

**MODUL
KARDIOVASCULER**

**RADIOLOGI
FAKULTAS KEDOKTERAN UNISSULA**

SISTEM KARDIOVASCULER

- ❖ JANTUNG
- ❖ PEMBULUH DARAH BESAR

PEMERIKSAAN JANTUNG & PEMBULUH DARAH

Non radiologis :

- Elektrokardiogram
- Echocardiogram

Radiologis:

- Tanpa kontras (X foto toraks)
- Dengan kontras (Angiografi, MSCT jantung)
- Nuklir

SYARAT FOTO THORAX

- ✓ Posisi PA
- ✓ Simetris
- ✓ Inspirasi cukup
- ✓ Bentuk dada normal
- ✓ FFD : 1,8 m – 2 m

PROYEKSI X FOTO THORAX

Proyeksi rutin: PA dan lateral.

Proyeksi tambahan : obliq kanan-kiri,
dengan esofagus diisi barium.

RADIOLOGI ANATOMI

Proyeksi Posteroanterior (PA)

Batas kiri :

- Tonjolan I : arkus aorta.
- Tonjolan II : arteri pulmonalis (pada anak-anak kadang agak besar).
- Tonjolan III : aurikel atrium kiri (biasanya tidak menonjol)
- Tonjolan IV : ventrikel kiri

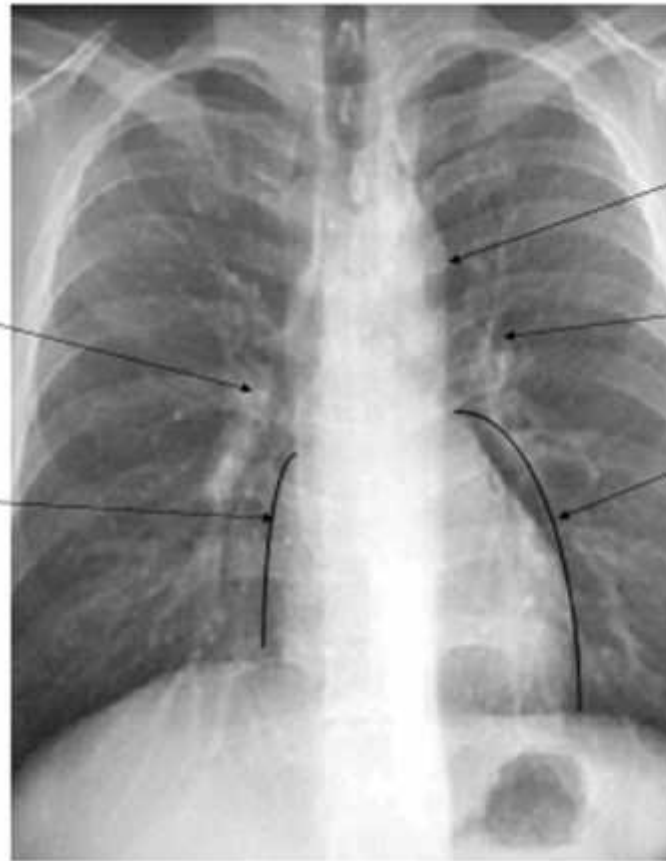
Batas kanan:

- Tonjolan I (pelebaran sisi mediastinum):
vena kava superior
- Tonjolan II: garis lurus menuju arkus aorta
(aorta ascenden, biasanya tak terlihat)
- Tonjolan III: kadang ada (v. Azygos).
- Tonjolan IV: atrium kanan.

PROYEKSI PA

Right
Pulmonary
Artery

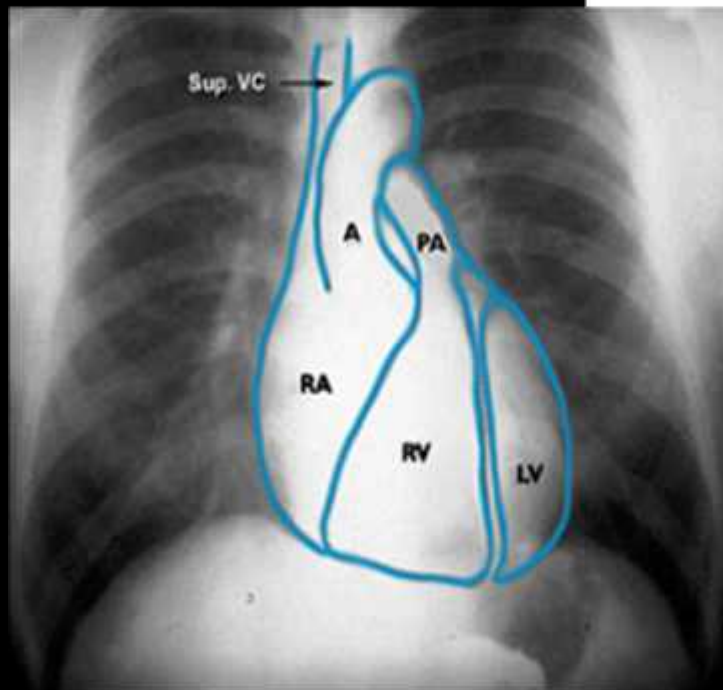
Right
Atrium



Aortic Arch

Left
Pulmonary
Artery

Left
Ventricle



Sup. VC

A

PA

RA

RV

LV

Proyeksi lateral

Batas depan: ventrikel kanan (belakang sternum), ke belakang menjadi lengkung aorta.

Batas belakang (1/3 tengah): atrium kiri.

Batas belakang bawah: ventrikel kiri.

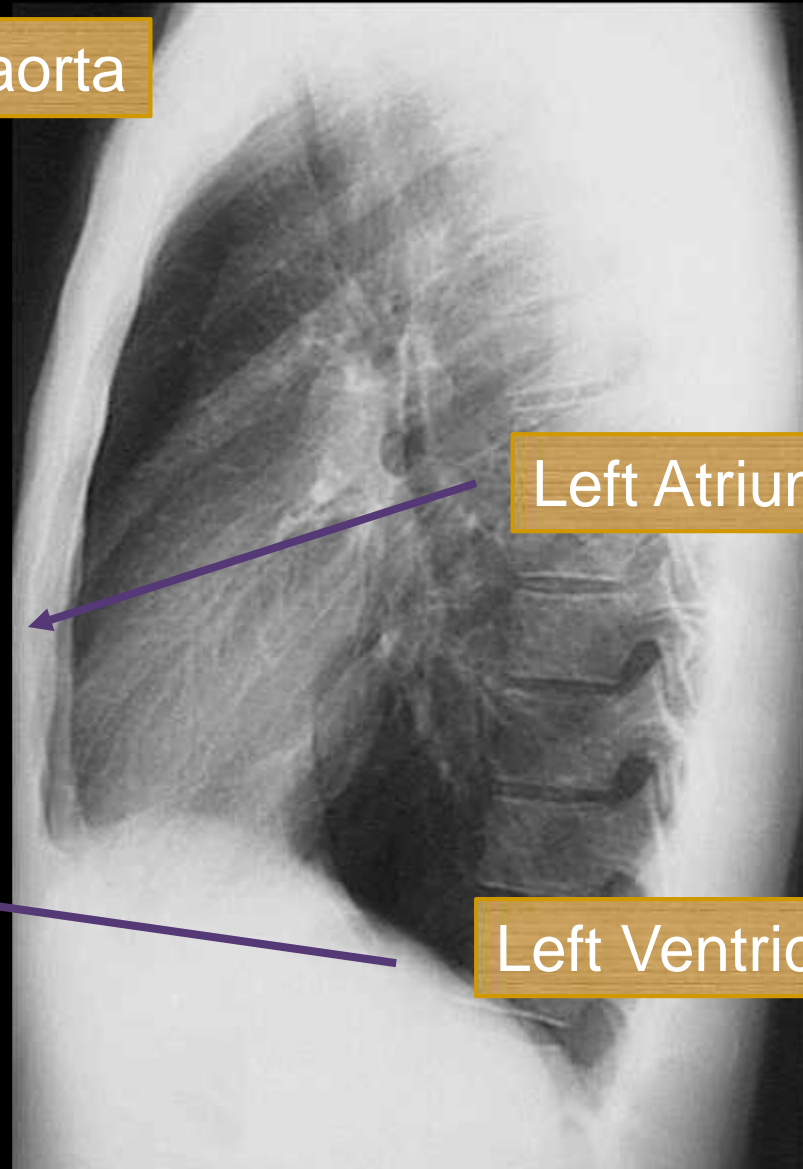
PROYEKSI LATERAL

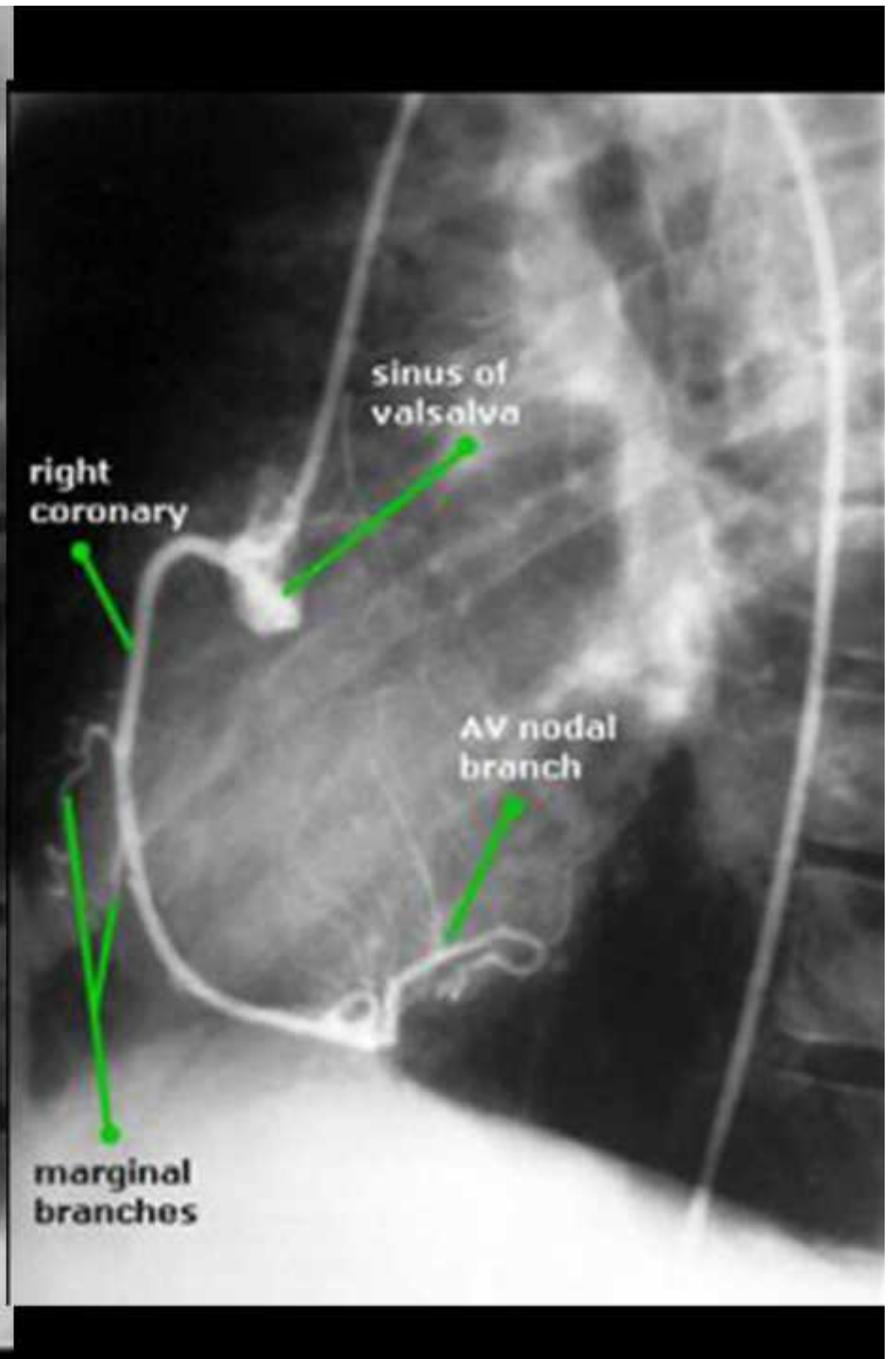
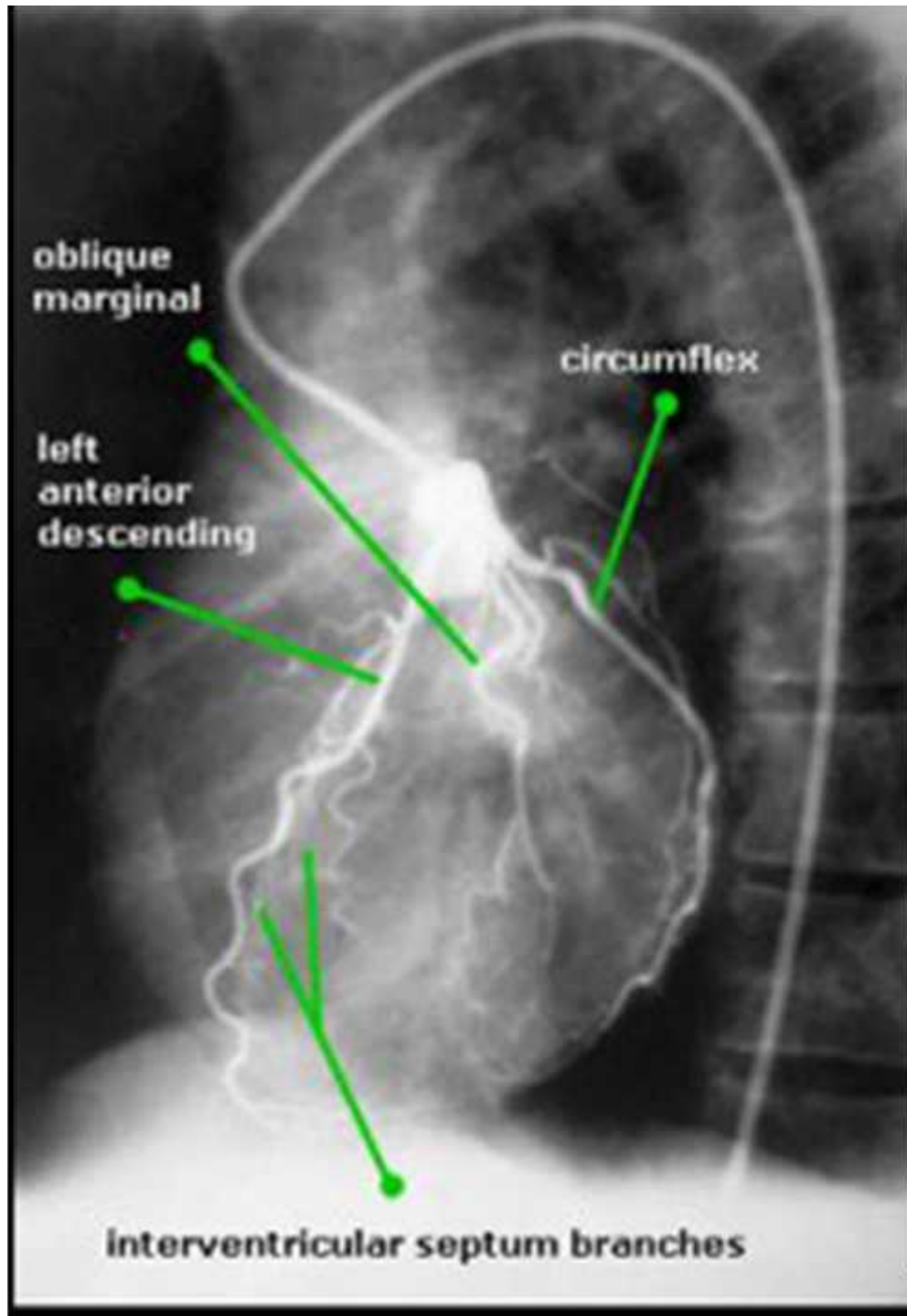
Ascending aorta

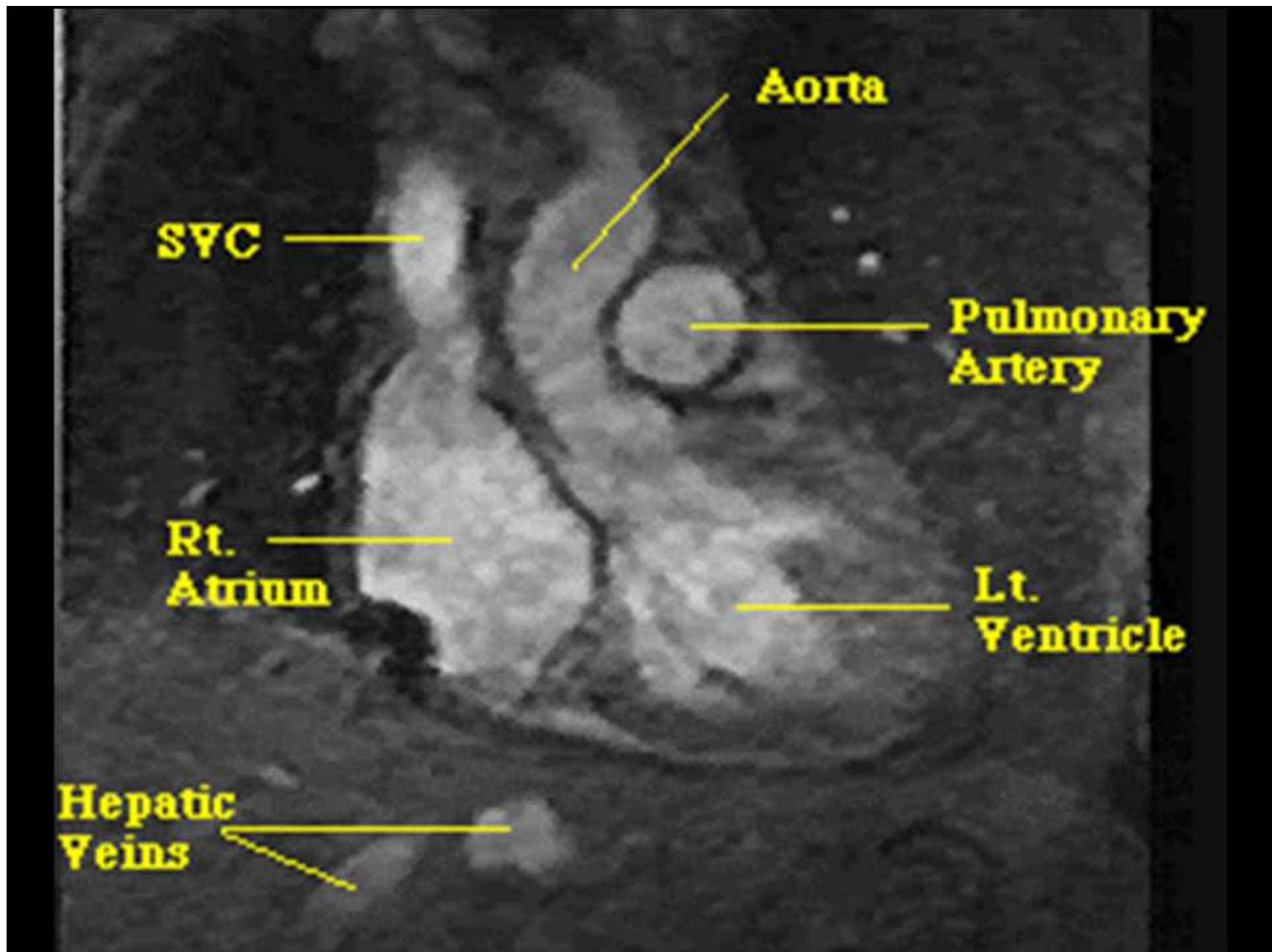
Left Atrium

Left Ventricle

Right
ventricle







PENILAIAN JANTUNG

- Konvigurasi.
- Letak/situs.
- Ukuran.

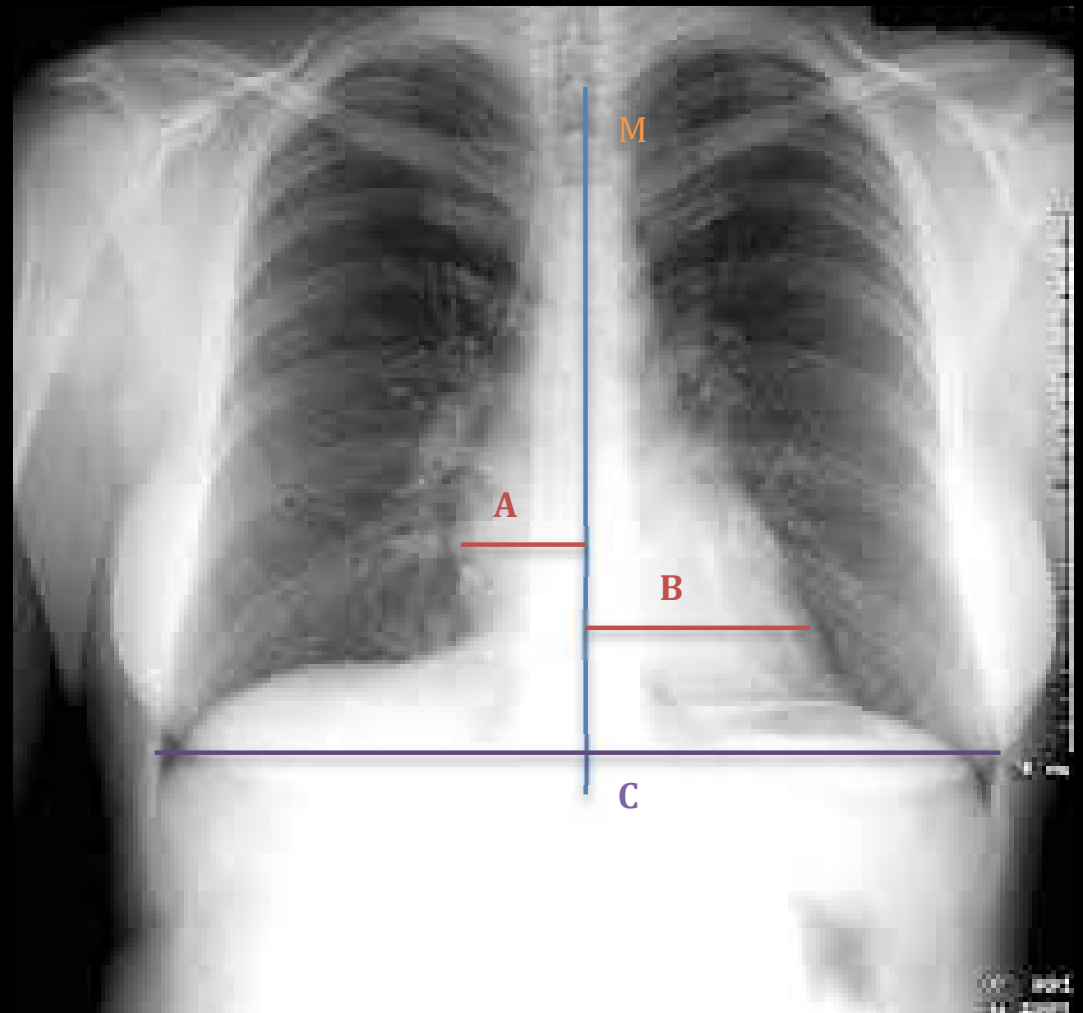
CTR

M: Garis tengah kolumna vertebra torakalis.

A: jarak antara M dgn batas kanan jantung yg terjauh

B: jarak antara M dgn batas kiri jantung yg terjauh.

C: garis transversal dari dinding toraks kanan ke dinding toraks kiri



RUMUS CTR

$$\text{CTR: } \frac{A + B}{C} \times 100 \%$$

N : CTR 50 %

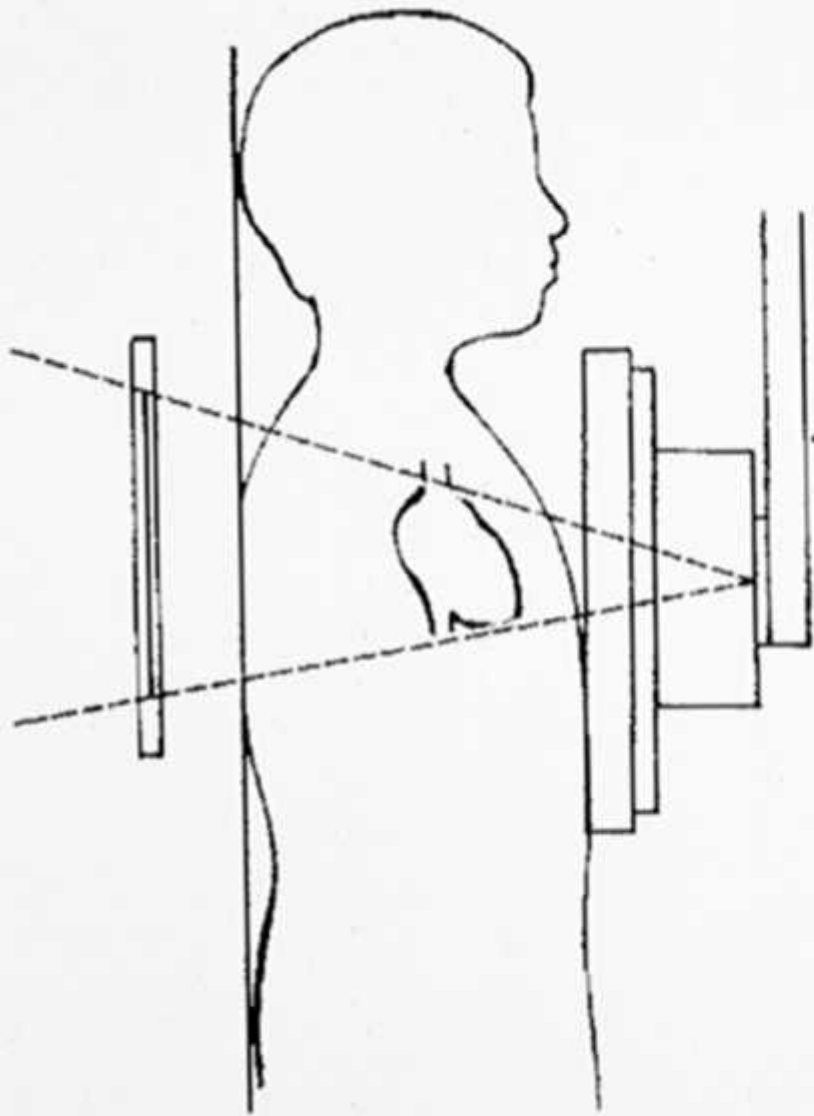
Kardiomegali: > 50 %

Cardiothoracic Ratio—Pitfalls

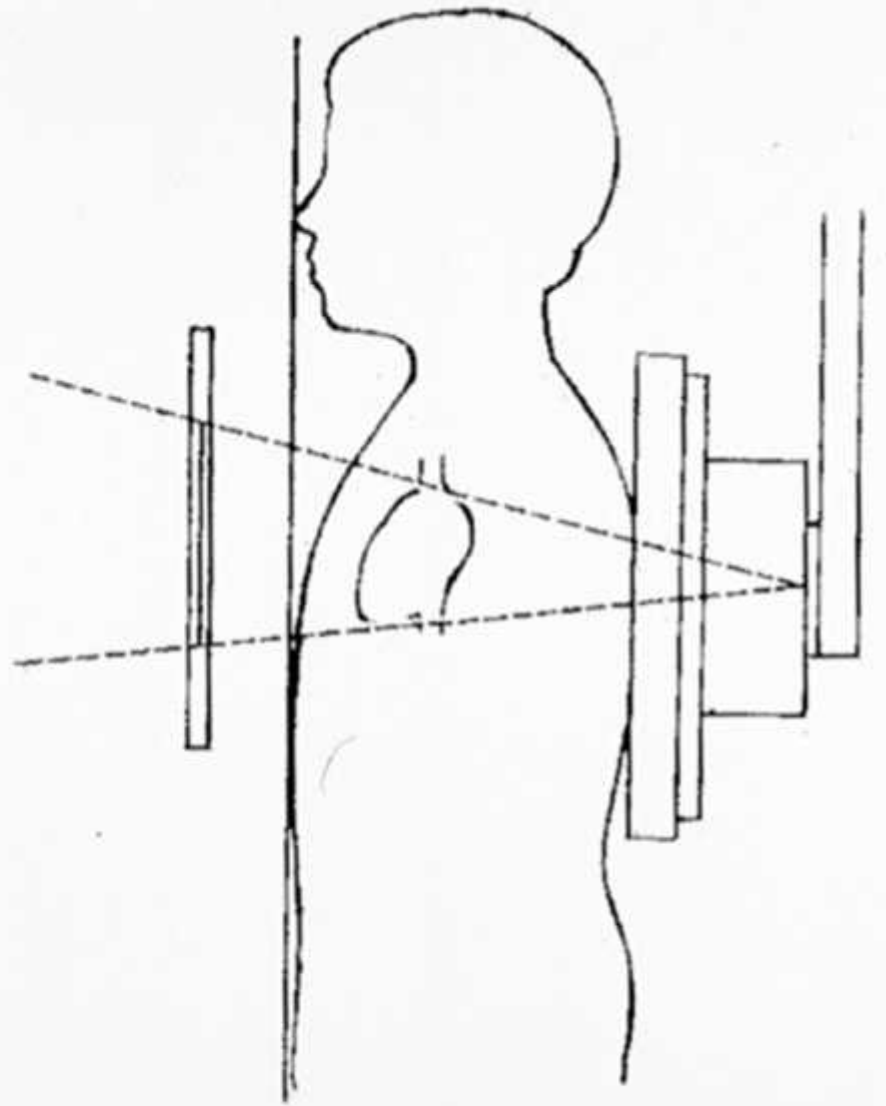
- Portable AP vs. PA films
- Depth of respiration—inspiration vs. expiration
- Thoracic deformity—pectus excavatum; in the elderly
- Pulmonary diseases that depress the diaphragm (emphysema)
- Abdominal diseases that elevate the diaphragm (hepatomegaly, ascites, pregnancy)
- Obesity

PA vs. AP Chest

- Less magnification on a PA Chest radiograph because:
 - ◆ The heart is closer to the cassette
 - ◆ X-ray source is 6 ft. from the cassette



AP



PA

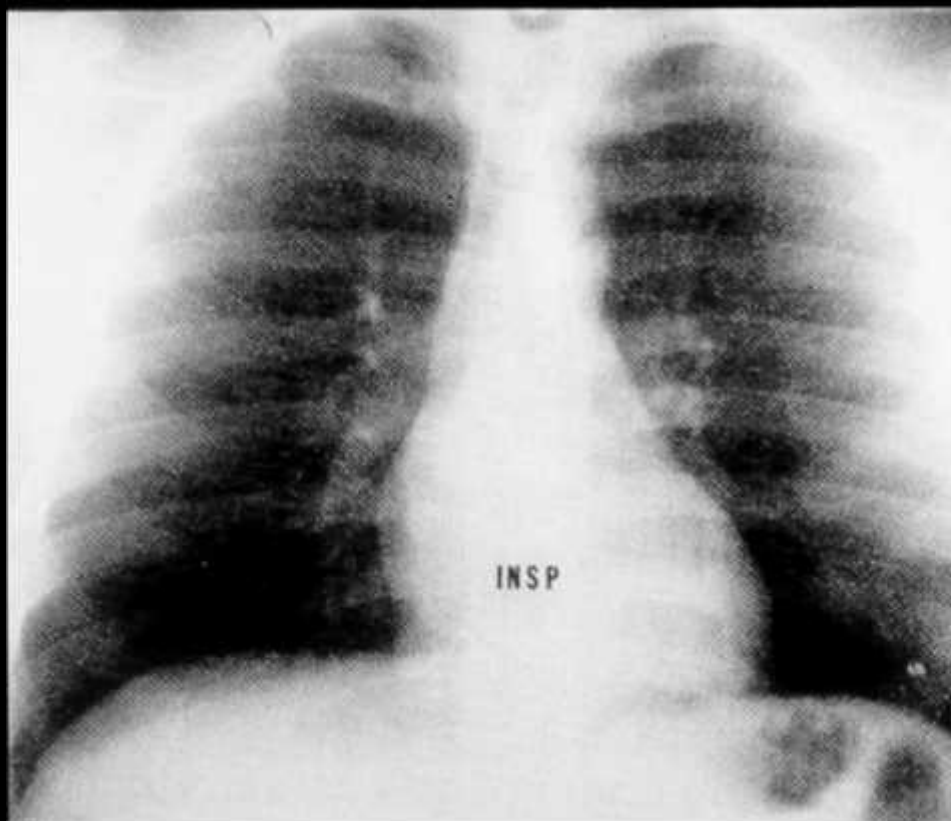
AP



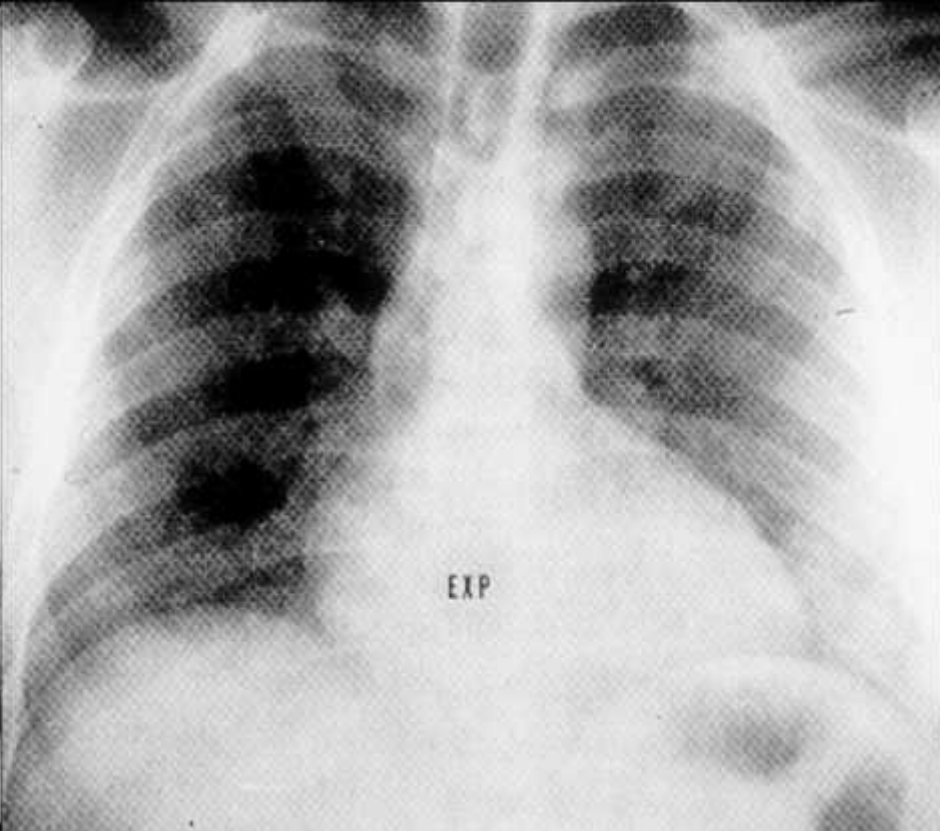
PA

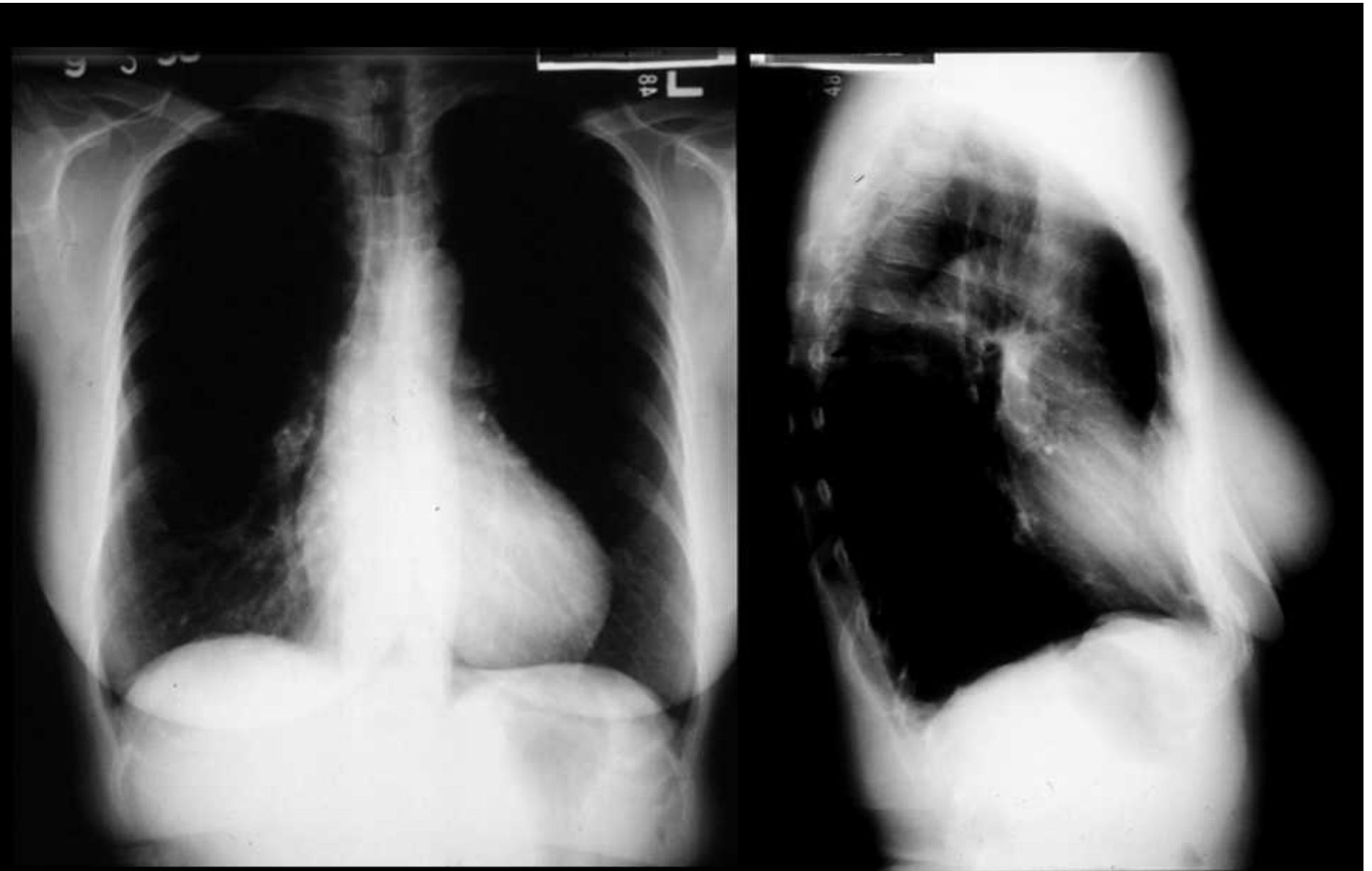


INSPIRASI

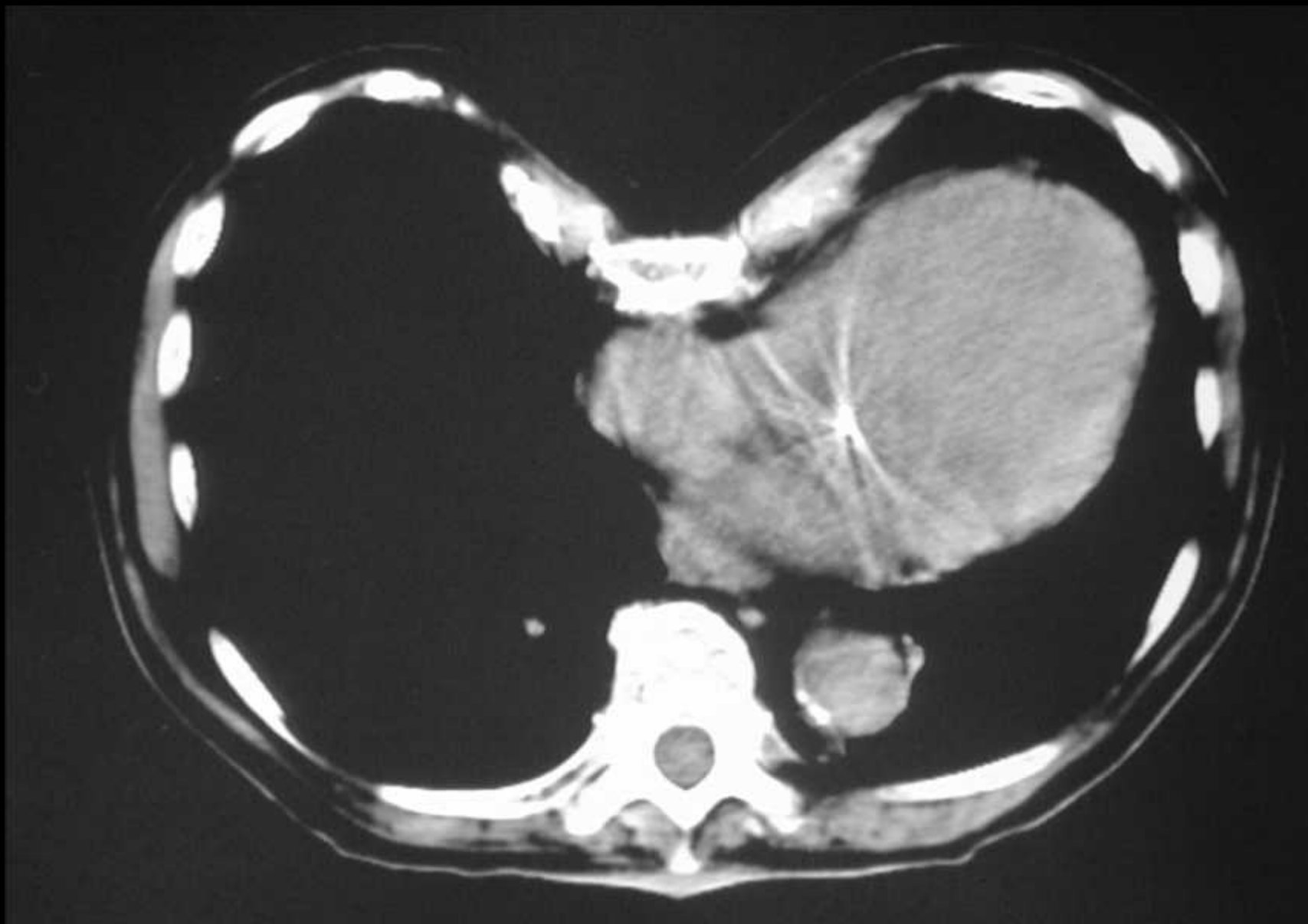


EKSPIRASI





Not only does pectus excavatum widen the transverse cardiac diameter, but frequently will cause blurring of the right heart border.



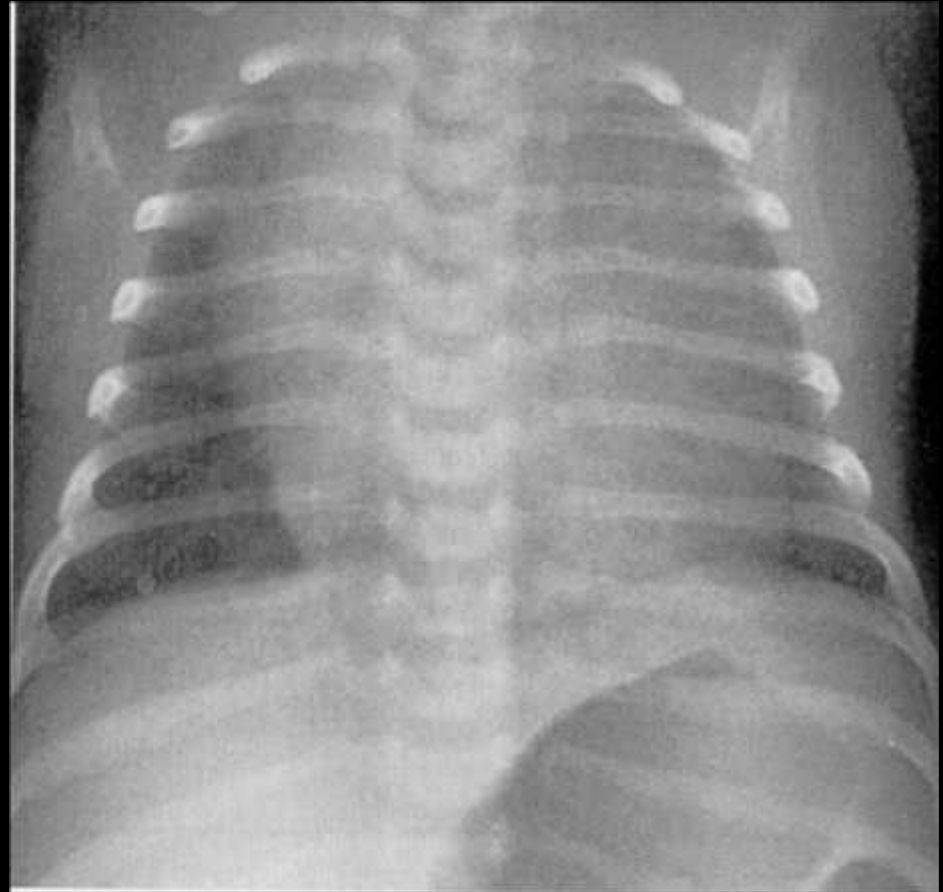
CT demonstrates why pectus excavatum causes widening of cardiac shadow

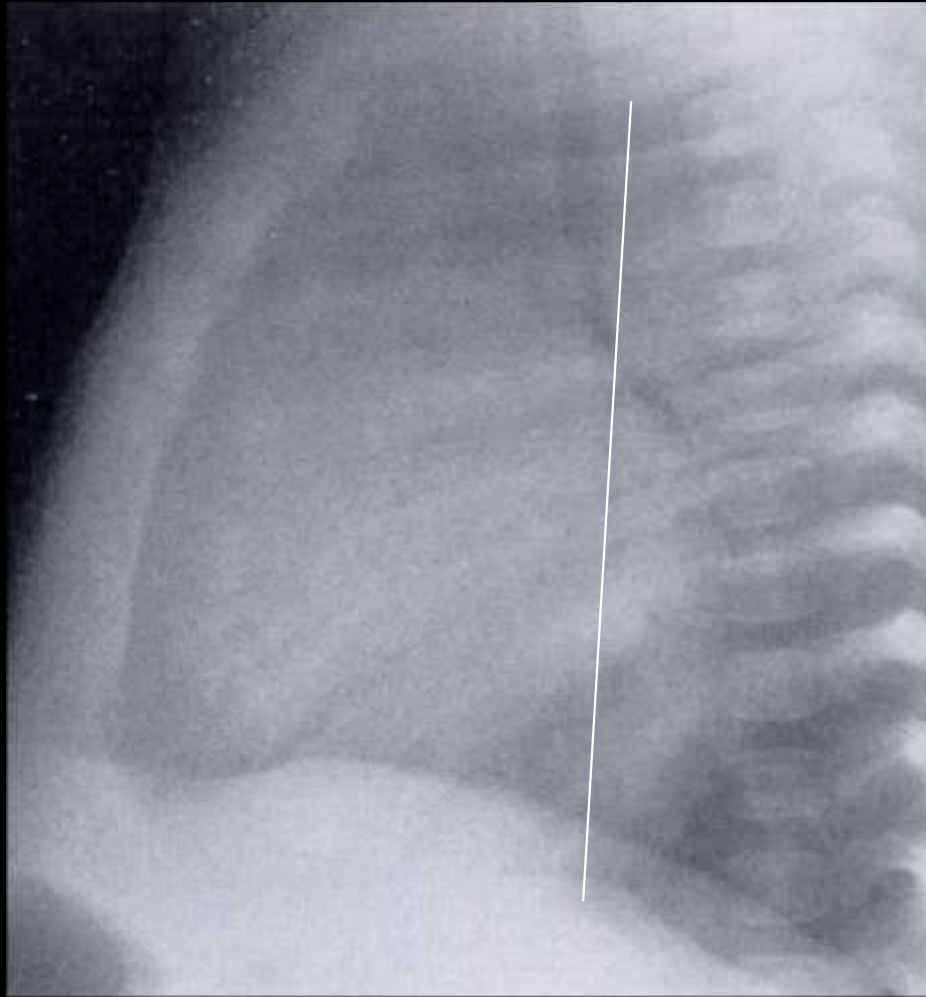


Patients with chronic obstructive pulmonary disease (COPD) usually have a narrow heart due to the hyperinflated lungs

Does Cardiothoracic ratio work from birth to age 5?

- Problems:
 - ◆ Thymus
 - ◆ Degree of inspiration
- Importance of Lateral view





Enlarged infant heart. A vertical line through the trachea does intersect the heart.

Hypertrophy vs. Dilatation

■ Hypertrophy

- ◆ Usually does not cause cardiac enlargement
- ◆ May affect cardiac contour

■ Dilatation

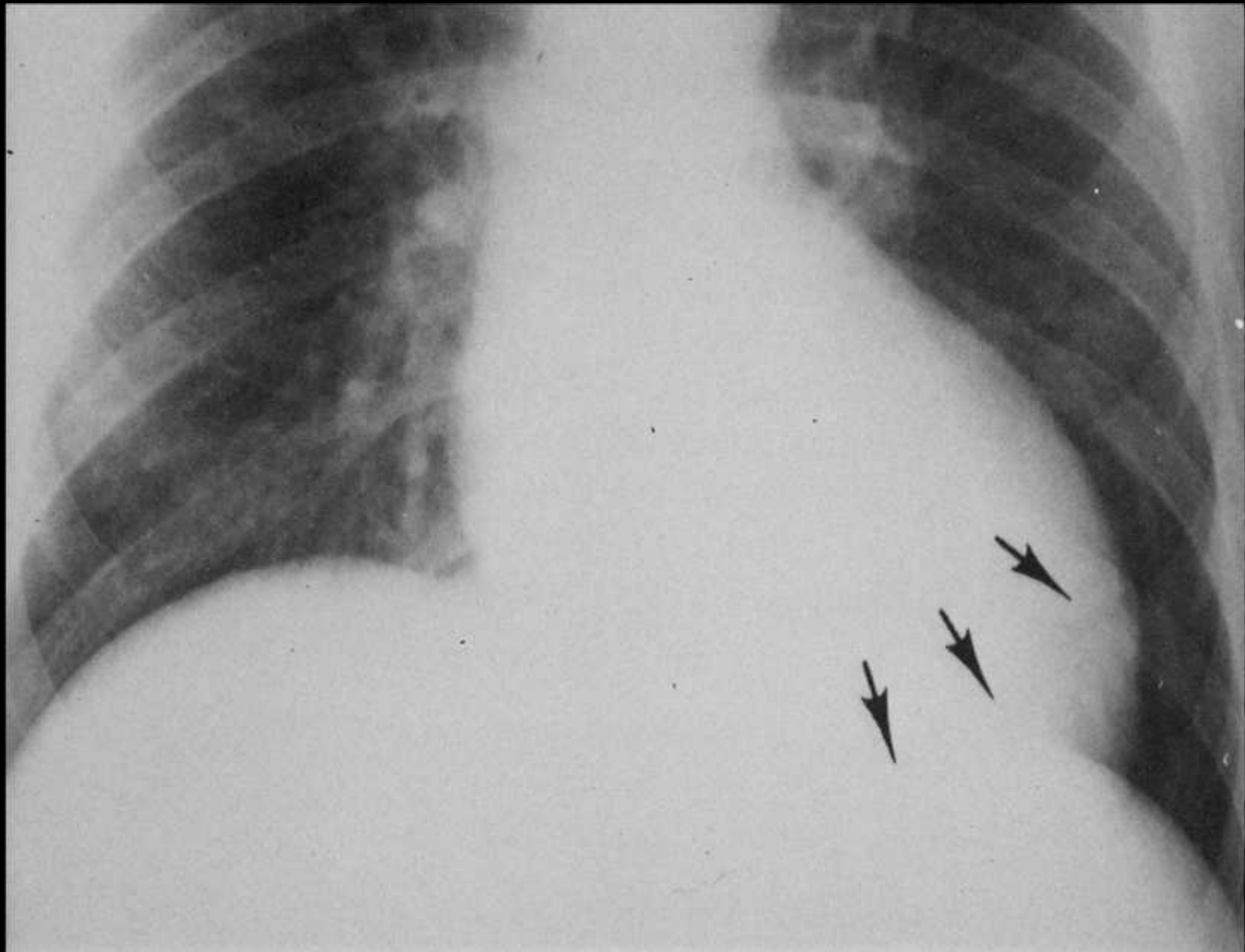
- ◆ Frequently causes cardiac enlargement
- ◆ Usually affects cardiac contour

Plain Film Radiography

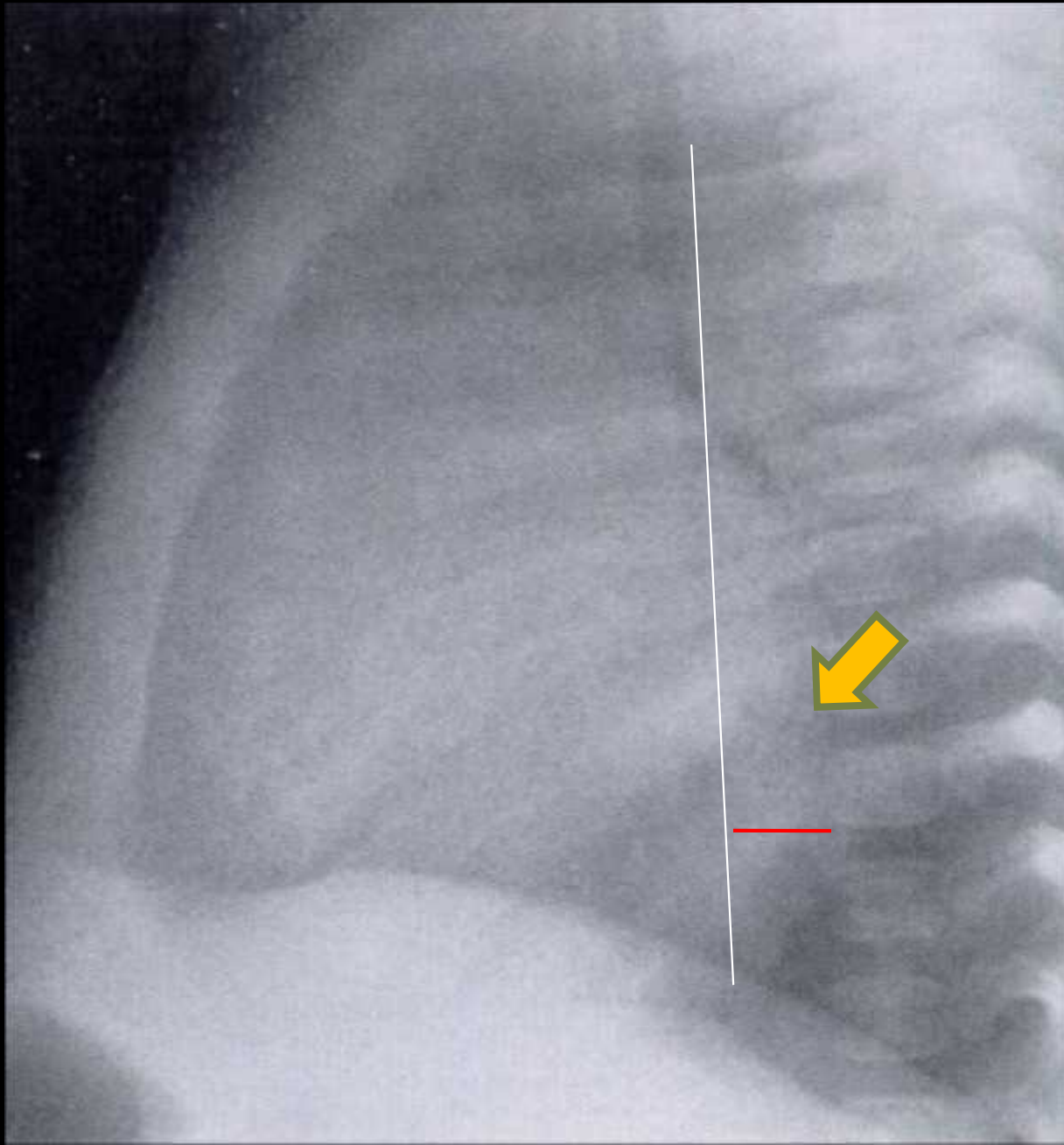
Cardiac Enlargement

Left Ventrikel :

- ✓ Cardiac apex bulged down and left
- ✓ Hoffman Rigler sign (+) (X Foto LAT) : the posterior border of the left ventrikel extends 1.8 cm or more posteriorly to the posterior border of the inferior V.Cava at level 2 cm cephalad to their crossing



LV dilatation with downward bulge

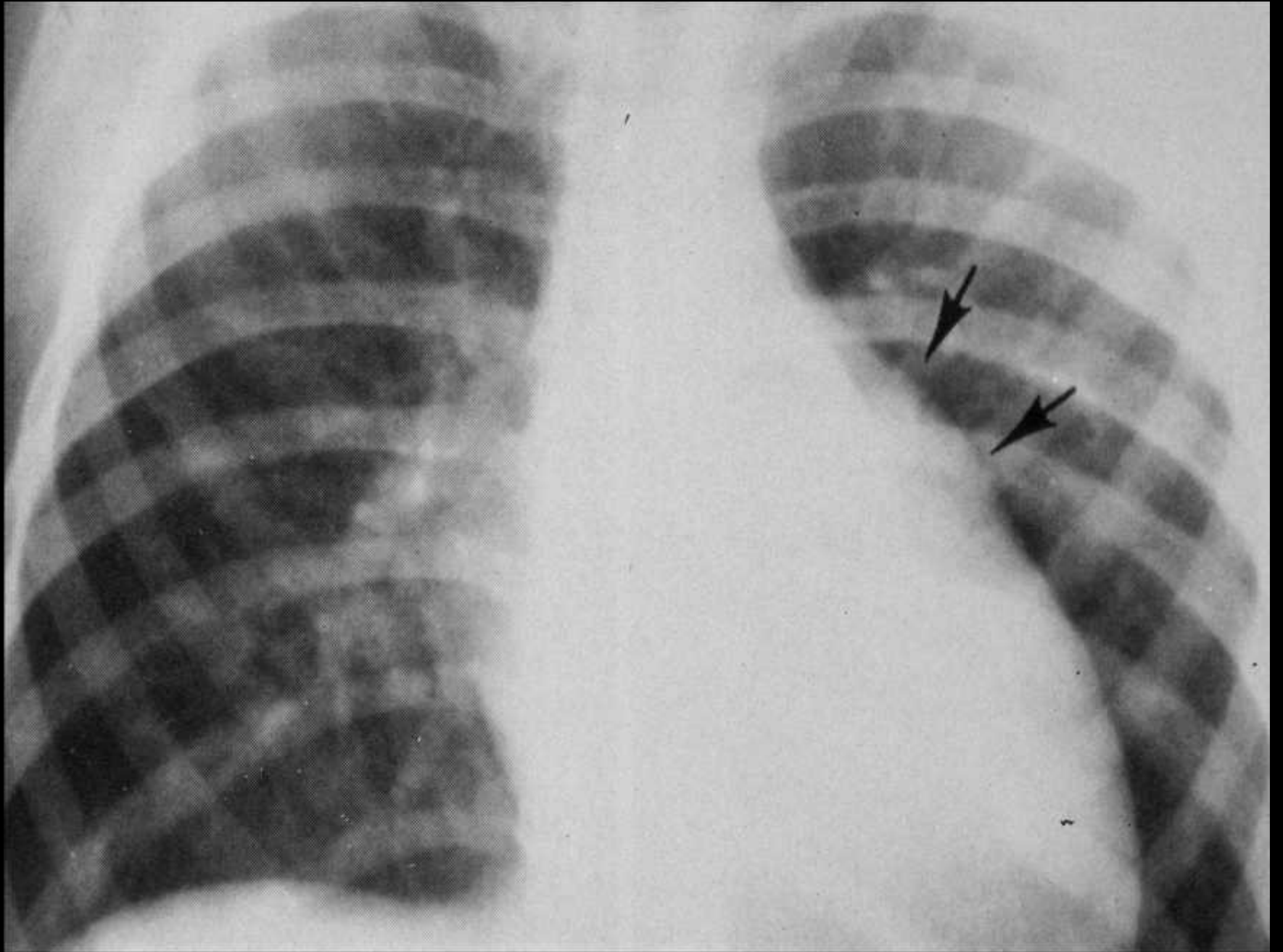


Plain Film Radiography

Cardiac Enlargement

Left Atrium :

- ✓ Esophagus displaced posteriorly
- ✓ Prominent left auricle
- ✓ Prominence of the upper posterior border of the heart on Lateral view
- ✓ Dense left atrial shadow, double contour on the right
- ✓ Elevated left main bronchus



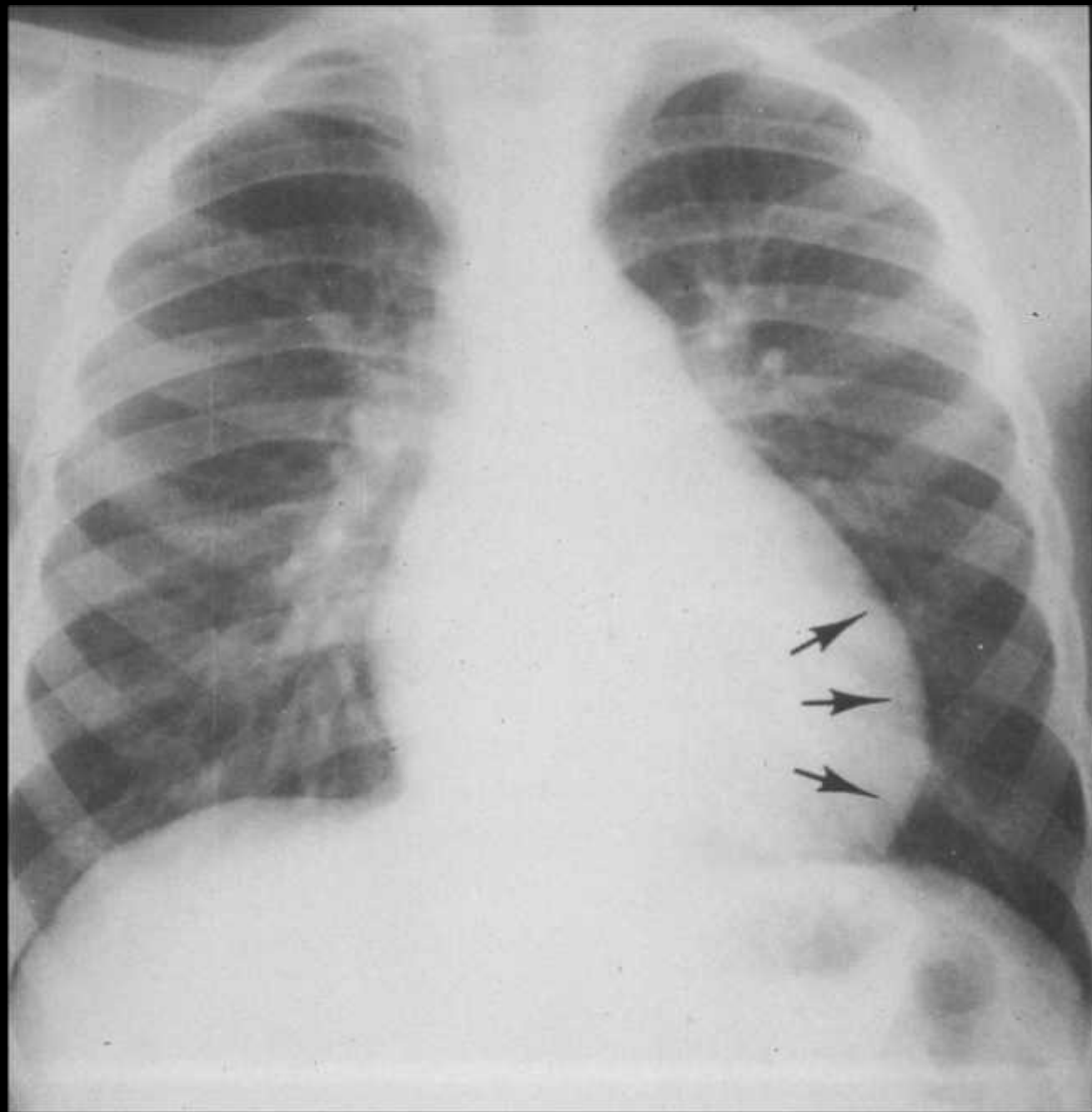


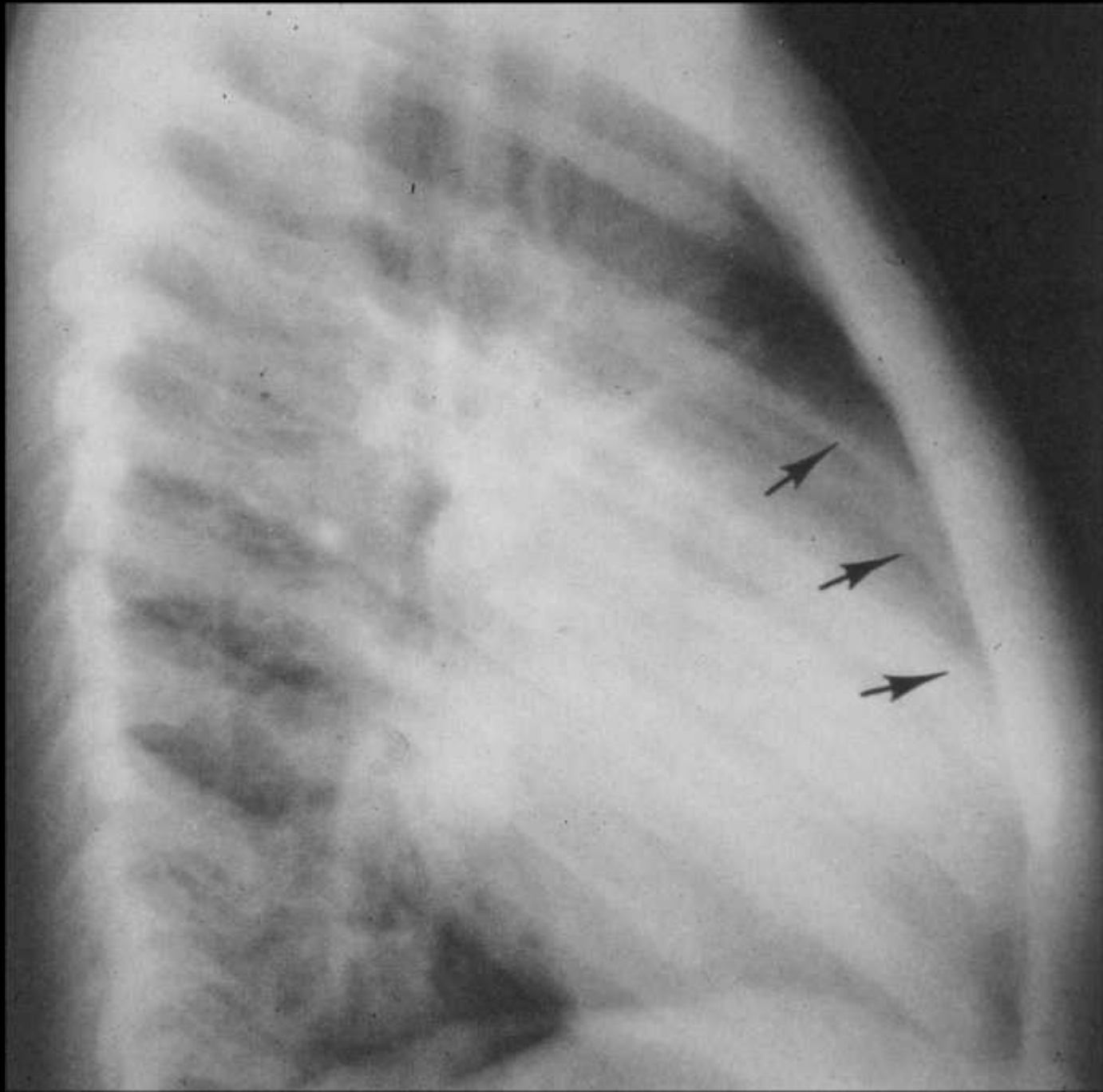
Plain Film Radiography

Cardiac Enlargement

Right Ventrikel :

- ✓ Cardiac enlargement toward left with elevated apex.
- ✓ Filling of retrosternal space
- ✓ May displace right atrium toward right
- ✓ May displace left ventricle backwards



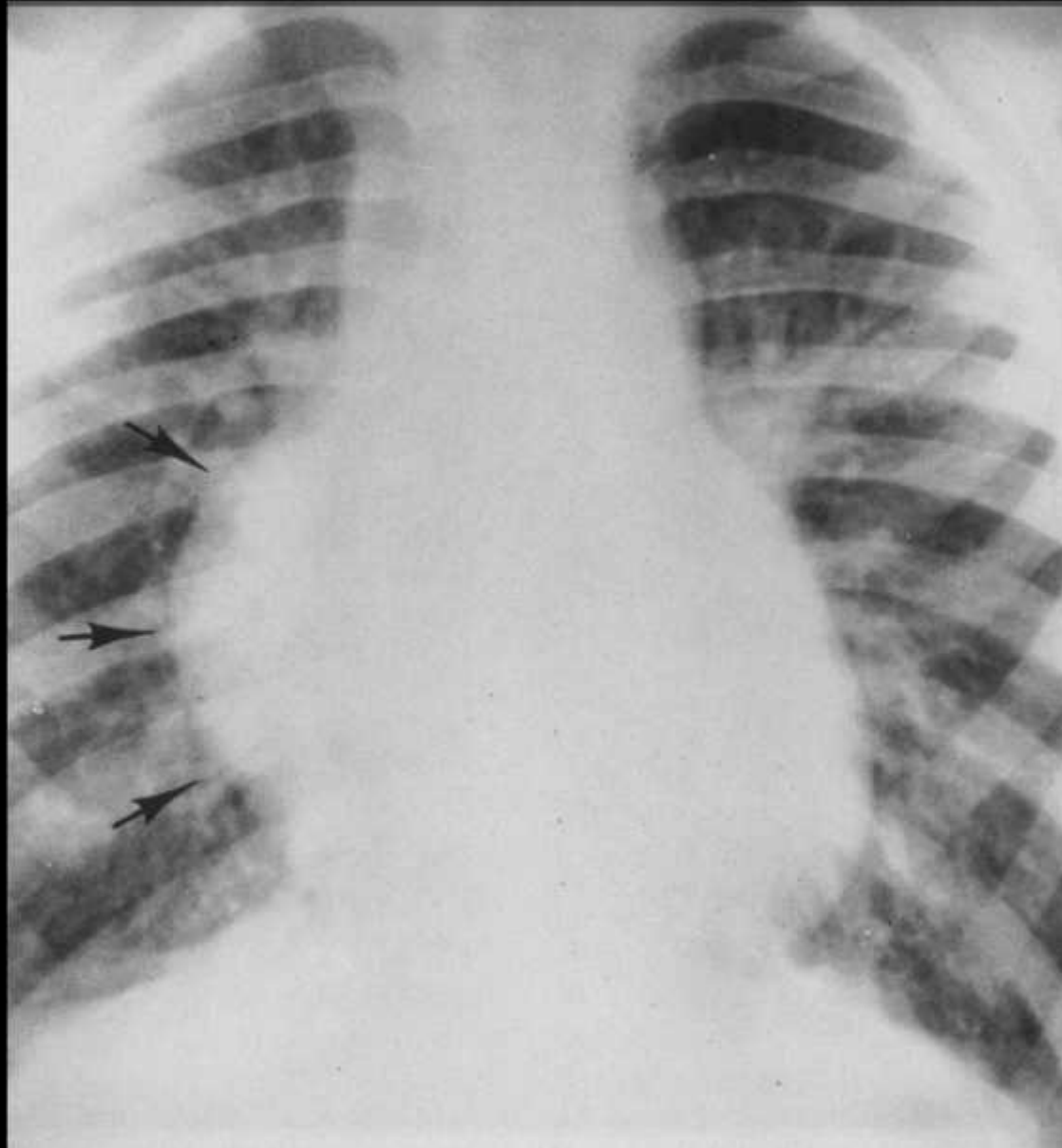


Plain Film Radiography

Cardiac Enlargement

Right Atrium:

- ✓ Right heart border beyond 1/3 of the right hemitorax
- ✓ May fill the retrosternal space
- ✓ Rare as solitary finding



Right atrial enlargement causes lateral bulge of R heart border—least reliable of all of the chamber enlargements e.g. can be prominent normally

Congestive Heart Failure (CHF)

Congestive heart failure (CHF) : the result of insufficient output because of cardiac failure, high resistance in the circulation or fluid overload.

Left ventricle (LV) failure >>, Cardiac output ↓

Pulmonary venous pressure ↑

→ Dilatations of pulmonary vessels →

Leakage of fluid into interstitial & pleural space

→ Into alveoli resulting in pulmonary edema

Stage of Congestive Heart Failure

Stage 1
Redistribution
PCWP 13-18 mmHg



Redistribution pulmonary vessels
Cardiomegaly
Broad vascular pedicle
(non acute CHF)

Stage 2
Interstitial edema
PCWP 18-25 mmHg

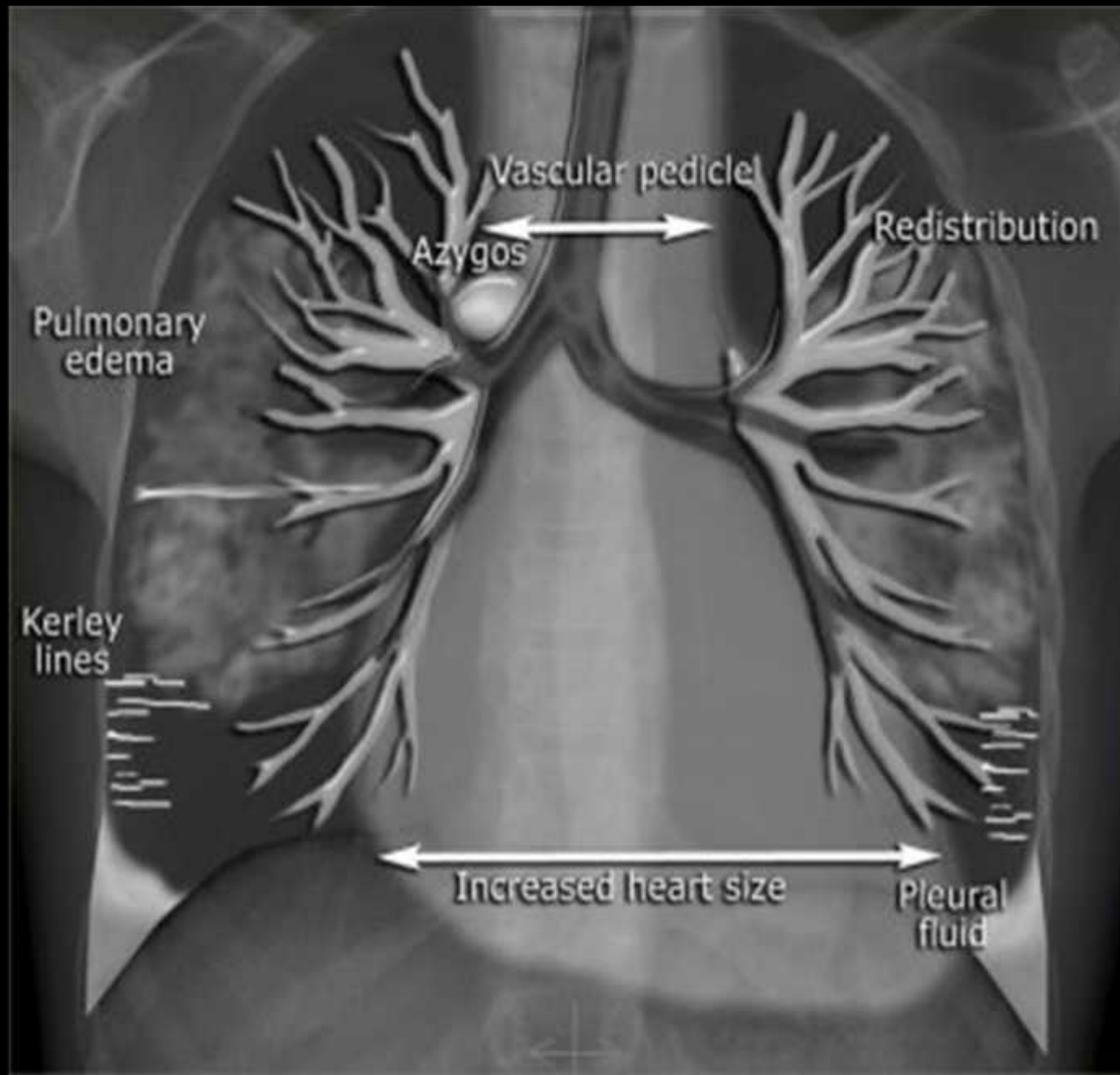


Kerley lines
Peribronchial cuffing
Hazy contour of vessels
Thickened interlobar fissure

Stage 3
Alveolar edema
PCWP > 25 mmHg

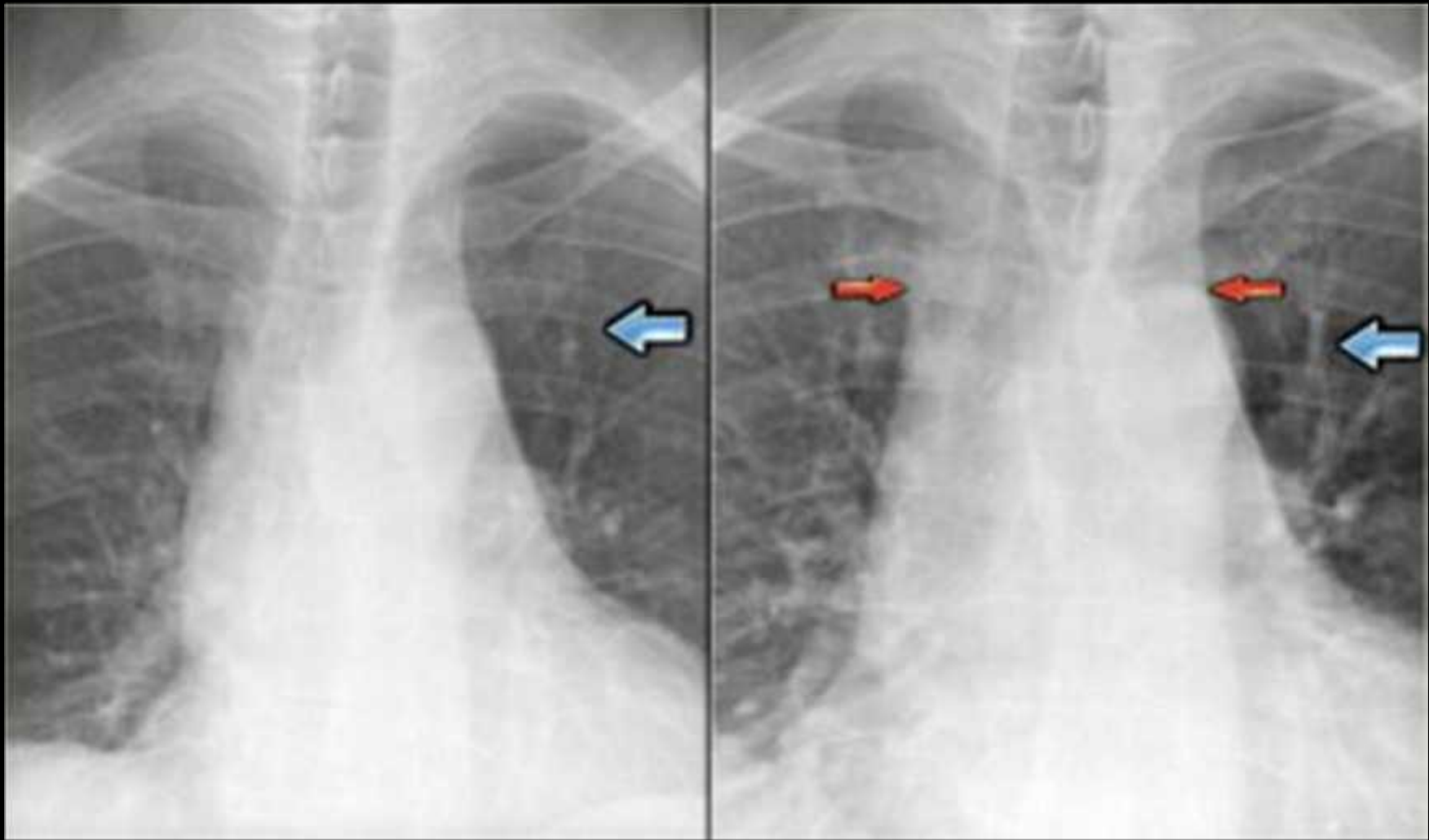


Consolidation
Air bronchogram
Cottonwool appearance
Pleural effusion



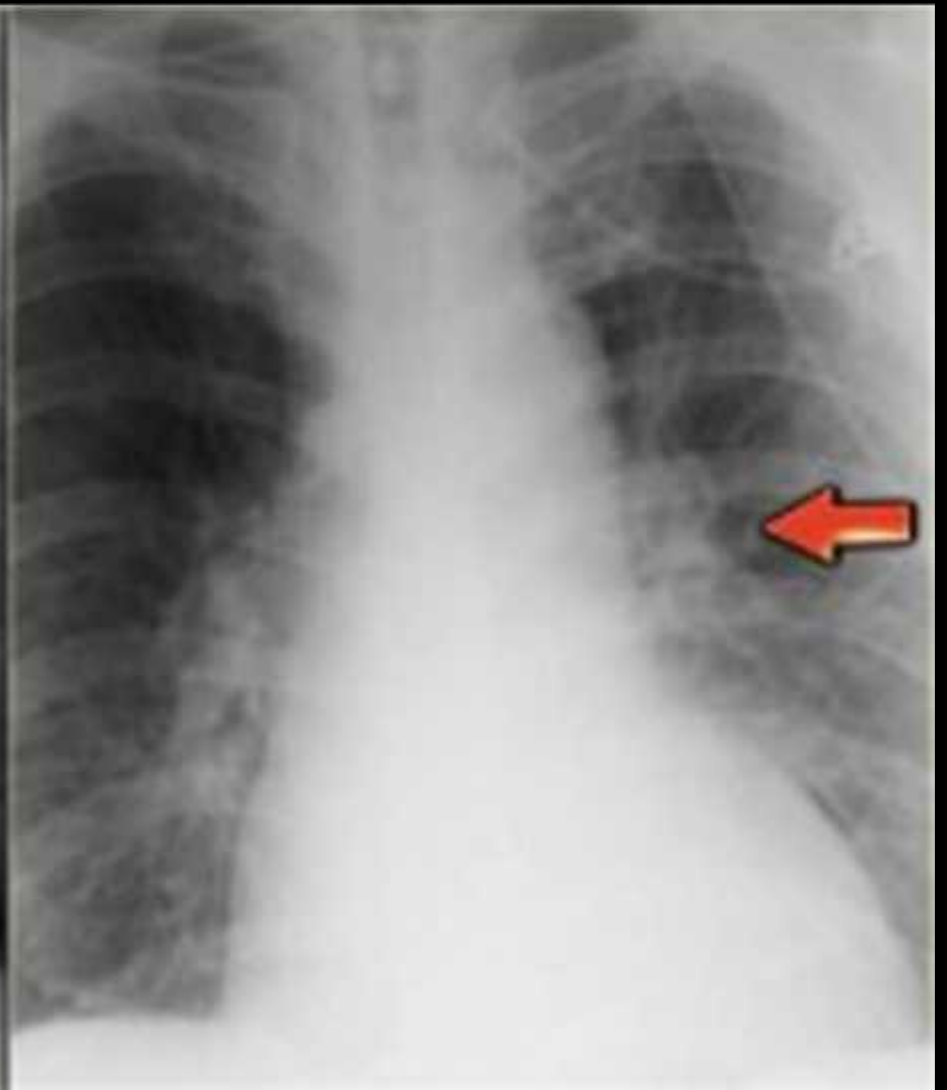
CHF—PA and Lat. Chest findings

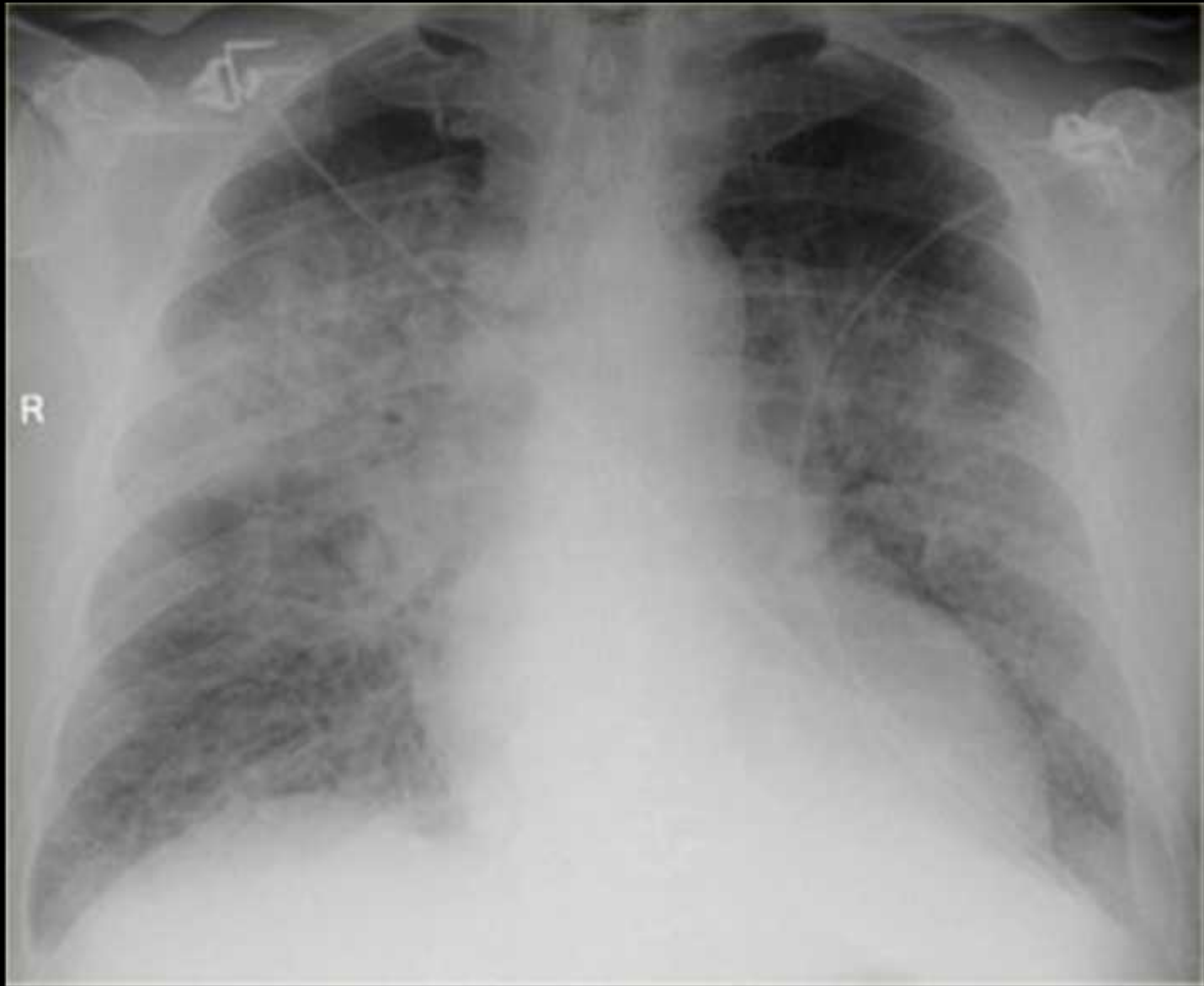
- ❑ Cardiomegaly
- ❑ Pulmonary vascular redistribution
- ❑ Vascular unsharpness due to interstitial edema
- ❑ Pleural effusion
- ❑ Septal lines
 - Kerley B—fluid distended interlobular septae
 - Kerley A—fluid distended central connective tissue septae



Views of the upper lobe vessels of a patient in good condition (left) and during a period of CHF (right). Notice also the increased width of the vascular pedicle (red arrows).







Alveolar edema

Left side
pulmonary edema
is less common

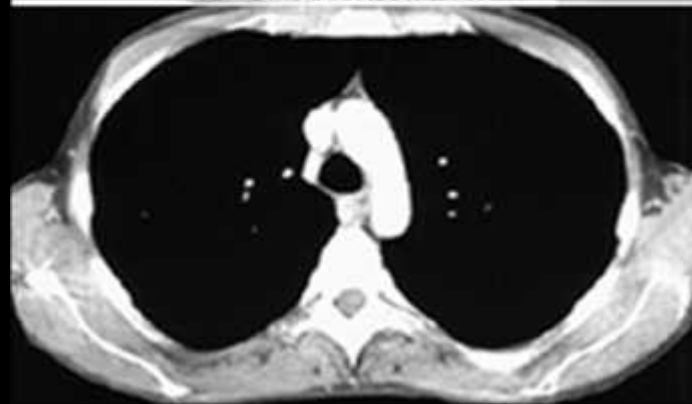
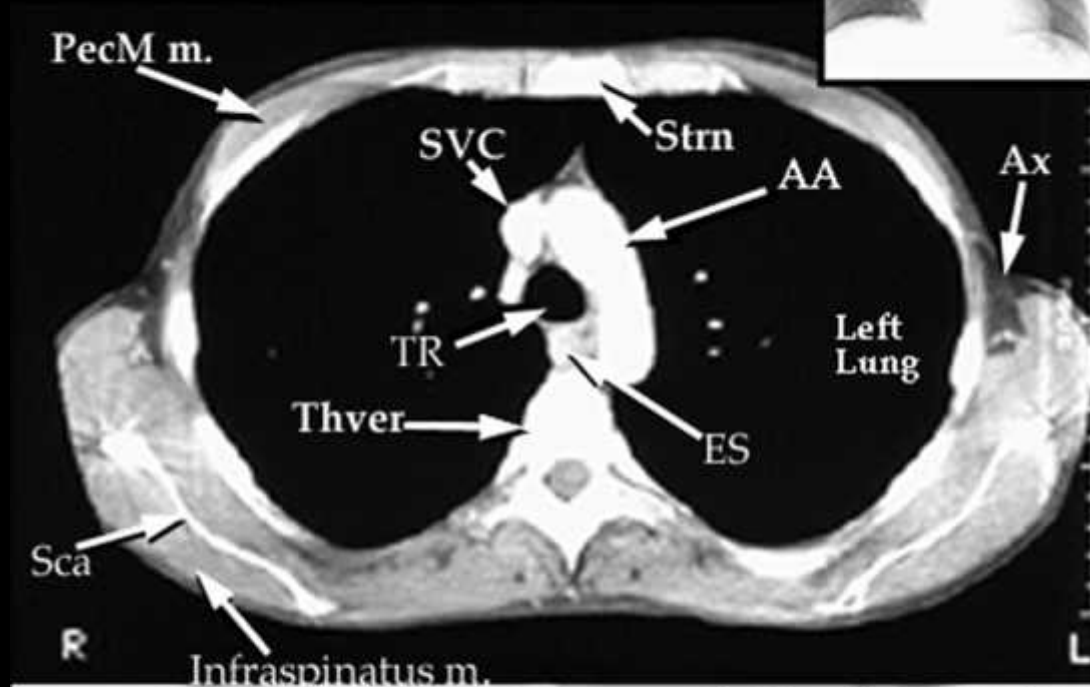


Cardiac X-sectional imaging

- Ultrasound—most common
- CT—the heart and great vessels are well visualized on chest studies done with I.V contrast
- MRI

CT #2

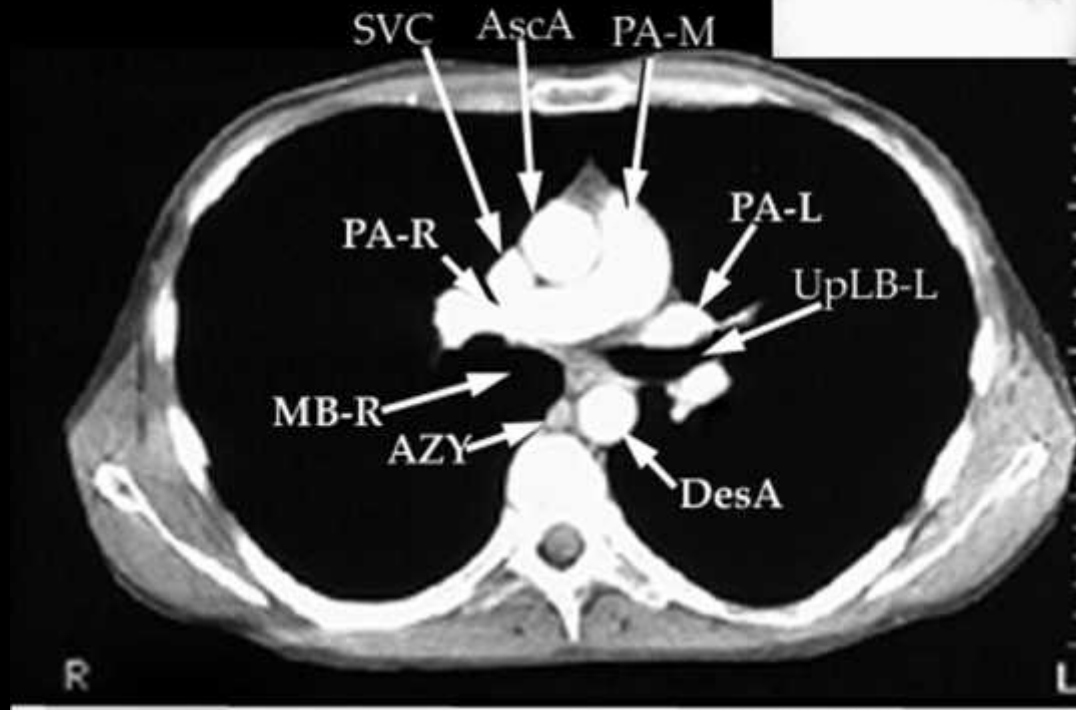
Axial-mediastinal window



- PecM m.=Pectoralis Major Muscle
- SVC=Superior Vena Cava
- Strn=Sternum
- AA=Aortic Arch
- Ax=Axilla
- TR=Trachea
- Thver=Thoracic Vertebra
- ES=Esophagus
- Sca=Scapula

CT #4

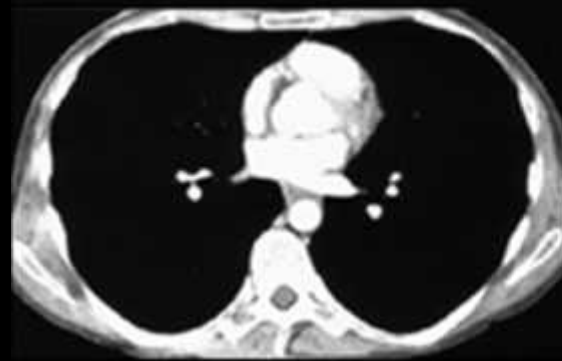
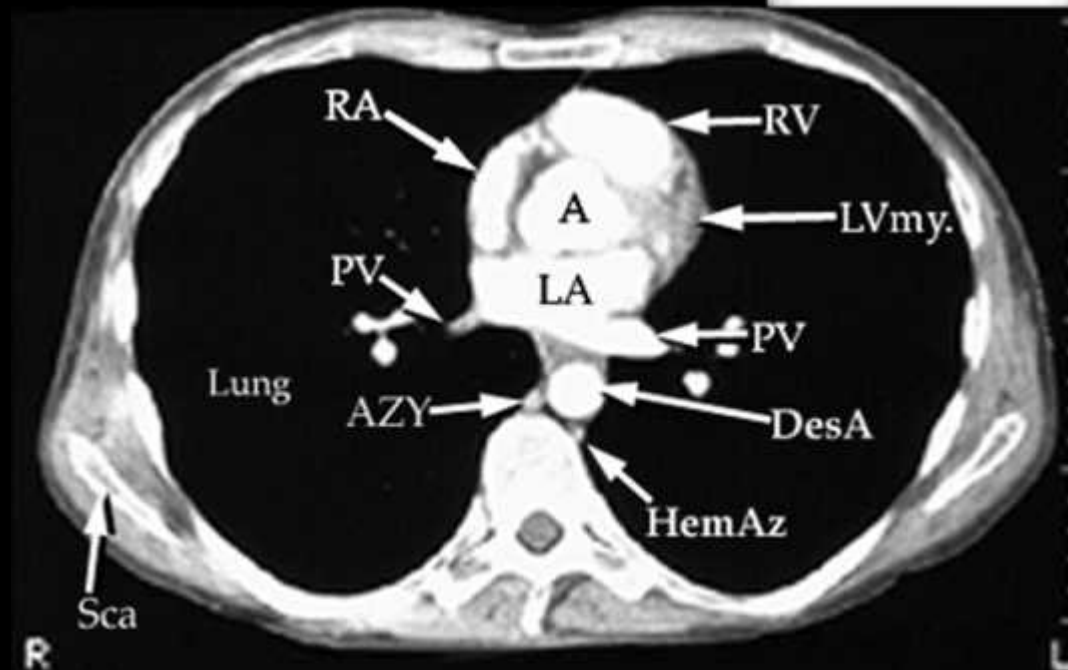
Axial-mediastinal window



- DesA=Descending Aorta
- UpLB-L=Left Upper Lobe Bronchus
- PA-L=Left Pulmonary Artery
- PA-M=Pulmonary Artery Trunk
- AscA=Ascending Aorta
- SVC=Superior Vena Cava
- PA-R=Right Pulmonary Artery
- MB-R=Right Main Stem Bronchus
- AZY=Azygos Vein

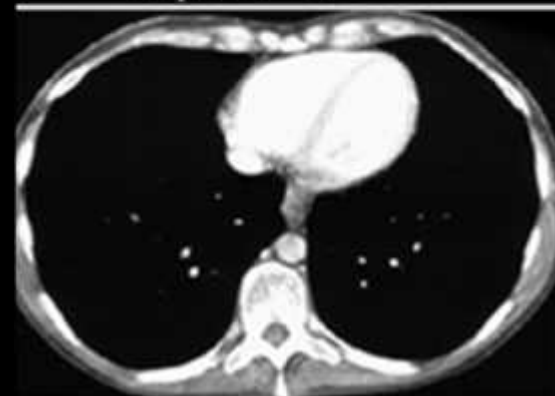
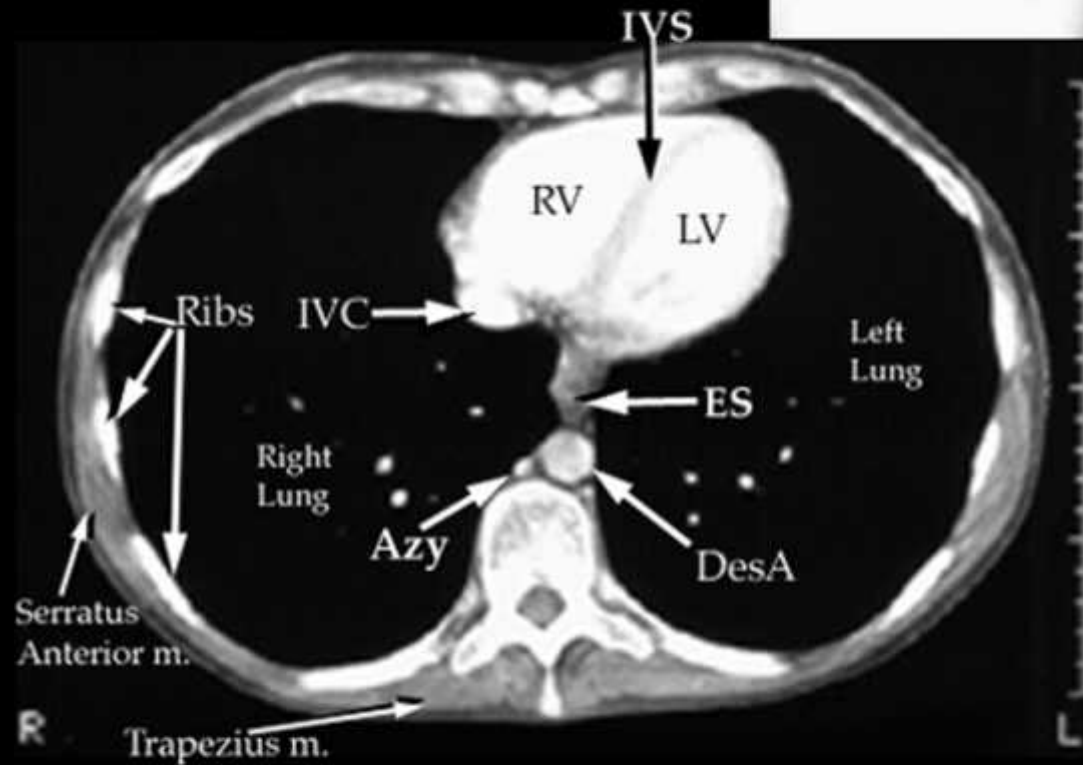
CT #6

Axial-mediastinal window



- RV=Right ventricle
- RA=Right atrium
- A=aorta
- LA=Left atrium
- LVmy.=Left ventricular myocardium
- DesA=Descending aorta
- AZY=Azygos Vein
- HemAz=Hemiazygos Vein
- PV=Pulmonary Vein

CT #8
Axial-mediastinal window



RV=Right ventricle
LV=Left ventricle
IVC=Inferior Vena Cava
DesA=Descending aorta
Azy=Azygos Vein
ES=Esophagus
IVS=Interventricular Septum

CT CARDIAC

Indication and patient selection

- ✓ CAD risk factor required to have a coronary CTA.
- ✓ Primary CAD risk factor:
 - Cigarette smoking
 - Hypertension
 - Elevated LDL (>130mg/dl)
 - Low HDL(< 40 mg/dl)
 - Diabetes mellitus
 - Family history
- ✓ Assessment post by-pass graft
- ✓ Anomali vascular.
- ✓ Triple rule out in chest pain → CAD, dissecting aorta (DA) and pulmonal emboli (PE)

Severe CAD, calcium score > 500 units.



tn.HS, 69th.
Riwayat AMI,
hiperlipidemi

Rekomendasi penanganan pasien berdasarkan calcium score

Calcium score	risk	recommendation
0	no atherosclerotic plaque CAD risk very low	healthy diet, stop smoking.
1-10	minimal plaque burden , CAD risk low	+tight control of DM and hypertension, consider of using statin.
11-100	mild plaque burden, CAD risk moderate	+statin, aspirin
101-400	moderate plaque burden CAD risk high	+exercise program, folic acid, vit. E
> 400	extensive plaque burden	+stress test, coronary angiography

Prognosis in calcium score

In 2000, The American College of Cardiology together with American Heart Association, base on EBCT calcium score in correlation with prognosis of CAD :

1. Zero calcium score: possibility of atherosclerosis plaque is very low, no evidence of CAD.
2. Positive calcium score : confirm the present of CAD.
3. High calcium score : possibility of vessel disease is high .
4. Severe calcium score : consistent with moderate-to-high risk CAD in 2-5 years.

Impression of the interpretation:

- ❖ Normal CTA : routine check up

- ❖ Mild Coronary Artery Disease:

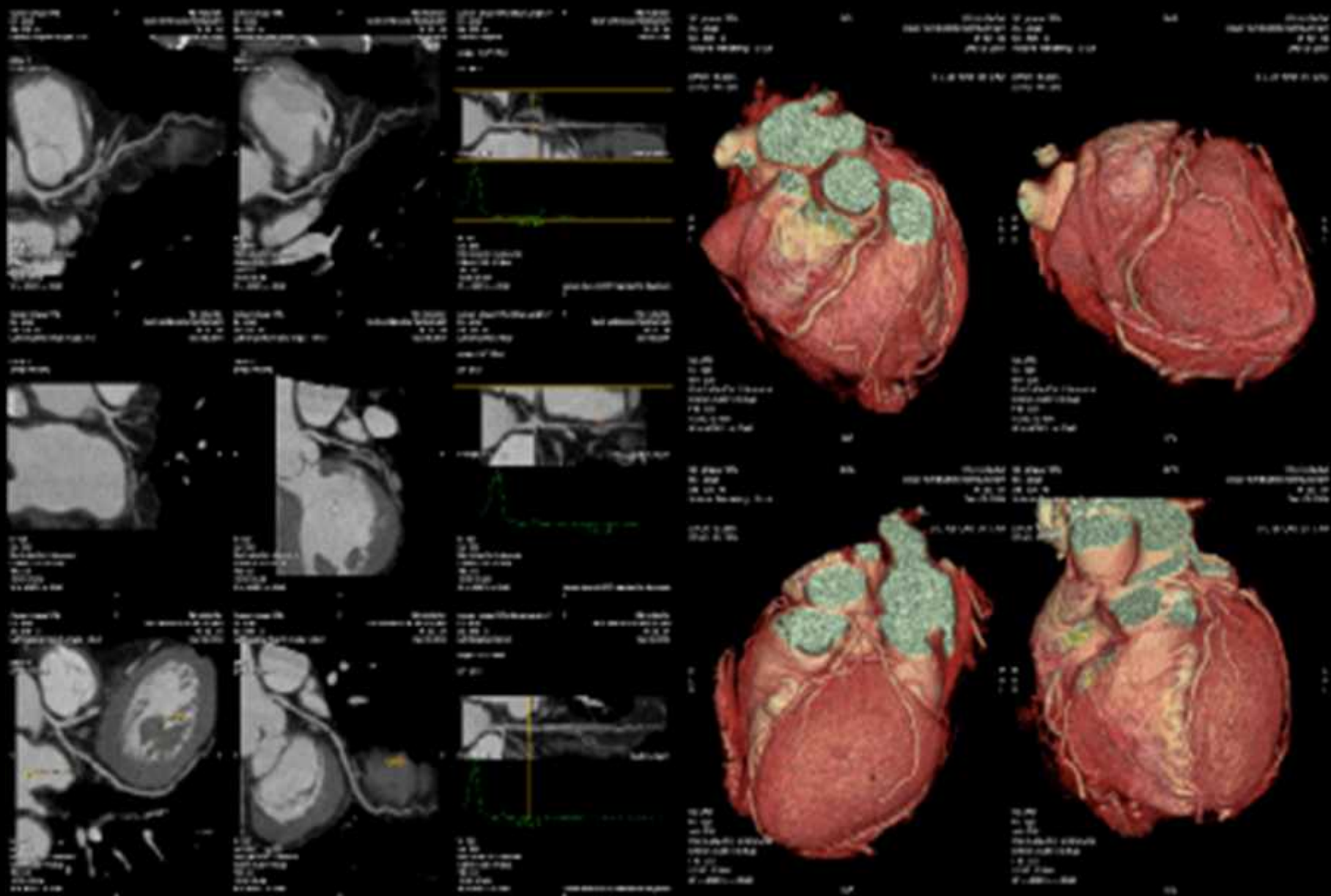
Recommend the patient to consult a cardiologist for risk factor assessment and possible statin + aspirin therapy.

- ❖ Moderate CAD:

Consult cardiologist for statin and aspirin therapy as well as a nuclear stress test.

- ❖ Severe CAD:

Recommend for heart catheterization



Stenosis proximal LAD

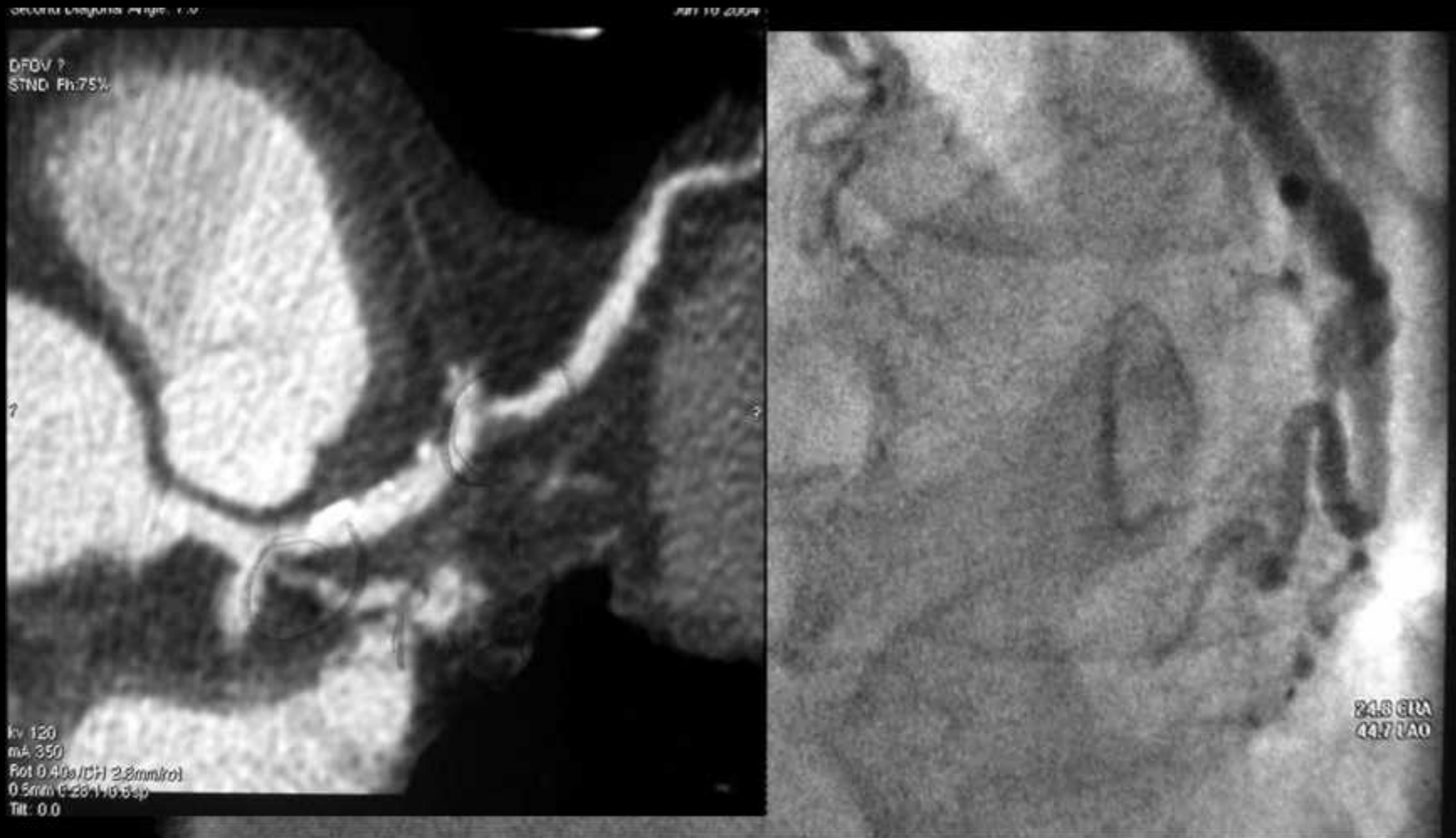
EX: 2070
Se: 3
Left Anterior Descending Artery Angles: 0.0
M 61 CT070
Feb 01 2

DFOV 13.5 cm
STND Ph:75% (No Filt.)
355/1

kv 120
mA Mod.
Rot 0.35s/CH 8.0mm/rot
0.6mm 0.2:1/0.6sp
Tilt: 0.0
11:40:57 AM
W = 1046 L = 405



Stenosis proximal LAD and LCX



*CTA coronary does not meant to
replace coronary angiography*

CTA coronary is a screening
modality in CAD risk patient
with no symptom.

In patient with high risk coronary
heart disease and high calcium
scoring, it is better to proceed for
direct *coronary angiography* .

Pericardial Effusion

- Sometimes suggested by PA and lateral chest x-ray
- Ultrasound is the best diagnostic method
- CT also capable of diagnosing



0.100000
0.100000



Cardiac masses

- Thrombus in LV or atrial appendage most common—2ndary to MS, atrial fib., cardiomyopathy—echo best
- Myxoma—usually near atrial septum
- Lipoma
- Primary (sarcomas) or metastatic tumors (breast or lung most common).



Left atrial myxoma in a 60-year-old man

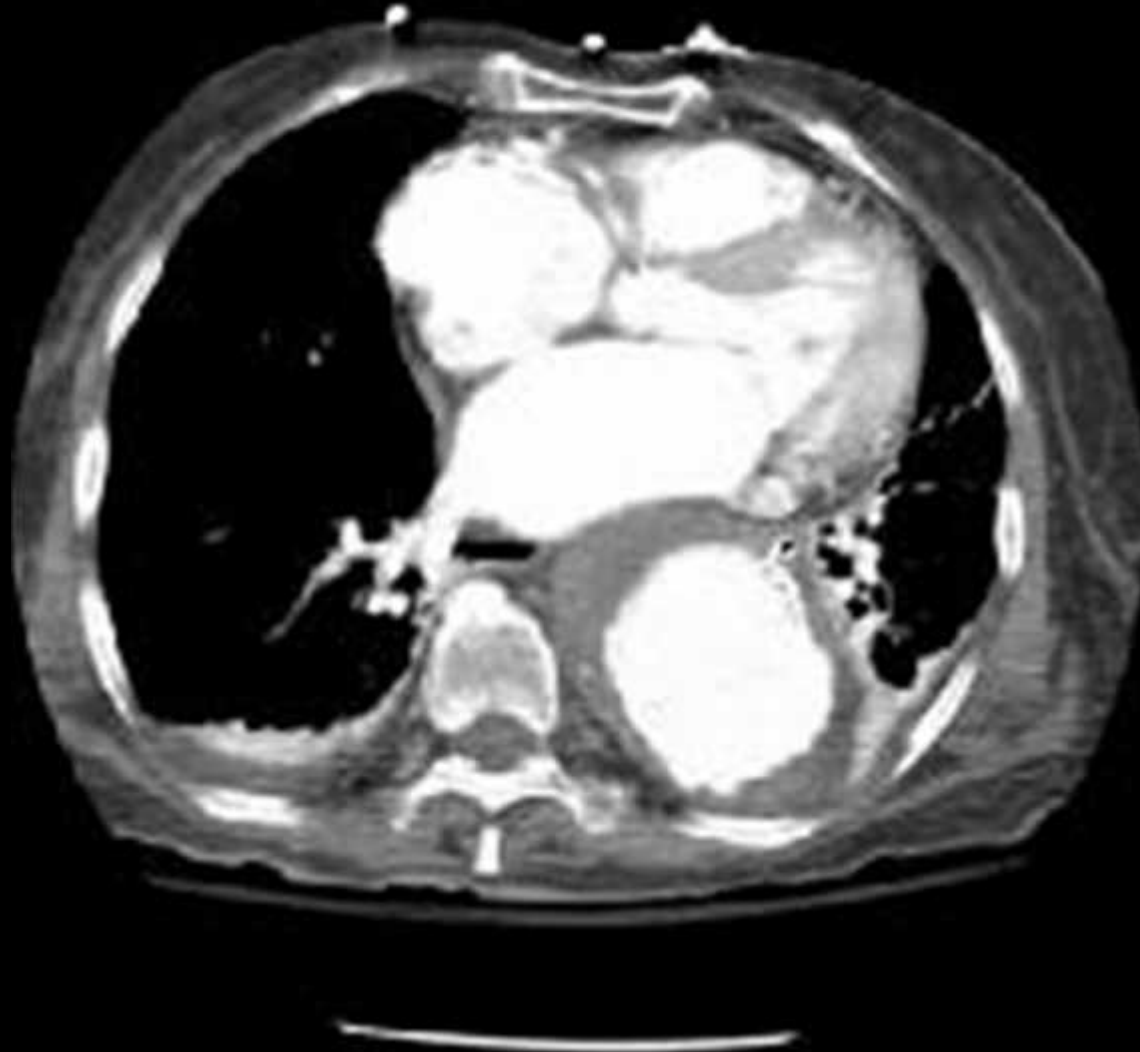
Aortic Aneurysm or Dissection

- Trans-esophageal echo (TEE) and MRI are reliable diagnostic methods for dissection but spiral CT most commonly used because of availability
- Angiography is the gold standard

Aortic aneurysm
(arrow)



23. Test 5.4



Descending thoracic aortic aneurysm with mural thrombus at the level of the left atrium

Aortic Dissection

- Double aortic knob sign (40% of patients)
- Diffuse enlargement of the aorta
- Tracheal displacement to the right
- Pleural effusion
- Pericardial effusion
- Cardiac enlargement
- Displacement of a nasogastric tube
- Left apical opacity



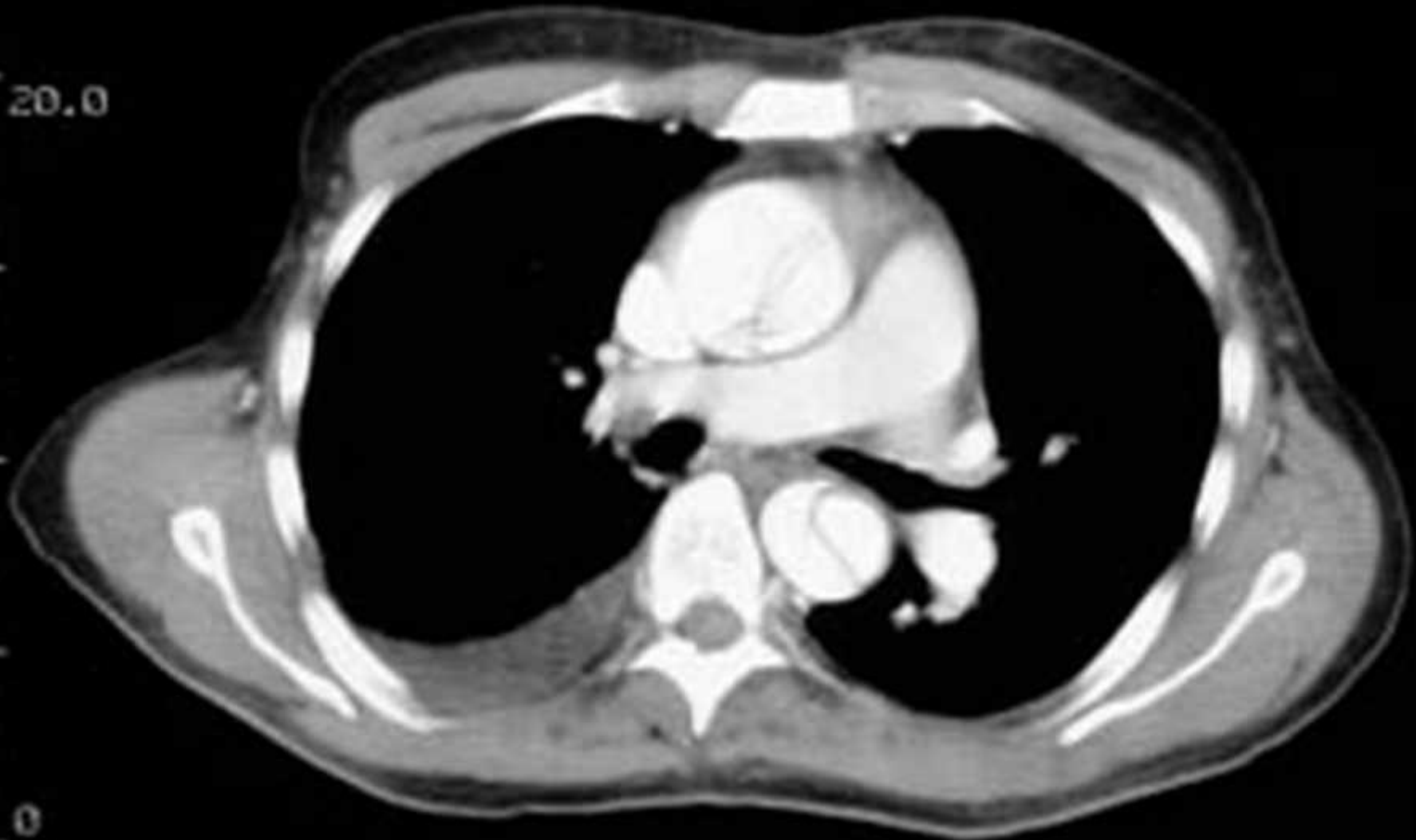
Plain anteroposterior view of the chest demonstrates
a wide mediastinum

33

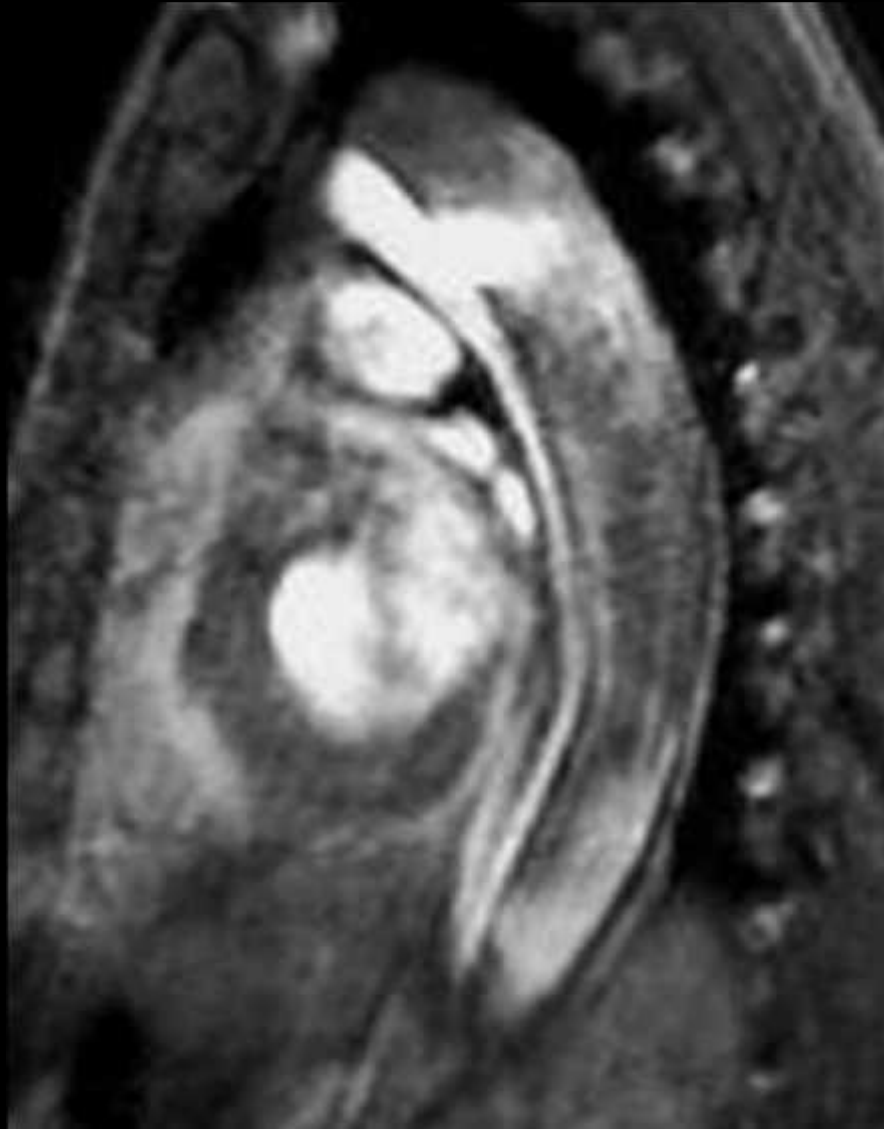
20.0

0

111



Sagittal gradient-echo MRI image obtained in early systole shows a jet of blood flowing through the intimal tear from the smaller anterior true lumen into the larger posterior false lumen.



Summary

Plain film indications

- Valvular Heart Disease—chamber enlargement
- Congestive Heart Failure
- Congenital Heart Disease—pulmonary vascularity
- Some Aortic Aneurysms
- Pulmonary AVM

Summary

CT Indications

- Coronary artery calcification—screening test for coronary artery disease particularly
- Cardiac Masses
- Pericardial disease
- Pulmonary AVM
- Aortic aneurysms or dissections

Summary

MRI Indications

- Multiplanar imaging of cardiac anatomy and pathology
- Aneurysms and dissections
- Intracardiac thrombi and tumors
- Coronary artery disease
- Congenital heart disease

References

- Gunderman RB: Essential Radiology. The Circulatory System: The Heart and Great Vessels. Thieme 103-174
- Stanford W, Thompson BH: Imaging of Coronary Artery Calcification. Rad Clinics North Am 37#2:257-272, 1999
- Duerincikx AJ: Coronary MR Angiography: Rad Clinics North Am 37#2:273-318, 1999
- Lipton MJ, Coulden R: Valvular Heart Disease. Rad Clinics North Am 37#2:319-339, 1999