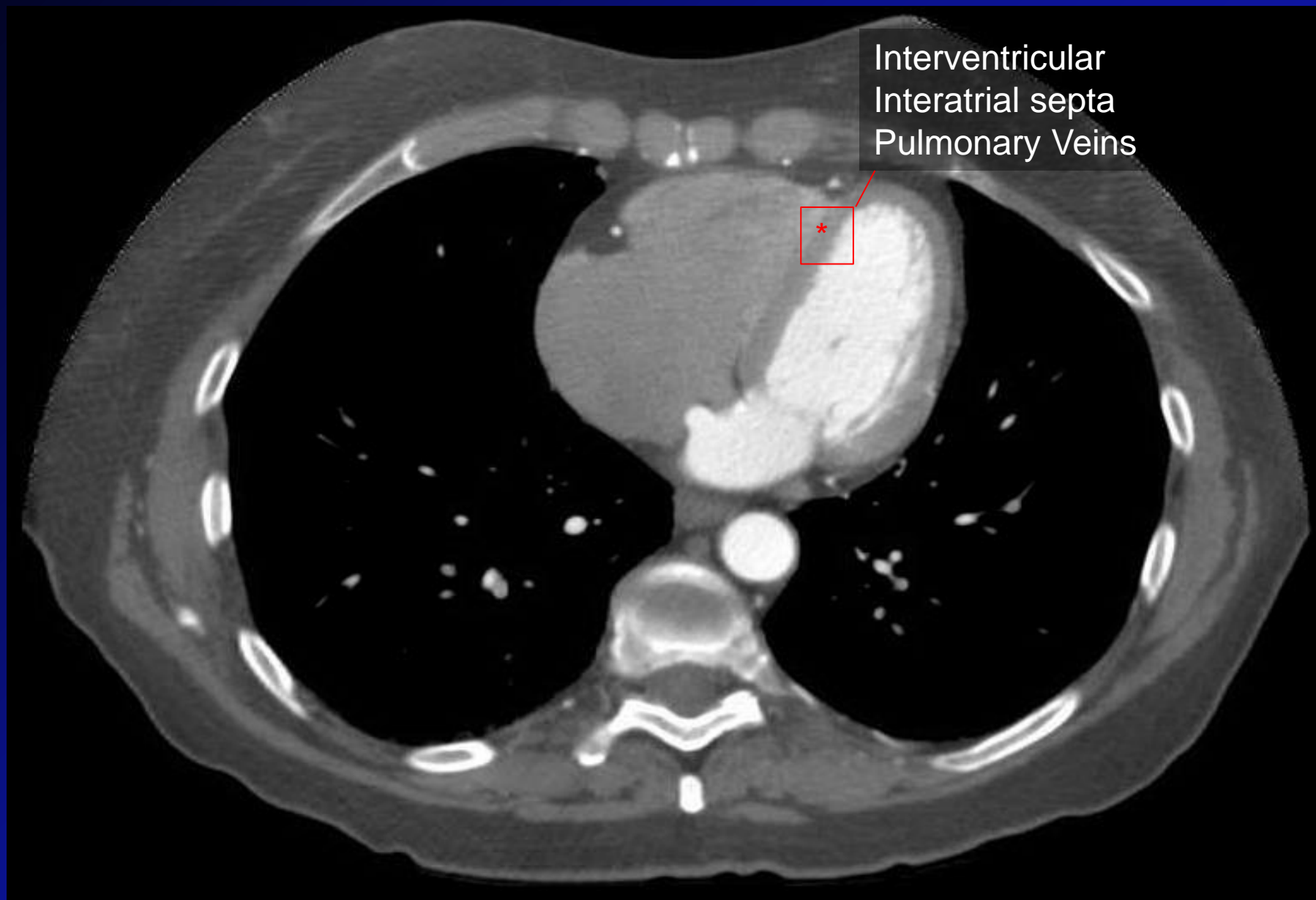


LV Apical Aneurysm & Calcification
Intra-Cavitary thrombus (*)



Small Bowel Ischemia due to Superior Mesenteric Artery Embolism from LV thrombus

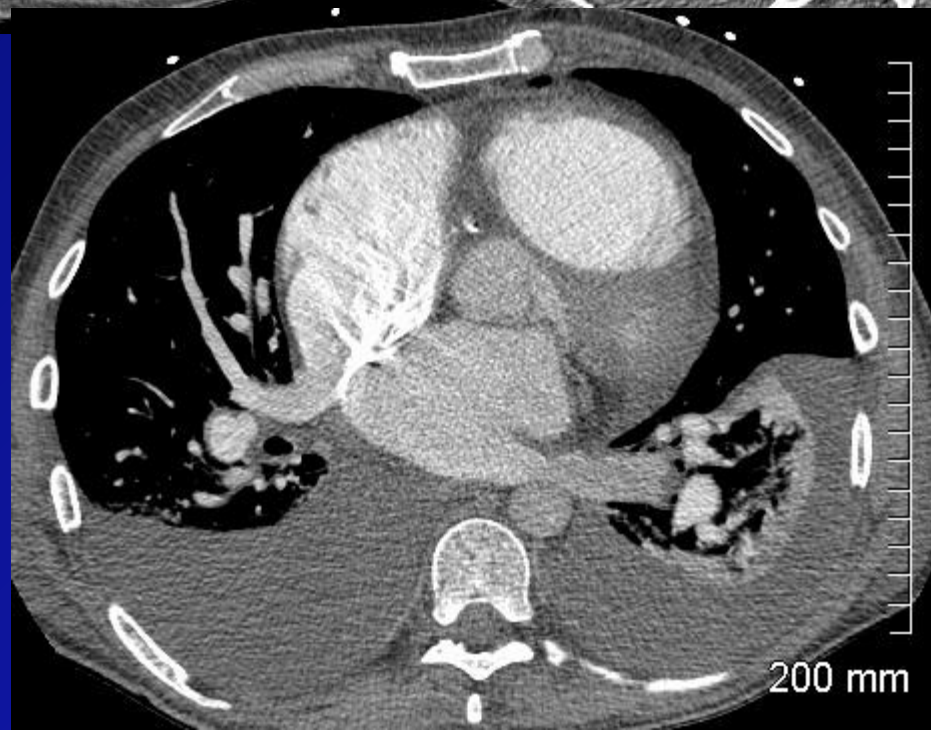
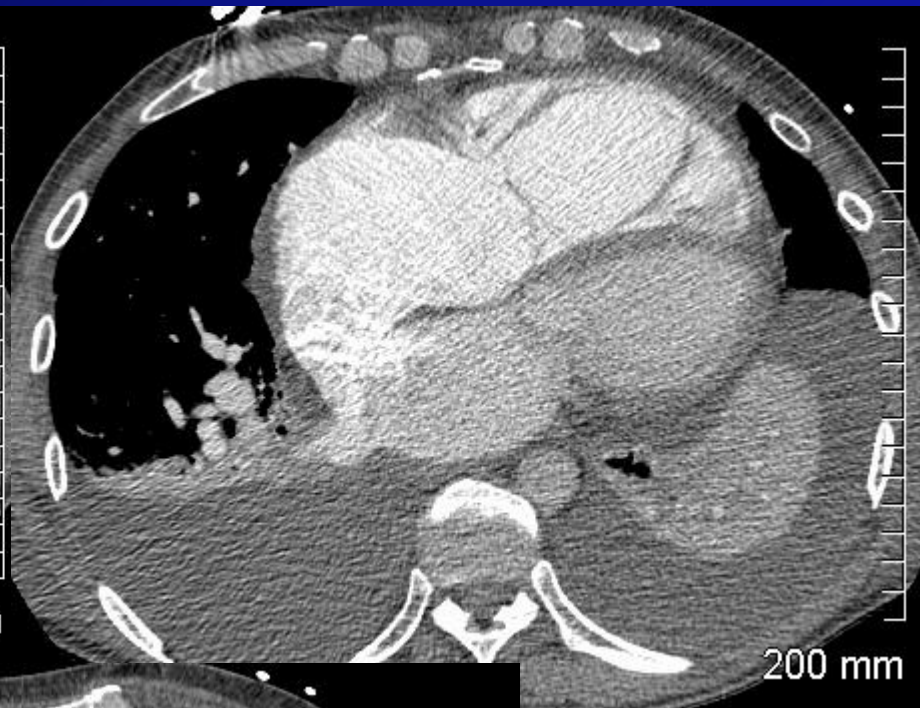
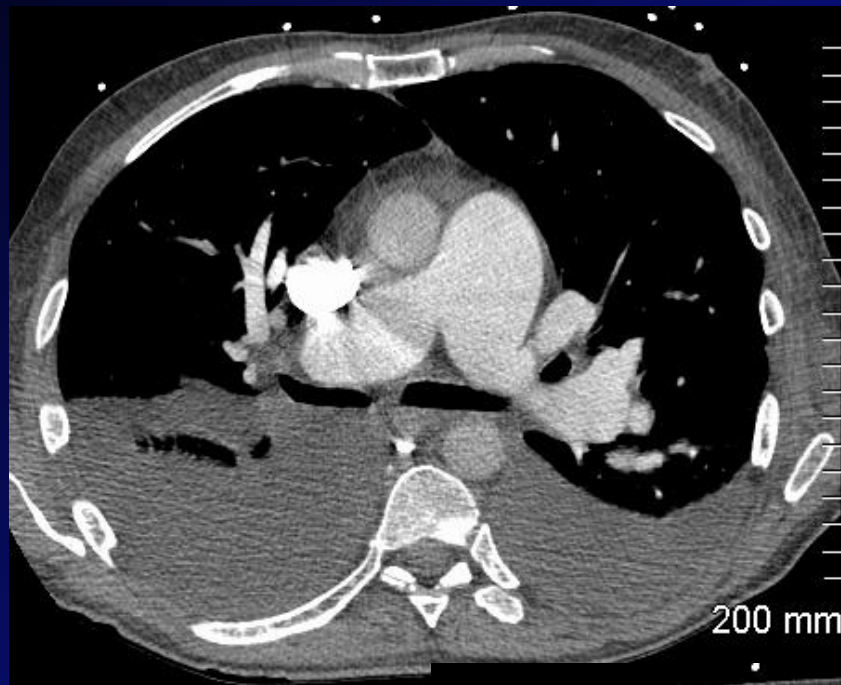
- In the presence of systemic embolism inspect the heart to look for sources of embolism
 - ✓ Intracardiac thrombus should be reported and communicated to the referring physician
 - ✓ Patients may need anticoagulation



Interventricular
Interatrial septa
Pulmonary Veins

Case 2

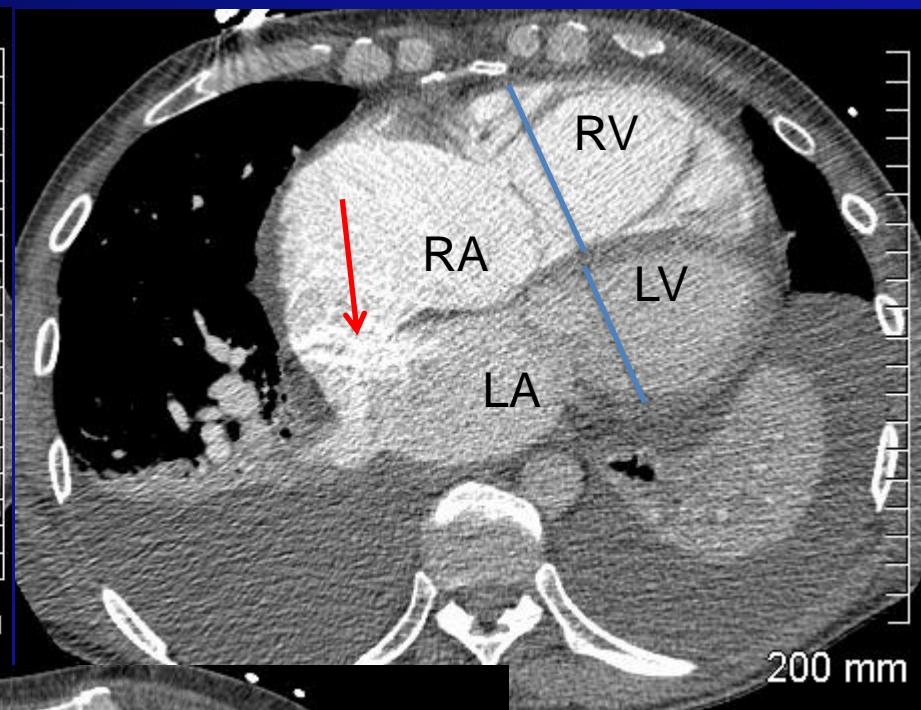
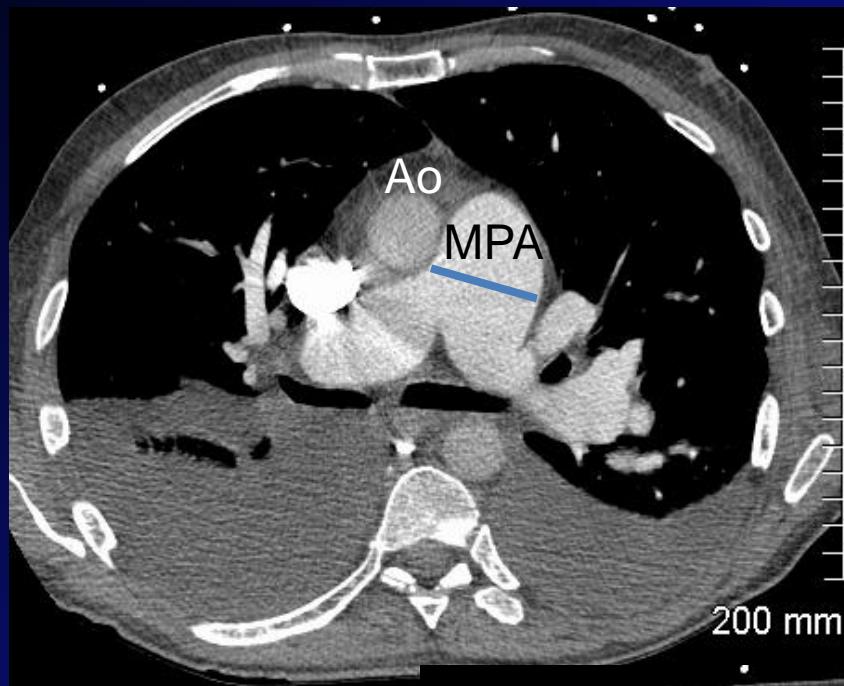
- 68-year-old man with heart failure
- Rule out PE



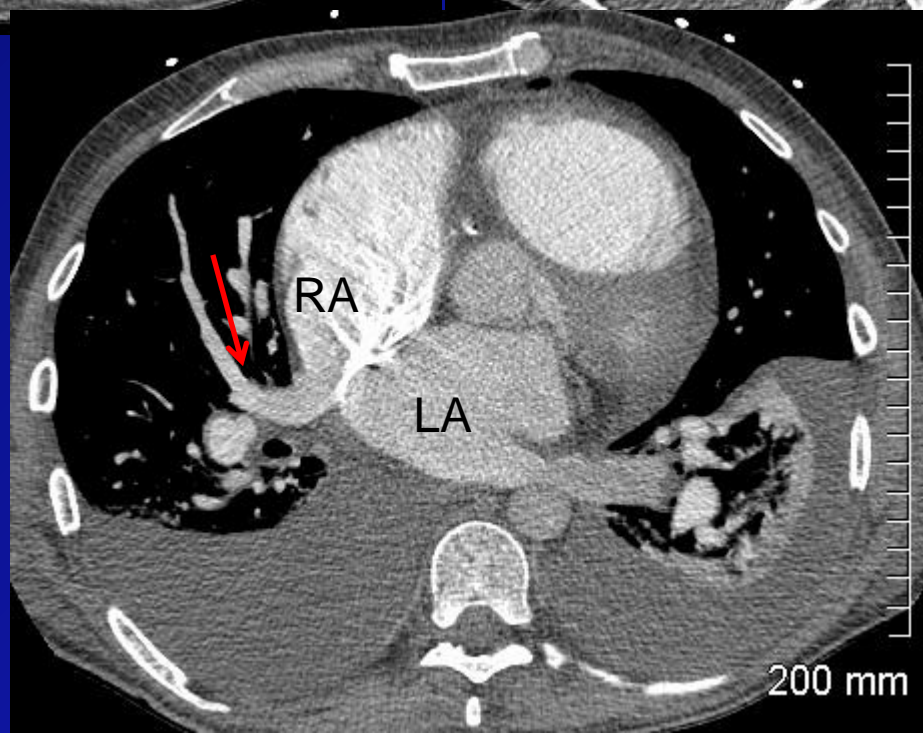
Case 2 - What is the most likely diagnosis?

1. Secundum ASD with PAPVR
2. Secundum ASD
3. Septum primum ASD
4. Unroofed coronary sinus

Dilated
MPA (>29
mm)
 $Ao/MPA > 1$



RV/LV ratio > 1 -
Dilated RV
Contrast
extends from RA
to LA - ASD

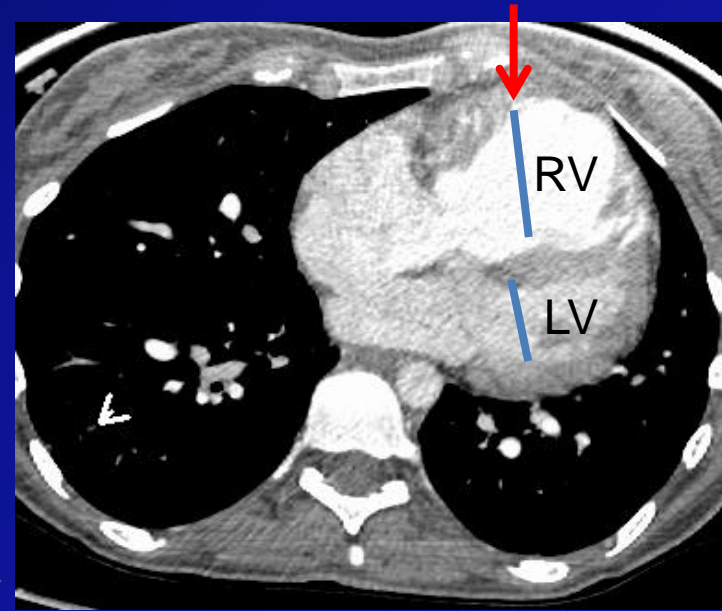
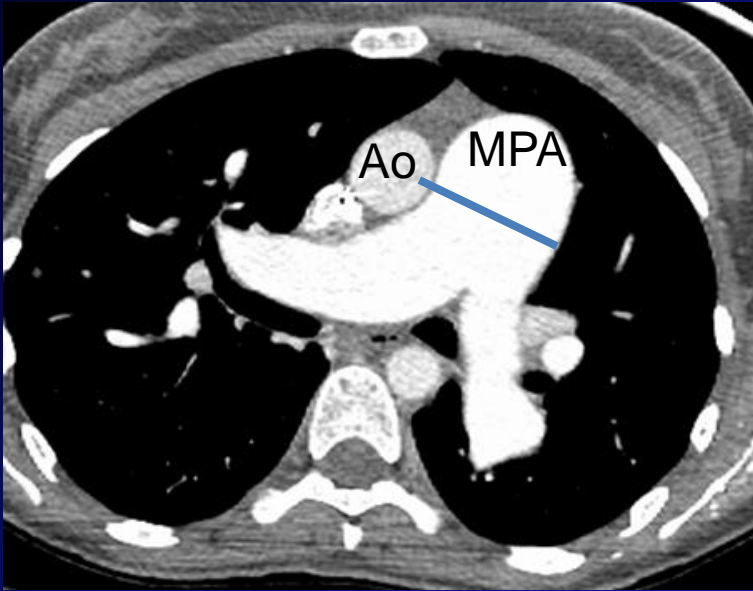


Pulmonary vein drains
into RA

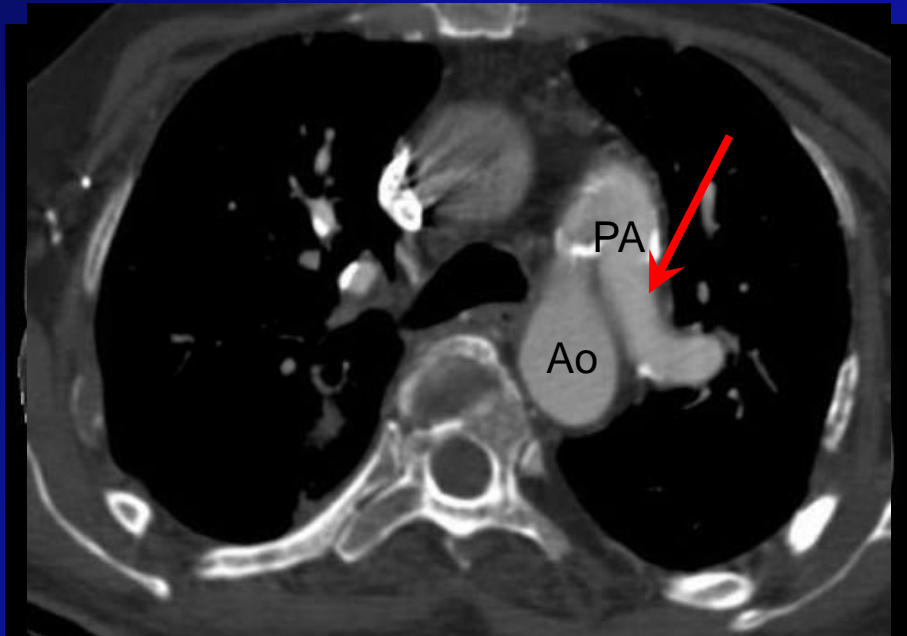
Secundum ASD with associated partial anomalous pulmonary venous return

- ✓ Increased flow in right heart results in pulmonary hypertension
- Over time increased PA pressures may reverse shunt from L-R to R-L → Eisenmenger Syndrome

Dilated MPA
(>29 mm)
MPA/Ao
ratio >1



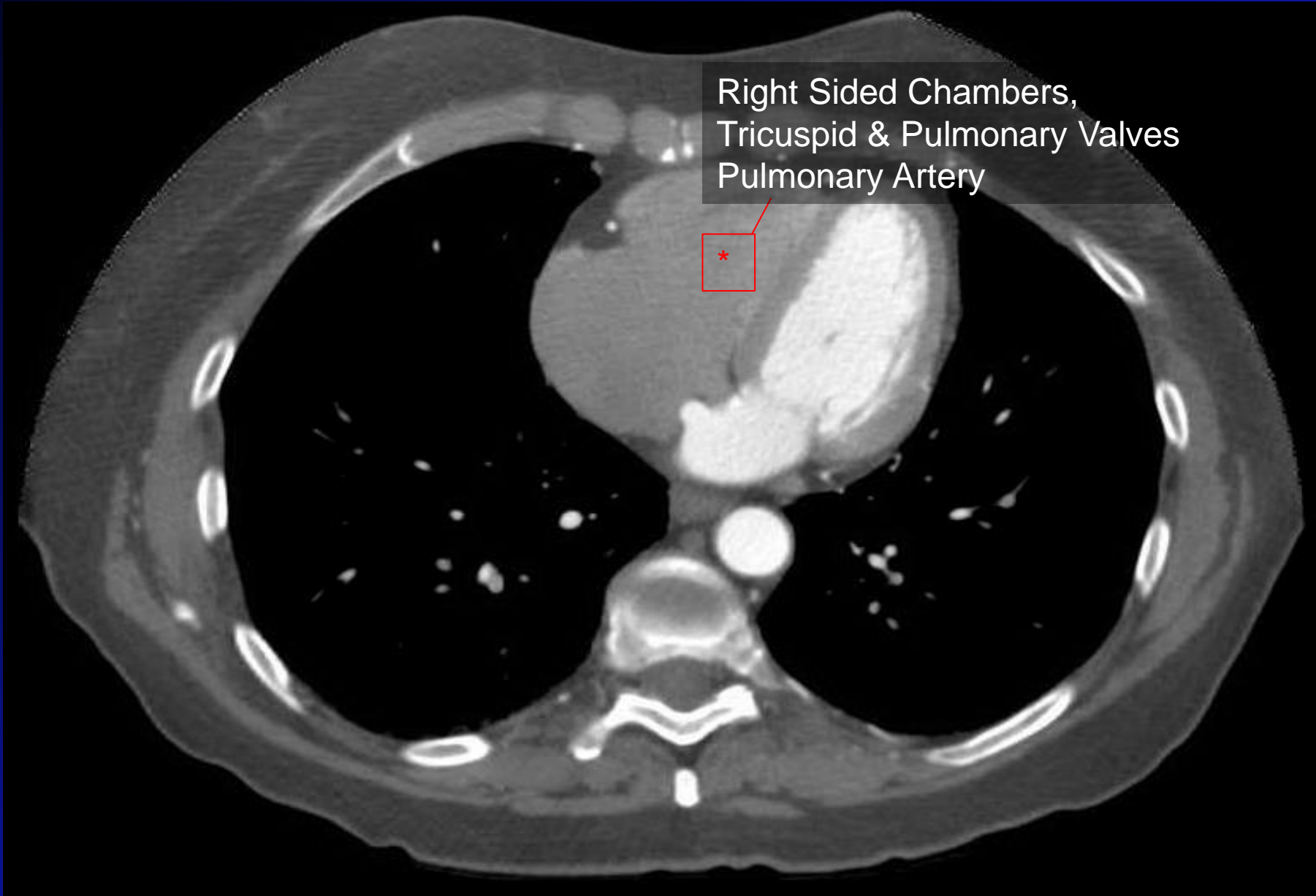
RV
hypertrophy
(>4 mm)
Dilated RV
(RV/LV
ratio >1)
Flattening of
interventricula
r septum



✓ Pearls

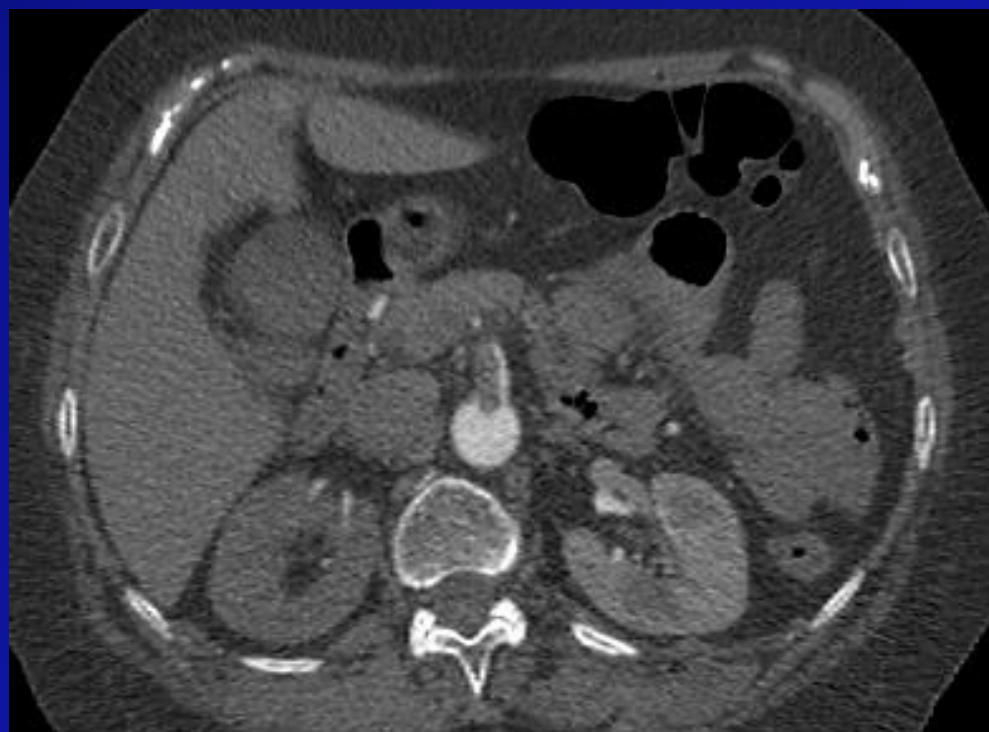
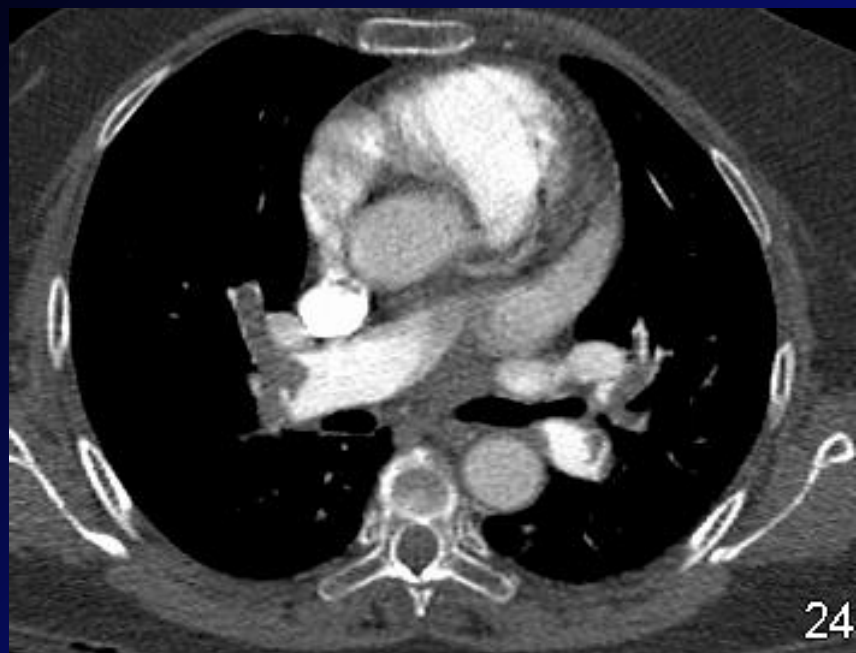
- ✓ Suspect a shunt in patients with unexplained PH, right heart dilatation and RV hypertrophy
 - ASD
 - PAPVR
 - Patent ductus arteriosus
- ✓ May present in adulthood and be missed on echocardiography

Right Sided Chambers,
Tricuspid & Pulmonary Valves
Pulmonary Artery



Case 3

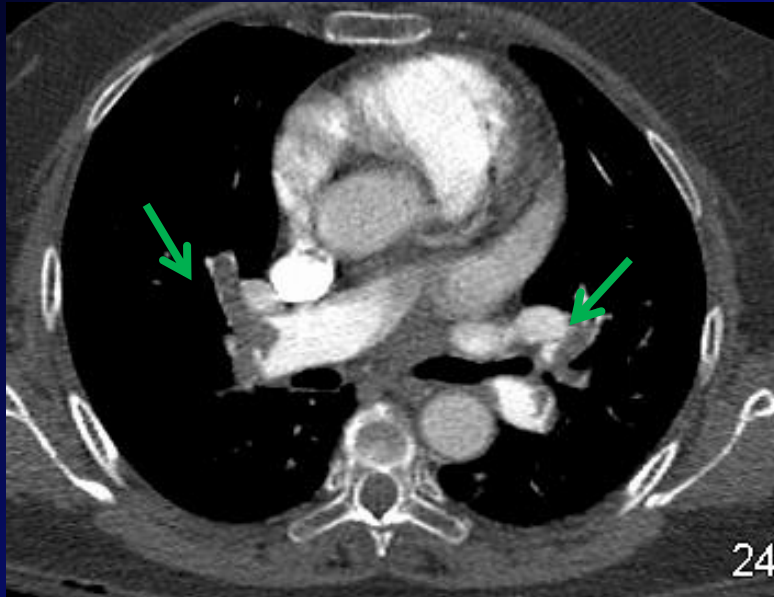
- 67-year-old woman presents with facial numbness, chest, back and abdominal pain



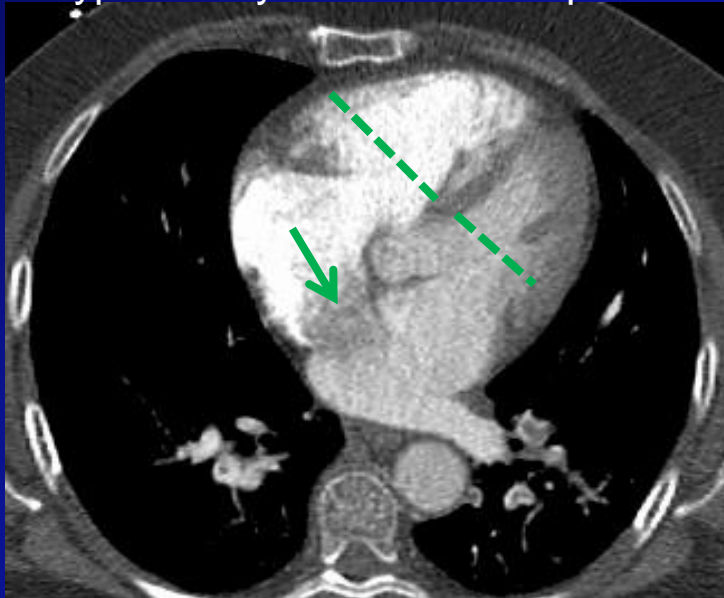
Case 3 - What is the most likely diagnosis?

1. Massive PE
2. Massive PE and RV strain
3. Mesenteric ischemia and simultaneous PE
4. Paradoxical embolism

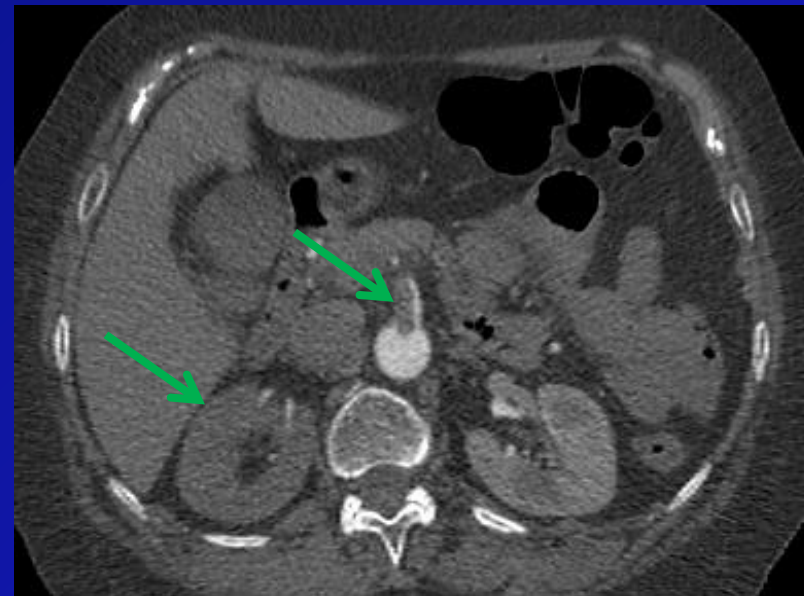
Multiple pulmonary emboli



Dilated RV ($RV/LV > 1$)
Hypodensity in interatrial septum

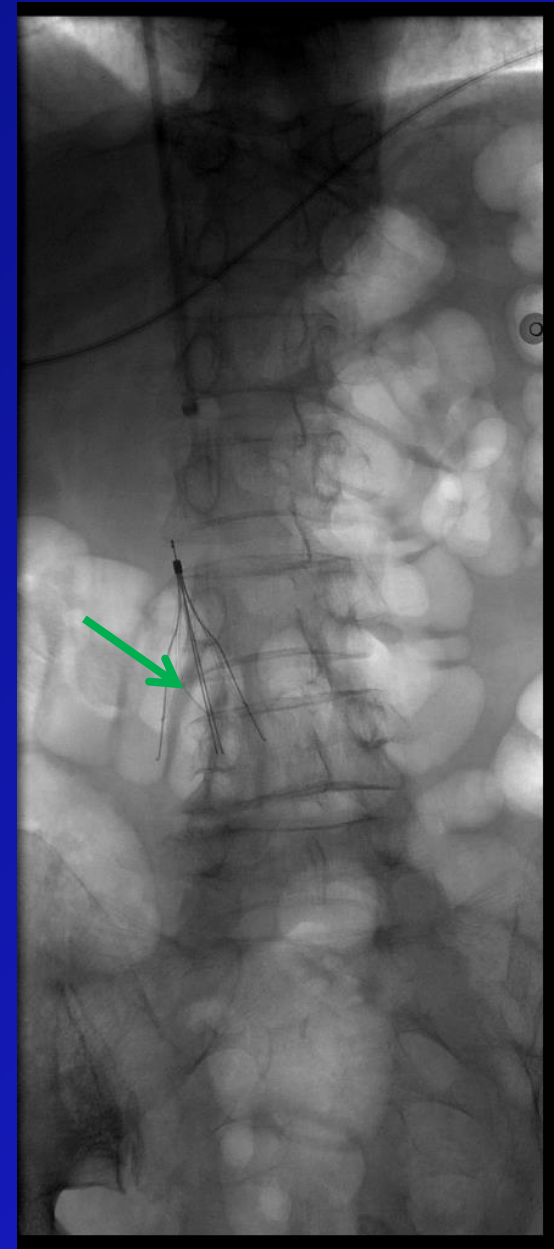


Filling defect superior mesenteric artery
Asymmetric enhancement of kidneys



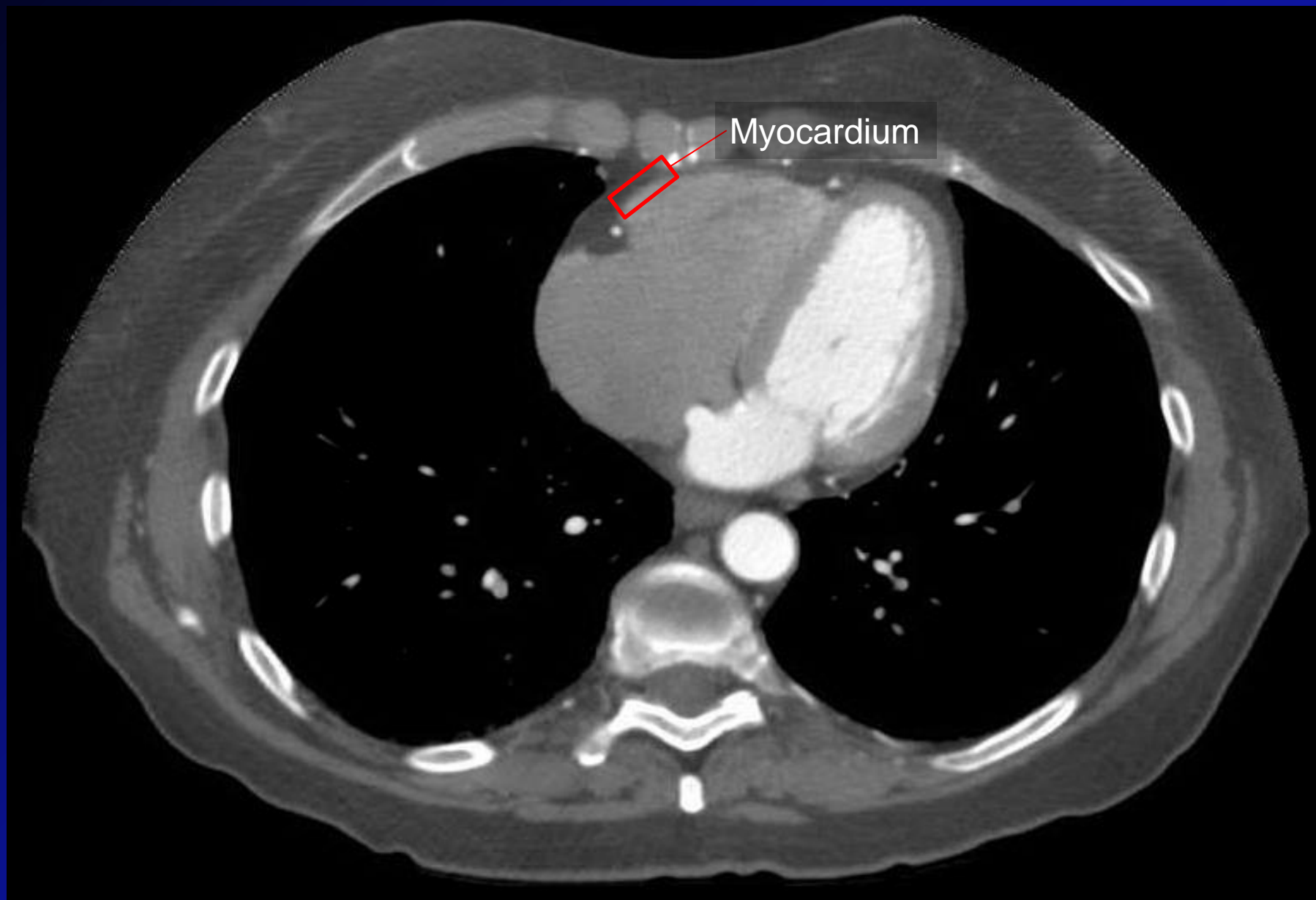
Transesophageal echocardiogram

- ✓ Large PFO with right to left shunt
- ✓ No intracardiac thrombus
- ✓ RV dilatation and dysfunction
- ✓ Pulmonary hypertension
- SMA thrombus removed with surgical embolectomy
- IVC filter implanted

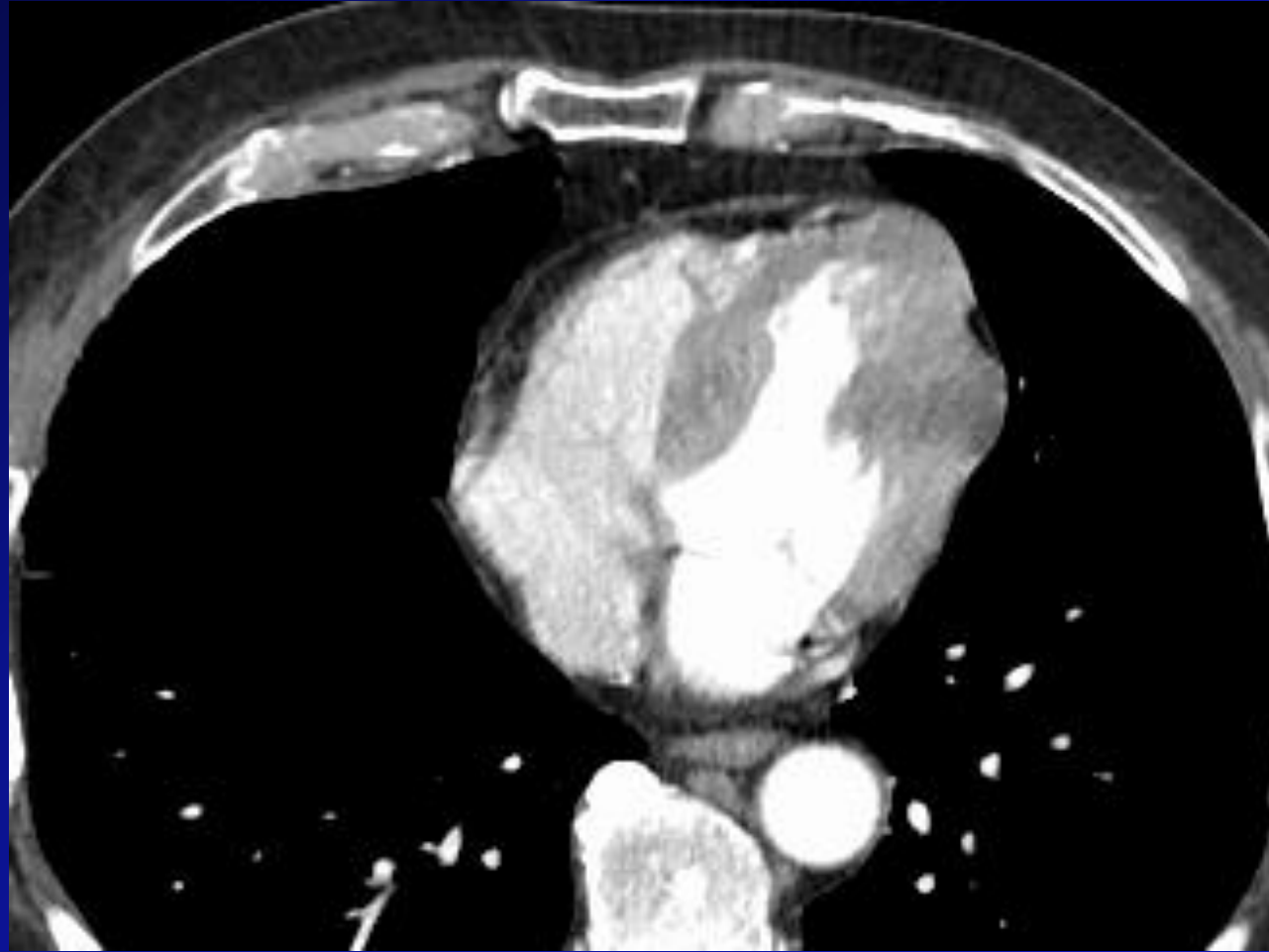


Paradoxical Embolism

- Emboli from venous system reach arterial system through abnormal communication between cardiac chambers resulting in systemic embolism

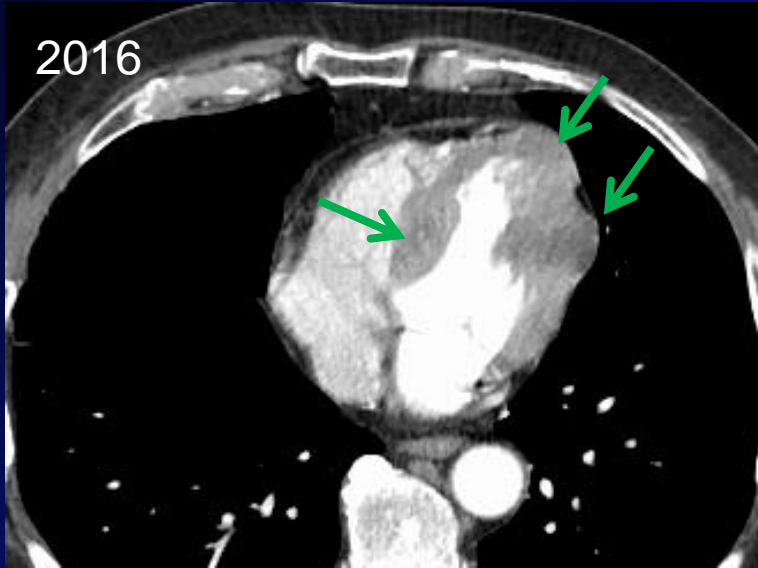


Case 4 - 58-year-old man with renal cancer

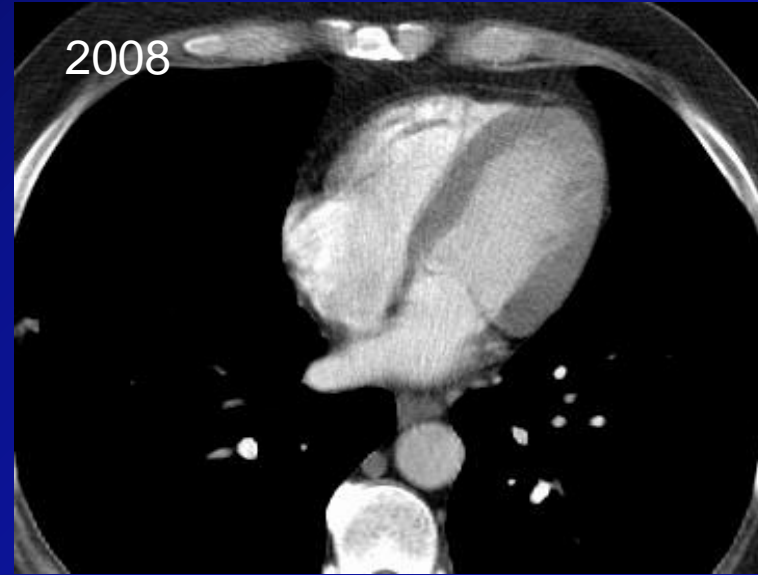


Case 4 - What is the most likely diagnosis?

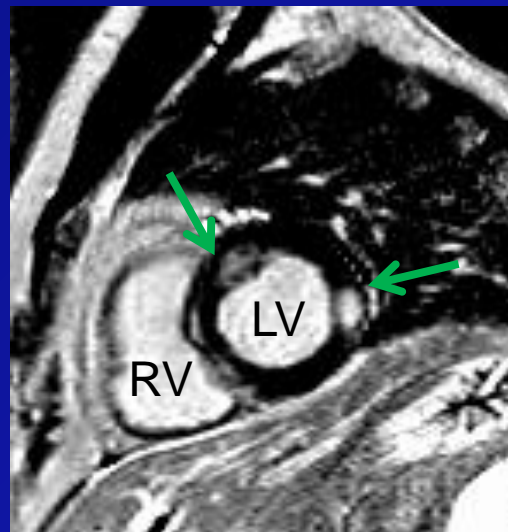
1. Hypertrophic cardiomyopathy
2. Cardiac metastasis
3. Cardiac angiosarcoma
4. Cardiac amyloidosis



Hypodense nodules within myocardium
Nodular contour of myocardium



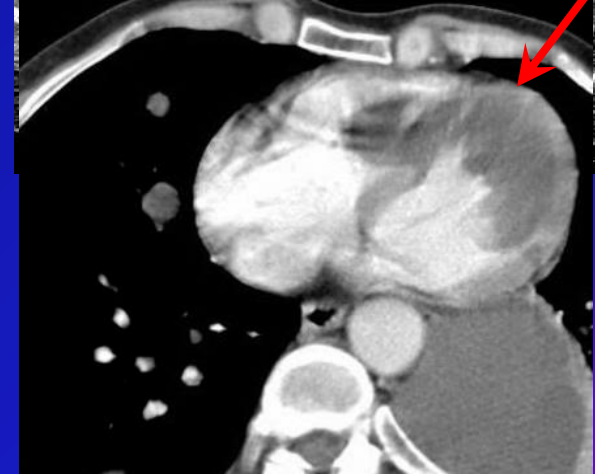
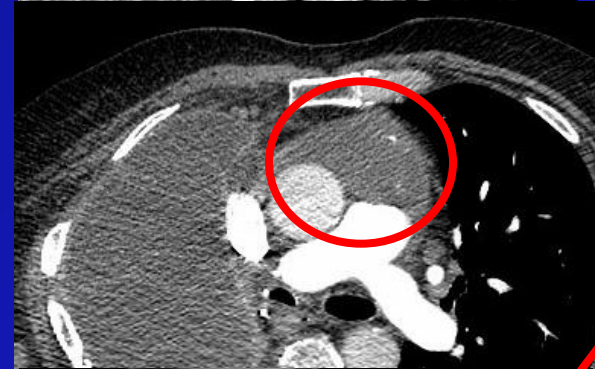
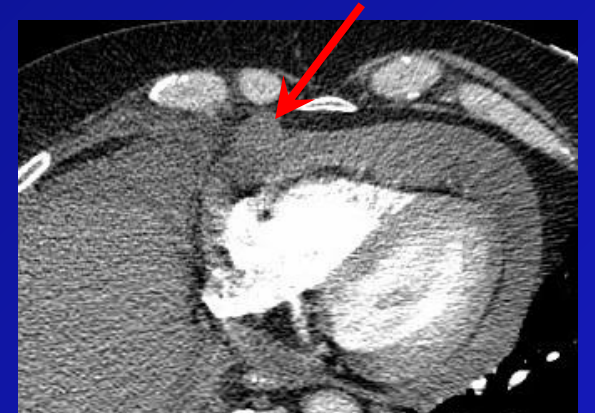
Uniform thickness and contour
Homogeneous enhancement

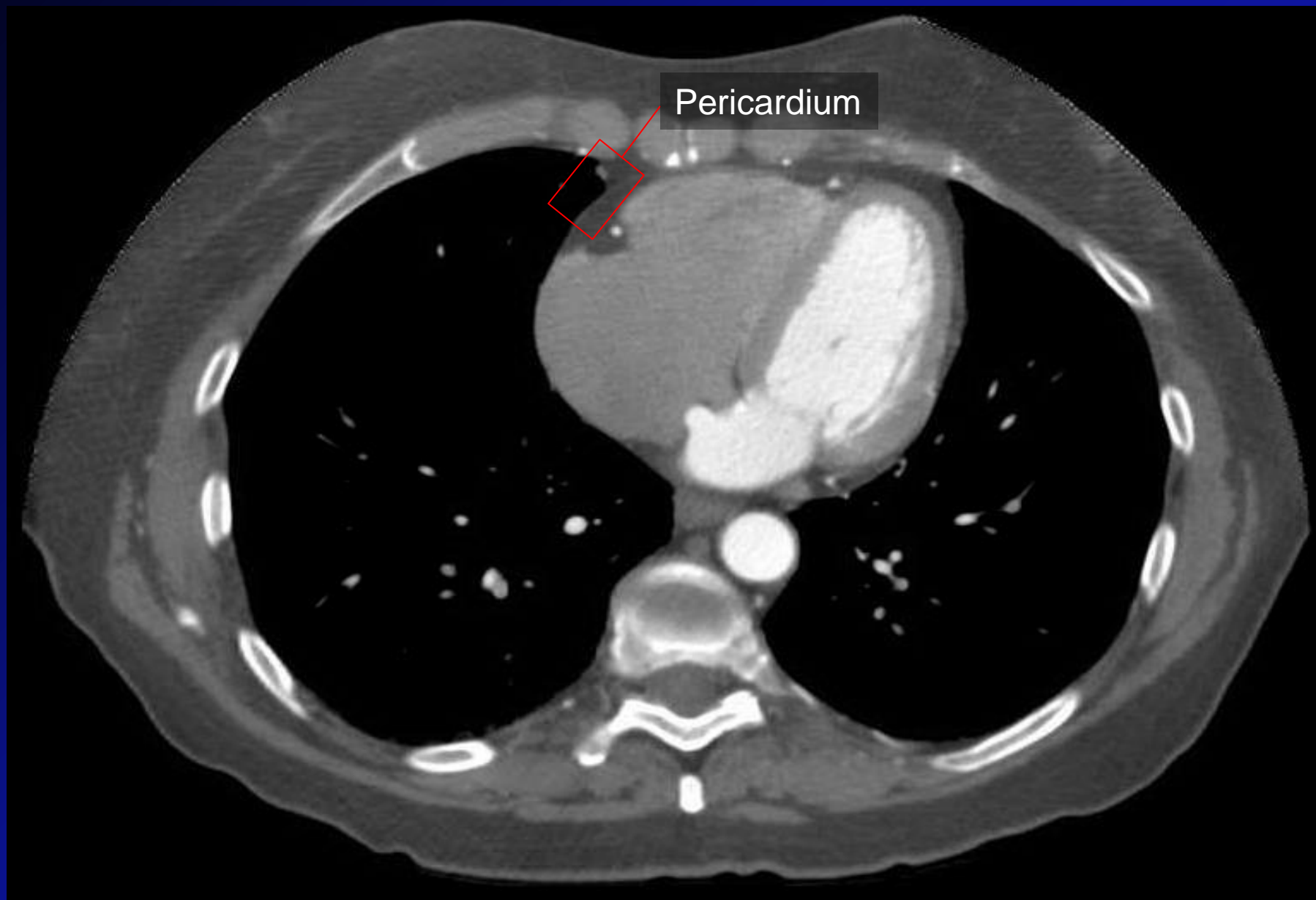


Multiple enhancing nodules in myocardium

Cardiac Metastases

- ✓ Most common cardiac neoplasm
- ✓ Myocardium, epicardium
pericardium, intracavitary
- ✓ Multifocal masses
- ✓ CMR-Delayed enhancement
- ✓ Primaries: Lung, breast, melanoma,
kidney, lymphoma and leukemia





Case 5 - 34-year-old woman with pneumonia, fever, hypotension



Rule out empyema

Case 5 - What is the most likely diagnosis?

1. Constrictive pericarditis
2. Acute pericarditis
3. Loculated pericardial effusion with suspected tamponade
4. Loculated pleural effusion



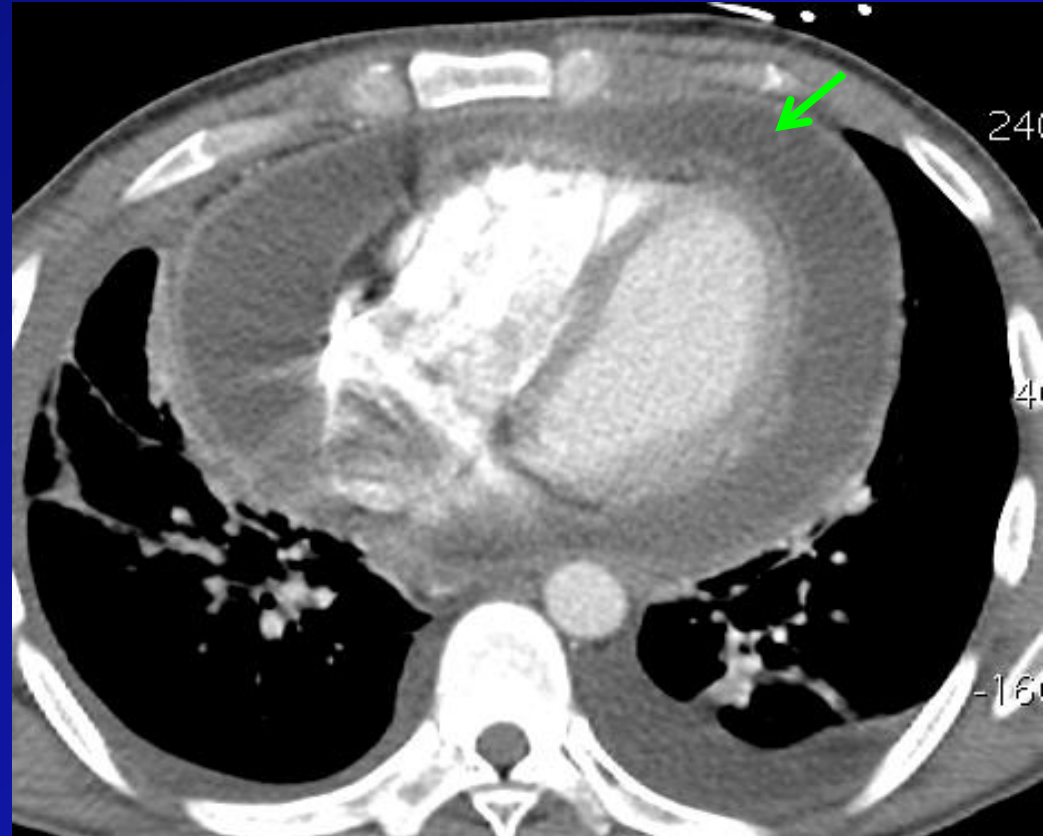
- Large loculated pericardial effusion (*)
- Compression and flattening of RA and RV free wall
- Concerning for Tamponade

Cardiac Tamponade

- ✓ Accumulation of fluid, gas or soft tissue resulting in elevation of intrapericardial pressure
- ✓ Intrapericardial pressure - no effective filling of ventricles → decreased cardiac output → cardiogenic shock
- ✓ Life threatening condition → pericardiocentesis
- ✓ Clinical diagnosis

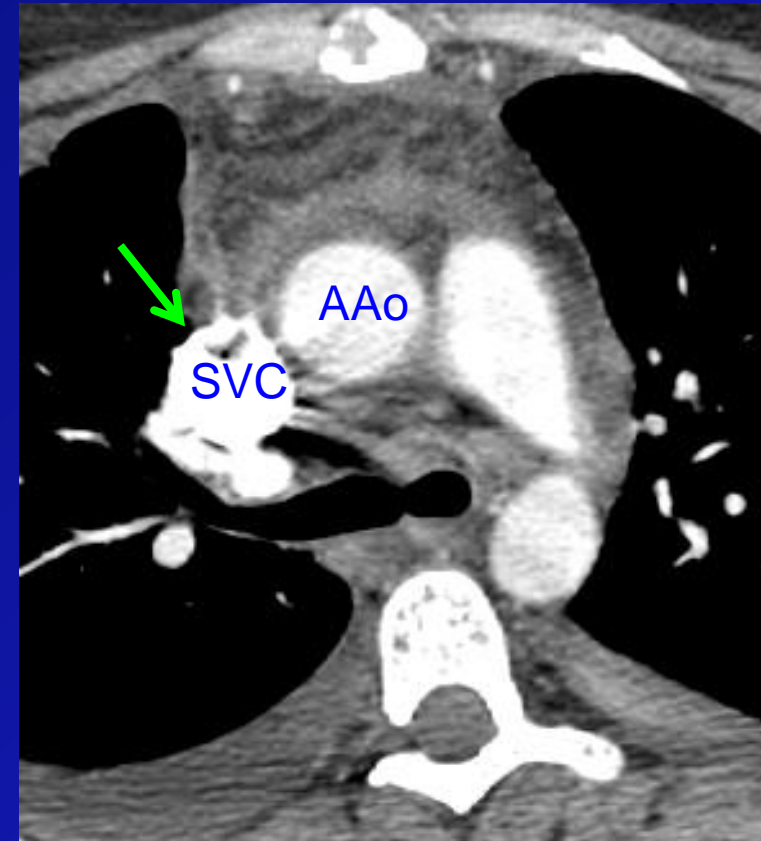
CT Findings in Cardiac Tamponade

- ✓ Large effusion
- ✓ \uparrow SVC \geq AAO diameter
- ✓ \uparrow IVC $> 2 \times$ adjacent Ao
- ✓ Reflux of contrast into azygous vein and IVC
- ✓ Periportal edema
- ✓ Bowing of IVS towards left
- ✓ Compression of cardiac chambers
- ✓ Flattened heart sign



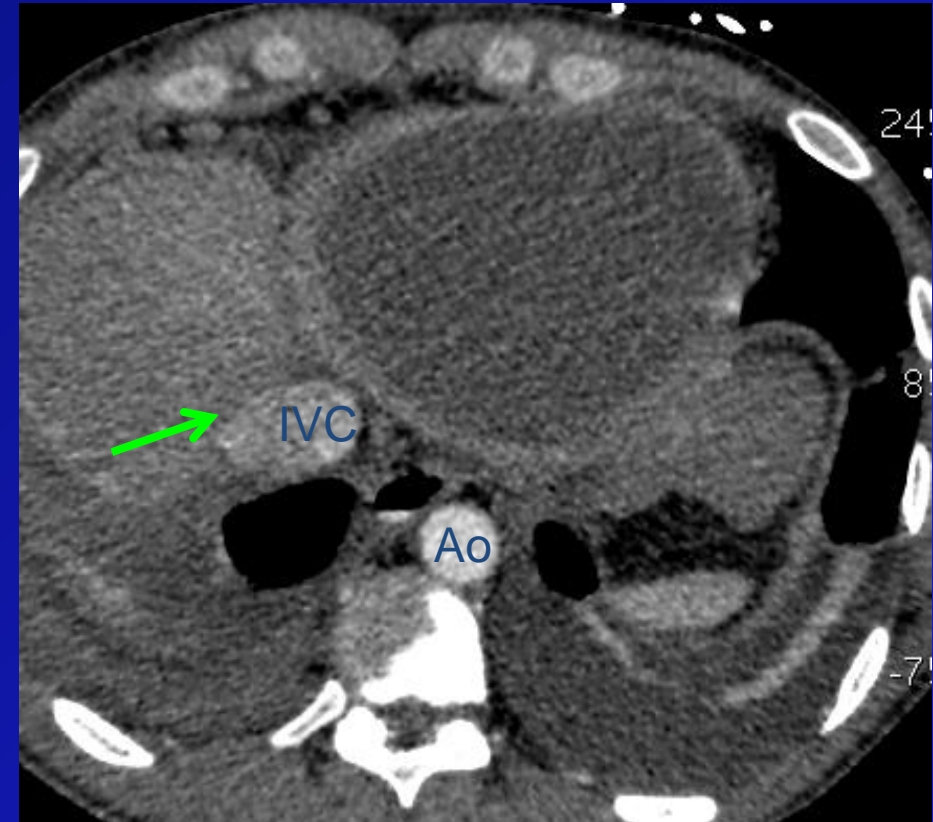
CT Findings of Tamponade

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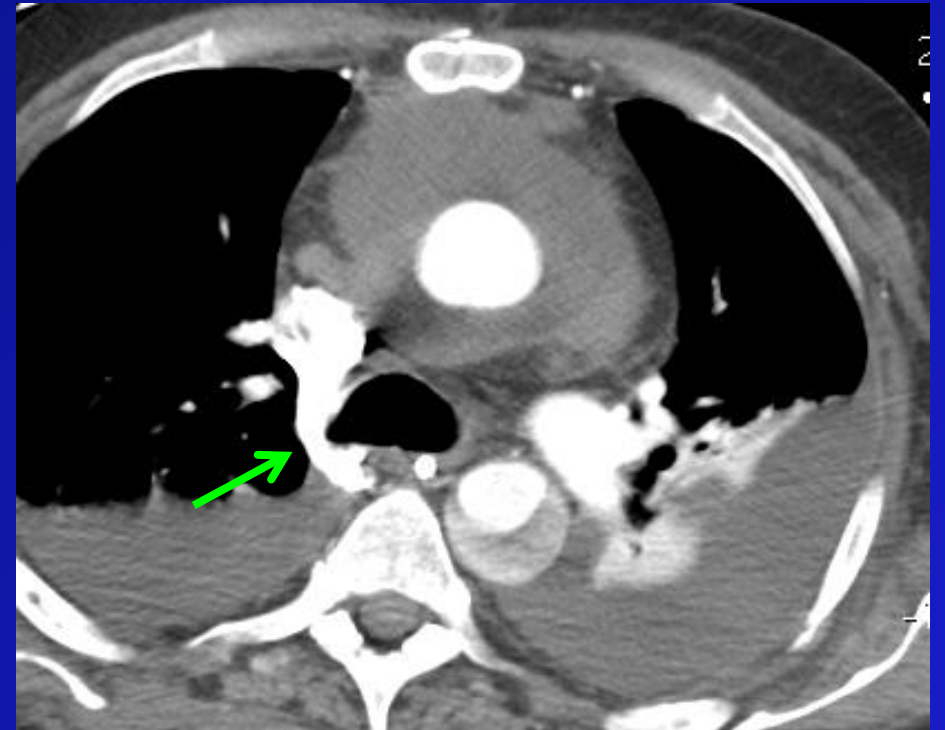
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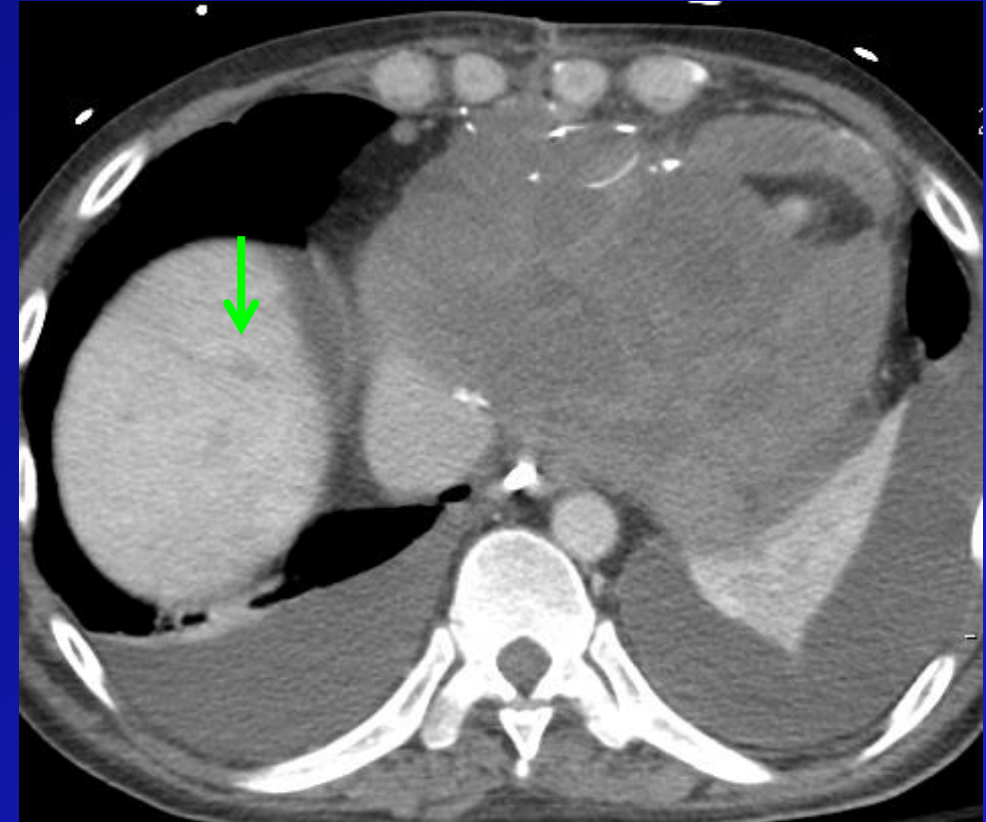
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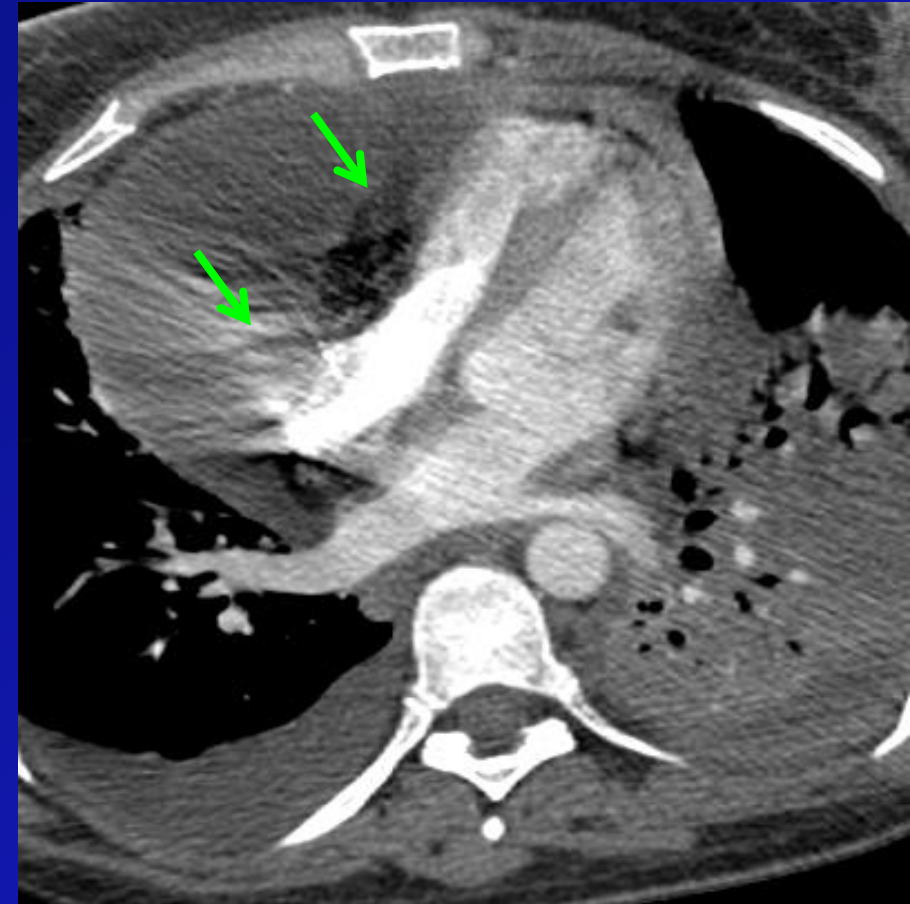
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CT Findings in Cardiac Tamponade

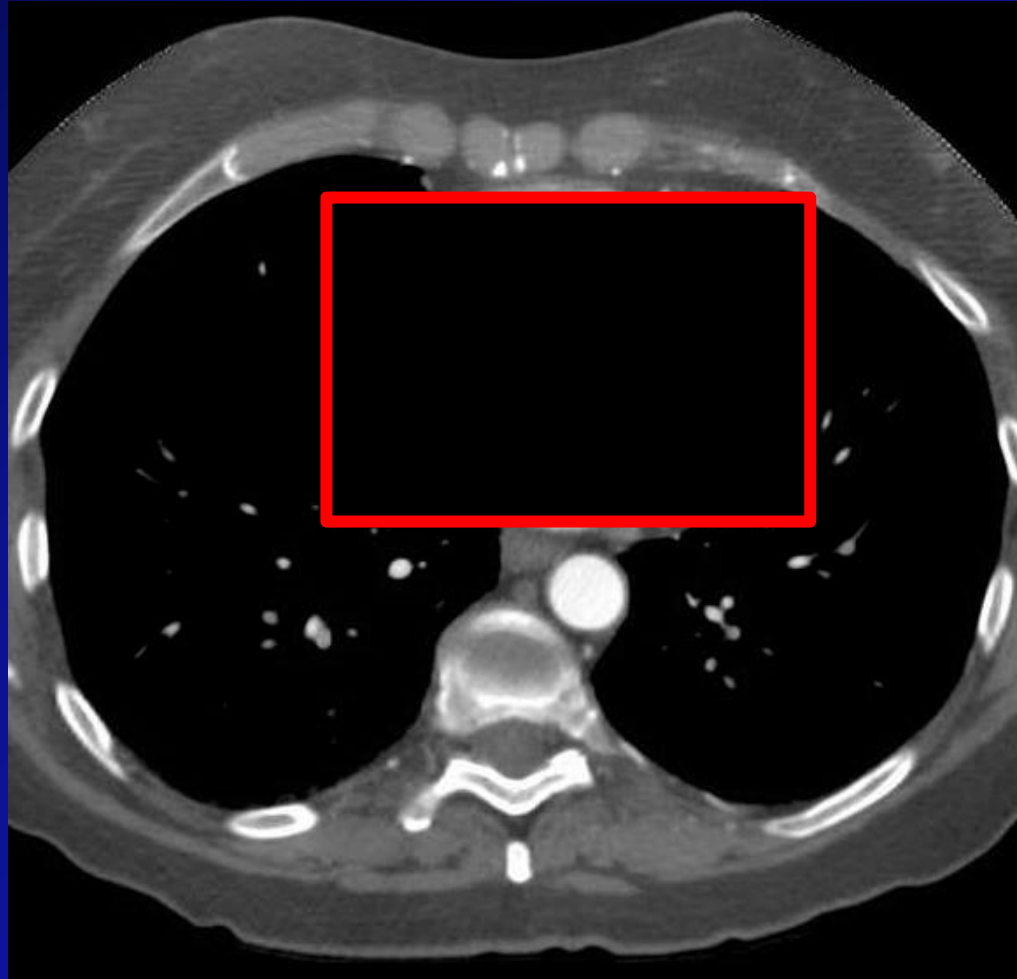
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Take Home Messages

- Incidental cardiac findings are common and usually not reported
- Opportunity for radiologist to diagnose cardiac disease which may influence clinical decisions and management
- Incidental findings may require further work up and diagnose other conditions

Thank you for your attention!



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