Shedding Light on Neonatal X-rays

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Objectives

- Utilize a systematic approach to neonatal x-ray interpretation
- Identify correct positioning of the endotracheal tube, umbilical catheters and chest tubes
- Identify common pathologies seen on neonatal x-rays

Indications for X-Rays

- Assess lungs and abdomen to follow progression or resolution of a disease process
- Assess heart size and position
- Assess tube and catheter positions
Technical Problems

- Expiratory Film
- Rotated Film
- Underpenetrated Film
- Overpenetrated Film
- Artifact

Expiratory Film
Diaphragm at T7
Ideal expansion is 8-9 ribs

Rotation
Turned from midline
Rib cage uneven
Chest structures closest to X-ray beam are magnified
Distorts appearance of structures
Technical Problems

- Penetration
  - Different tissue densities absorb differing amounts of x-rays
  - X-rays pass through gas → dark shadow
  - Bone and fluid absorbs more x-ray → white image

Non-Rotated
Same patient 40 minutes later
Even rib cage

Under Penetrated
Too little radiation
Sharp skin edge
Lungs appear lighter
Over Penetrated
Too much radiation
Film appears dark
Arms and skin "disappear"

Artifact
Extraneous objects can obscure areas of interest
Systematic Evaluation

- Technique
- Heart size and shape
- Lung fields
- Abdominal gas
- Tubes
- Bones

Normal Film
Good Technique
Normal Heart size
Diaphragms domed, 9 rib expansion
Lungs normal
Right Liver
Left Stomach
Mosaic Bowel Gas
12 Ribs
No Fractures
No Lines
Mediastinum
Contains heart, aorta, vena cava, trachea and esophagus
Trachea to right of esophagus
Carina - bifurcation of trachea T3 – T4
Left mainstem bronchus at sharper angle
ETT should be midway between clavicles and carina

Cardiomegaly

Small heart size due to hyperinflated lungs.
Diaphragms flattened, 11 rib expansion
Umbilical Lines

UAC (T8). Loops down umbilical artery to iliac, then turns up the aorta to LEFT of the spine
Low: L3-4  High: T6-9
UVC (crossing PFO). No loop. Umbilical vein → ductus venosus → IVC.
UVC desired position is just above diaphragm.

ETT down R mainstem

Lines Lateral View

(same patient)

UAC down umbilical artery to aortic bifurcation, then up the aorta along spine.
UVC straight from umbilicus thru liver and ductus venosus into heart

Chest Tube

For evacuating pneumothorax or pleural effusion
Chest Tube
(cross table lateral)
Anterior position for evacuating air
Posterior position for evacuating fluid

Bones
Fractured right humerus

Bones
Hemi-vertebra
Respiratory Diseases

- Atelectasis
- RDS
- Pneumonia
- Meconium Aspiration Syndrome (MAS)
- Congenital Diaphragmatic Hernia (CDH)
- Air Leaks
  - PIE
  - Pneumothorax
  - Pneumomediastinum
  - Pneumopericardium

Left Atelectasis
(ETT right mainstem)

- Volume loss as air is absorbed from left lung
- Heart pulled toward left
- Due to: malpositioned ETT, obstruction of bronchus (mucus plug, blood, meconium, foreign body)

RDS

- Surfactant deficiency
- Homogenous pattern
- Low lung volumes
- Diffuse reticulogranular “ground glass” pattern (White-out)
- Air bronchograms (aerated bronchioles)
- UVC: T6  UAC: T6
RDS after surfactant
(same patient)
Improved but unequal aeration
ETT right mainstem
UVC: T8 (improved)

Pneumonia
Coarse, streaky, interstitial markings
Appearance can vary widely

RLL Pneumonia
RLL patchy, granular opacities
ETT good position midway between clavicles and carina
OG tube artifact
MAS (meconium aspiration)
Irregular, diffuse pattern of patchy or nodular infiltrates, “chunky”
Lungs hyperinflated
Air trapping can lead to air leaks

MAS (same patient)
Lungs hyperinflated with bowing of diaphragms

Left CDH
Lucent bowel gas in pleural space
Herniation of abdominal organs into chest cavity
May contain stomach, bowel, liver, or spleen
85-90% occur on left
Mediastinal shift to right due to mass effect of the bowel
ETT just above carina
Soft tissue edema
Right CDH
Liver and bowel in right pleural space
Mediastinal shift with OG tube & heart pushed left
ETT: T1 (high)

Pulmonary Interstitial Emphysema (PIE)
Alveolar rupture with air accumulation within lung tissue
Pinpoint dark bubbles throughout lung fields
Unilateral or bilateral
Hyperinflation common
Can progress to pneumothorax

Tension Pneumothorax
Accumulation of air in pleural cavity due to alveolar rupture
Collapsed lung outlined by air
Mediastinal shift toward opposite side
Anterior Pneumothorax
Free air is anterior with lucency along cardiac border or diaphragm
Usually no mediastinal shift
Lateral film helpful to see anterior air
Can progress to tension pneumo
Overpenetrated film

Pneumomediastinum
Lucency over upper chest
Free air accumulates within mediastinum
Air lifts thymus off heart outlining the undersurface of the thymus, creating the "sail sign"
Can progress to a pneumothorax or pneumopericardium

Pneumopericardium
Free air accumulates within pericardial sac
Radiolucent halo completely surrounds the heart
Classic dome-shaped upper margin
Pericardial rim may be visible (arrows)
Decreased heart size with cardiac tamponade
Case Study

- 30 week gestation infant was just born at a nearby hospital ED
- Was intubated with difficulty by the ED physician secondary to respiratory distress
- You are part of the transport team and arrive 1 hour later.
Case Study

- Term infant with respiratory distress after a difficult vaginal birth
- Was placed on nasal CPAP initially and transport was requested
- You are part of the transport team and arrive to find he was just intubated for a sudden bradycardic/desaturation event