Lecture 2

Chest X-Ray
Technical Consideration

• **Entire chest should be included**

• Thoracic vertebrae should be barely seen through heart on PA film

• Optimal inspiration – diaphragm at level of 10th rib posterior

• Medial clavicles (anterior midline) equidistant from spinous processes (posterior midline)

• Ribs slightly offset on lateral
Chest Normal

Normal Chest Anatomy

- Right heart border
  - Upper portion - SVC and ascending aorta
  - Lower portion – right atrium
- Left heart border
  - Upper portion – aortic arch
  - Mid portion – main pulmonary artery
  - Lower middle portion – left atrium
  - Lower portion – left ventricle
Normal
Chest Lateral

- Anterior heart border
  - Upper portion – aortic arch
  - Mid portion – pulmonary artery
  - Lower portion – right ventricle
- Posterior heart border
  - Upper portion – left atrium
  - Lower portion – left ventricle and IVC

Chest Normal
Normal Pulmonary Vascularity

- Lung markings branch and taper symmetrically
- Upper markings sparser and thinner than mid and lower on upright film, difference less prominent on recumbent studies
Normal Pulmonary Vascularity

- Easily see vessels in inner third
- Vessels identified but less prominent middle third
- Difficult to see discrete vessels outer third

Cardiac Radiography

- Frontal view
  - Left ventricular
  - Left atrial appendage
  - Pulmonary artery
  - Aorta
  - Superior vena cava
Cardiac Radiography

- Lateral view
  - Right ventricular size
  - Posterior border left atrium
  - Posterior border left ventricle
  - PA dimension of thorax
- Oblique views
  - Optimize evaluation of cardiac margins
Cardiac Radiography

• Cardiac size
  – 50% or less of the trans thoracic diameter
  – UP to 60% in children
  – Cardiac thoracic ratio
  – Caution!! Poor inspiration false increase in cardiac size
  – Evaluate both frontal and lateral views
  – Pericardial fluid also can cause apparent cardiac enlargement
Reading the Chest X-ray
a Systematic Approach

- Diaphragm
- Pleura
- Costophrenic angles
- Lungs
- Heart and great vessels
- Trachea and mediastinum
- Bones and soft tissues

Chest Normal
What Is the Finding?

Absent Left Breast
Where Are the Shotgun Pellets?

3-D Imaging

- Lateral view reveals pellets in the anterior aspect of the chest wall
- Need perpendicular view to ascertain exact location
Where is the Straight Pin?

- Straight pin in the bronchus
- Lateral view is needed for 3-dimensional orientation
Acute Abdominal Series

- Supine abdomen (KUB, “flat plate”)
- Upright abdomen –
  - detects air-fluid levels and free intraperitoneal air, horizontal beam (parallel to the floor);
  - Patient needs to maintain position for at least 10 minutes prior to obtaining x-rays

Acute Abdominal Series

- Chest x-ray – detects free intraperitoneal air and chest pathology
- Left lateral decubitus abdomen
  - substitutes for upright view in debilitated patients,
  - patient needs to maintain position for at least 10 minutes
Abdominal Imaging Positioning

Radiographic Appearance

- **Supine**
  - Air in body of stomach
  - Air in transverse colon

- **Upright**
  - Air in fundus

- **Prone**
  - Air in fundus of stomach
  - Air in rectum
  - Air in ascending and descending colon

- **Decubitus**
  - Right side up air in right colon and duodenum
  - Left side up air in left colon and stomach

Reading the Abdominal X-ray

(ABCD Approach)

A. -- Air (air pattern, free air)
B. -- Bone
C. -- Calcifications
D. -- Density (soft tissue)
Normal Mucosal Folds

A. Valvulae conniventes of small intestine
B. Haustra of colon
C. Gastric rugae of stomach

Normal Acute Abdomen
- Normal abdomen
- Upright abdomen
- Air-fluid level stomach fundus
- Stool in colon
Normal Chest, Acute Abdomen
Study
• No free air
• No chest disease

Normal Acute Abdomen Series
• Supine film
• Normal gas distribution
• No masses
• Normal organs
Uroradiologic Studies

• X-Ray:
  – Plain film, KUB (Kidneys Ureter Bladder) and tomography
  – Intravenous Urography (IVU)
  – Voiding CystoUrethroGraphy (VCUG)
  – Angiography and Digital Subtraction Angiography (DSA)
• Ultrasound (US)
• Computed Tomography (CT) and Magnetic Resonance Imaging (MRI)
• Radionuclide renal scan
• Positron Emission Tomography (PET)

Normal Urinary Tract Anatomy

• Renal parenchyma:
  – Cortex, medulla
• Urinary collecting system:
  – Calyces, infundibula, pelvis, ureters
• Urinary bladder
• Urethra
Normal KUB Film

- Kidneys Ureter Bladder (KUB)
- Supine
- Left kidney visualized
- Right kidney partially obscured
- Evaluate kidney size, shape, position and presence/absence of calcifications

Normal KUB Film

- Evaluate kidney size
  - 9-13 cm
- Shape-
  - Reniform
  - Bean shaped
- Position
  - Parallel to the psoas muscles
Anatomic Correlation

- Normal Anatomy

IVU Tomogram

- Immediately after contrast injection
- Contrast in proximal tubules
Intravenous Urogram (IVU)

**Indications**
- Hematuria
- Trauma
- Abdominal Pain (referred to urinary tract)
- Palpable abdominal mass
- Mass or calcification on KUB

Iodine Contrast Physiology

- Intravenous contrast excreted by Glomerular Filtration
- Concentration of filtrate = concentration in the plasma
- Proximal tubule water resorption increases contrast concentration 5 - 10 fold
- Distal Tubule/Collecting system water resorption increases contrast concentration to a total of 30 - 50 fold greater than plasma concentrations
IVU

- Insignificant contrast secretion
  - <2% excretion by liver and small bowel
  - Primary route of clearance in renal failure

IVU

- Risks
  - An incidence of allergic reaction
    - Not dose related
    - May be related to iodine or carrier molecule
    - Use of non-ionic agents
  - Renal failure exacerbation
    - Low function to start
    - Multiple Myeloma
Nephrotoxic Effects of Contrast

• Ionic Contrast
  – Hyperosmolar to plasma
  – Significant risk of inducing renal failure
    • Especially if “at risk”
  – Relatively inexpensive

• Non-Ionic Contrast
  – Recent innovation ~1970
  – Reduces risk of inducing renal failure
  – Increase cost – initially 25x ionic contrast

Nephrotoxic Effects of Contrast

• Non-Ionic Contrast
  – Recent developments
    • Even lower osmolality
    • May reduce risks even more
IVU

• Nephrogram-
  – Contrast concentration in the renal parenchyma
  – Short period immediately following injection
  – Rapidly disappears as contrast moves into the calyces and renal pelvis

Renal Size and Contours

• Size
  – Symmetric
  – 9-12 cm in adults
  – <1 cm difference right to left

• Contours
  – Smooth or slightly undulating
  – Occasional lobulation especially on left
Normal IVU

Normal Examination

IVU Tomogram
CT Indications

- **Indications**
- Suspicion of ureteral calculi (*Procedure of choice*)
  - Evaluation of all retroperitoneal structures
  - Renal mass by other modalities
  - Hematuria with suspicion for renal neoplasm
  - Staging of neoplasm
    - Prostate
    - Ovary

CT Normal Anatomy

- Superior MesentericVein
- Duodenum
- Vena Cava
- Aorta
- Renal Pelvis
- Crus of Diaphragm
CT Urogram
CT Angiography

US Principles

• High frequency sound
  – Relatively uniform speed of transmission in tissues
  – Passes through fluid without interaction
  – Reflected by bone and air
• Acoustic windows
  – Liver for right kidney
  – Left more difficult no good window
  – Bladder for Pelvis
Normal Bladder

MRI Normal

Normal kidneys

Liver
MRI Normal 2

MR Angiography
Normal Flow

Radionuclide Renal Scan

- Normal perfusion
- IV injection followed by imaging every 3 seconds
- See uptake in aorta, arteries, kidneys
- Allows evaluation of blood flow