IN THE NAME OF GOD

Chest X-Ray

In Emergency Department

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Introduction

- **CXR:** 1) Adult
  2)Childeren

- 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**

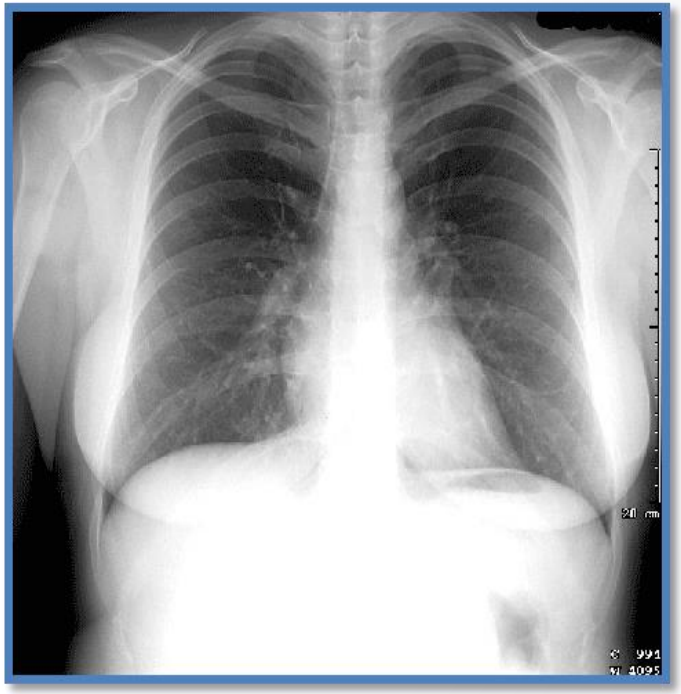
- **PA :** Anatomy reading
- **AP view**
- **AP supine :** Ambulatory limit
- **Lateral** (Lt/Rt)
- **Lateral decubitus :** Effusion or thickening
- **Lordotic :** Apical lesion
- **Oblique :**

helpful localize lesions and eliminate superimposed structures

Right anterior oblique for left side lesion

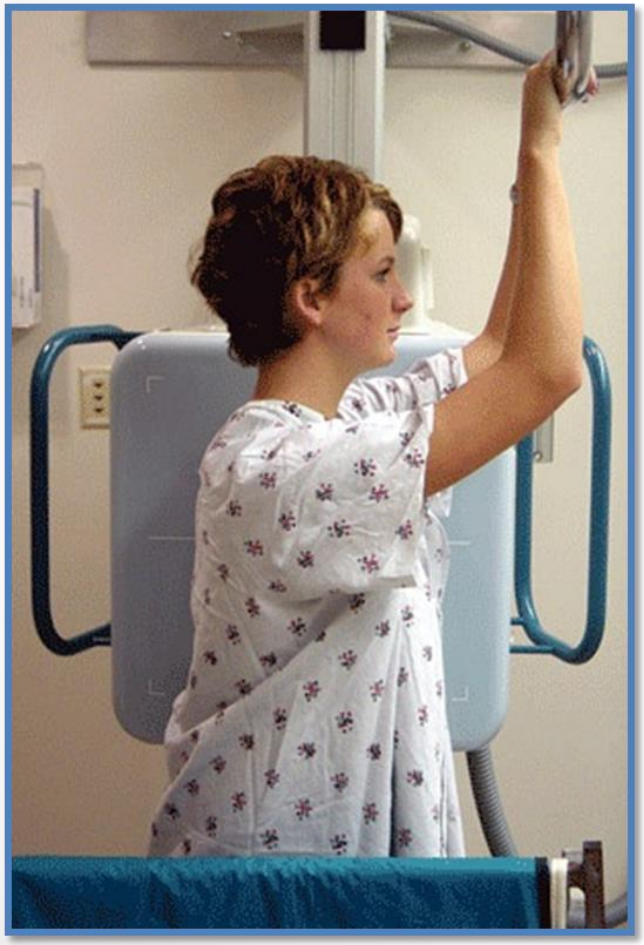
- بررسی استاندارد شامل : 1) دو عکس خلفی – قدامی و لترال و تفسیر هردو با هم & مقایسه عکس های قدیمی با جدید

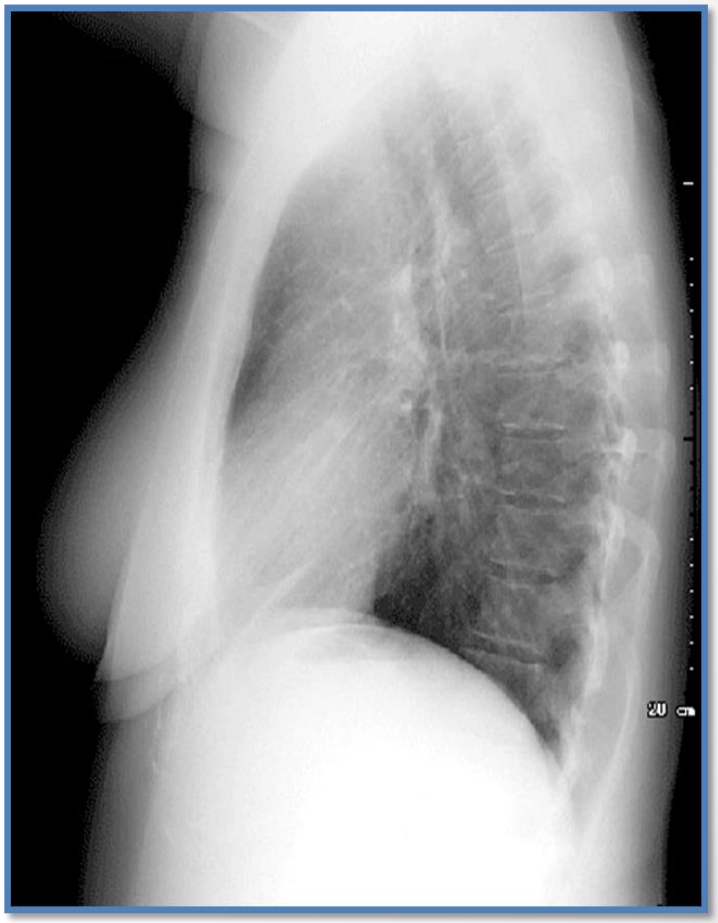
PA



قرار دادن پشت دست ها بر روي لگن باعث چرخيدن استخوان هاي كتف به كناره ها مي شود كه اين كار باعث مي شود كه كناره هاي داخلي استخوان هاي كتف روي ريه ها نيفتد يا در حد كمتري بيفتد.

Lat



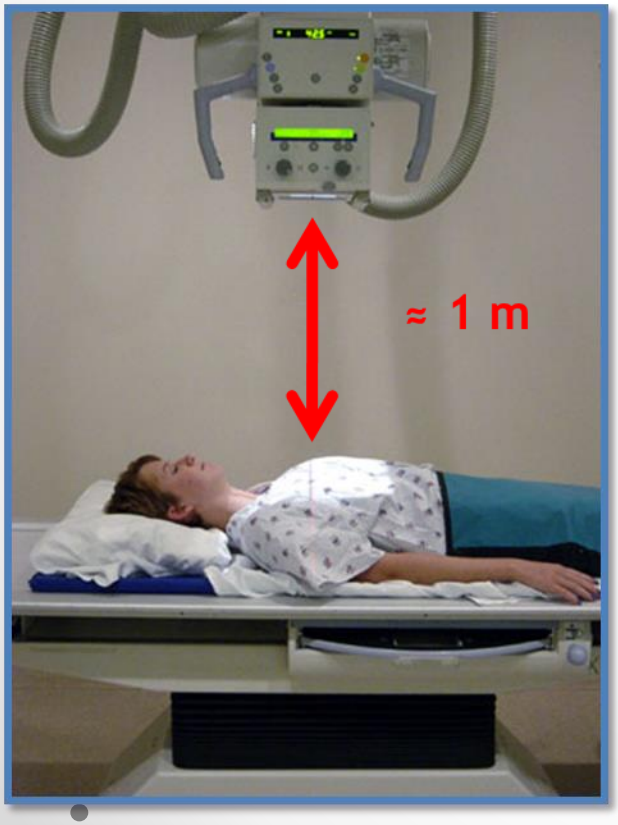


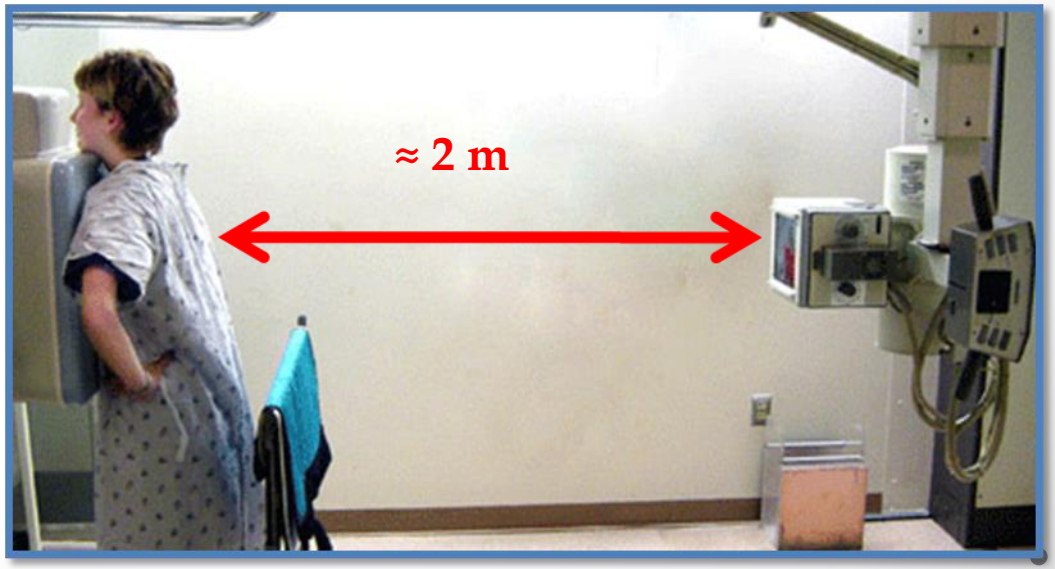
AP

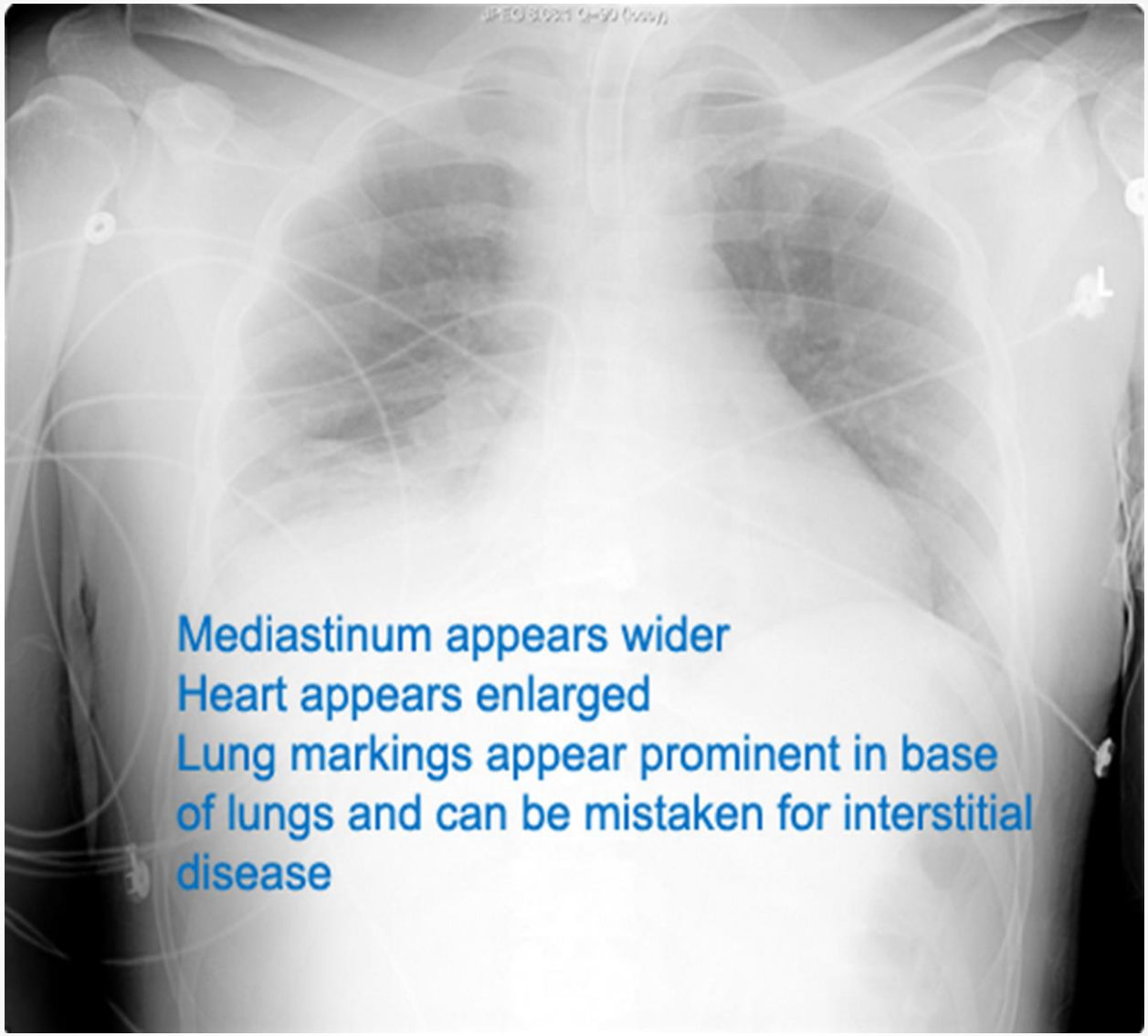
AP views are less useful and should be reserved for very ill patients who cannot stand erect (trauma, LOC, …..)

تفاوتهای PA و AP

- بزرگی سایه قلب و سایر ساختارهای قدامی (مدیاستینوم)
- تشخیص پنوموتوراکس و افیوژن واحتقان ریوی مشکل تر
- سایه های مزاحم (سیم مانیتور، Back Board)
- چرخش، دم و نفوذپذیری کمتر



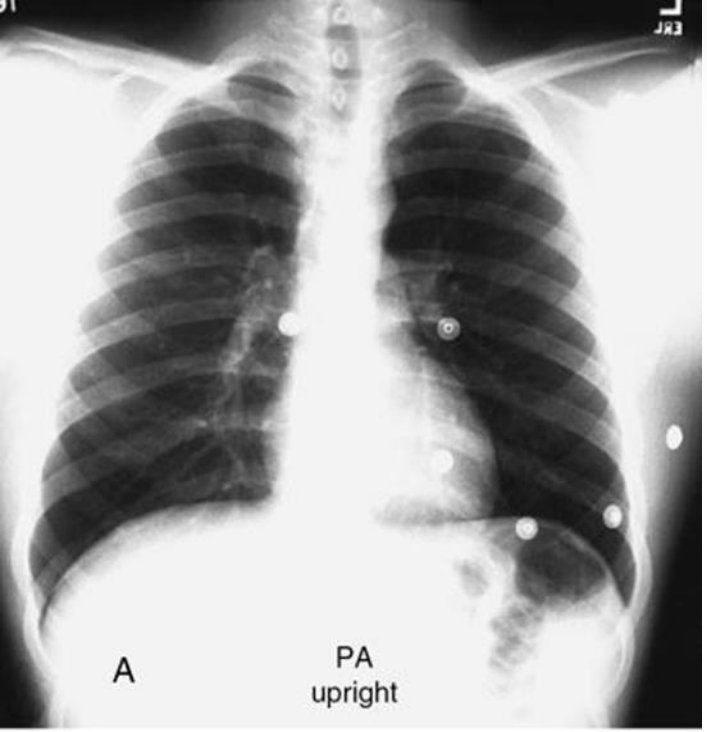


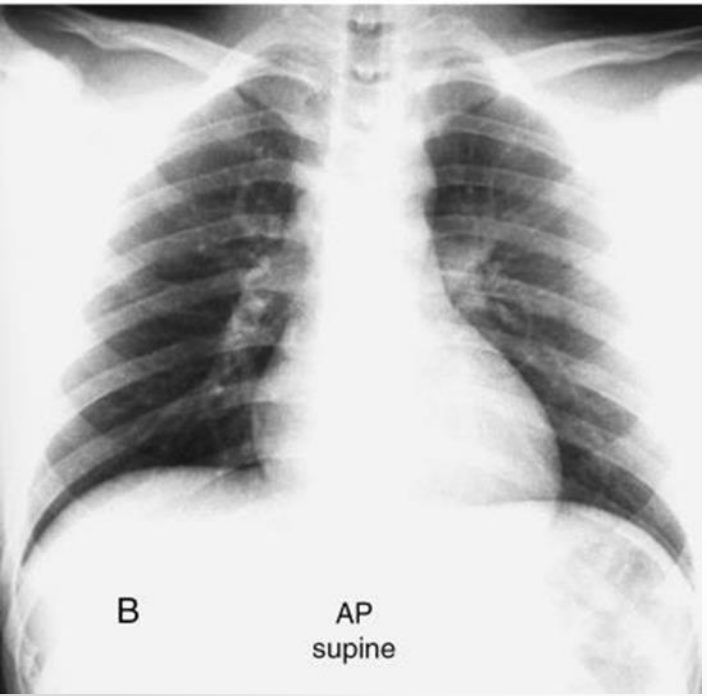

Mediastinum appears wider
Heart appears enlarged
Lung markings appear prominent in base of lungs and can be mistaken for interstitial disease

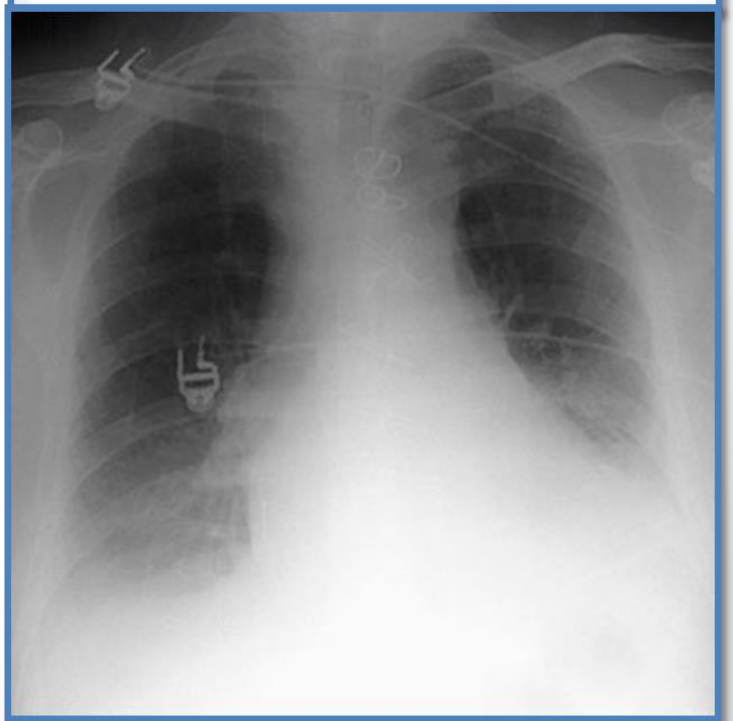
Techniques

- 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

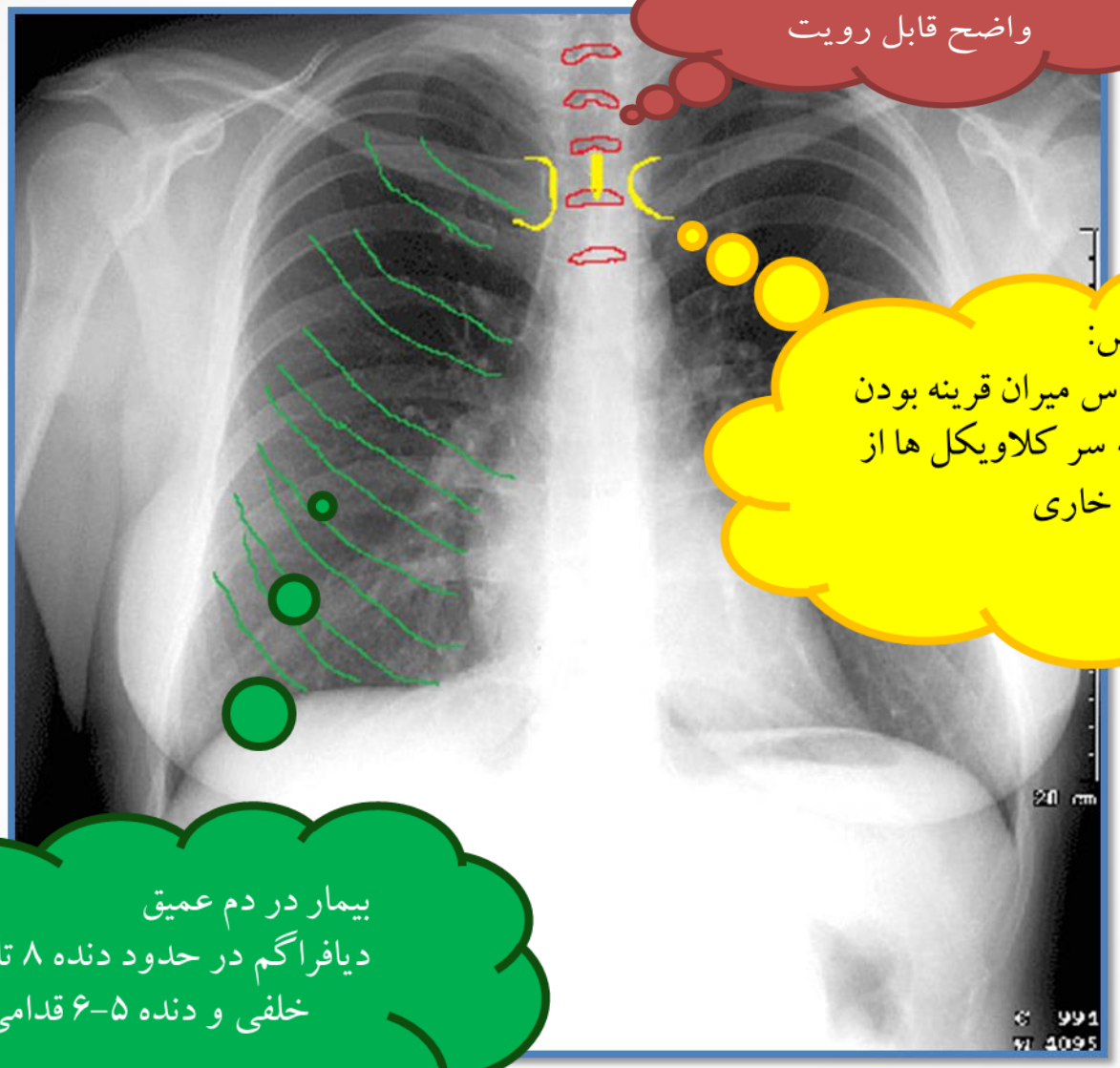
✓ **Good expose:** You will be able to see the thoracic vertebrae

✓ **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**

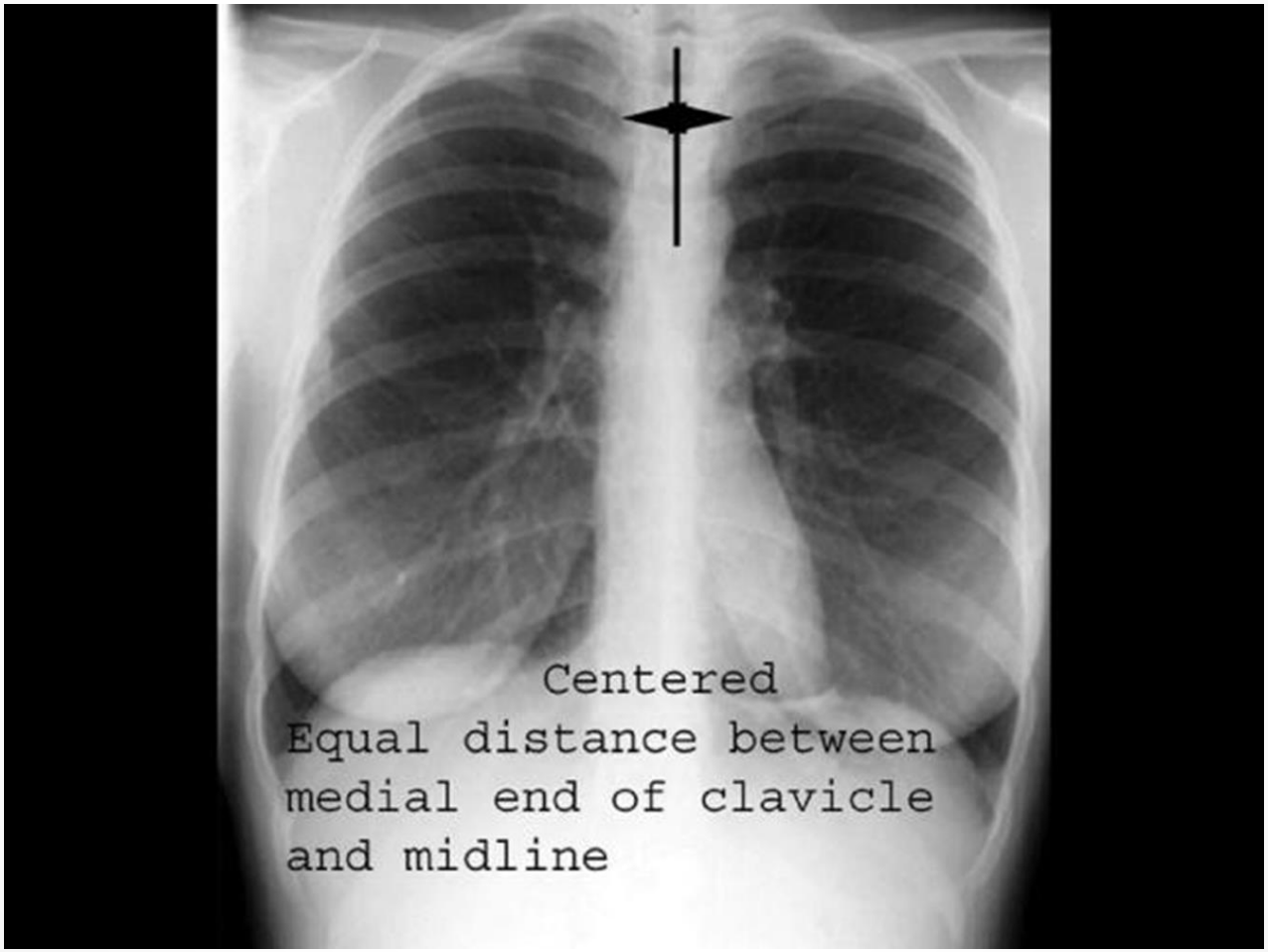
نفوذپذیری اشعه:
فضای دیسک بین
مهره ای توراسیک
واضح قابل رویت



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

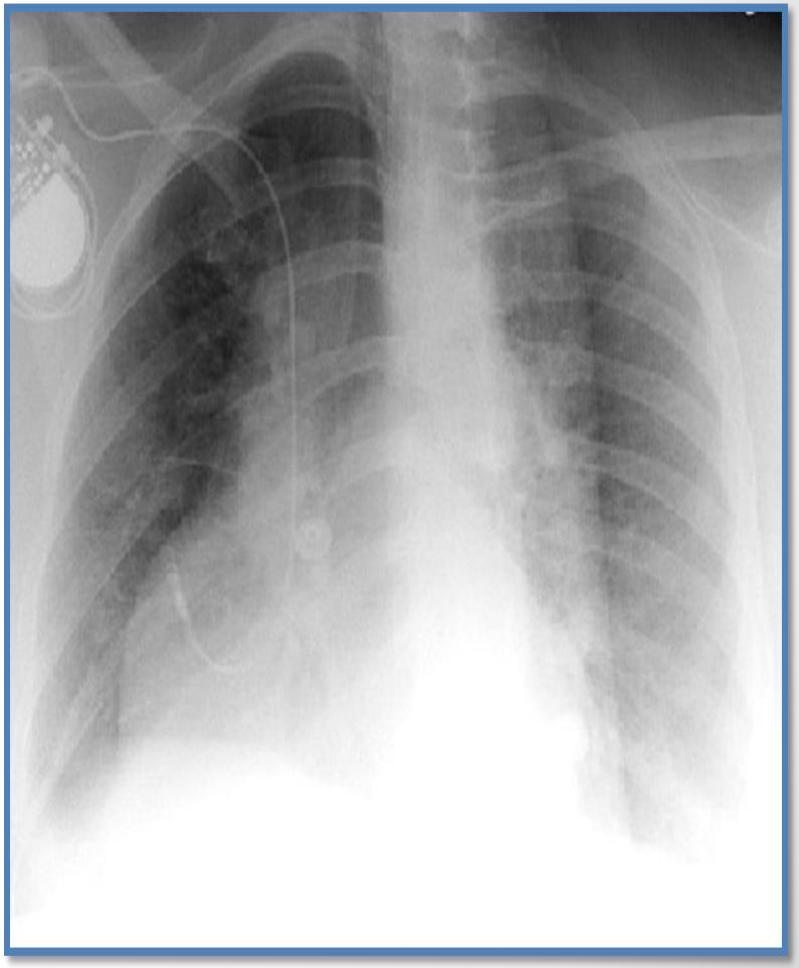
بیمار در دم عمیق
دیافراگم در حدود دنده ۸ تا ۱۰
خلفی و دنده ۵-۶ قدامی

Well centered

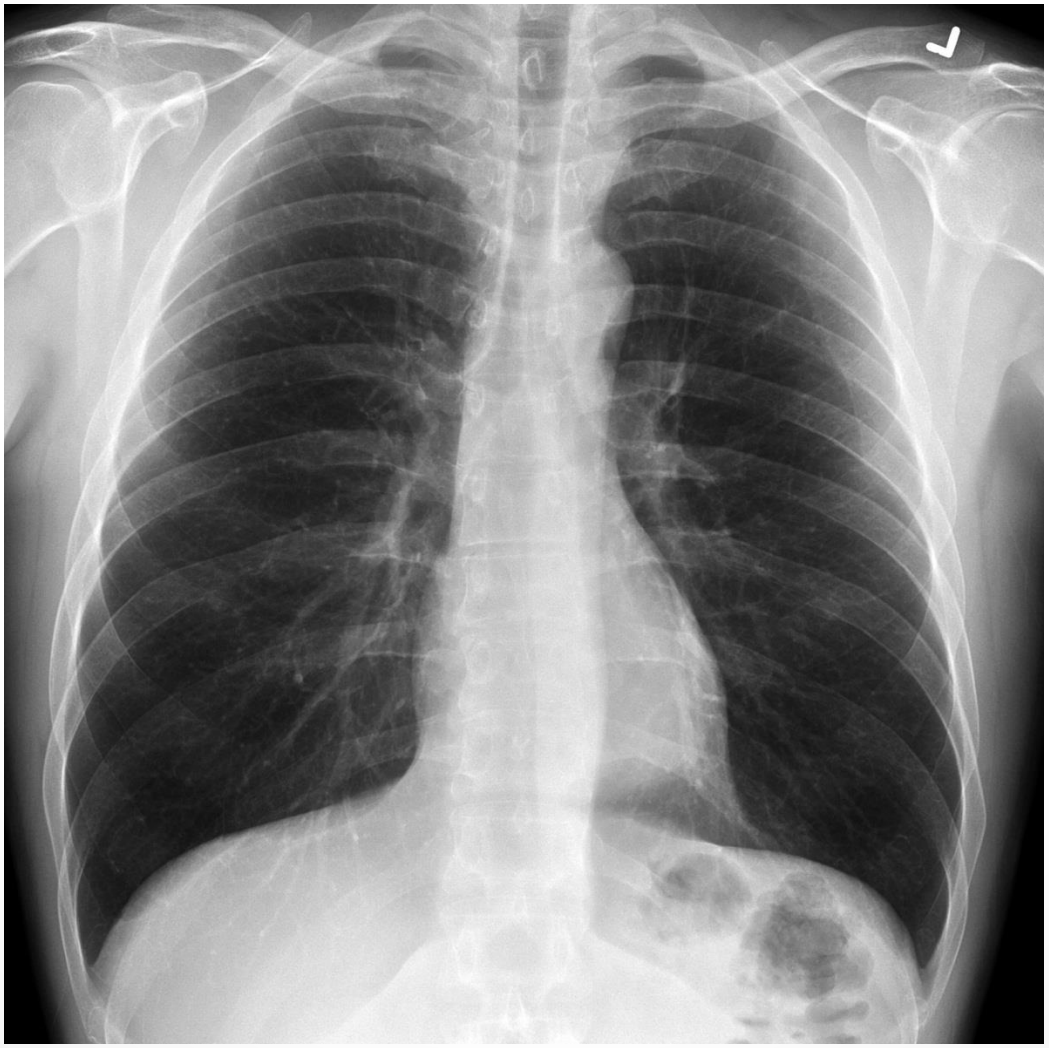


Rotation


Not Centered
Unequal distance between medial end of clavicles and central line



Good exposure(penetrate)



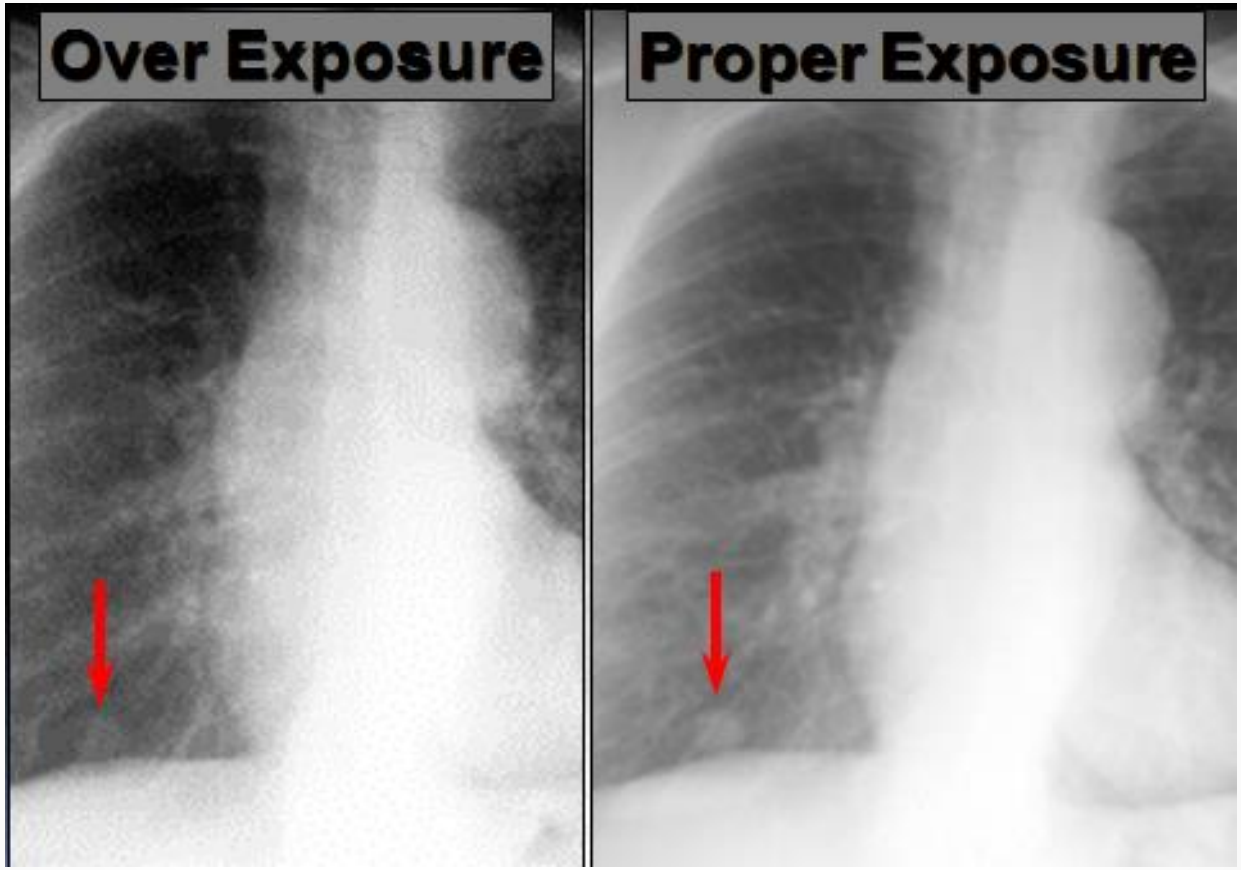
Under exposed/Over exposed

اشكالاتي كه به دليل نفوذ كم اشعه به وجود مي آيد :

1- همي ديافراگم چپ و قاعده ريه چپ به خوبي ديده نمي شود.

2- علائم ساختاري ريه نسبت به شكل واقعيشان برجسته تر به نظر مي رسند.

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

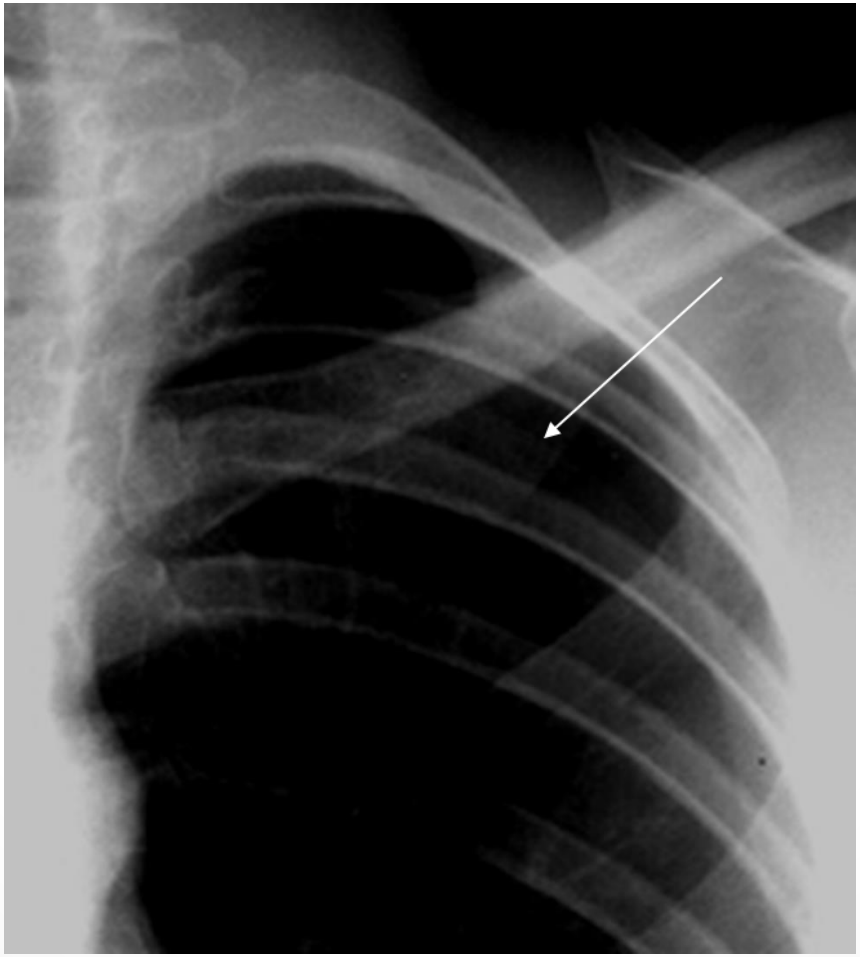

Over Exposure
Proper Exposure

Good expose

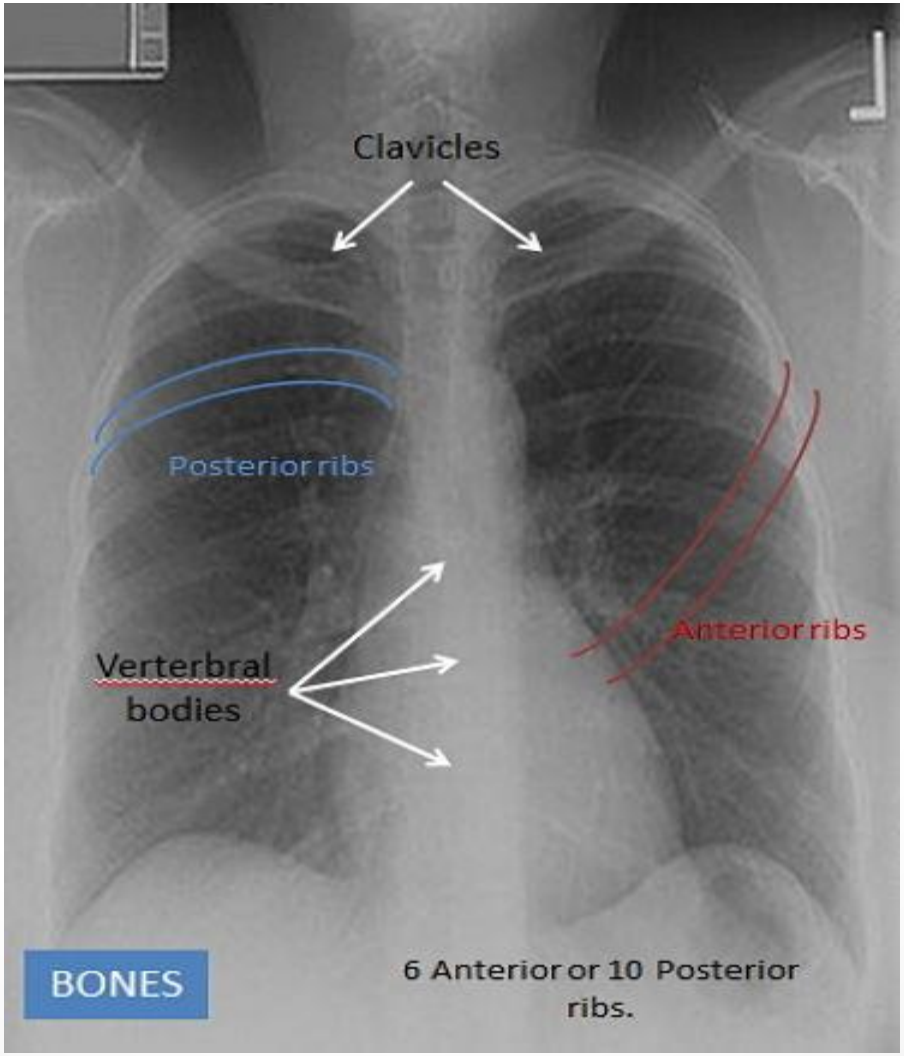
small pneumothorax

Over expose

small pneumothorax



Full inspiration

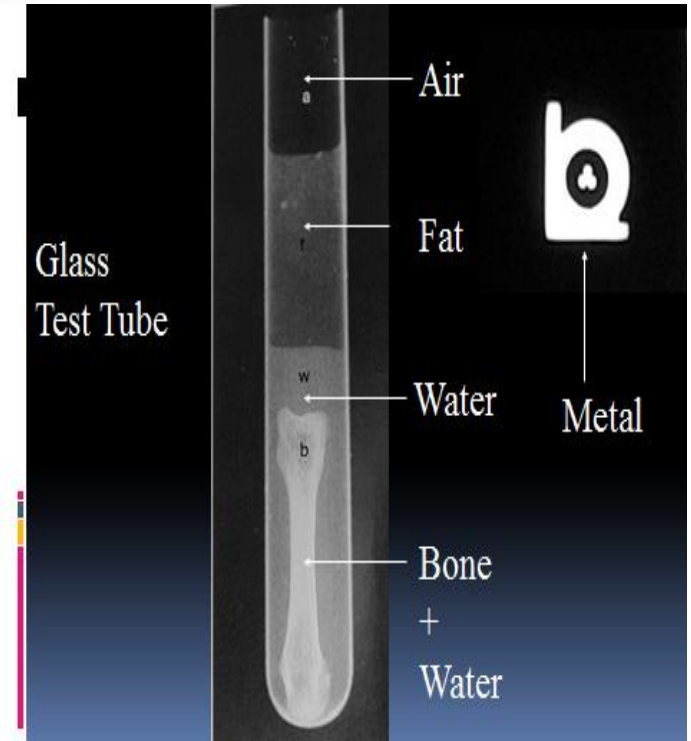


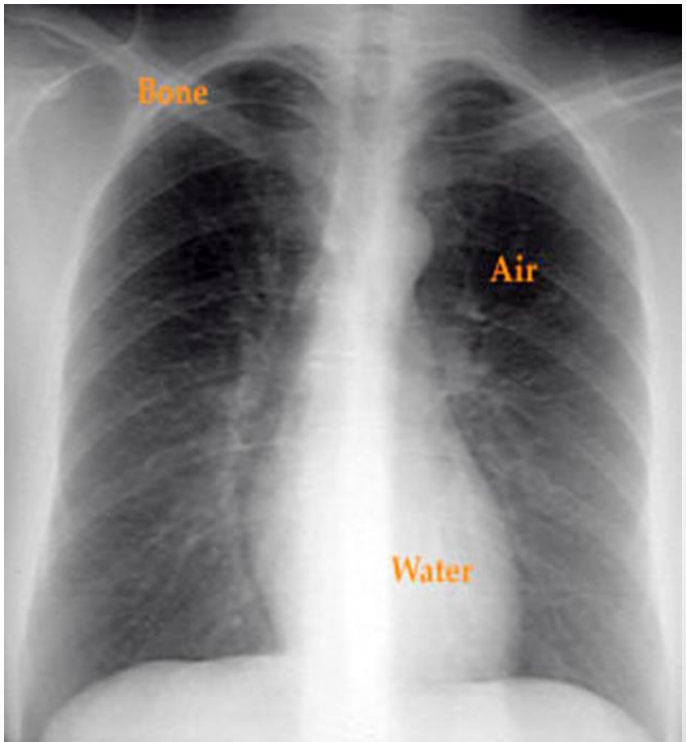
شمارش دنده ها (PA)

- ✓ به دليل نزديك بودن دنده هاي قدامي نسبت به دنده هاي خلفي به فيلم، در يك نماي PAسايه آن ها كمتر دچار بزرگنمايي شده و معمولاً شارپ تر هستند.

- ✓ دنده هاي 1 و 2 در امتداد رائده عرضي T1 روي هم مي 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.

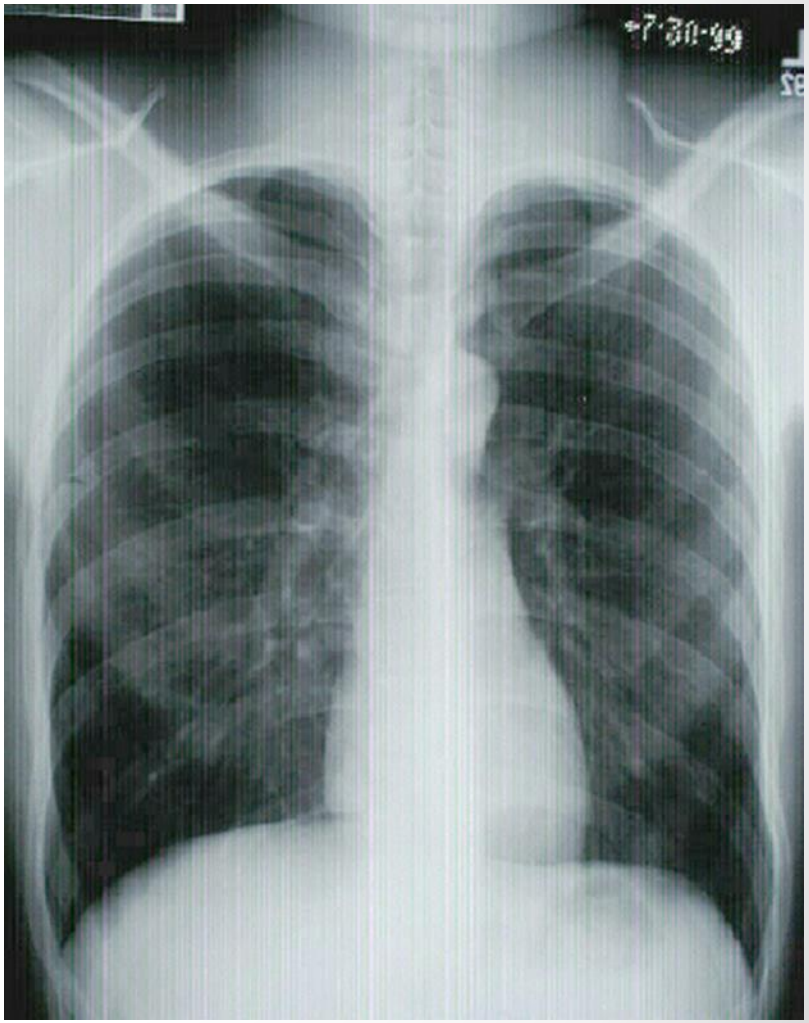
STEP 4. Assess the parenchyma for evidence of laceration. Lacerations appear as a hematoma, vary according to the magnitude of injury, and appear as areas of consolidation.

Pleural

- Layers: Parietal
  Visceral

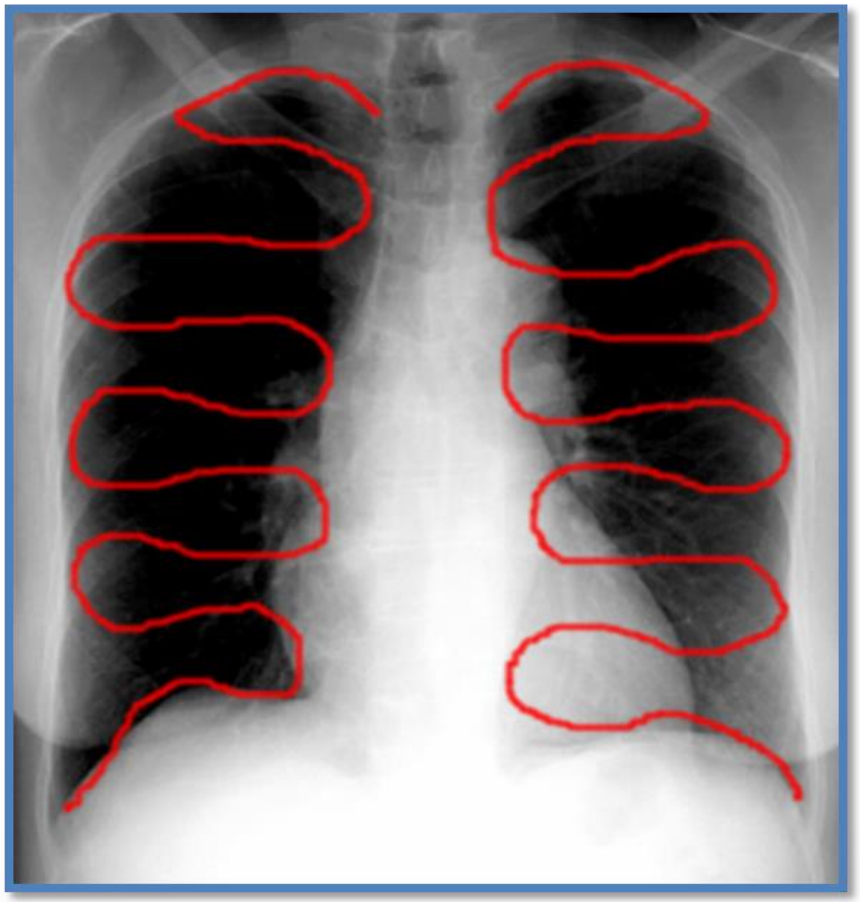
- Check the costophrenic angles
  Margins should be sharp

- پلور: افیوژن، ضخیم شدن، کلسیفیه شدن

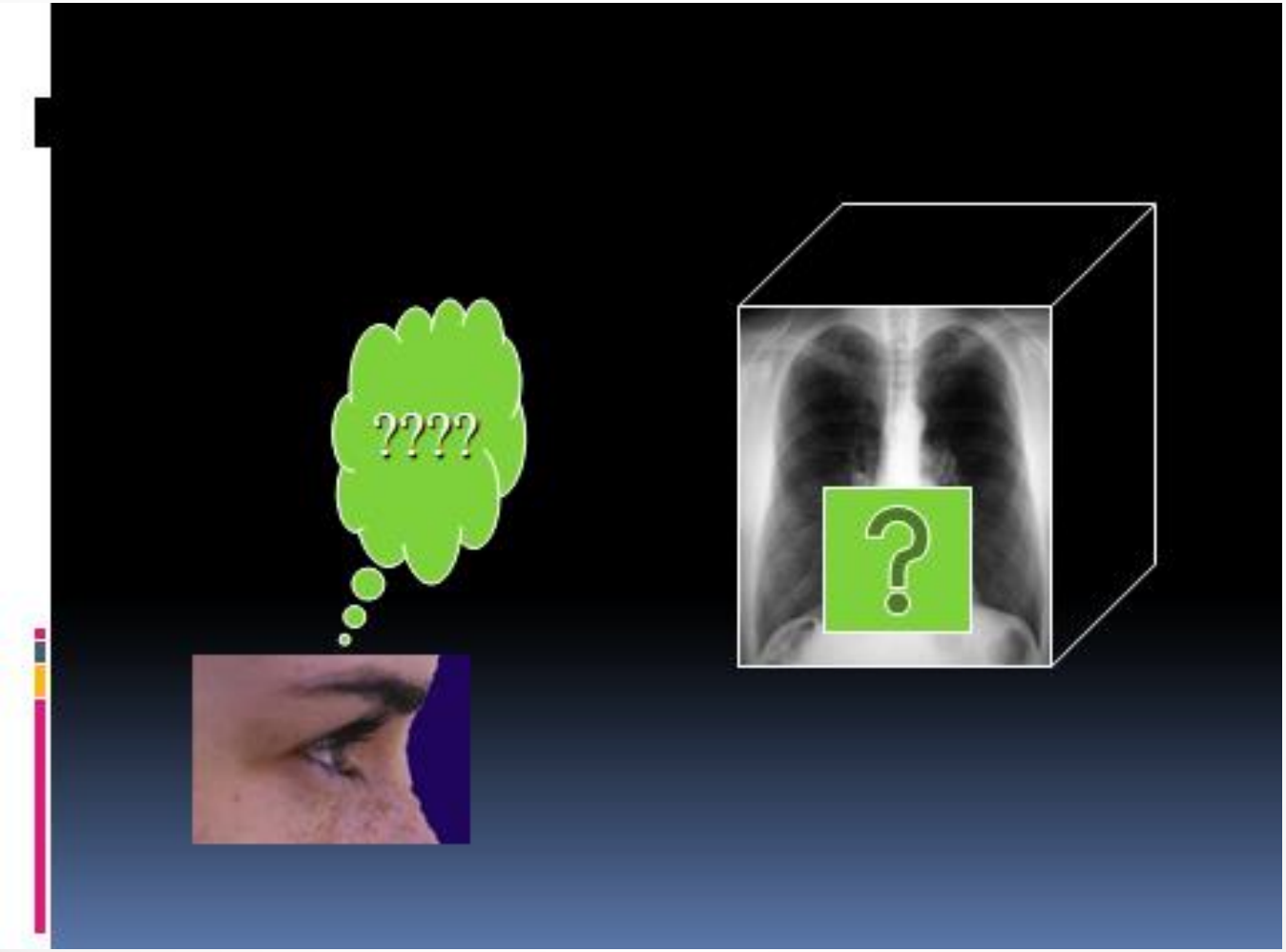


Lungs

Density
Symmetry
Lesions



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

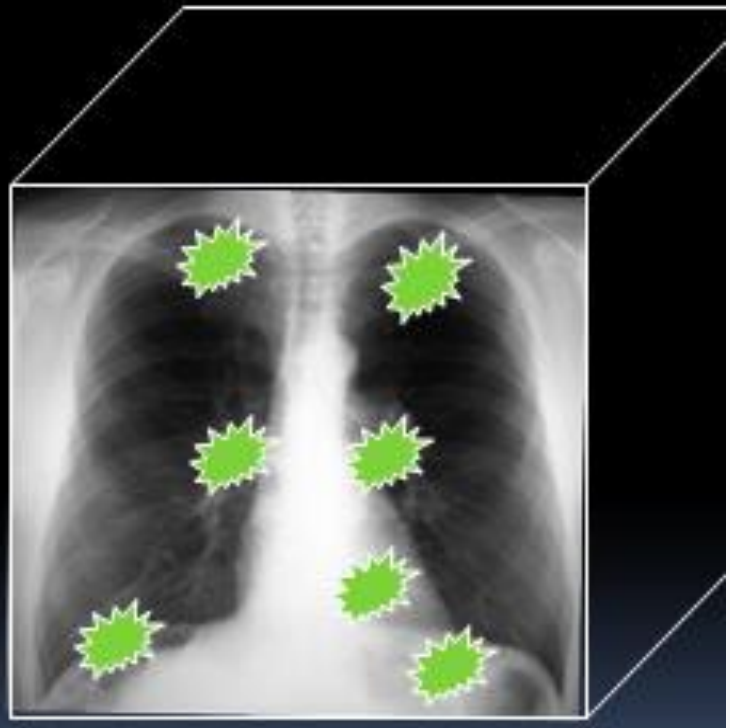


Before taking an x-ray off the monitor

you must say:

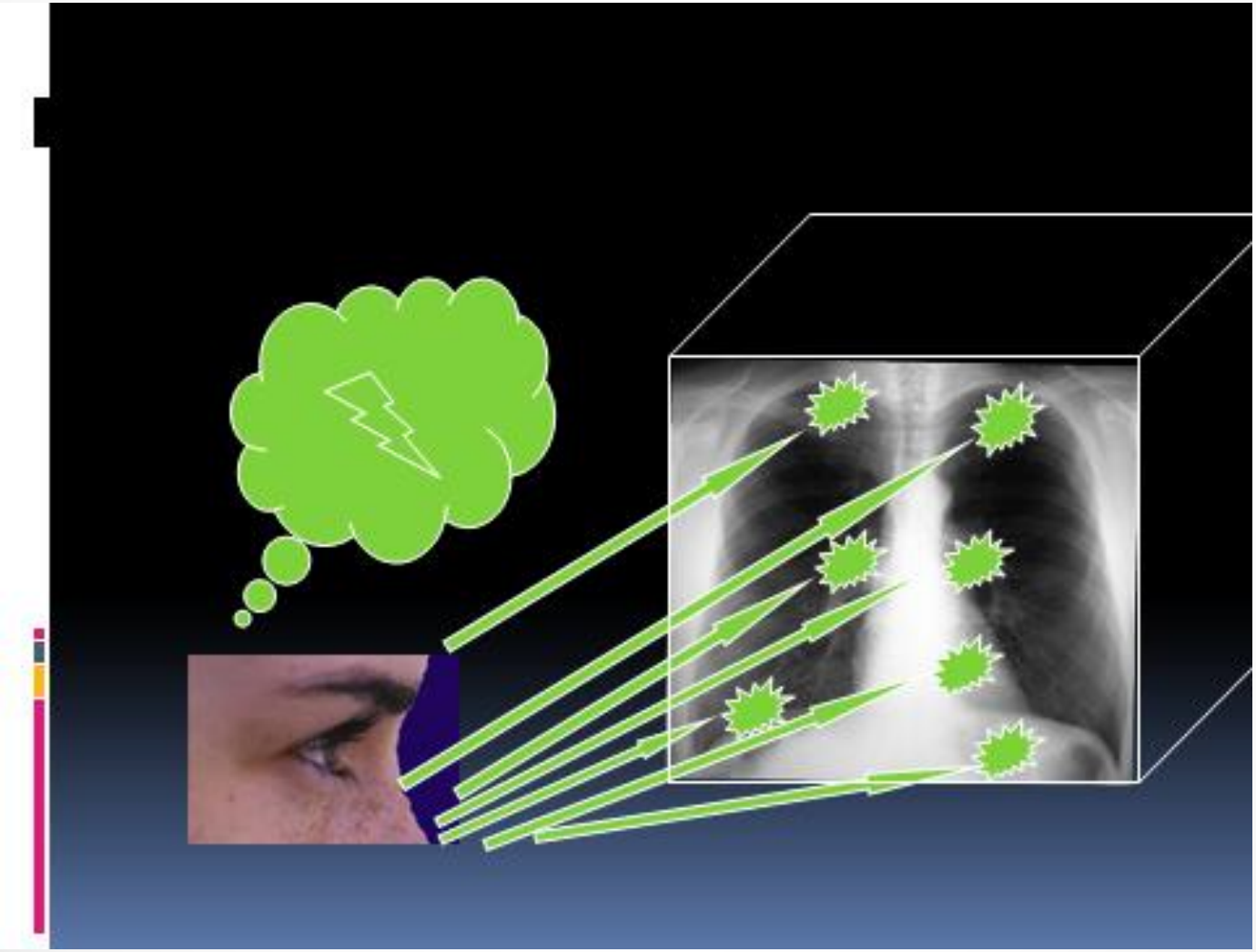
AH HA !!!

AH HA!



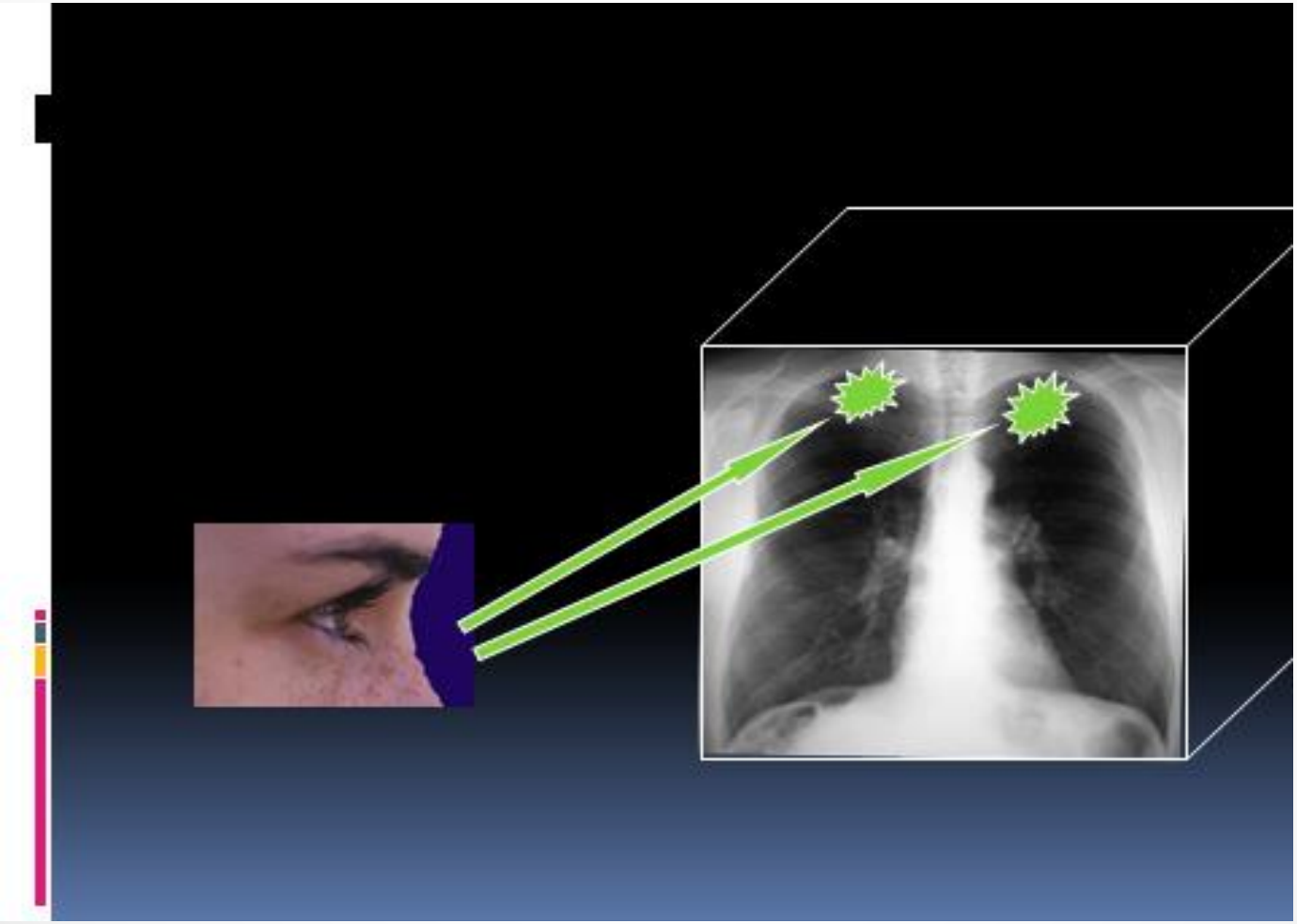
*APEX *HILUM *HEART *ABDOMEN
(retrocardiac space)

With your eyes, you define the 4 following target zones

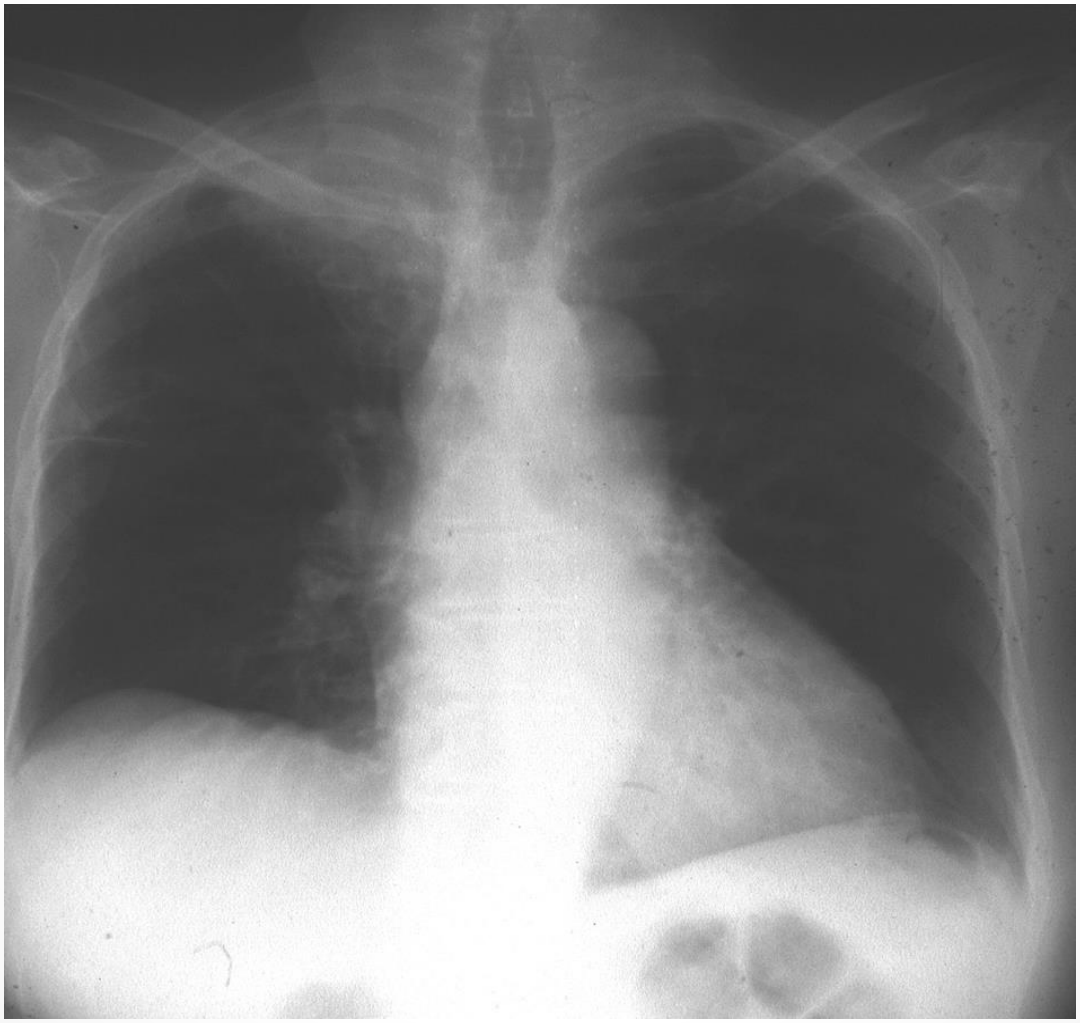


The first target is: the retroclavicular zone

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

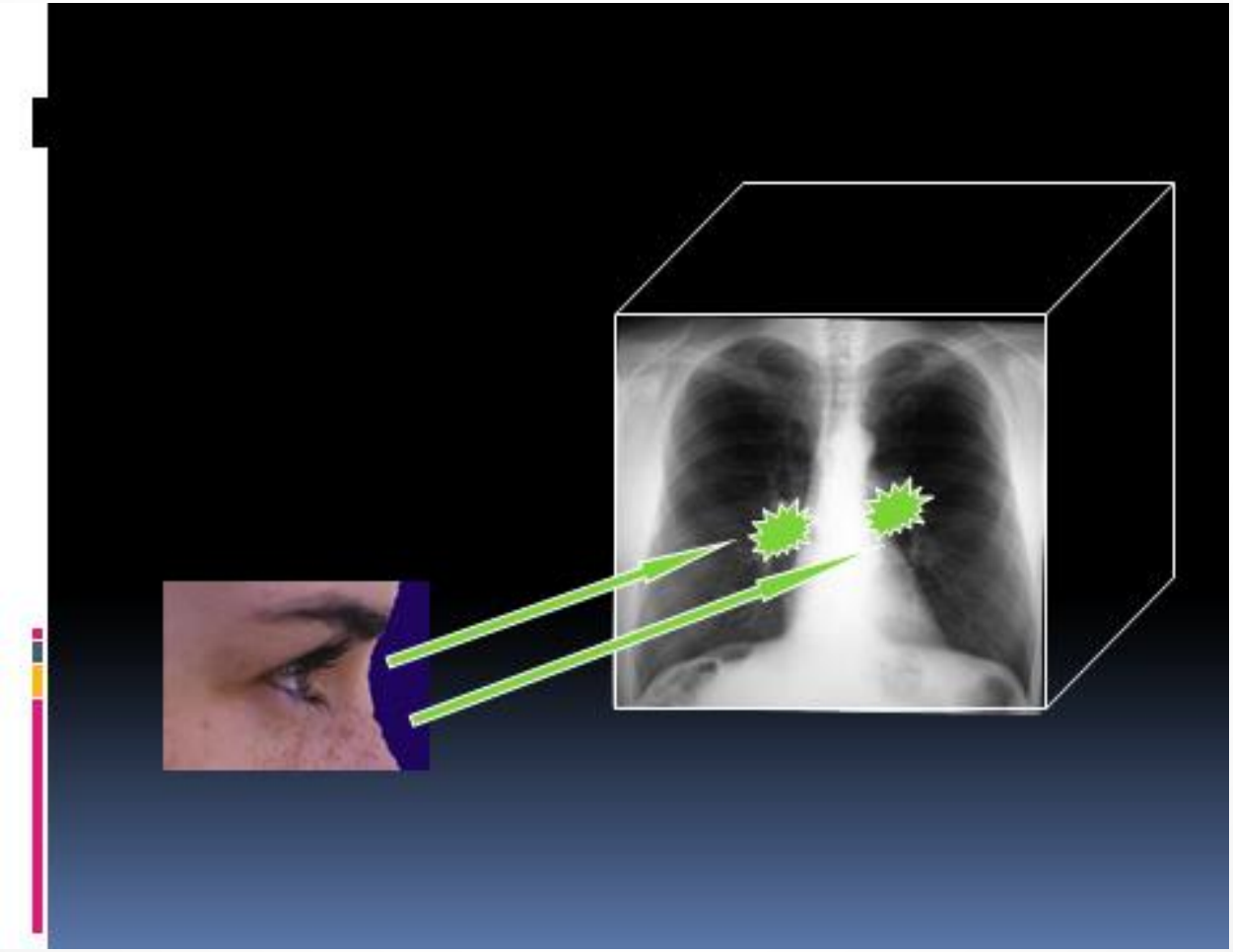


Right retro clavicular opacity

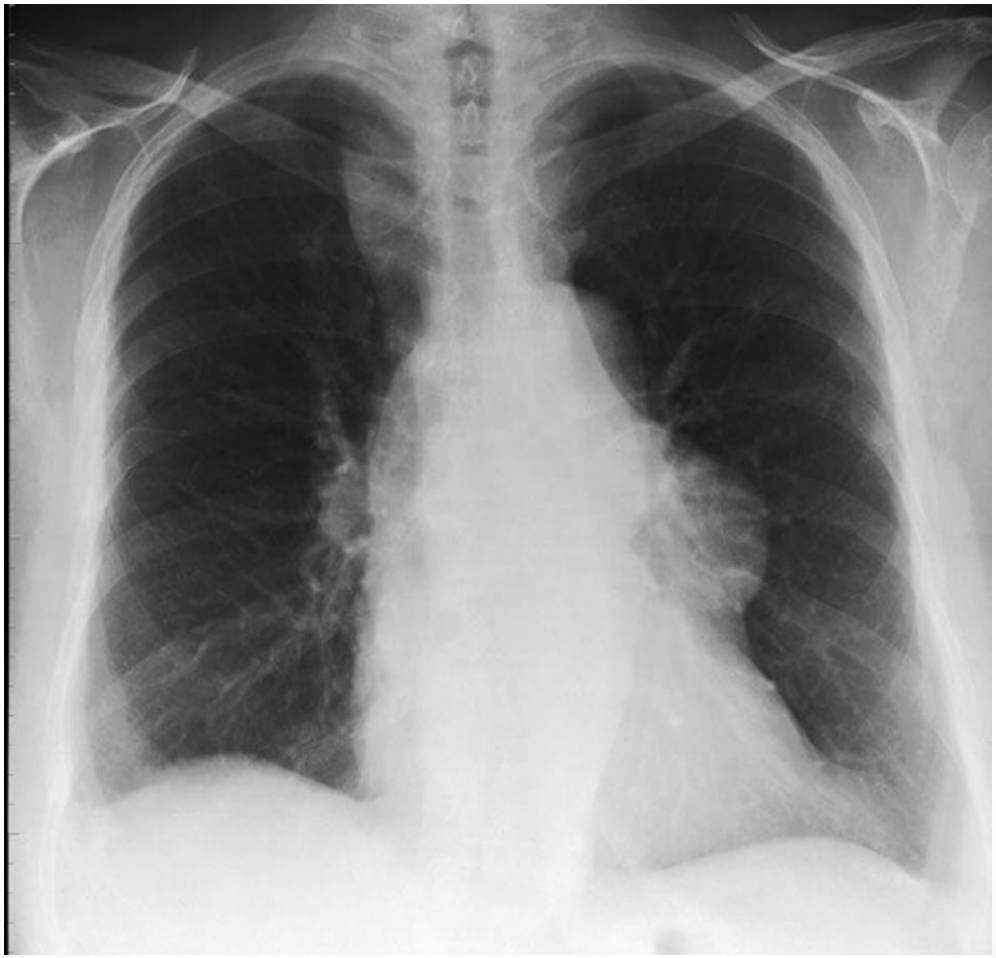


The second target is : the hilum

(density, size, abnormal opacity, lymph nodes)



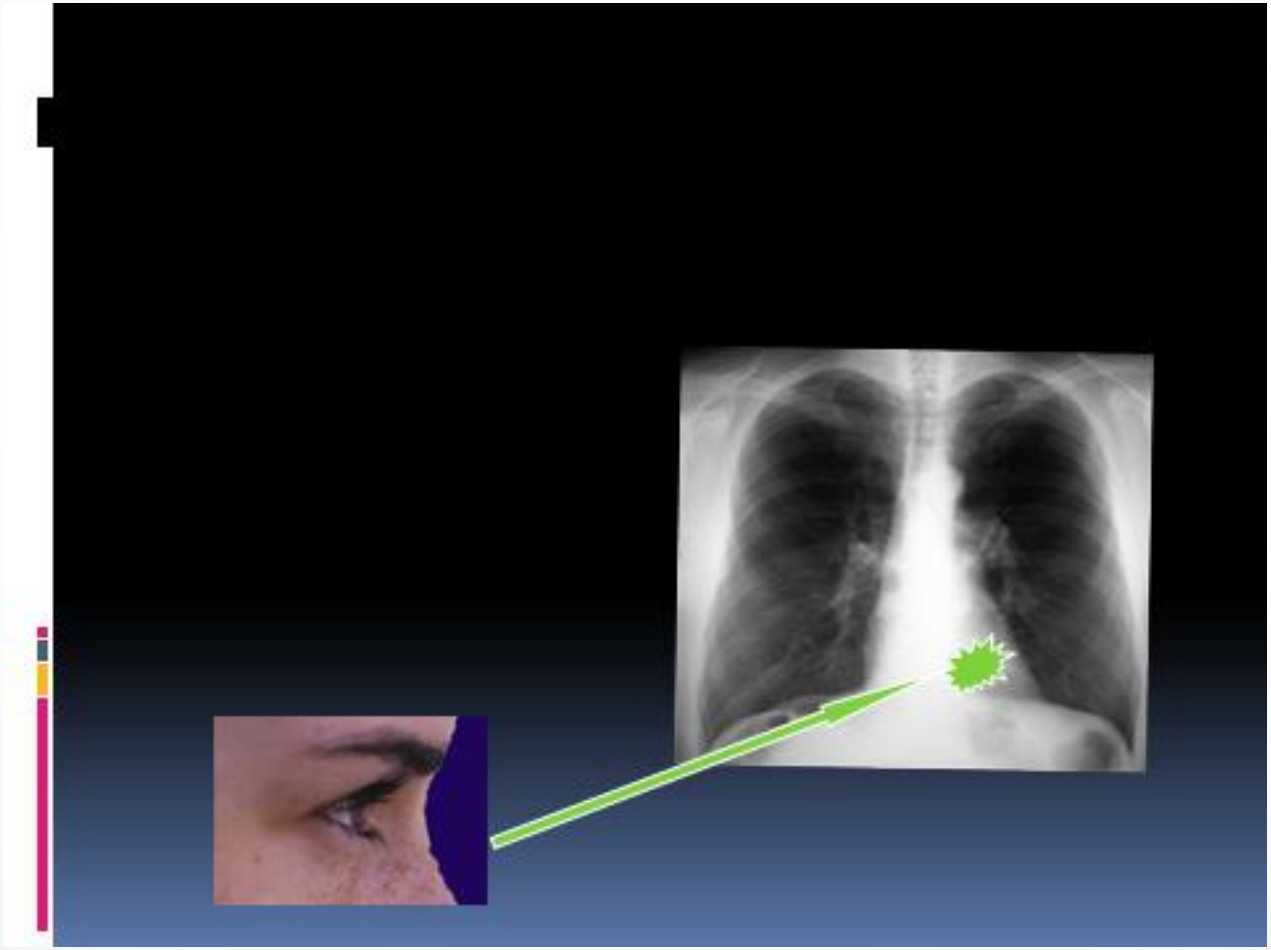
Dermoid cyst (hilum overlay sign)



Bilateral hilar and mediastinal enlargement

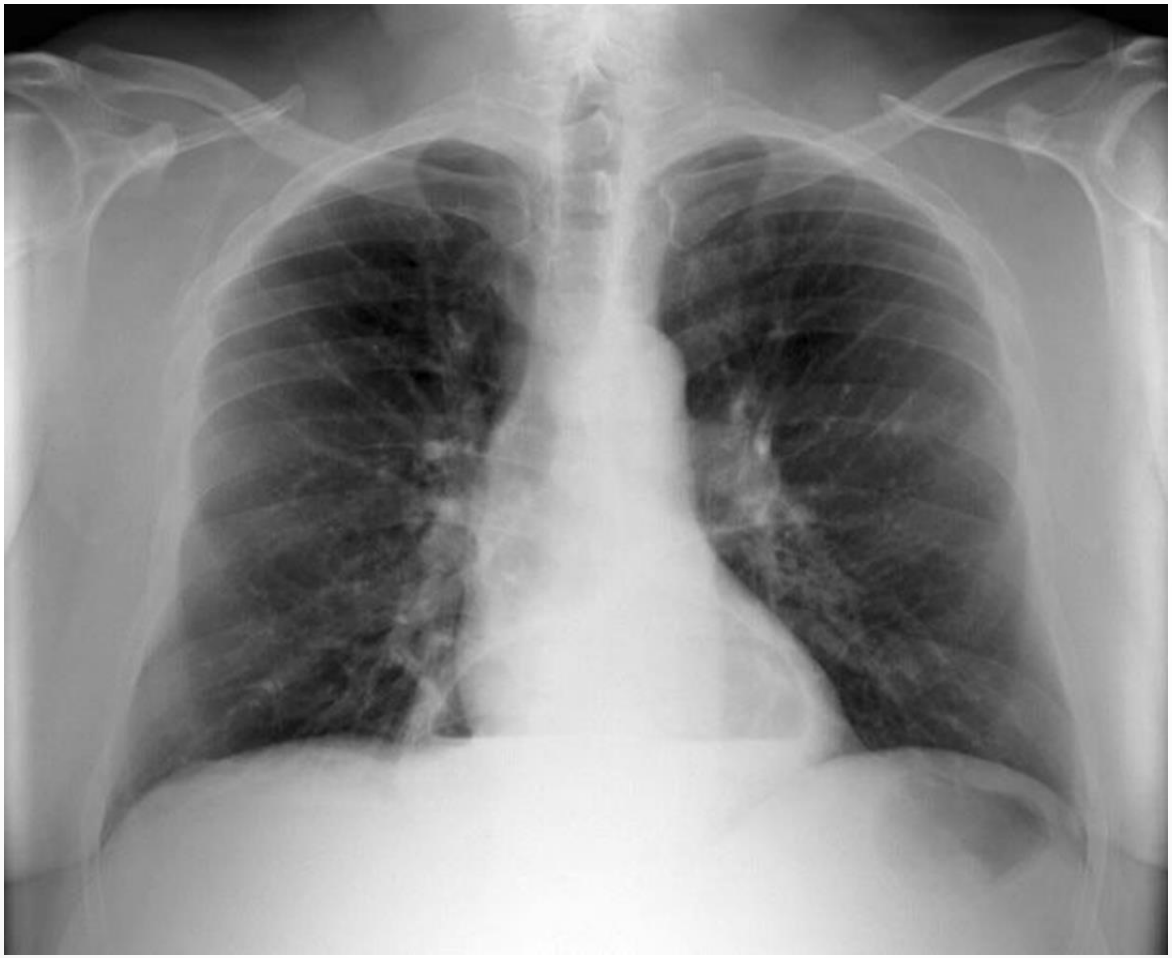
The third target is: the retrocardiac region

(bronchopneumonia, atelectasis, neoplasm)



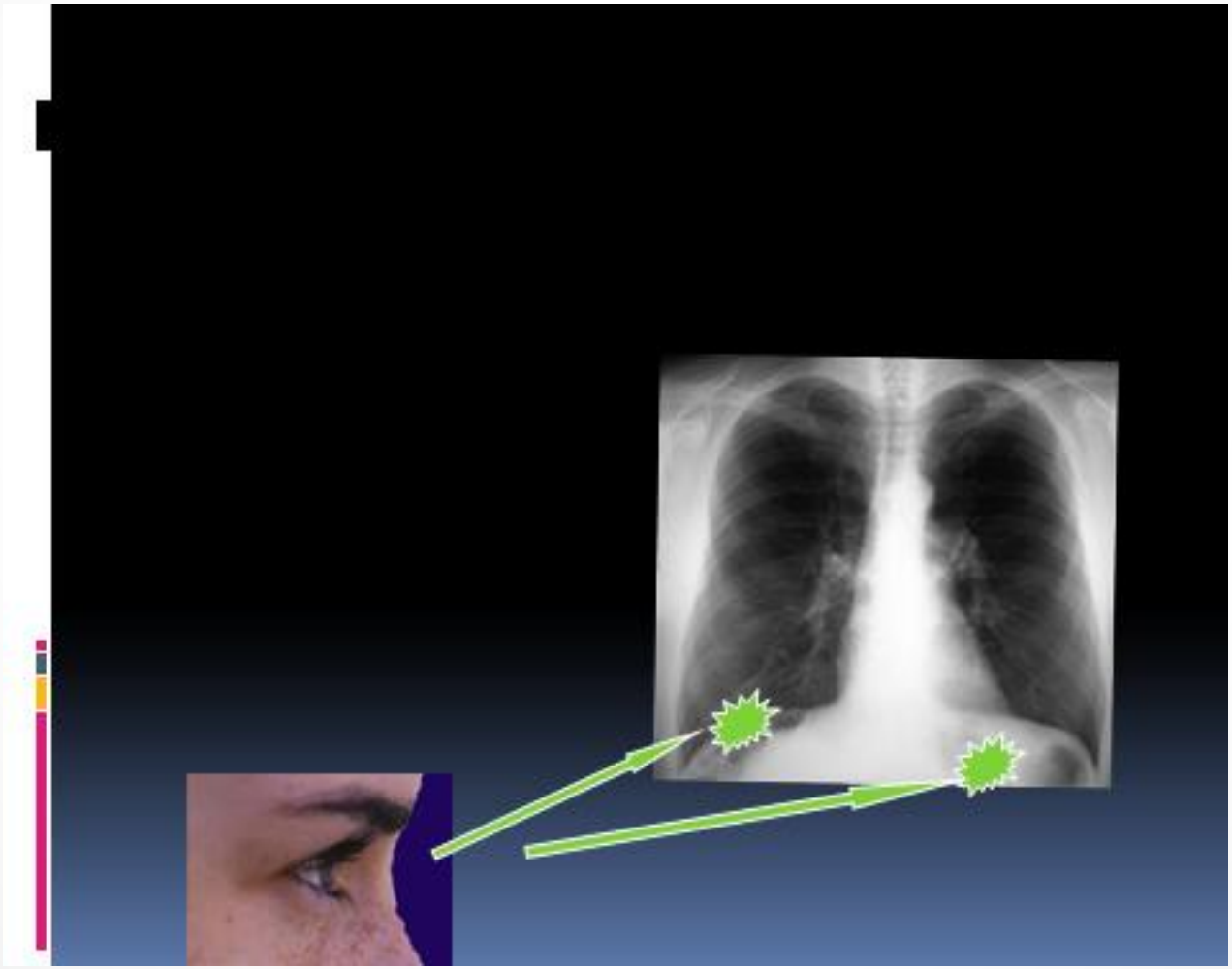
Bronchopneumonia in the posterior and lateral basal segments of the LLL

Large hiatus hernia

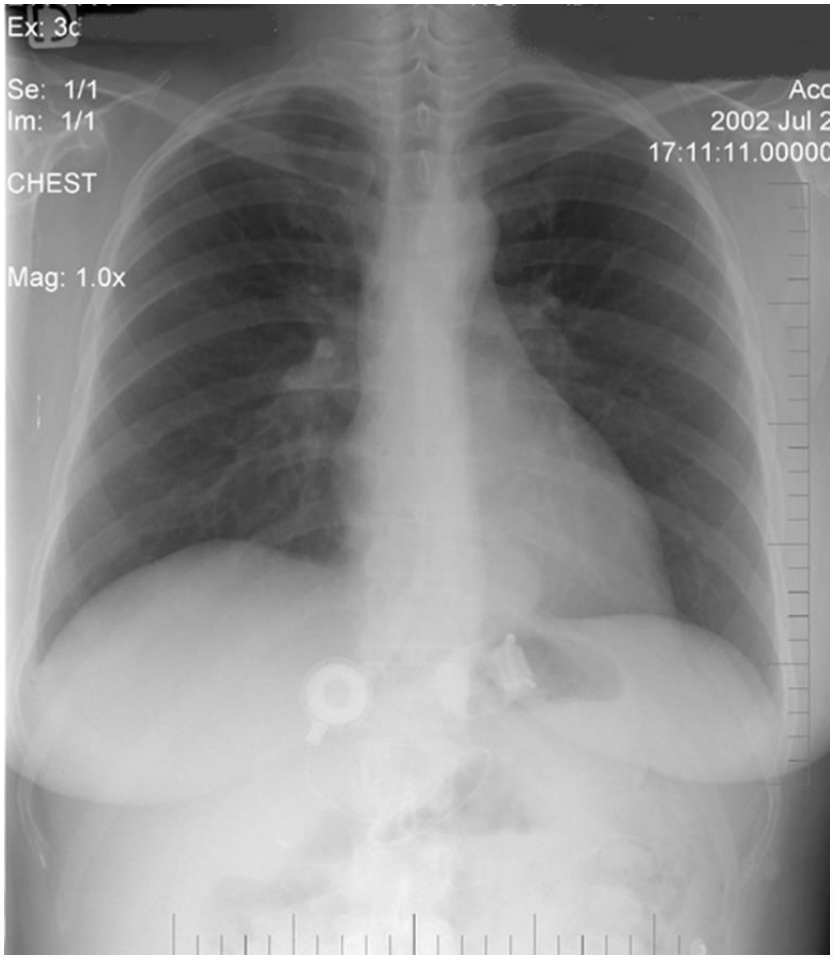


The fourth target is: the subdiaphragmatic zone

(abdominal and abdomino-thoracic diseases)

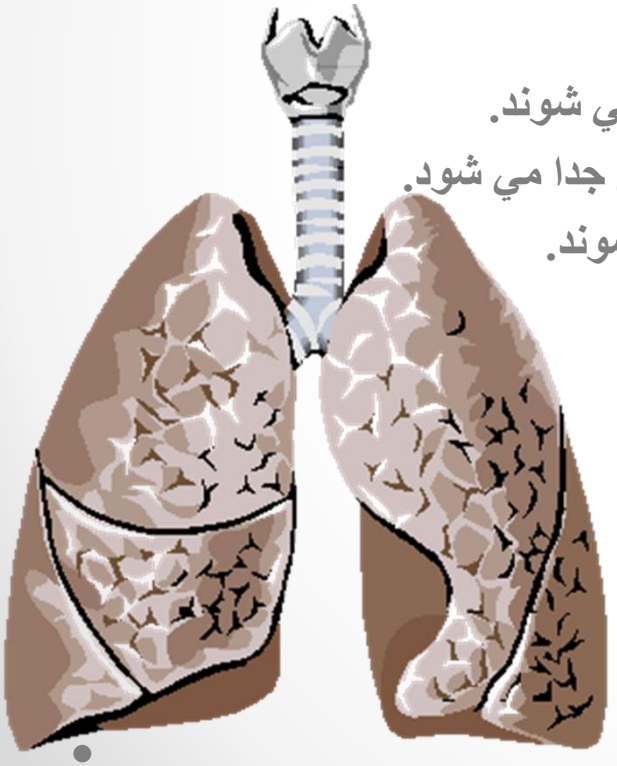


Gastric ring



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

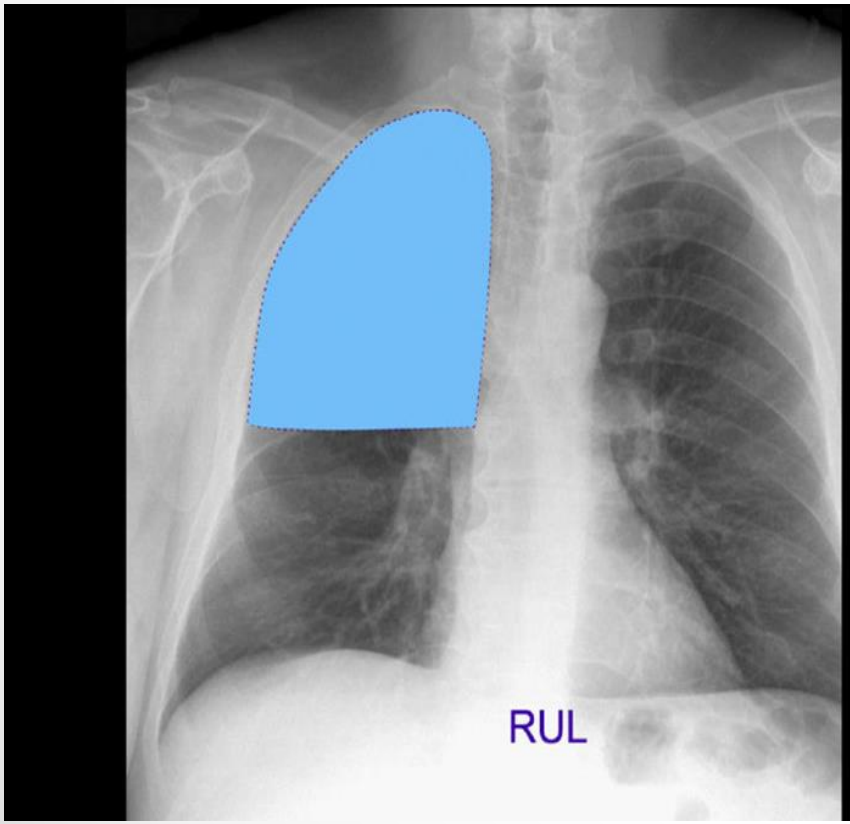


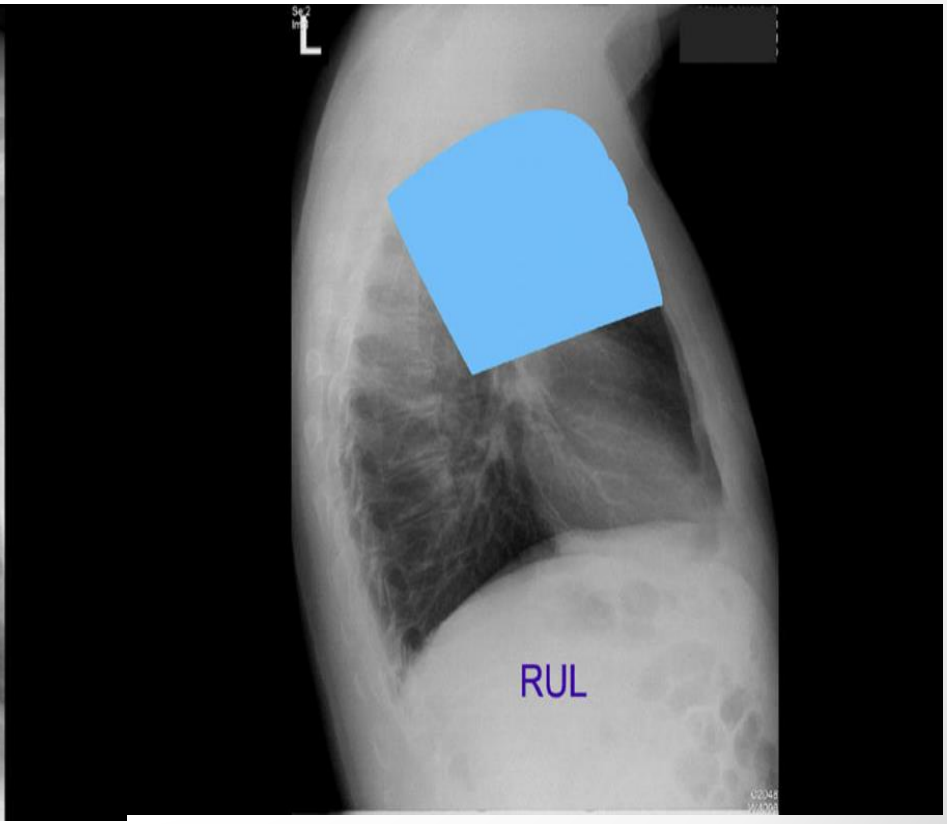
لوب فوقاني و مياني راست توسط شكاف مينور يا عرضي از يكديگر جدا مي شوند.
لوب تحتاني ريه راست توسط شكاف ماژور يا مايل از لوب فوقاني و مياني جدا مي شود.
لوب فوقاني و تحتاني چپ توسط شكاف ماژور يا مايل از يكديگر جدا مي شوند.

-شكاف مينور يا عرضي دقيقاً از محل ناف گسترده مي شود،
به سختي ديده مي شود يا اصلاً ديده نمي شود.

Lobes

Right upper lobe:

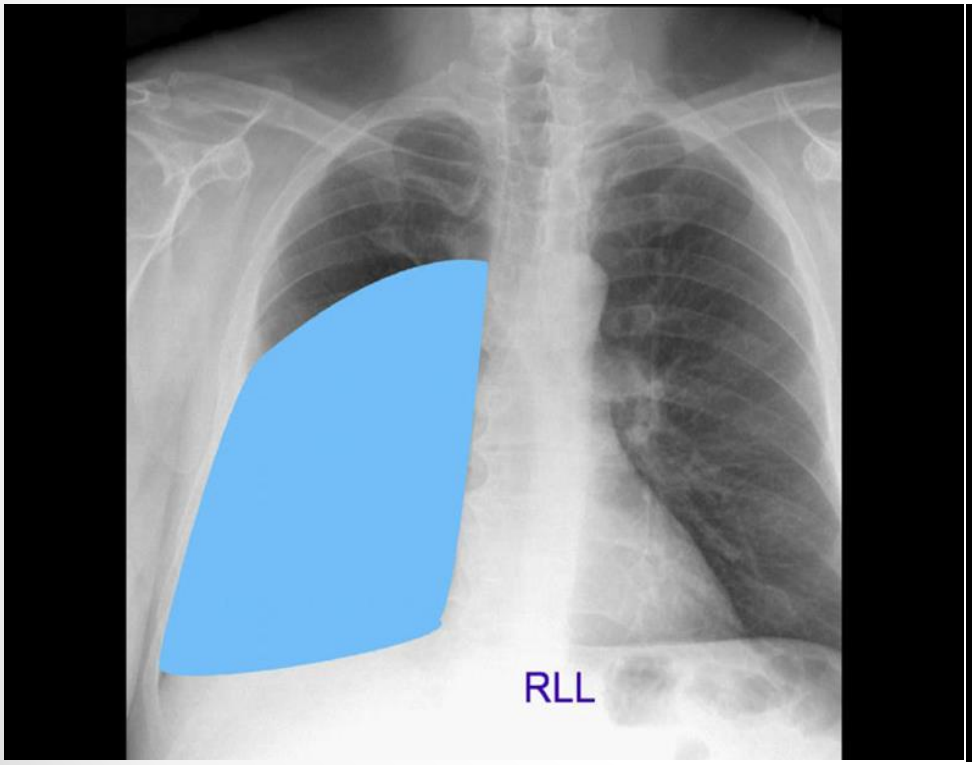


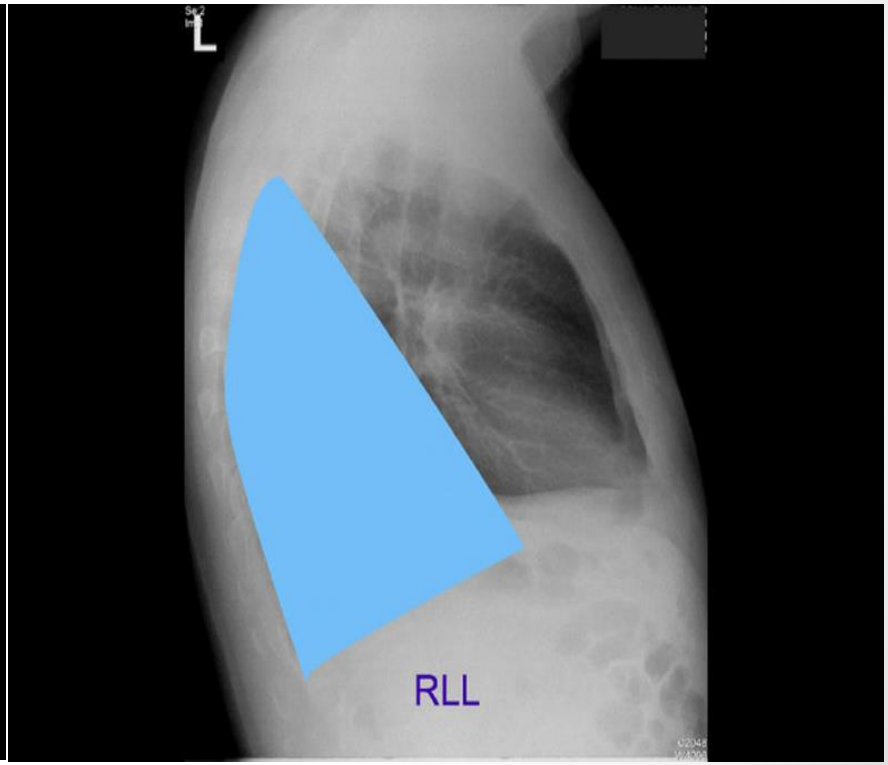


Right middle lobe:

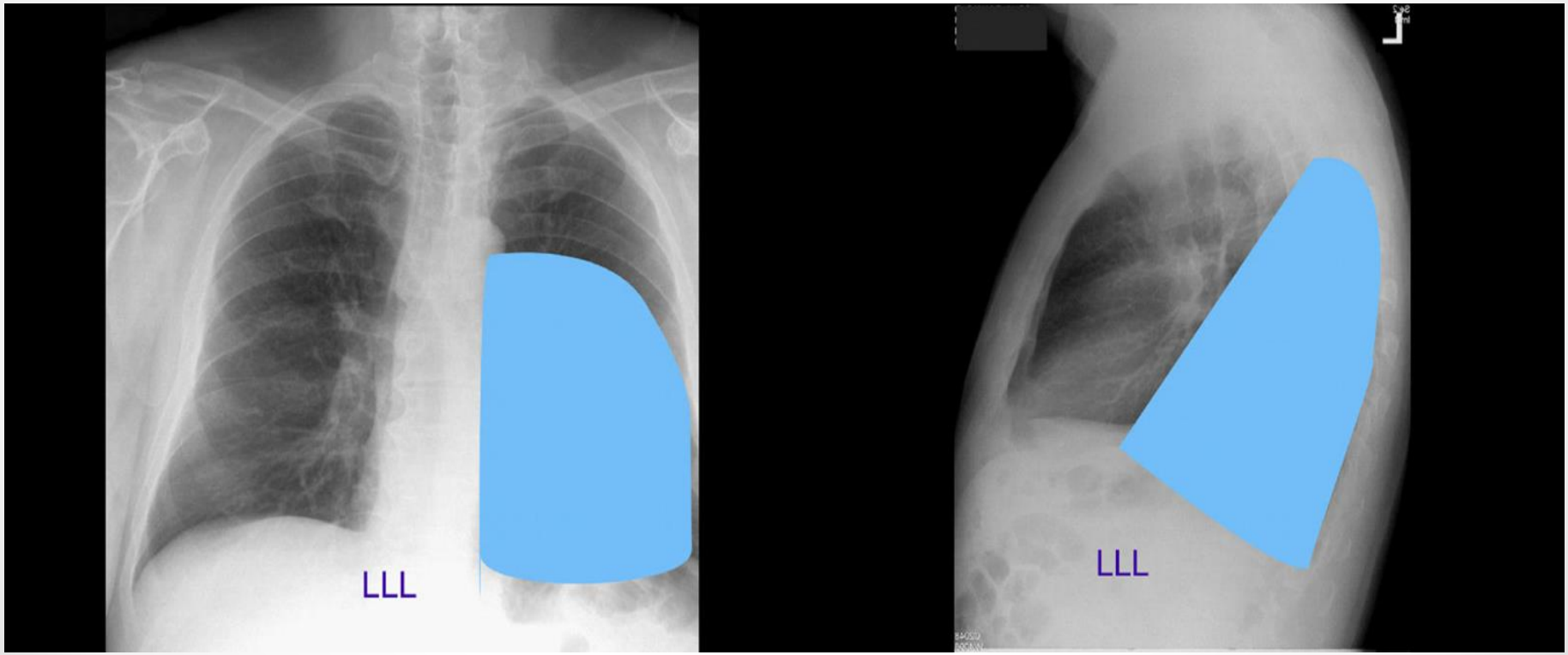
لوب مياني راست در مجاورت كناره راست قلب قرار دارد

Right lower lobe:

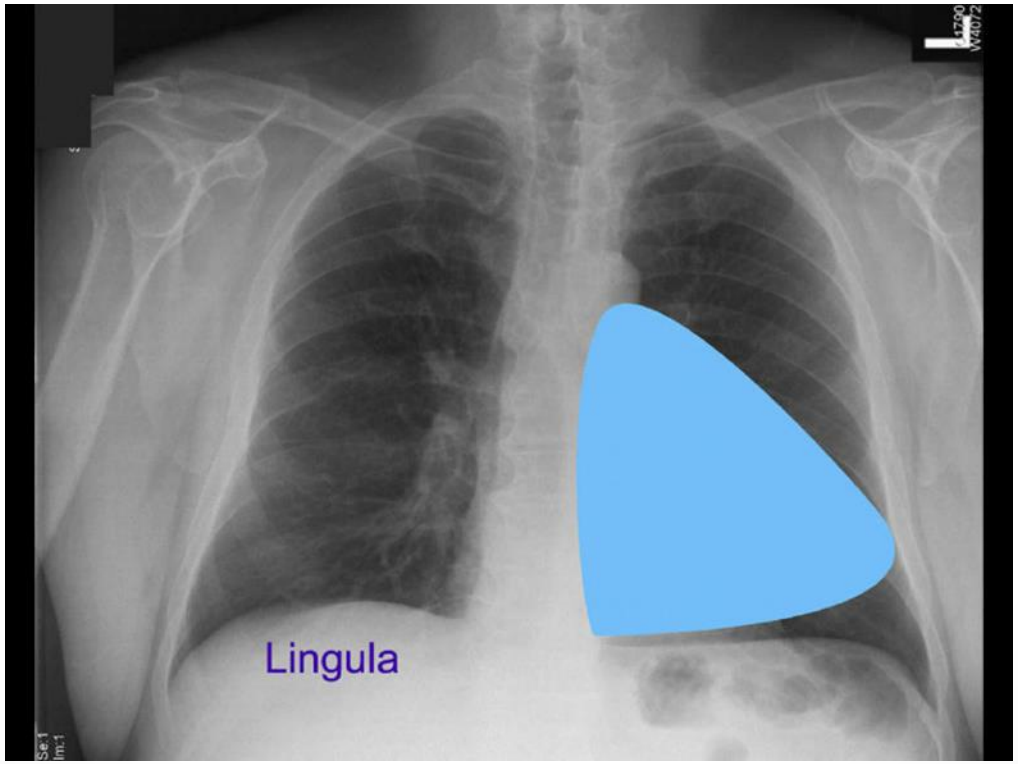




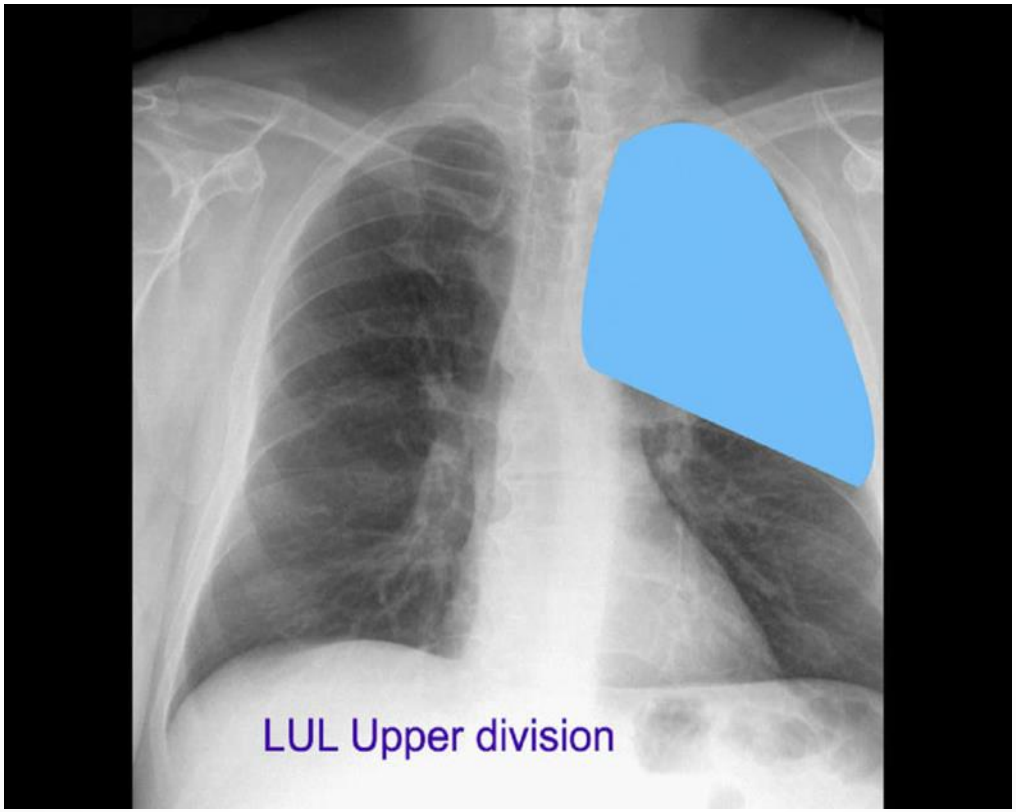
Left lower lobe:



Lingula:

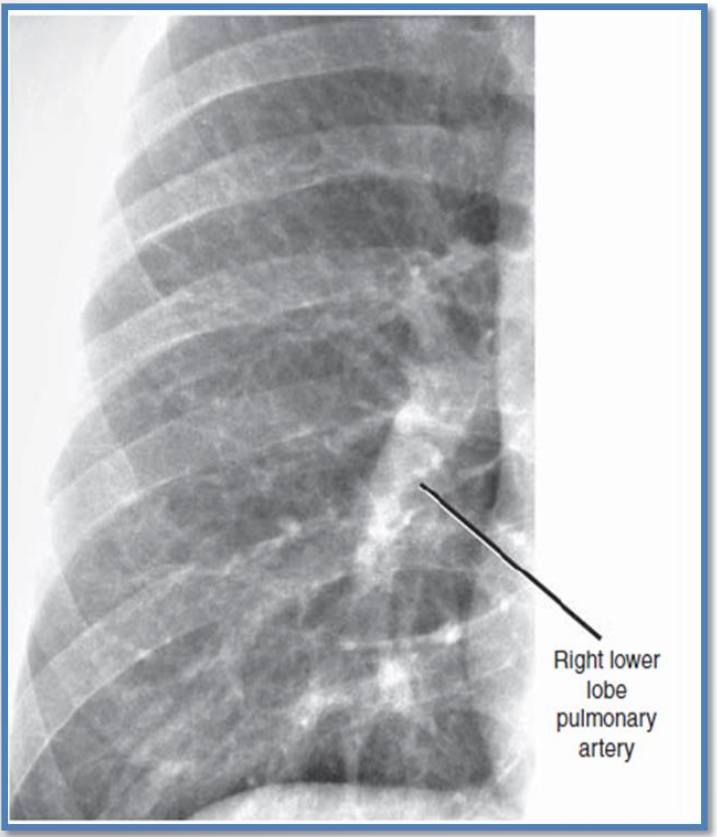


Left upper lobe - upper division:

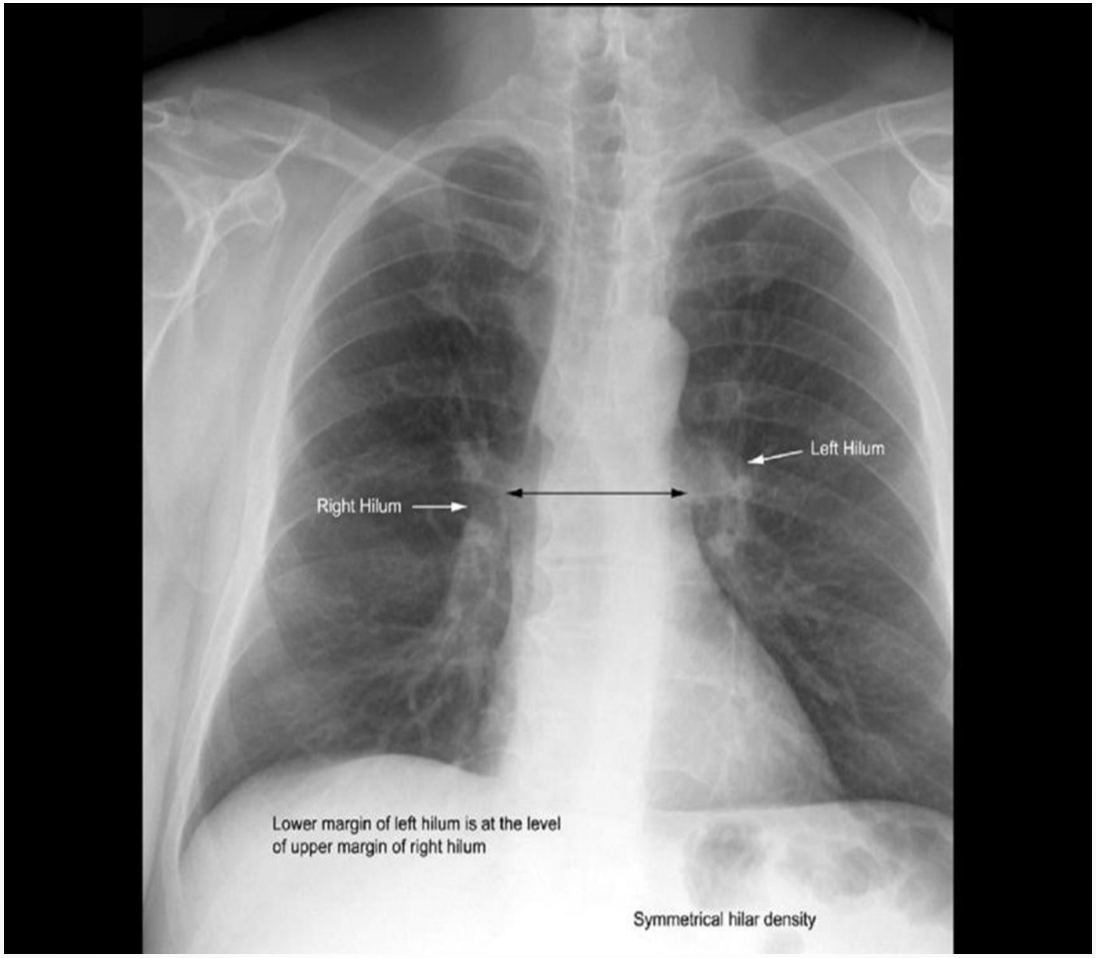


آناتومی طبیعی؛ ناف ریه

- ناف ریه مجموعه ای از: شریان های اصلی ریوی ، وریدهای ریوی و برونکوس ها
- مشخص کردن سایز، 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 & Medistinum

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.

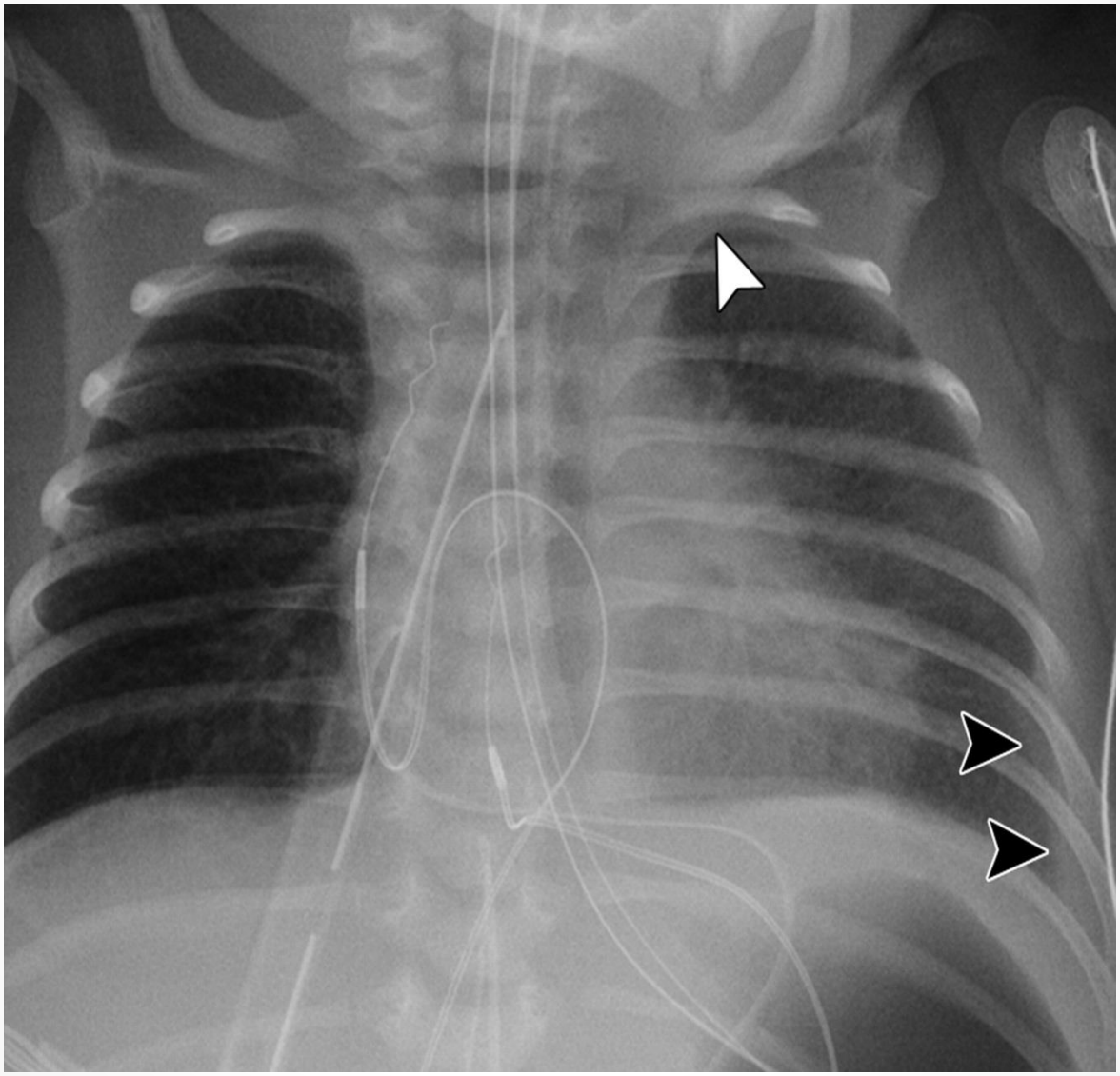
b. Aortic rupture can be suggested by:

- 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

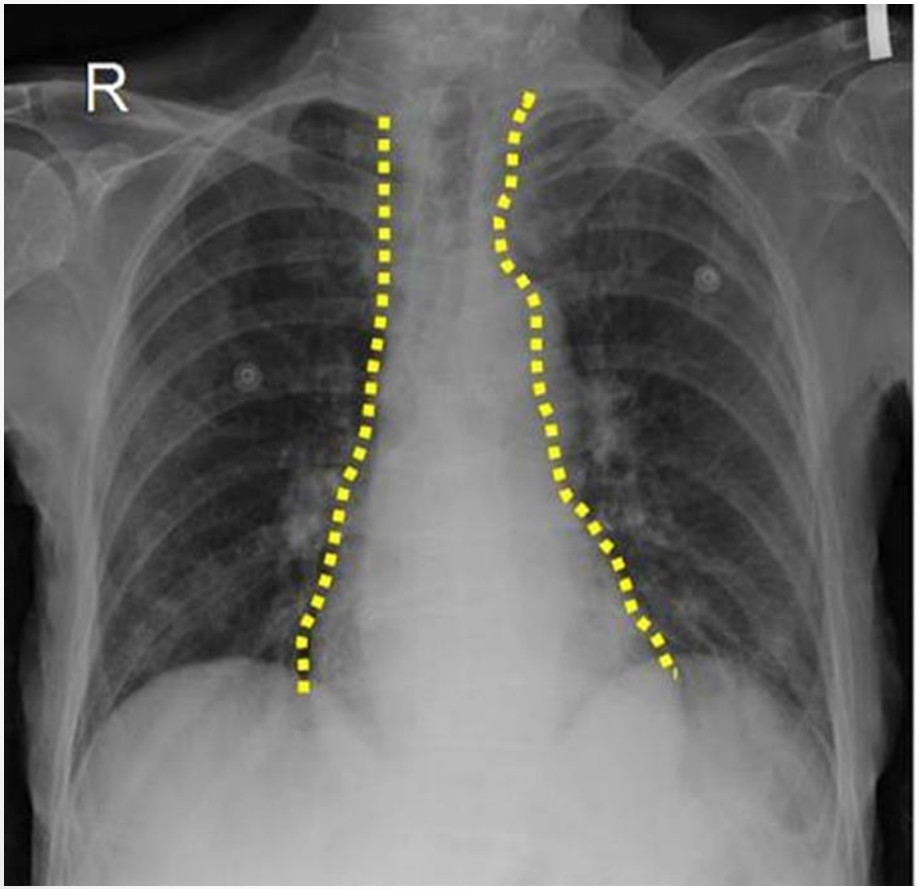
Define:

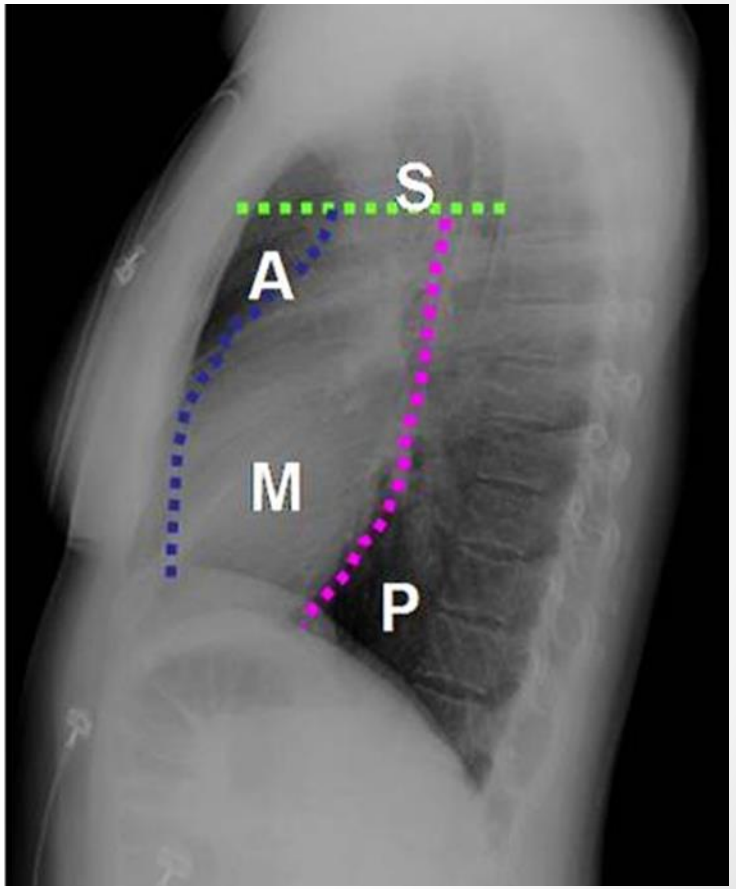
- Area between the lung
- Water density
  Surrounded two air filled lungs and
  Intersected by the air filled trachea and major bronchi

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


R


S
A
M
P

Superior Mediastinum

- **Retrosternal:** Great vessels and branches
  Thymus

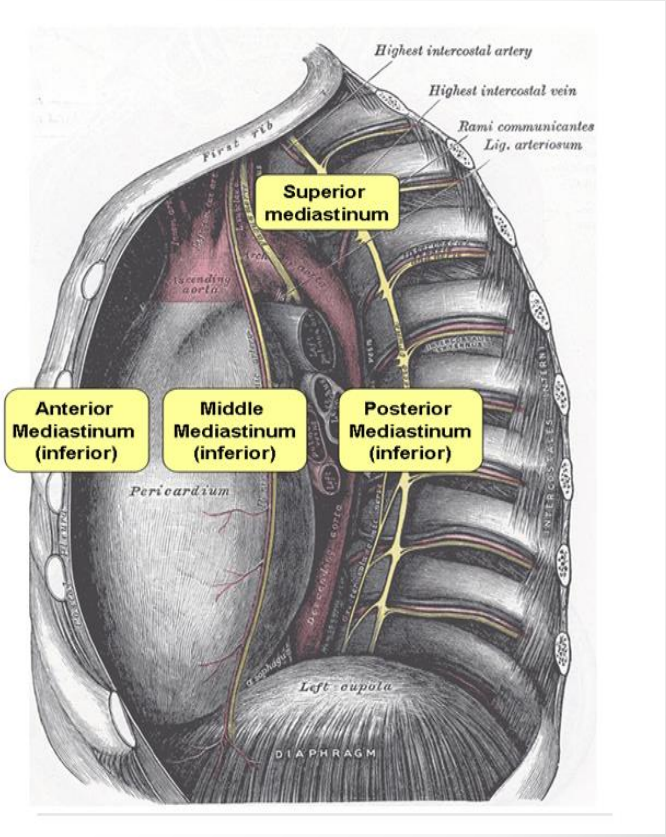
- **Prevertebral:** Trachea
  Esophagus
  Thoracic duct
  Sympathetic trunks
  Vagus nerves

Inferior Mediastinum

- **Anterior:** Thymus, fat, lymph nodes

- **Middle:** Pericardium
  Phrenic nerves
  Pericardiacophrenic artery
  Heart and great vessels

- **Posterior:** Esophagus
  Thoracic duct
  Aorta and branches
  Vagus nerves
  Sympathetic trunks
  Azygos system of veins



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

1- پهن شدن ، انحراف ، توده

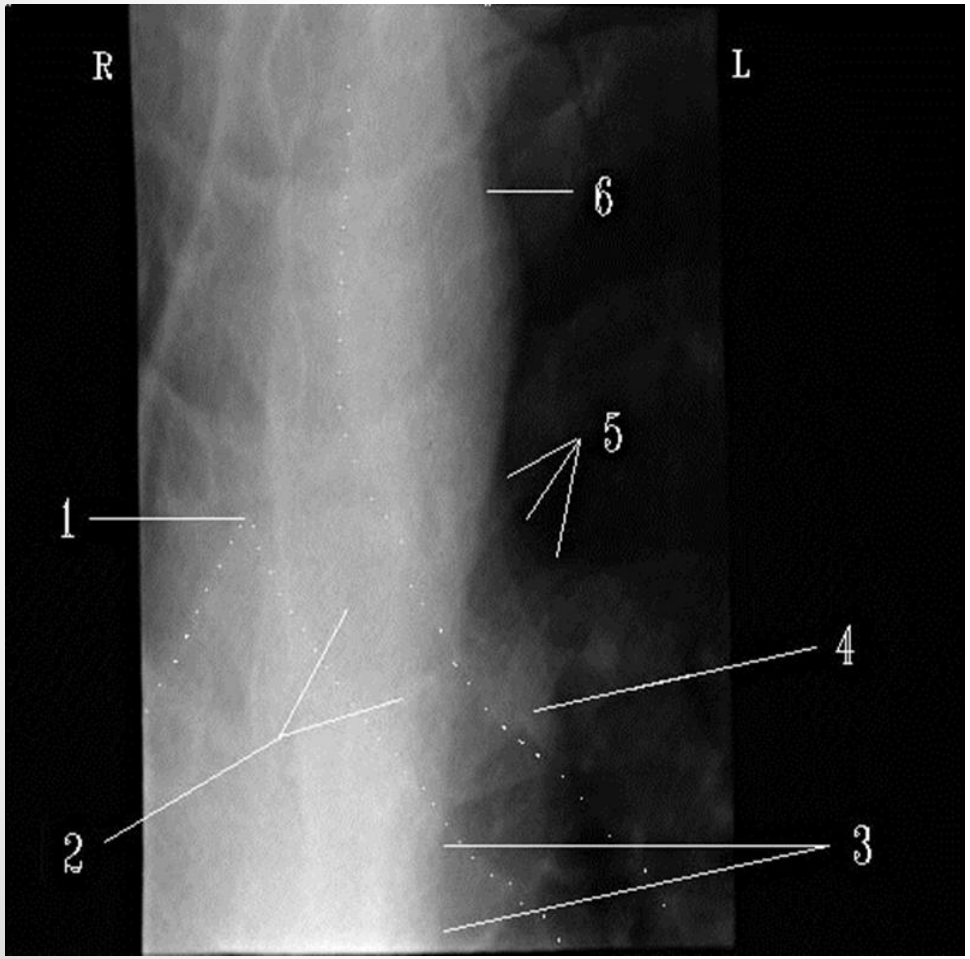
2- تراشه در خط وسط است یا نه؟

اگر راه هوايي دقيقاً در خط وسط نيست، آبنورمالي ها را بررسي كنيد . مثل پلورال افيوژن، تنشن پنوموتوراكس، آتلكتازي.

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

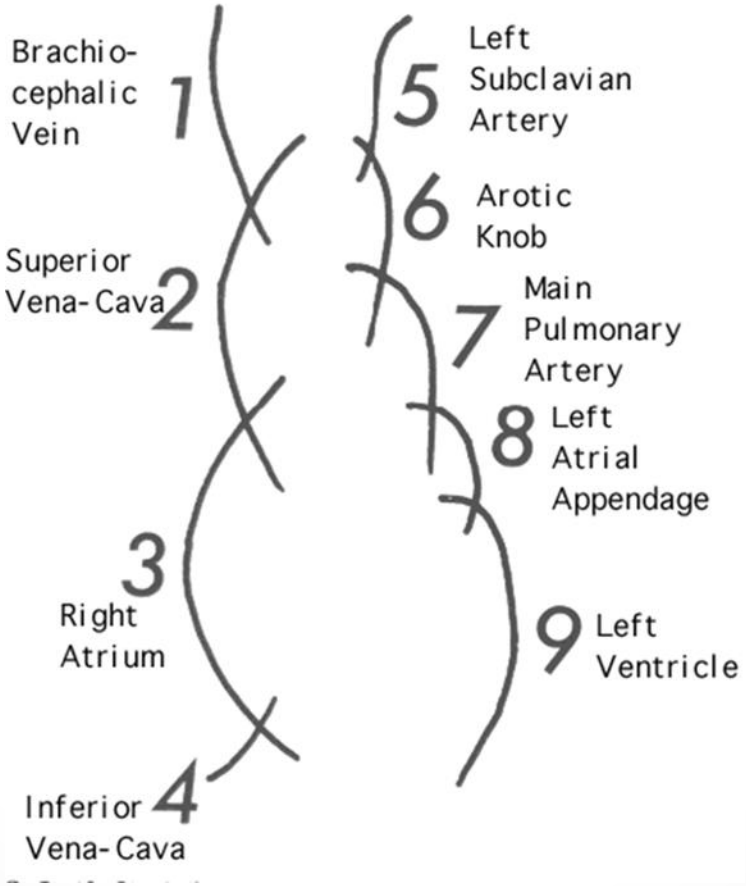
وجود هوای آزاد در اطراف تراشه و برونش اصلی (پنومو مدیاستن)

کارینا : در محاذات T7 - T6 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- بزرگي دهليز چپ در زير كارينا
2- وجود Lymphadenopathy
3- وجود توده در مدیاستن

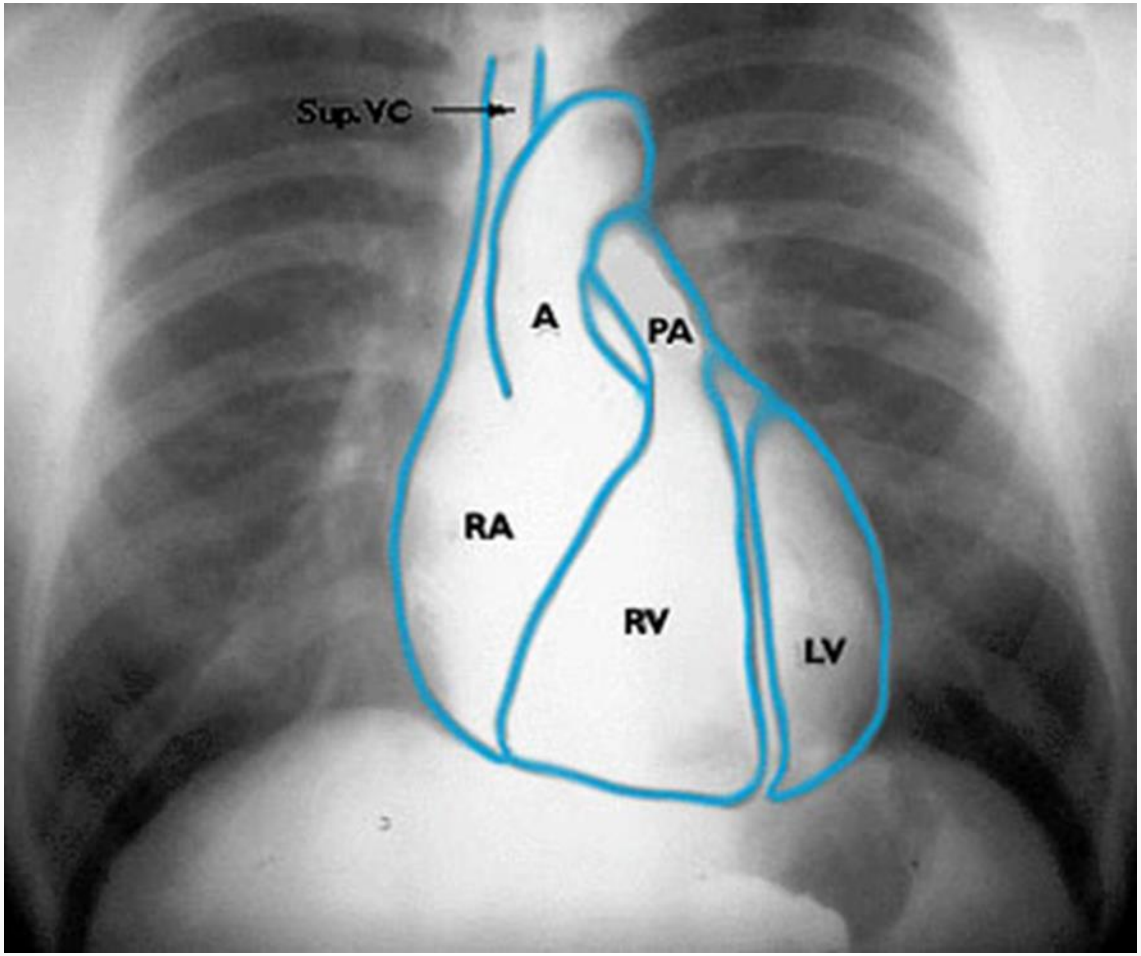


1. Carina
2. Left Main Stem Bronchus
3. Descending Aorta
4. Main Pulmonary Artery
5. Aorticopulmonary Window
6. Arch of Aorta

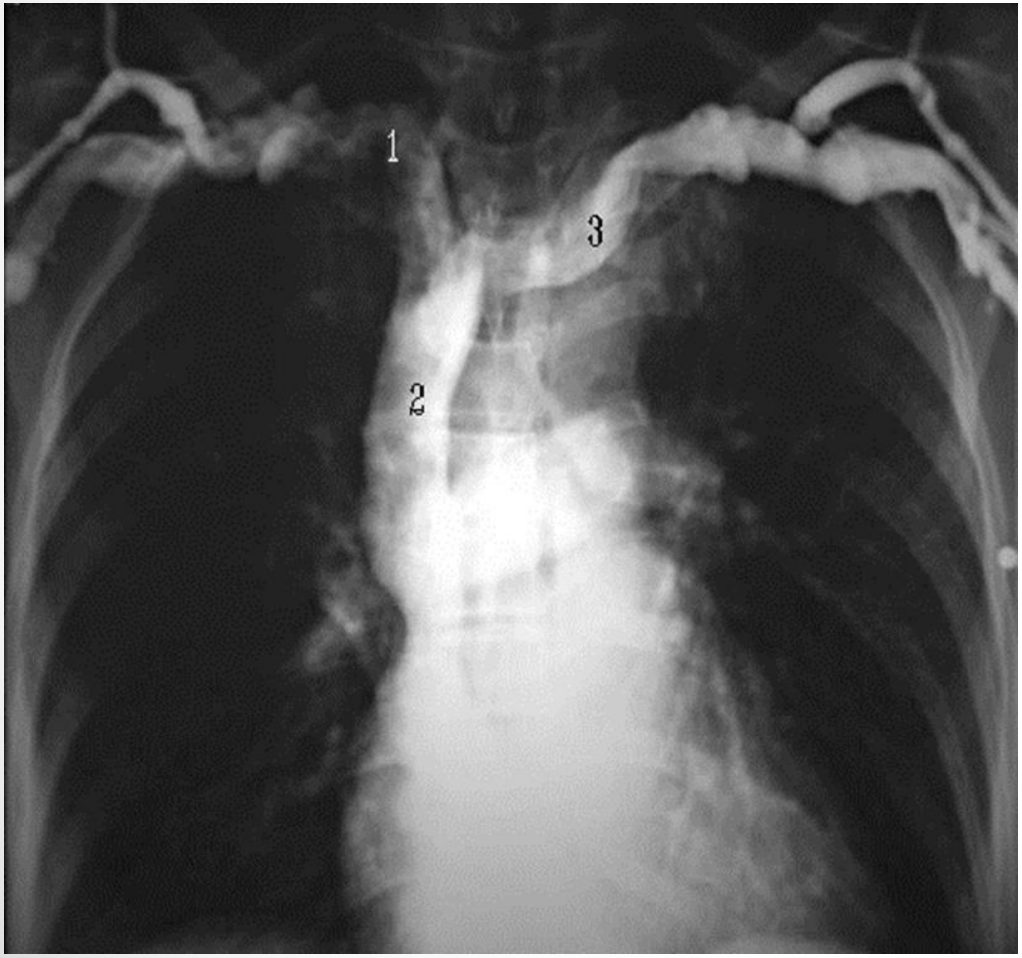
3-Margins


Brachio-
cephalic
Vein
1
Superior
Vena-Cava
2
3
Right
Atrium
Inferior
Vena-Cava
4
5
Left
Subclavian
Artery
6
Arotic
Knob
7
Main
Pulmonary
Artery
8
Left
Atrial
Appendage
9
Left
Ventricle

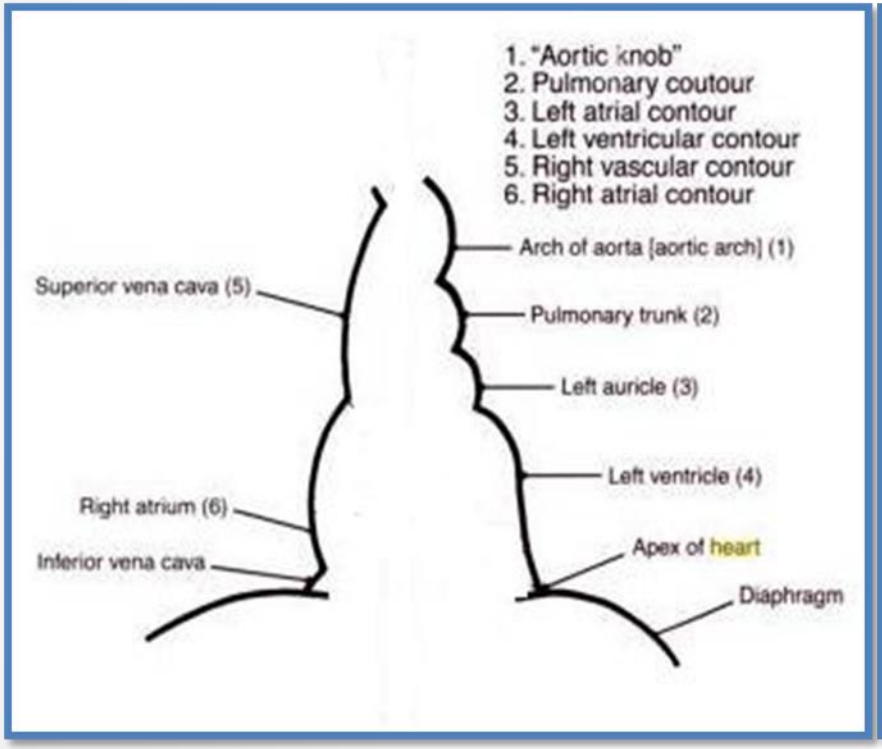
آناتومی طبیعی؛ قلب و آئورت

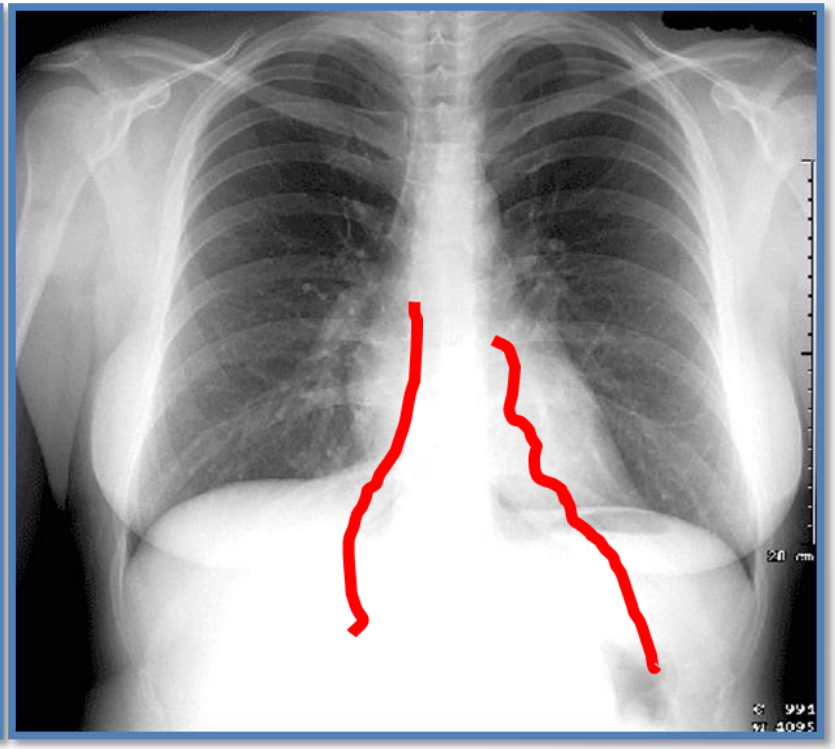


Venography



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

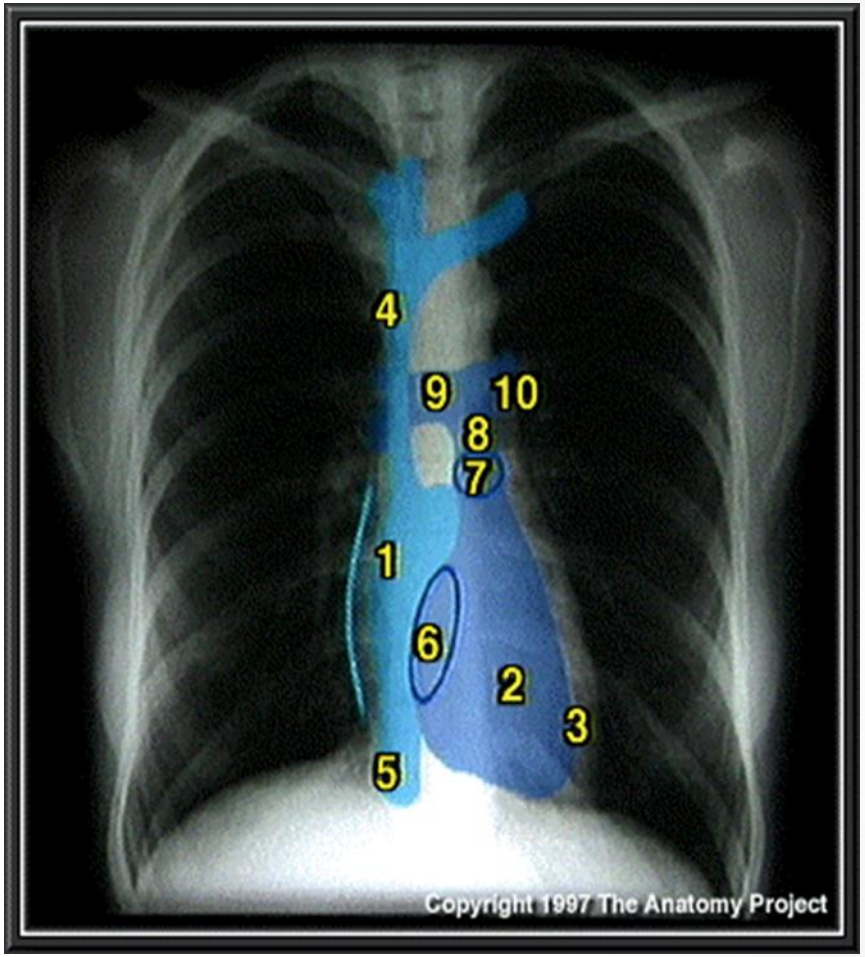

1. "Aortic knob"
2. Pulmonary coutour
3. Left atrial contour
4. Left ventricular contour
5. Right vascular contour
6. Right atrial contour
Arch of aorta [aortic arch] (1)
Superior vena cava (5)
Pulmonary trunk (2)
Left auricle (3)
Left ventricle (4)
Right atrium (6)
Apex of heart
Inferior vena cava
Diaphragm

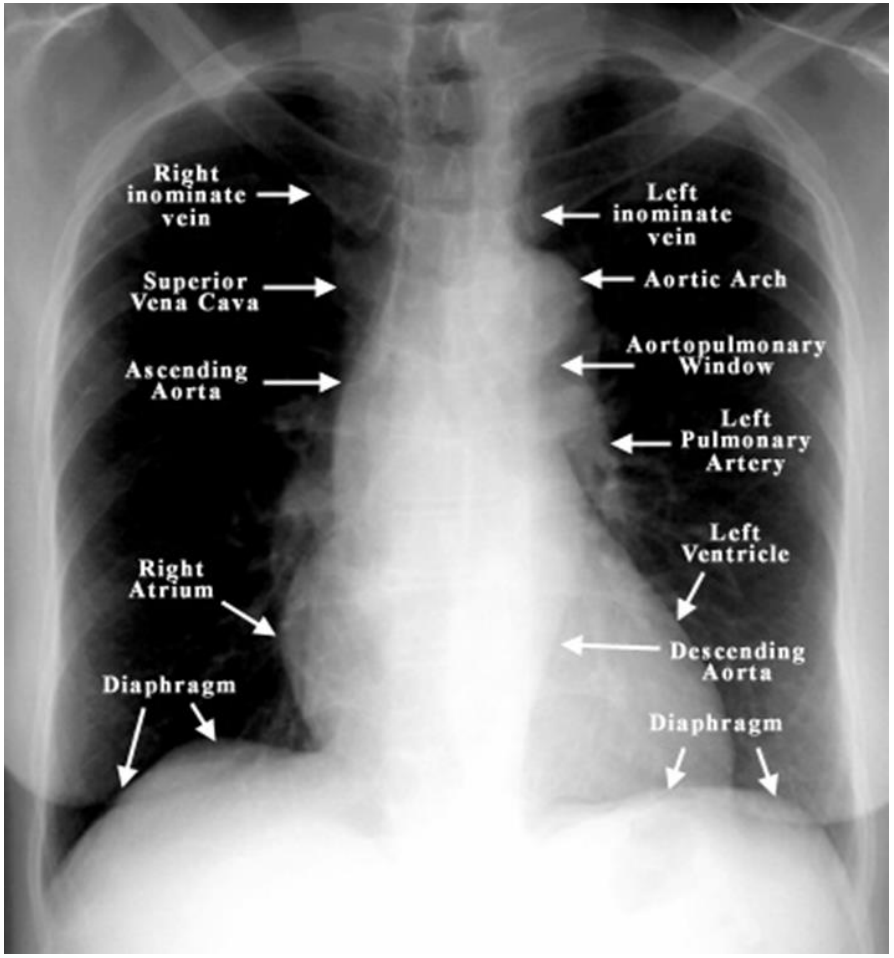


1. R Atrium
2. R Ventricle
3. Apex of L Ventricle

4. Superior Vena Cava
5. Inferior Vena Cava
6. Tricuspid Valve

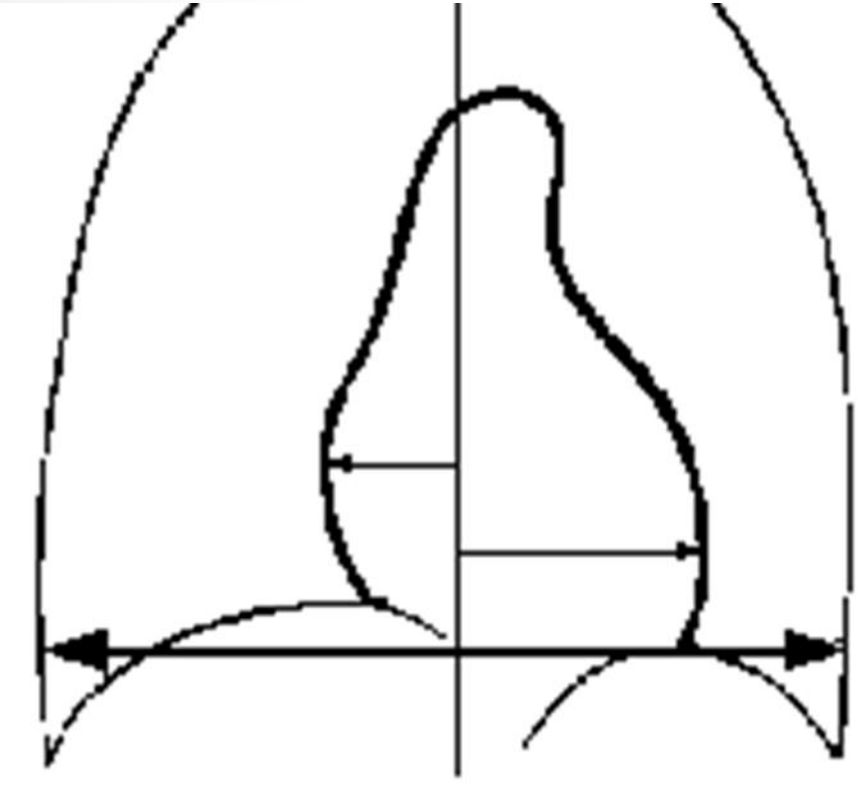
7. Pulmonary Valve
8. Pulmonary Trunk
9. R PA 10. L PA

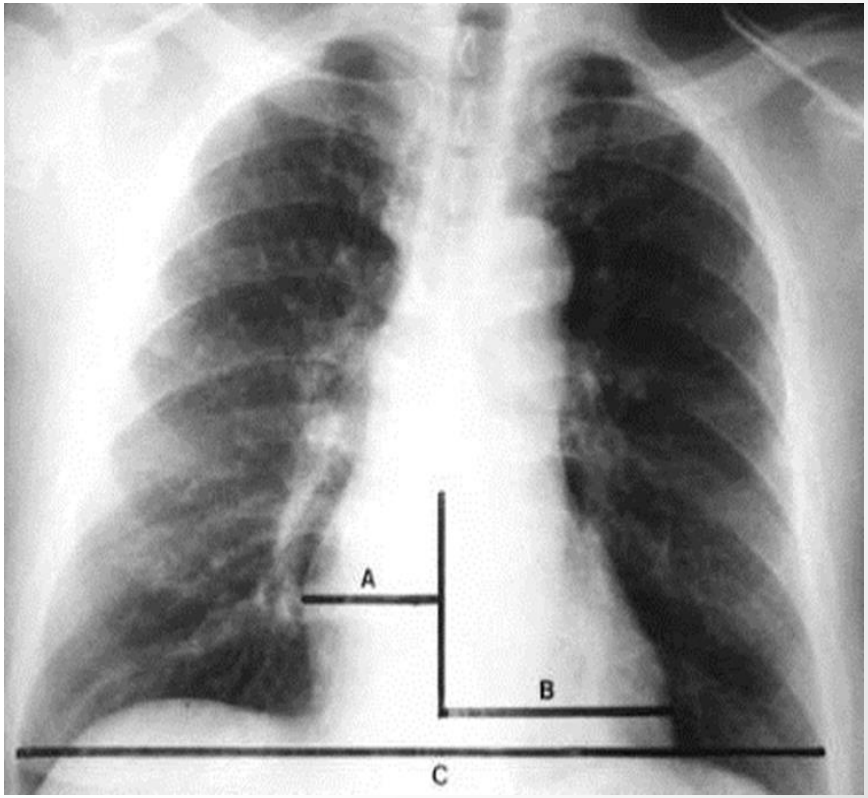



Right inominate vein
Superior Vena Cava
Ascending Aorta
Right Atrium
Diaphragm
Left inominate vein
Aortic Arch
Aortopulmonary Window
Left Pulmonary Artery
Left Ventricle
Descending Aorta
Diaphragm

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 خيلي كم باشد، احتمال بزرگ شدن بطن چپ وجود دارد.
- اگر فاصله خيلي زياد باشد، احتمال بيماري انسدادي ريه 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

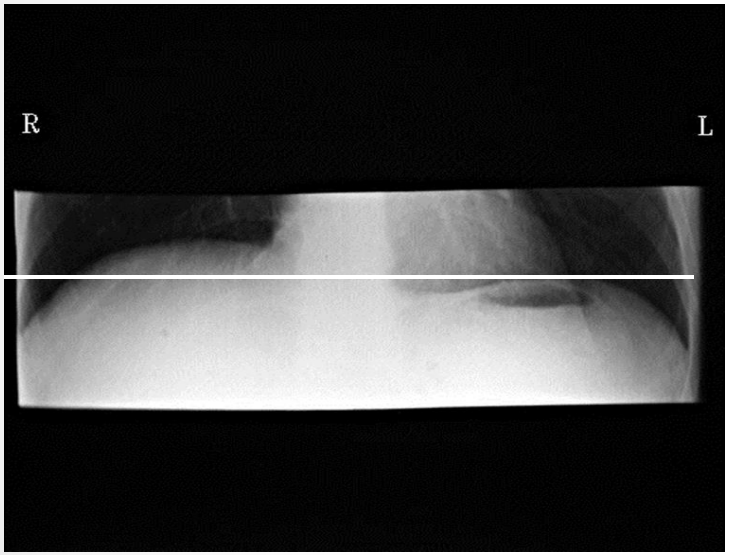
STEP 2. X-ray changes suggesting injury include:

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 ديافراگم:

- ديافراگم با مقادير مختلف تنفس، داراي موقعيت هاي متفاوتي است.
- همي ديافراگم راست معمولاً كمي **بالاتر** ازهمي ديافراگم چپ است.(2 تا 3 سانتی متر)
به خاطر اثر کبدی و موقعیت آناتومیکی قلب



- تمام ديافراگم راست ديده می شود ولی ديافراگم چپ خير، بدليل اينكه قلب روی ديافرگم قرارمی گيرد.

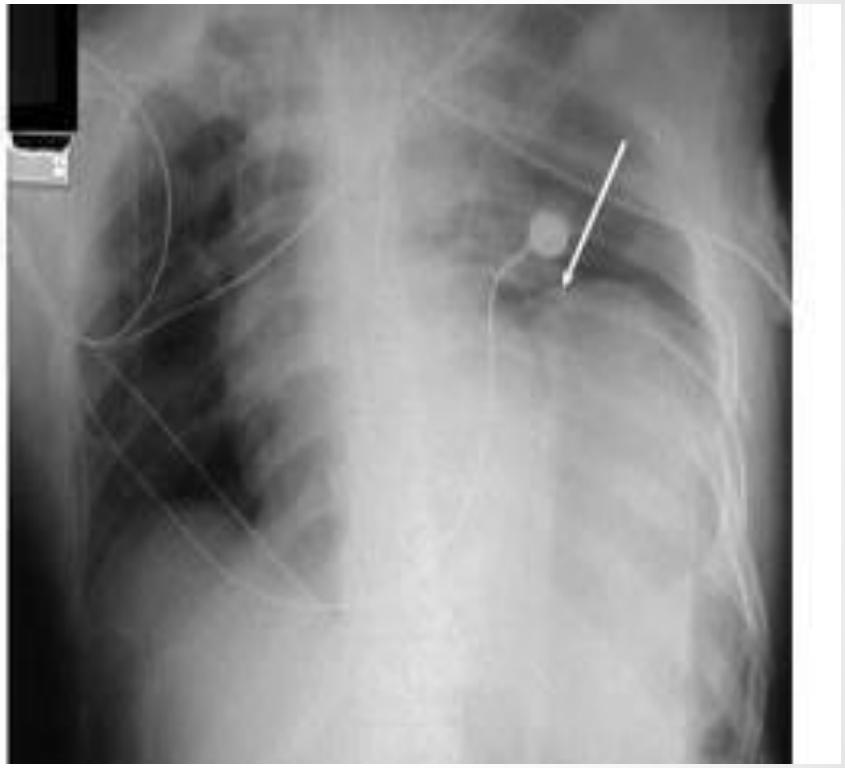
- **بررسی هوای زيرديافراگم** (پنومو پريتوين)
penetrating trauma, peritonitis, recent surgery

Laparoscopy, hallow viscus perforation

- **عدم رويت ديافراگم :** افيوژن يا نفوذ مايعات

- **تفا وت بيشتربين دوسطح ديافراگم:** افيوژن ، كلاپس ، فلج ديافراگم

- **محو شدن زاويه كوستوفرنيک :** پلورال افيوژن، هموتوراكس، اسكار، 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:

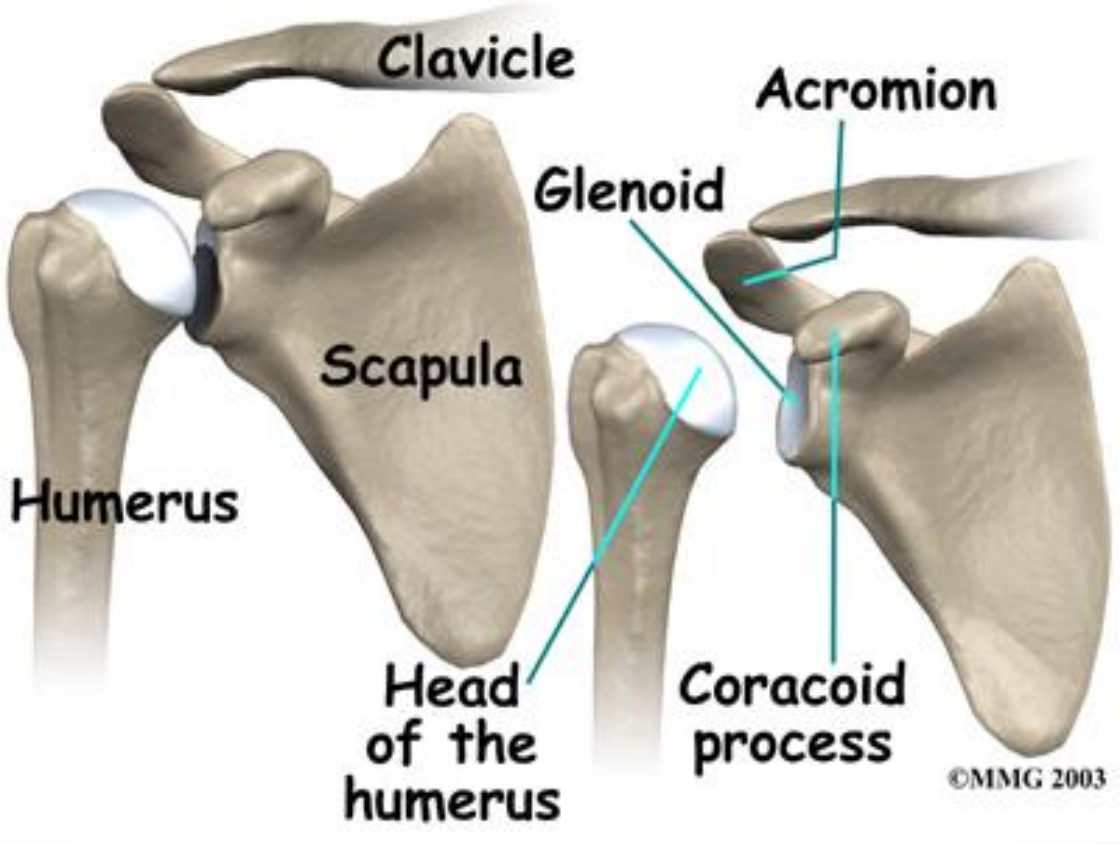
- Density(mineralization)
- Compare cortical thickness to medullary cavity, trabecular pattern
- Erosions, fractures, any lytic or blastic regions

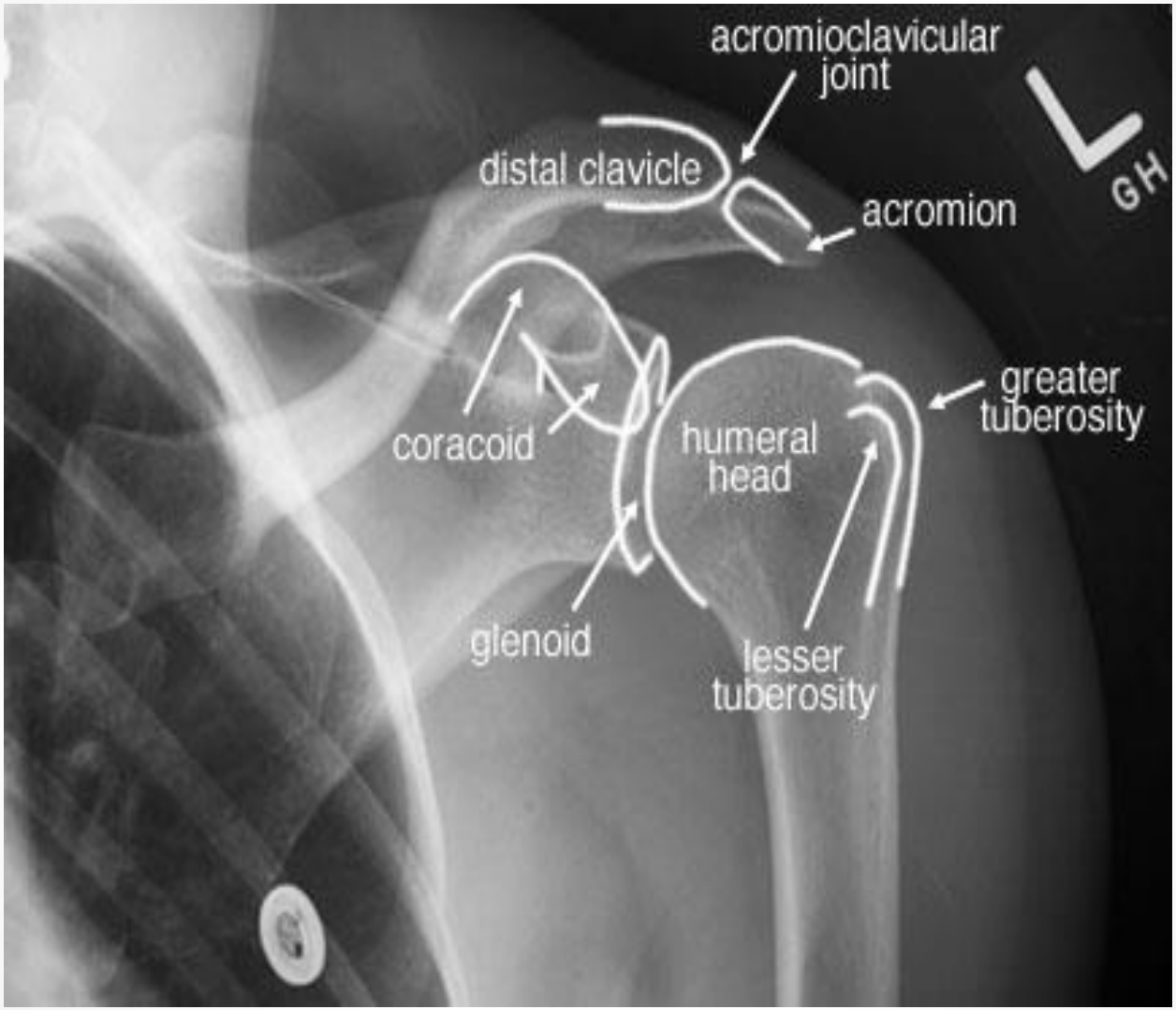
Joints:

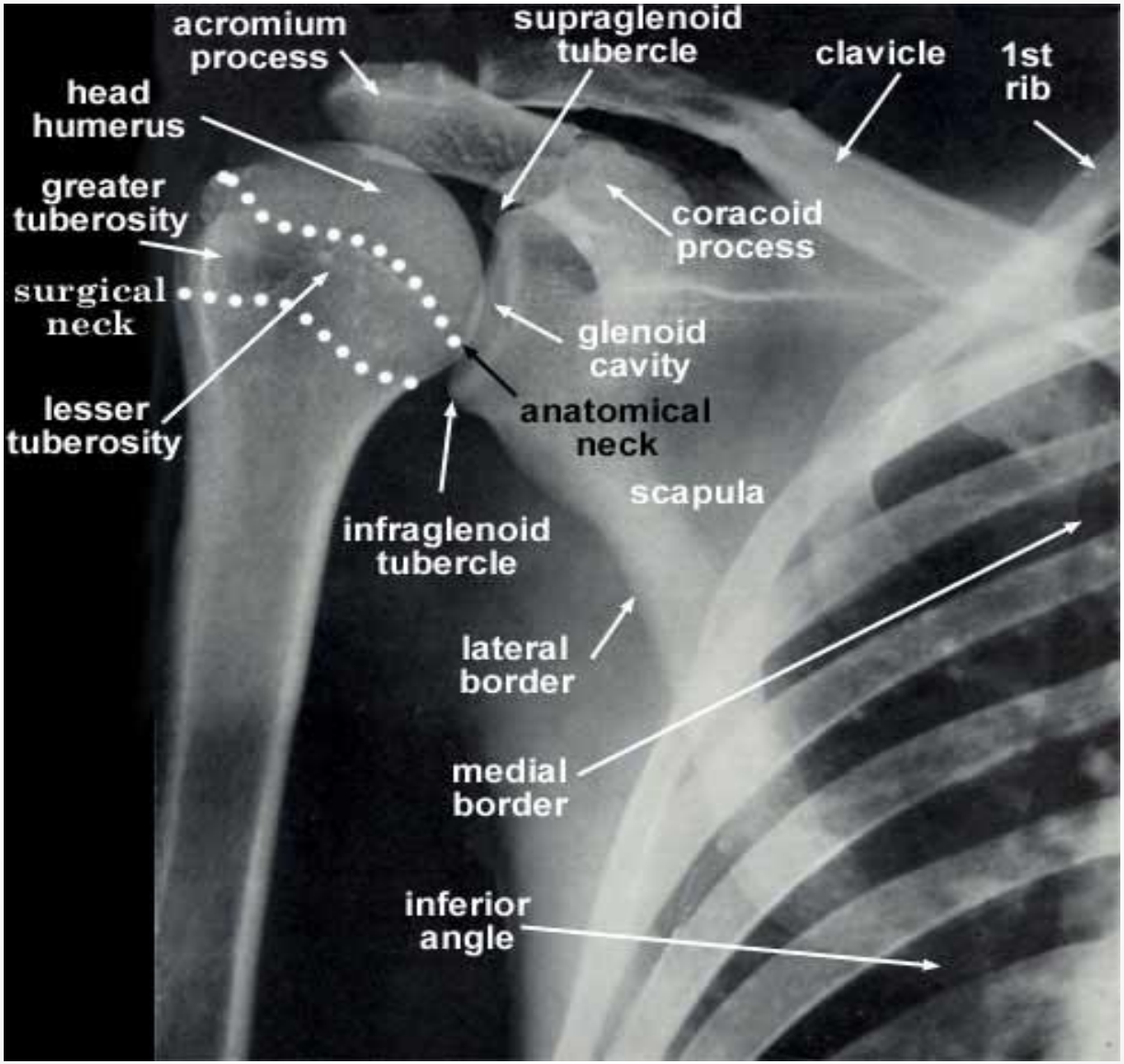
- Articular relationships
- Joint spaces narrowed, widened
- Calcification in the cartilages
- Air in the joint space, abnormal fat pads

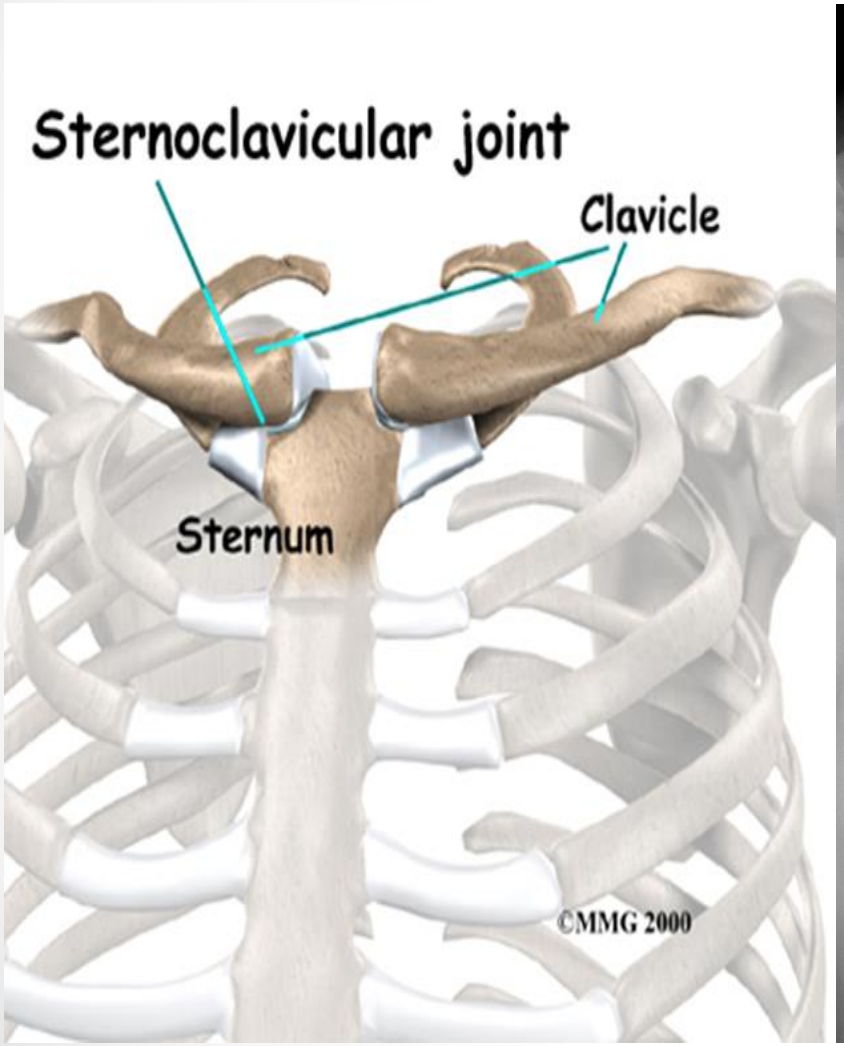
- **Note calcified anterior cartilages may obscure or mimic underlying lung lesions**
- **Compare side to side**

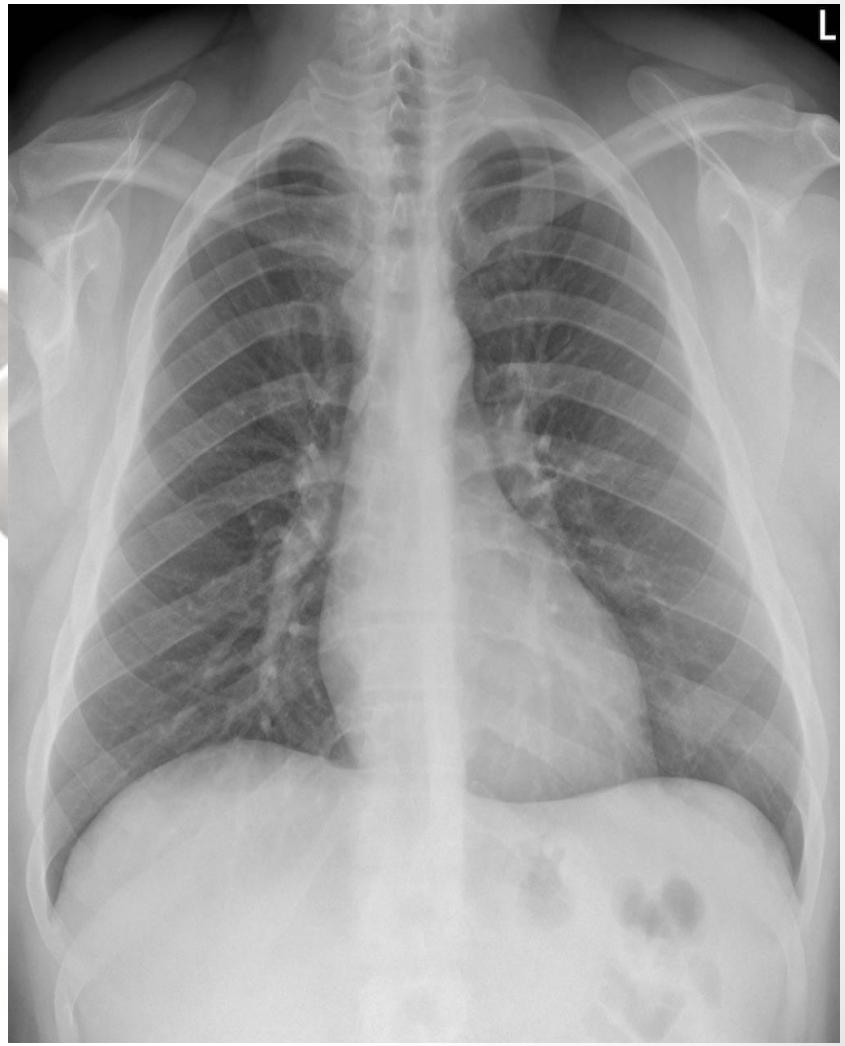
Anatomy of Shoulder




acromioclavicular joint
distal clavicle
acromion
GH
coracoid
humeral head
greater tuberosity
glenoid
lesser tuberosity


acromium process
supraglenoid tubercle
clavicle
1st rib
head humerus
greater tuberosity
coracoid process
surgical neck
glenoid cavity
lesser tuberosity
anatomical neck
scapula
infraglenoid tubercle
lateral border
medial border
inferior angle


Sternoclavicular joint
Clavicle
Sternum
©MMG 2000


L

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