# The ABC's of Heart Disease

In Slide Show mode, to advance slides, press spacebar
or click left mouse button

William Herring, M.D.

Albert Einstein Medical Center

Philadelphia, PA

With Acknowledgement

For Its Creation to

Bernard J. Ostrum, M.D.

# What It Is

- An approach
- For congenital or acquired heart disease in adults
- Asking systematic set of questions
- Answers based on certain fundamental observations
- Visible on frontal chest x-ray alone

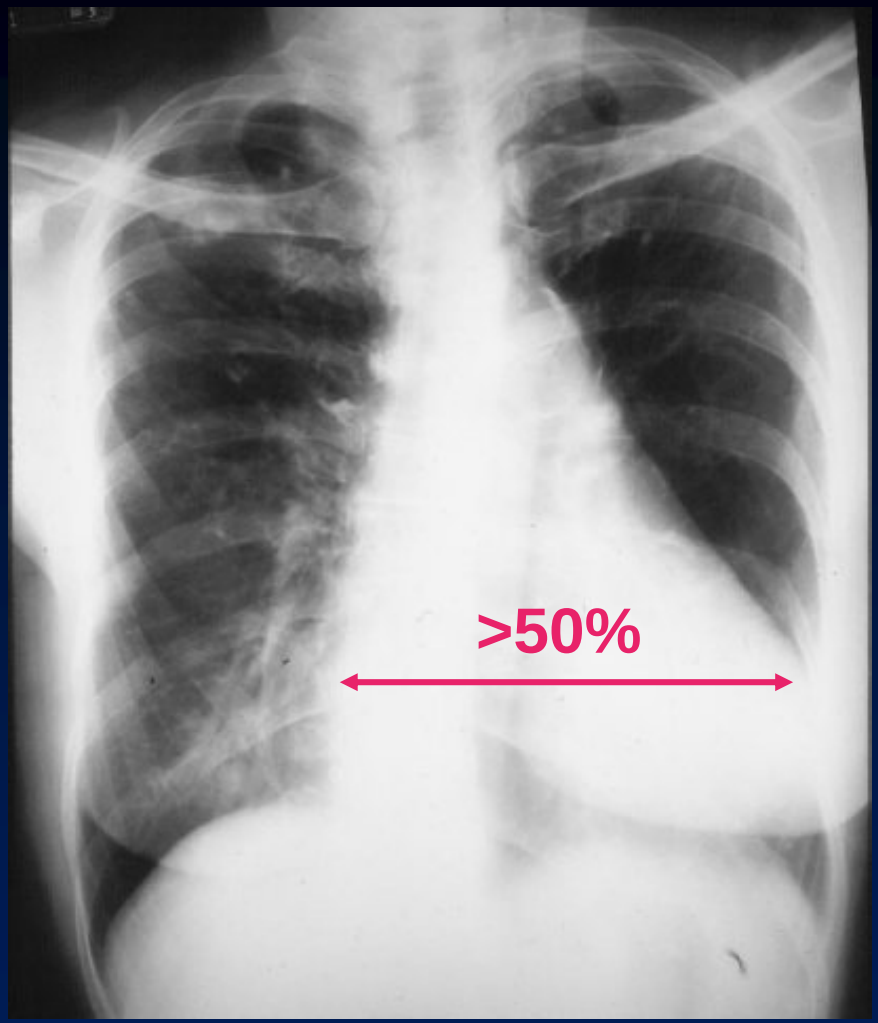
# Cardio-thoracic Ratio

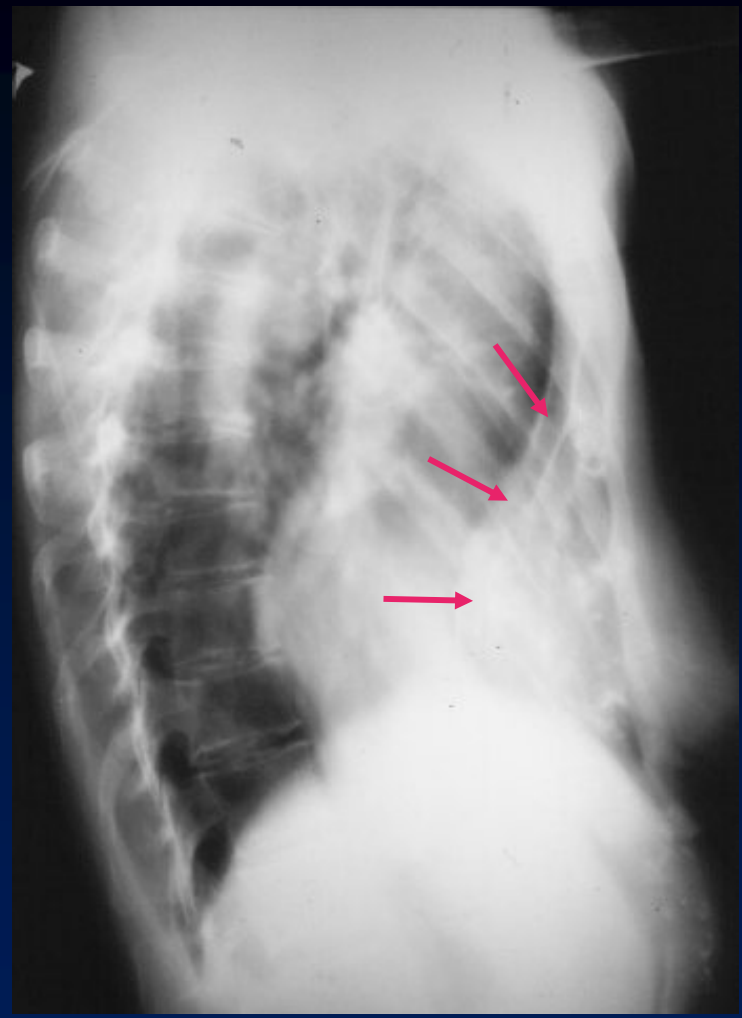
One of the easiest observations to make is something you already know: the cardio-thoracic ratio which is the widest diameter of the heart compared to the widest internal diameter of the rib cage

**<50%**

# Sometimes, CTR is more than 50%
## But Heart is Normal

- Extracardiac causes of cardiac enlargement
  - Portable AP films
  - Obesity
  - Pregnant
  - Ascites
  - Straight back syndrome
  - Pectus excavatum

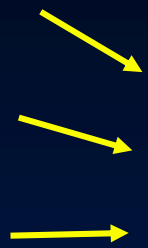


Here is a heart that is larger than 50% of the cardiothoracic ratio, but it is still a normal heart. This is because there is an extracardiac cause for the apparent cardiomegaly. On the lateral film, the arrows point to the inward displacement of the lower sternum in a pectus excavatum deformity.

# Sometimes, CTR is less than 50%
## But Heart is Abnormal

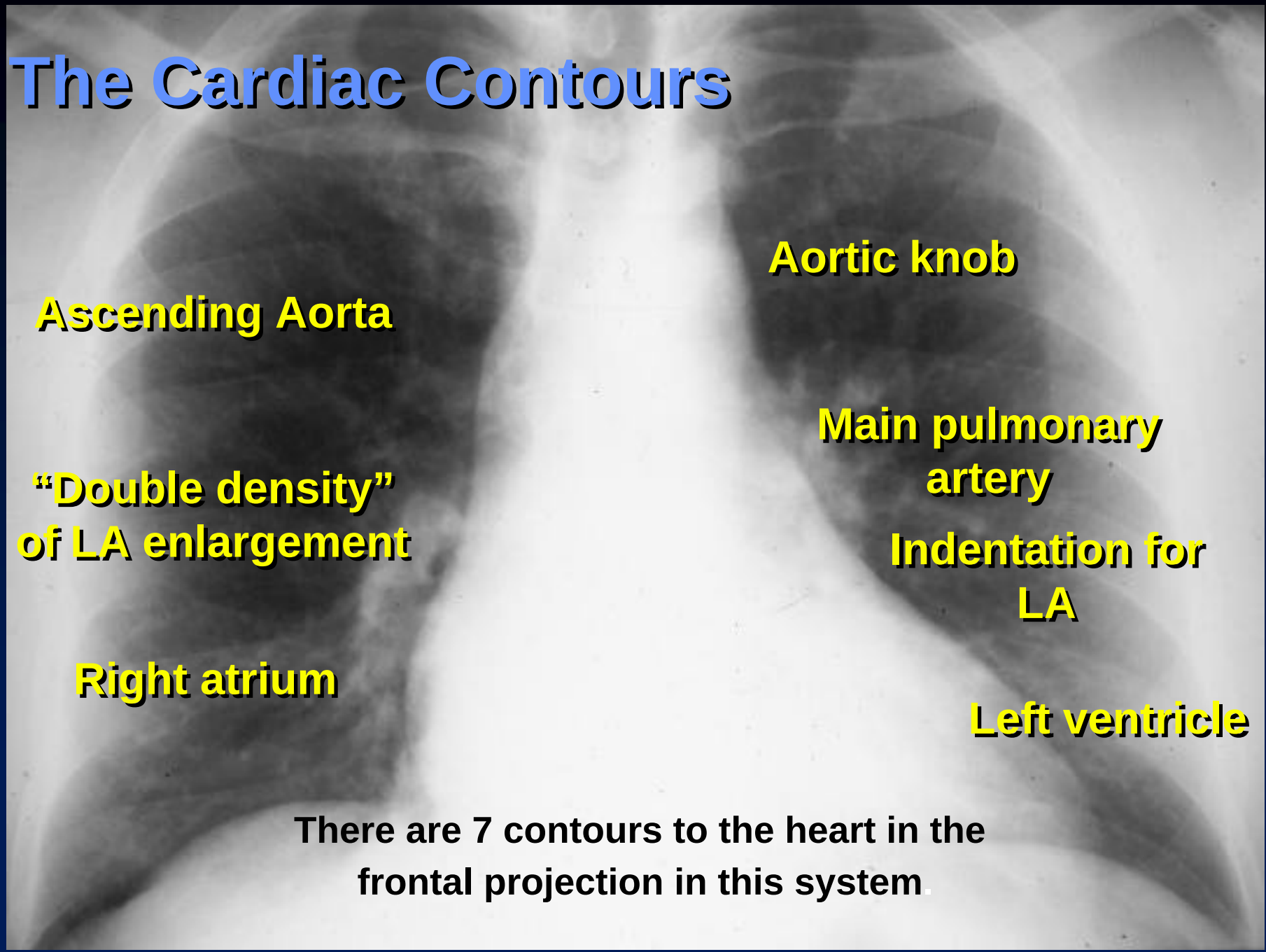
- Obstruction to outflow of the ventricles
  - Ventricular hypertrophy
- Must look at cardiac contours



<50%

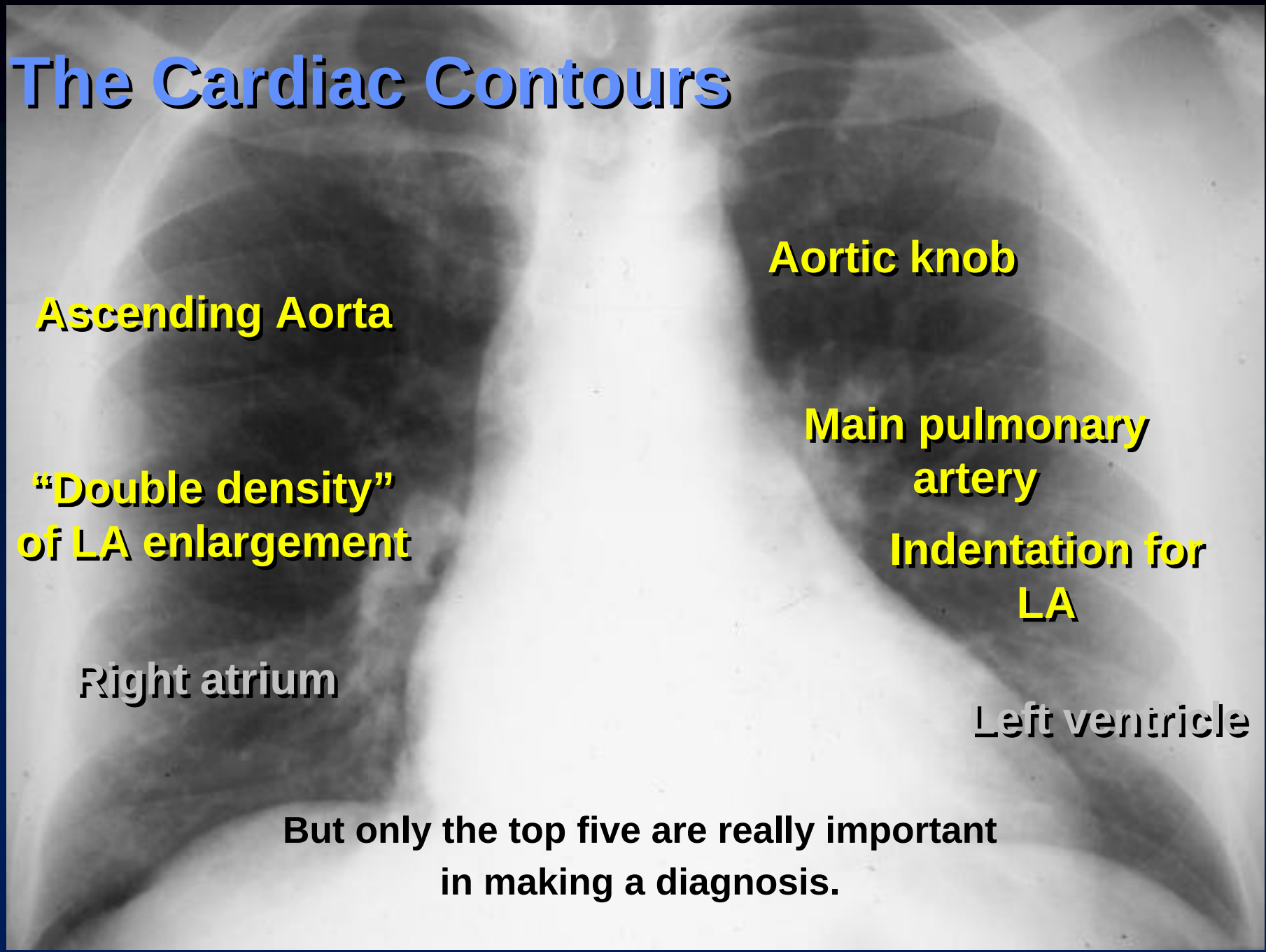
Here is an example of a heart which is less than 50% of the CTR in which the heart is still abnormal. This is recognizable because there is an abnormal contour to the heart (yellow arrows).

# The Cardiac Contours




There are 7 contours to the heart in the frontal projection in this system.

# The Cardiac Contours

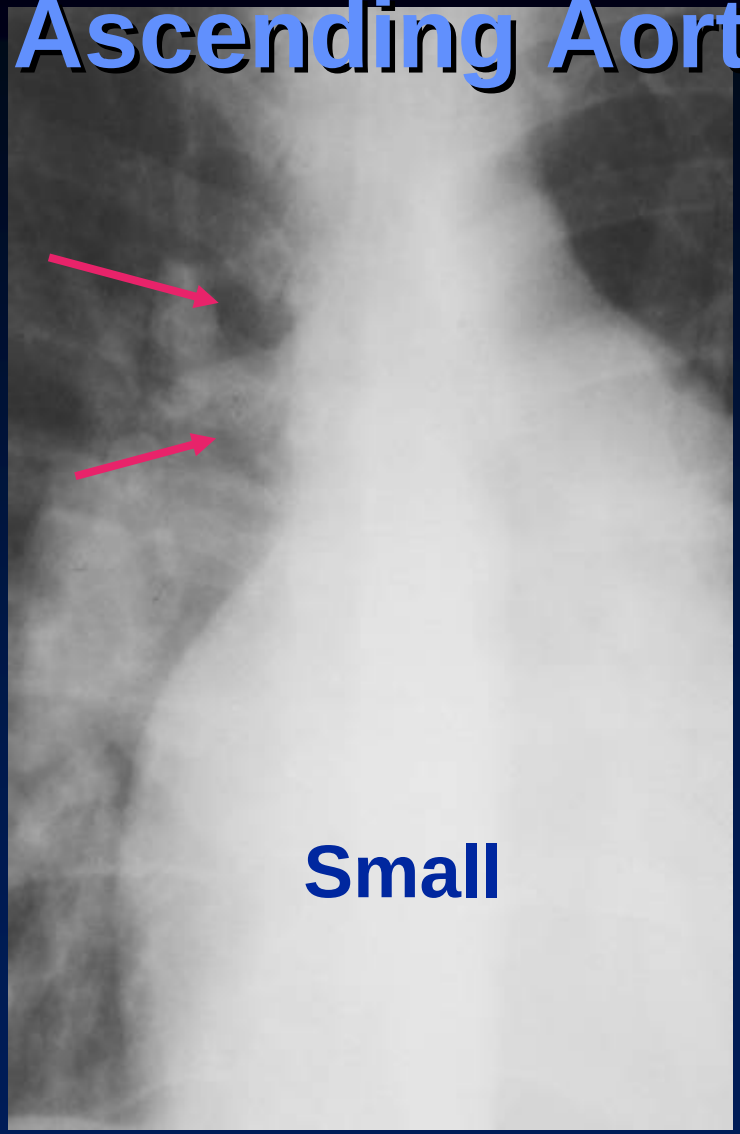



**But only the top five are really important in making a diagnosis.**

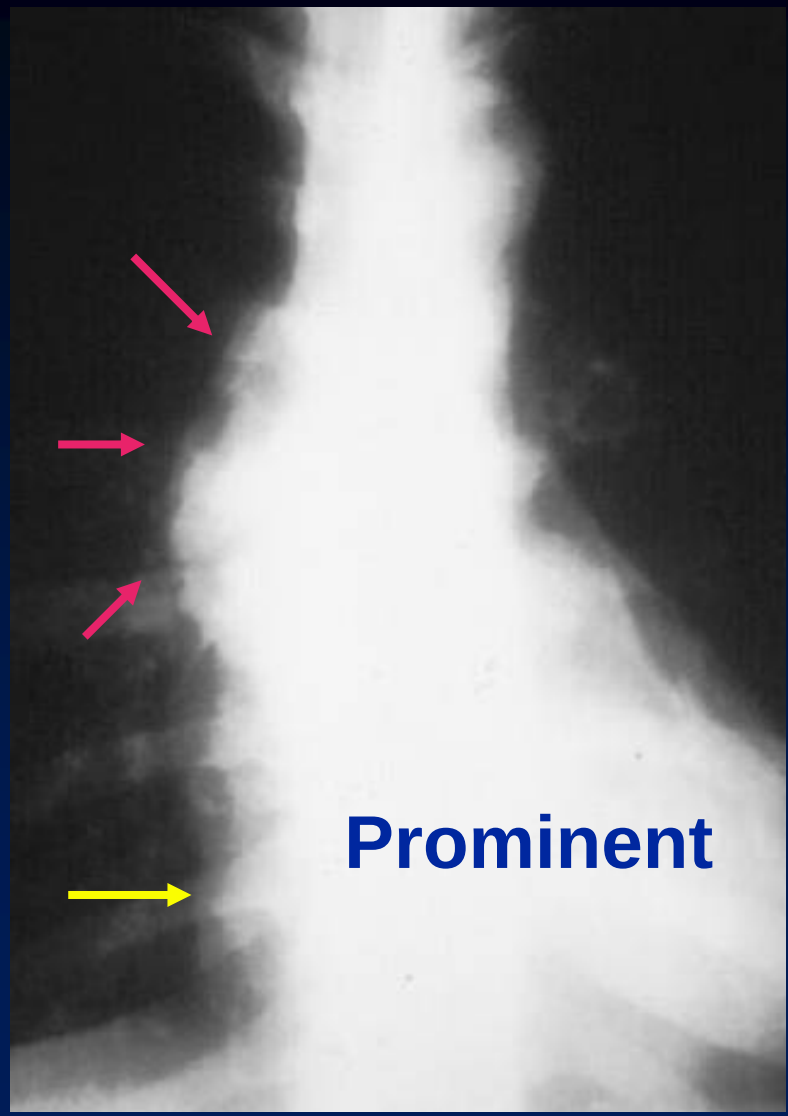
# Ascending Aorta

Low density, almost straight edge represents size of ascending aorta

# Ascending Aorta

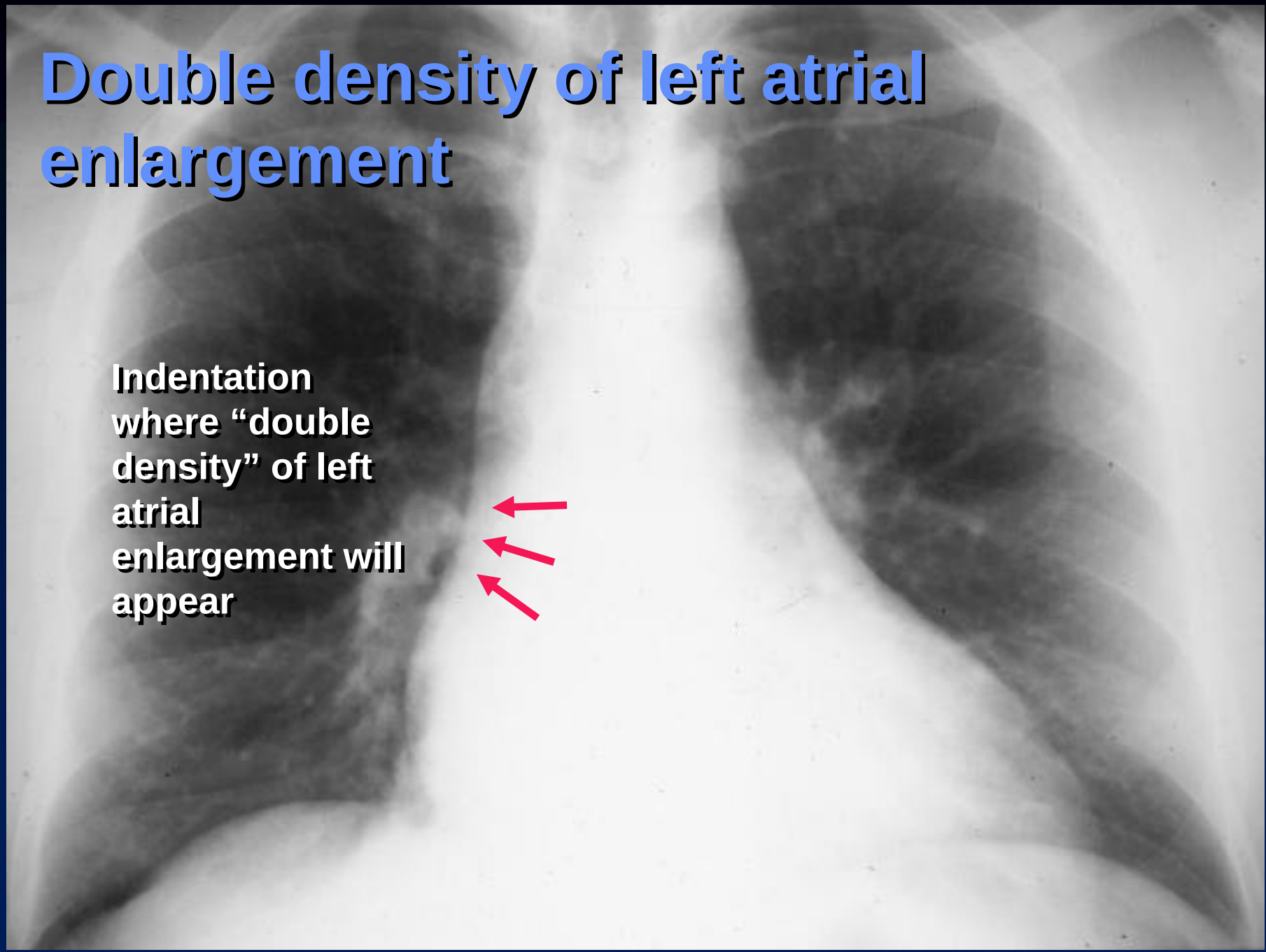


Small



Prominent

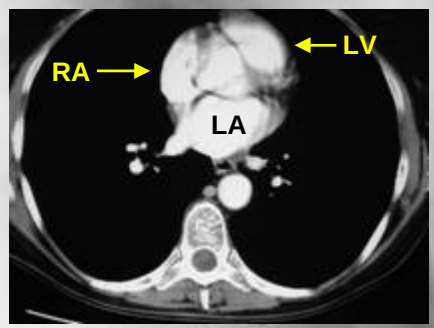
# Double density of left atrial enlargement



Even though we are on the right side of the heart, we can see left atrial enlargement. Normally the left atrium sits right in the middle of the heart posteriorly and does not form a normal border on the frontal film.

Left atrium forms no border of normal heart in PA view

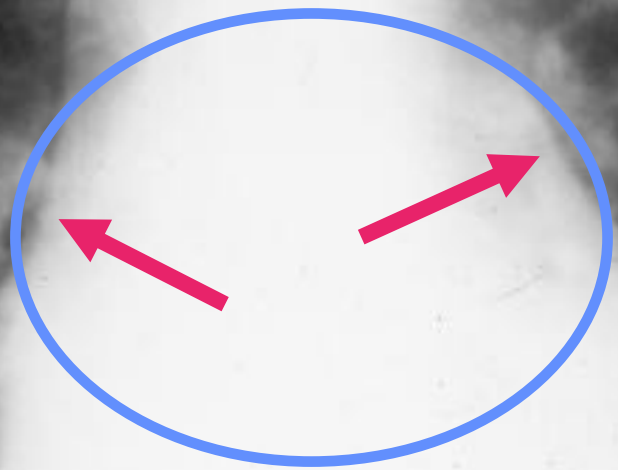
Left atrium sits in middle of heart posteriorly



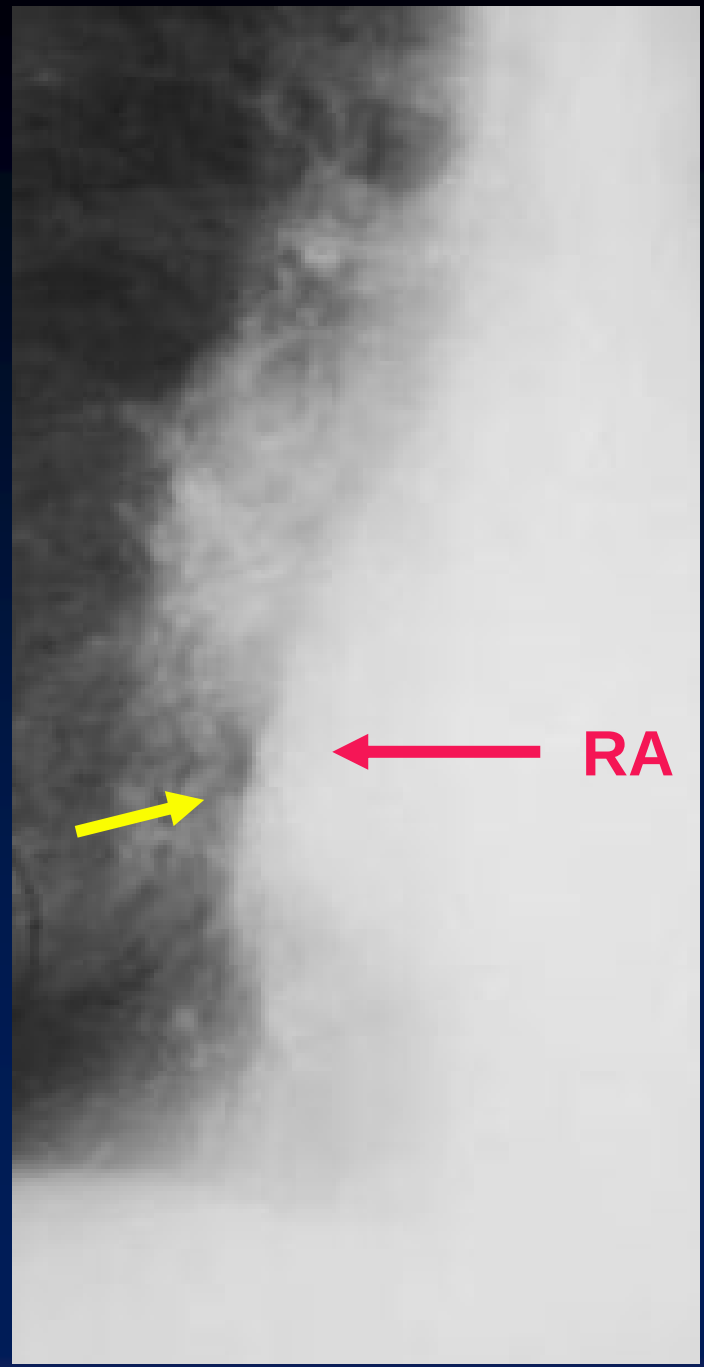

This inset from a CT scan of the chest shows how RA and LV obscure LA from forming a heart border on the frontal film.

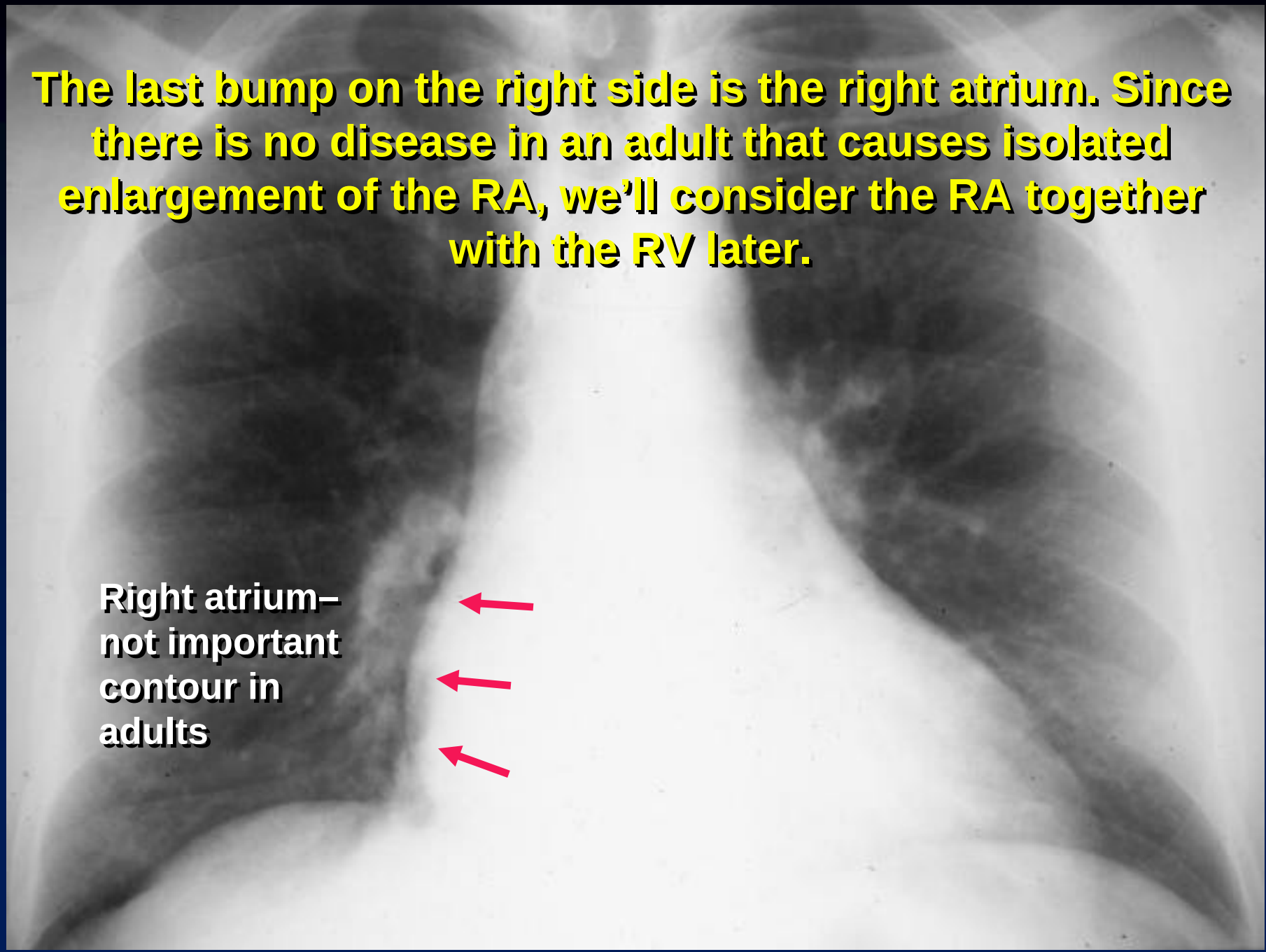
**When the LA enlarges, it will do something on the left side of the heart we'll talk about in a minute. And it may produce a "double-density" on the right side of the heart.**

"Double Density" of left atrial enlargement



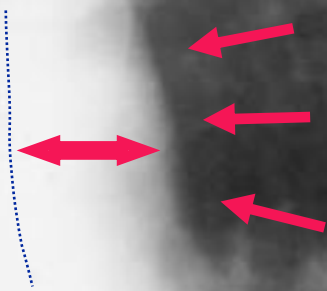
Two shadows, the yellow arrow pointing to the LA and the red arrow to the RA overlap each other where the indentation between the ascending aorta and right heart border meet




The last bump on the right side is the right atrium. Since there is no disease in an adult that causes isolated enlargement of the RA, we'll consider the RA together with the RV later.
Right atrium– not important contour in adults

# Aortic Knob

The first bump on the left-side is the aortic arch. We can measure the knob from the lateral border of air in the trachea to the edge of the aortic knob.

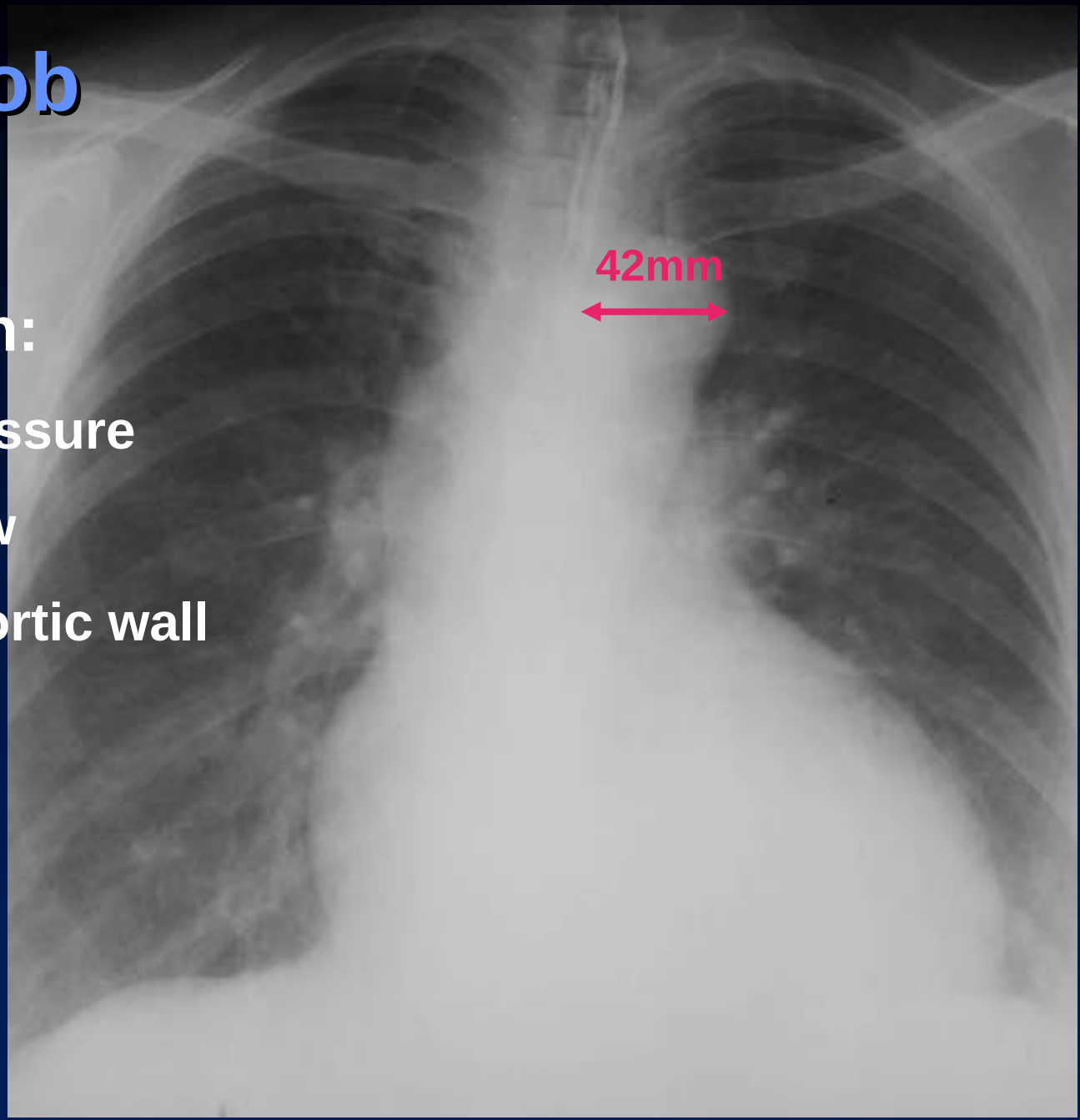


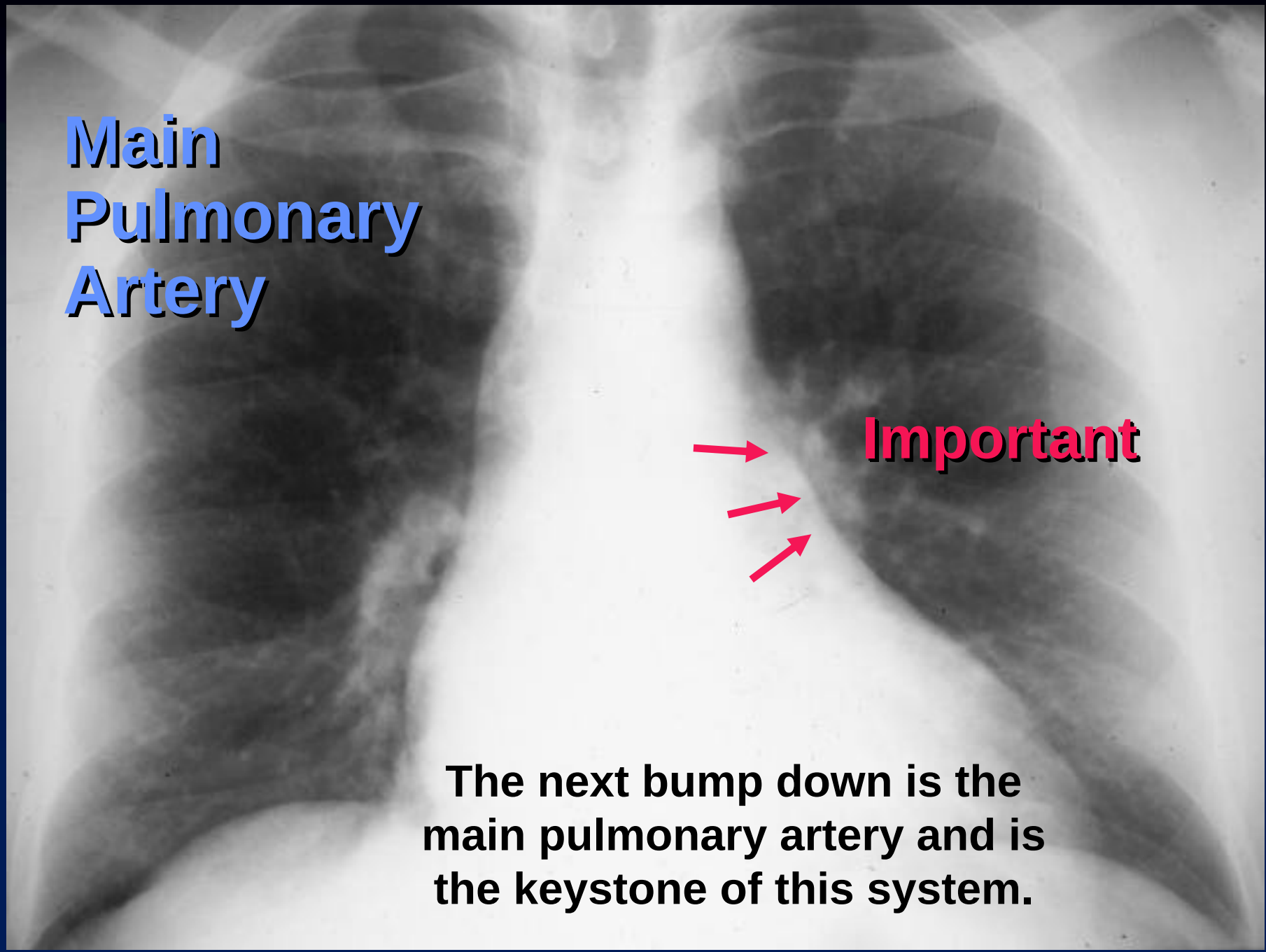
Aortic knob should measure < 35mm

# Aortic Knob

**Enlarged with:**

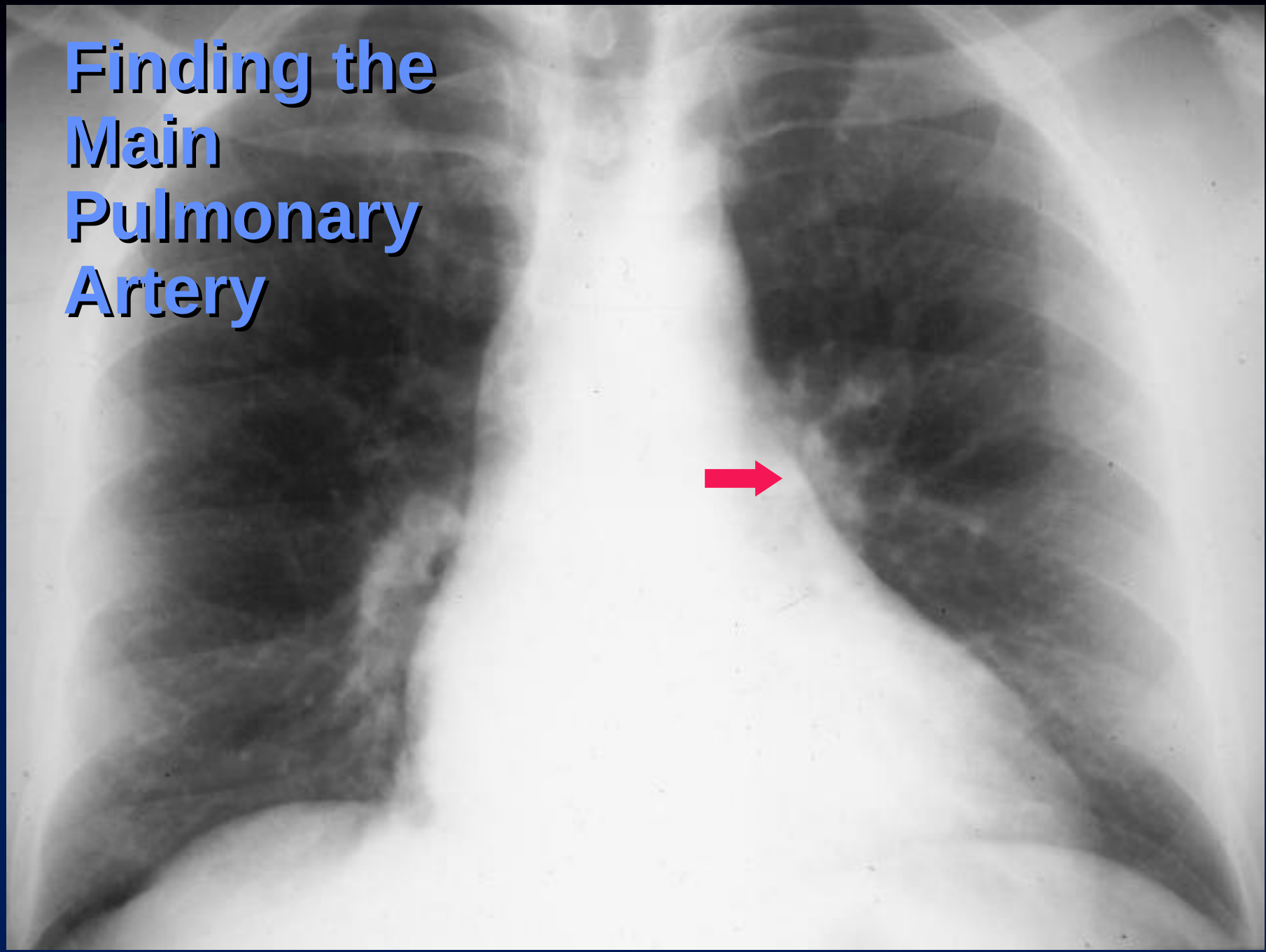
- **Increased pressure**
- **Increased flow**
- **Changes in aortic wall**



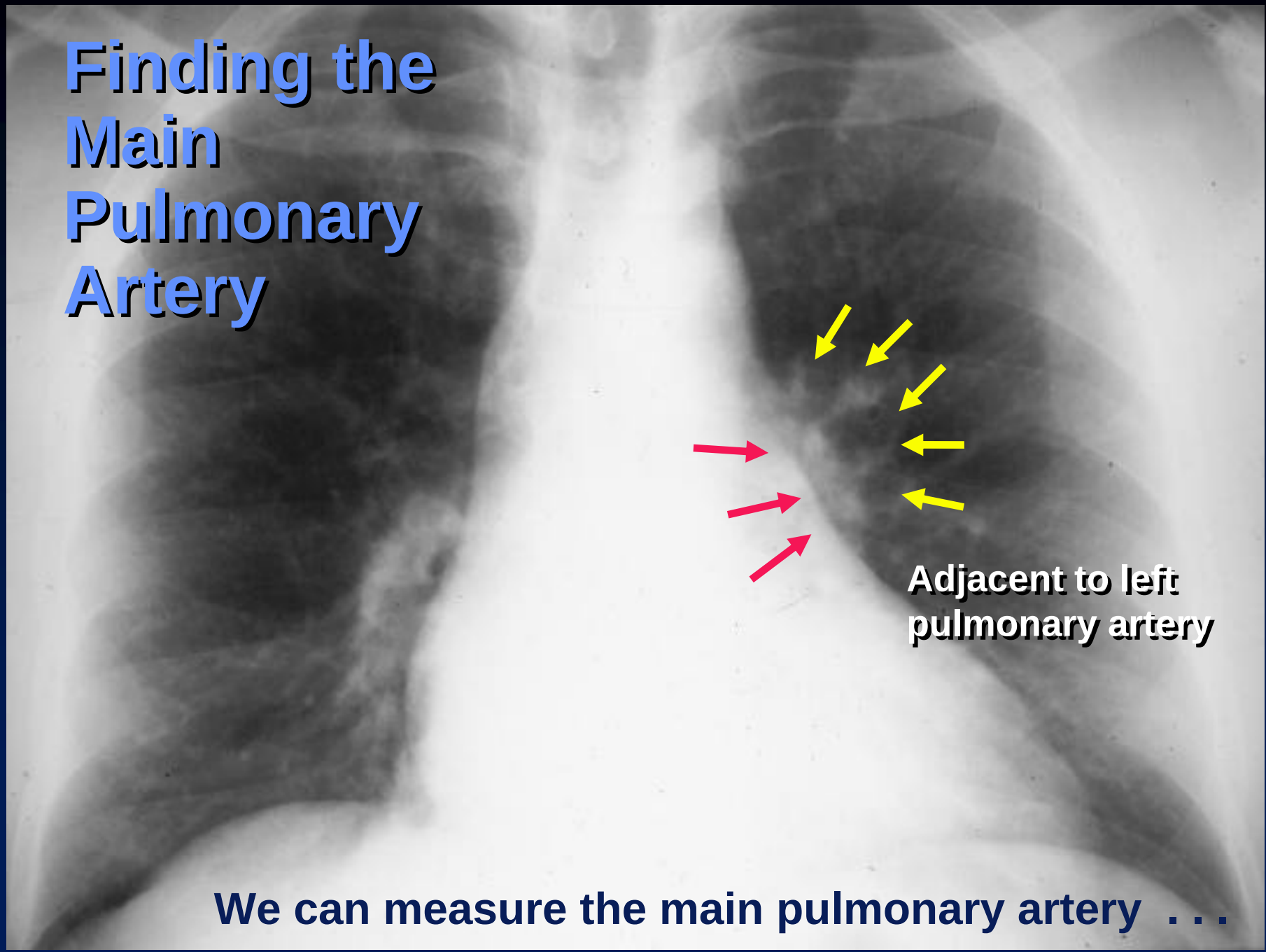



**The next bump down is the main pulmonary artery and is the keystone of this system.**

# Finding the Main Pulmonary Artery

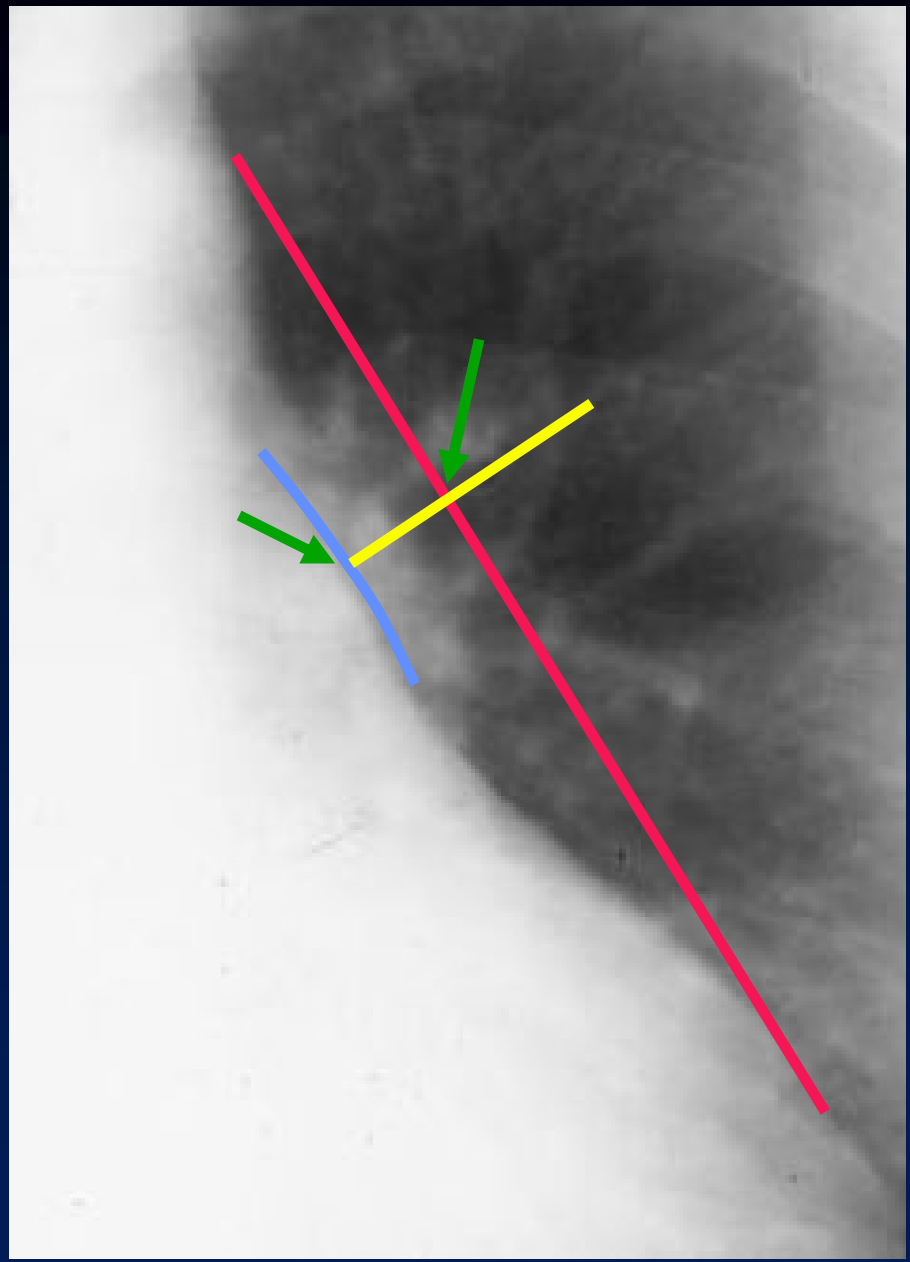


# Finding the Main Pulmonary Artery

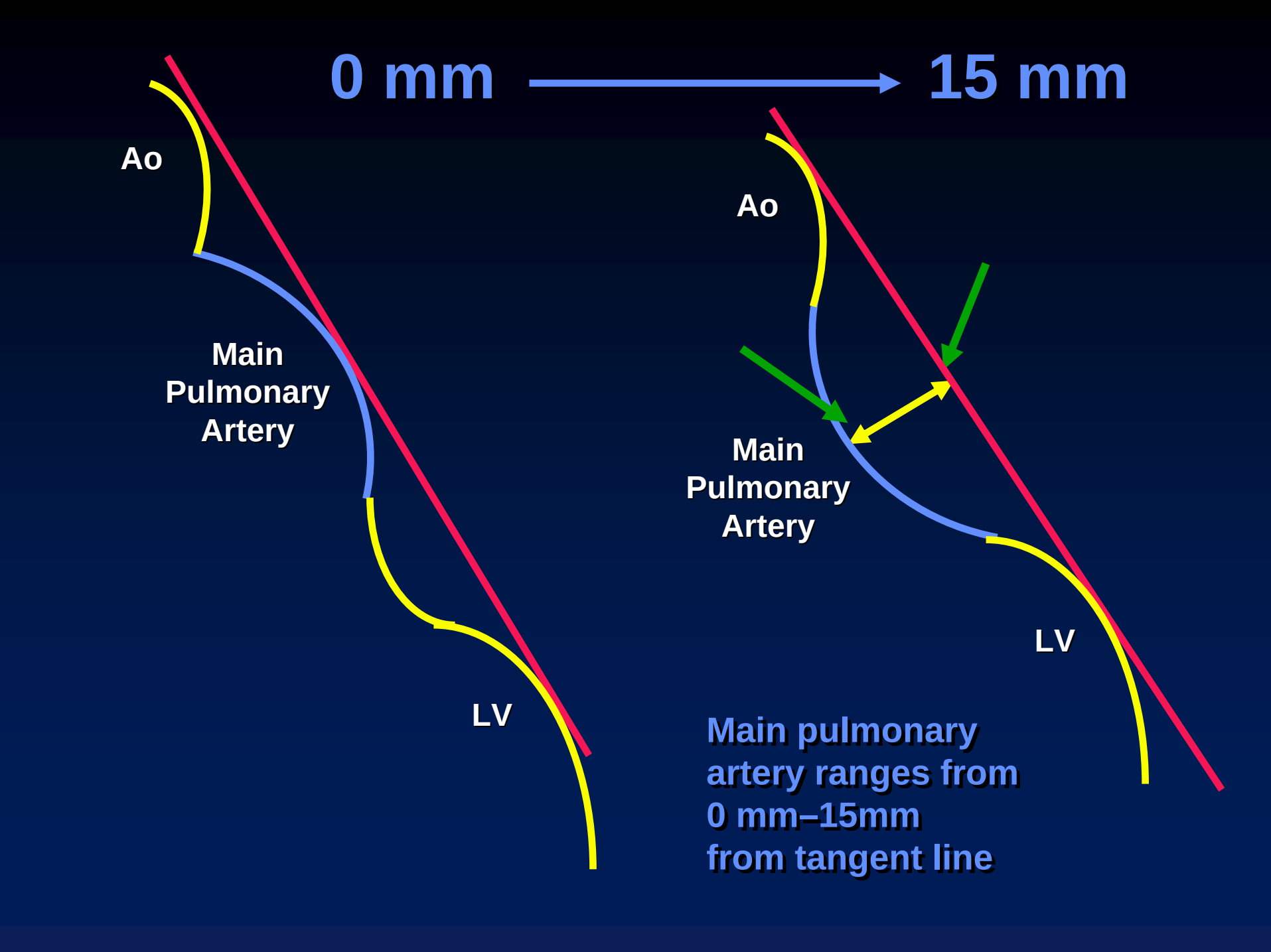



We can measure the main pulmonary artery . . .

If we draw a tangent line from the apex of the left ventricle to the aortic knob (red line) and measure along a perpendicular to that tangent line (yellow line)



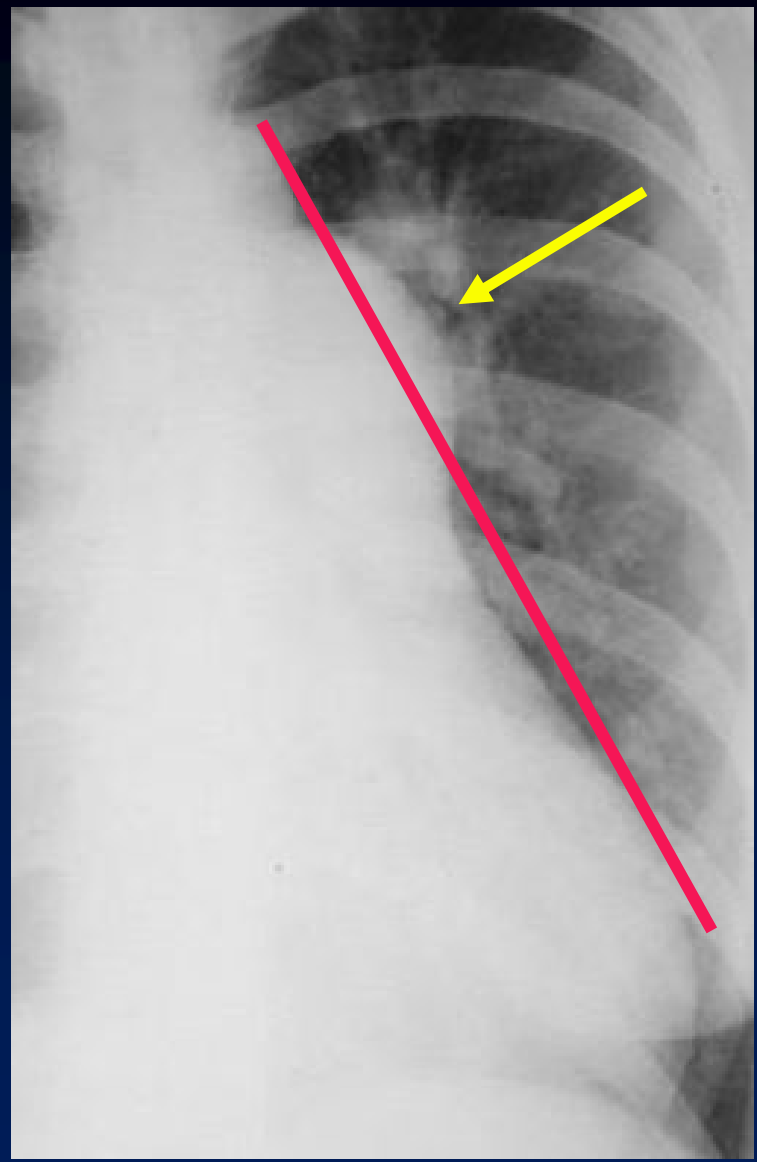
The distance between the tangent and the main pulmonary artery (between two small green arrows) falls in a range between 0 mm (touching the tangent line) to as much as 15 mm away from the tangent line


0 mm
15 mm
Ao
Main
Pulmonary
Artery
LV
Ao
Main
Pulmonary
Artery
LV
Main pulmonary
artery ranges from
0 mm–15mm
from tangent line

# Two Major Classifications

- The main pulmonary artery (MPA) projects beyond the tangent line
- The main pulmonary artery is more than 15 mm away from the tangent line
  - Because the MPA is small or absent
  - Because the tangent line is being pushed away from the MPA

# Main pulmonary artery projects beyond tangent



**Increased pressure**

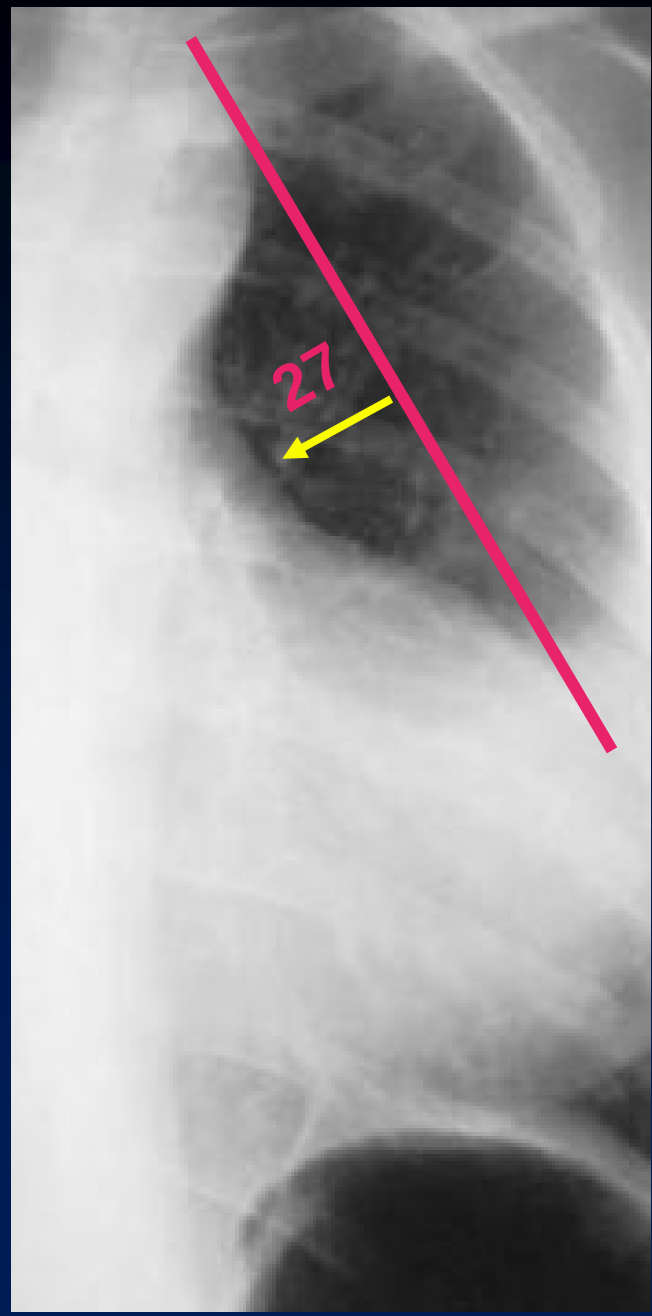
**Increased flow**

# Main pulmonary artery is more than 15 mm from tangent

**Small pulmonary artery**

**Truncus arteriosus**

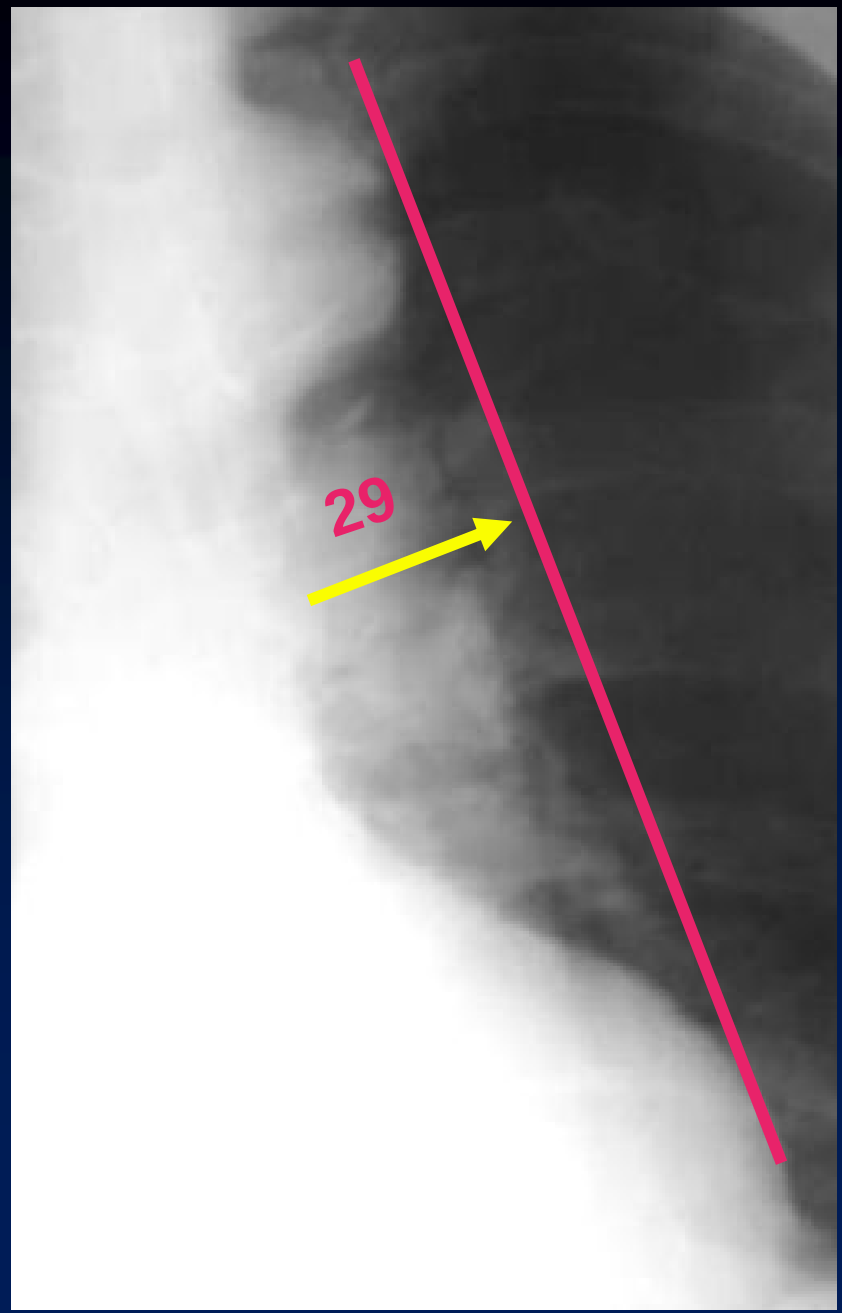
**Tetralogy of Fallot**



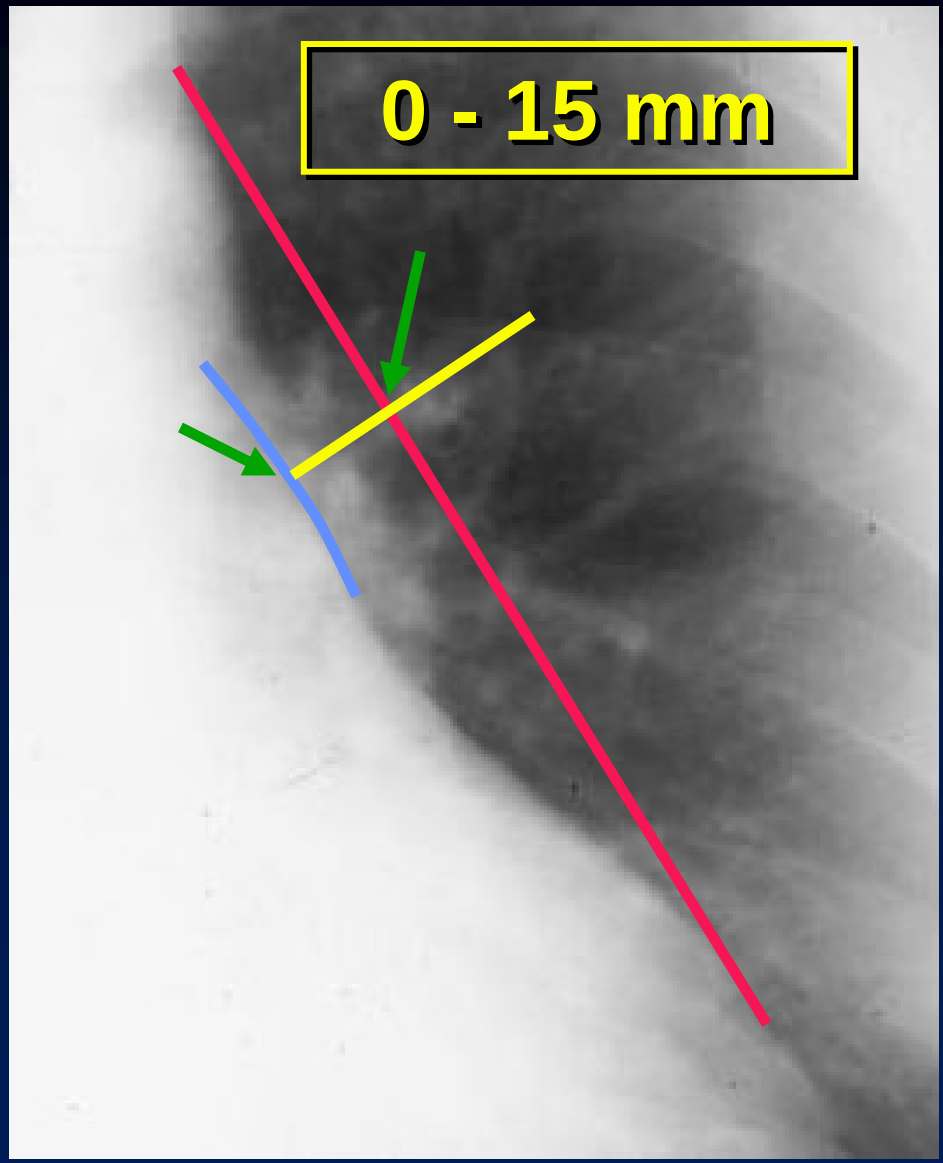
# Main pulmonary artery is more than 15 mm from tangent

Left ventricle and/or aortic knob push the tangent away

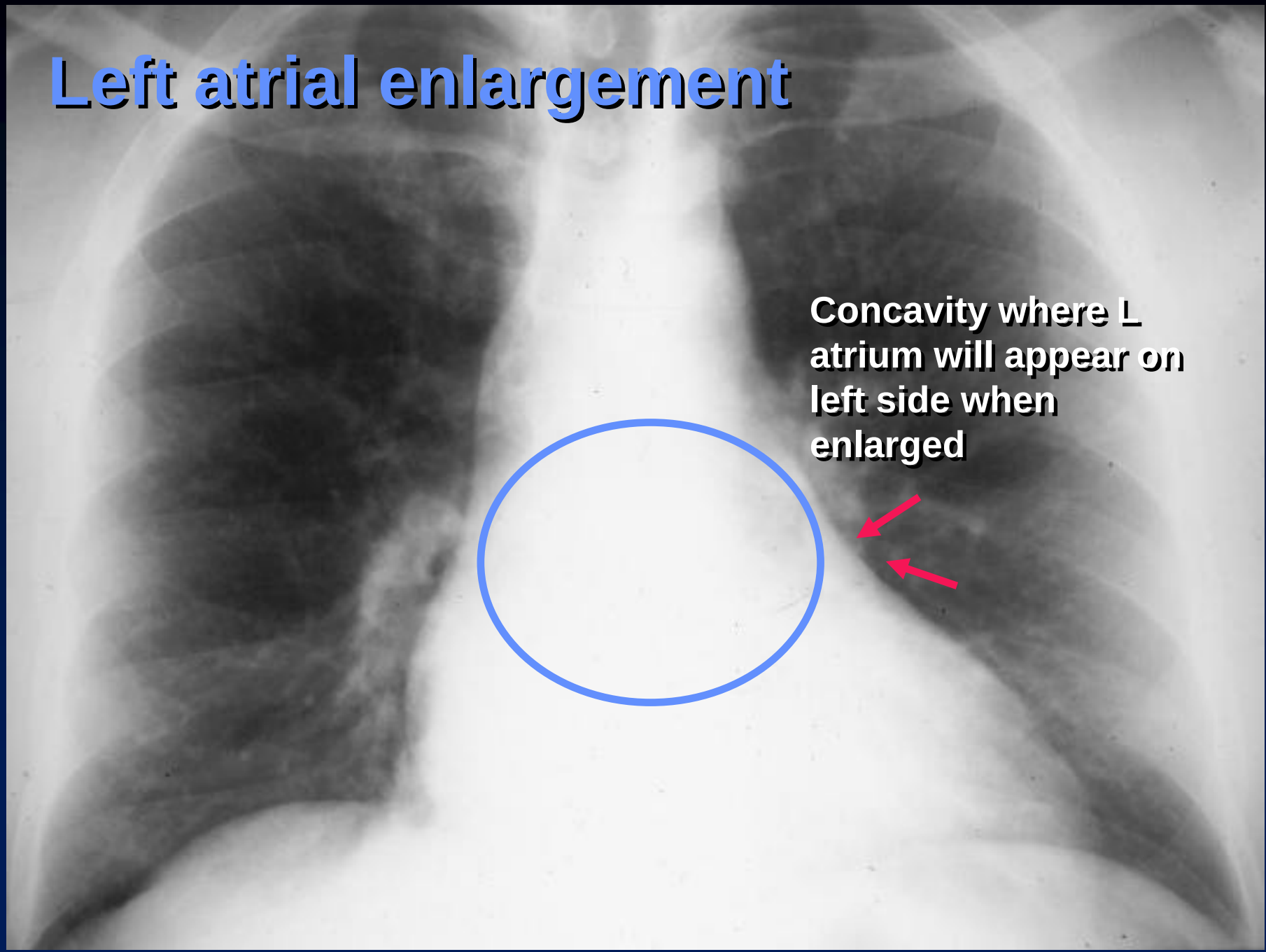
Common



**To recapitulate:**



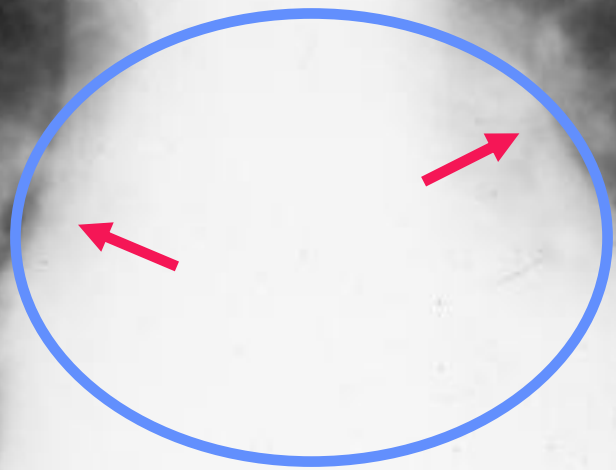
# Left atrial enlargement



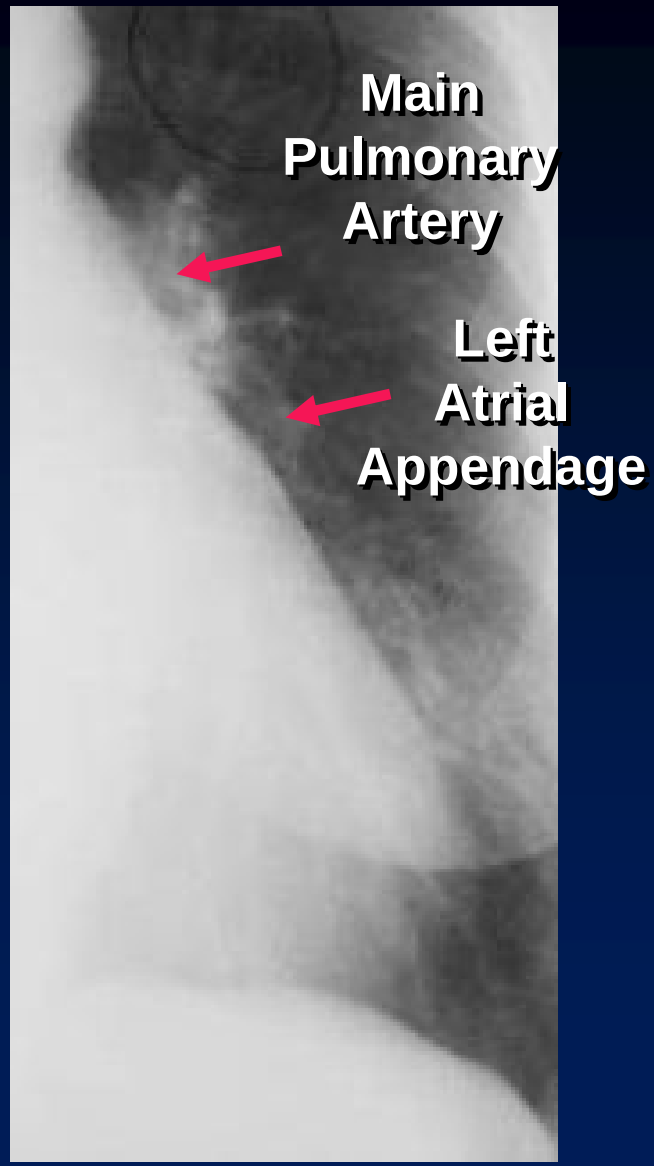
# Left atrial enlargement

"Straightening of the left heart border"

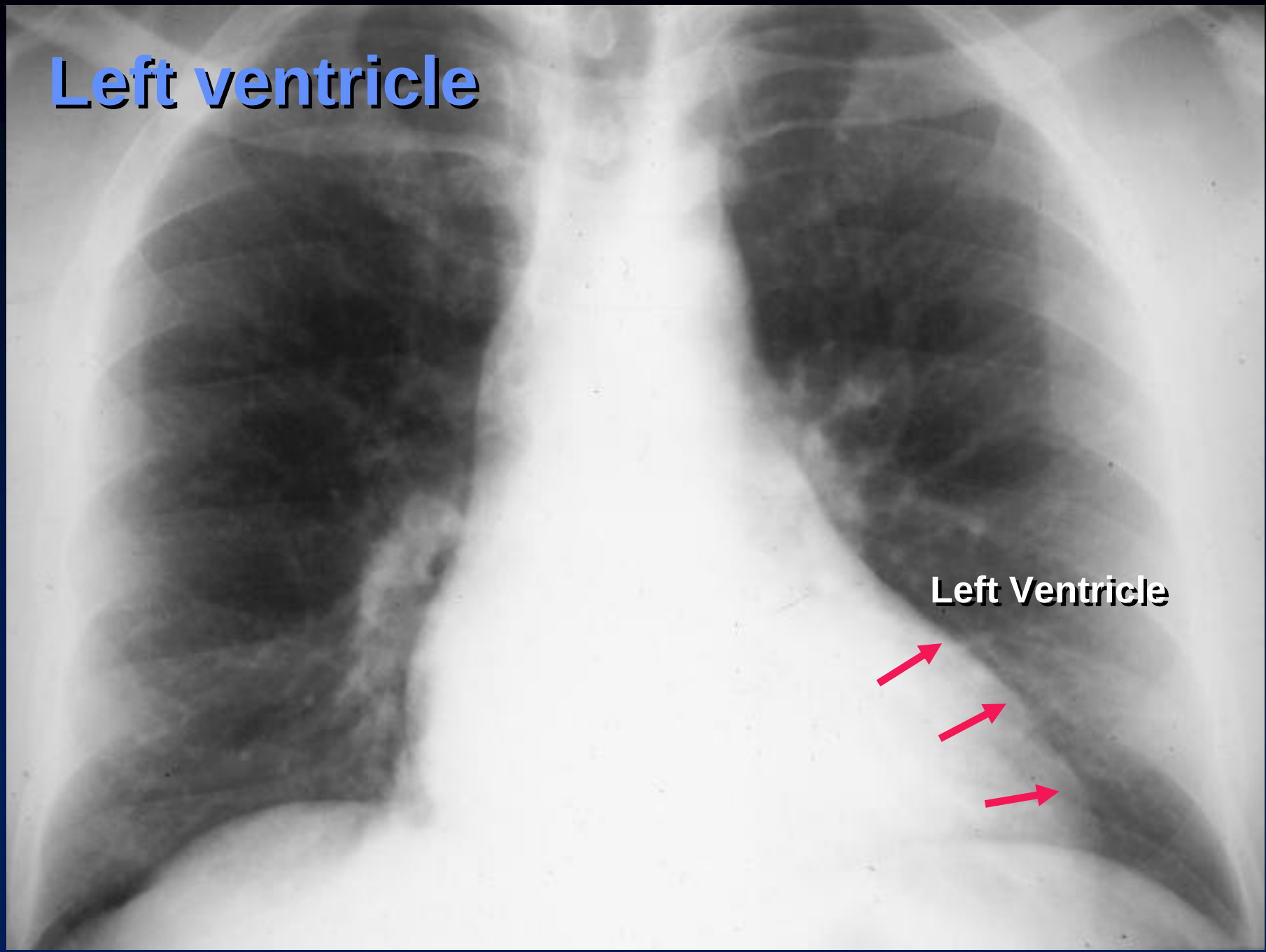
Left atrium may enlarge without producing double density



In the example on the right, not only is the left atrium enlarged, but the left atrial appendage is too. So there is a convexity outward where there is normally a concavity inward.



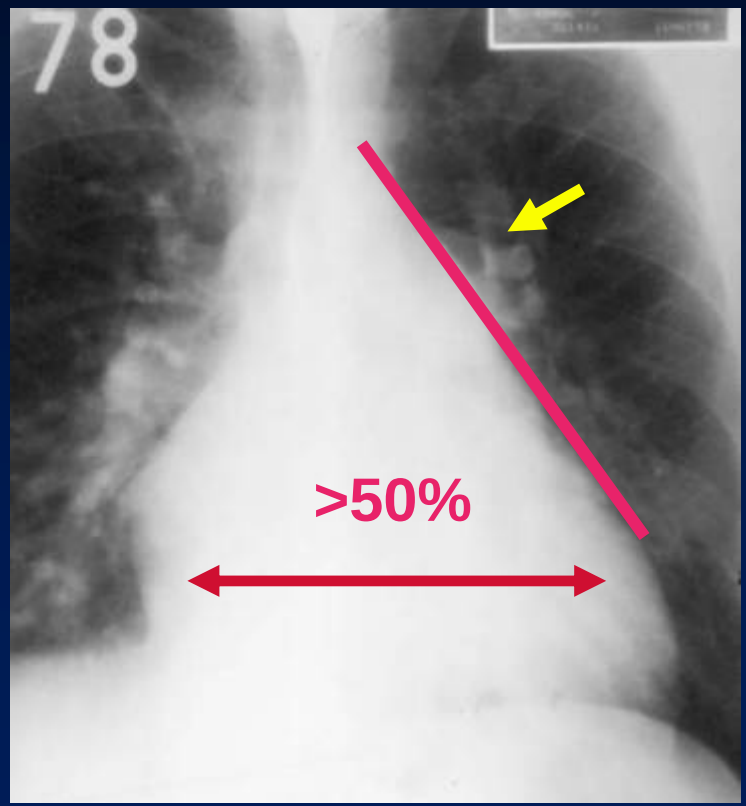
# Left ventricle



# Which Ventricle is Enlarged?

**The best way to determine which ventricle is enlarged is to look at the corresponding outflow tract for each ventricle**

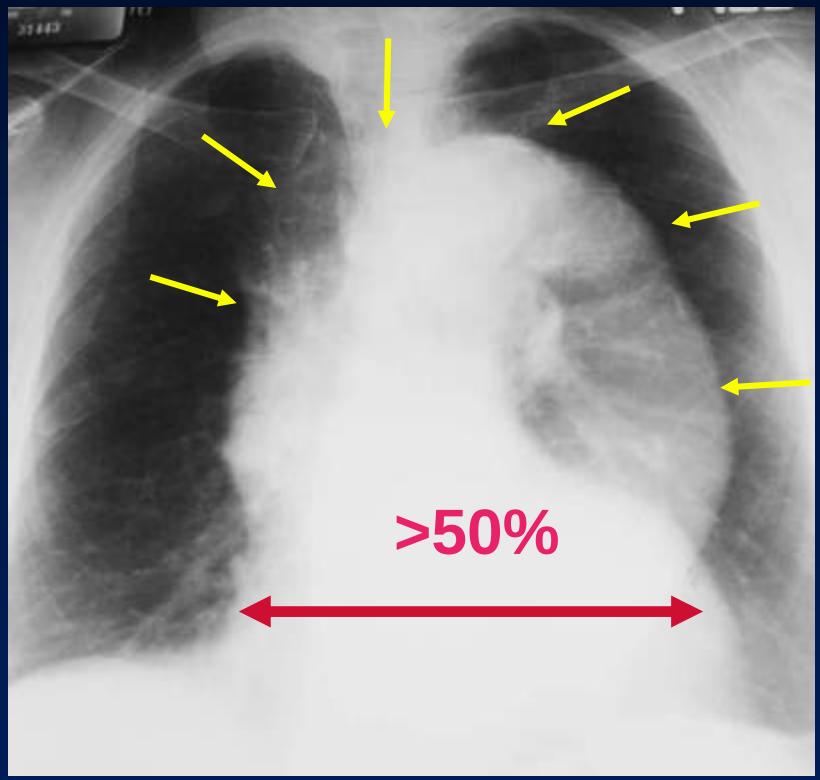
# Which Ventricle is Enlarged?




**If Heart Is Enlarged, And Main Pulmonary Artery is Big**

**Then Right Ventricle is Enlarged**

# Which Ventricle is Enlarged?




**If Heart Is Enlarged, And Aorta is Big**

**Then Left Ventricle is Enlarged**

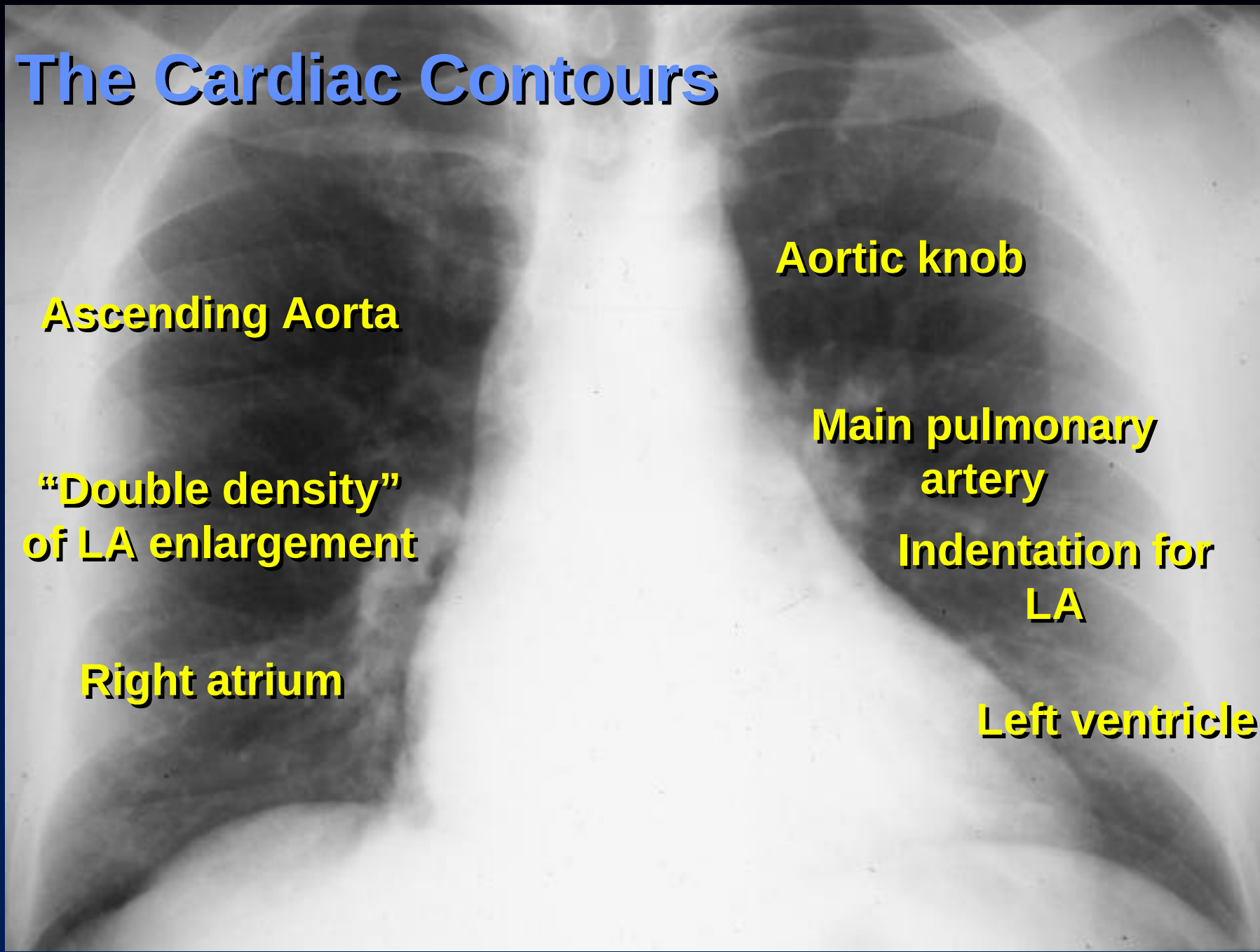
# Which ventricle is enlarged?

- The best way to determine which ventricle is enlarged is to look at the corresponding outflow tract for each ventricle
  - Aorta for the LV
  - MPA for the RV

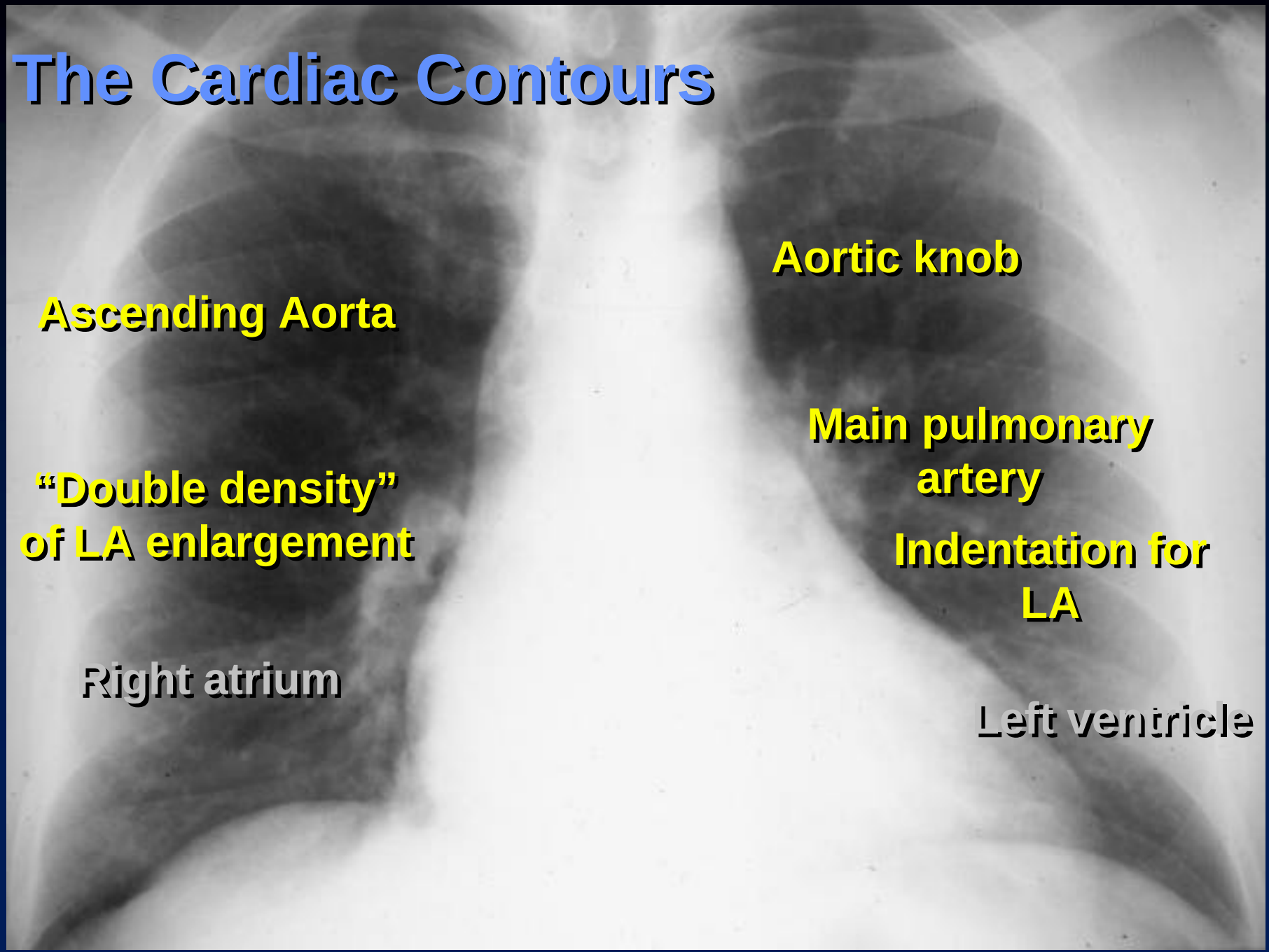
# Which Ventricle is Enlarged?

**Once one ventricle is enlarged, it's impossible to tell if other ventricle is also enlarged**

# The Cardiac Contours



# The Cardiac Contours



# The Pulmonary Vasculature

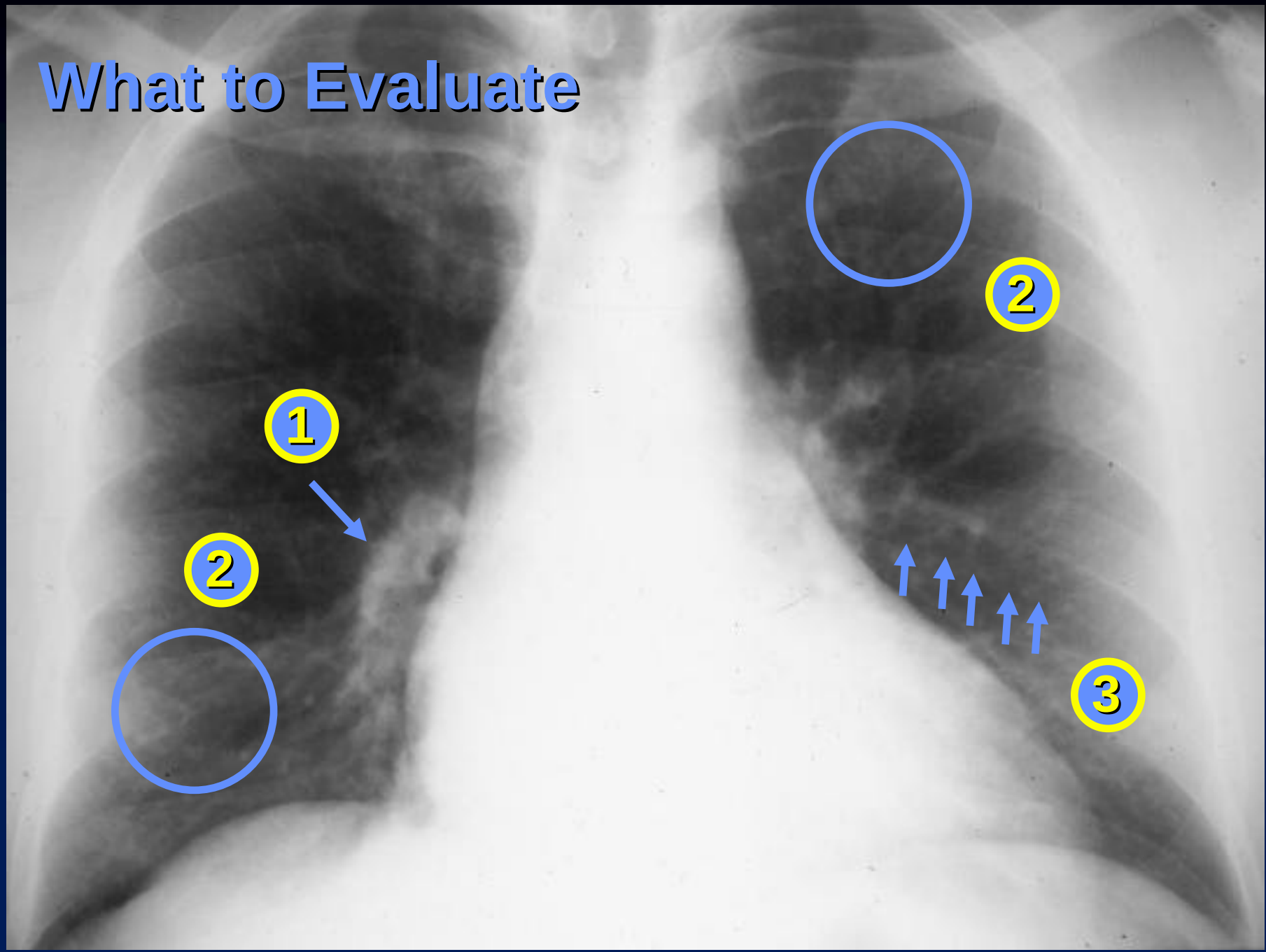
# Five States of the Pulmonary Vasculature

- Normal
- Pulmonary venous hypertension
- Pulmonary arterial hypertension
- Increased flow
- Decreased flow

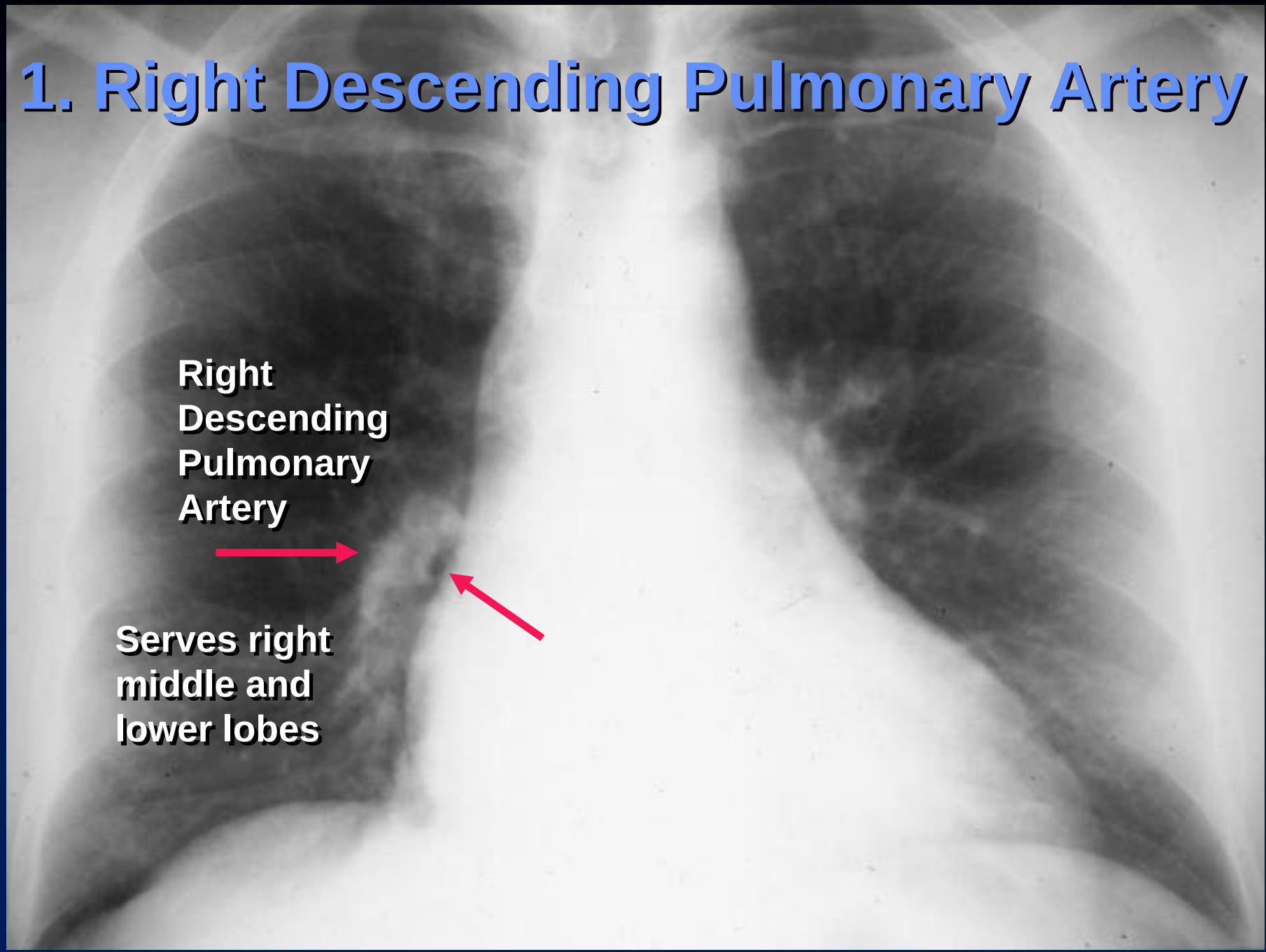
# What We're Going to Evaluate

- Right Descending Pulmonary Artery
- Distribution of flow in the lungs
  - Upper versus lower lobes
  - Central versus peripheral

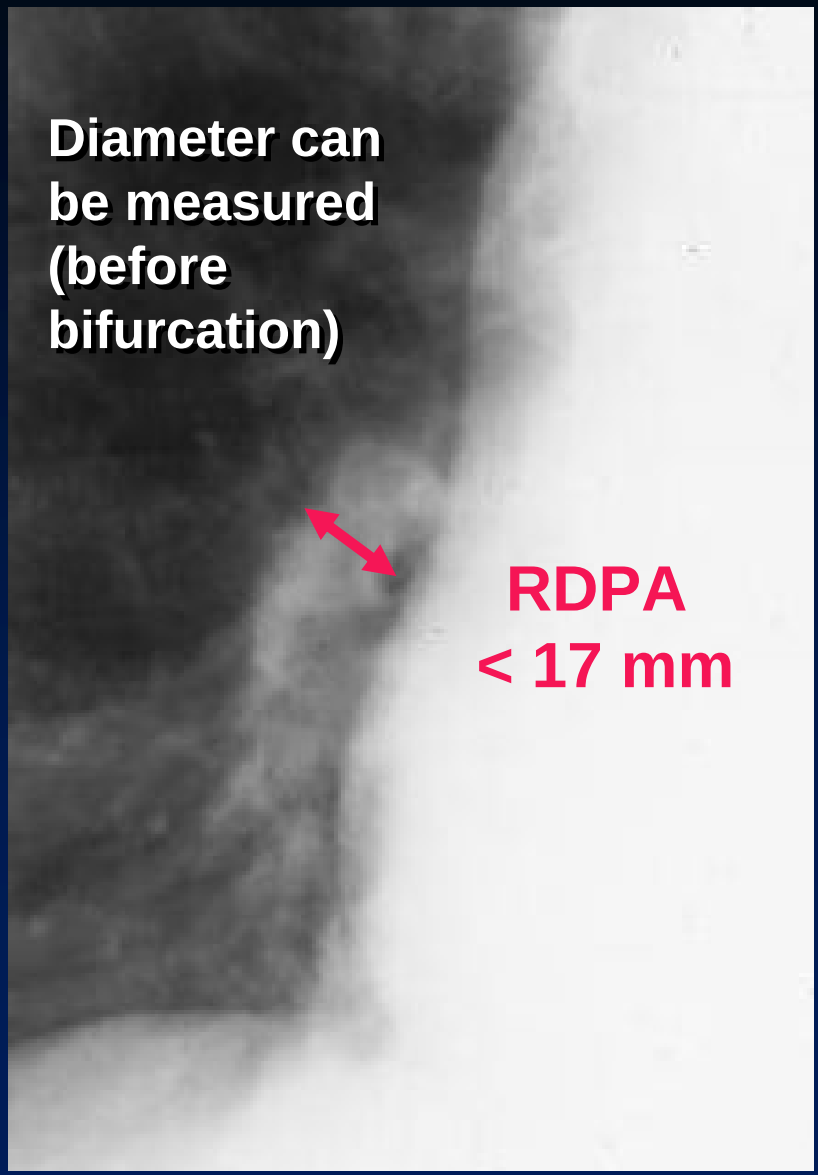
# What to Evaluate



# 1. Right Descending Pulmonary Artery



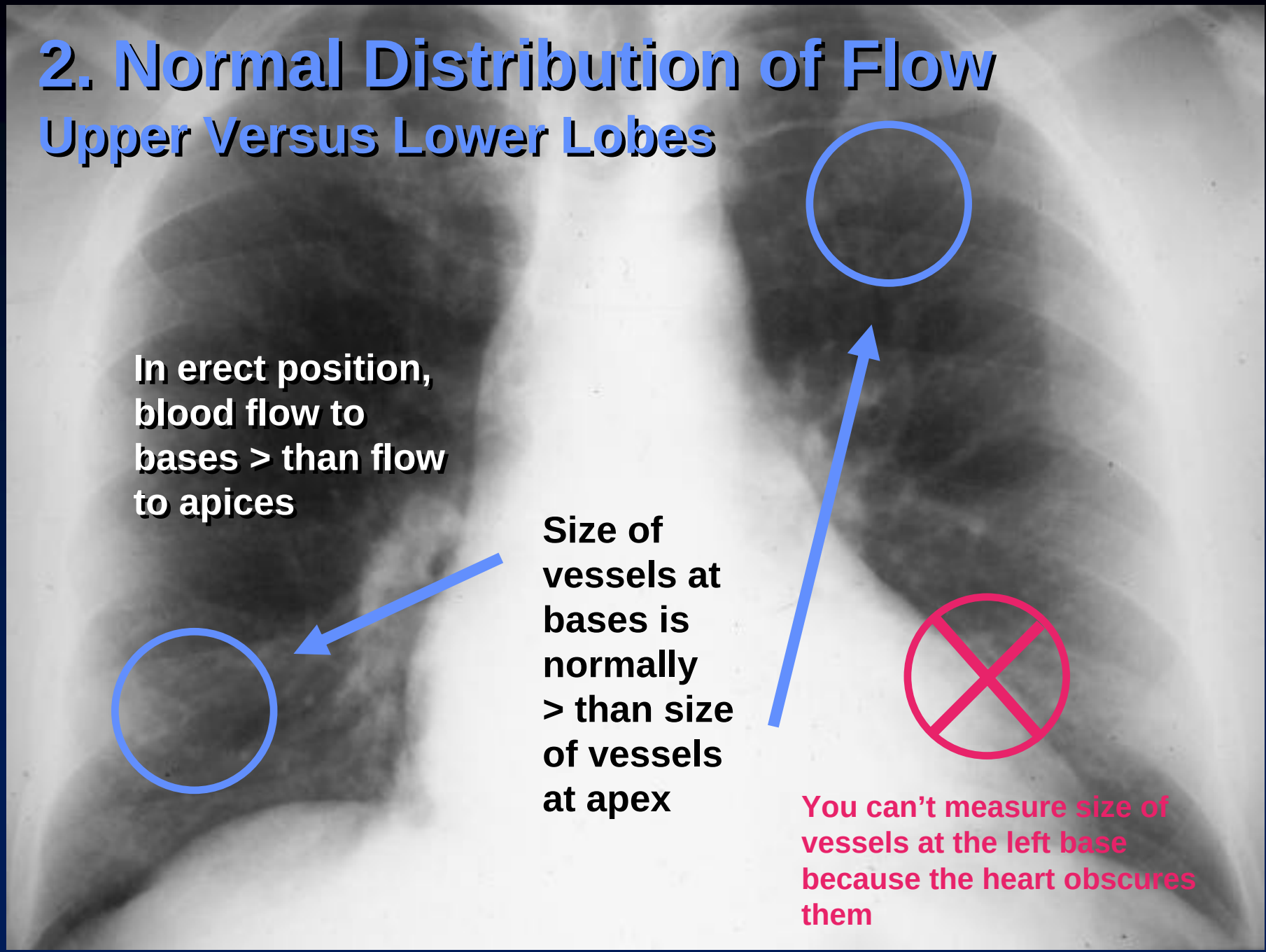
# 1. Right Descending Pulmonary Artery




Normally, the right descending pulmonary artery should not be more than 17mm in diameter

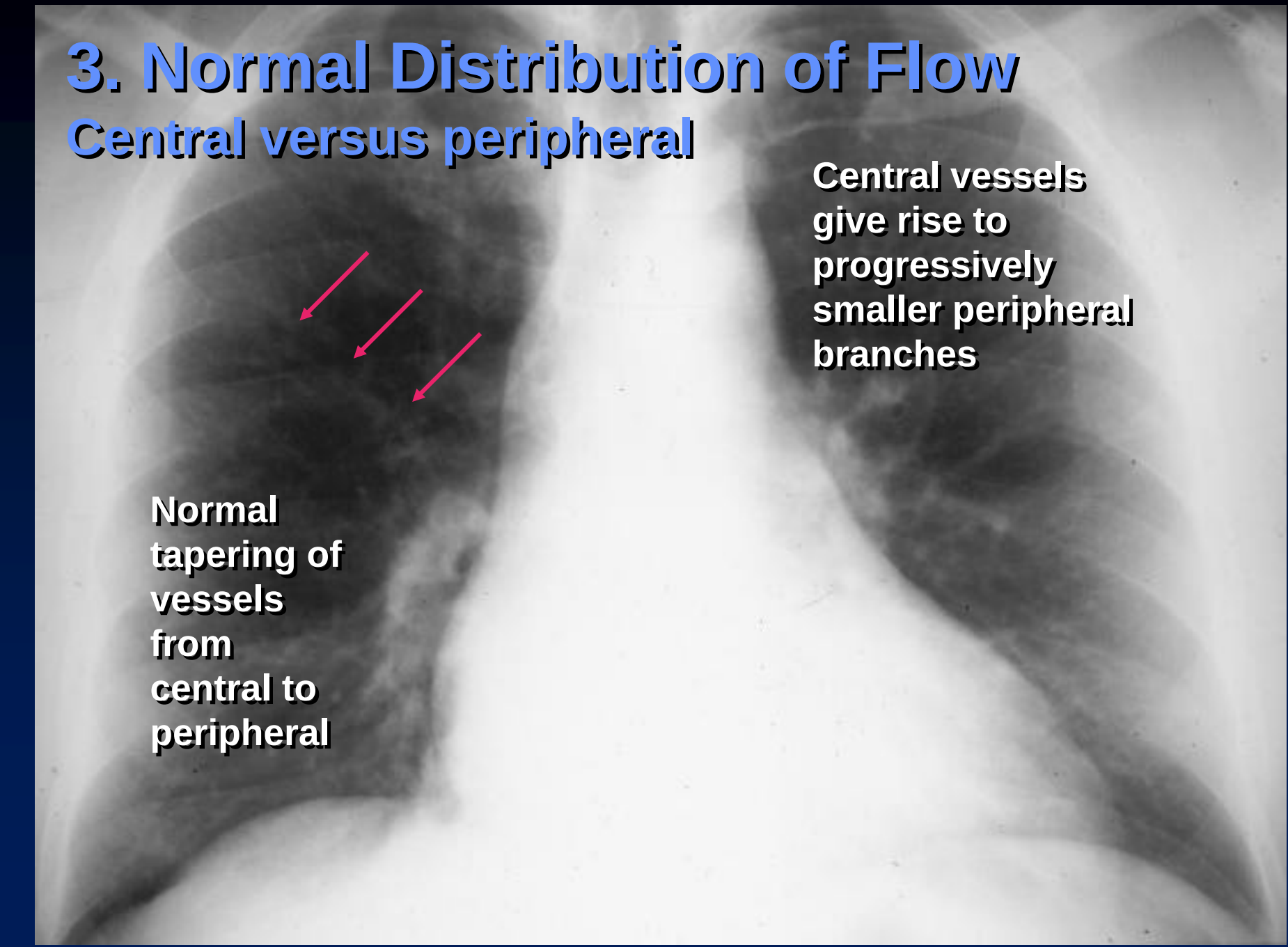
# 2. Normal Distribution of Flow

## Upper Versus Lower Lobes



# 3. Normal Distribution of Flow

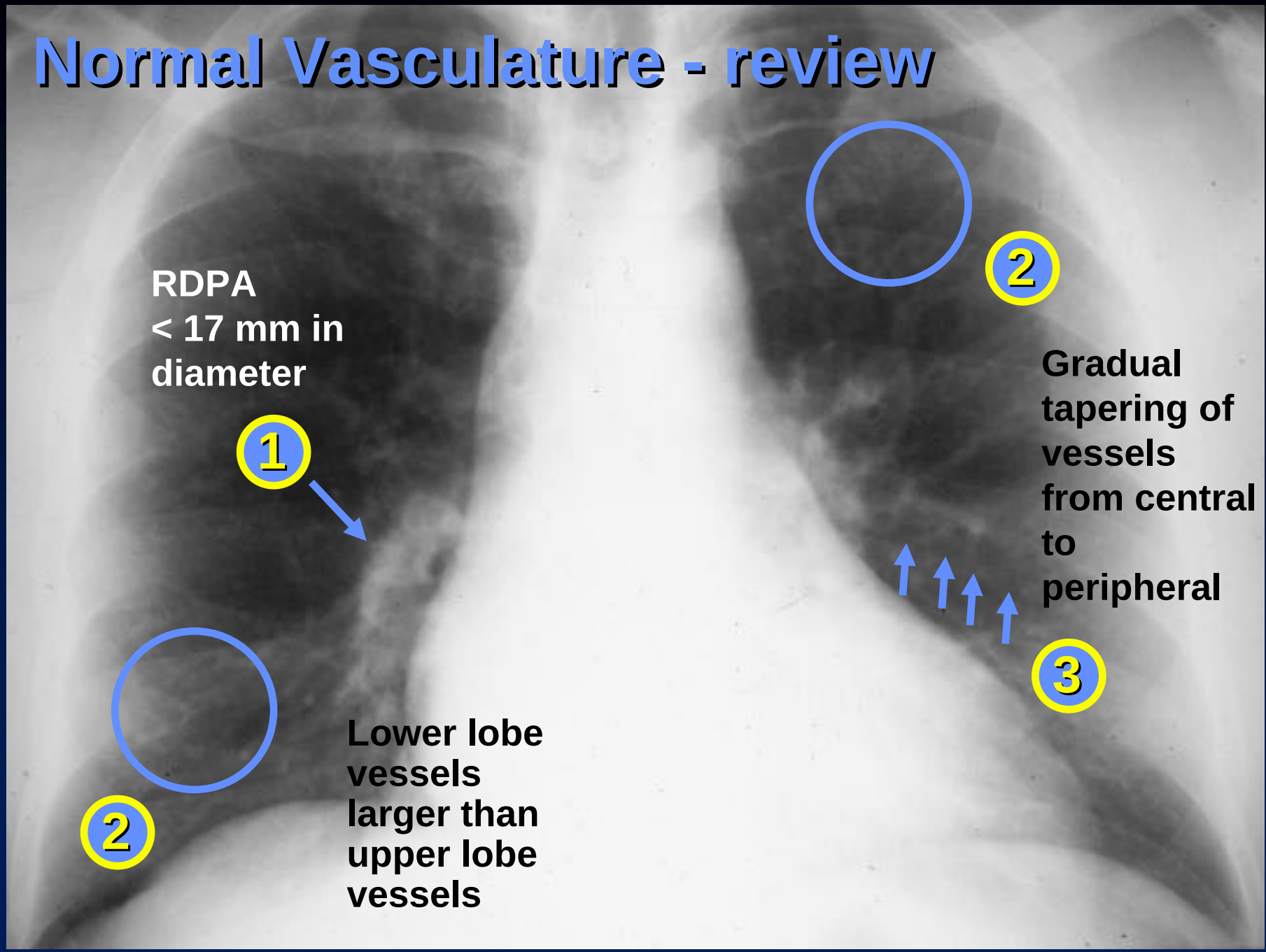
## Central versus peripheral



Central vessels give rise to progressively smaller peripheral branches

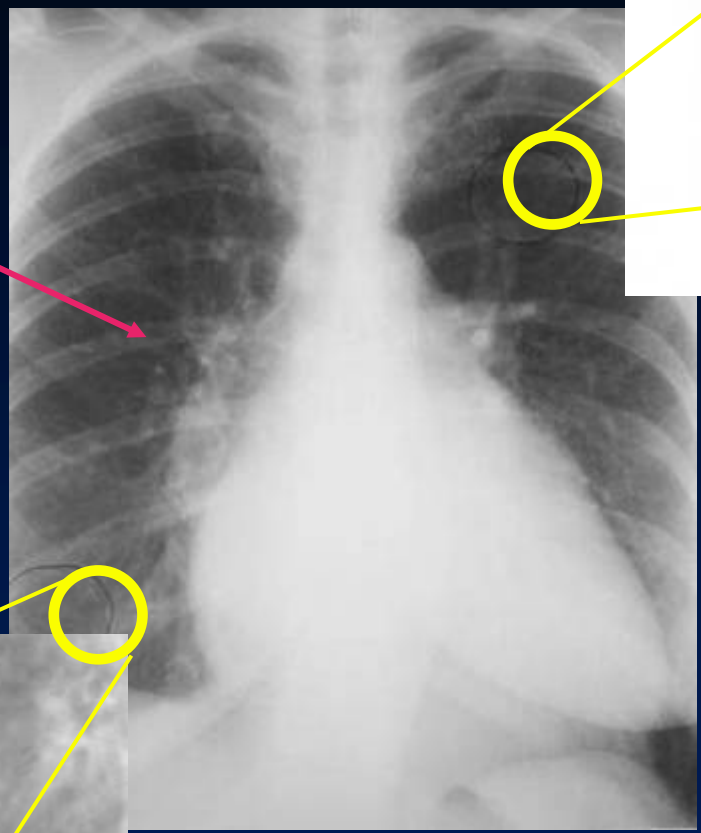
Normal tapering of vessels from central to peripheral

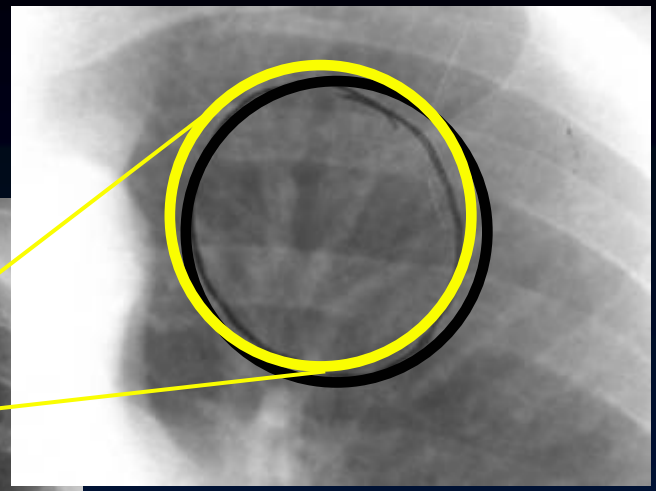
# Normal Vasculature - review

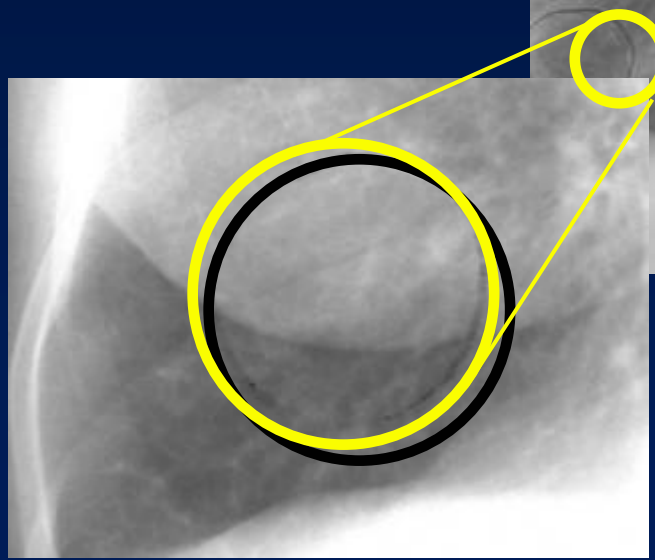


# Venous Hypertension

RDPA usually
> 17 mm







Upper lobe vessels equal to or larger than size of lower lobe vessels = Cephalization

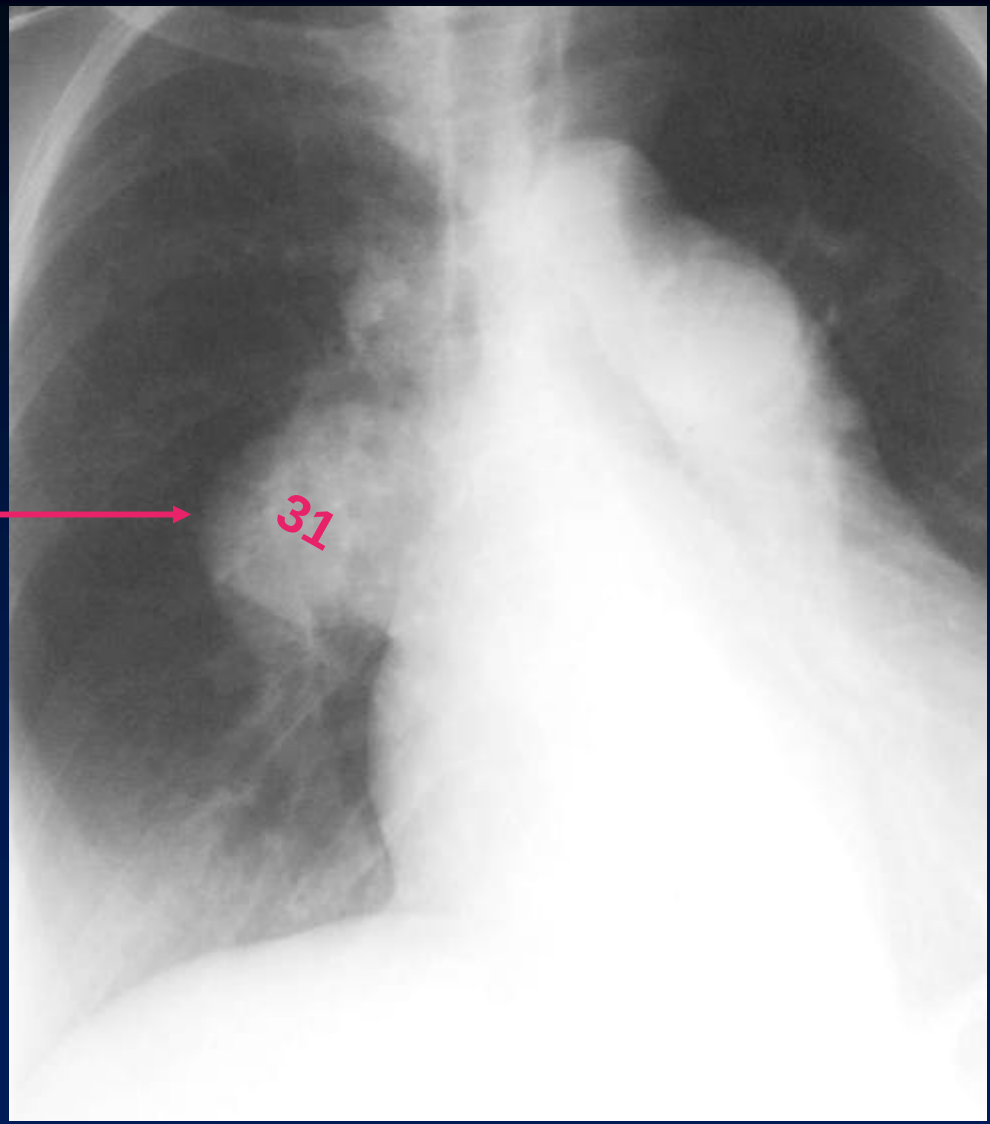
# Pulmonary Arterial Hypertension


RDPA usually
> 17 mm

Main
Pulmonary
Artery
projects
beyond
tangent line

# Pulmonary Arterial Hypertension

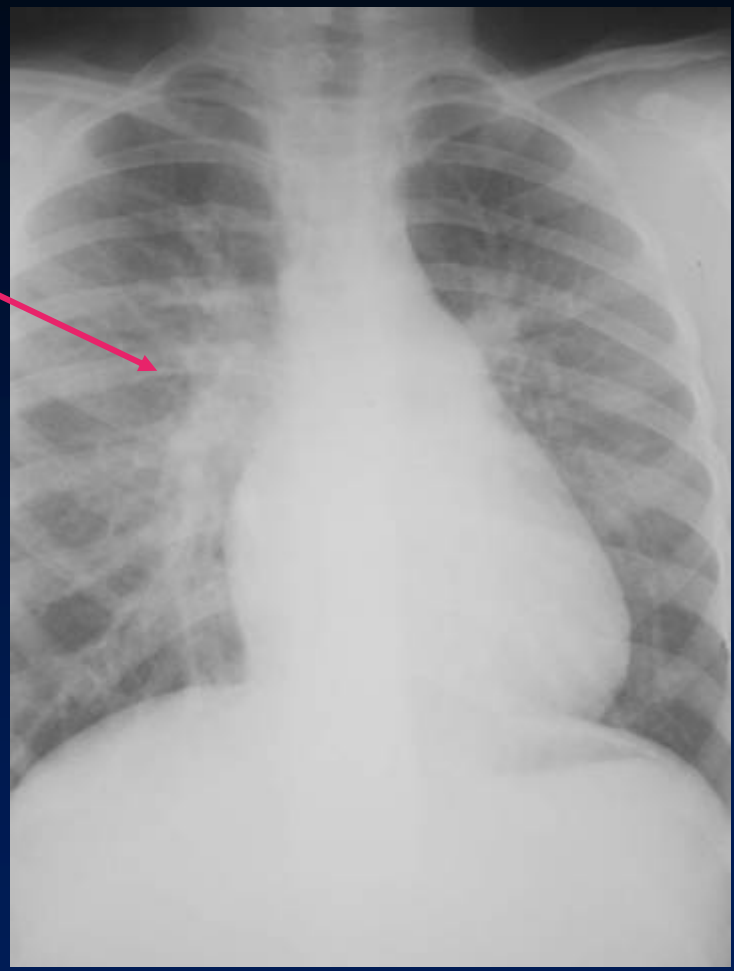
Rapid cutoff in size of peripheral vessels relative to size of central vessels




Central vessels appear too large for size of peripheral vessels which come from them = Pruning

# Increased Flow

RDPA usually
> 17 mm



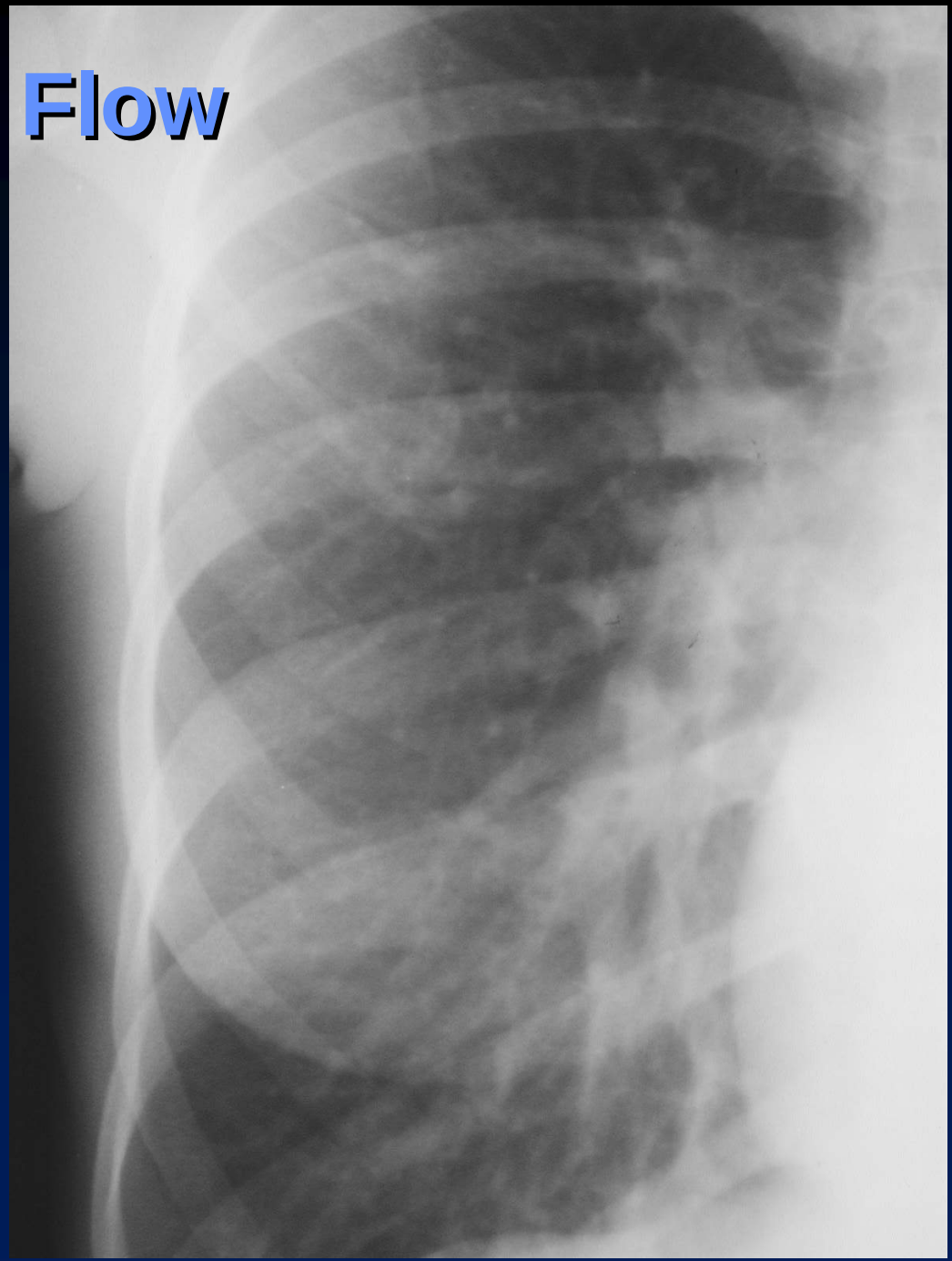
All of blood vessels everywhere in lung are bigger than normal

# Increased Flow

Distribution of flow is maintained as in normal

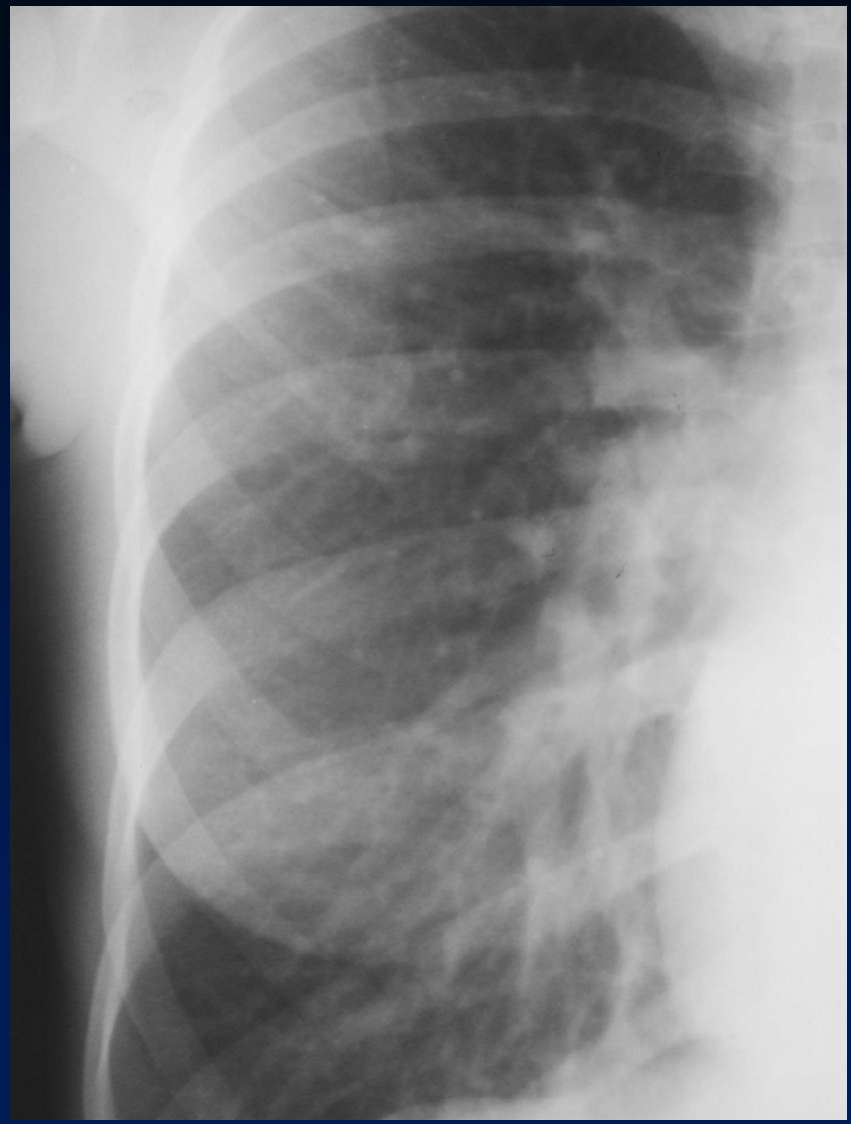
Gradual tapering from central to peripheral

Lower lobe vessels bigger than upper lobe

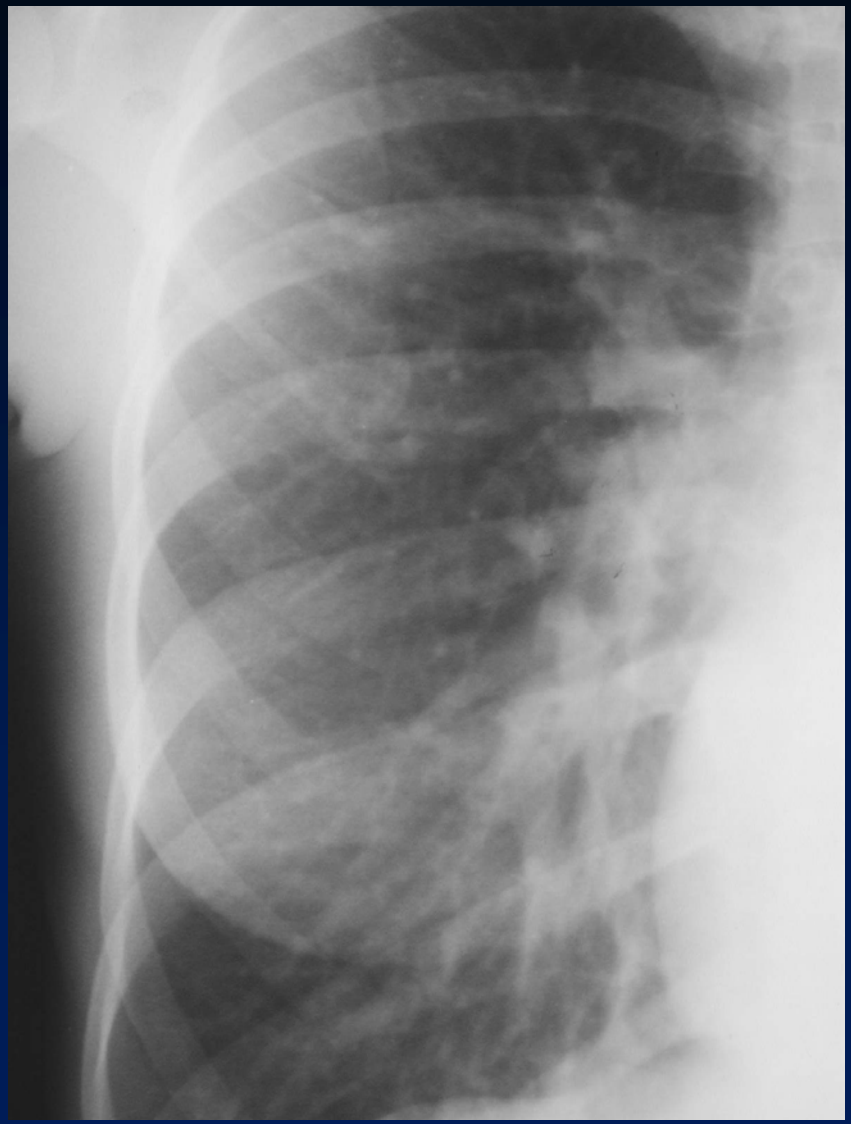


# Normal

# Increased Flow



# Increased Flow



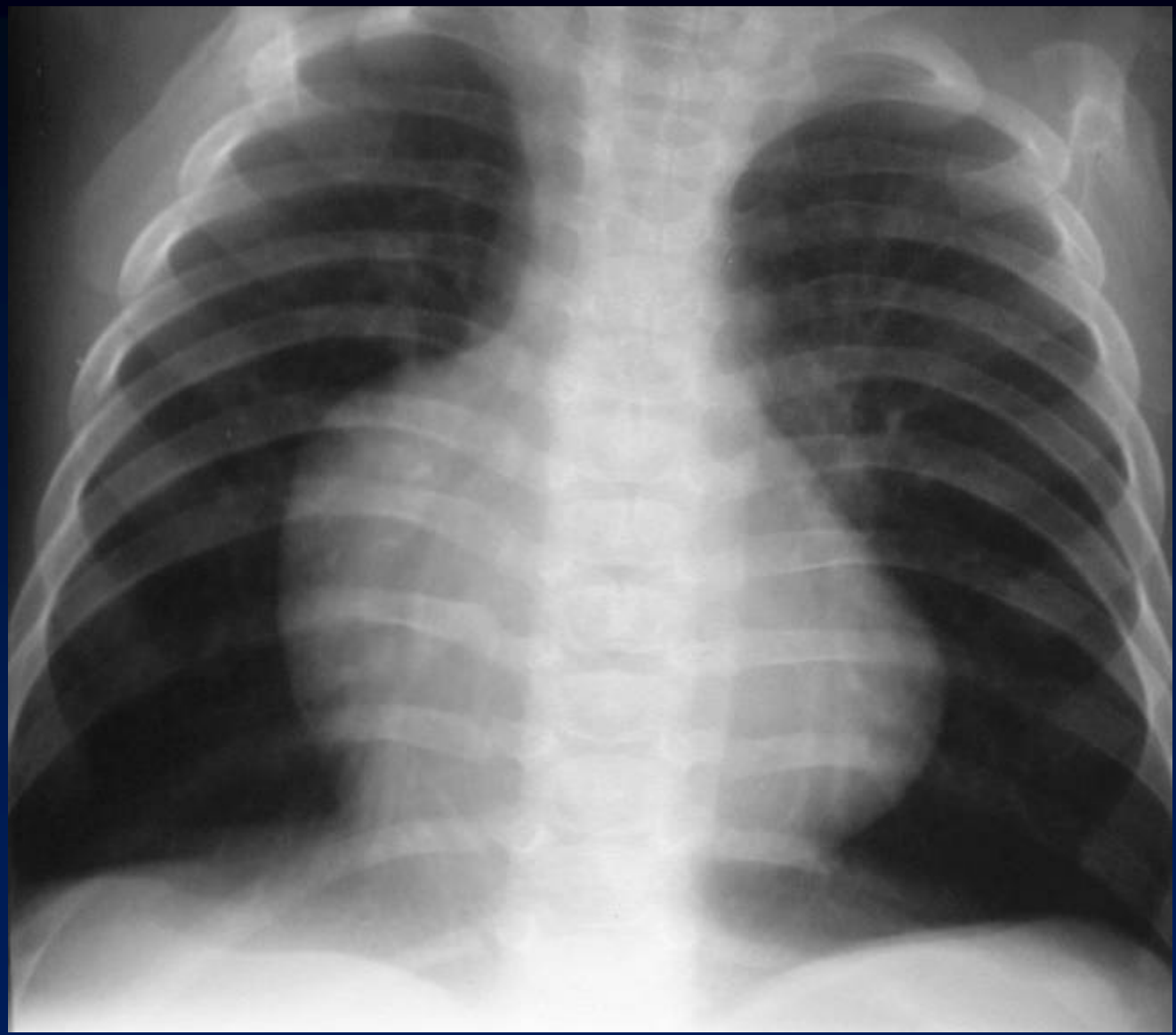
# PAH

# Decreased Flow

**Unrecognizable most of the time**

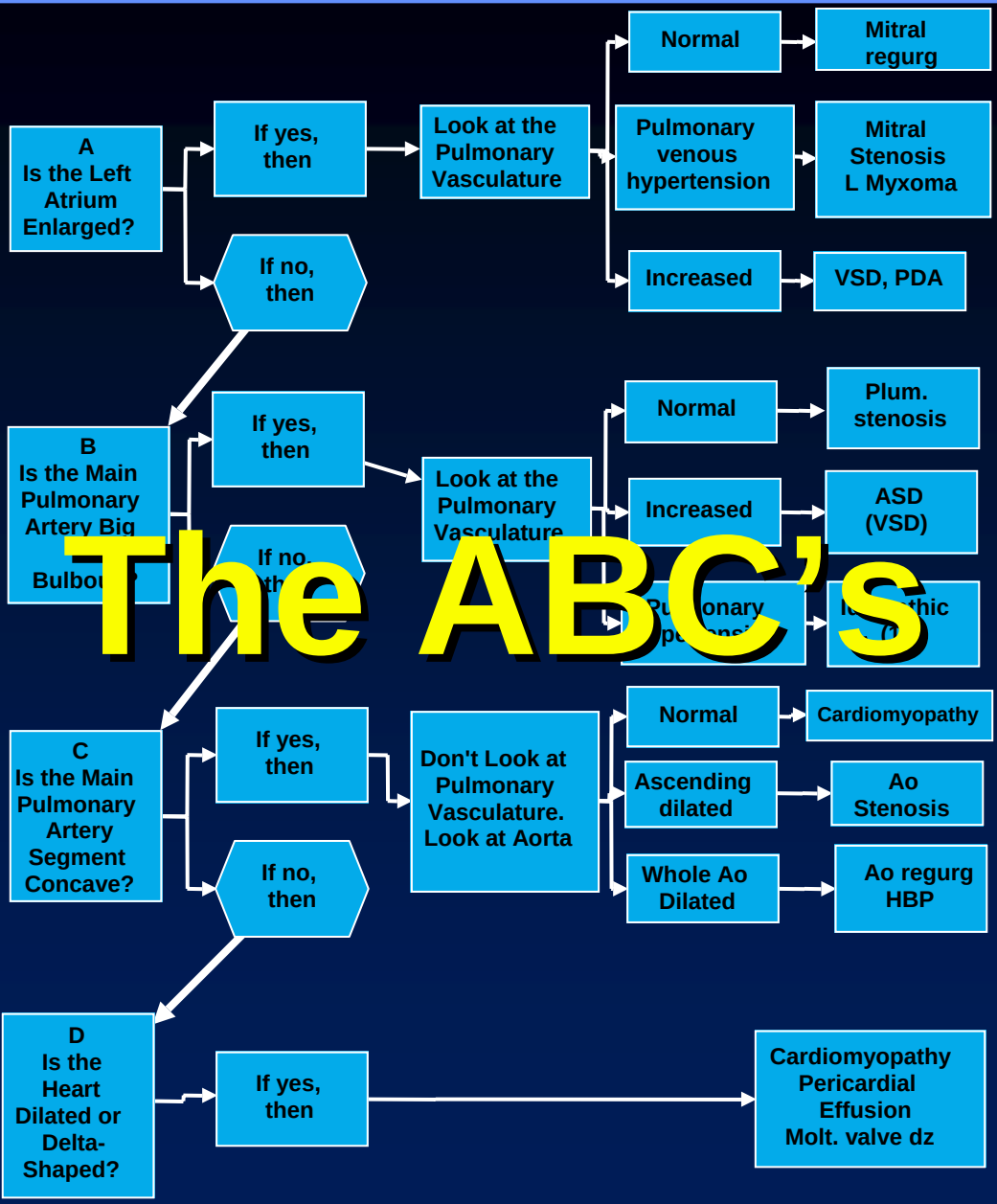
**Small hila**

**Fewer than normal blood vessels**



# The Pulmonary Vasculature

- Normal
- Pulmonary venous hypertension
- Pulmonary arterial hypertension
- Increased flow
- Decreased flow - mostly unrecognizable even when it is present


A
Is the Left Atrium Enlarged?
If yes, then
Look at the Pulmonary Vasculature
Normal
Mitral regurg
Pulmonary venous hypertension
Mitral Stenosis
L Myxoma
Increased
VSD, PDA
If no, then
B
Is the Main Pulmonary Artery Big
If yes, then
Look at the Pulmonary Vasculature
Normal
Plum. stenosis
Increased
ASD (VSD)
C
Is the Main Pulmonary Artery Segment Concave?
If yes, then
Don't Look at Pulmonary Vasculature. Look at Aorta
Normal
Cardiomyopathy
Ascending dilated
Ao Stenosis
Whole Ao Dilated
Ao regurg HBP
If no, then
D
Is the Heart Dilated or Delta-Shaped?
If yes, then
Cardiomyopathy
Pericardial Effusion
Molt. valve dz

# The ABC's

# The System

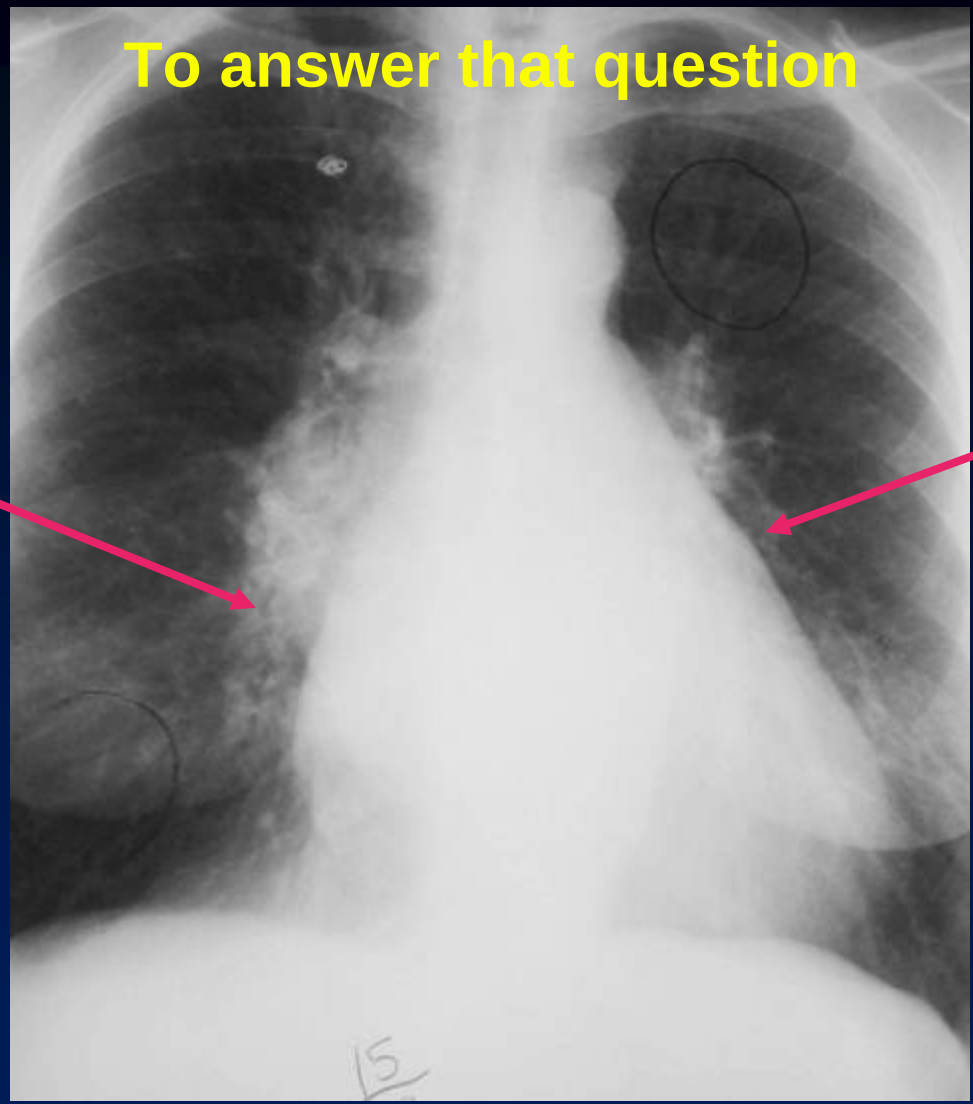
- Those were all of the answers
- Now here are the questions
- The system is successful only if you ask the questions in this order
- The answers are the fundamental observations you make on the frontal film alone

# A

## Is The Left Atrium Enlarged ?

# A

## To answer that question



"Double density" at site of normal indentation

Straight or convex at site of normal concavity

# A

**If Answer To Question “A” Is YES**

**Look At Pulmonary Vasculature**

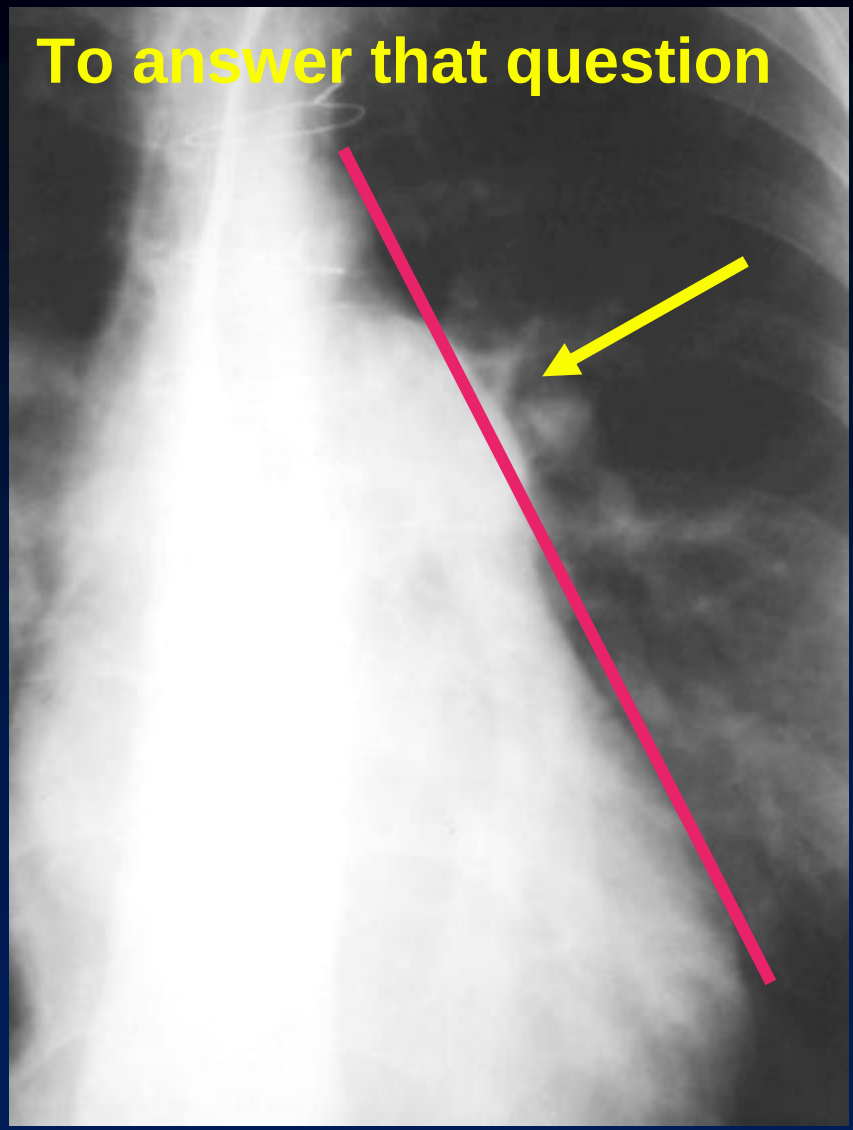
# A

**If Answer To Question “A” Is NO Then...**

# B

## Is The Main Pulmonary Artery Big ?

# B




**Main pulmonary artery projects beyond tangent line**

# B

**If Answer To Question “B” Is YES**

**Look At Pulmonary Vasculature**

# B

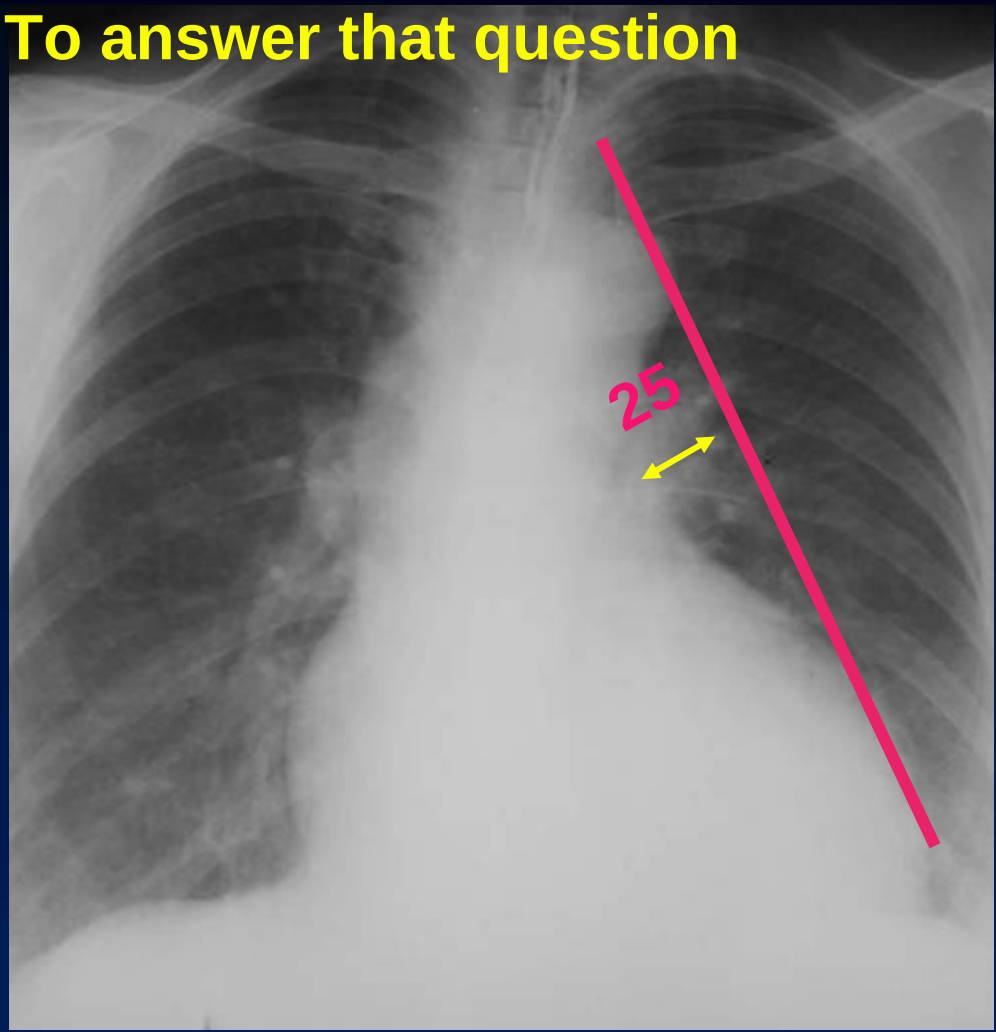
**If Answer To Question “B” Is NO Then…**

C

# Is The Main Pulmonary Artery Concave ?

C

To answer that question




Main pulmonary artery is > 15mm away from tangent line

# C

**If Answer To Question “C” Is YES**

**Look At Configuration of Aorta**

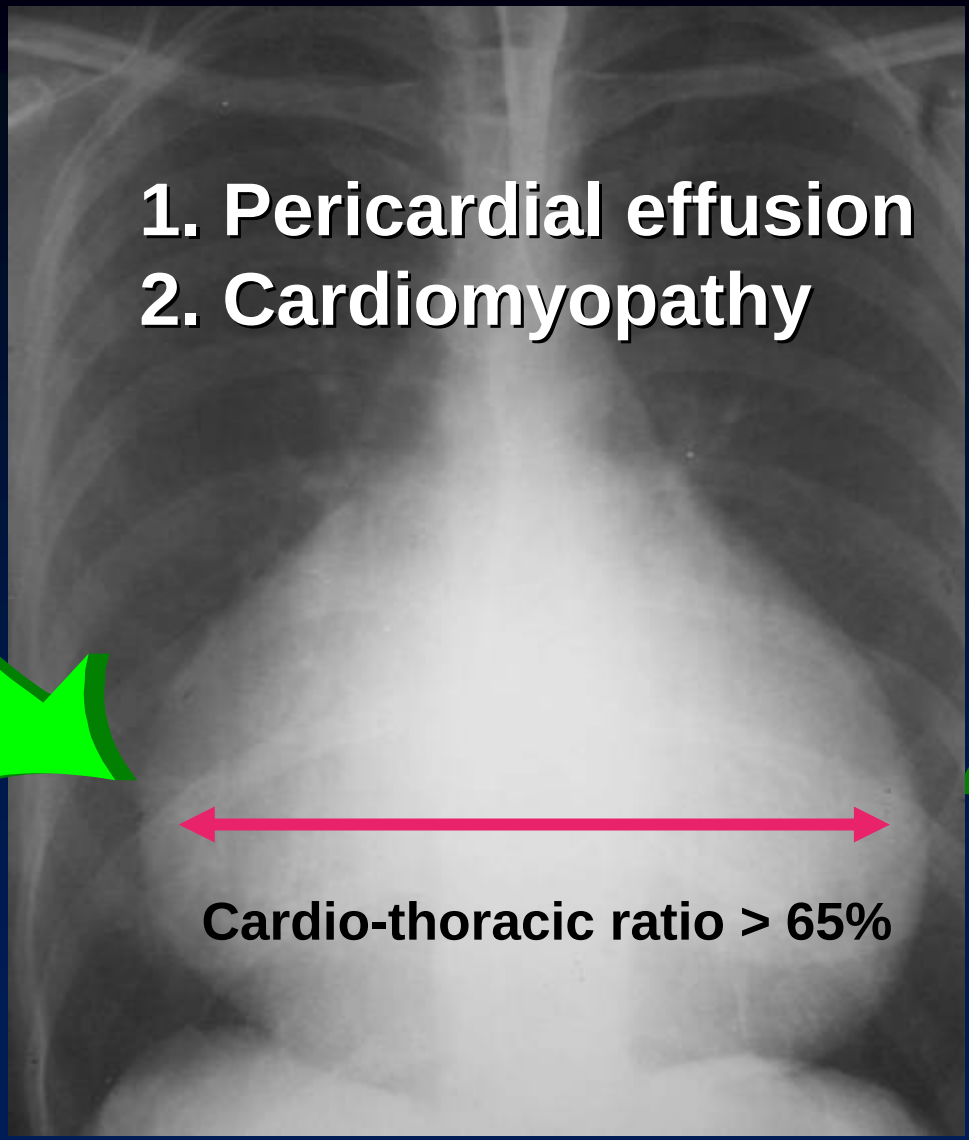
# C

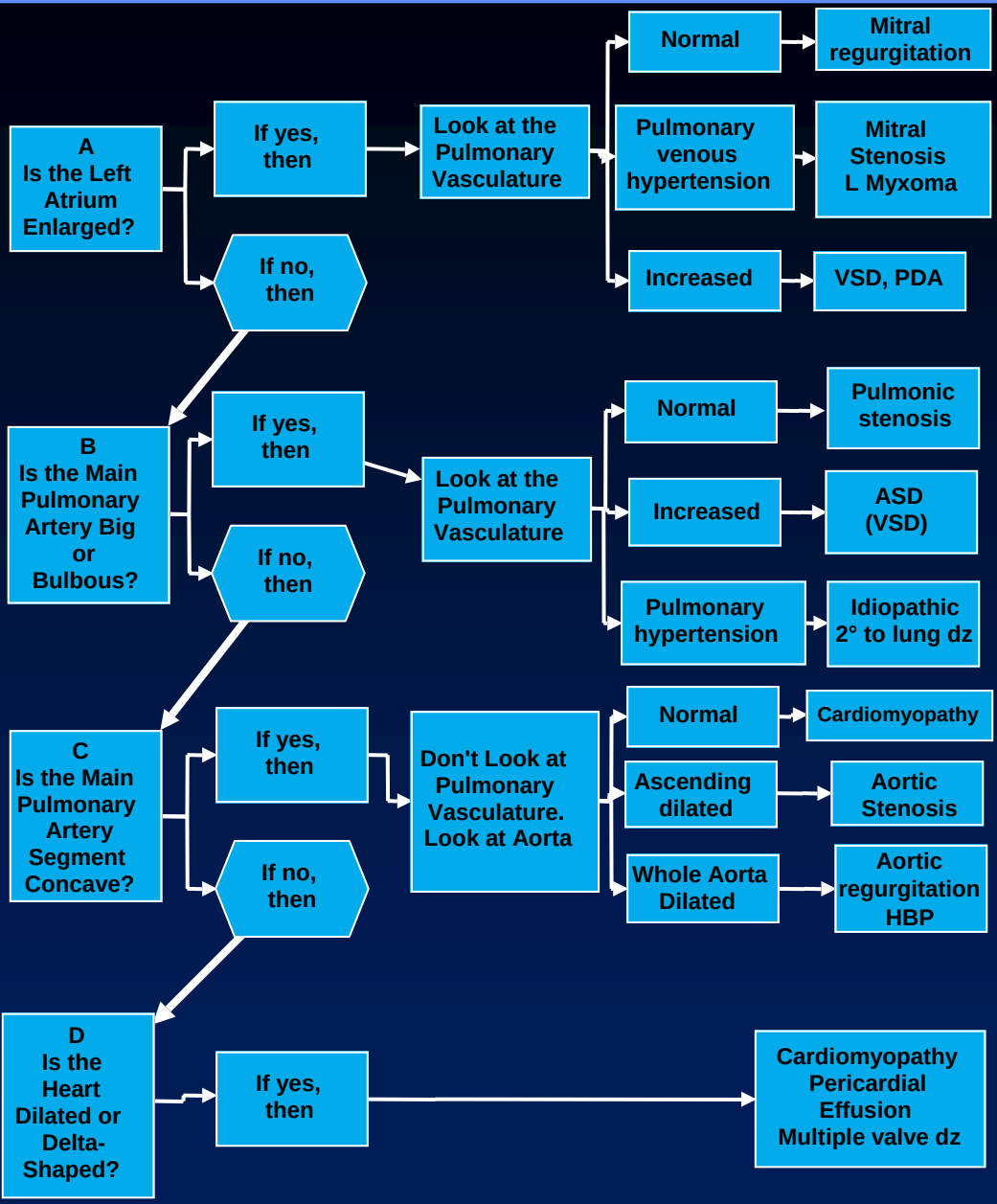
**If Answer To Question “C” Is NO Then…**

# D

## Is The Heart a Dilated Or Delta-Shaped Heart ?

# D


1. Pericardial effusion
2. Cardiomyopathy
Cardio-thoracic ratio > 65%


A
Is the Left Atrium Enlarged?
If yes, then
If no, then
Look at the Pulmonary Vasculature
Normal
Mitral regurgitation
Pulmonary venous hypertension
Mitral Stenosis
L Myxoma
Increased
VSD, PDA
B
Is the Main Pulmonary Artery Big or Bulbous?
If yes, then
If no, then
Look at the Pulmonary Vasculature
Normal
Pulmonic stenosis
Increased
ASD (VSD)
Pulmonary hypertension
Idiopathic 2° to lung dz
C
Is the Main Pulmonary Artery Segment Concave?
If yes, then
If no, then
Don't Look at Pulmonary Vasculature. Look at Aorta
Normal
Cardiomyopathy
Ascending dilated
Aortic Stenosis
Whole Aorta Dilated
Aortic regurgitation
HBP
D
Is the Heart Dilated or Delta-Shaped?
If yes, then
Cardiomyopathy
Pericardial Effusion
Multiple valve dz

**Choose the link**
**“Test Yourself on the ABCs”**
**to see how the system works**

**For printed notes, choose the link under**
**Cardiac Notes for**
**“The ABCs of Heart Disease”**

# The End