Basic Chest X-ray Interpretation for the FY1 Doctor

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Posterior-Anterior (PA) Film
Densities on X-rays

In increasing order of density

- **AIR** – black e.g. Lungs, bowel, stomach
- **FAT** – dark grey e.g. subcutaneous or retroperitoneal
- **SOFT TISSUES including body fluids** – light grey e.g. solid organs, muscle, vessels
- **BONE** – off-white
- **METAL/CONTRAST MATERIAL** – bright white
Simply...

• Remember that an abnormality can only be one of 3 things:
  – An OPACITY (Something which stops/absorbs/attenuates X-rays – appears White)
  – A RADIOLUCENCY (Something which allows X-rays to pass with little absorption)
  – A DISTORTION/DISPLACEMENT of a normal structure.
## Projections used in CXRs

<table>
<thead>
<tr>
<th>Projection</th>
<th>Routine for fit and able bodied persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erect P.A.</td>
<td>Routine for fit and able bodied persons</td>
</tr>
<tr>
<td>Lateral</td>
<td>To localise opacity</td>
</tr>
<tr>
<td>Erect A.P</td>
<td>Mobile and the infirm</td>
</tr>
<tr>
<td>Supine A.P</td>
<td>Very ill patients and those with multiple injuries</td>
</tr>
</tbody>
</table>
| Expiratory            | Shallow pneumothorax may become more obvious
Children with suspected foreign body inhalation causing bronchial obstruction. |
| Decubitus (pt lying on their side) | To visualise small effusions, & determine solid / fluid. |
## PA Vs AP Essential differences

<table>
<thead>
<tr>
<th>Structure</th>
<th>PA Radiograph</th>
<th>AP Radiograph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart</td>
<td>Little magnification</td>
<td>Magnified image</td>
</tr>
<tr>
<td>Scapula</td>
<td>Rotated away from lungs fields</td>
<td>Superimposed on lung fields.</td>
</tr>
<tr>
<td>Clavicle</td>
<td>2 inches below apex</td>
<td>Above Apex</td>
</tr>
</tbody>
</table>
Implications of an AP Supine Film

- Exaggerated heart size
- Gravity related:
  - Pleural fluid layers posteriorly, giving increased density to the hemithorax.
  - A Pneumothorax will lie anteriorly & will be difficult to detect
  - The diaphragm will be higher & reduce the lung volumes
  - Prominence of the upper zone vessels is normal and does not reflect left heart failure as is often the case in an Erect PA film.
System

- Introduction
- A – Adequacy
- B – Breathing
- C – Circulation
- D – Diaphragm
- E – Everything else
- Review areas – A B C D S
• Introduction
  – Name, DOB/age
  – Male or female? Look for the presence of breast shadows (this will help you to notice a mastectomy too).
  – Type of film (chest PA/AP)
  – (Can mention now if a strikingly obvious abnormality)

• A – adequacy
  – Can you see everything? (top of first rib to below diaphragm)
  – Penetration (lower thoracic spine just visible)
  – Inspiration (diaphragms at 5th or 6th anterior rib)
  – Rotation (spinous processes of upper vertebrae midway between end of clavicles)
Presentation part 1

• “This is a PA chest radiograph of a 33 year old male patient. Mr. John Smith, date of birth 11/02/1975. The patient has taken a good/adequate inspiration and is not rotated; the film is well penetrated.”
• **B – breathing**
  - Apices
  - Trachea
  - Move down lung fields
  - Pleura

• **C – circulation**
  - Cardiac shadow – size, shape, well defined?
  - Mediastinum
  - Hilar – position, size, density
• D – diaphragm
  – Costophrenic angles clear?
  – Shape- flat? well defined?
  – Look under diaphragm

• E – everything else
  – Bones – ribs, shoulders
  – Soft tissues - breasts, surgical emphysema
  – Any surgical material, ECG leads, etc.
Review areas

“I have not seen any obvious abnormalities yet, so I will now look at my review areas…”

- A - Apices
- B - Bones
- C - Cardiac i.e. behind the heart, hilar
- D - Diaphragm
- S – Soft tissues
Presentation part 2

• "The trachea is central, the mediastinum is not displaced. The cardiac and mediastinal contours appear normal. The lungs appear clear, with no evidence of a pneumothorax. There is no free air under the diaphragm. The bones and soft tissues appear normal."
Opacities

• Large
  - Consolidation
  - Collapse
  - Pleural fluid
Consolidation

• Also known as ‘air-space (acinar) disease’ or ‘alveolar opacity’.

• Is seen when a substance, usually fluid, fills the alveolar spaces but not the airways (bronchial tree)

• Fluid can be *Transudate* pulmonary oedema, *Pus* of infection/pneumonia or *Blood* from trauma, tumour, infarction & haemorrhage, vasculitis
Collapse/Atelectasis

- Collapse is demonstrated by an opacity and loss of volume.
- Causes: Obstruction of an airway, Relaxation of the lung parenchyma e.g. with a pneumothorax or pleural effusion, Fibrosis
- Signs: - small hemithorax
  - deviation of the mediastinum
  - raised hemi-diaphragm
  - shift of a fissure
  - hilar shift
Pleural Fluid

• Detectable once there is more than 100mls present.

• Seen in the lateral or posterior costophrenic angles as a meniscus curving up the chest wall.

• Bilateral Effusions - Often the result of Cardiogenic or Non-cardiogenic pulmonary oedema.

• Unilateral Effusion – due to infection, infarction, tumour, trauma, surgery, immunological disease
The Silhouette Sign

- Indicates air space disease
- Obscuration of a normally seen border e.g. heart or diaphragm
Localising disease from the Silhouette Sign
Other Opacities

- Nodules (from 1mm) and masses (>3cms)
- Linear opacities can be:
  - straight
  - curvilinear
  - circular
  - acute or chronic
  - localised or diffuse
Radioluencies

- Emphysema is the most common cause of radiolucent lungs
- A pulmonary embolus (PE) can cause lung oligaemia (decreased blood volume)
- Air in the pleural cavity (Pneumothorax)
- Absent breast tissue (mastectomy) gives a more diffuse radiolucency
Distortion/displacement of a normal structure

If the structure is the wrong shape or in the wrong place there MUST be a reason

- Is the structure being pulled or pushed from its usual position?
- Pushed: by a pneumothorax, pleural effusion, neoplasm, pectus excavatum moving the heart to the left
- Pulled: by lung collapse or fibrosis
Case 1 – 65 Male, Pleuritic Chest Pain
Pulmonary Embolism

- **CXR:**
  - Often normal
  - Linear atelectasis/blunting of costophrenic angles
  - Raised hemidiaphragm
  - Pulmonary oligaemia (Westermark’s sign)
  - Wedge shaped infarct
Case - 24 Male Sudden Chest Pain & SOB
Tension Pneumothorax

- Increased radiolucency
- Lung compressed against mediastinum, so lung vasculature not visible
- Tracheal and Mediastinal Shift to the opposite side
Case 3- 72 Female Increasing SOB
Heart Failure

- Upper lobe venous congestion due to blood diversion
- Interstitial pulmonary oedema with blurring of the hilar outlines
- Kerley B (septal) lines at the lung bases due to lymphatic engorgement of the interlobular septa.
- Alveolar pulmonary oedema resulting in Consolidation, air bronchograms and the production of pink frothy sputum.
Case 4 – 59 Female, smoker
Case 5 – 65 Female known Lung Ca, Sudden Increase in SOB
Case 6 – 79 male, vomiting ++, SOB
Case 7- 85 male weightloss, Increased SOB
Case 8- 49 Male Fever, Malaise, Cough
Case 9 – 67 Female failed Central line insertion
Case 10 - 22 Female tender skin rash, arthralgia