NORMAL CHEST RADIOGRAPHY

Front and lateral view

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How to obtain a good quality chest radiography (1)

3 functions are very important for good quality:

- The penetrating power of the x-ray beam (adjustment of x-ray tube voltage)
- The x-ray tube current (milliampere)
- The exposure time adjustment
How to obtain a good quality chest radiography (2)

• The adjustment of the x-ray tube voltage controls the contrast: the difference of density levels of the different organs and tissues in the thorax

• The x-ray tube current and the exposure time controls the intensity of x-ray beams
How to obtain a good quality chest radiography (3)

Adjustment of voltage

**High voltage: a range of 100 /120 kV:** optimal contrast between lungs and bones, and good visualisation of mediastinum and vessels

Exposure time

**0.005 seconds:** decrease of motion artefact caused by the beating of the heart or respiratory movement
A long distance between the tube focus and the film improves the image clarity and decreases the geometric blur.
How to obtain a good quality chest radiography (5)

Other criteria

- Quality of the x-ray grid: the flat metallic plate with very narrow lead trips close to the film: increase in the image clarity and reduction of the scattered radiation from the patient
- Good quality electrical power supply
- Efficient and frequent maintenance of x-ray equipment
- Quality of films and good conditions of storage
- Good screen-film system
- Good techniques for x-ray film processing (developing, rinsing, fixing, washing and drying procedure). If possible automatic film processor.
What about digital X ray system?(1)

composed with:

- Electronic flat-panel X ray detector
- High resolution grayscale diagnostic display
- High performance computer
What about digital X ray system?(2)

**Avantages:**
- feasible imaging quality adjusted by computer processing
- easy and quick image processing
- X-ray film and its processing procedures in dark room no more needed.

**Disadvantages:**
- Costly initial investment (61000 to 400000 $)
- Significant training in digital technology needed for the radiological technicians and costly running maintenance
Incidences

Front view
profile view

Other:

radiography in expiration
radiography in decubitus and lateral position

Back view

Other rare incidences:

Oblique view

Opacification of œsophagus

Valsalva’s test
The thorax is composed of:

- **Bone** (vertebrae, ribs, scapula…). The main component is calcium, which absorbs the x-ray considerably: the bone image is very opaque (white on the radiography).

- **Blood and soft tissue** (heart, mediastinum, vessels). The absorption of x-rays is less complete than bones: Therefore, the image is less opaque (light grey).

- **Fat tissue.** the absorption of x-rays is lower: the image is dark grey.

- **Air** (in lungs) which does not absorb the x-ray at all. The image of the lungs is black.
Picture of 4 different solutions on a chest x-ray film

calcium
water
oil
Air
## Dosage of x-rays

<table>
<thead>
<tr>
<th>type of investigation</th>
<th>Equivalent of chest x-ray</th>
<th>Equivalent of natural radiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>chest x-ray</td>
<td>1</td>
<td>3 days</td>
</tr>
<tr>
<td>TDM</td>
<td>10 -100</td>
<td>1 month-1year</td>
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NMR: no radiation
Chest x-ray: criteria for quality

- Deep inspiration
- Adequate density
- Good position of the patient
- X-ray beam in postero-anterior incidence (the patient is standing)
Poor inspiration
False opacity of the inferior lobes

9 posterieur parts of ribs over the diaphragm

Same patient with deep inspiration
cardiomegaly
clavicles are high and horizontal
The x-ray beam is antero posterior

Same patient with correct postero-anterior x-ray beam incidence
The heart outline is bigger on D2 (bird’s-eye view of the patient)
Correct standing or sitting position for chest radiography
If the patient is in decubitus position (too ill to stand up), the cardiac outline and mediastinum is enlarged. The scapula may be on the lung field. The chest x-ray is of poorer quality for analysis.
Patient in decubitus

Patient standing up with postero-anterior X ray beam
Too low density
No detail visible
In the mediastinum area.

Too high density
No detail visible
In the lung area.
Correct density:

Pulmonary vessels visible in the lungs, behind the diaphragm and behind the heart
Para-aortic line visible
Vertebra visible behind the mediastinum
Conditions for adequate density

- Correct x-ray factor (Kv, Mas, exposure time)
- Good conditions for developing and good quality of developing solution
- Correct temperature of developer
- Correct quality of film
**Exact front view**: the vertical line connecting the spinous process of thoracic vertebrae is in the middle of the two sterno-clavicular joints.
Front View

D1

D2

D3

D3 > D1 > D2
Chest x-ray: to ensure top quality

- deep inspiration
- adequate density
- correct position of the patient (exact front view)
- x-ray beam in postero anterior incidence (the patient is standing)
Process for analysis of the chest radiography: the check list

- Verification of the name and the date
- Verification of the factors for good quality
- Analysis of the thoracic wall and thoracic skeleton
- Analysis of the mediastinum
- Analysis of each lung field, one after the other

NO EXCEPTIONS IN THIS PROCESS!
Normal chest radiography and some pitfalls...
(trouble-shooting)
Thoracic wall
And skeleton
Thoracic wall

Sus and retro clavicular field

External side of Sternocleidomastoid muscle
Thoracic wall

Sus and retro-clavicular field

Pseudo aeric picture
The clavicles are projected on the level of the 3rd or 4th posterior part of ribs
Cervical ribs: minor malformation
trap picture: opacity of the superior part of right lung due to a hair braid

Be wary of foreign substances on the chest x-ray
The retro-clavicular fields are always difficult to analyse, because of bone superposition:

- Clavicles
- Anterior part of first rib
- Posterior part of third and fourth rib,
- Sterno-clavicular joint
There are 2 ways to correctly analyse the retro-clavicular fields:

- Always compare right and left
- Ask for a chest x-ray with the patient’s back against the film
Always compare left and right

TB infiltrate
Patient with fever, cough, AFB in sputum ++...
You have no scanner. So use your eyes and Compare right and left! If you hesitate, ask for a chest X ray back against film
Normal chest x-ray, front close to the film

Normal chest x-ray, back close to the film
Chest x-ray, front close to the film

Chest x-ray, back close to the film
Thoracic wall

Physiological blur of the inferior side of the ribs

Rib view section
You must always «read» a chest x-ray with methodical analysis:
Example: for the chest wall, you must look at every rib, one after the other
Chest wall

- Top of the axillary hole
- Big pectoral muscle
thoracic wall

Scapula
What is wrong with this chest x-ray?

Congenital clavicles agenesis
Thoracic wall

Breast silhouette
Be careful with false opacities in the inferior lobes, consequences of breast superposition.
Chest x-ray. Before and after right mastectomy
Thoracic wall

Diaphragm

The right side is usually higher than the left side (3cm)
Component elements of Mediatinum and hilus
Right pulmonary artery

Left pulmonary artery

Right pulmonary artery
The pulmonary vena are not physiologically visible
The main mediastinum lines
Mediastinum enlargement due to fat tissue
Be wary of false enlargement of mediastinum in cases of obesity, poor inspiration, oblique view or decubitus position.
Trap: false mediastinum enlargement in the case of this older woman with cyphoscoliosis, in decubitus position.
Component elements of lungs
On a normal chest x-ray, bronchi are not visible
...but pulmonary arteries are visible.
Right view

Small fissura

Big fissura
Left fissura

Left view
Normal lateral view
Lateral view
Heart and Mediastinum vessels

- Superior vena cava
- Ascending Aorta
- Pulmonary arteria
- Right ventricle
- Descending aorta
Heart and Mediastinum 
vessels

- Left ventricle
- Inferior vena cava
Mediastinum vessels

Aortic arch
mediastinum
vessels

Descending aorta
Mediastinum vessels

Right pulmonary artery

Left pulmonary artery
trachea

20 mm
Right superior lobe bronchus

Left inferior lobe bronchus
Inferior vena cava
The «clear spaces»

Retro sternal clear space

Retro cardiac clear space
The «clear spaces»

Retro tracheal space
enlargement of the clear spaces: Emphysema
Emphysema

Normal lateral view
The retro sternal space is filled: thymoma. Normal view on the right.
The retro sternal space is filled: thymoma
The clear spaces

Retro cardiac clear space
Diaphragm
Thoracic wall

Pectus excavatum

Pectus carinatum

sternum
Thoracic wall
dorsal spinal column
Left lateral view

Projection of the right posterior cul de sac

Projection of the left posterior cul de sac
Projection of the left posterior cul de sac

Projection of the right posterior cul de sac

RIGHT LATERAL VIEW