

IN THE NAME OF GOD

Chest X-Ray

In Emergency Department

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Introduction

- **CXR:** 1) Adult
2) Children
- Reading → Pathologic Finding → Diagnosis
- Every doctor will have a different approach to reading chest X-rays
- **CXR:** 1) TRUMA → ATLS → ABCDEFG
2) Internal Medicine
Chest radiographs are read « **concentrically** » from the periphery towards the center

A B C D E F G

- **OVERVIEW**
- **A = Airway**
- **B = Breathing**
- **C = Circulation**
- **D = Diaphragm**
- **E = Emphysema (Soft Tissues)**
- **F = Fracture (Bones)**
- **G = Tube & Lines**

OVERVIEW

1- Name & AGE & Sex

2- Date

- important for **comparing** prior exams
- Serial image

3- Position markers right(**R**) vs. left(**L**)

- Gastric bubble should be on the left
- Cardiac Anatomy

4- Patients position : sitting , standing , supine

1-P-A view

2-A-P

3-A-P supine

4-Lateral (Lt/Rt)

5-Lateral decubitus (Lt/Rt)

6-Lordotic

7-Oblique(Rt/Lt; post/anterior)

- در تمام موارد شکم حاد باید رادیوگرافی قفسه سینه در حالت ایستاده انجام شود.

5- Technical quality

Position

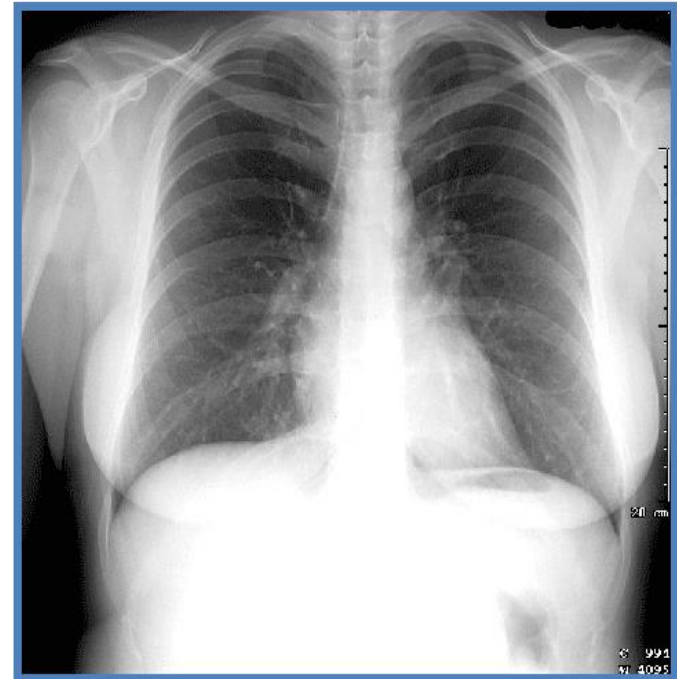
➤ Special position for special purpose

- PA : Anatomy reading
- AP view
- AP supine : Ambulatory limit
- Lateral (Lt/Rt)
- Lateral decubitus : Effusion or thickening
- Lordotic : Apical lesion
- Oblique :
helpful localize lesions and eliminate superimposed structures
Right anterior oblique for left side lesion

- بررسی استاندارد شامل : 1) دو عکس خلفی – قدامی و لترال و تفسیر هر دو با هم

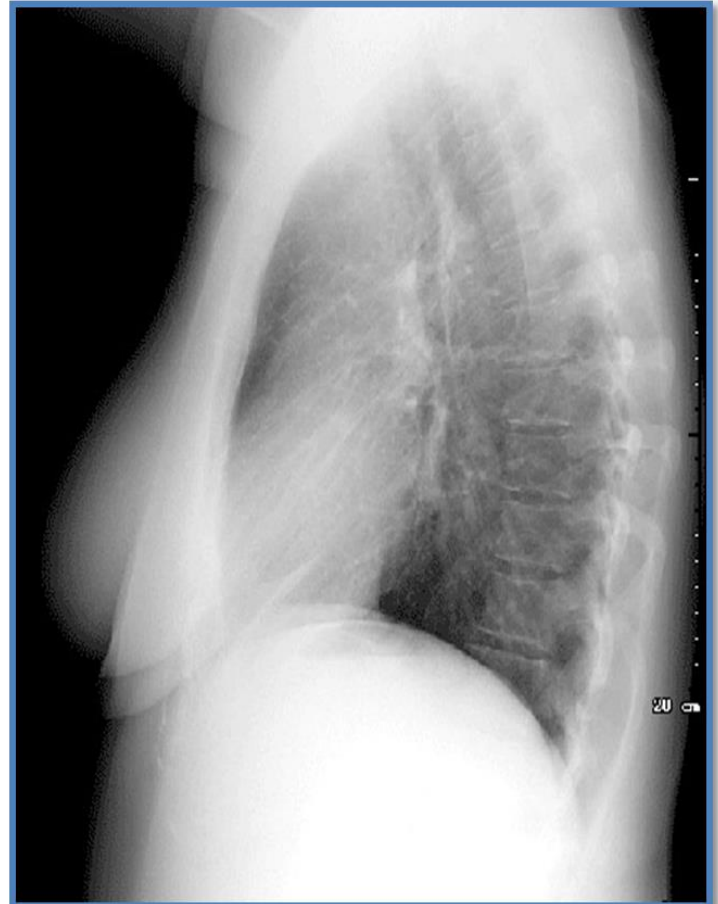
& مقایسه عکس های قدیمی با جدید

PA



قرار دادن پشت دست ها بر روی لگن باعث چرخیدن استخوان های کتف به کناره ها می شود که این کار باعث می شود که کناره های داخلی استخوان های کتف روی ریه ها نیفتد یا در حد کمتری بیفتد.

Lat



AP

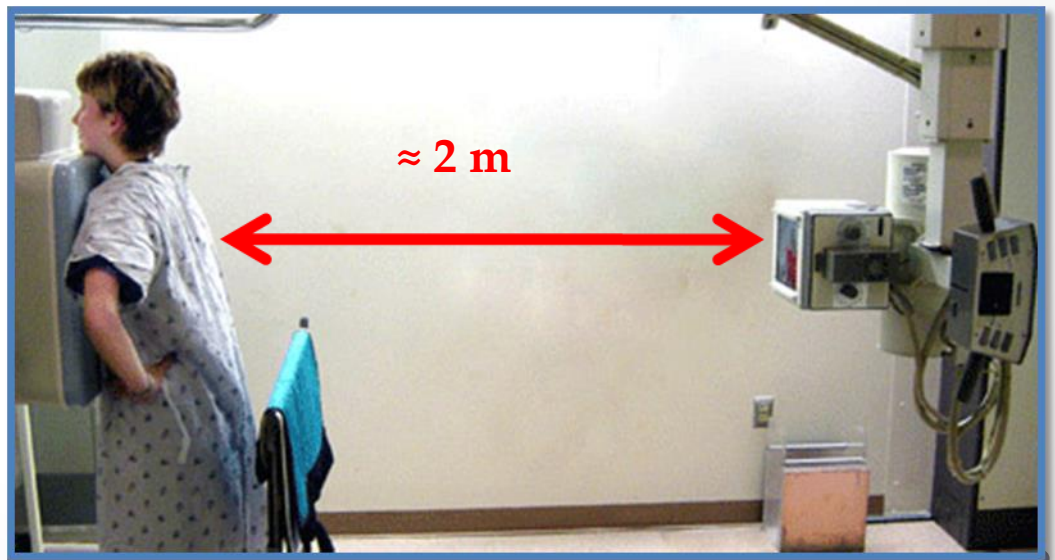
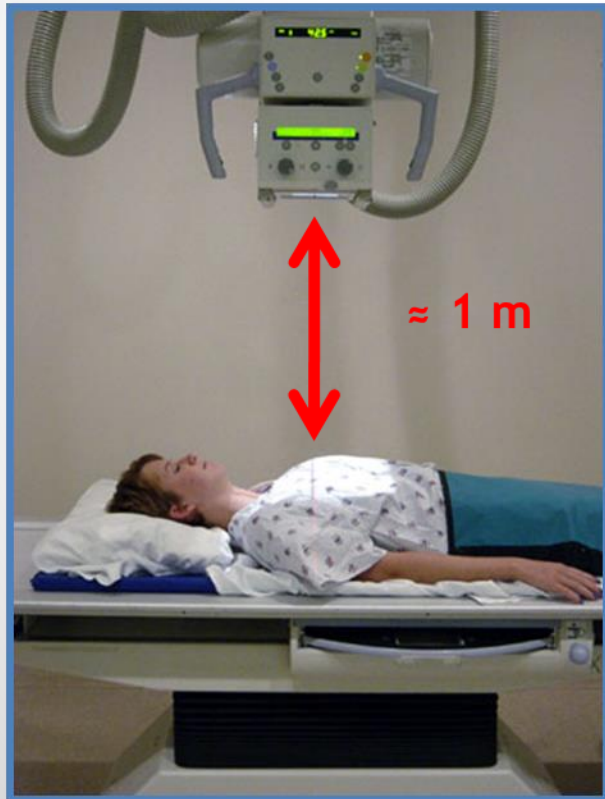
AP views are less useful and should be reserved for very ill patients who cannot stand erect (trauma, LOC,)

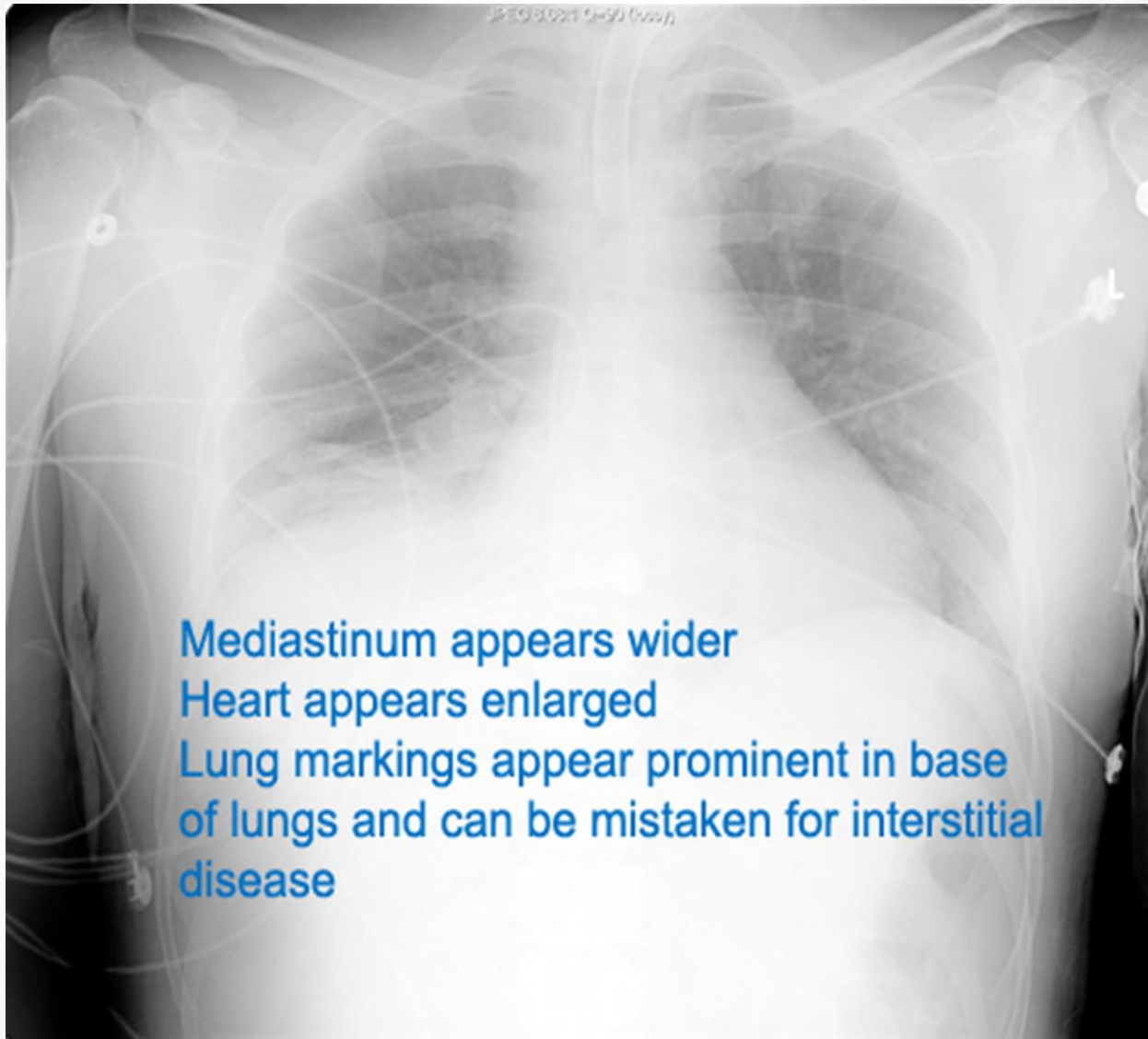




تفاوت‌های AP و PA

- بزرگی سایه قلب و سایر ساختارهای قدامی (مדיاستینوم)
- تشخیص پنوموتوراکس و افیوژن واحتقان ریوی مشکل‌تر
- سایه‌های مزاحم (سیم مانیتور، Back Board)
- چرخش، دم و نفوذپذیری کمتر





Techniques

PA & Lateral ■

- More information ▢

- Two views ▢

- Standardized ▢

- Distance ▢

- Pt needs to be stable ▢

Portable ■

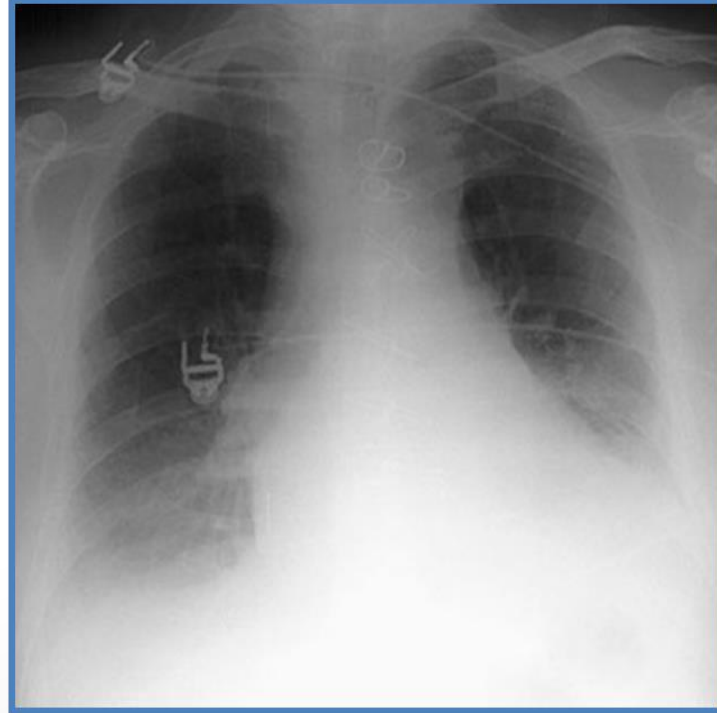
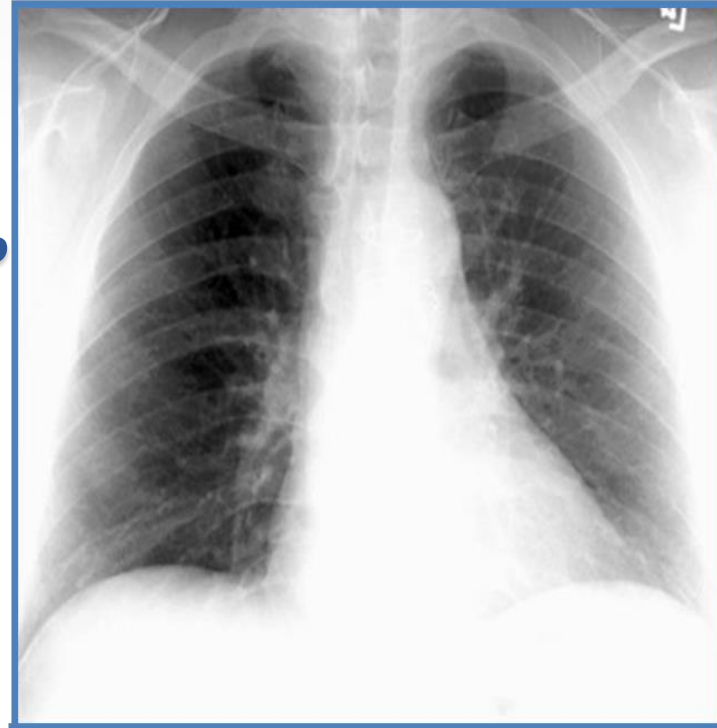
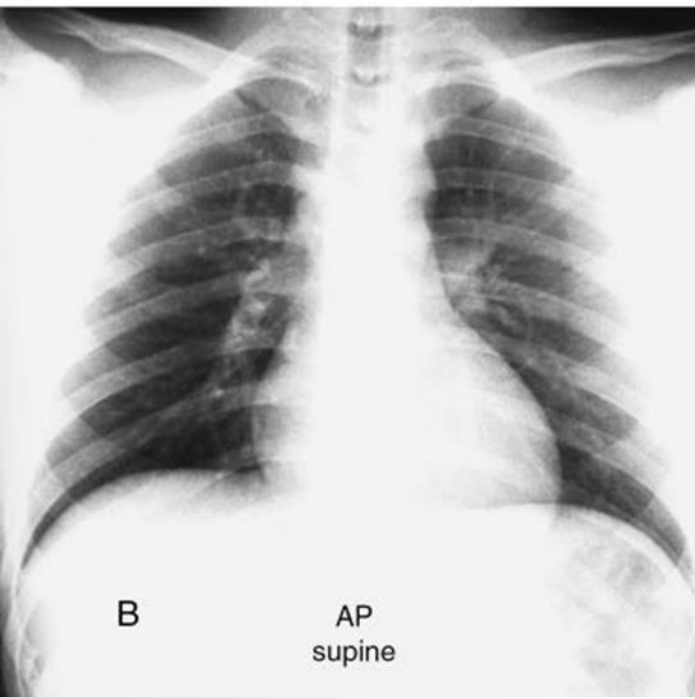
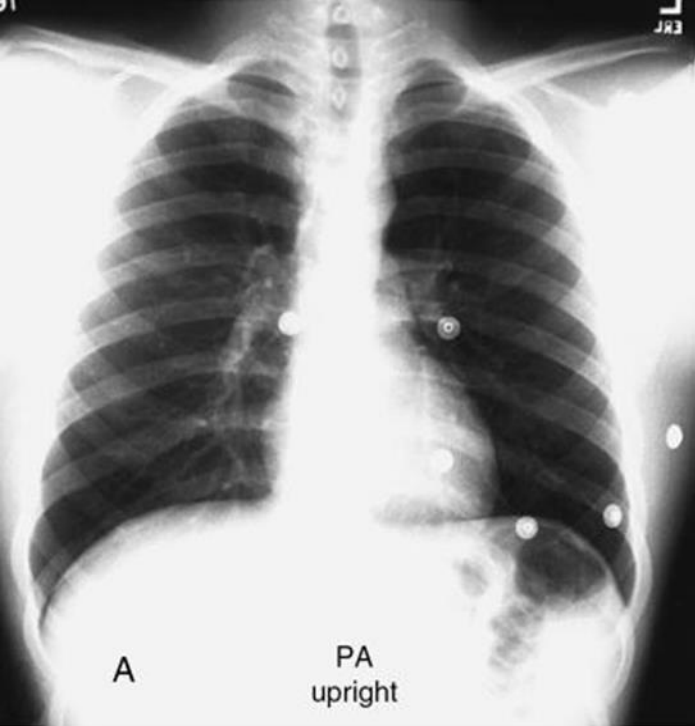
- Quick ▢

- Anywhere ▢

- One shot ▢

- No standardization ▢

PA versus AP



Lat. decubitus

وضعیت لترال دکوپیتوس برای بررسی:

حجم مایع پلور

متحرک بودن یا لوکالیزه بودن

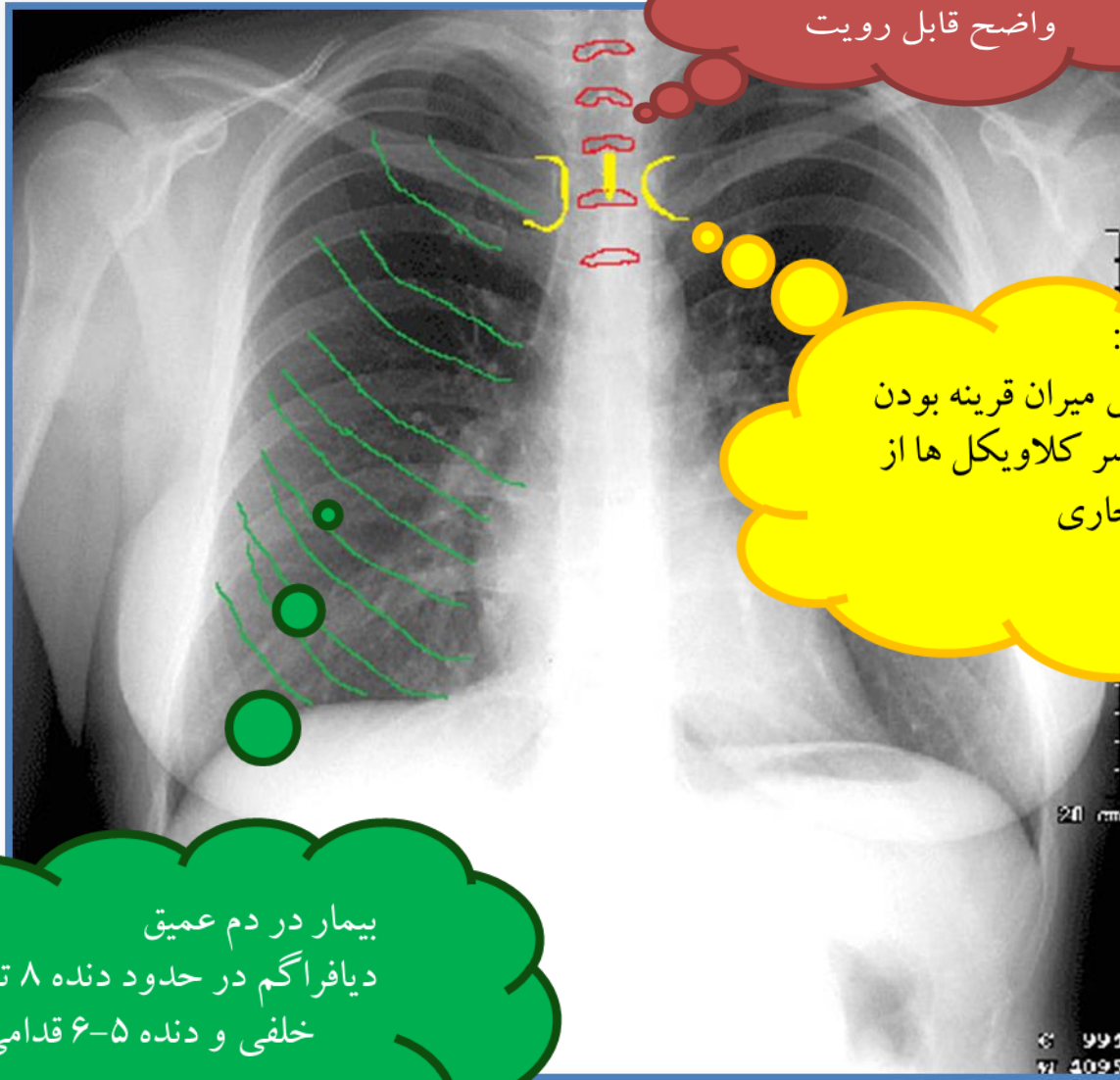


افزایش دانسیته ریه پایین قرار گرفته به علت اثر جاذبه

Technical quality

- Well centered: (Rotation?)
 - Spinous process of T4 should be between the heads of the clavicle
- Exposure (penetration):
 - It is affected by both the duration of exposure and the power of the beam
- ✓ **Good expose:** You will be able to see the thoracic vertebrae
- ✓ **Over expose** film looks **diffusely dark** and features such as **lung markings are poorly seen**
- ✓ **Under (poorly) expose** film looks **diffusely light** (an x-ray is a negative) and **soft tissue structures are readily obscured** (especially those behind the heart)
- Full inspiration

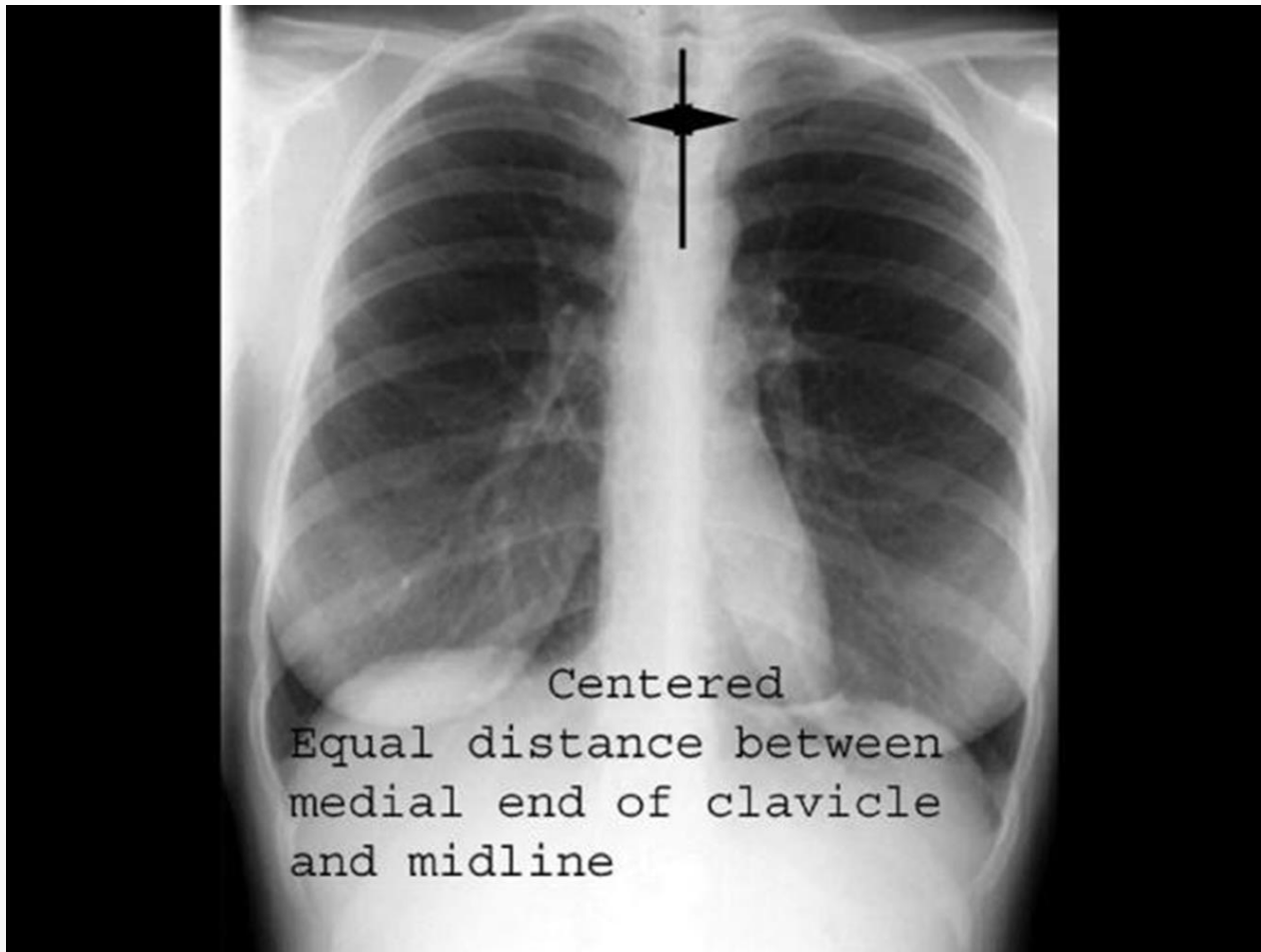
نفوذپذیری اشعه:
فضای دیسک بین
مهره ای توراسیک
واضح قابل رویت



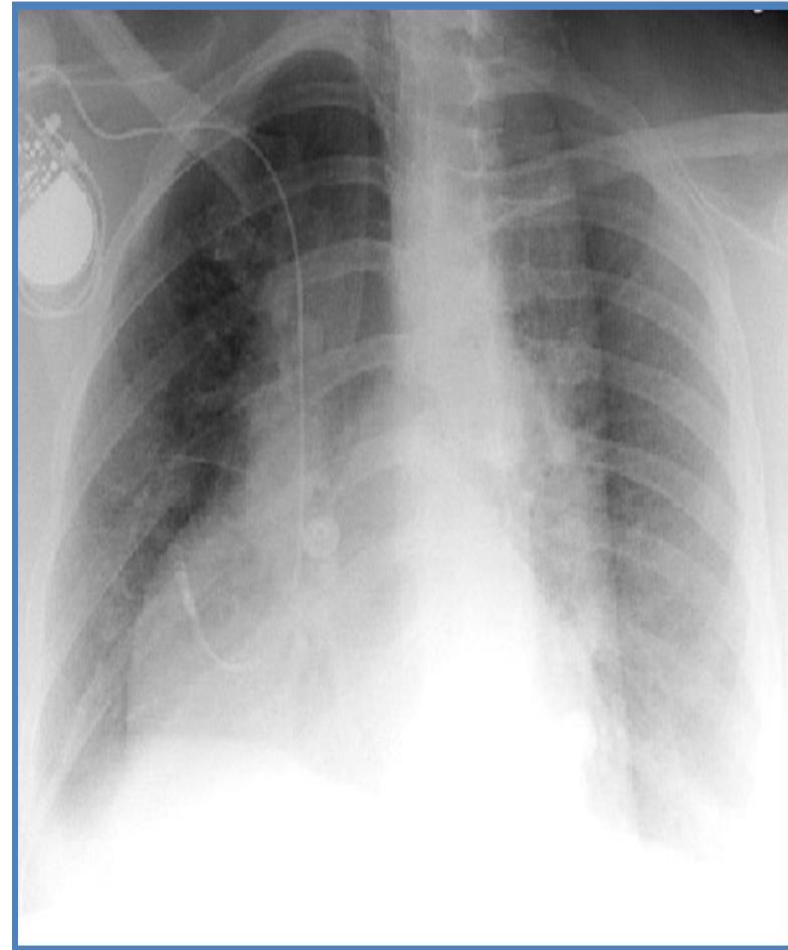
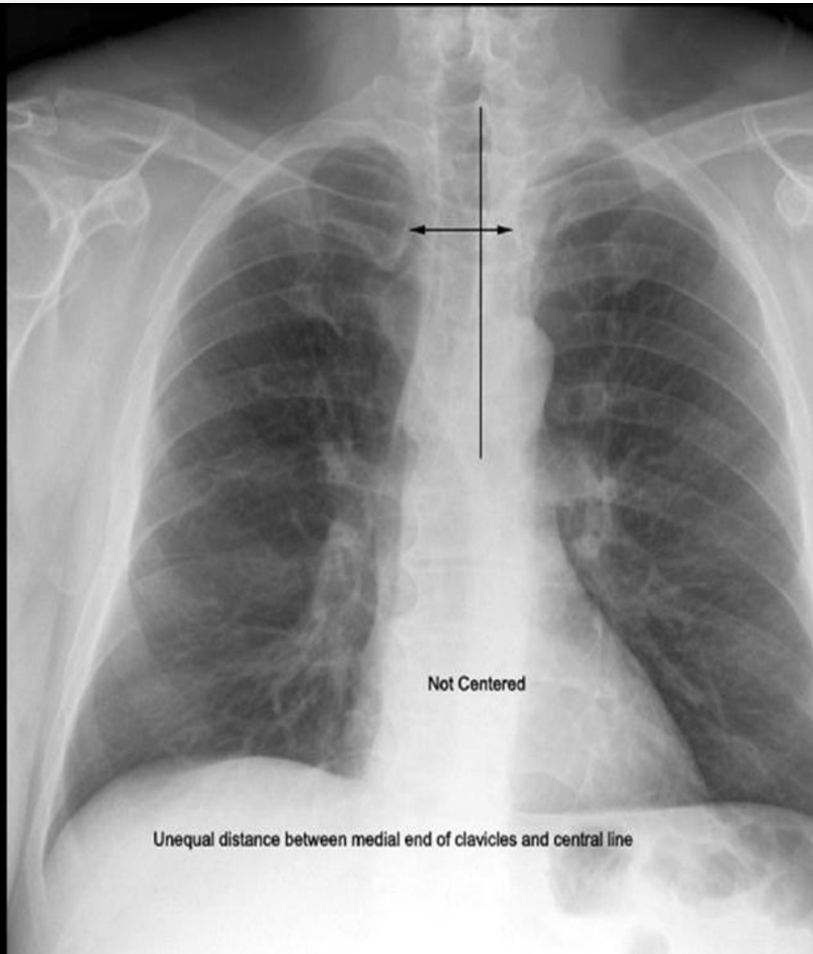
میزان چرخش:
بر اساس میزان قرینه بودن
فاصله سر کلاویکل ها از
زائده خاری

بیمار در دم عمیق
دیافراگم در حدود دنده ۸ تا ۱۰
خلفی و دنده ۵-۶ قدامی

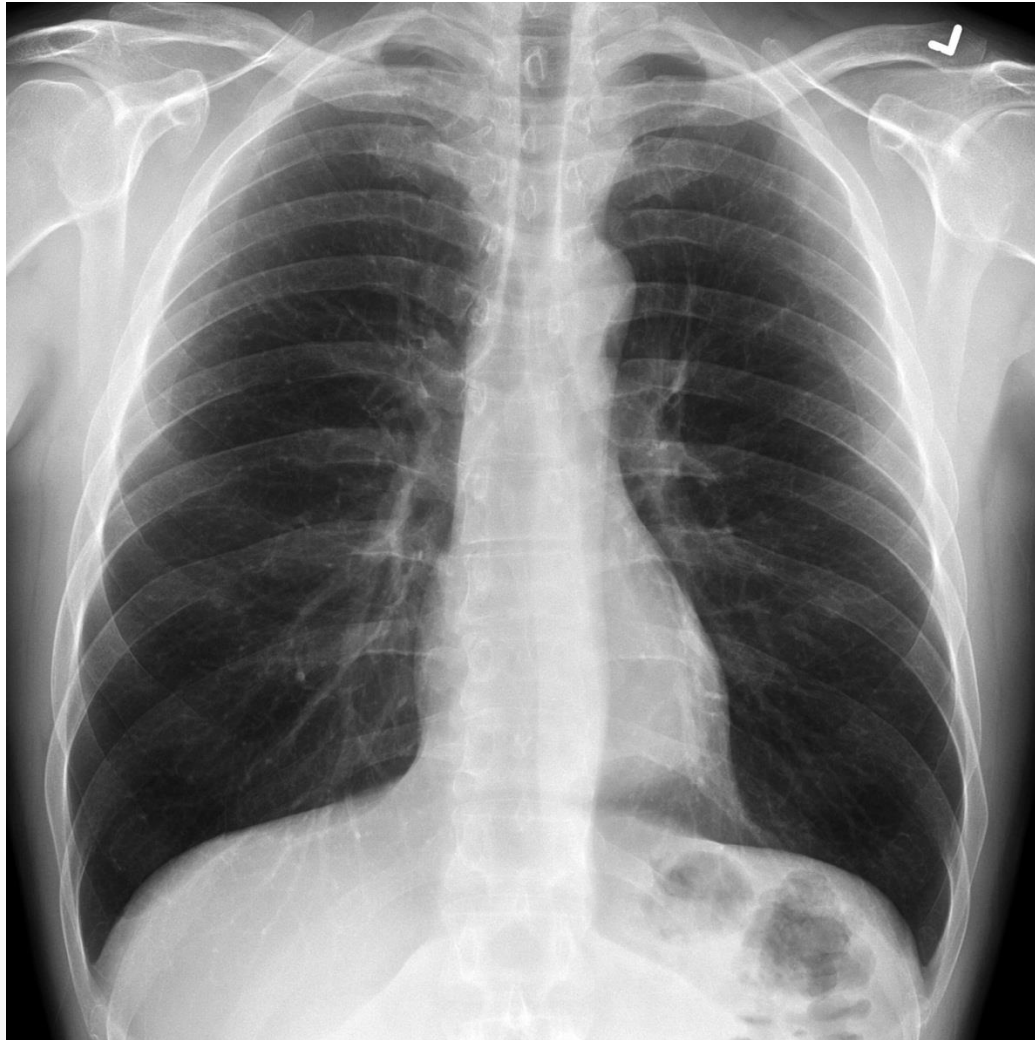
Well centered



Rotation



Good exposure (penetrate)



Under exposed/Over exposed

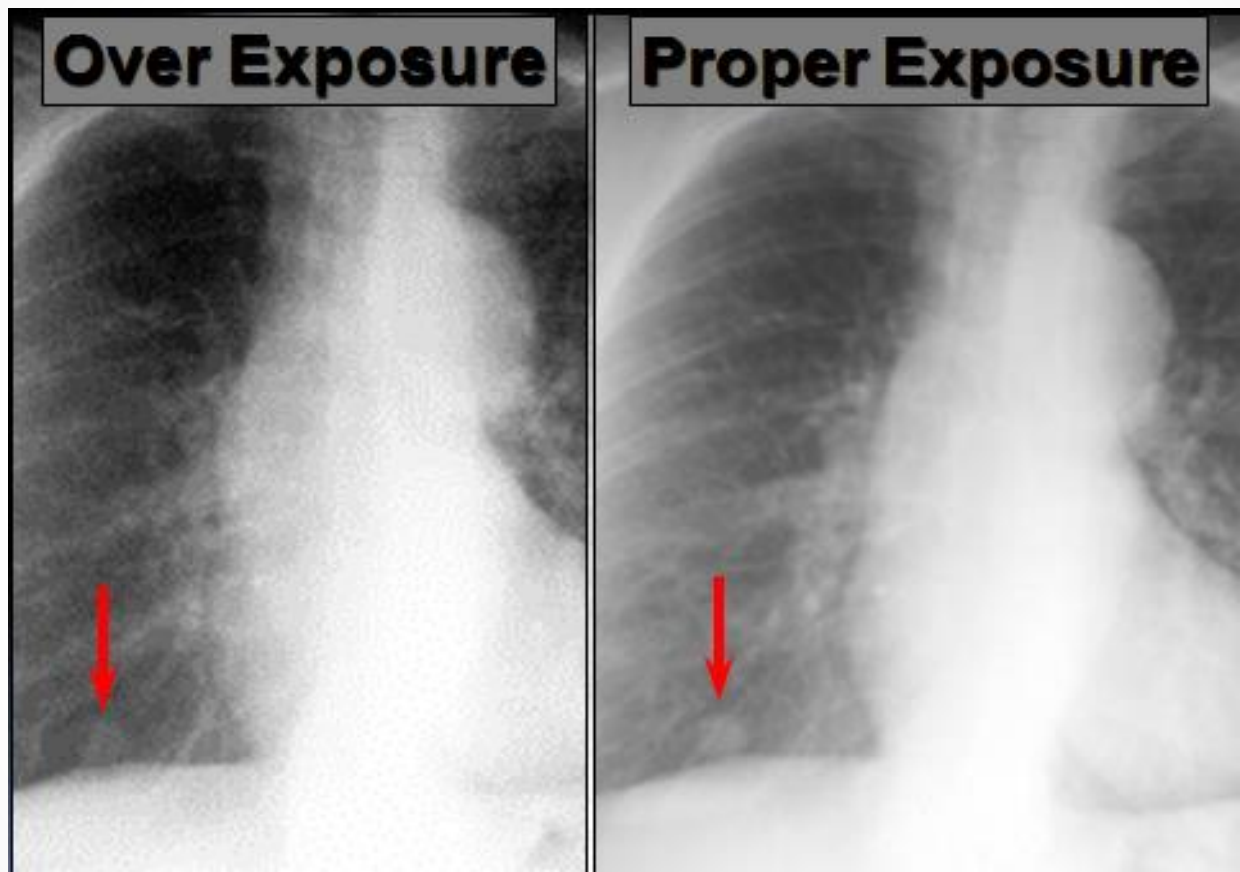
اشکالاتي که به دلیل نفوذ کم اشعه به وجود مي آید :

1- همي دیافرآگم چپ و قاعده ریه چپ به خوبی دیده نمي شود.

2- علائم ساختاري ریه نسبت به شکل واقعیشان برجسته تر به نظر مي رسند.

3- Soft tissue structures are readily obscured (especially those behind the heart)





Good expose

small pneumothorax

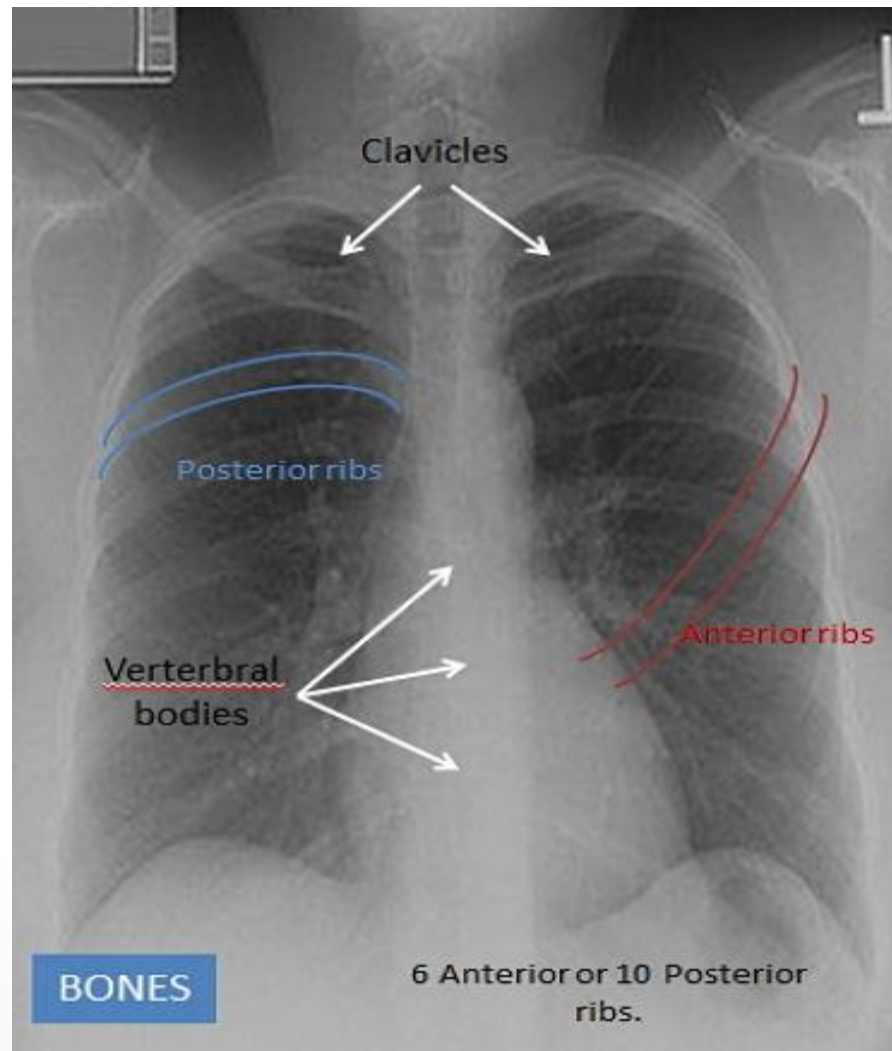


Over expose

small pneumothorax



Full inspiration



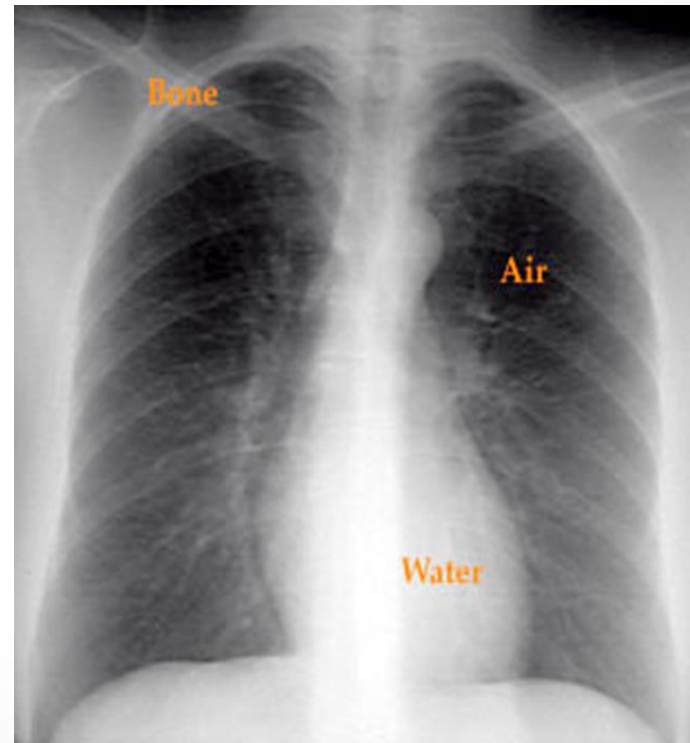
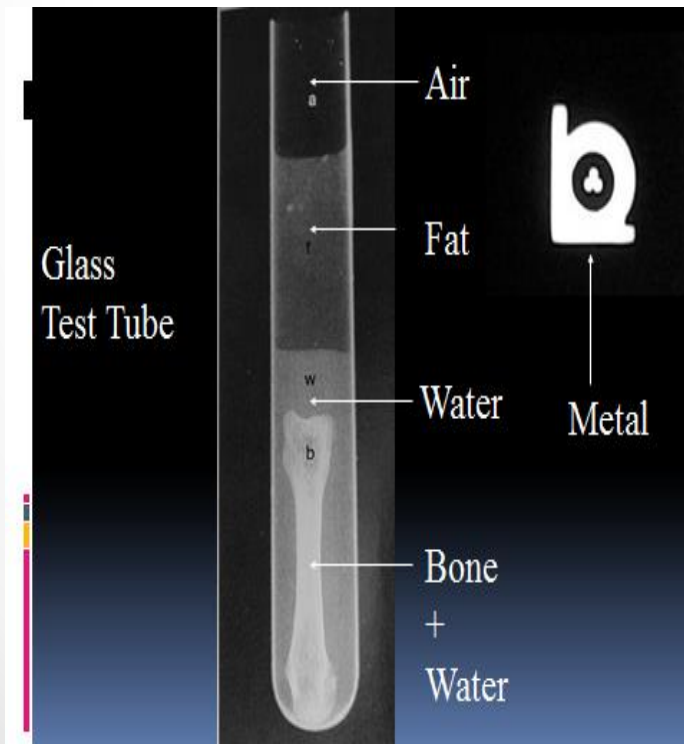
شمارش دنده ها (PA)



✓ به دلیل نزدیک بودن دنده های قدامی نسبت به دنده های خلفی به فیلم، در یک نمای PA سایه آن ها کمتر دچار بزرگنمایی شده و معمولاً شارپ تر هستند.

✓ دنده های 1 و 2 در امتداد رانده عرضی T1 روی هم می افتند.

- Different tissues in our body absorb X-rays at different extents:
- Bone - high absorption (**White**)
- Air - low absorption (**Black**)
- Tissue - somewhere in the middle absorption (**Grey**)
 - GREY- Soft tissue/water
 - DARK GREY- Fat



A = Airway

Trachea & Bronchi

✓ آیا تراشه در خط وسط است یا نه؟

- STEP 1.** Assess the position of the tube in cases of endotracheal intubation.
- STEP 2.** Assess for the presence of interstitial or pleural air that can represent tracheobronchial injury.
- STEP 3.** Assess for tracheal lacerations that can present as pneumomediastinum, pneumothorax, subcutaneous and interstitial emphysema of the neck, or pneumoperitoneum.
- STEP 4.** Assess for bronchial disruption that can present as a free pleural communication and produce a massive pneumothorax with a persistent air leak that is unresponsive to tube thoracostomy.

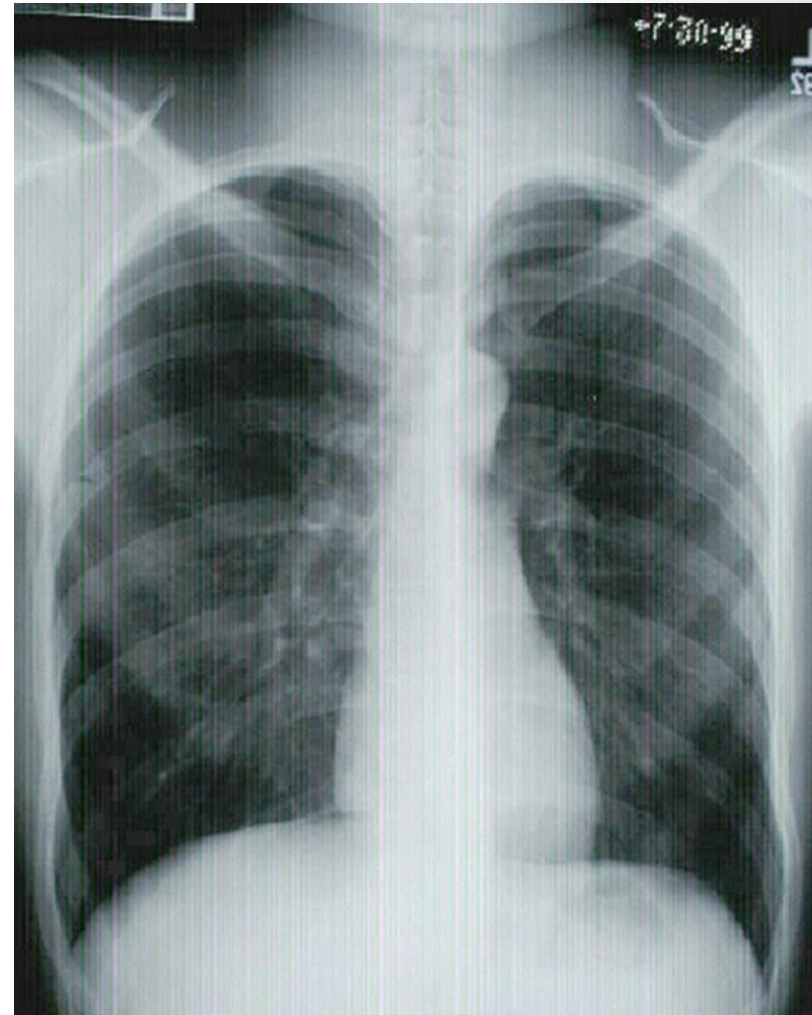
B = Breathing

Pleural Space & Lung Parenchyma

- STEP 1.** Assess the pleural space for abnormal collections of fluid that can represent a hemothorax.
- STEP 2.** Assess the pleural space for abnormal collections of air that can represent a pneumothorax—usually seen as an apical lucent area without bronchial or vascular markings.
- STEP 3.** Assess the lung fields for infiltrates that can suggest pulmonary contusion, hematoma, aspiration, etc. Pulmonary contusion appears as air-space consolidation that can be irregular and patchy, homogeneous, diffuse, or extensive.
- STEP 4.** Assess the parenchyma for evidence of laceration. Lacerations appear as a hematoma, vary according to the magnitude of injury, and appear as areas of consolidation.

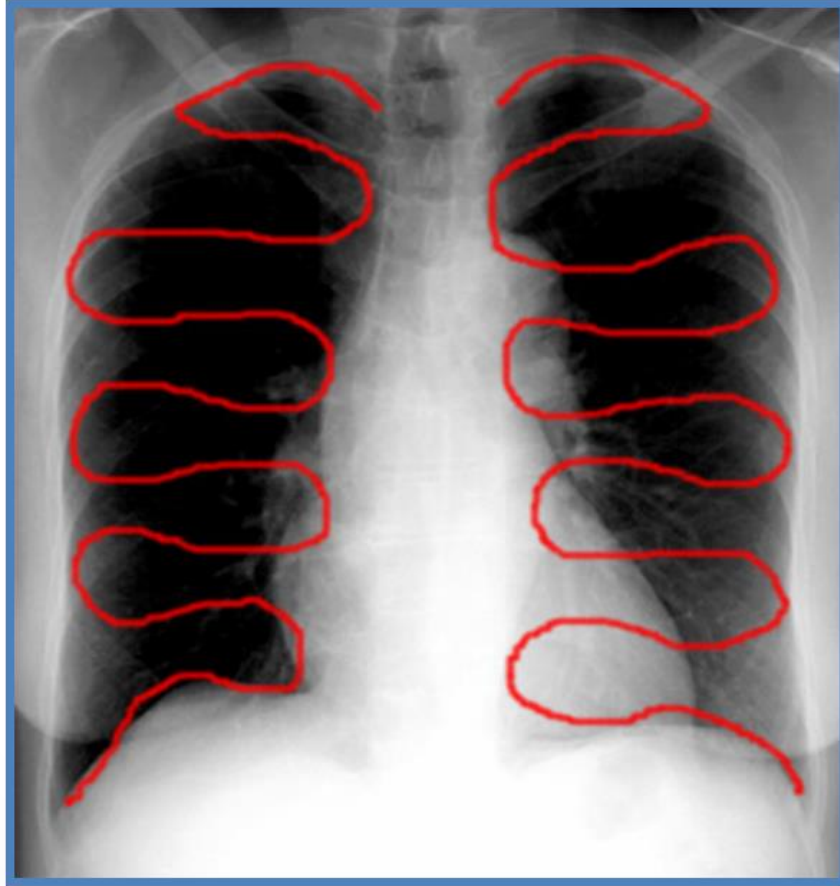
Pleural

- Layers: Parietal
Visceral
- Check the costophrenic angles
Margins should be sharp
- پلور: افیوژن، ضخیم شدن، کلسیفیه شدن

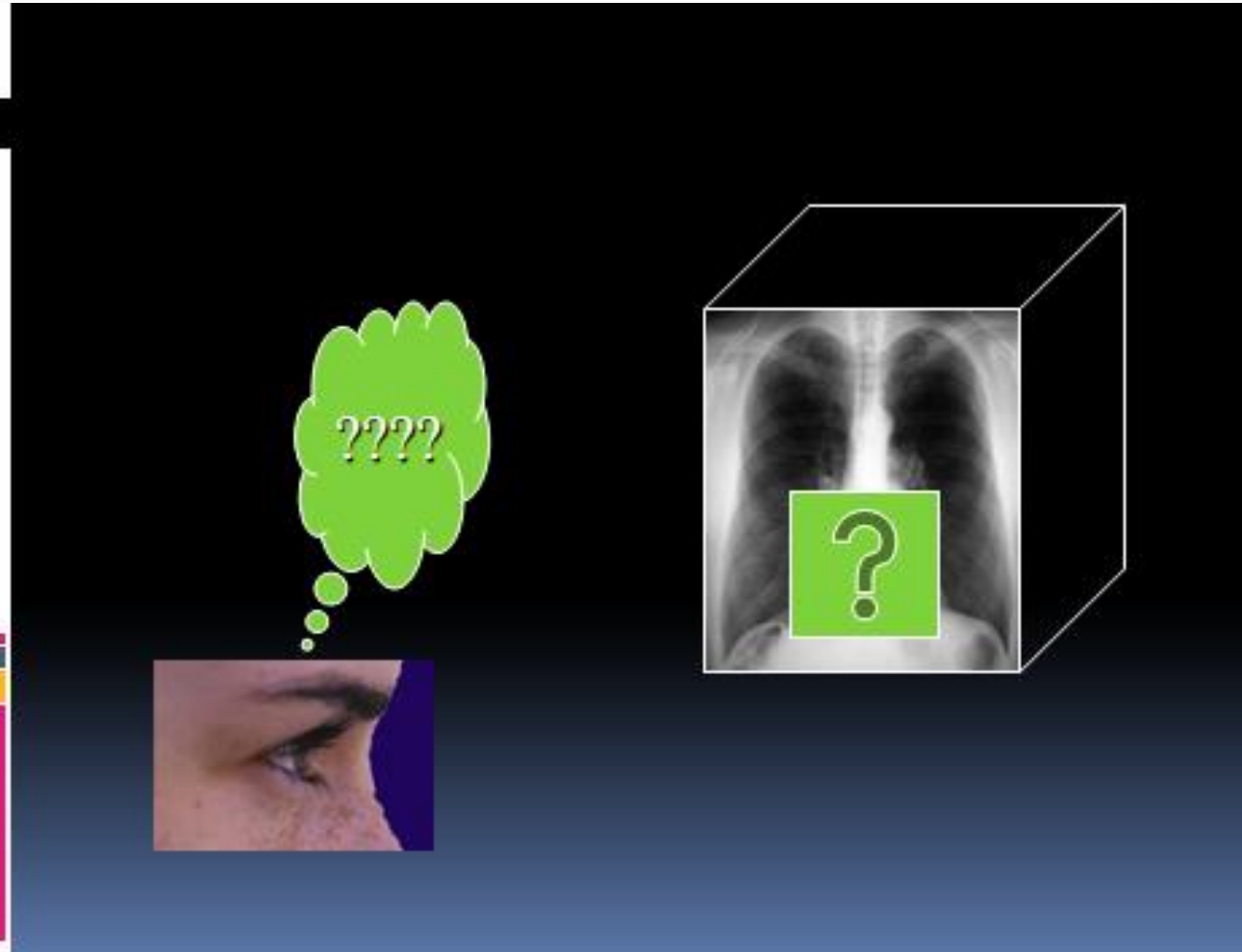


Lungs

Density
Symmetry
Lesions



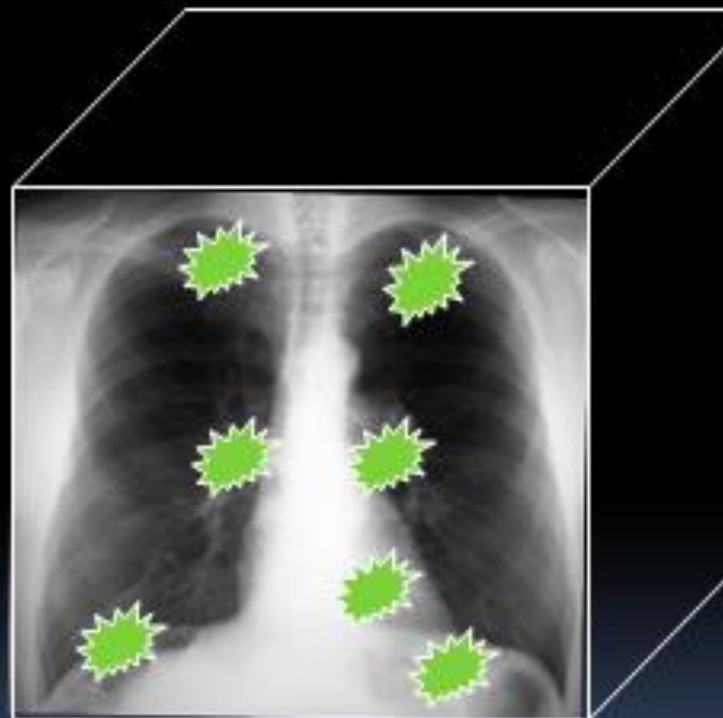
If you see nothing abnormal on the x-ray, and yet clinical examination or history suggests otherwise, what do you do?



Before taking an x-ray off the monitor

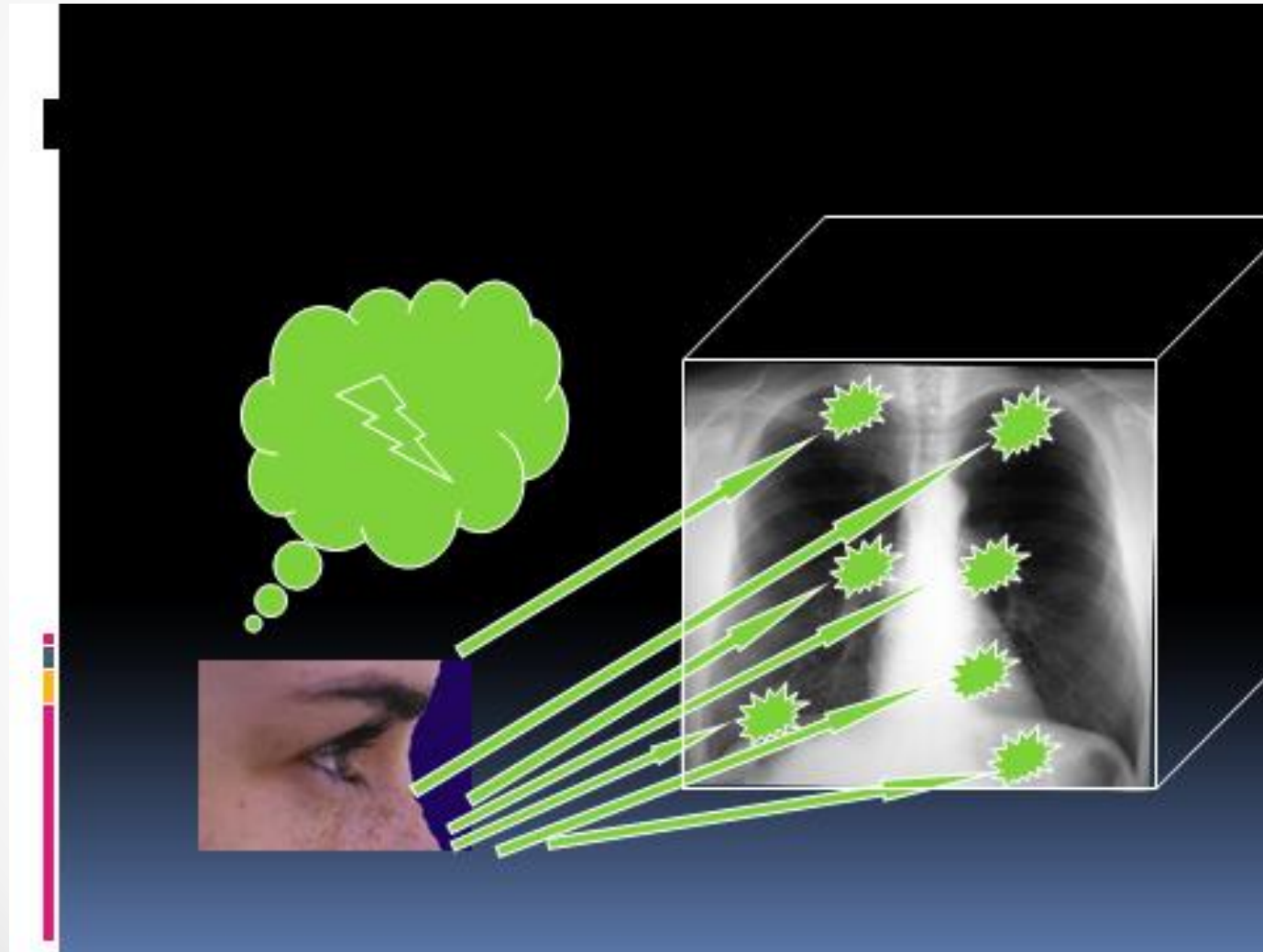
you must say:

AH HA !!!



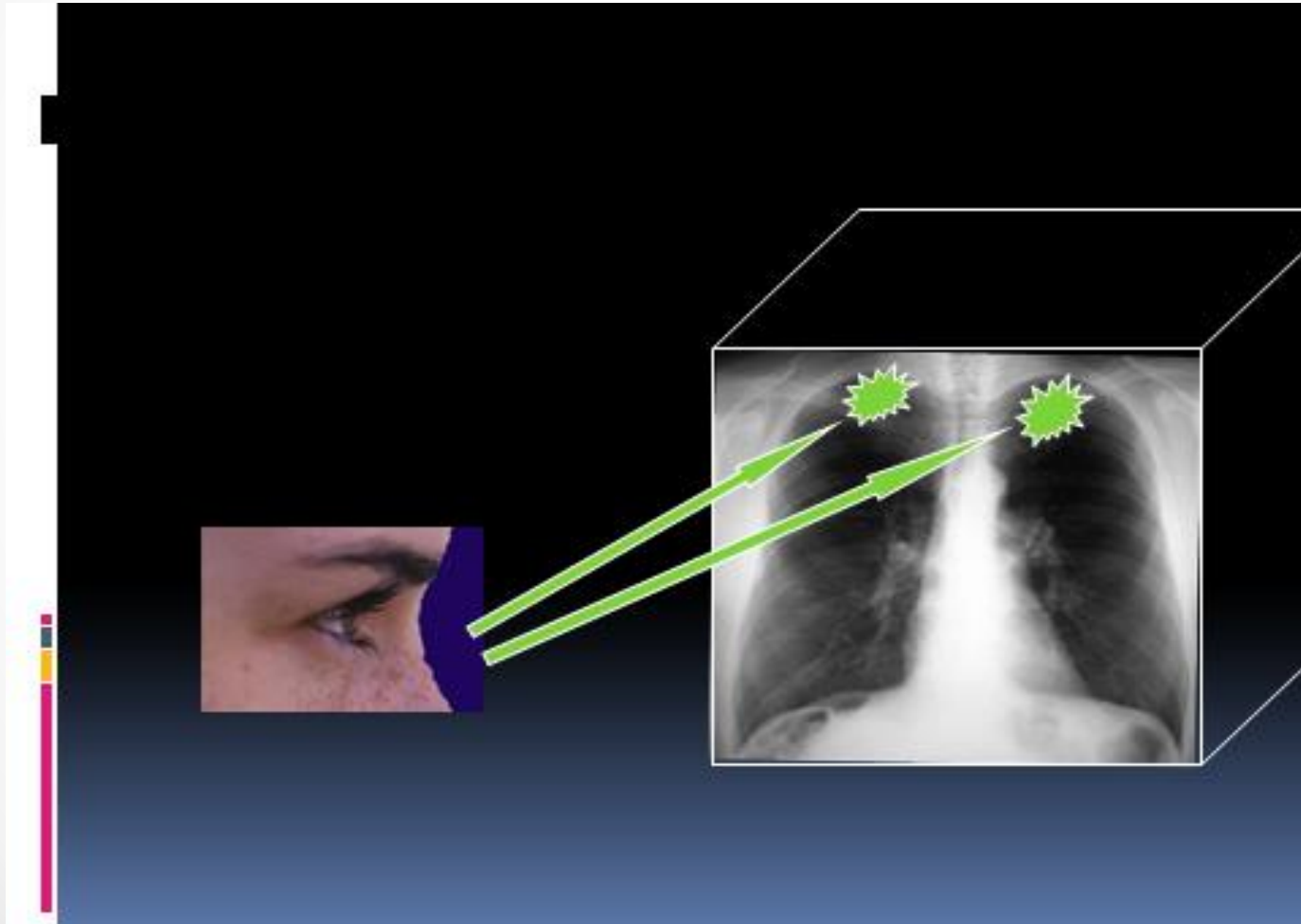
*APEX *HILUM *HEART *ABDOMEN
(retrocardiac space)

With your eyes, you define the 4 following target zones

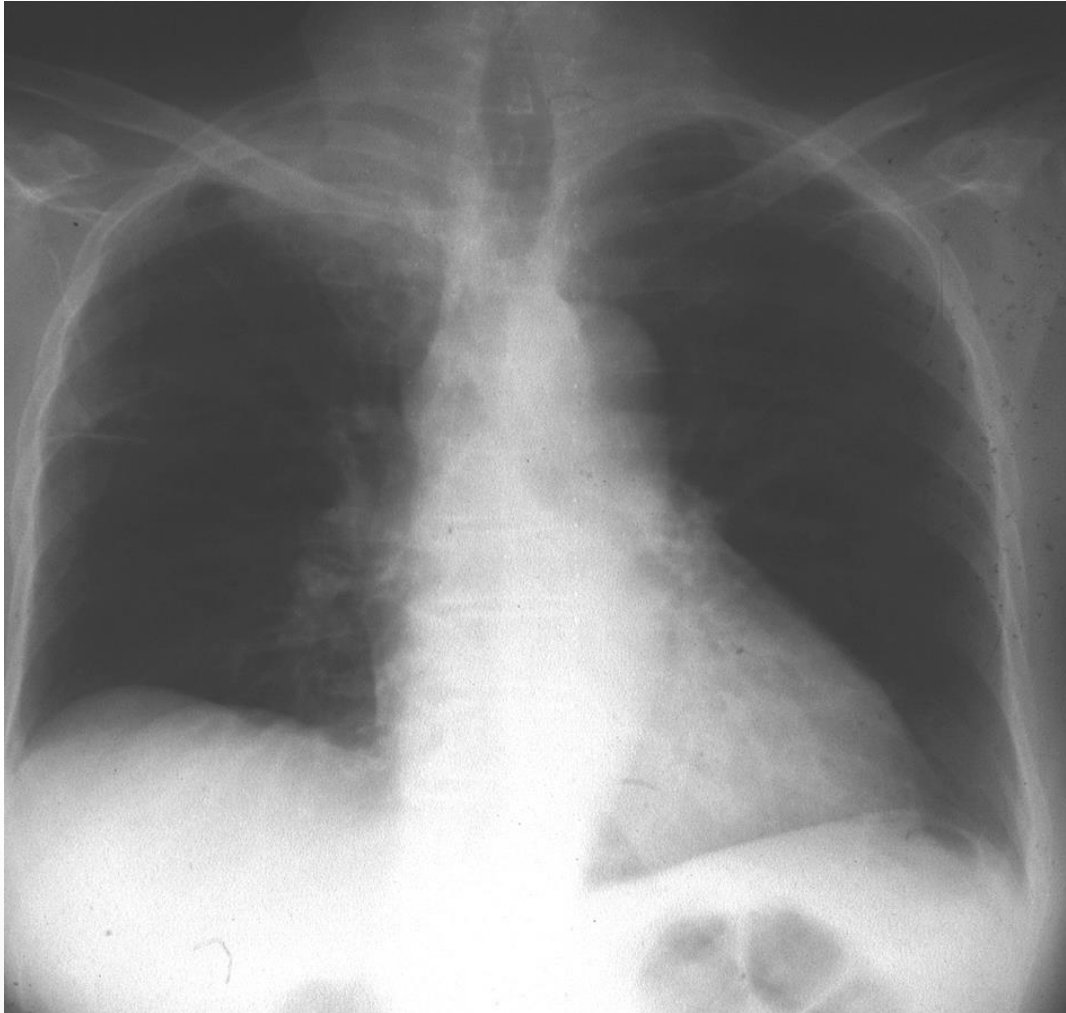


The first target is: the retroclavicular zone

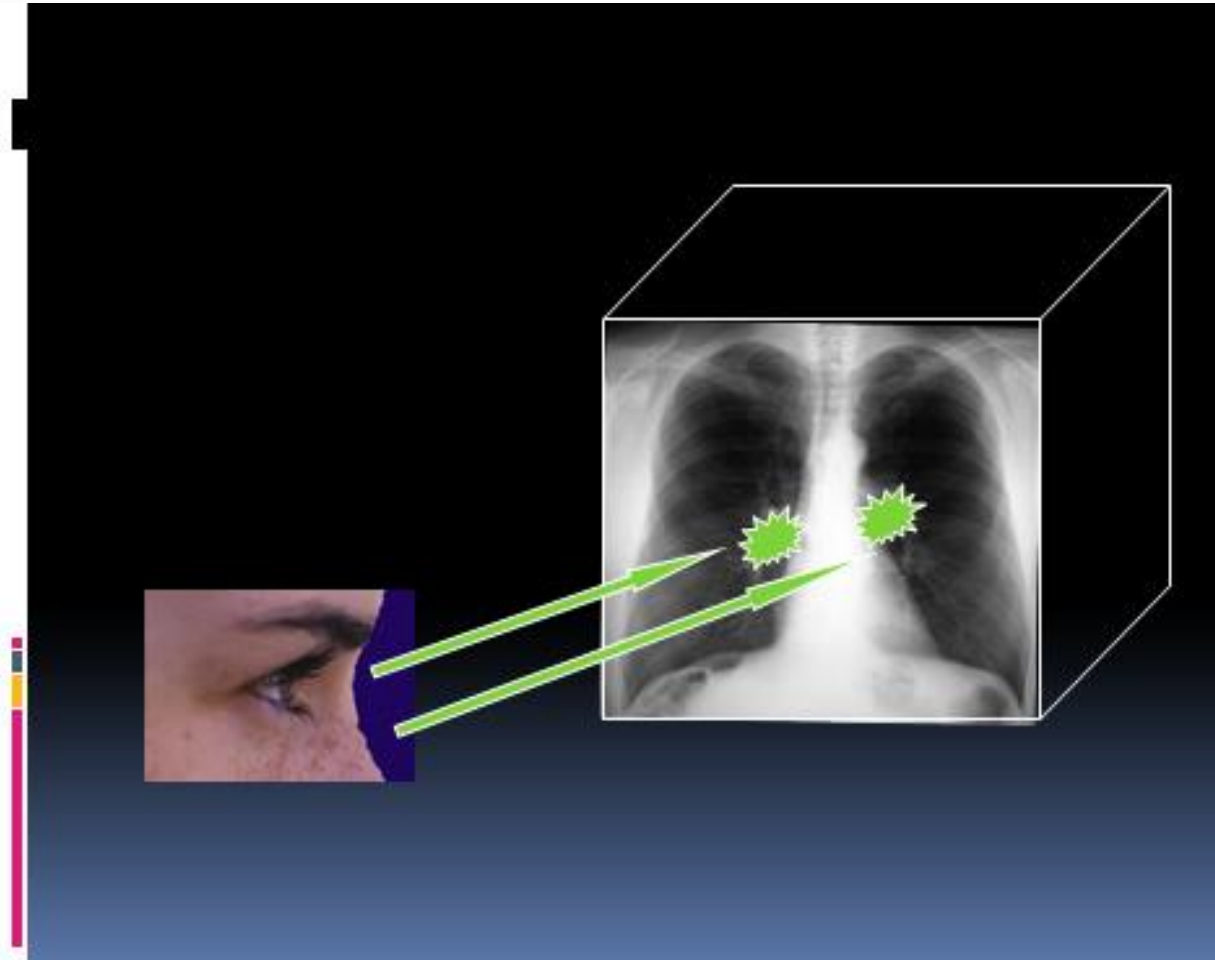
(foci of pulmonary tuberculosis, lung neoplasms, Pancoast's tumour)



Right retro clavicular opacity



The second target is : the hilum
(density, size, abnormal opacity, lymph nodes)



Dermoid cyst (hilum overlay sign)

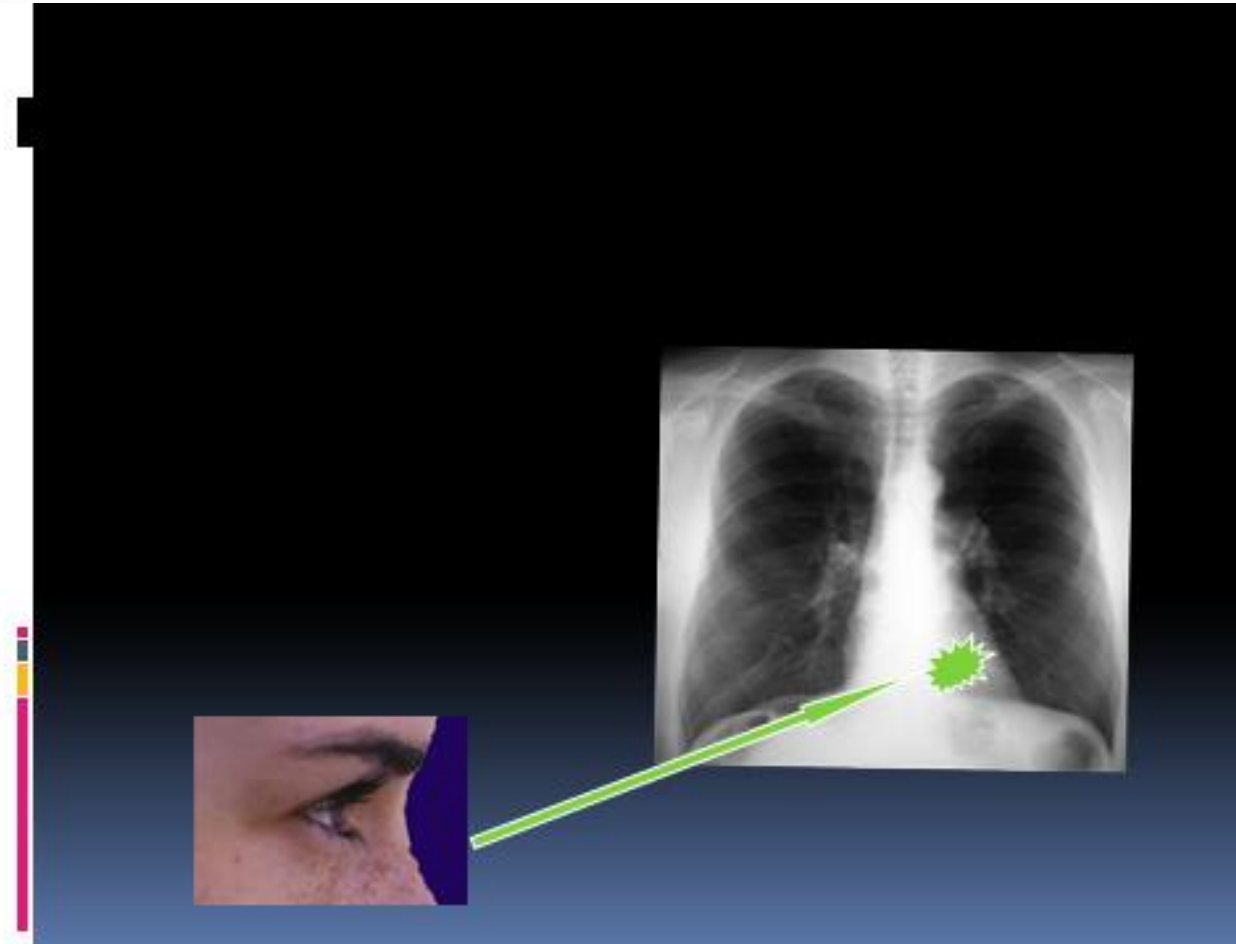


Bilateral hilar and mediastinal enlargement



The third target is: the retrocardiac region

(bronchopneumonia, atelectasis, neoplasm)



Bronchopneumonia in the posterior and lateral basal segments of the

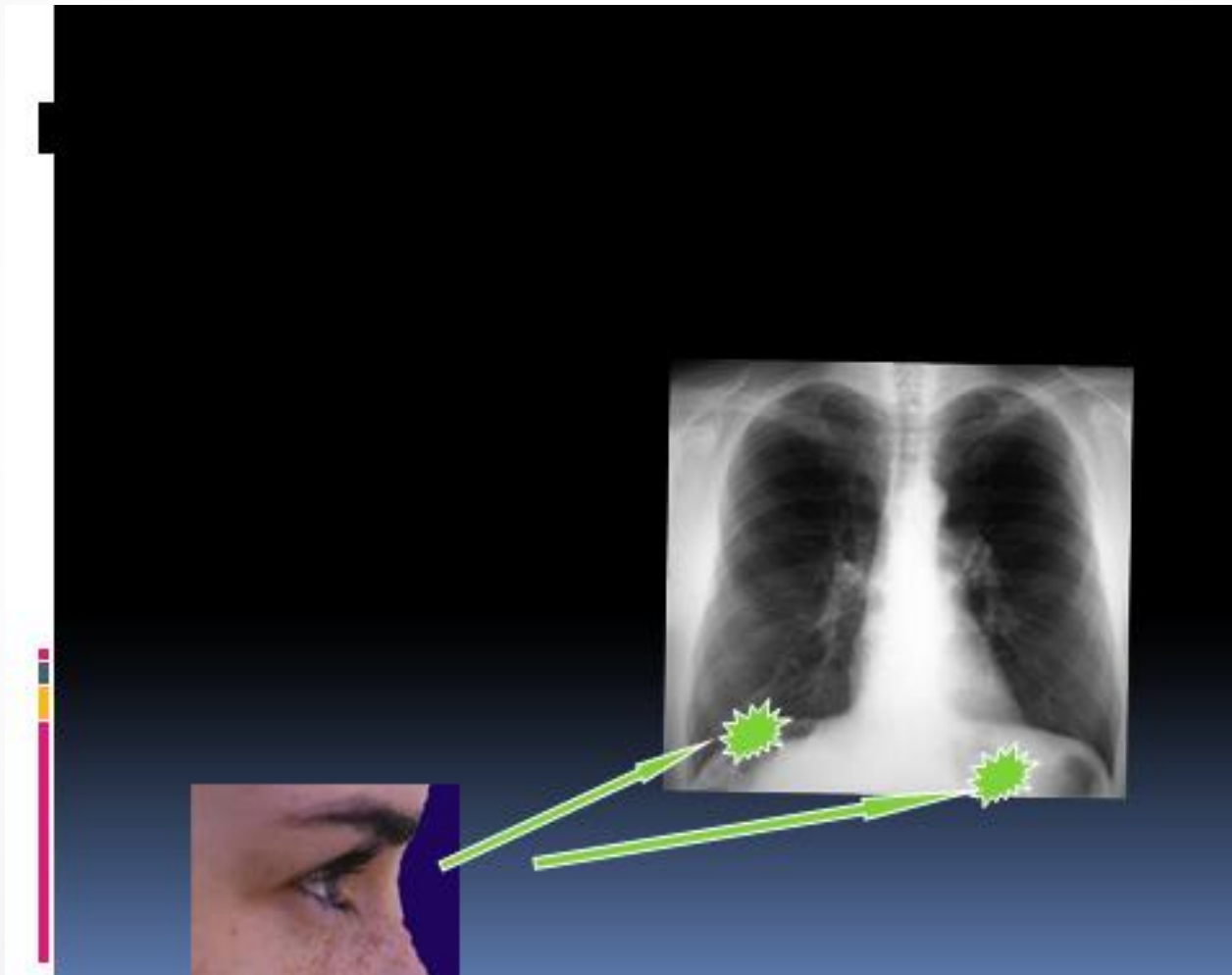
LLL



Large hiatus hernia



The fourth target is: the subdiaphragmatic zone (abdominal and abdomino-thoracic diseases)



Gastric ring



آناتومی طبیعی ریه ها

- ریه راست 3 لوب و ریه چپ 2 لوب

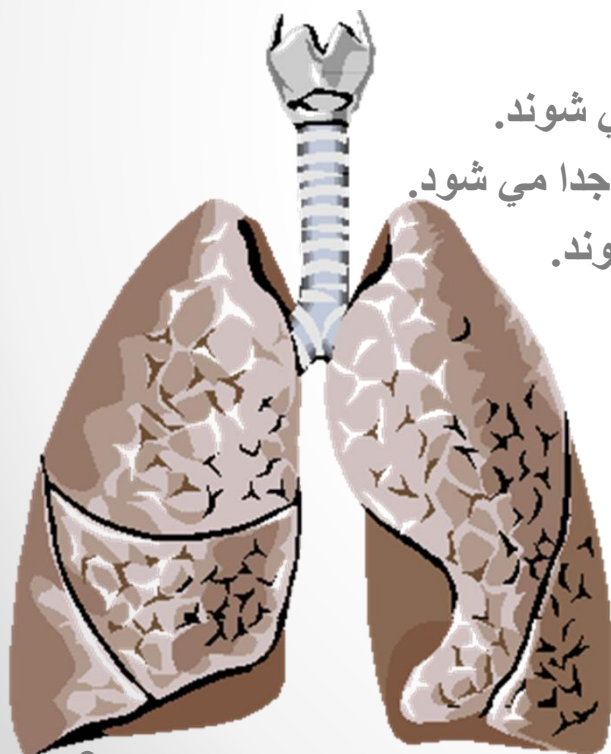
- ریه راست دو فیشر مایل (اصلی) و افقی (کوچک) و ریه چپ یک فیشر مایل (اصلی)

- ریه راست 10 و ریه چپ 9 سگمان

لوب فوقانی و میانی راست توسط شکاف مینور یا عرضی از یکدیگر جدا می شوند.

لوب تحتانی ریه راست توسط شکاف ماژور یا مایل از لوب فوقانی و میانی جدا می شود.

لوب فوقانی و تحتانی چپ توسط شکاف ماژور یا مایل از یکدیگر جدا می شوند.

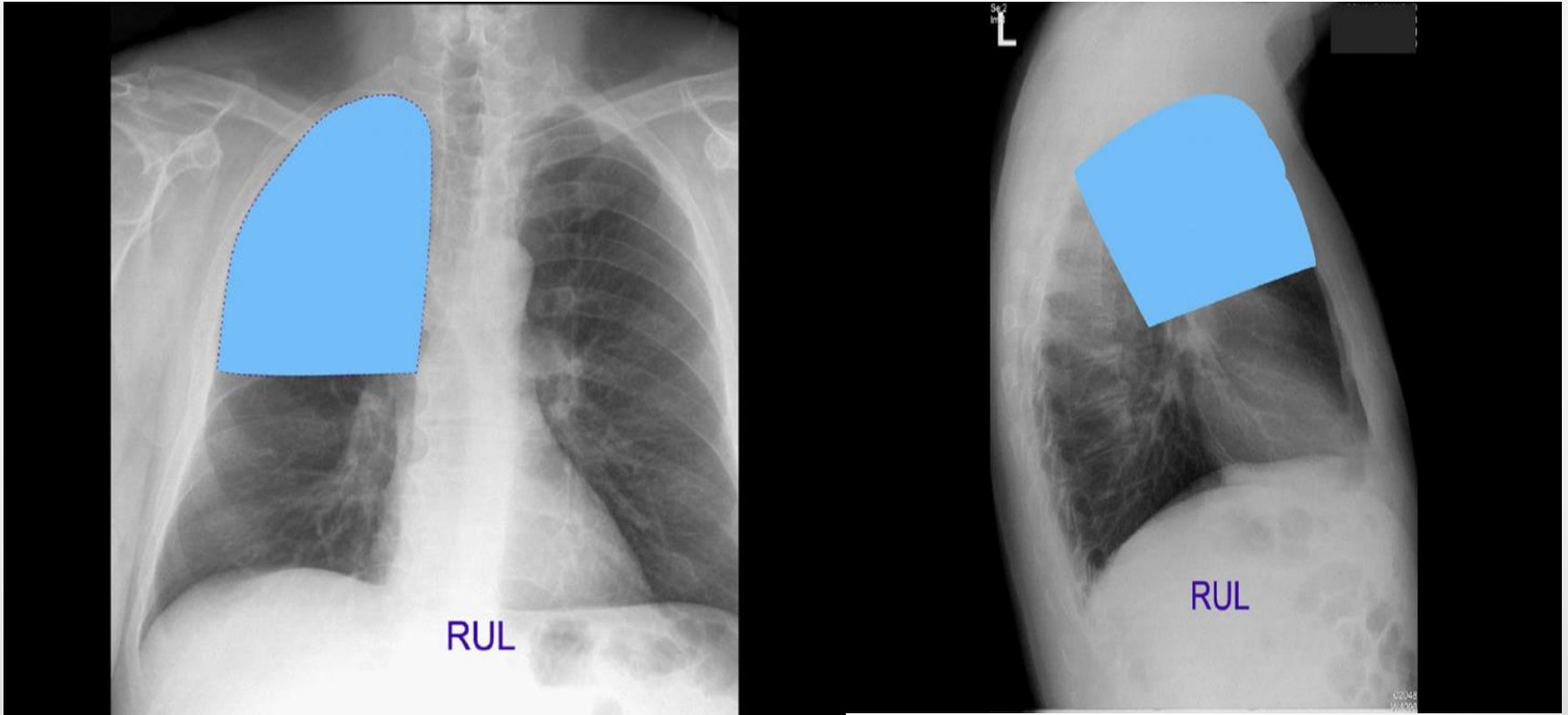


-شکاف مینور یا عرضی دقیقاً از محل ناف گسترده می شود،

به سختی دیده می شود یا اصلاً دیده نمی شود.

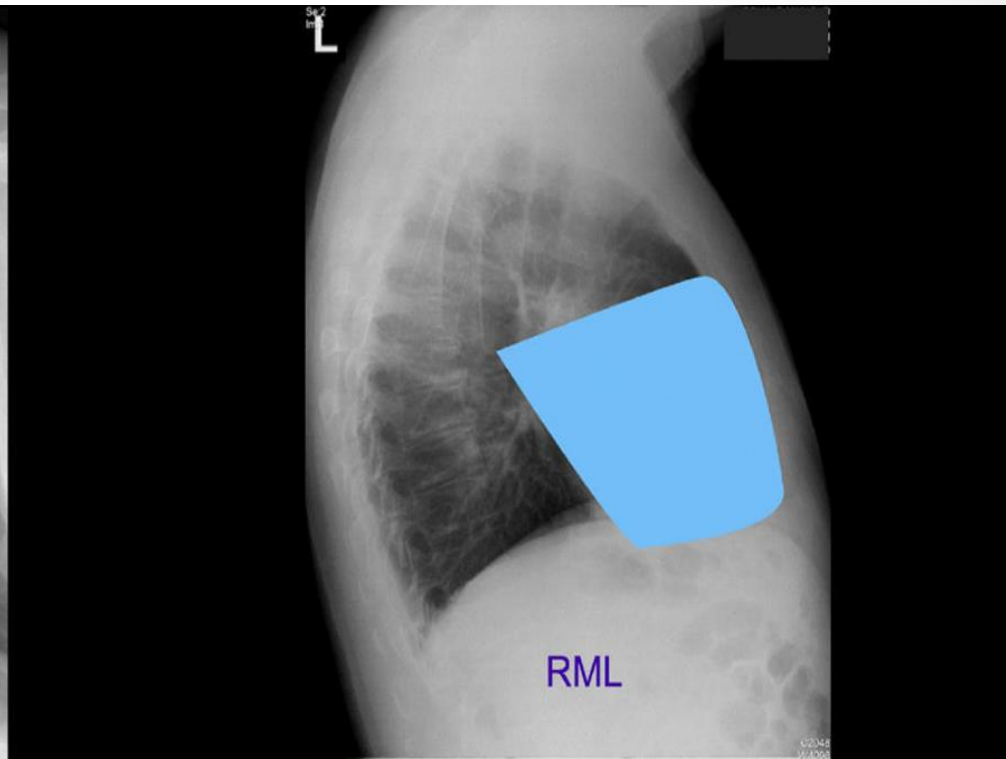
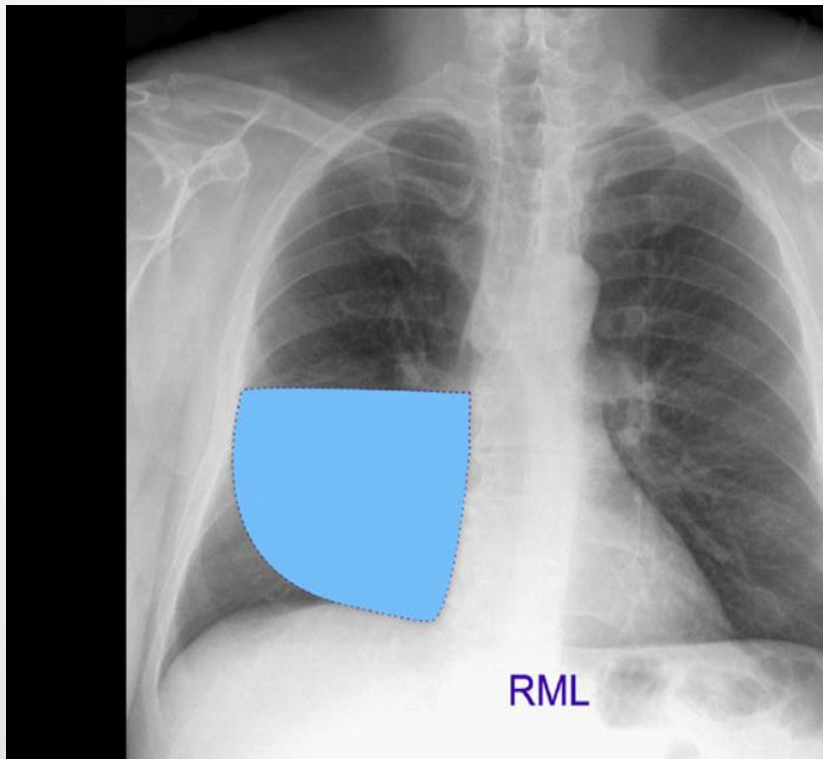
Lobes

Right upper lobe:

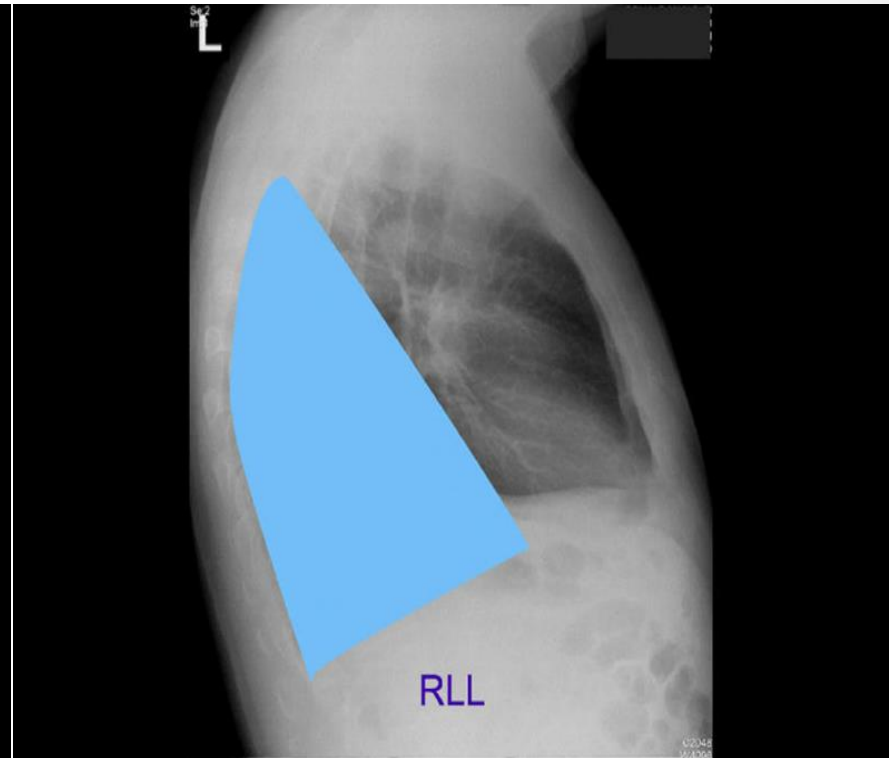
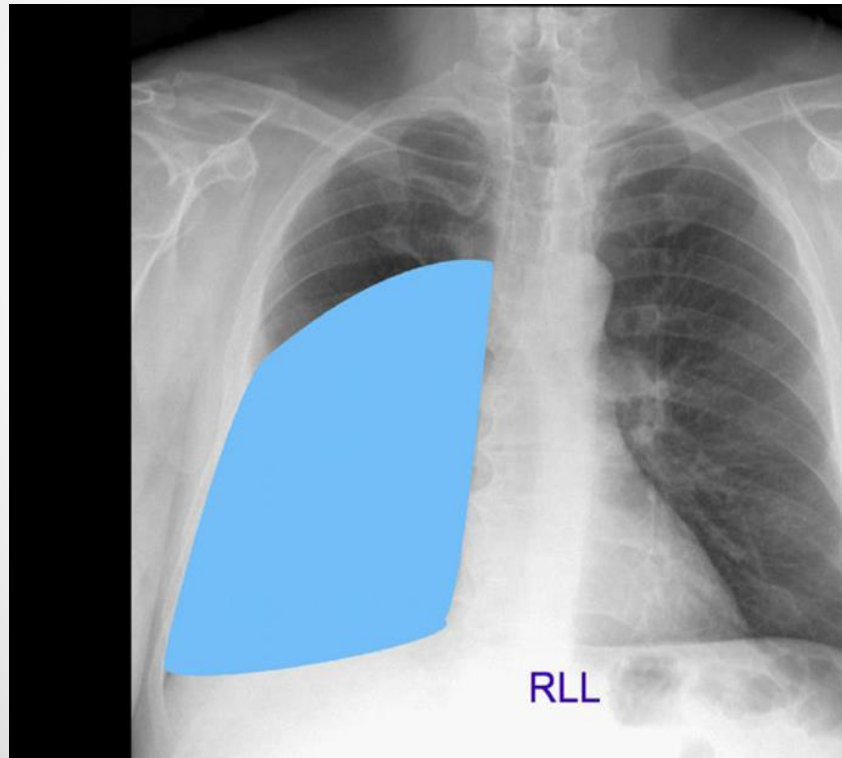


Right middle lobe:

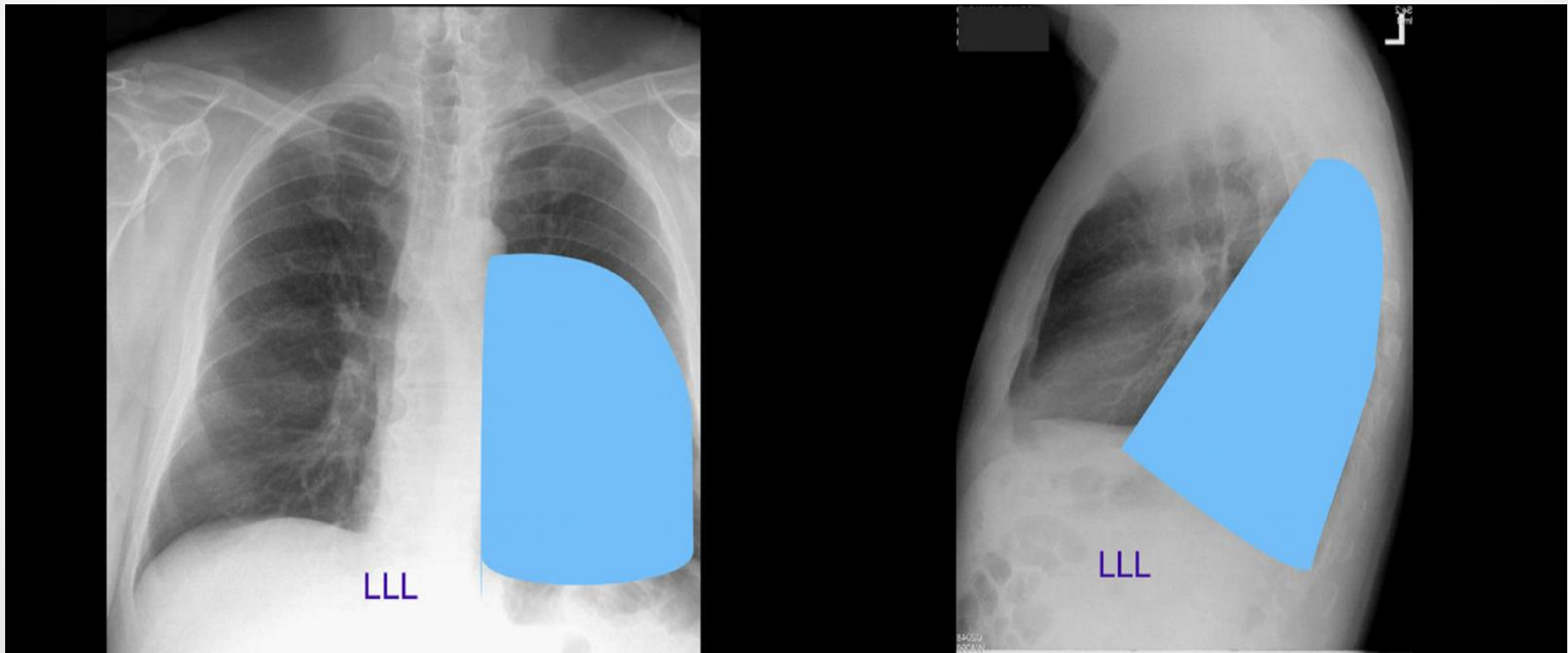
لوب میانی راست در مجاورت کناره راست قلب قرار دارد



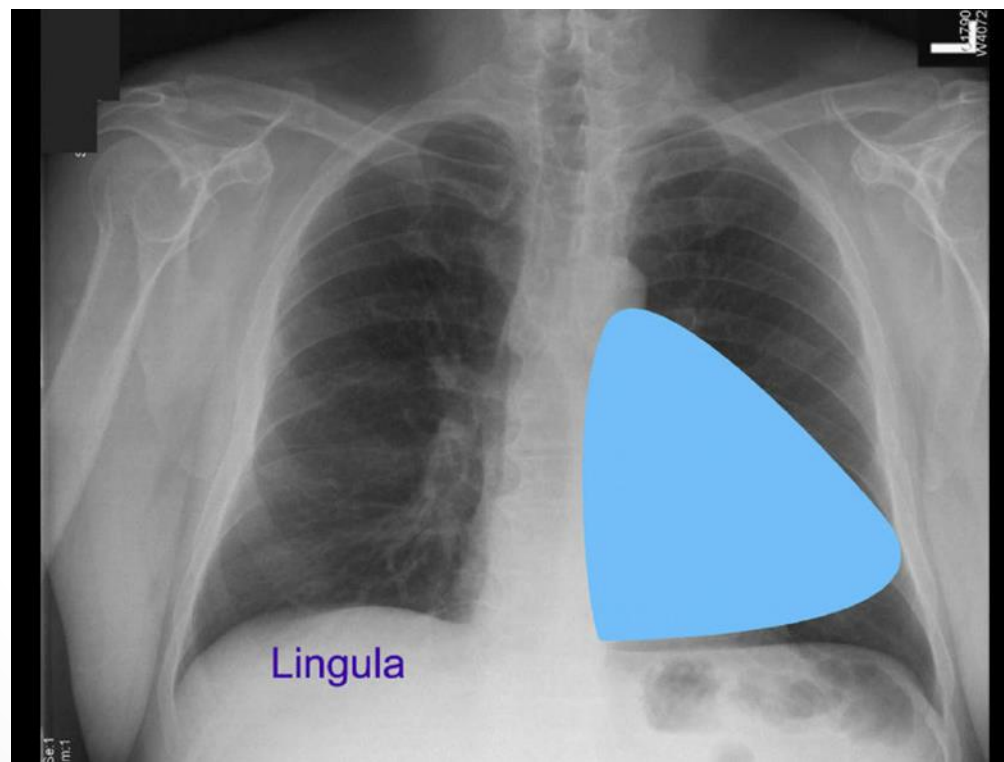
Right lower lobe:



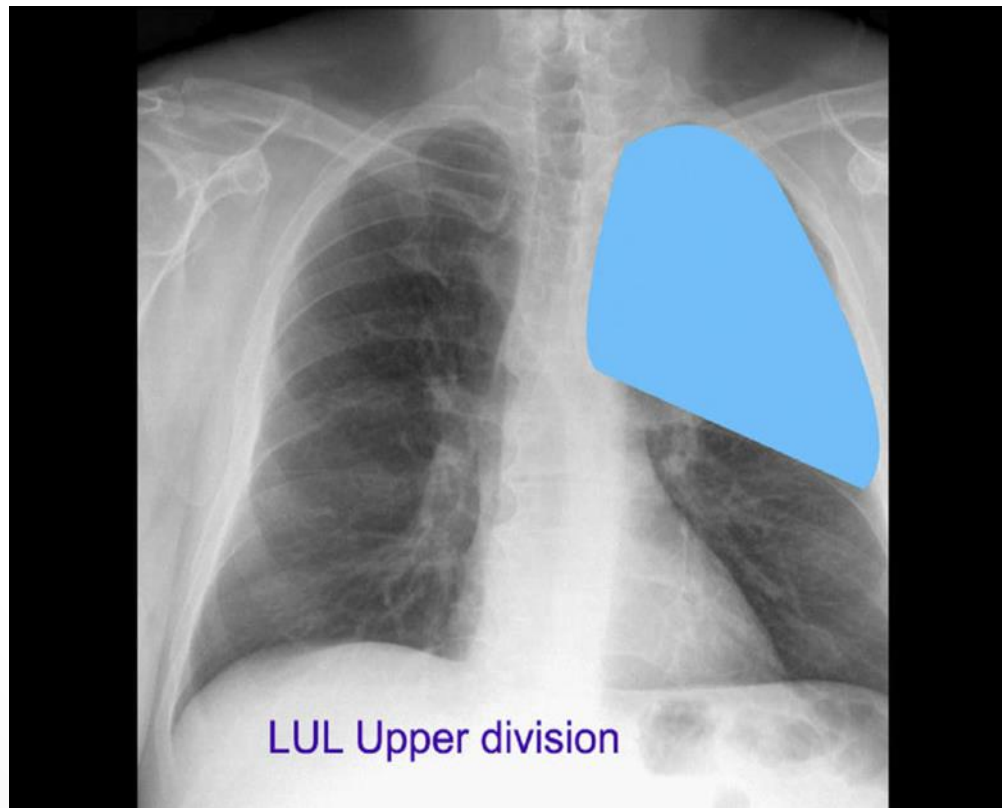
Left lower lobe:



Lingula:

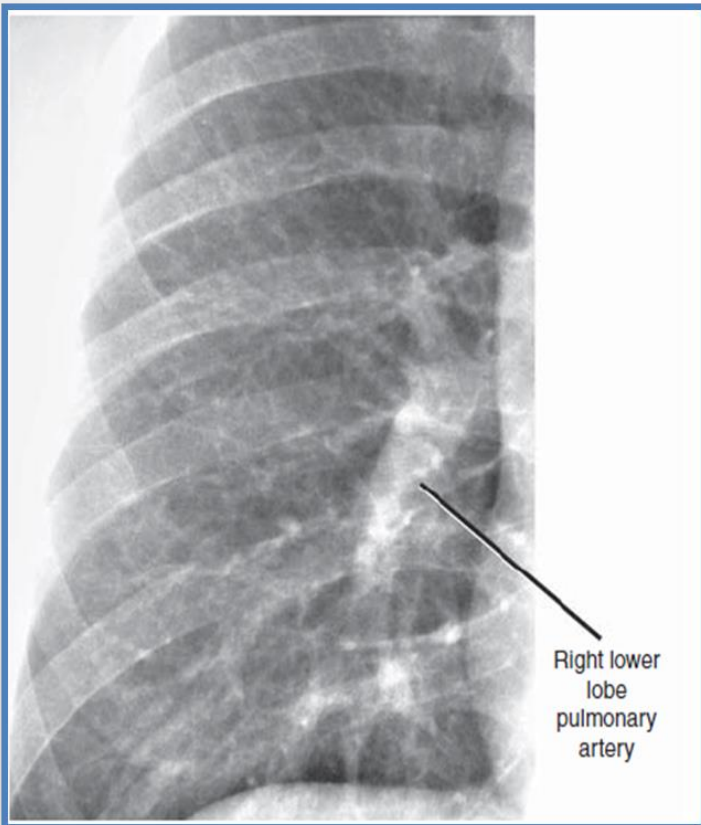


Left upper lobe - upper division:

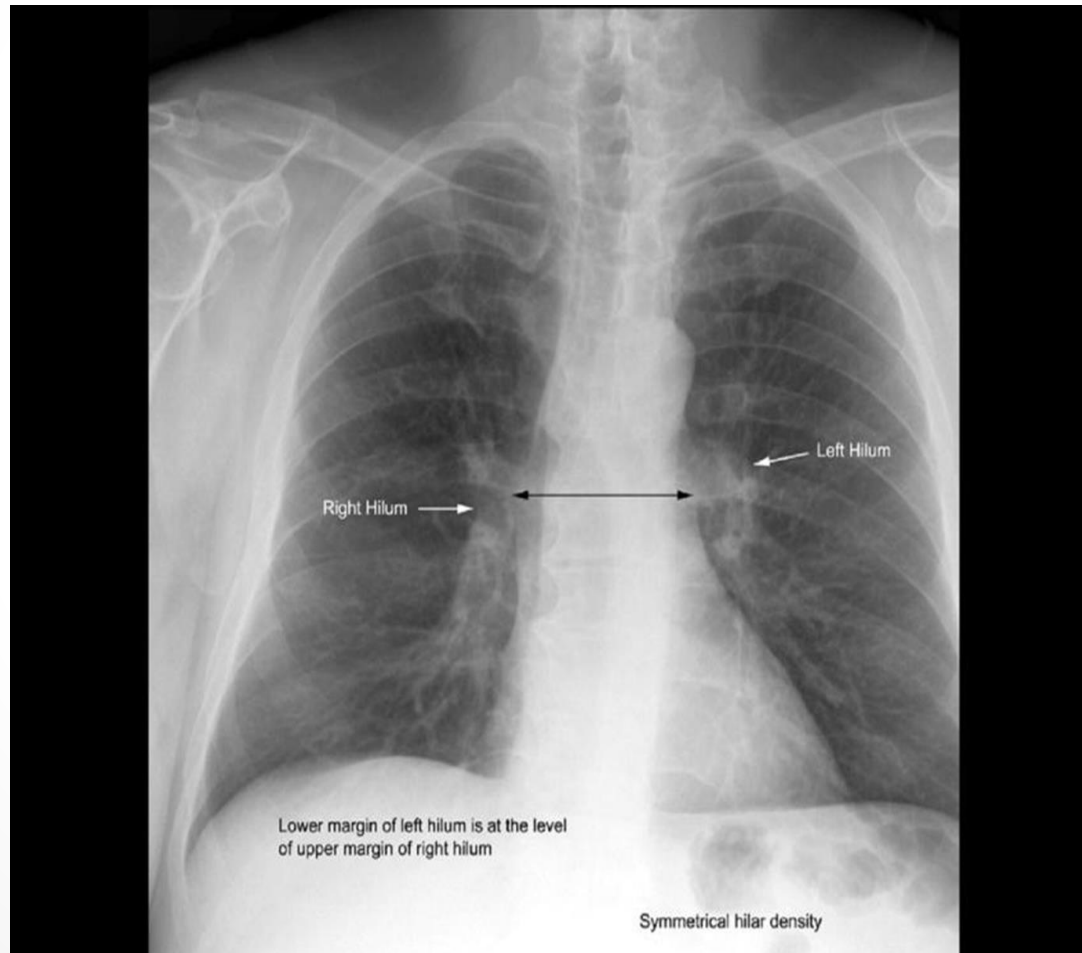


آناتومی طبیعی؛ ناف ریه

- ناف ریه مجموعه ای از: شریان های اصلی ریوی ، وریدهای ریوی و برونکوس ها
- مشخص کردن سائز، شکل ، دانسیته ناف ریه
- شاخه لوب تحتانی شریان ریوی تا 2-4 سانتیمتر ادامه دارد
- نمای طبیعی بافت ریه حاصل شاخه های
- عروقی و تا 1 سانتیمتری جداره توراکس



Left Hilus higher (max 1-2.5 cm)



C = Circulation

Heart & Mediastinum

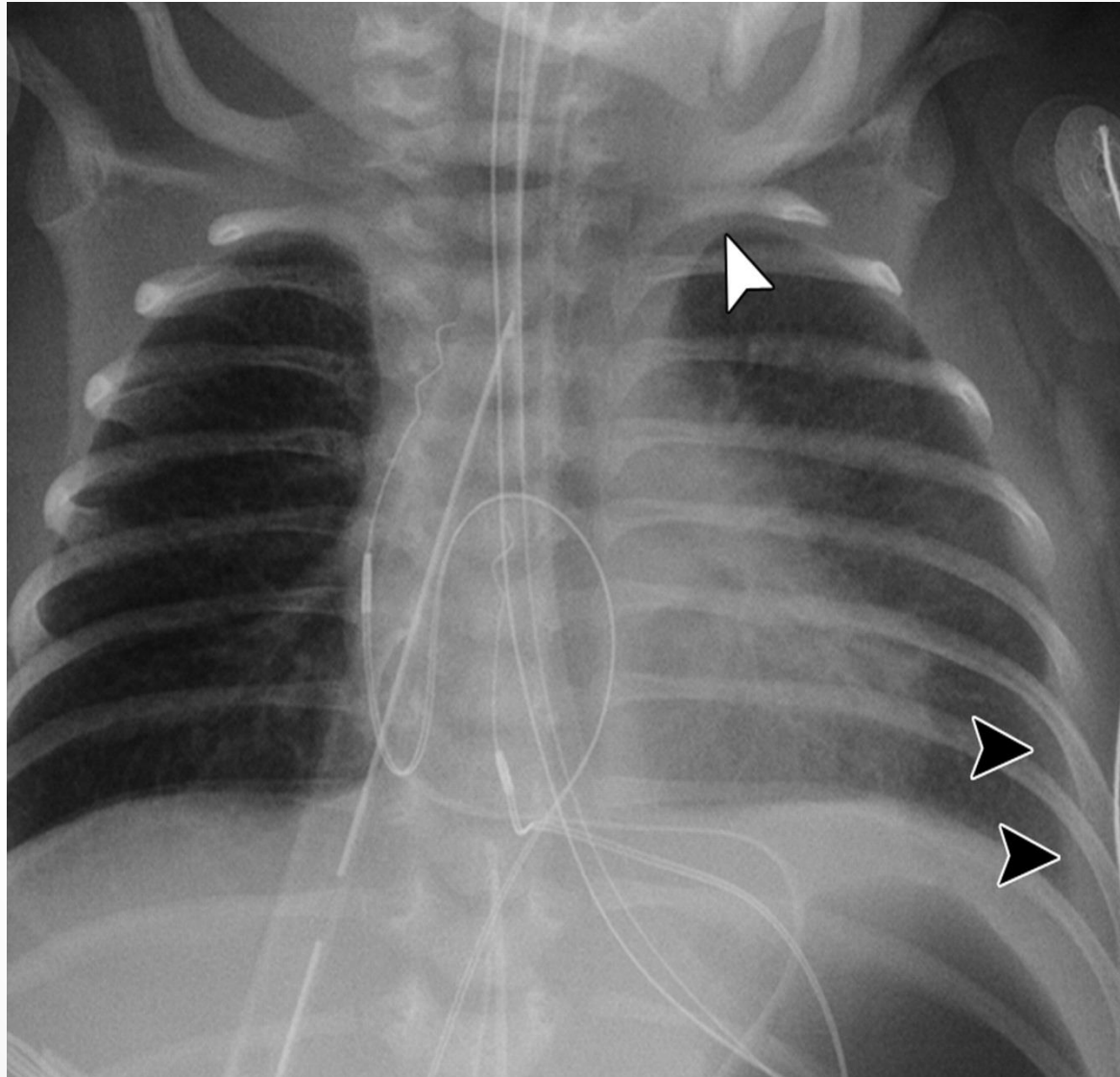
STEP 1. Assess for air or blood that can displace mediastinal structures or blur the demarcation between tissue planes or outline them with radiolucency.

STEP 2. Assess for radiologic signs associated with cardiac or major vascular injury.

- a. Air or blood in the pericardium can result in an enlarged cardiac silhouette. Progressive changes in cardiac size can represent an expanding pneumopericardium or hemopericardium.
- b. Aortic rupture can be suggested by:
 - A widened mediastinum—most reliable finding
 - Fractures of the first and second ribs
 - Obliteration of the aortic knob
 - Deviation of the trachea to the right
 - Presence of a pleural cap
 - Elevation and rightward shift of the right mainstem bronchus
 - Depression of the left mainstem bronchus
 - Obliteration of the space between the pulmonary artery and aorta
 - Deviation of the esophagus (NG tube) to the right

Apical pleural cap

- An apical pleural cap refers to a curved density at lung apex seen on chest radiograph
- It has relatively narrow differential diagnosis:
 - Pleural thickening / scarring
 - secondary to previous apical infection - typically pulmonary tuberculosis
 - radiation fibrosis
 - may be present in upto 10% of radiographs
 - Pancoast tumour
 - Haematoma
 - thoracic aortic injury
 - fractured first rib
 - Lymphoma : extending from neck or mediastinum
 - Abscess within the neck / mediastinum



آناتومی طبیعی؛ مدیاستینوم

Define:

- Area between the lung
 - Water density
- Surrounded two air filled lungs and
Intersected by the air filled trachea and major bronchi

Anatomy dividing region:

1- SUPERIOR MEDIASTINUM

Begins - root of the neck and

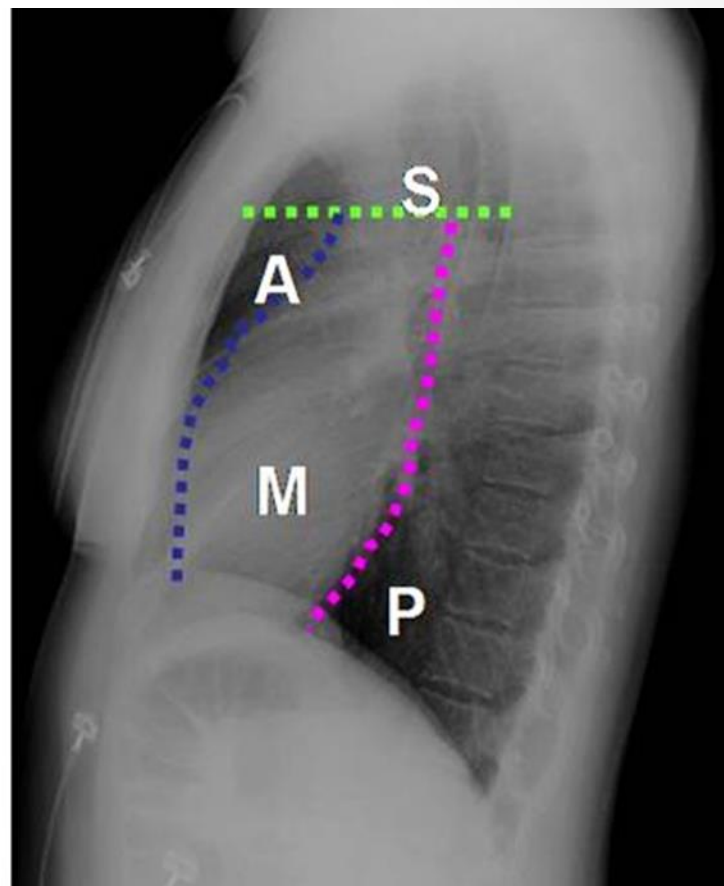
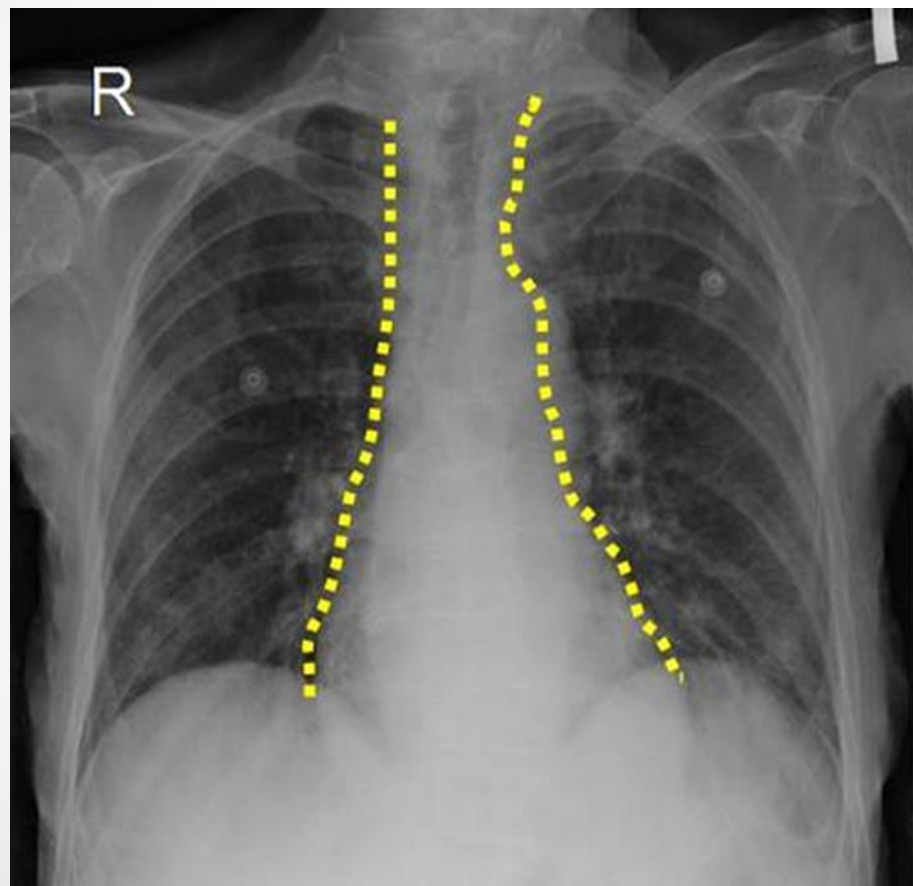
Ends - line drawn **T-4 vertebrae** --- sternomanebrum junction
line skims the top of the aortic arch

2- INFERIOR MEDIASTINUM

Begins - this line End - diaphragm

Further divided into three regions:

- 1- Anterior
- 2- Middle
- 3- Posterior

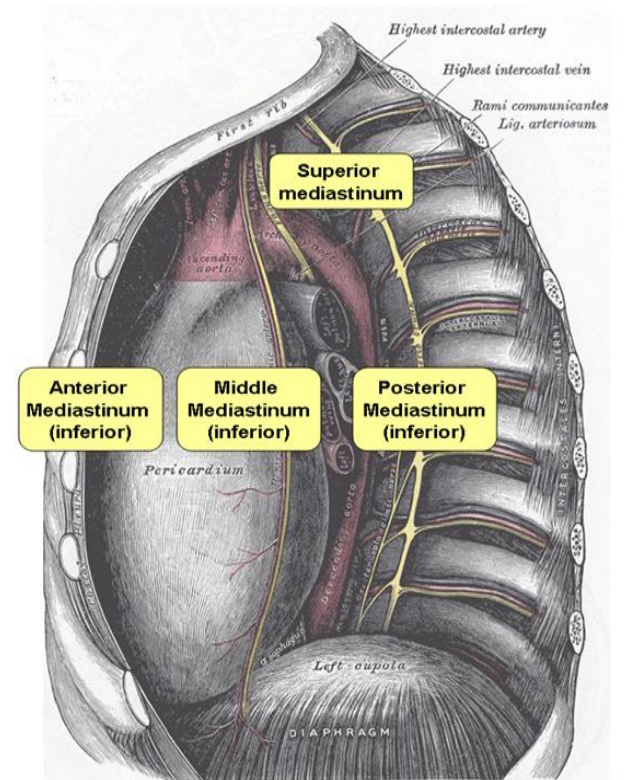


Superior Mediastinum

- **Retrosternal:** Great vessels and branches
Thymus
- **Prevertebral:** Trachea
Esophagus
Thoracic duct
Sympathetic trunks
Vagus nerves

Inferior Mediastinum

- **Anterior:** Thymus, fat, lymph nodes
- **Middle:** Pericardium
Phrenic nerves
Pericardiophrenic artery
Heart and great vessels
- **Posterior:** Esophagus
Thoracic duct
Aorta and branches
Vagus nerves
Sympathetic trunks
Azygos system of veins



- 1- Overall size and shape
- 2- Trachea: position
- Mediastinum :
- 3- Margins (Cardiac)
- 4- Lines and stripes
- 5- Retrosternal clear space

1- پهن شدن ، انحراف ، توده

2- تراشه در خط وسط است یا نه؟

اگر راه هوایی دقیقاً در خط وسط نیست، آبنورمالي ها را بررسی کنید . مثل پلورال افیوژن، تنشن پنوموتوراکس، آتلکتازی.

اگر بیمار لوله تراشه دارد باید محل آن باید 3-4 cm بالاتر از کارینا باشد.

وجود هوای آزاد در اطراف تراشه و برونش اصلی (پنومو مدیاستن)

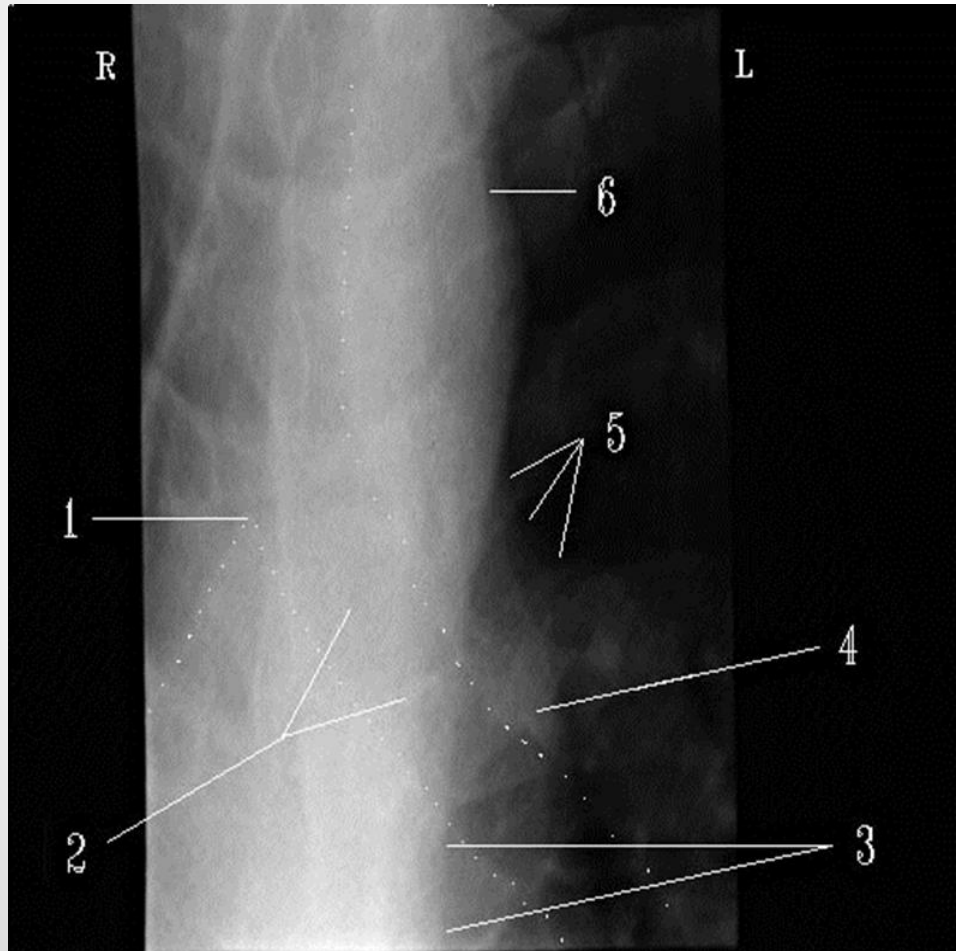
کارینا : در محاذات T6 - T7 قرار گرفته و زاویه آن 60 تا 70 درجه می باشد.

اگر این زاویه بیش از 90 درجه باشد، به سه علت ممکن است رخ داده باشد :

1- بزرگی دهلیز چپ در زیر کارینا

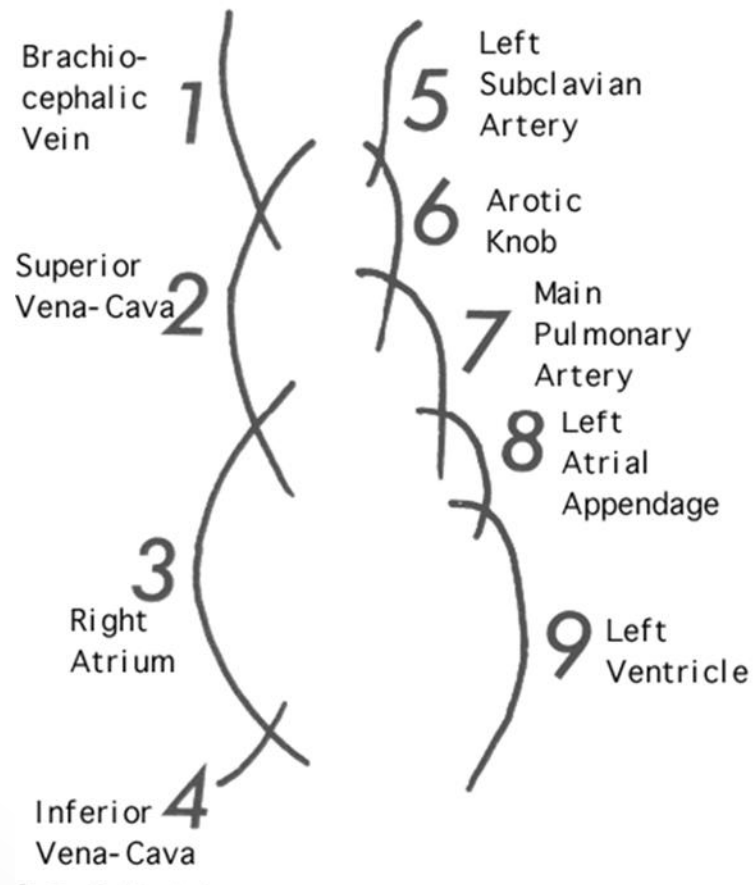
2- وجود Lymphadenopathy

3- وجود توده در مدیاستن

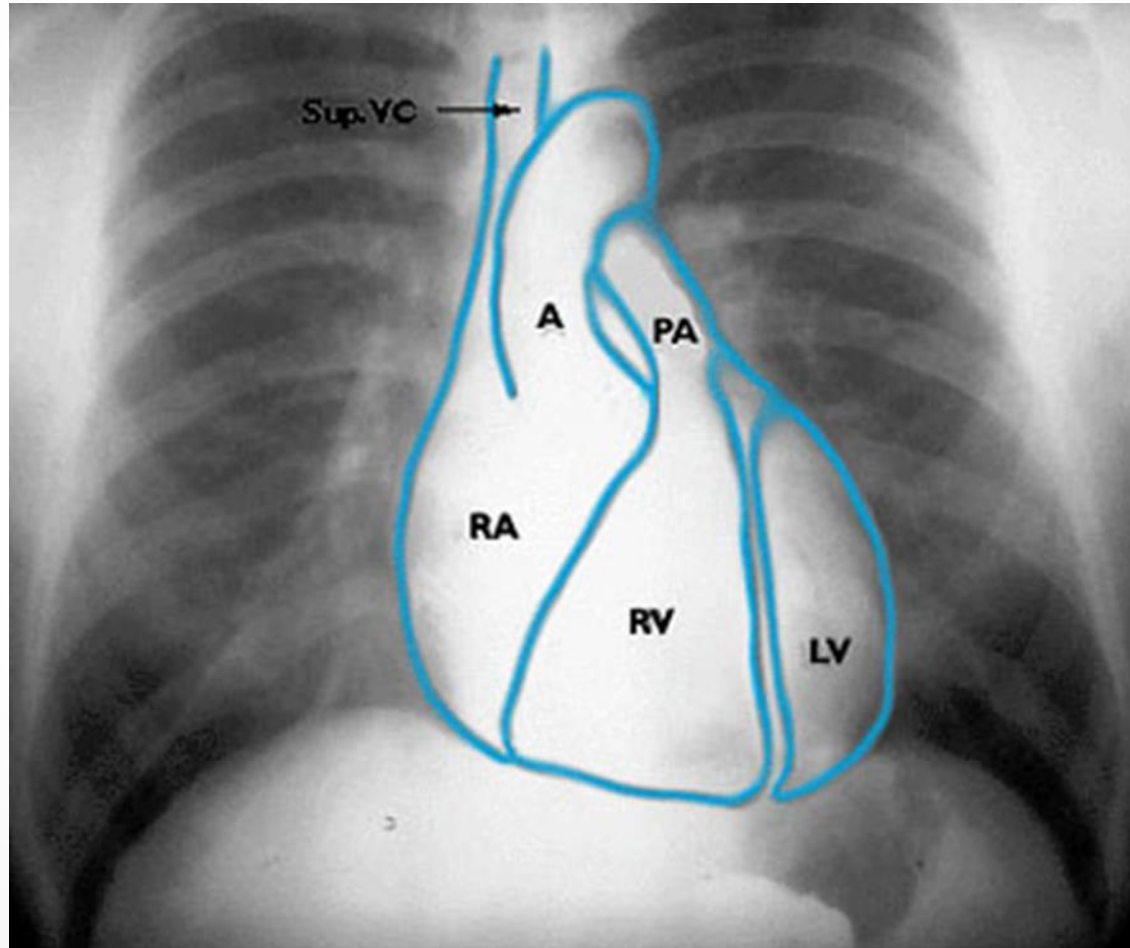


1. Carina
2. Left Main Stem
Bronchus
3. Descending Aorta
4. Main Pulmonary
Artery
5. Aorticopulmonary
Window
6. Arch of Aorta

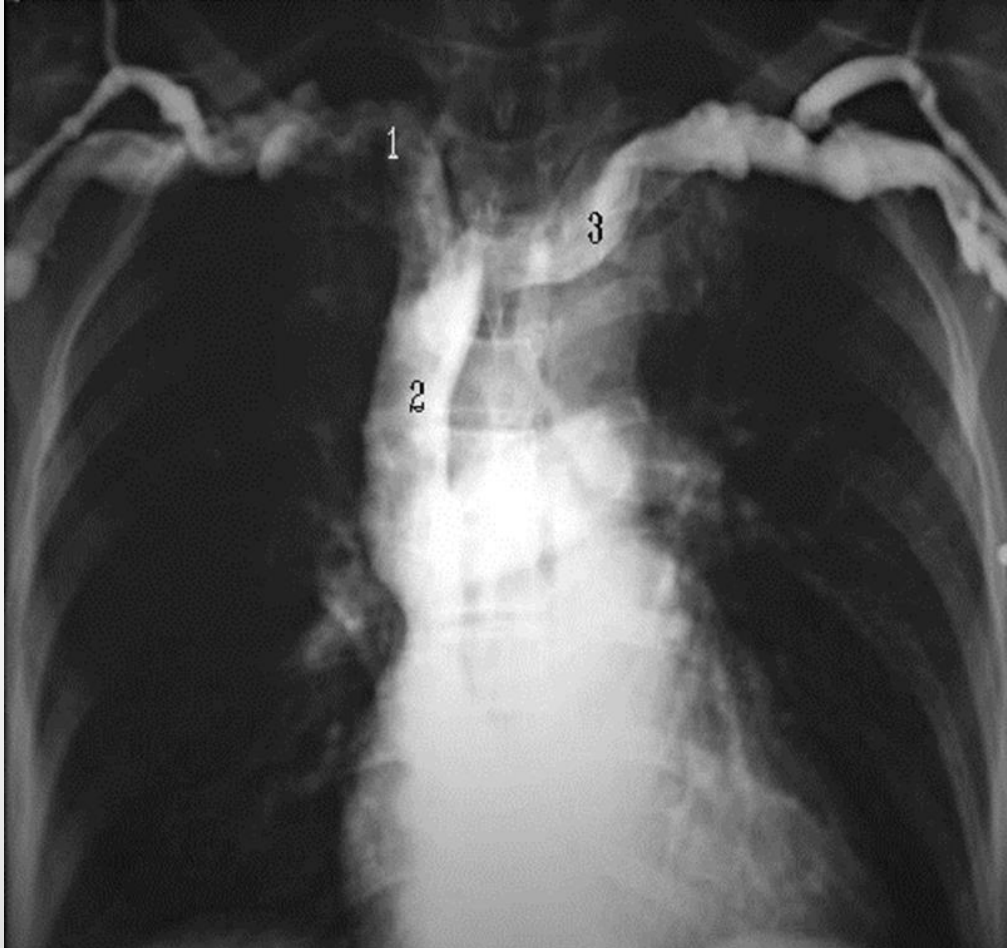
3-Margins



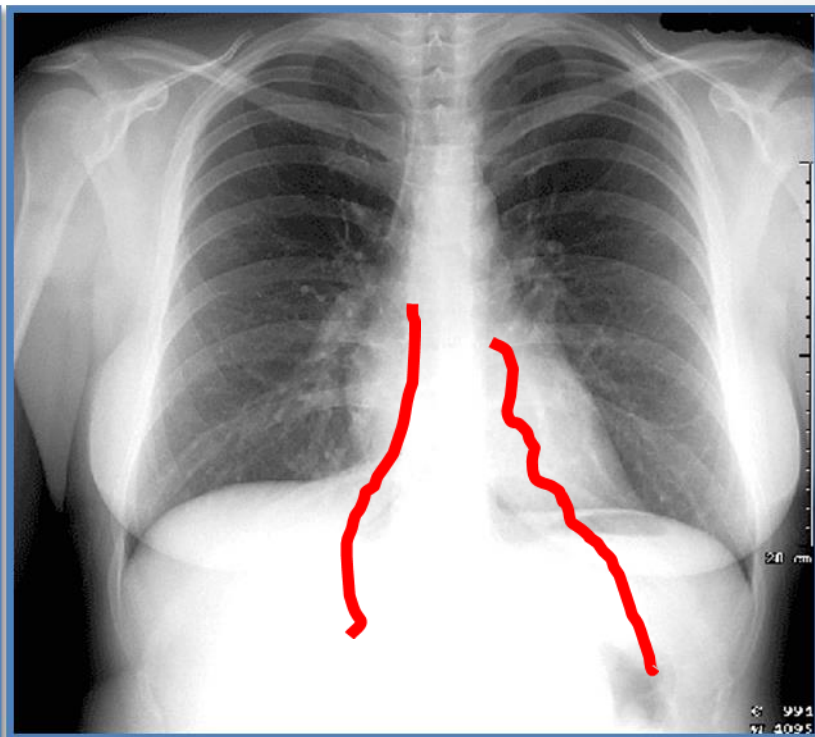
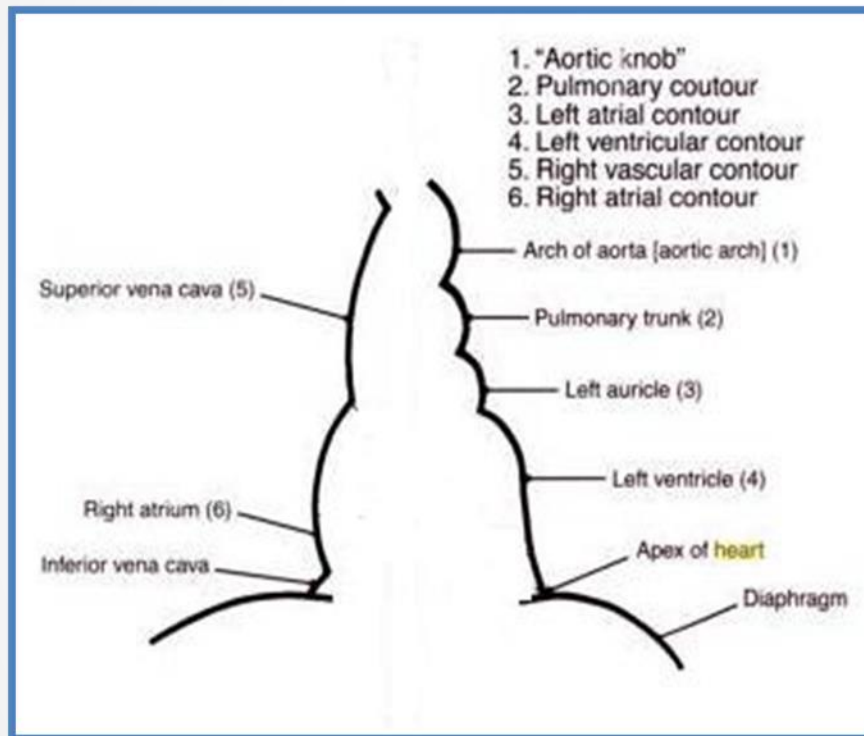
آناتومی طبیعی؛ قلب و آئورت



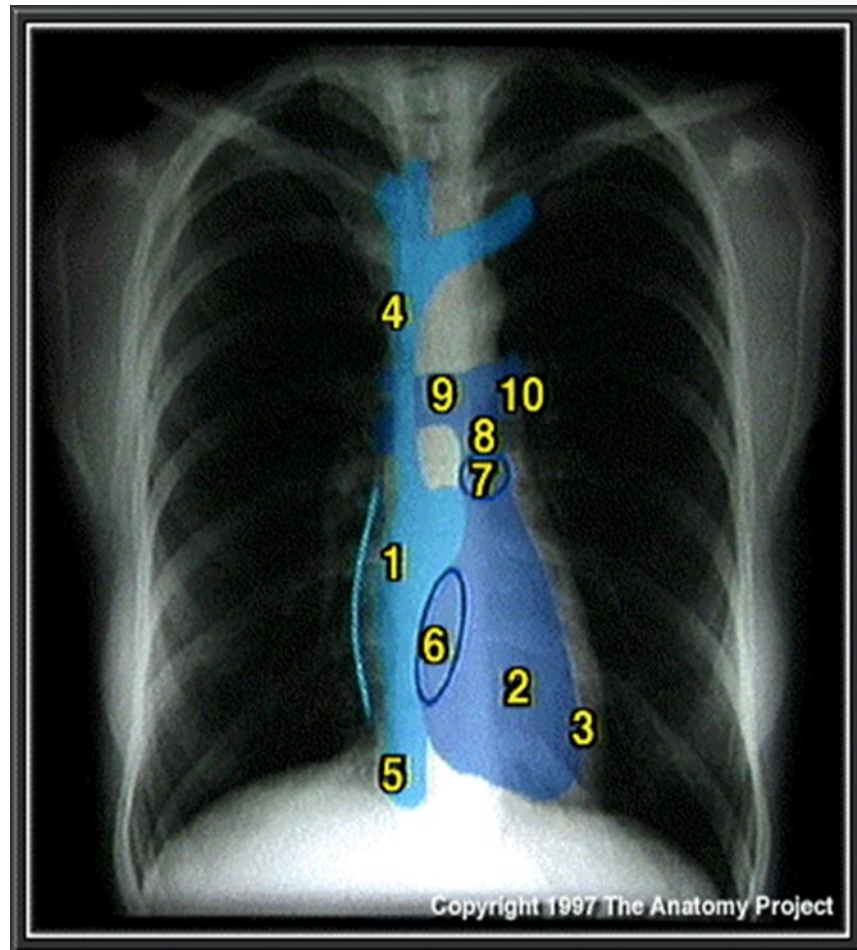
Venography

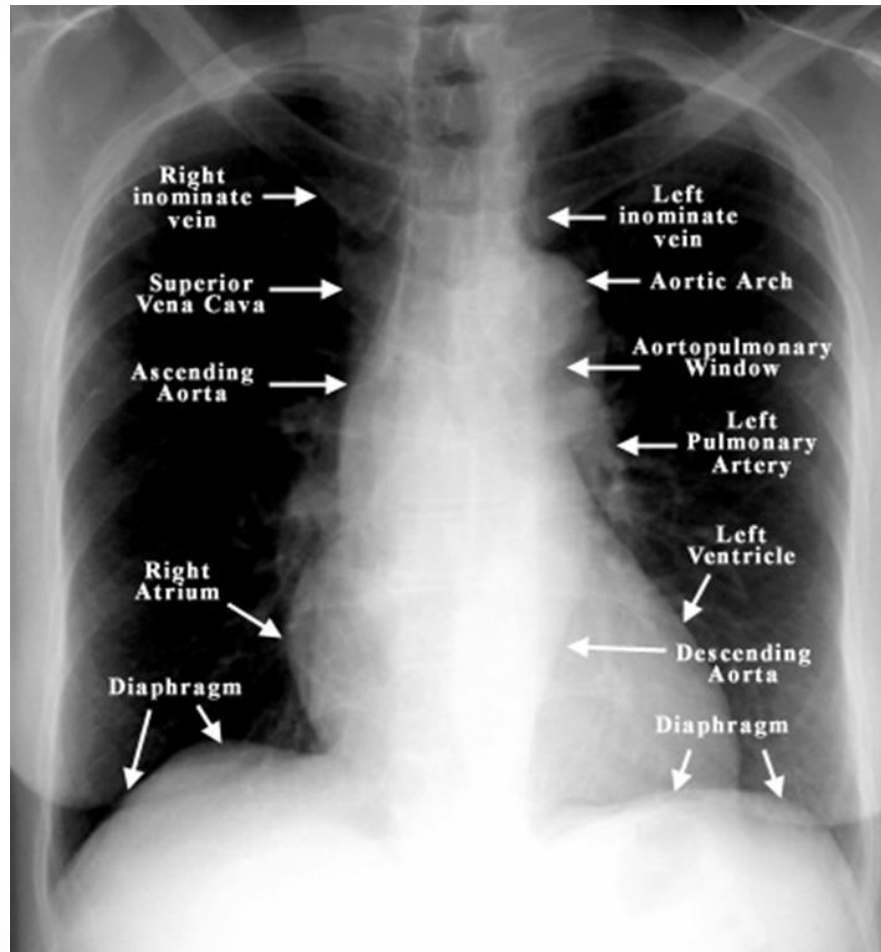


1. Right
Brachiocephalic Vein
2. Superior Vena Cava
3. Left Brachiocephalic
Vein



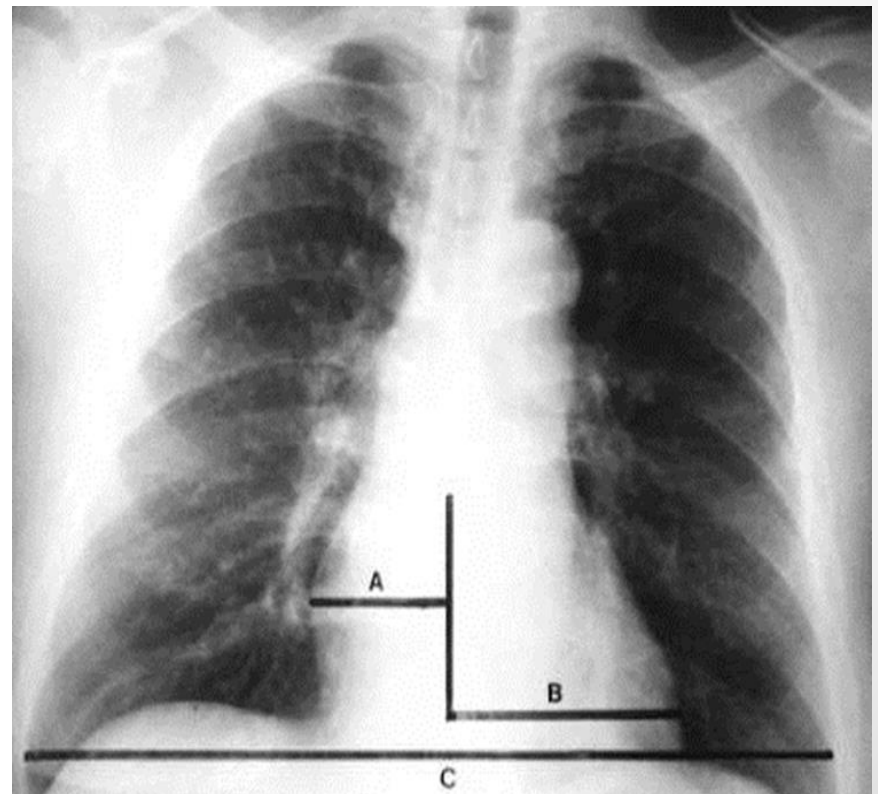
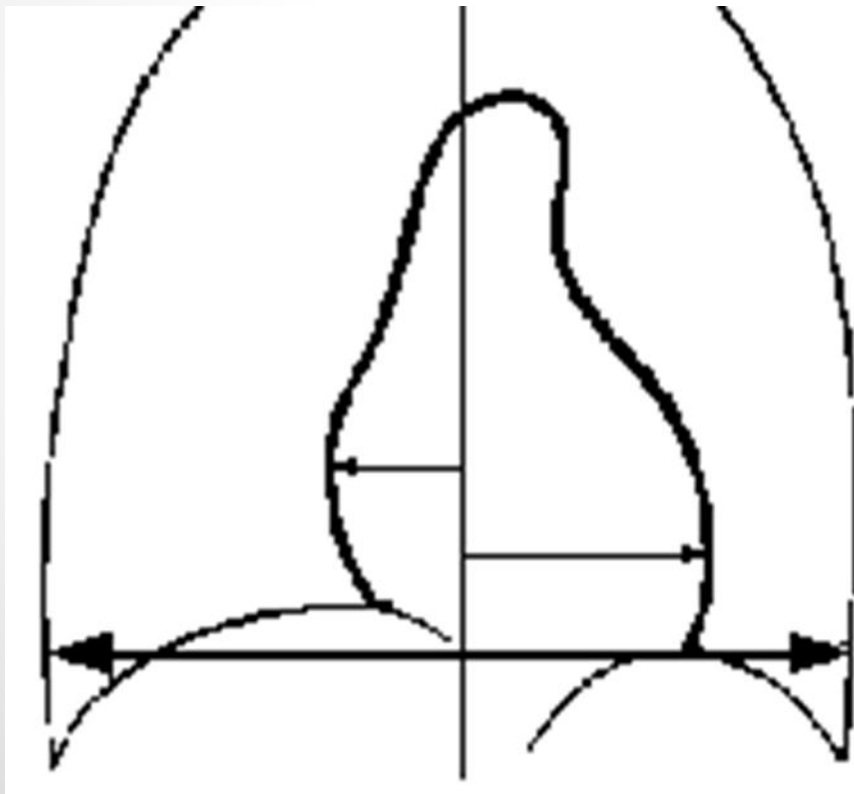
1. R Atrium
2. R Ventricle
3. Apex of L Ventricle
4. Superior Vena Cava
5. Inferior Vena Cava
6. Tricuspid Valve
7. Pulmonary Valve
8. Pulmonary Trunk
9. R PA
10. L PA





Cardiothoracic Ratio نسبت بیشترین قطر قلب به بیشترین قطر عرضی قفسه سینه از لبه داخلی دنده

- ✓ Greater than 50% suggests cardiac enlargement (usually CHF or pericardial effusion)
- ✓ Remember: AP views make heart appear larger than it actually is Cardiac margins should be sharp



Widened mediastinum

- Widening of the mediastinum is most often due to technical factors such as patient positioning or the projection used. **Rotation, incomplete inspiration, or an AP view**, may all exaggerate the width of the mediastinum, as well as heart size
- In the setting of trauma, patients are positioned supine while a chest x-ray is acquired, very often causing the mediastinum to appear wide spuriously
- Is a mediastinum with a measured width greater than **6 cm** on an upright PA chest X-ray or **8 cm** on supine AP chest film(at the level of the **aortic knob** on the best film)
- Use of cross-sections from CT and MRI will supplement this section

4- Lines and stripes:

Para tracheal /Para spinal/Para esophageal(azygo esophageal)/Para aortic

- Lines typically measure less than 1 mm in width and are formed by air, typically within the lung, outlining thin intervening tissue on both sides

Lines present on chest radiographs include the anterior and posterior junction lines

- Stripes are thicker lines formed by air outlining thicker intervening soft tissue

Stripes are seen on chest radiographs including:

L&R paratracheal stripes
posterior tracheal stripe

5-Retrosternal clear space

- اگر فاصله خیلی کم باشد، احتمال بزرگ شدن بطن چپ وجود دارد.
- اگر فاصله خیلی زیاد باشد، احتمال بیماری انسدادی ریه COPD وجود دارد.

D = Diaphragm

Note: Diaphragmatic rupture requires a high index of suspicion, based on the mechanism of injury, signs and symptoms, and x-ray findings. Initial chest x-ray examination may not clearly identify a diaphragmatic injury. Sequential films or additional studies may be required.

STEP 1. Carefully evaluate the diaphragm for:

- a. Elevation (may rise to fourth intercostal space with full expiration)
- b. Disruption (stomach, bowel gas, or NG tube above the diaphragm)
- c. Poor identification (irregular or obscure) due to overlying fluid or soft-tissue masses

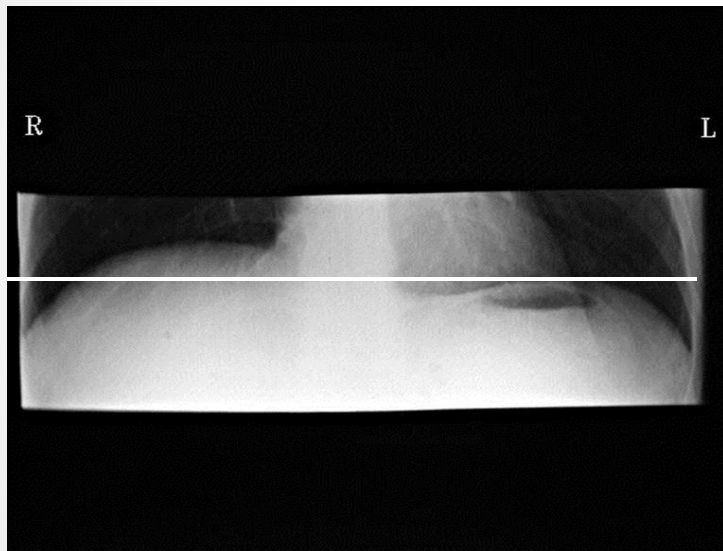
STEP 2. X-ray changes suggesting injury include:

- a. Elevation, irregularity, or obliteration of the diaphragm—segmental or total
- b. A mass-like density above the diaphragm that can be due to a fluid-filled bowel, omentum, liver, kidney, spleen, or pancreas (may appear as a “loculated pneumothorax”)
- c. Air or contrast-containing stomach or bowel above the diaphragm
- d. Contralateral mediastinal shift
- e. Widening of the cardiac silhouette if the peritoneal contents herniate into the pericardial sac
- f. Pleural effusion

STEP 3. Assess for associated injuries, such as splenic, pancreatic, renal, and liver.

قله هاي ديفراگم:

- ديفراگم با مقادير مختلف تنفس، داراي موقعيت هاي متفاوتي است.
- همي ديفراگم راست معمولاً كمی بالاتر از همي ديفراگم چپ است. (2 تا 3 سانتي متر) به خاطر اثر كبدي و موقعيت آناتوميكي قلب



- تمام ديفراگم راست ديده می شود ولی ديفراگم چپ خير، بدليل اينكه قلب روی ديفراگم قرار می گيرد.

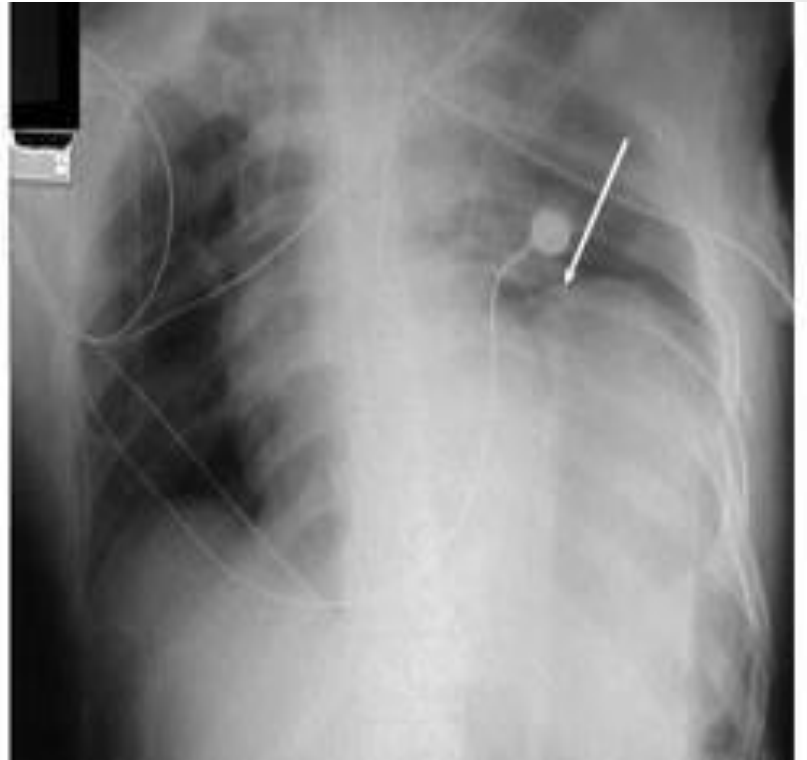
- بررسی هوای زیردیفراگم (پنومو پريتوين)
penetrating trauma, peritonitis, recent surgery

Laparoscopy, hollow viscus perforation

- عدم رویت ديفراگم : افیوژن یا نفوذ مایعات

- تفاوت بیشترین دوسطح ديفراگم: افیوژن ، کلاپس ، فلج ديفراگم

- محو شدن زاويه کوستوفرنیک : پلورال افیوژن، هموتوراکس، اسکار، تومور



E = Emphysema

Soft Tissues

STEP 1. Assess for:

- a. Displacement or disruption of tissue planes
- b. Evidence of subcutaneous air

Soft tissue:

- Look for subcutaneous emphysema (suggestive of trauma)
- Soft tissue swelling
- Axillary line
- Calcification
- Foreign body
- Breasts shadow

F = Fracture

Bones

STEP 1. Assess the clavicle for evidence of:

- a. Fracture
- b. Associated injury, such as great-vessel injury

STEP 2. Assess the scapula for evidence of:

- a. Fracture
- b. Associated injury, such as airway or great-vessel injury, pulmonary contusion

STEP 3. Assess ribs 1 through 3 for evidence of:

- a. Fracture
- b. Associated injury, such as pneumothorax, major airway, or great-vessel injury

STEP 4. Assess ribs 4 through 9 for evidence of:

- a. Fracture, especially in two or more contiguous ribs in two places (flail chest)
- b. Associated injury, such as pneumothorax, hemothorax, pulmonary contusion

STEP 5. Assess ribs 9 through 12 for evidence of:

- a. Fracture, especially in two or more places (flail chest)
- b. Associated injury, such as pneumothorax, pulmonary contusion, spleen, liver, and/or kidney

STEP 6. Assess the sternomanubrial junction and sternal body for evidence of fracture or dislocation. (Sternal fractures can be mistaken on the AP film for a mediastinal hematoma. After the patient is stabilized, a coned-down view, overpenetrated film, lateral view, or CT may be obtained to better identify suspected sternal fracture.)

STEP 7. Assess the sternum for associated injuries, such as myocardial contusion and great-vessel injury (widened mediastinum), although these combinations are relatively infrequent.

Skeletal structures

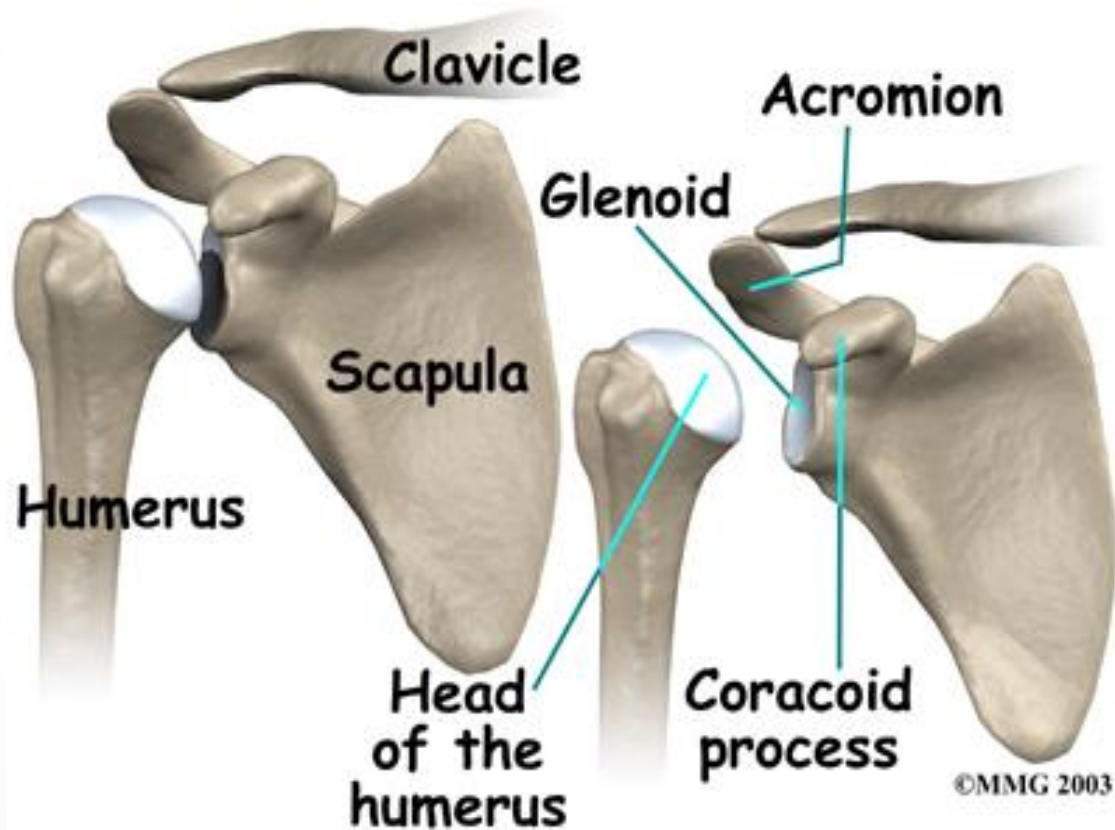
Overall size, shape, contour of each bone:

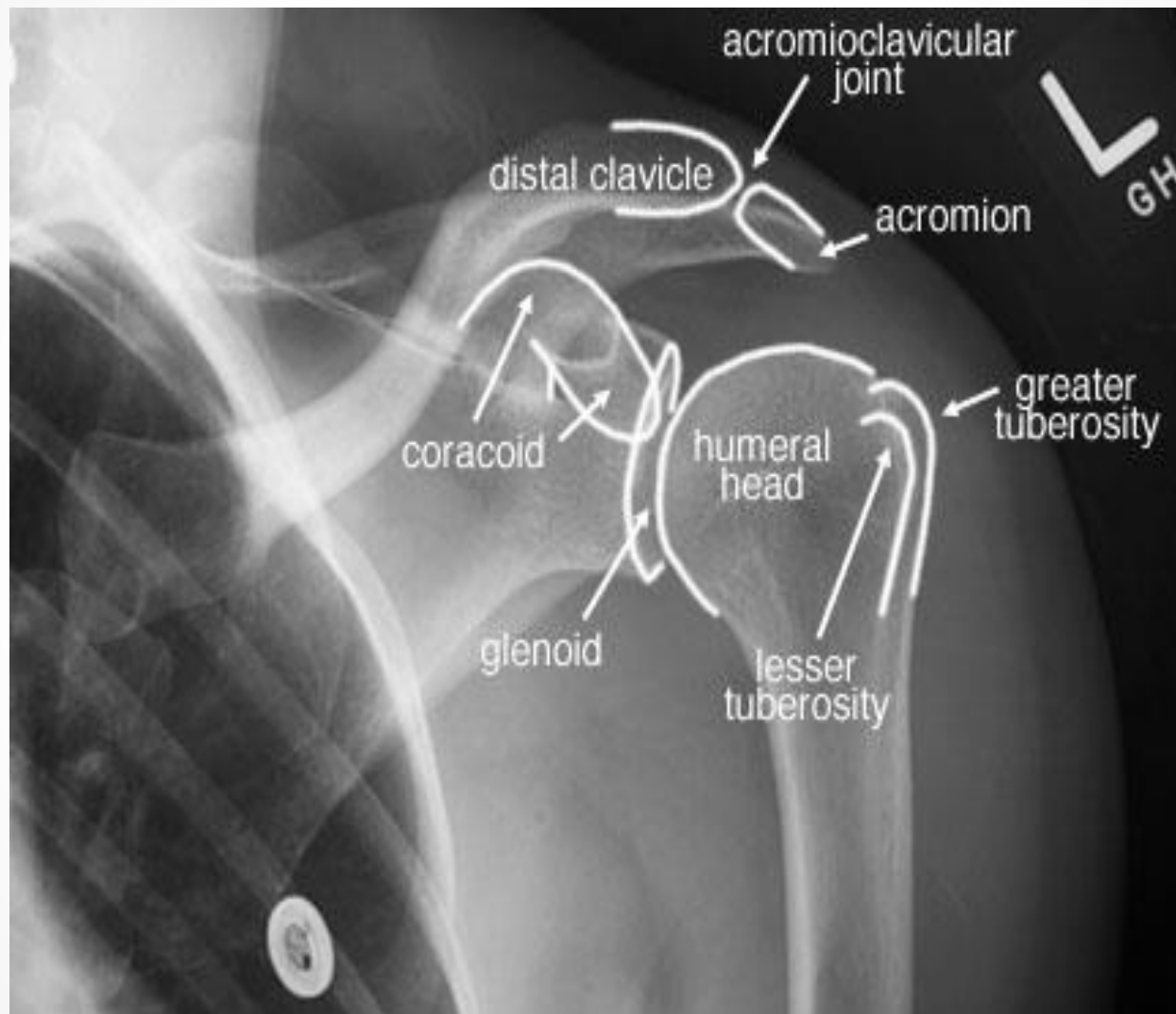
- Density(mineralization)
- Compare cortical thickness to medullary cavity, trabecular pattern
- Erosions, fractures, any lytic or blastic regions

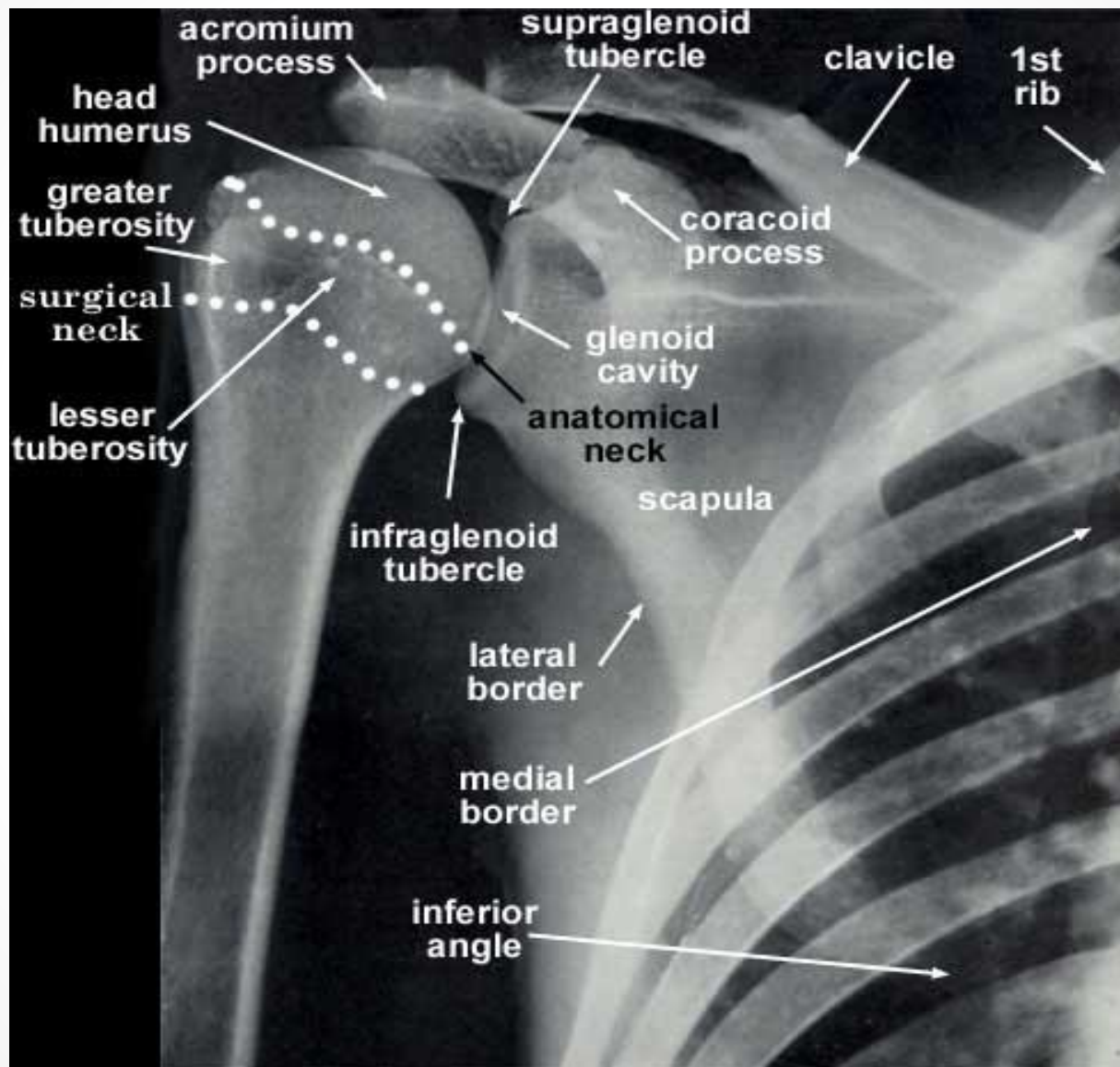
Joints:

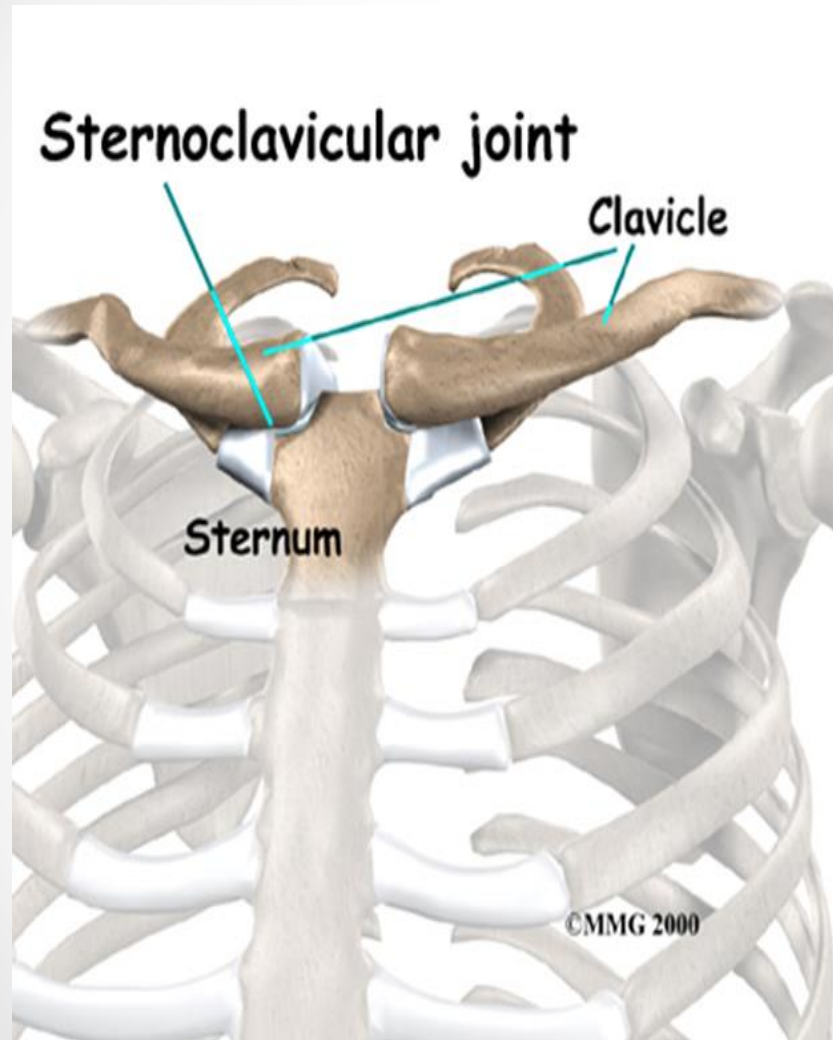
- Articular relationships
- Joint spaces narrowed, widened
- Calcification in the cartilages
- Air in the joint space, abnormal fat pads
- **Note calcified anterior cartilages may obscure or mimic underlying lung lesions**
- **Compare side to side**

Anatomy of Shoulder









G = Tube & Lines

- STEP 1.** Assess for placement and positioning of:
- a. Endotracheal tube
 - b. Chest tubes
 - c. Central access lines
 - d. Nasogastric tube
 - e. Other monitoring devices

Chest Tube, NG Tube, Pulmonary artery cath

