

# **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

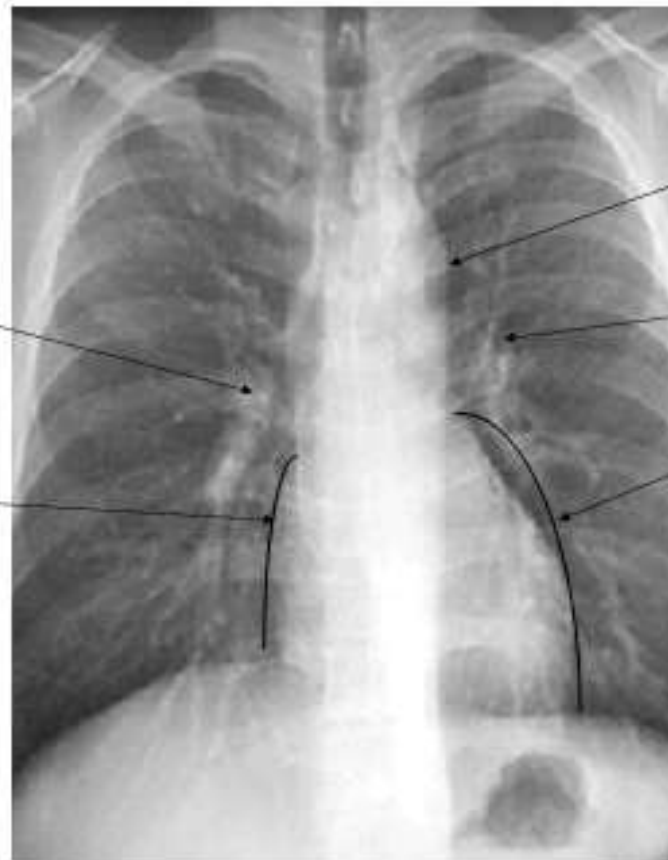
## Batas kanan:

- 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

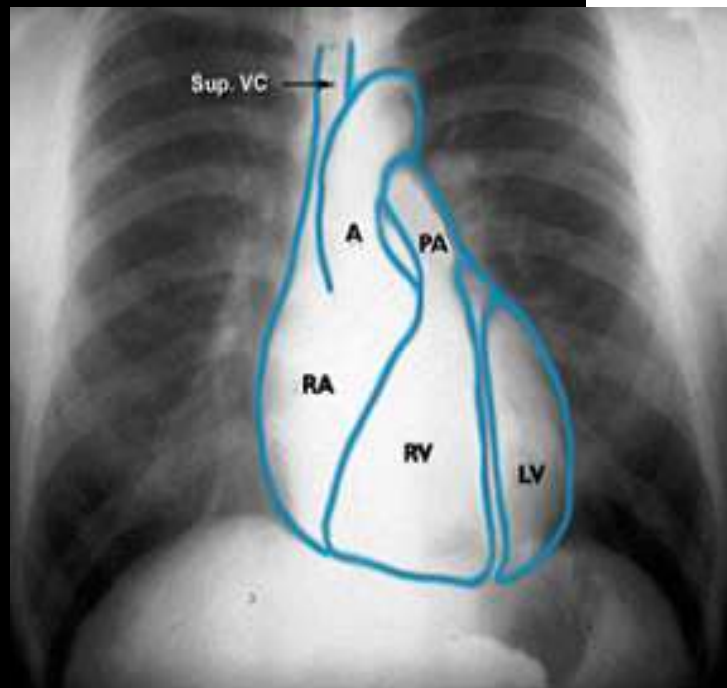
A

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.

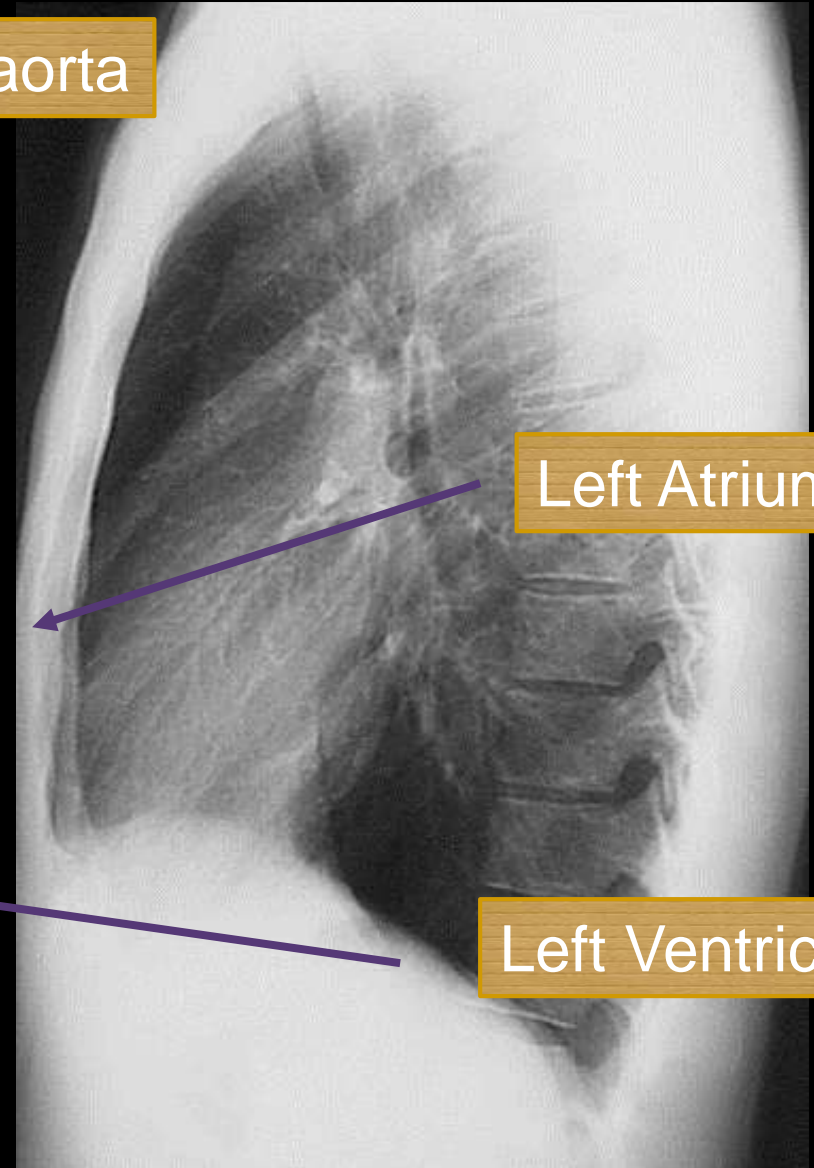
# PROYEKSI LATERAL

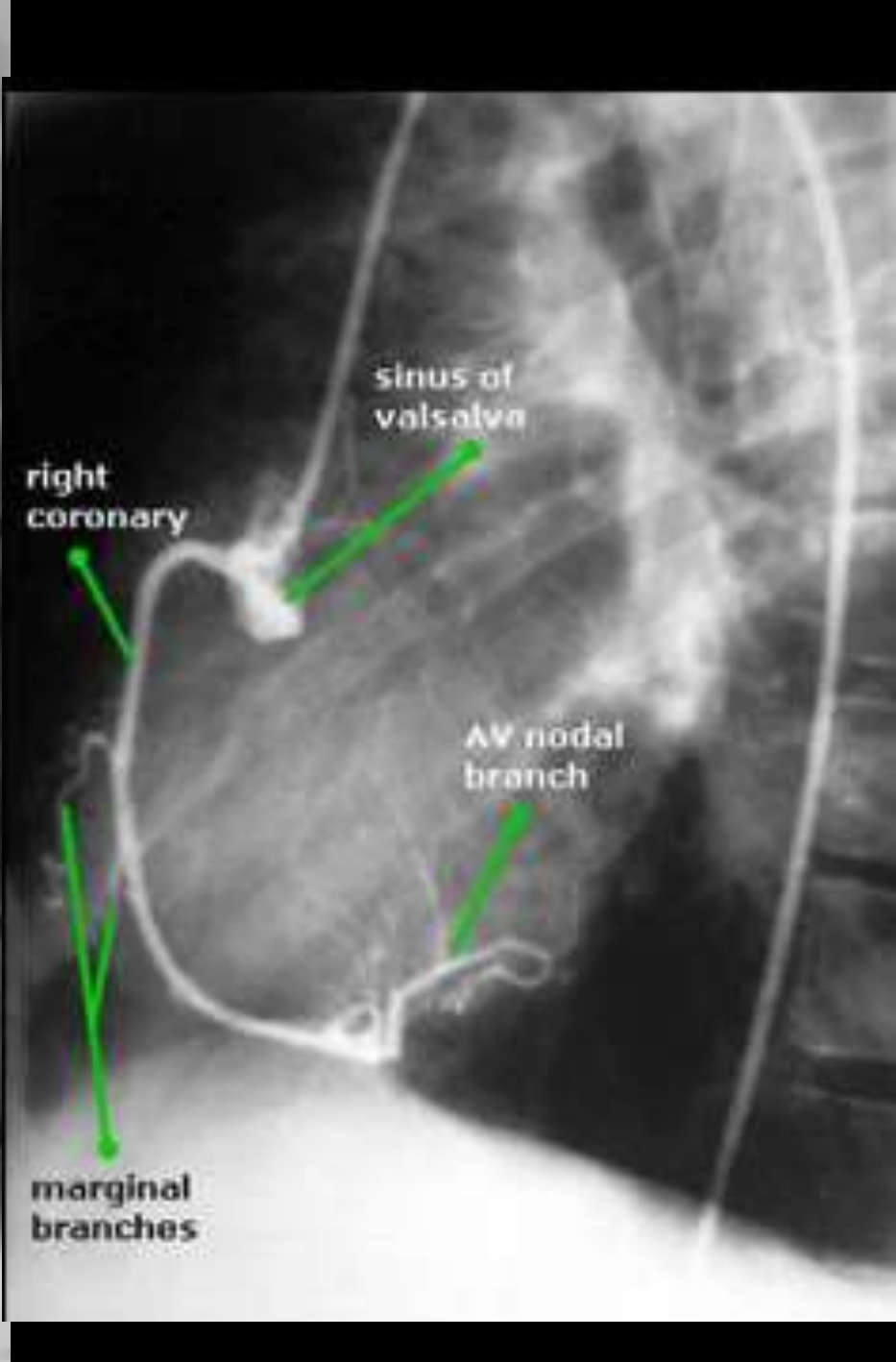
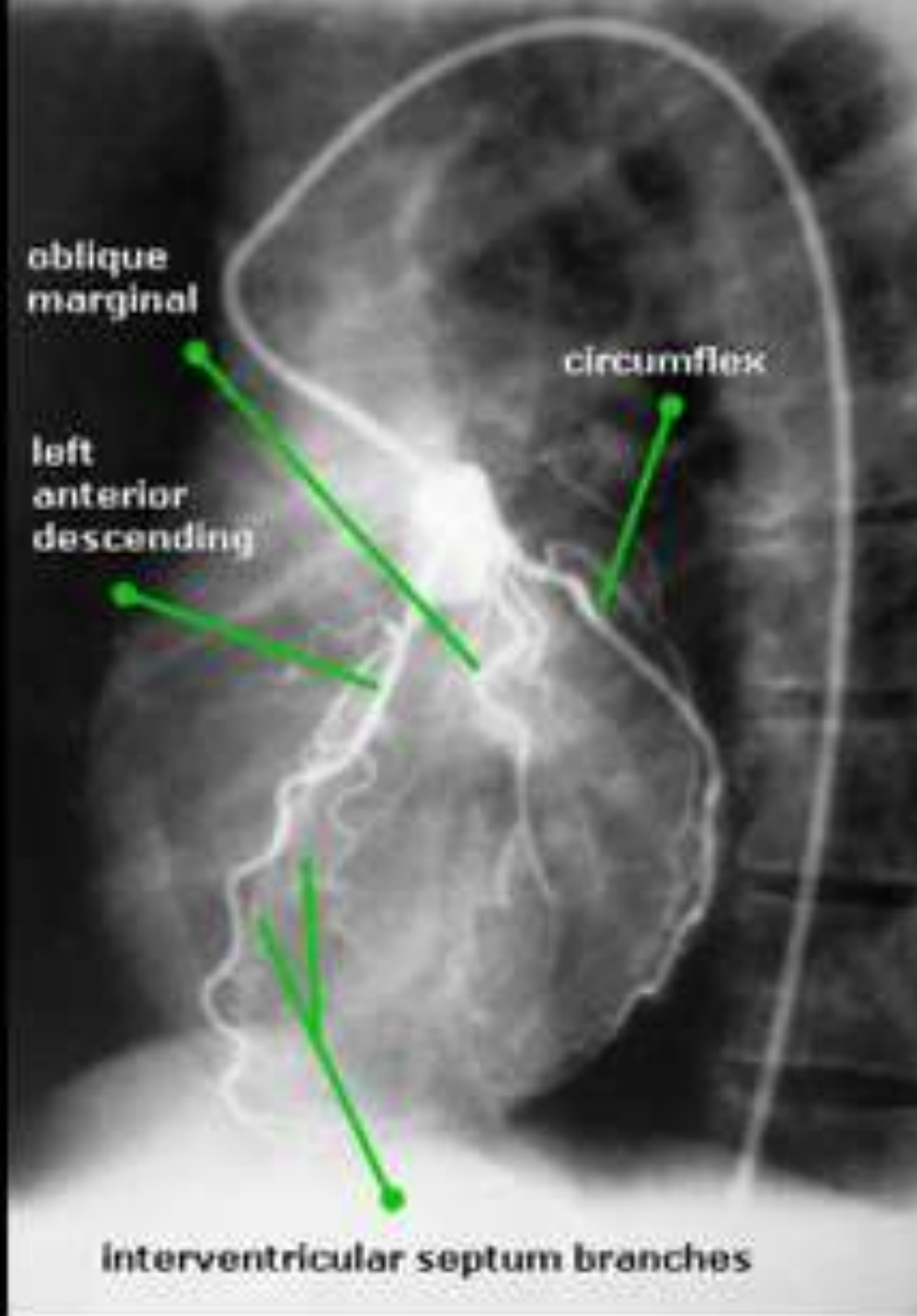
Ascending aorta

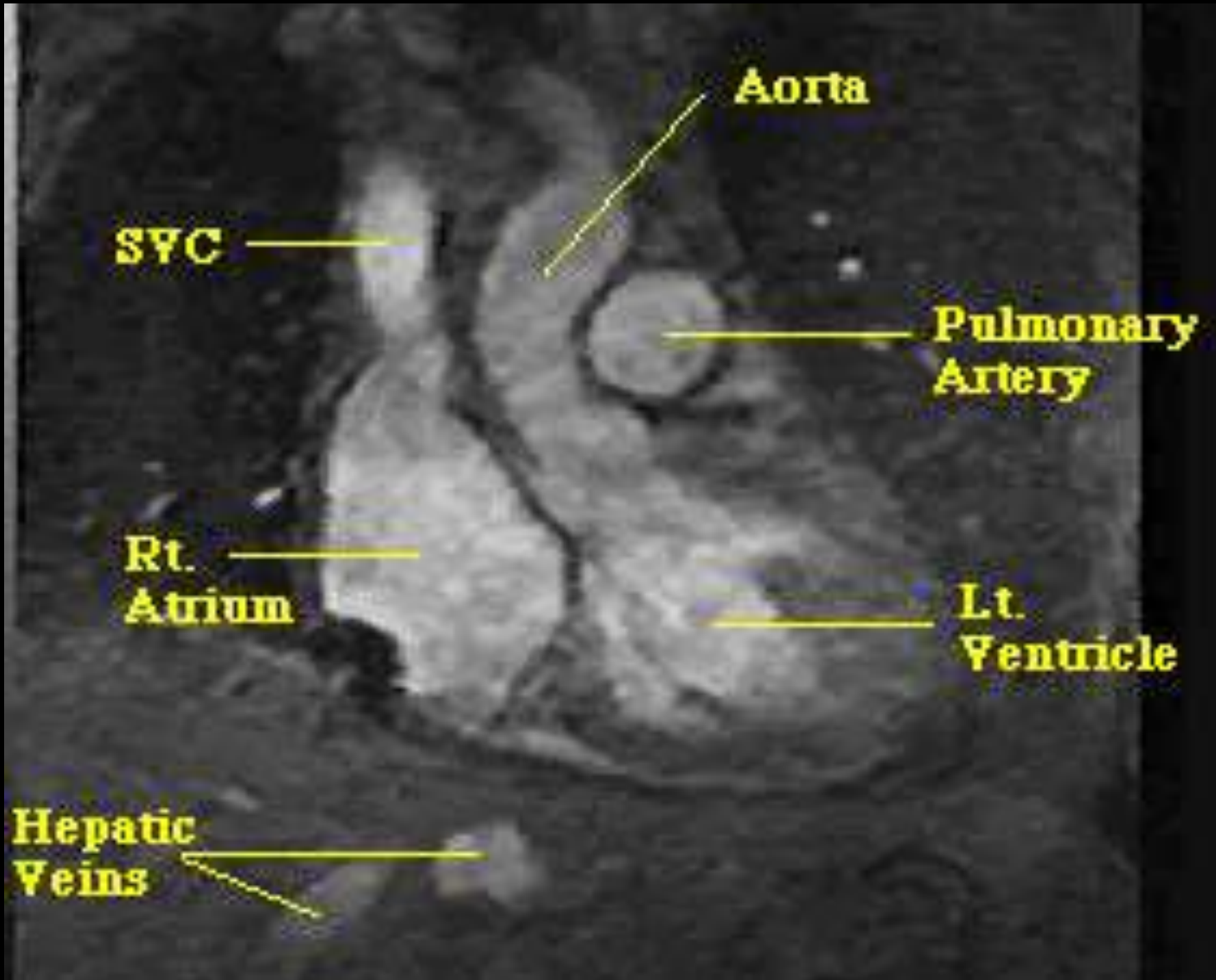
Left Atrium

Left Ventricle

Right  
ventricle







# PENILAIAN JANTUNG

- Konvigurasi.
- Letak/situs.
- Ukuran.

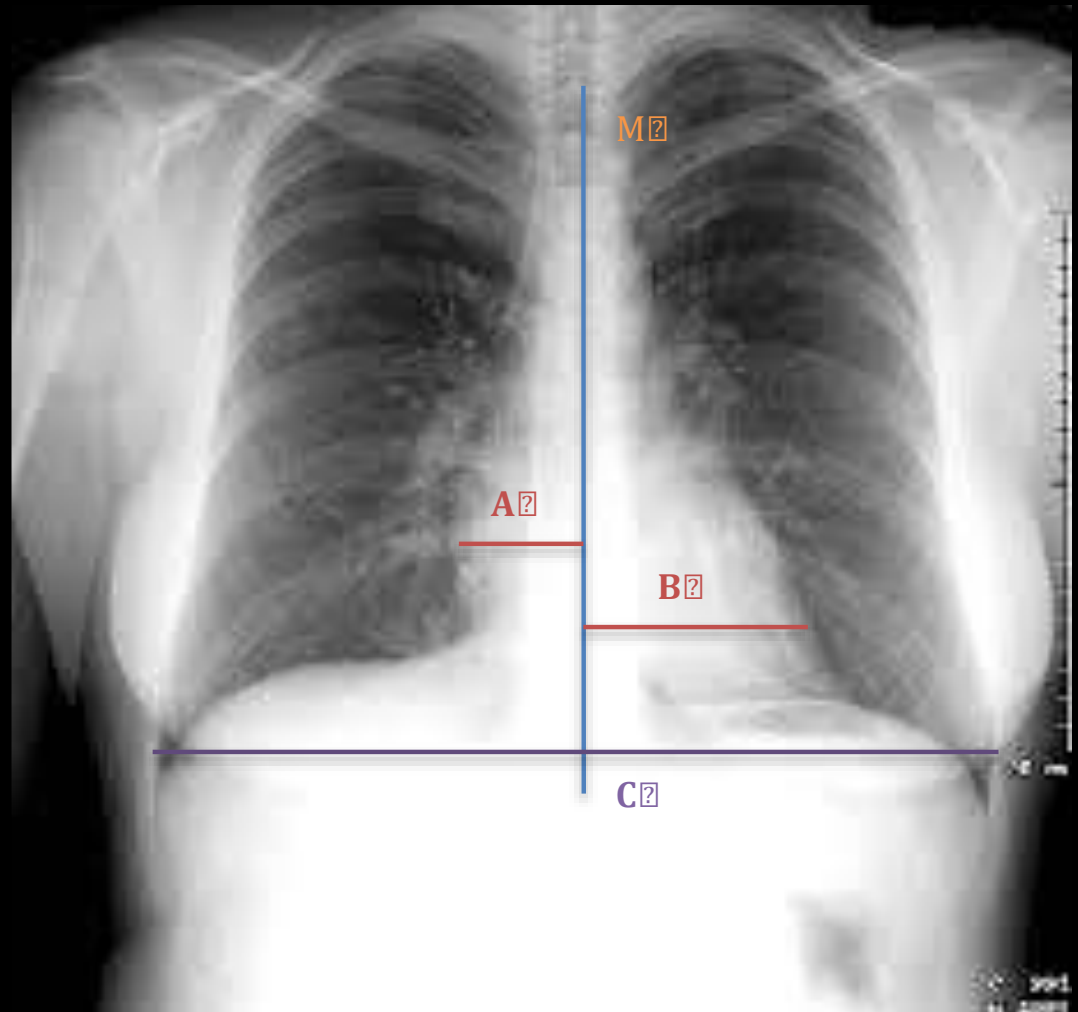
# CTR

**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  $\leq$  50 %

Kardiomegali:  $>$  50 %

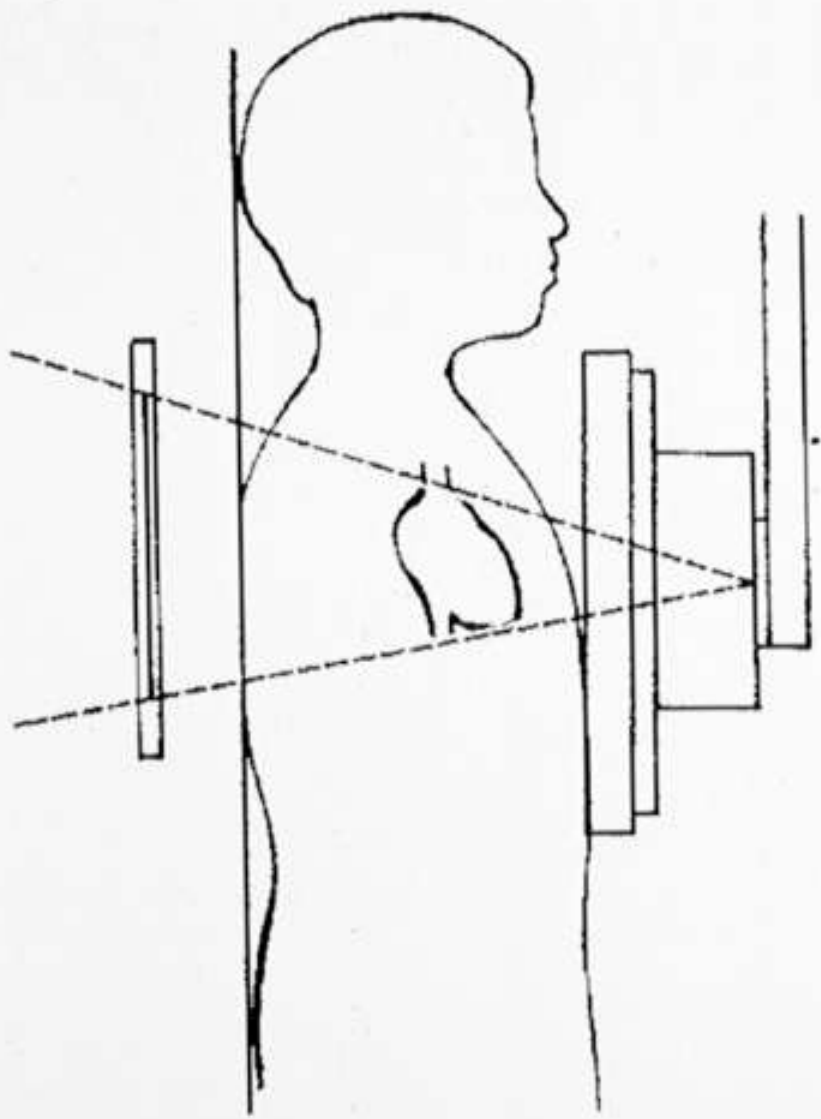
# Cardiothoracic Ratio—Pitfalls

- 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

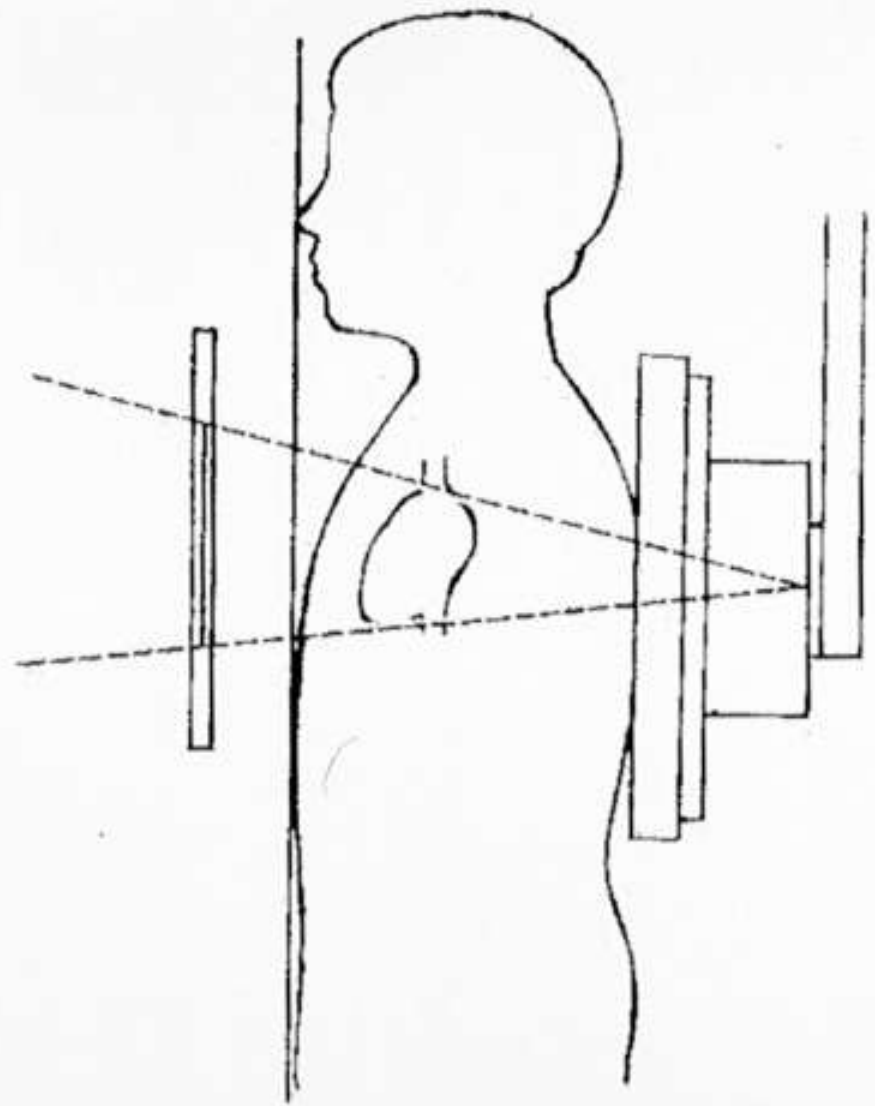


# PA vs. AP Chest

- 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

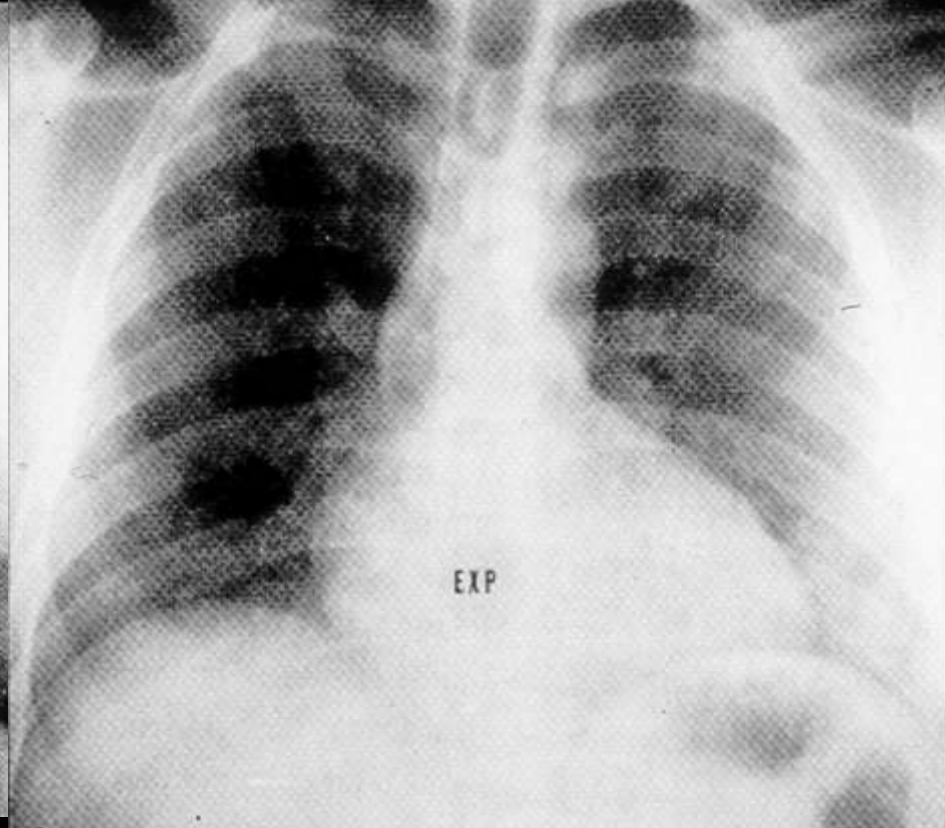
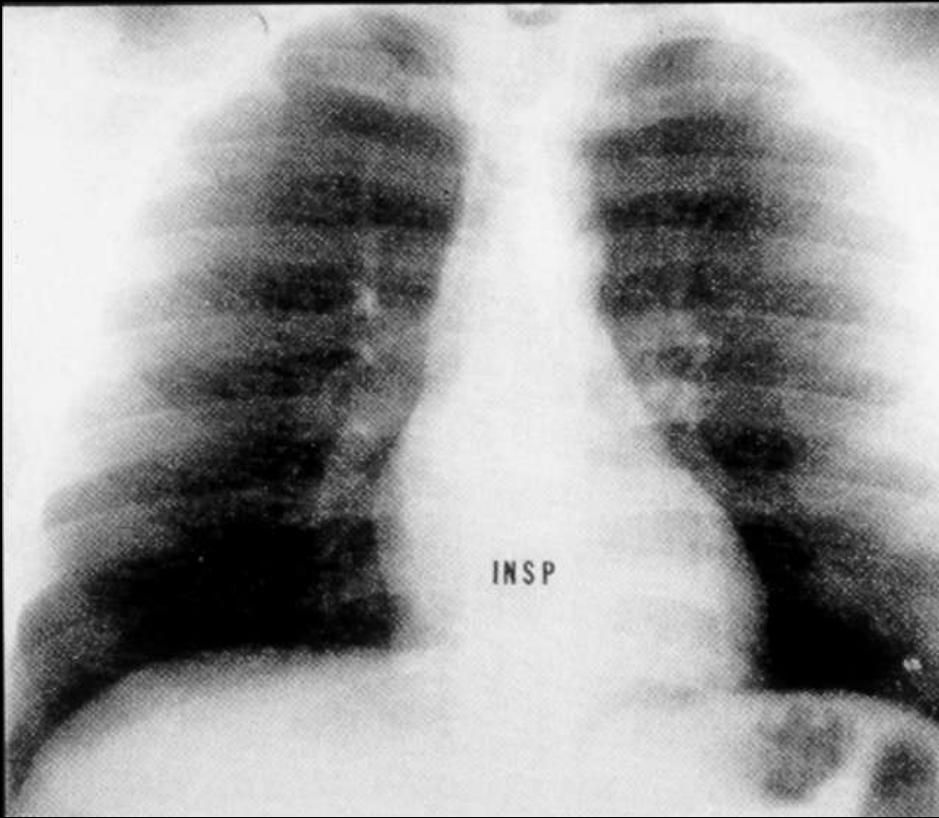


PA



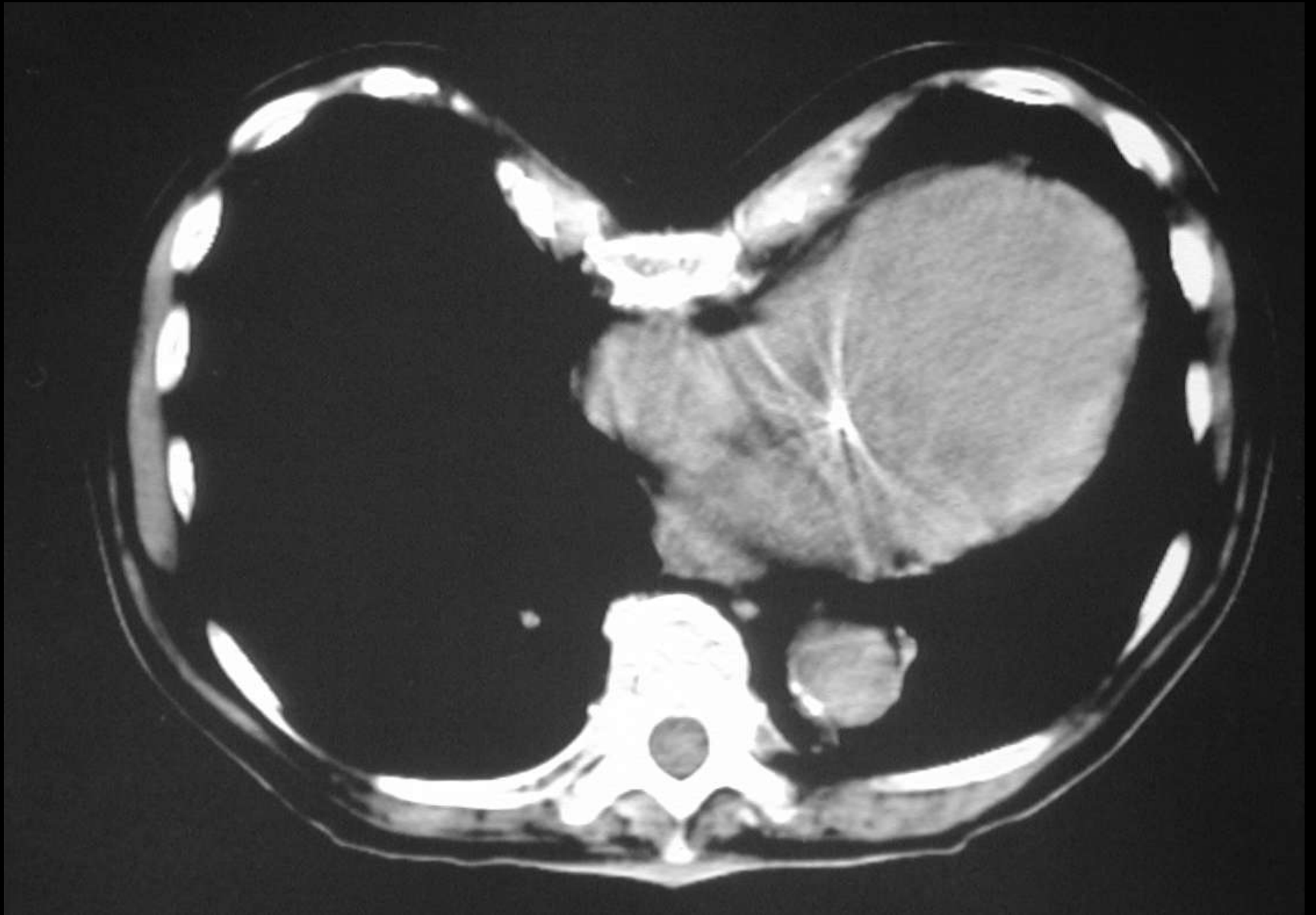
# INSPIRASI

# EKSPIRASI





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



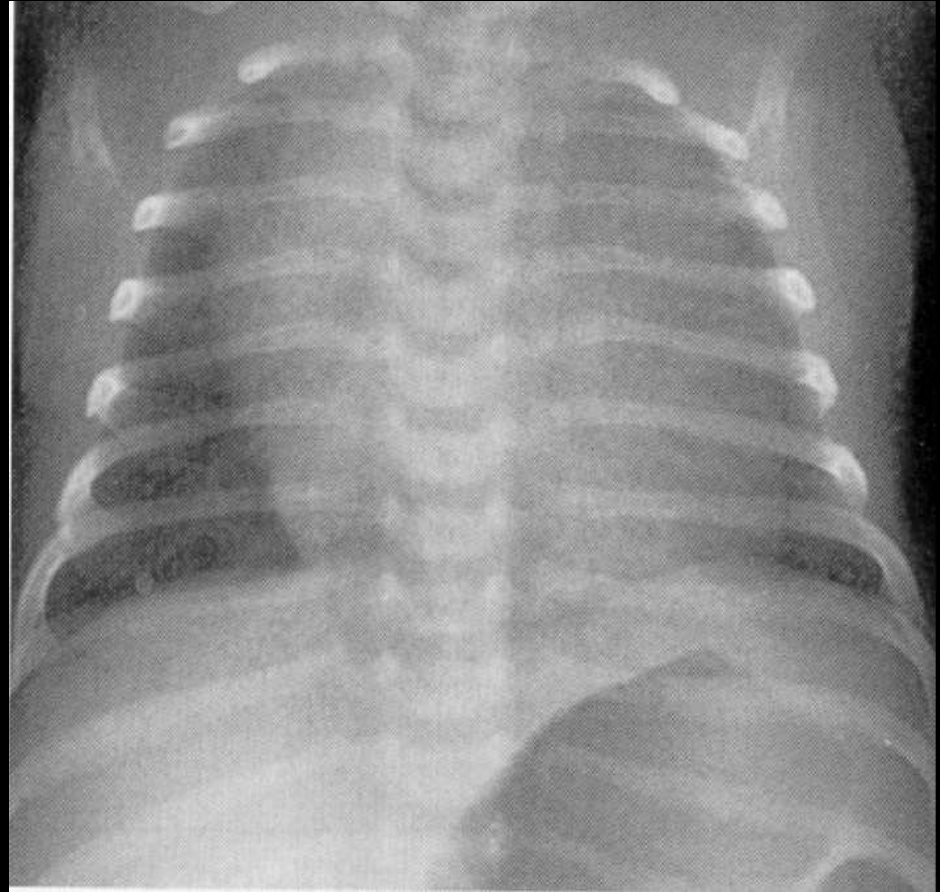
CT demonstrates why pectus excavatum causes widening of cardiac shadow



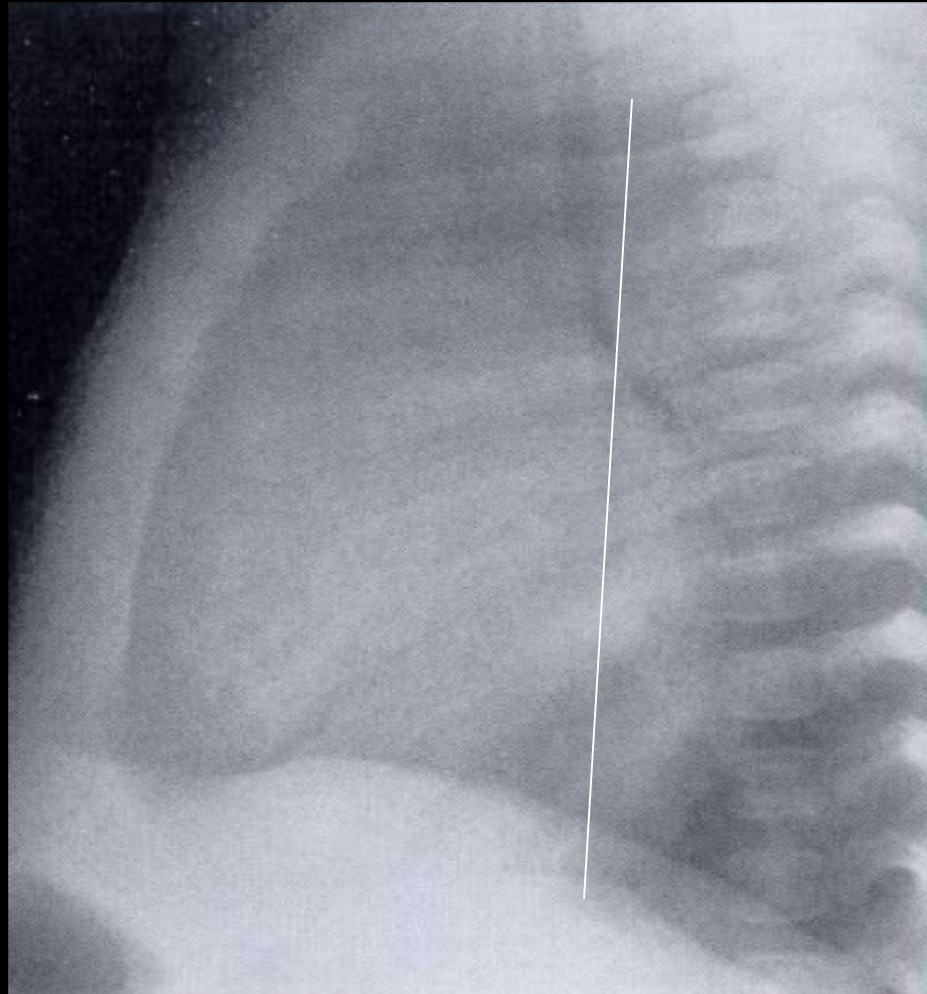
Patients with chronic obstructive pulmonary disease (COPD) usually have a narrow heart due to the hyperinflated lungs

# 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

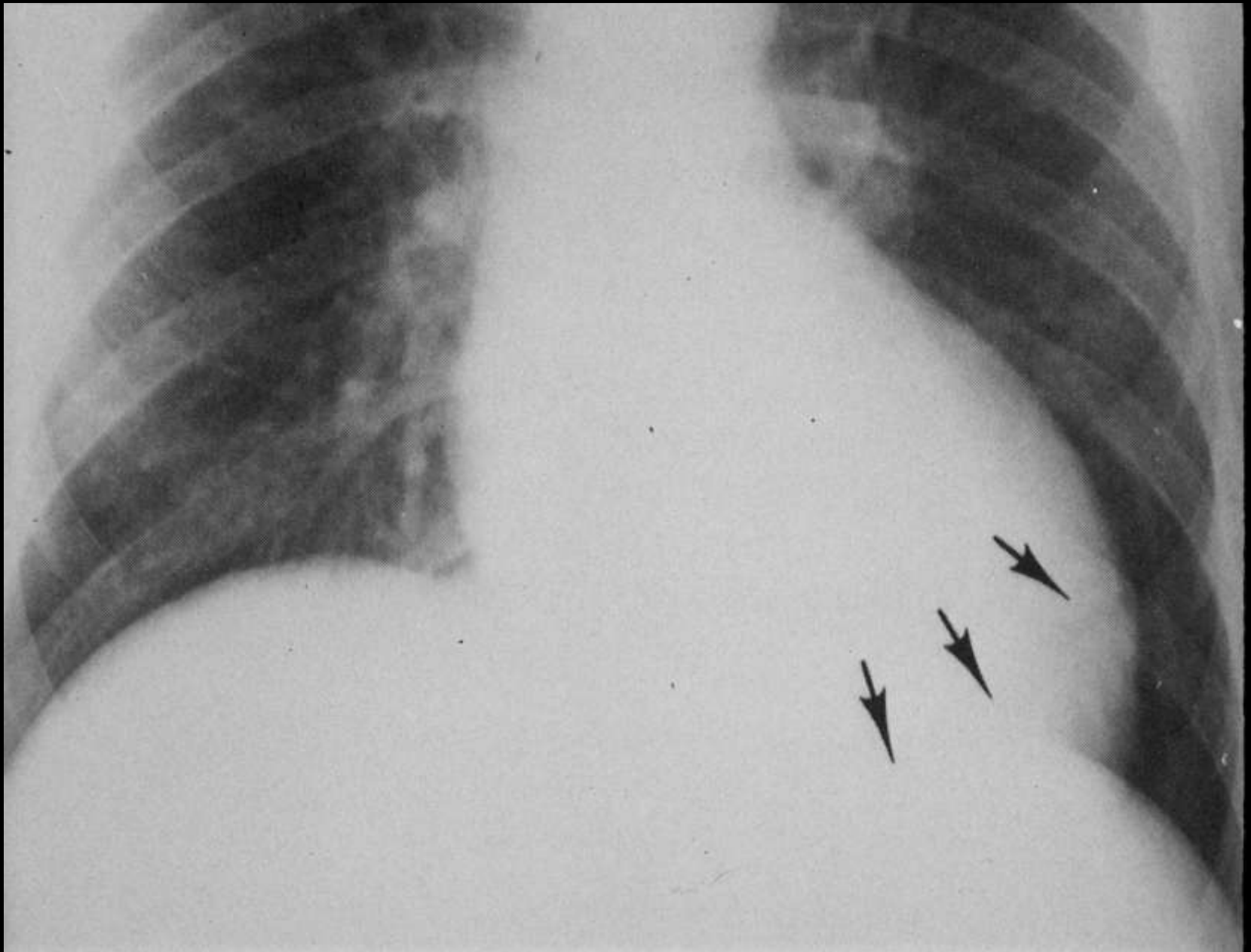
- ◆ Frequently causes cardiac enlargement
- ◆ Usually affects cardiac contour

# Plain Film Radiography

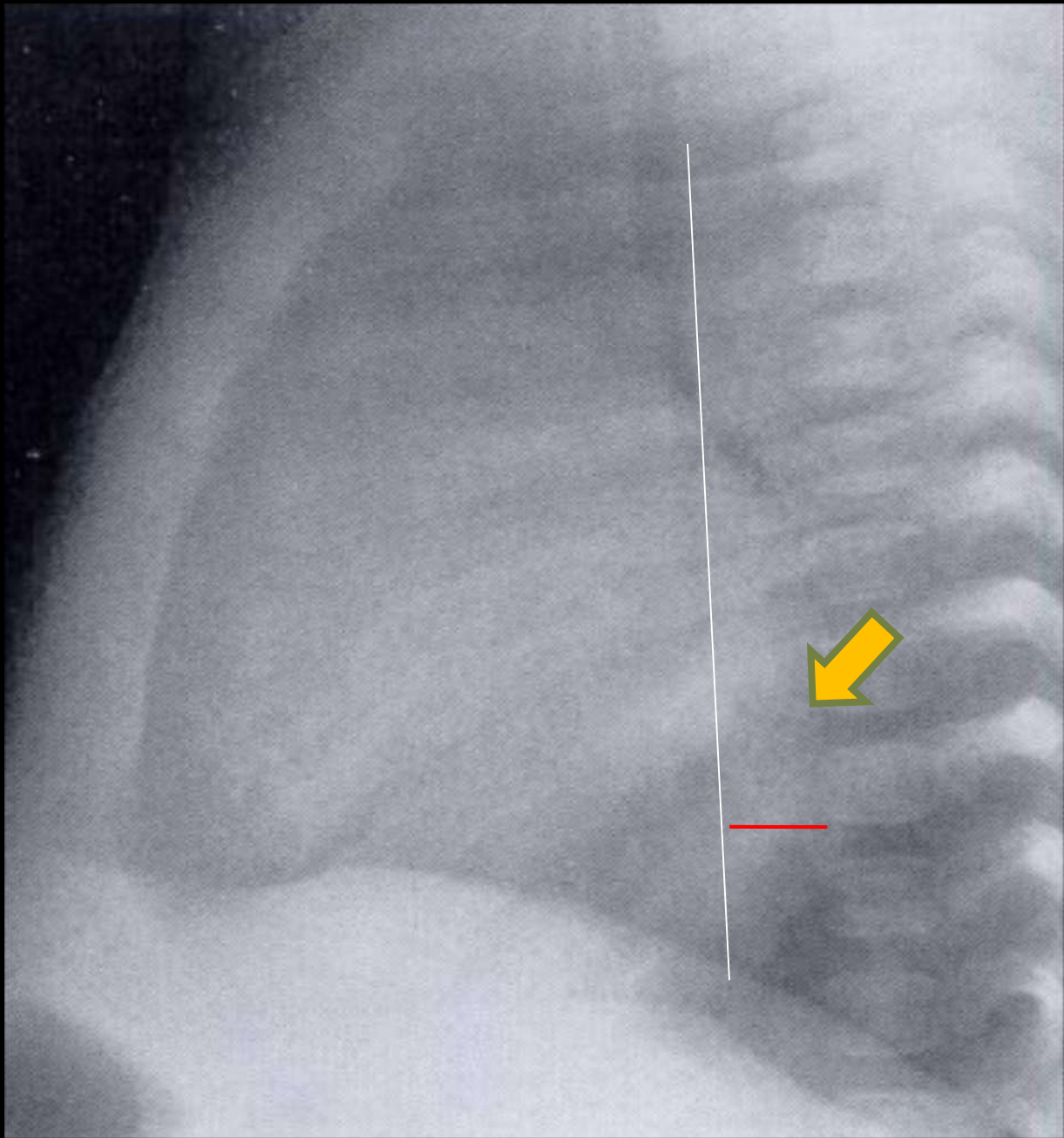
## Cardiac Enlargement

### 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

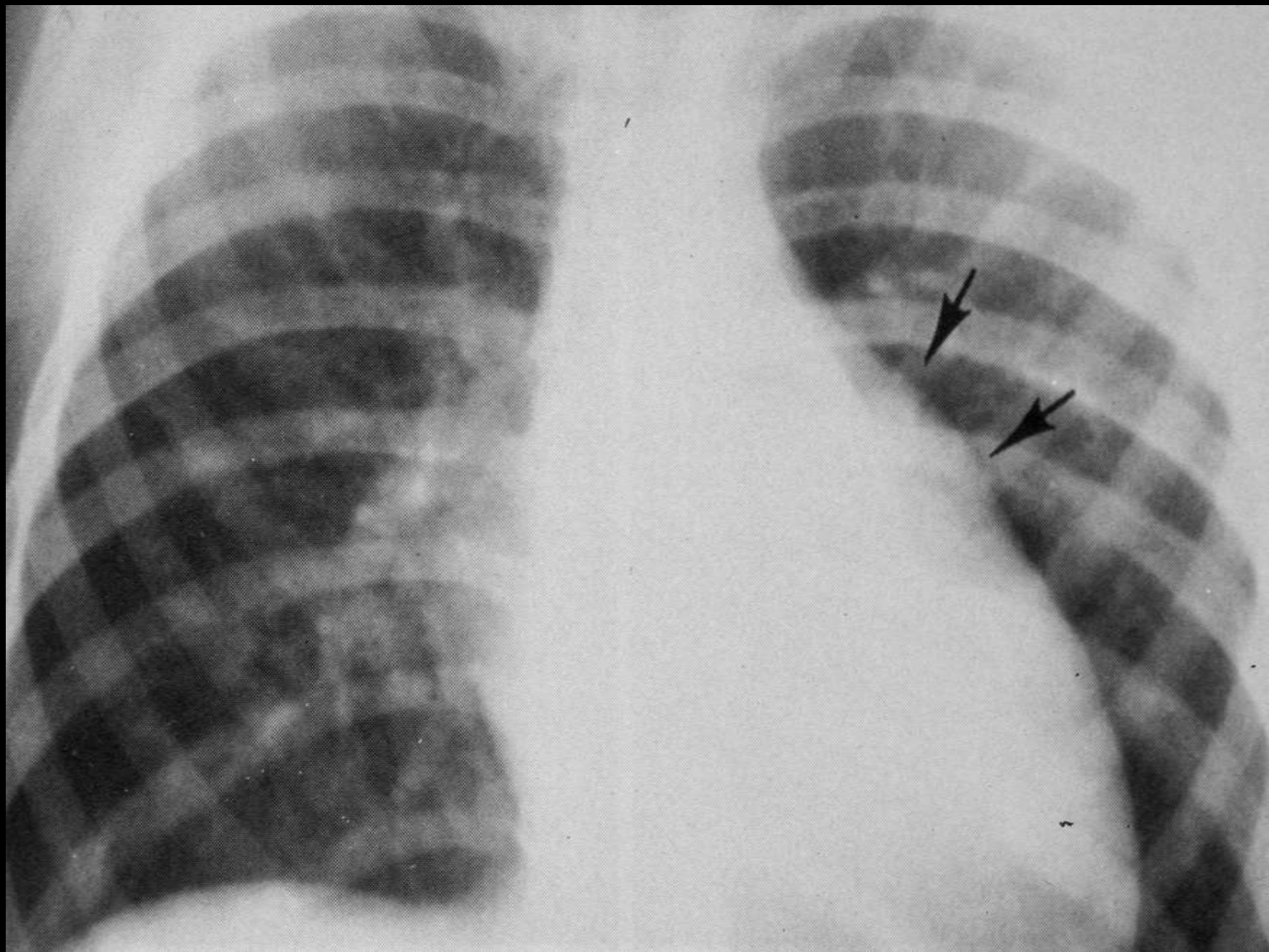


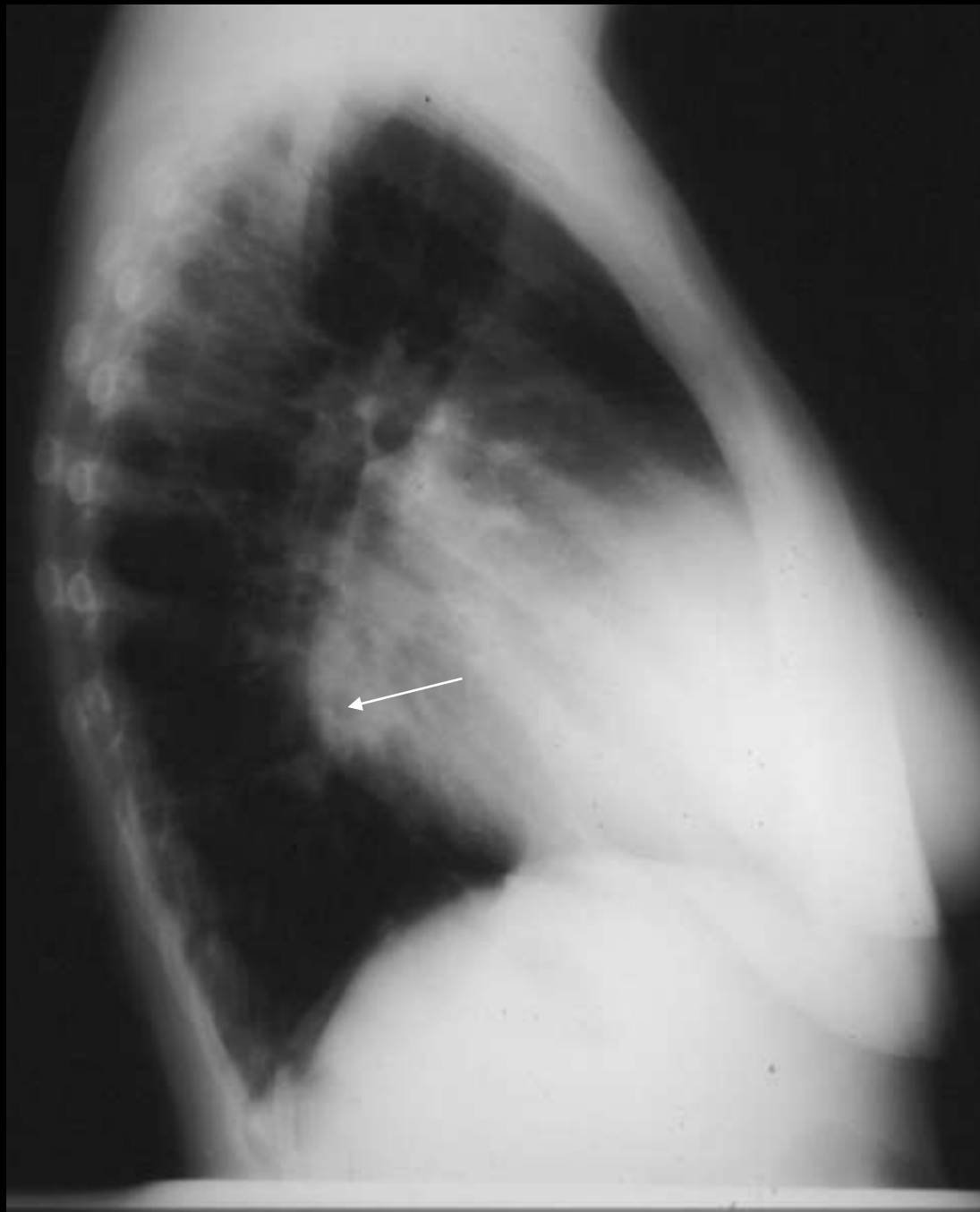
# Plain Film Radiography

## 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





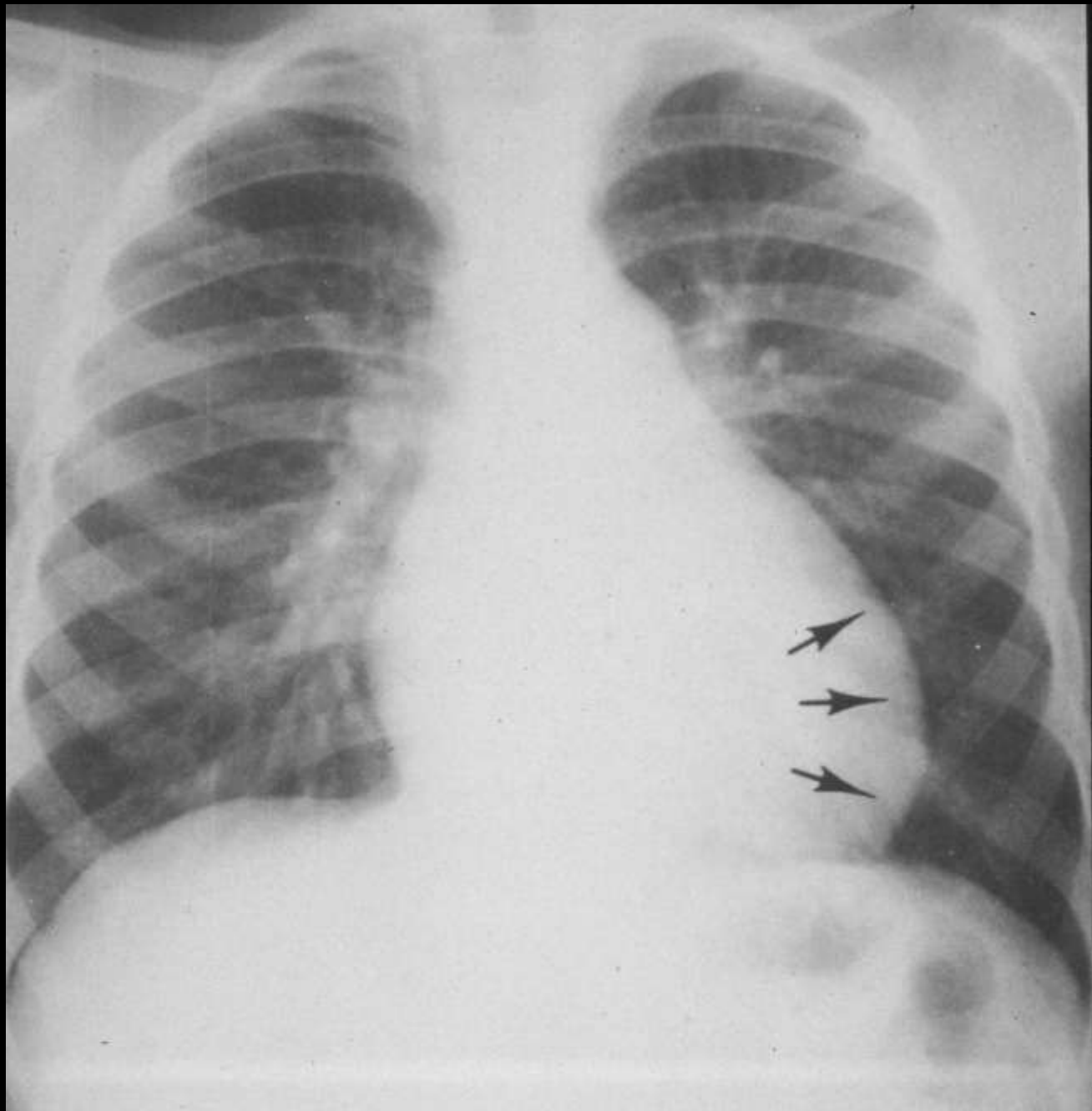


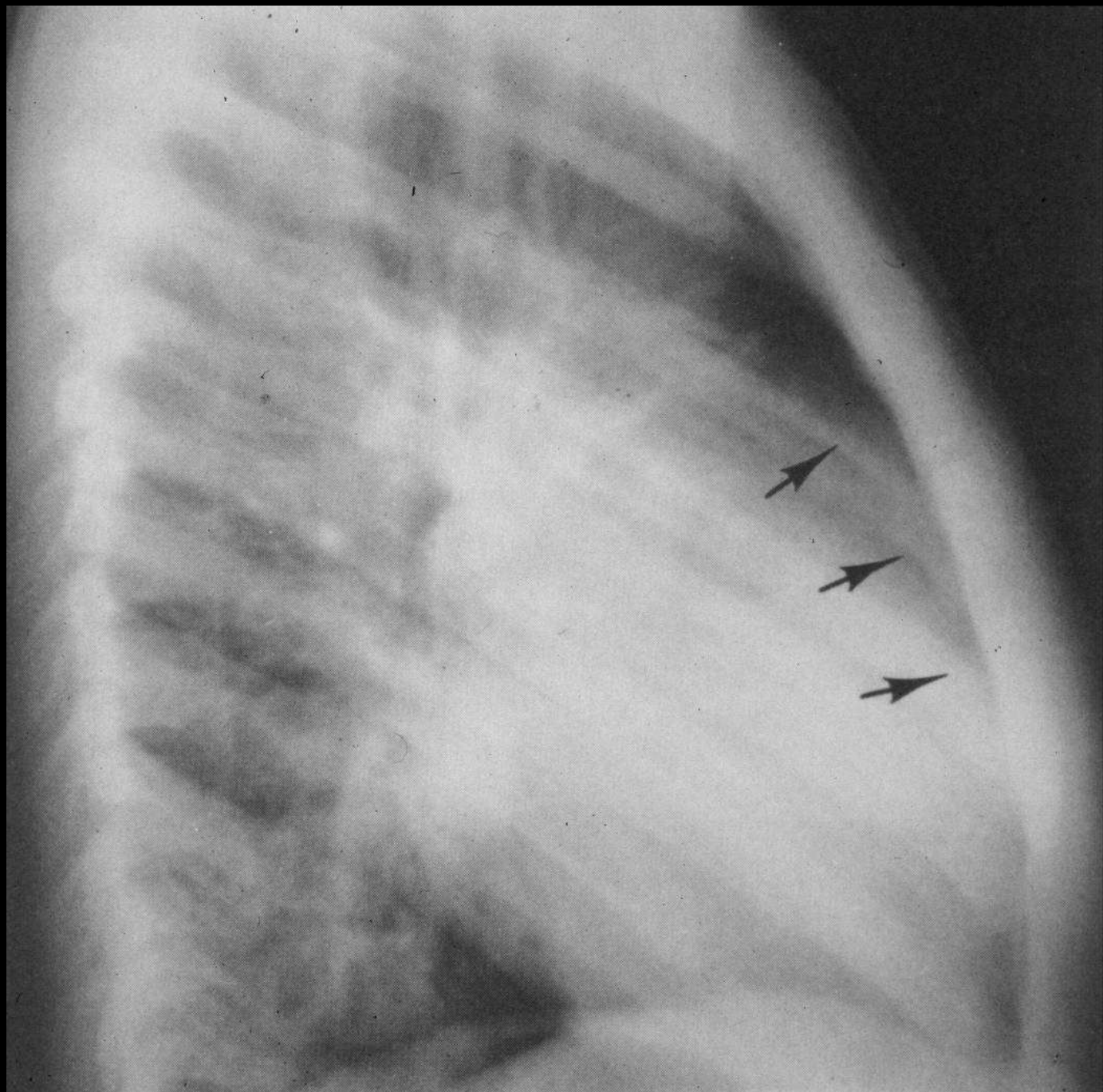
# Plain Film Radiography

## 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



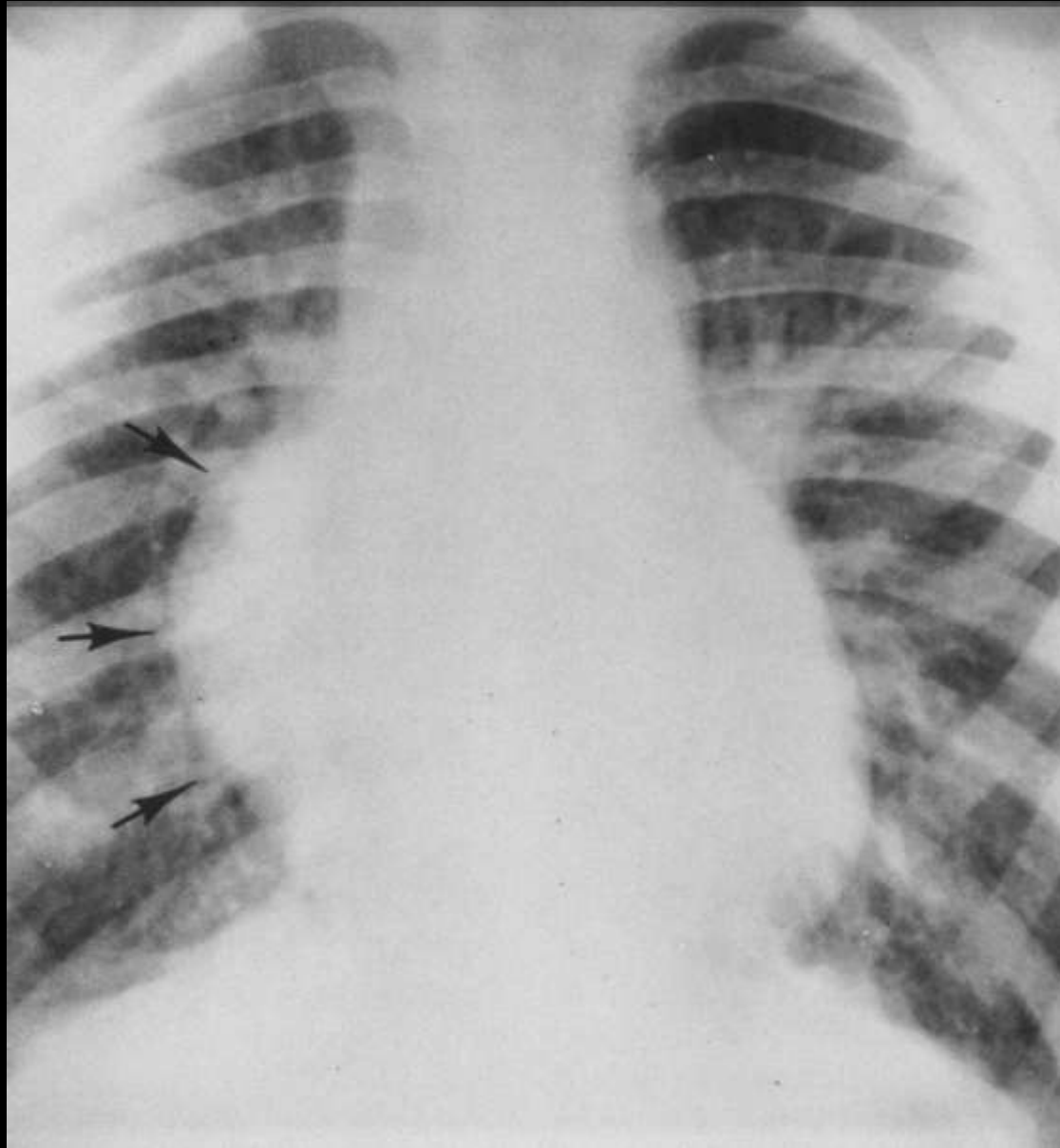


# Plain Film Radiography

## 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 ↑

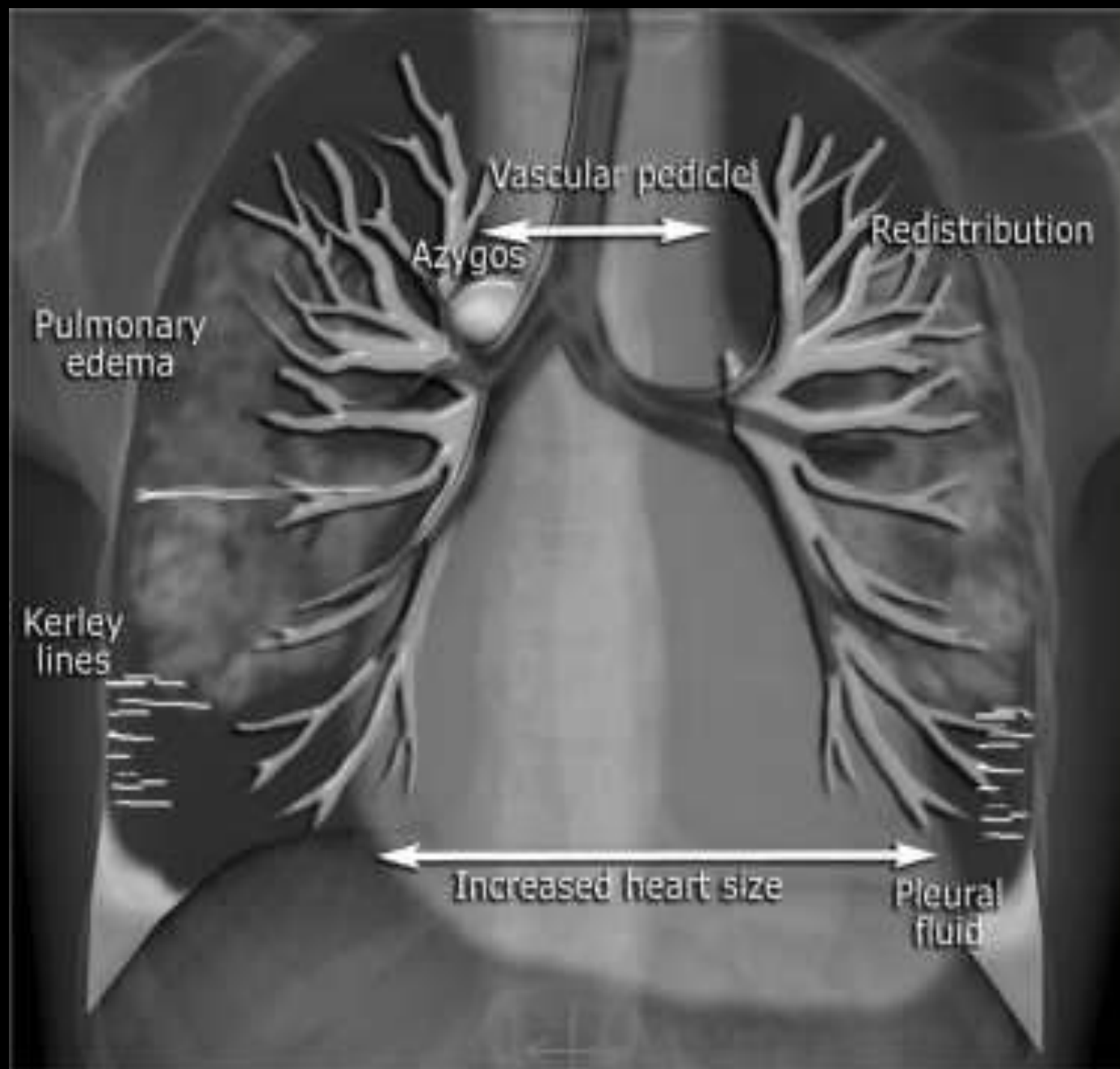
→ Dilatations of pulmonary vessels →

Leakage of fluid into interstitial & pleural space

→ Into alveoli resulting in pulmonary edema

## Stage of Congestive Heart Failure

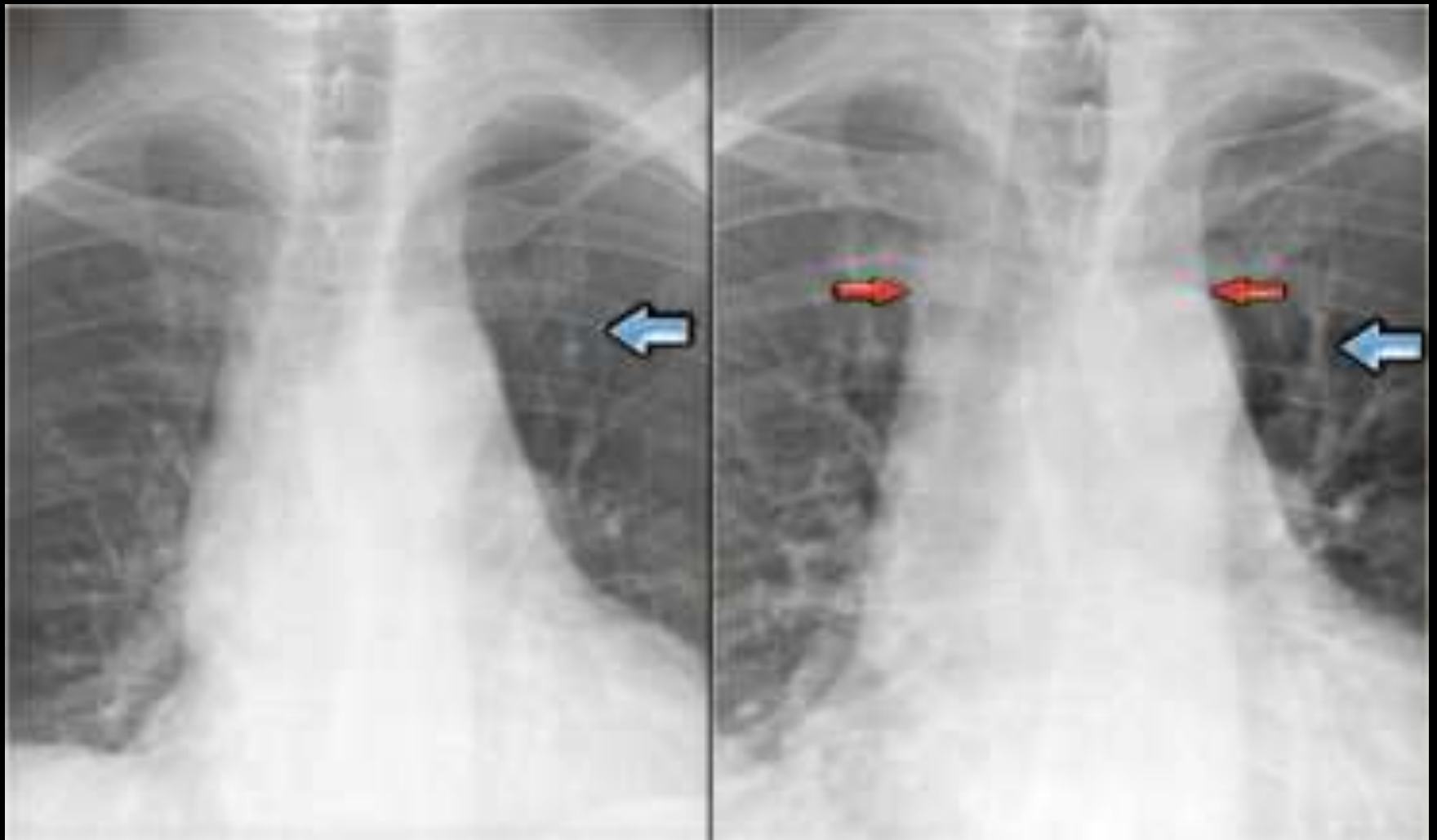
Stage 1 Redistribution PCWP 13-18 mmHg	→	Redistribution pulmonary vessels Cardiomegaly Broad vascular pedicle (non acute CHF)
Stage 2 Interstitial edema PCWP 18-25 mmHg	→	Kerley lines Peribronchial cuffing Hazy contour of vessels Thickened interlobar fissure
Stage 3 Alveolar edema PCWP > 25 mmHg	→	Consolidation Air bronchogram Cottonwool appearance Pleural effusion





# CHF—PA and Lat. Chest findings

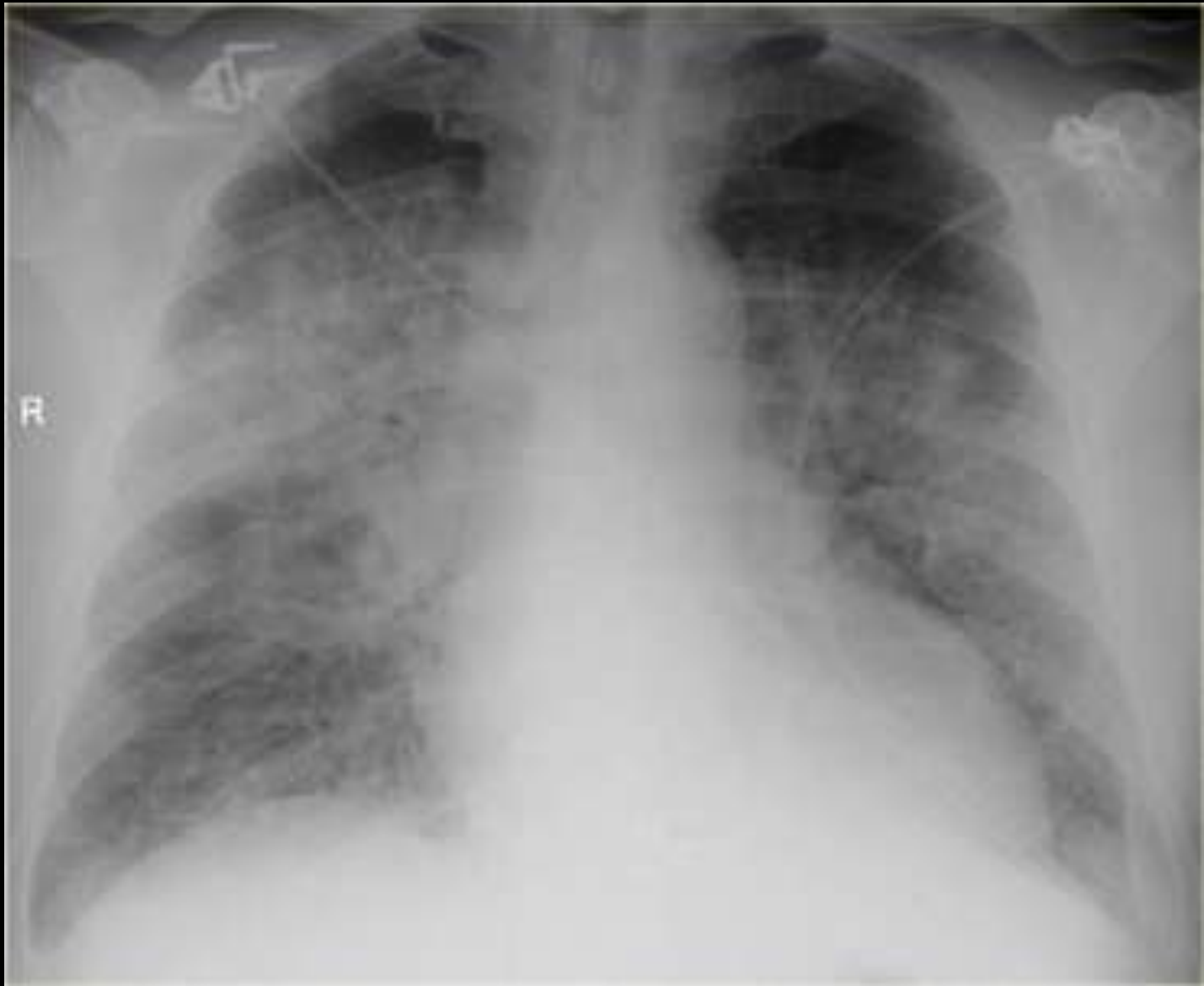
- ❑ Cardiomegaly
- ❑ Pulmonary vascular redistribution
- ❑ Vascular unsharpness due to interstitial edema
- ❑ Pleural effusion
- ❑ Septal lines
  - Kerley B—fluid distended interlobular septae
  - Kerley A—fluid distended central connective tissue septae



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

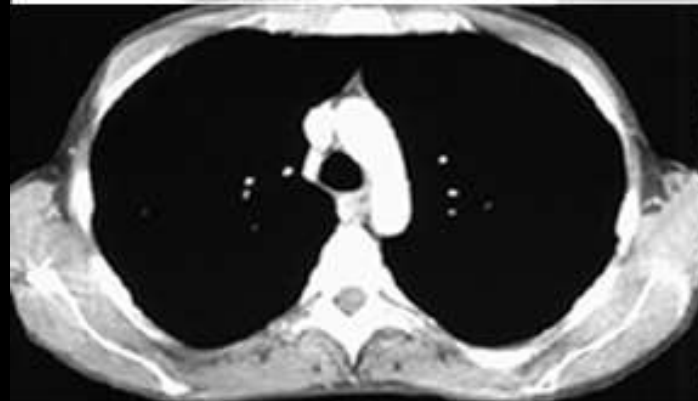
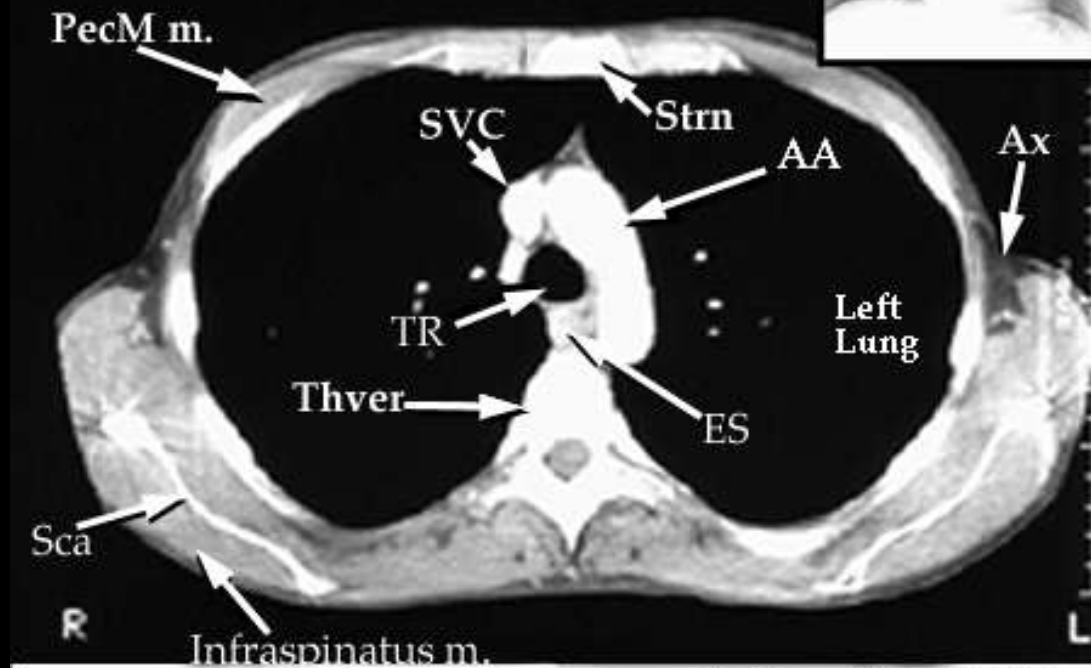


# Cardiac X-sectional imaging

- 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

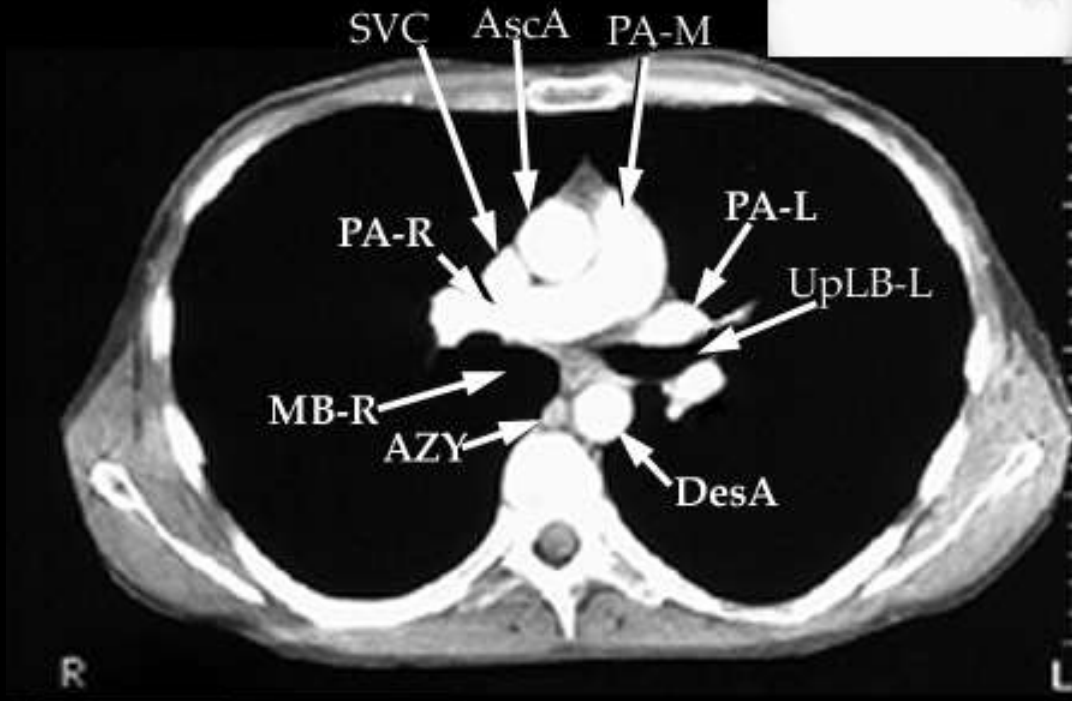


PecM m.=Pectoralis Major  
Muscle  
SVC=Superior Vena Cava  
Strn=Sternum  
AA=Aortic Arch  
Ax=Axilla  
TR=Trachea  
Thver=Thoracic Vertebra  
ES=Esophagus  
Sca=Scapula



CT #4

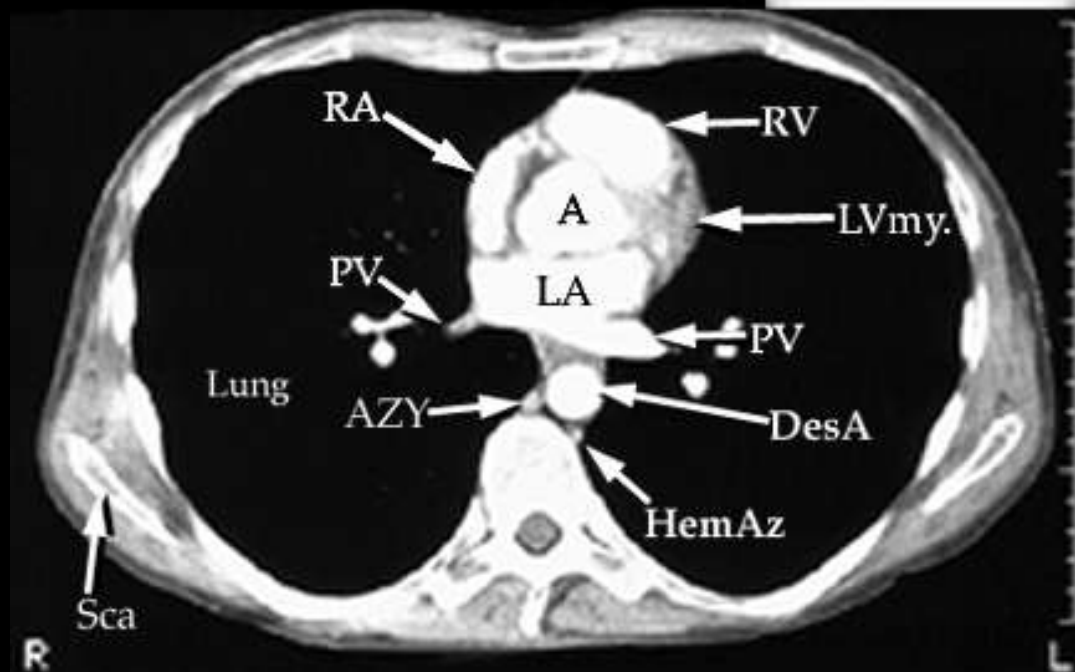
Axial-mediastinal window



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

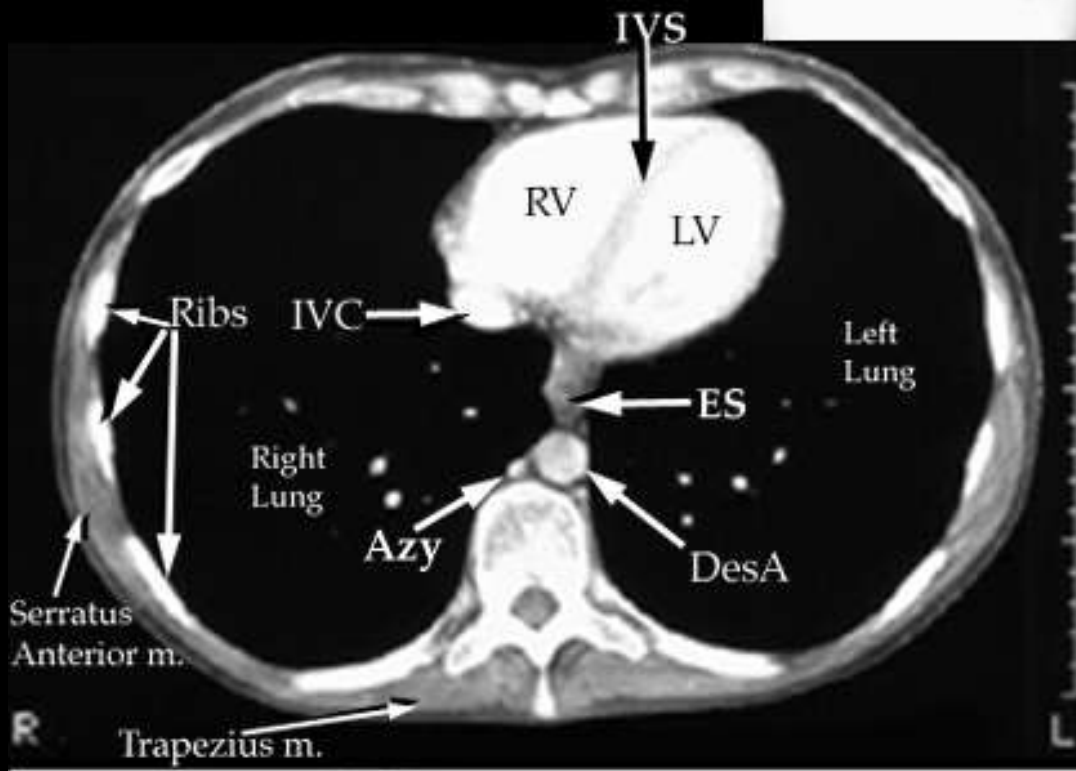
CT #6

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)

GE MEDICAL SYSTEMS  
LightSpeed Pro 16 CT01\_0C0  
Ex: 3795  
Se: 2  
In: 69  
SN 1173.56 Ax  
DFDV 25.0cm  
STND

A 139

RS HUSADA  
HAD1 SISWUJO,MR  
M69Y  
192  
Nov 19 2004  
08:40:04 AM  
SEG01 512 X 512

Mag = 1.00  
FL  
ROT

Severe CAD,calcium score  
> 500 units.

R  
7  
9

KV 120  
mA 320

Large  
2.500mm /8: 16 row  
Tilt: 0.0  
0.5s /CI:00.10

GE MEDICAL SYSTEMS  
LightSpeed Pro 16 CT01\_0C0  
Ex: 3795  
Se: 2  
In: 38  
SN 1141.08 Ax  
DFDV 25.0cm  
STND

A 139

RS HUS  
HAD1 SISWUJO,MR  
Large  
2.500mm /8: 16 row  
M Tilt: 0.0  
0.5s /CI:00.10  
Nov 19 2004  
08:40:00 AM  
SEG01 512 X 512

Mag = 1.00  
FL  
ROT

R  
7  
9

KV 120  
mA 320

Large  
2.500mm /8: 16 row  
Tilt: 0.0  
0.5s /CI:00.05

GE MEDICAL SYSTEMS  
LightSpeed Pro 16 CT01\_0C0  
Ex: 3795  
Se: 2  
In: 116  
SN 1201.08 Ax  
DFDV 25.0cm  
STND

A 139

RS HUSADA  
HAD1 SISWUJO,MR  
M69Y  
192  
Nov 19 2004  
08:40:06 AM  
SEG01 512 X 512

Mag = 1.00  
FL  
ROT

R  
7  
9

WW: 80

GE MEDICAL SYSTEMS  
LightSpeed Pro 16 CT01\_0C0  
Ex: 3795  
Se: 2  
In: 117  
SN 1201.58 Ax  
DFDV 25.0cm  
STND

A 139

RS HUSADA  
HAD1 SISWUJO,MR  
M69Y  
192  
Nov 19 2004  
08:40:08 AM  
SEG01 512 X 512

Mag = 1.00  
FL  
ROT

KV 120  
mA 320

Large  
2.500mm /8: 16 row  
Tilt: 0.0  
0.5s /CI:00.10

GE MEDICAL SYSTEMS  
LightSpeed Pro 16 CT01\_0C0  
Ex: 3795  
Se: 2  
In: 20  
SN 1143.58 Ax  
DFDV 25.0cm  
STND

A 139

R  
7  
9

KV 120  
mA 320

Large  
2.500mm /8: 16 row  
Tilt: 0.0  
0.5s /CI:00.25

Mag = 1.00  
FL  
ROT

WW: 804/41



tn.HS,69<sup>th</sup>.  
Riwayat AMI,  
hiperlipidemi

# Rekomendasi penanganan pasien berdasarkan calcium score

Calcium score	risk	recommendation
0	no atherosclerotic plaque	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 : rutine check up

- ❖ Mild Coronary Artery Disease:

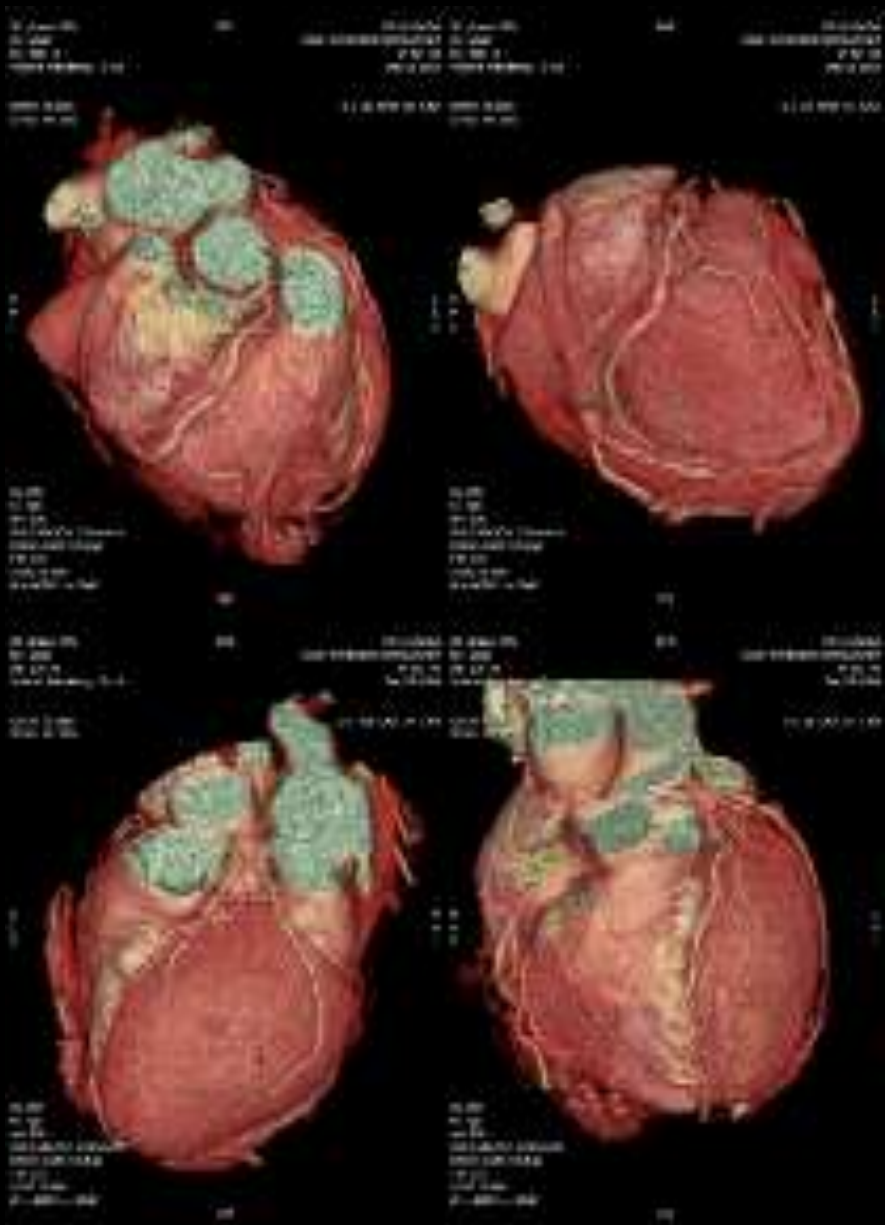
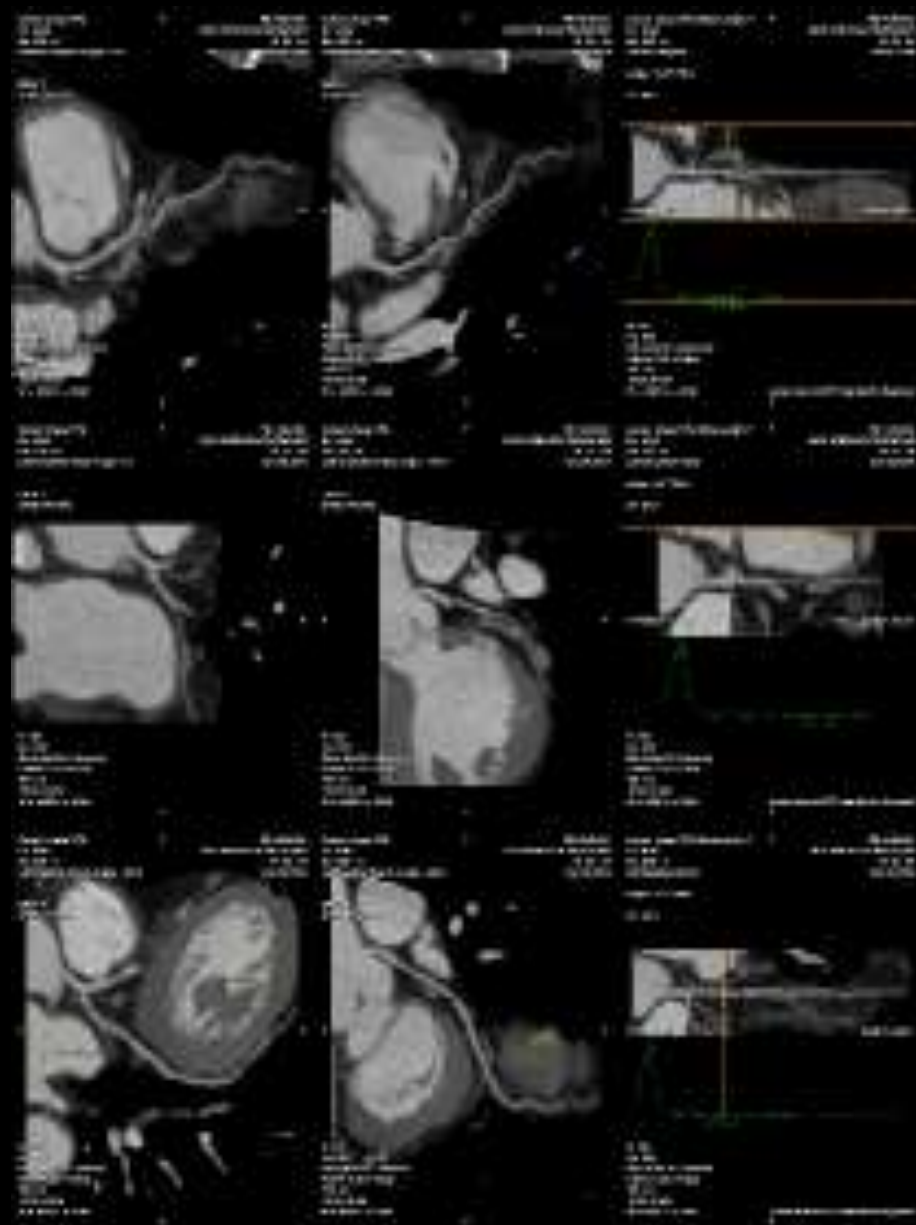
Recommend the patient to consult a cardiologist for risk factor assessment and possible statin + aspirin therapy.

- ❖ Moderate CAD:

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

- ❖ Severe CAD:

Recommend for heart catheterization



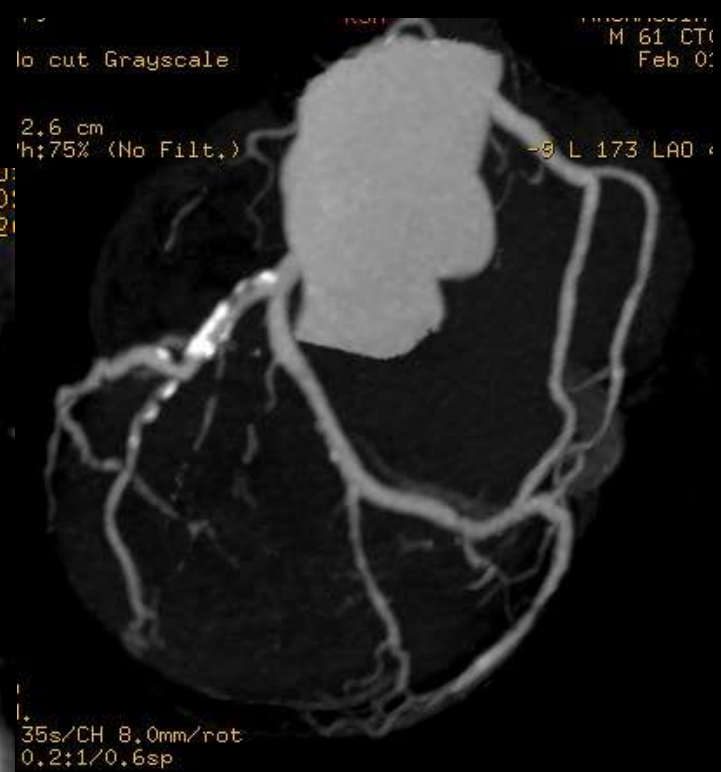
# Stenosis proximal LAD

EX: 2079  
Se: 3  
Left Anterior Descending Artery Angle: 0.0

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

MICHAEL J. J.  
M 61 CT070:  
Feb 01 21

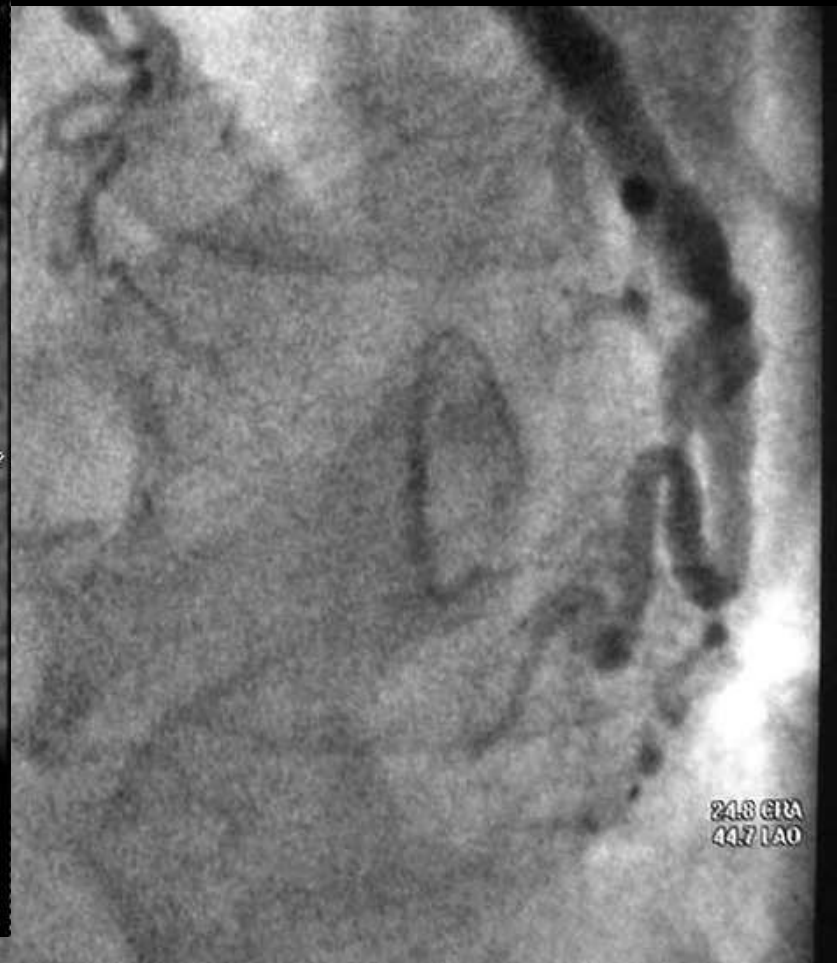


# Stenosis proximal LAD and LCX

Second Diagonal Artery, C.A.

JUL 10 2004

DFDV ?  
STND Ph:75%



*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



UNIVERSITY  
OF CHICAGO



# 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

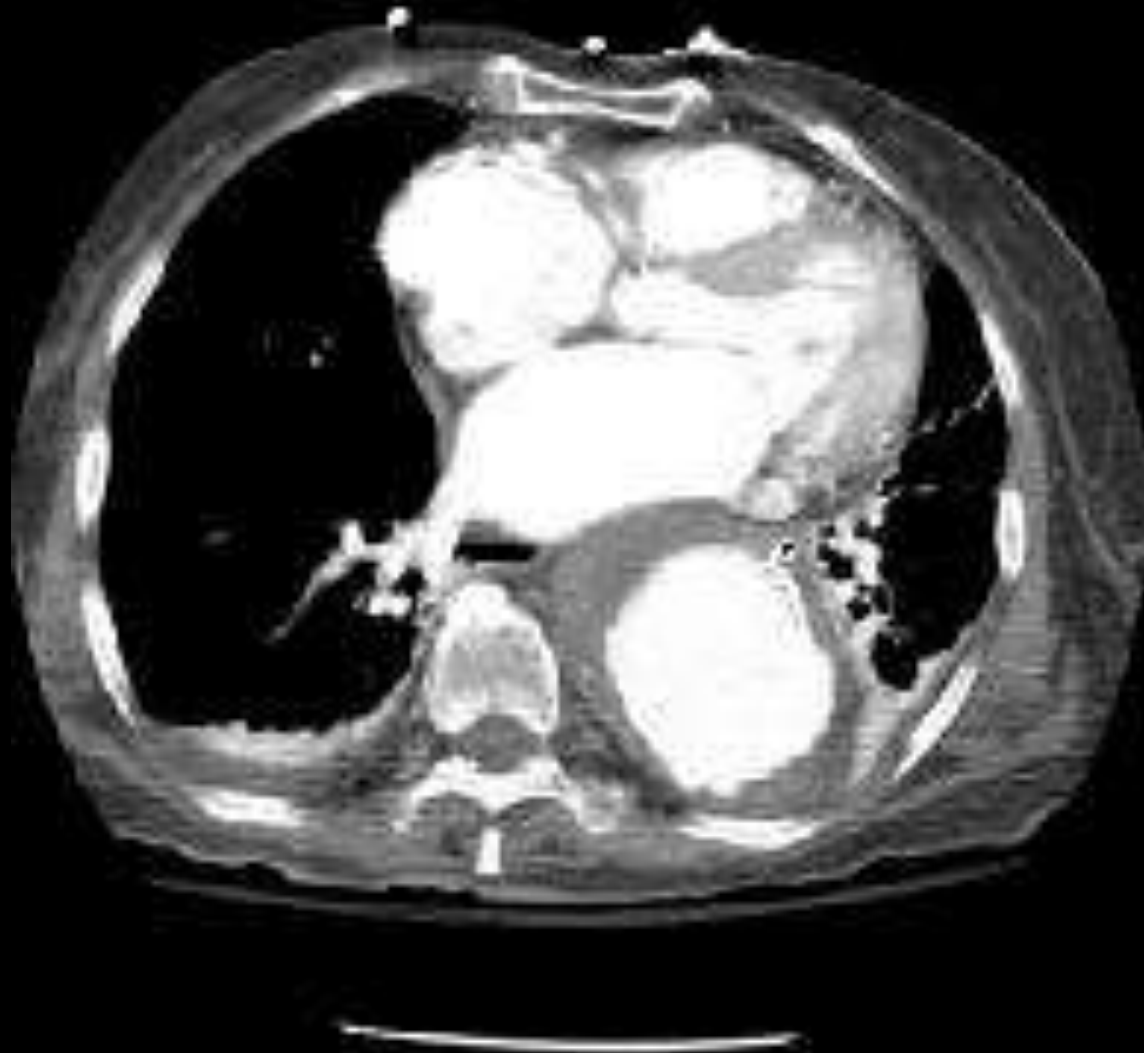
# Aortic Aneurysm or Dissection

- 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)



50. T1ax: 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

TH



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