Department of Anatomy
Second Faculty of Medicine
Charles University

Brief Introduction to Imaging Methods

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What this lecture is NOT about

- Learning how all the machines work
- Memorizing the physics of these methods
- Memorizing the units
- Mastering radiology in 45 minutes

What this lecture IS about

- Differentiating which imaging method comes up on your test —>
- Knowing what this method is good for —> knowing what to look for!
- What's white, gray, black?
- **Basic orientation**:
  - Right or Left?
  - Top or Bottom?
  - How am I viewing the image?

Basic imaging methods

- X-ray (rentgen)
- Computed Tomography (CT)
- CT Angiography (CTa)
- Magnetic Resonance Imaging (MRI)
- Ultrasound

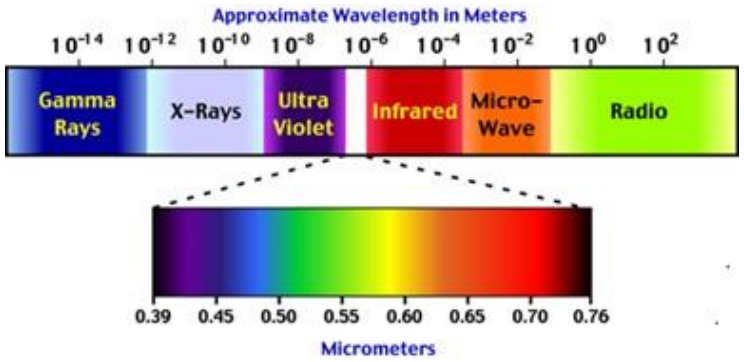
X-Rays

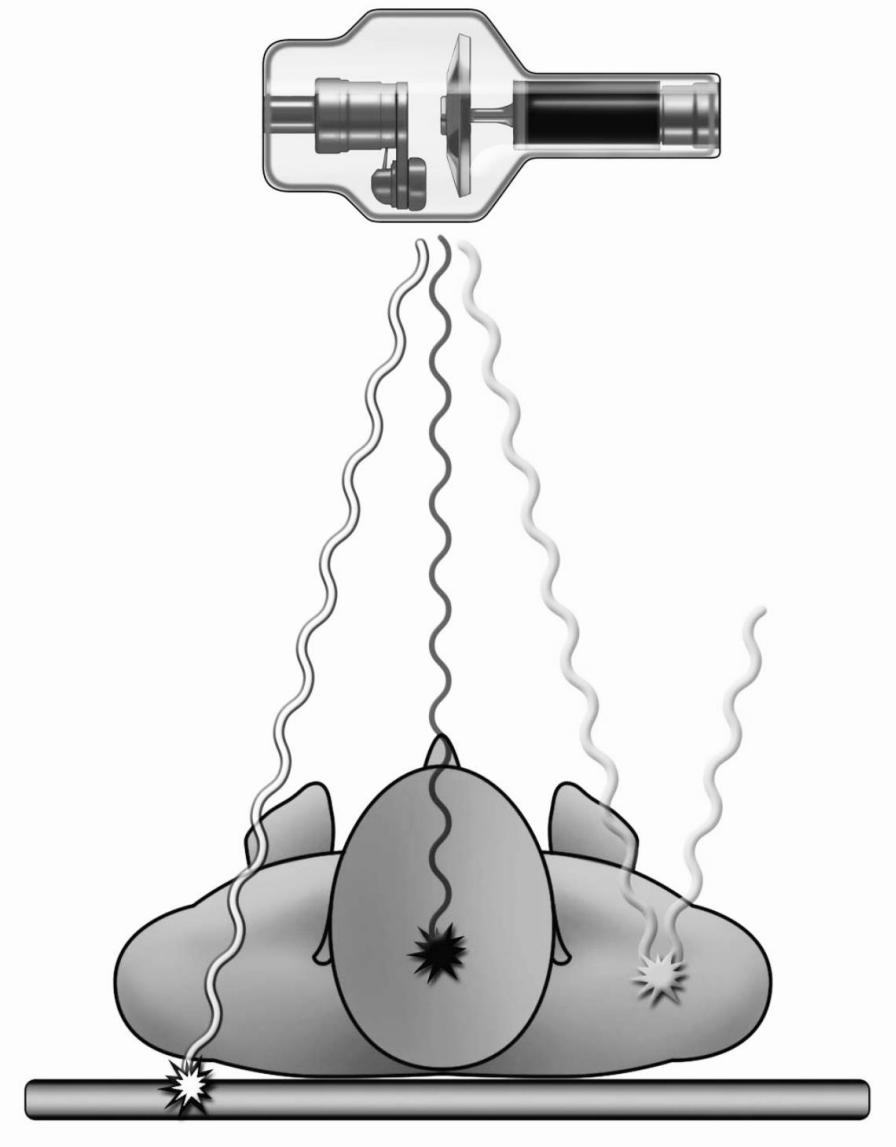
- A **source** produces X-rays

—> the waves pass *through* the body (**absorbed** differently by different tissues)

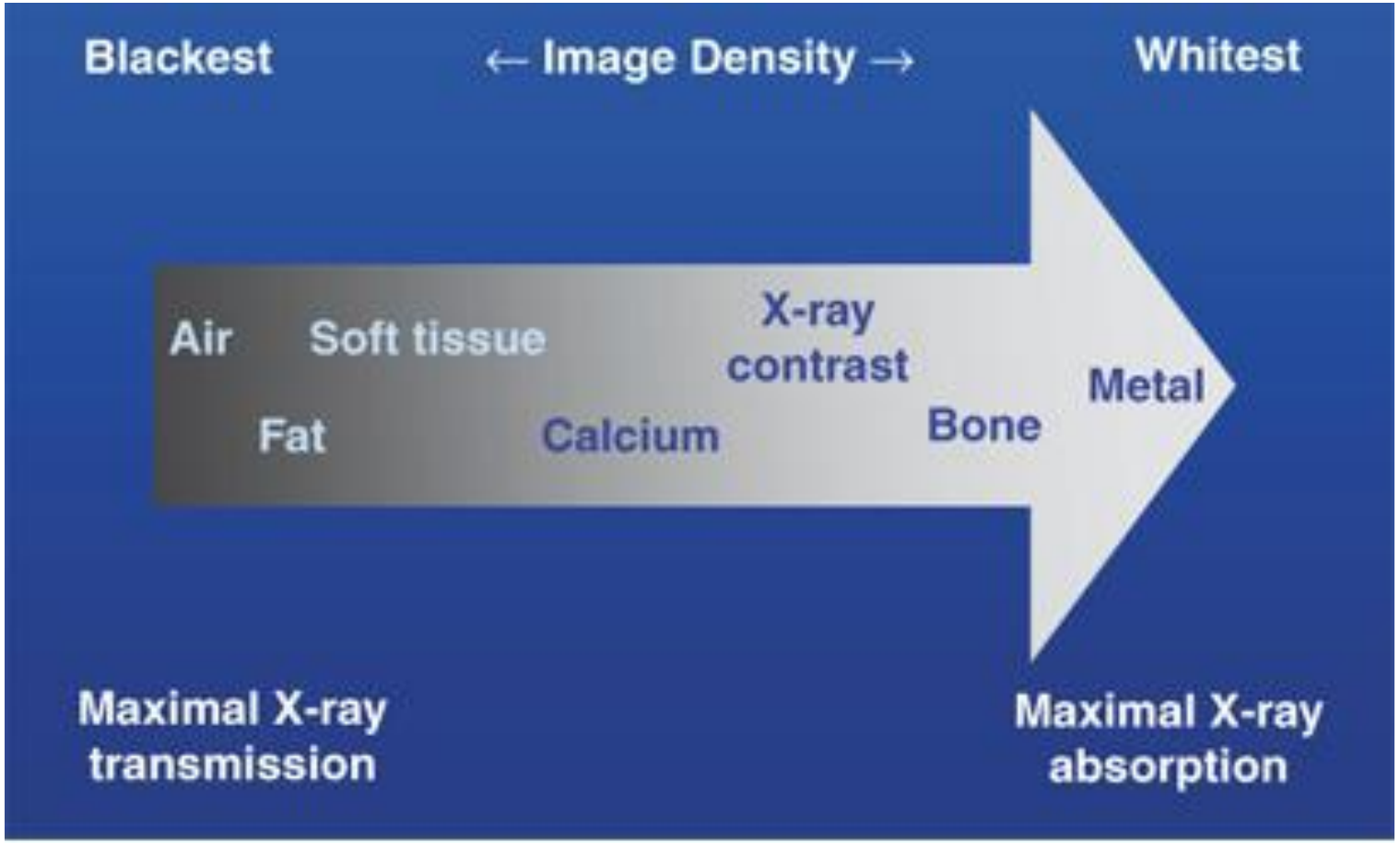
—> the waves are **detected** by a plate behind the person

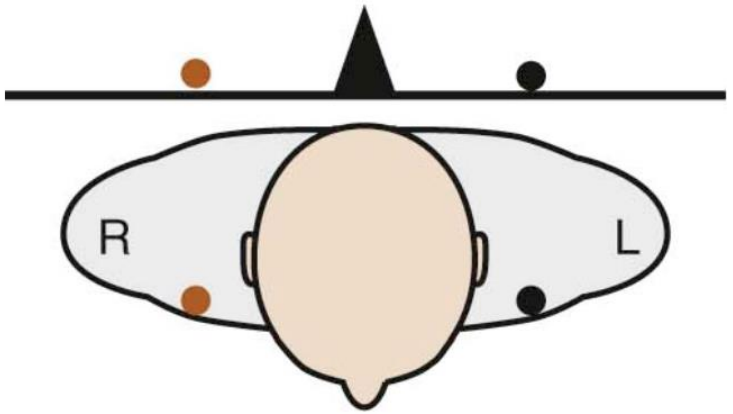
—> an image is created.





Densities!


Blackest
← Image Density →
Whitest
Air
Soft tissue
Fat
Calcium
X-ray contrast
Bone
Metal
Maximal X-ray transmission
Maximal X-ray absorption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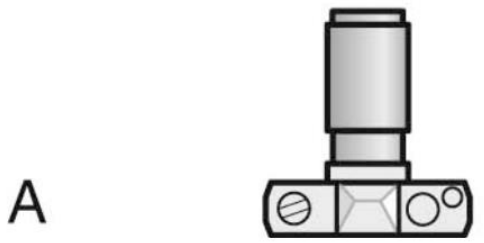
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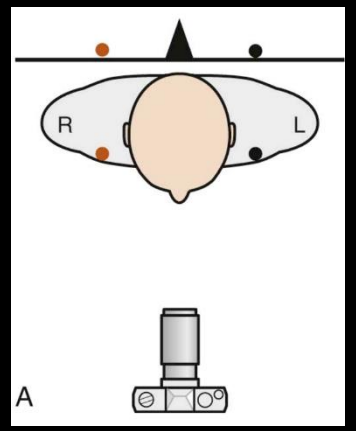
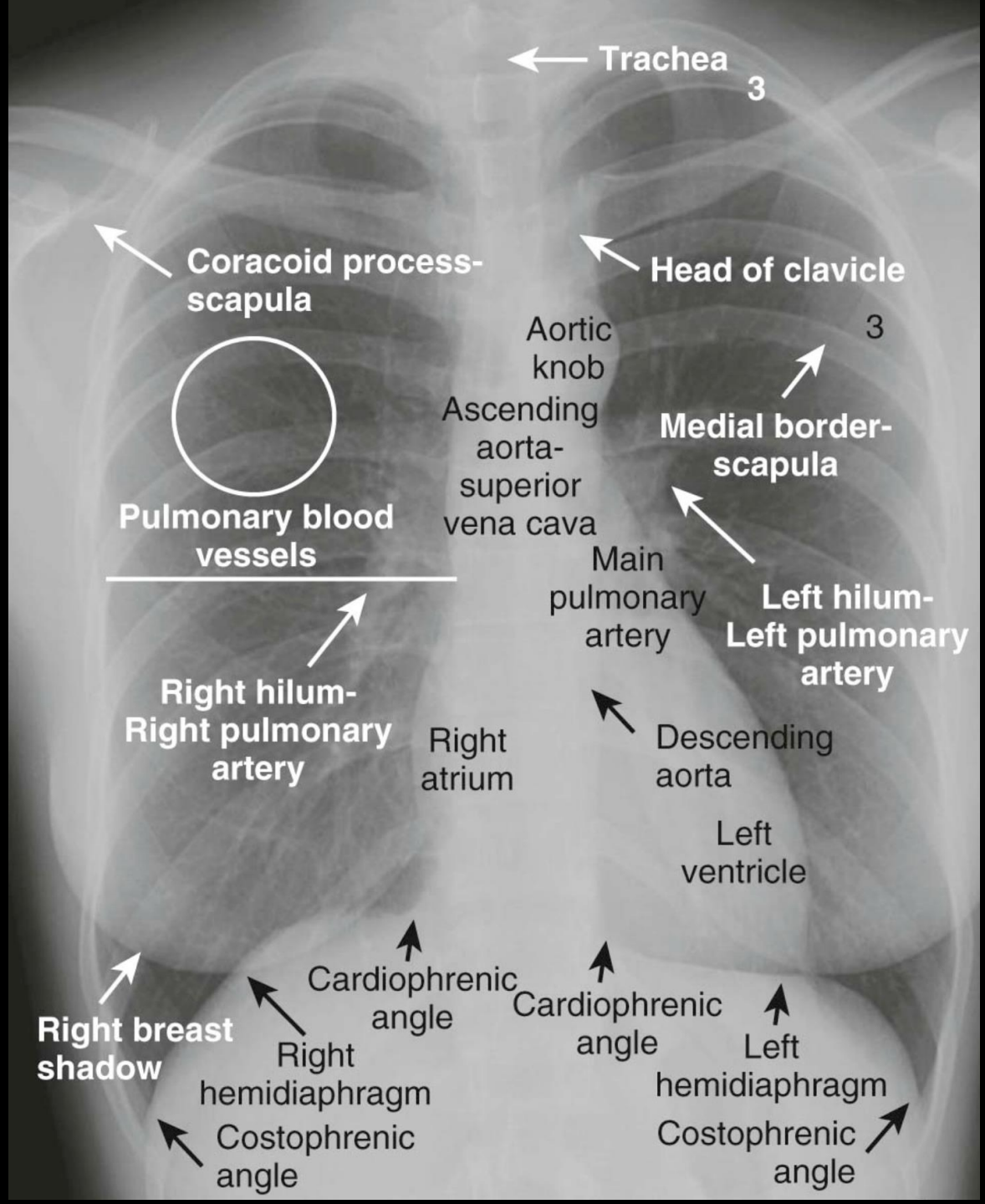
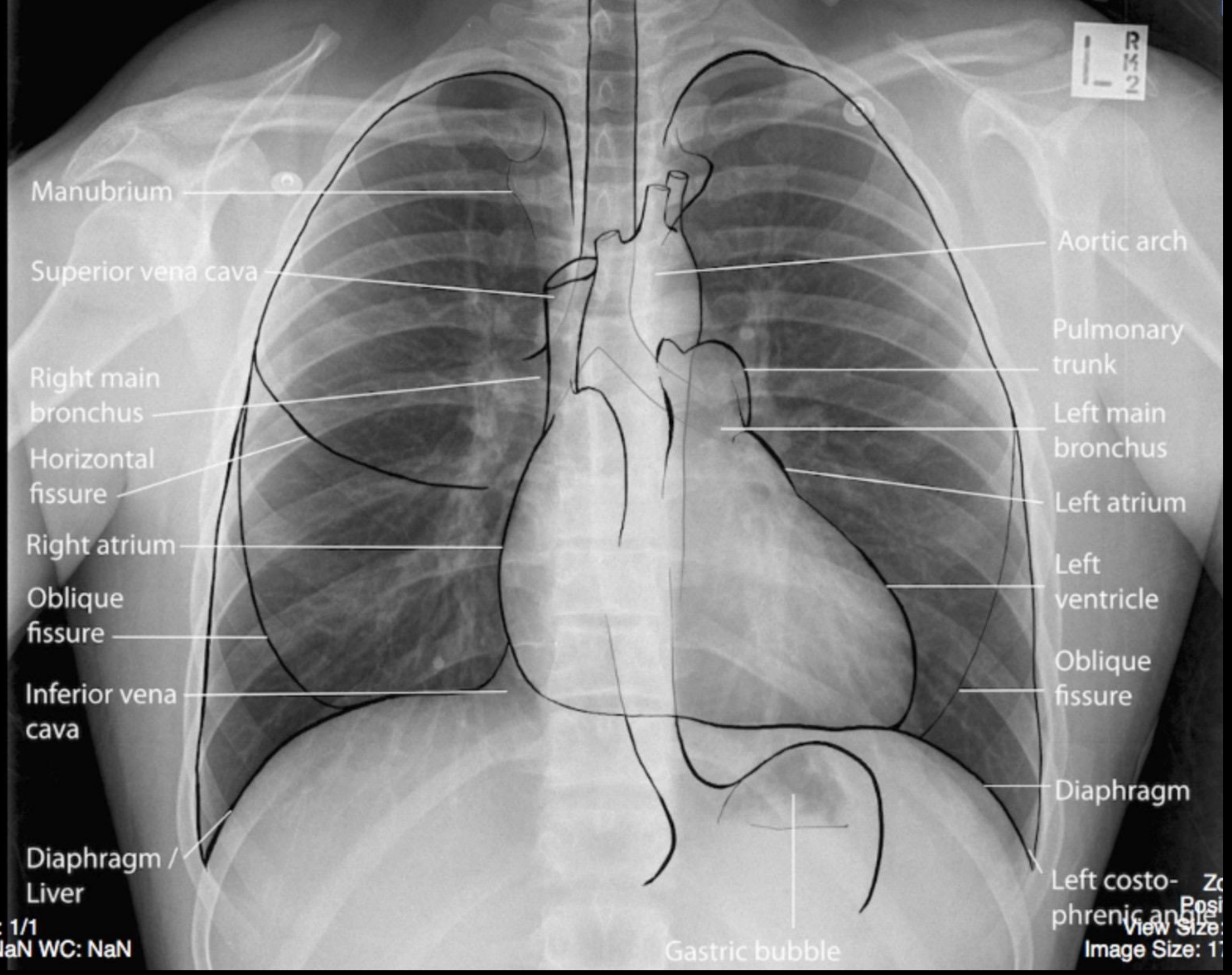
TABLE 1-1 Five Basic Densities Seen on Conventional Radiography

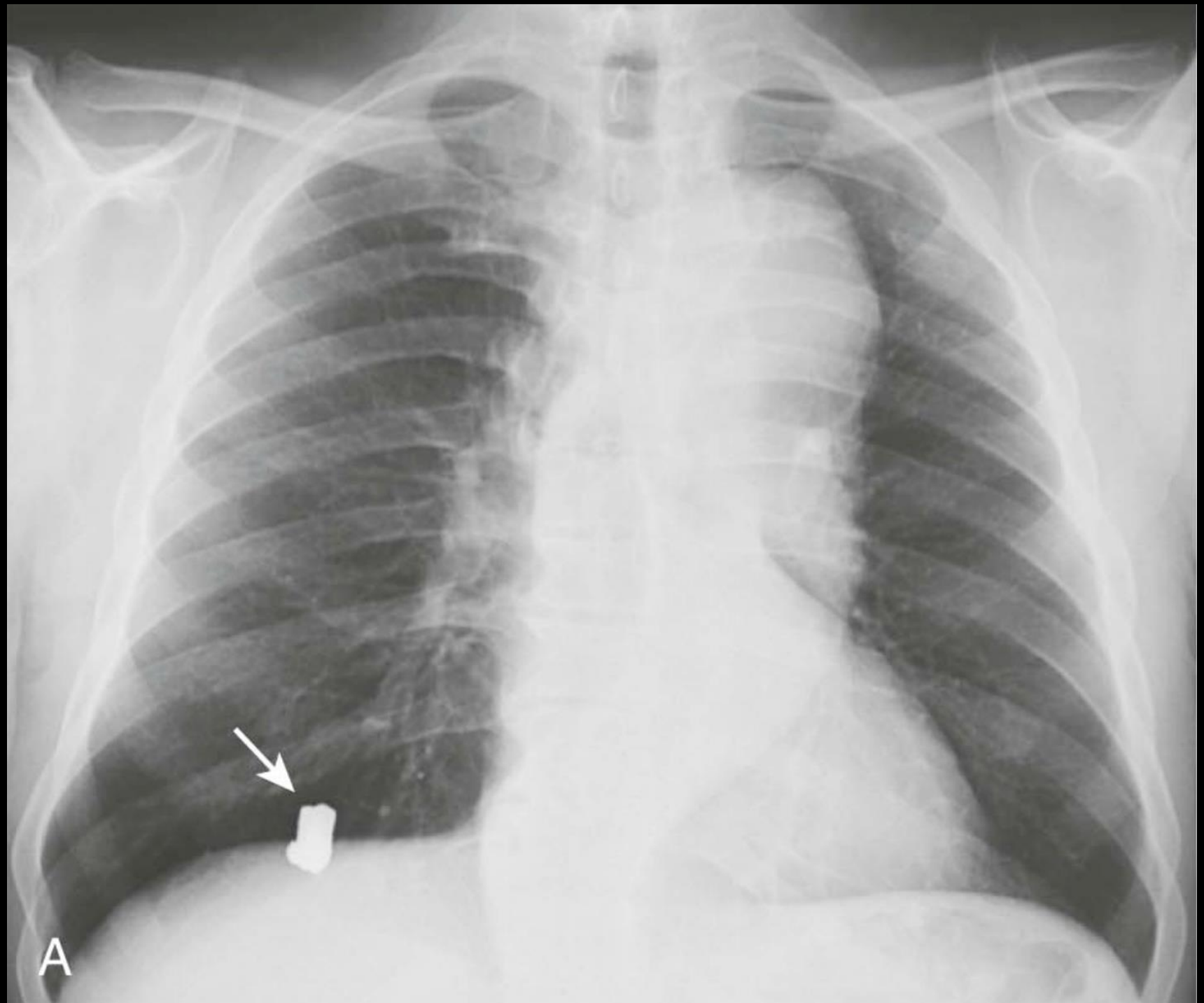
Density	Appearance
Air	Absorbs the least x-ray and appears "blackest" on conventional radiographs
Fat	Gray, somewhat darker (blacker) than soft tissue
Fluid or soft tissue	Both fluid (e.g., blood) and soft tissue (e.g., muscle) have the same densities on conventional radiographs
Calcium	The most dense, naturally occurring material (e.g., bones); absorbs most x-rays
Metal	Usually absorbs all x-rays and appears the "whitest" (e.g., bullets, barium)

CXR




Trachea
3
Coracoid process-scapula
Head of clavicle
3
Aortic knob
Ascending aorta-superior vena cava
Medial border-scapula
Pulmonary blood vessels
Main pulmonary artery
Left hilum-Left pulmonary artery
Right hilum-Right pulmonary artery
Right atrium
Descending aorta
Left ventricle
Right breast shadow
Cardiophrenic angle
Right hemidiaphragm
Cardiophrenic angle
Left hemidiaphragm
Costophrenic angle
Costophrenic angle


Manubrium
Superior vena cava
Right main bronchus
Horizontal fissure
Right atrium
Oblique fissure
Inferior vena cava
Diaphragm / Liver
Aortic arch
Pulmonary trunk
Left main bronchus
Left atrium
Left ventricle
Oblique fissure
Diaphragm
Left costo-phrenic angle
Gastric bubble
R
: 1/1
NaN WC: NaN
Image Size: 1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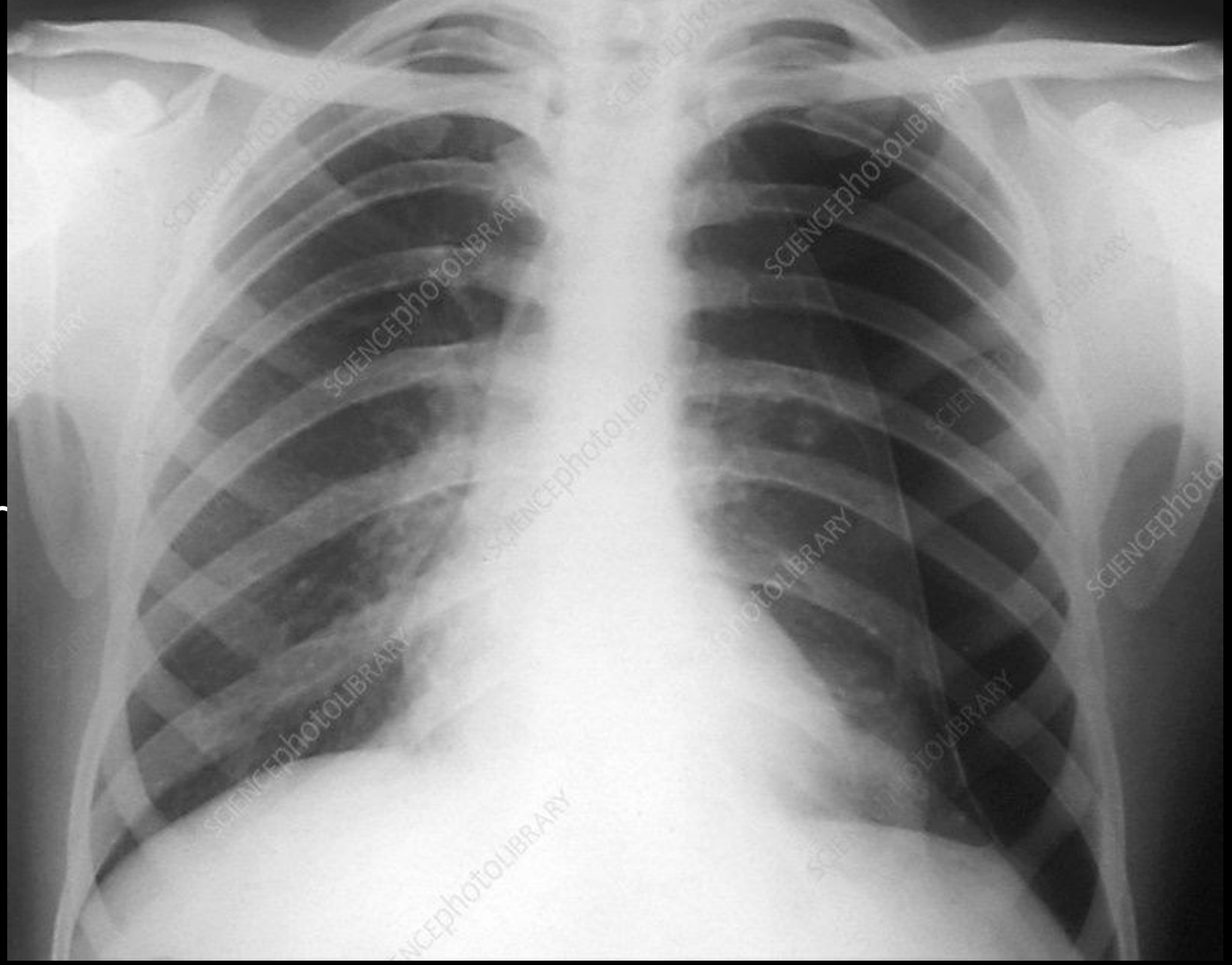
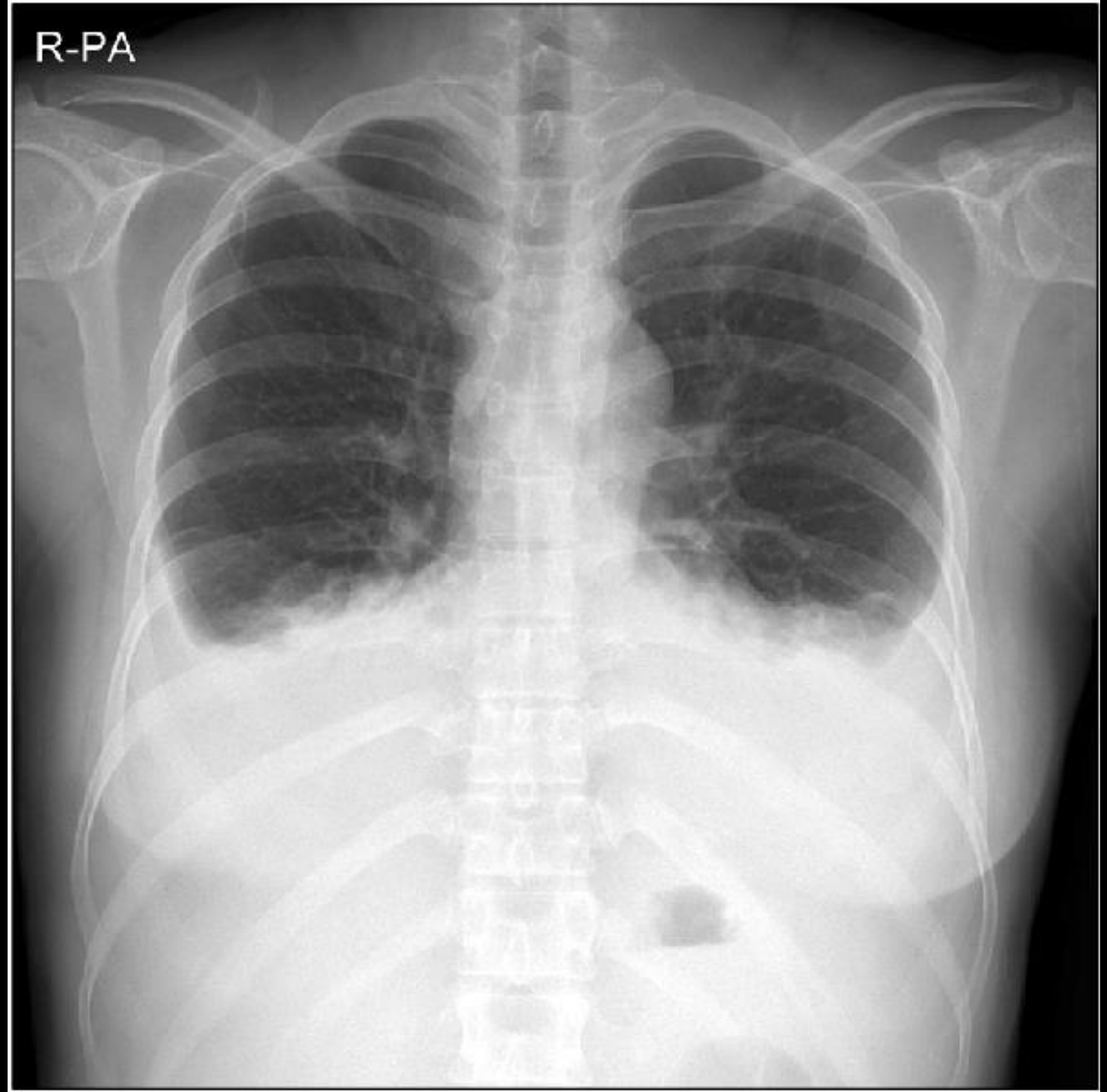
1) Where is the pathology?
2) Right or left?
3) Explain the color (density)
4) What's your Dx?
5) Something else?

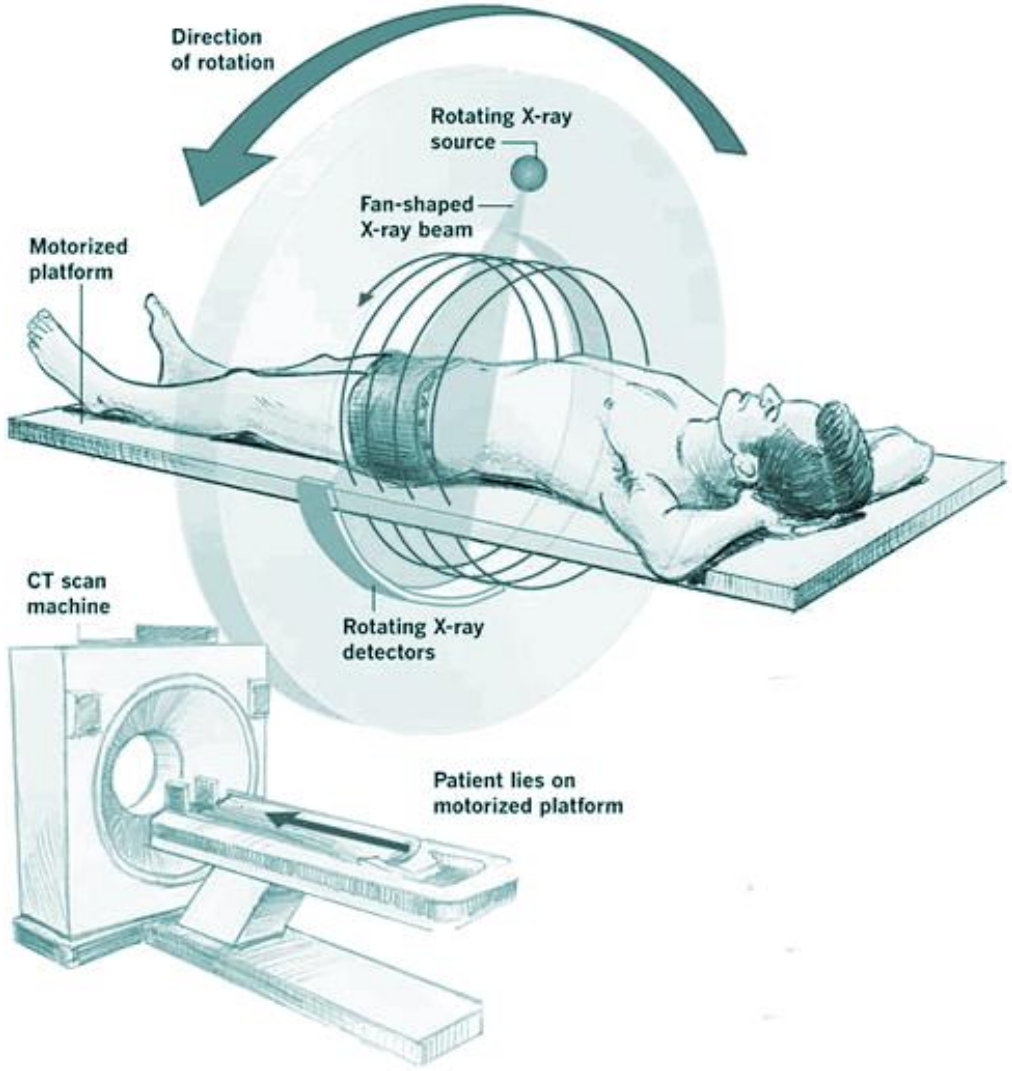


1) Where is the pathology?
2) Right or left?
3) Explain the color (density)
4) What's your Dx?



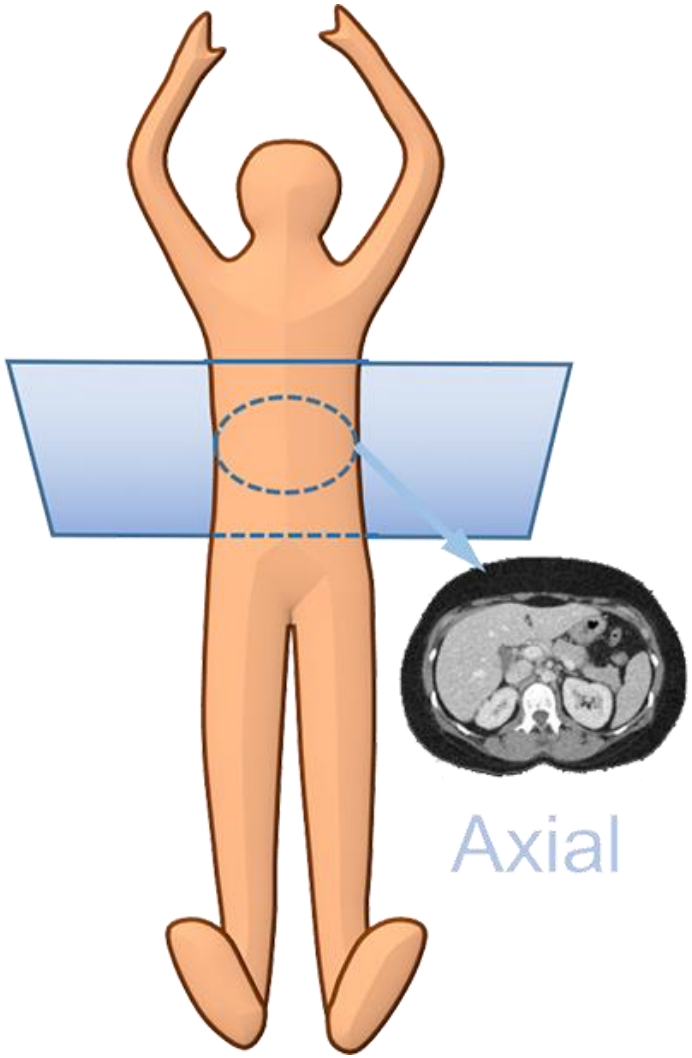
Computed Tomography (CT)

- Same physics as an X-ray! BUT
- Patient lies in the machine and multiple detectors **rotate** around them
- Slices (**cross-sections**) are generated in different planes
- Densities are the same as in X-rays

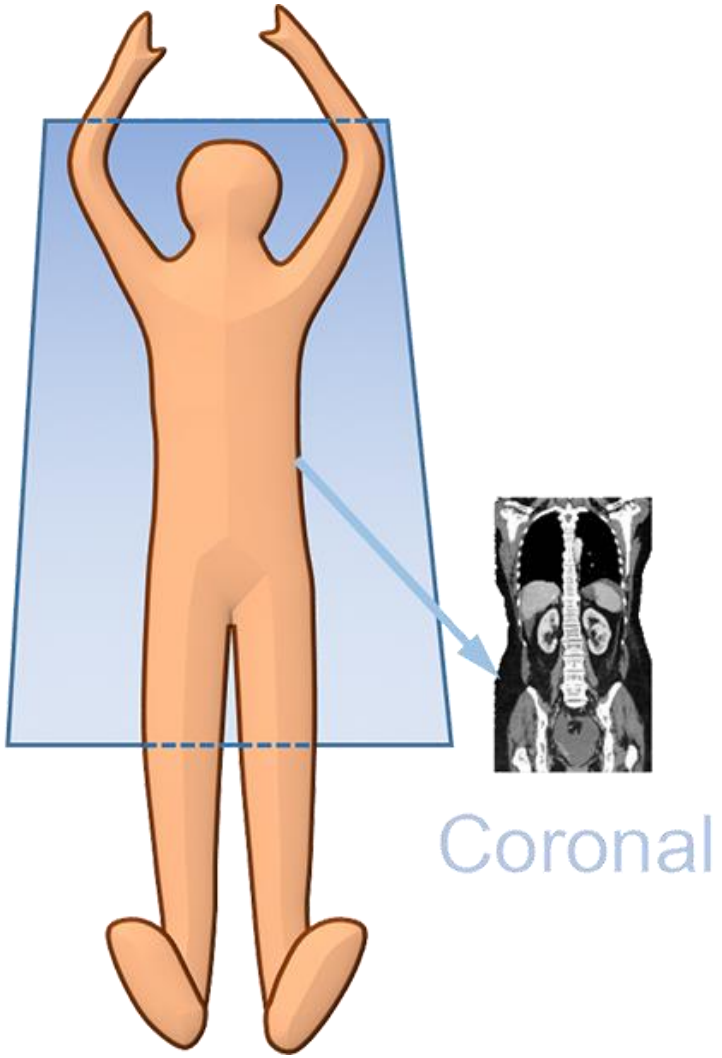


Three Planes

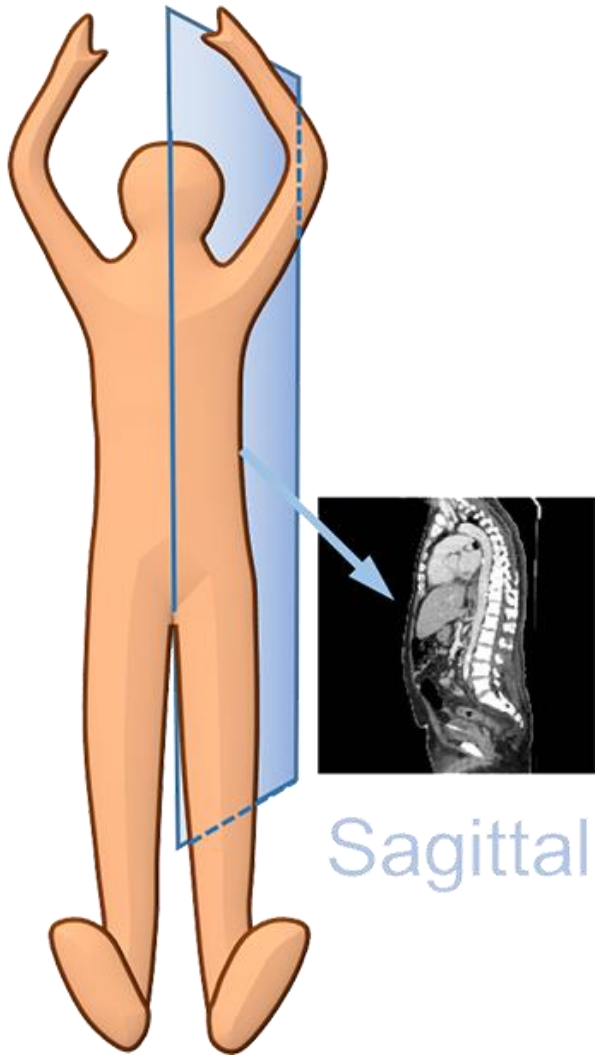
Transverse = AXIAL

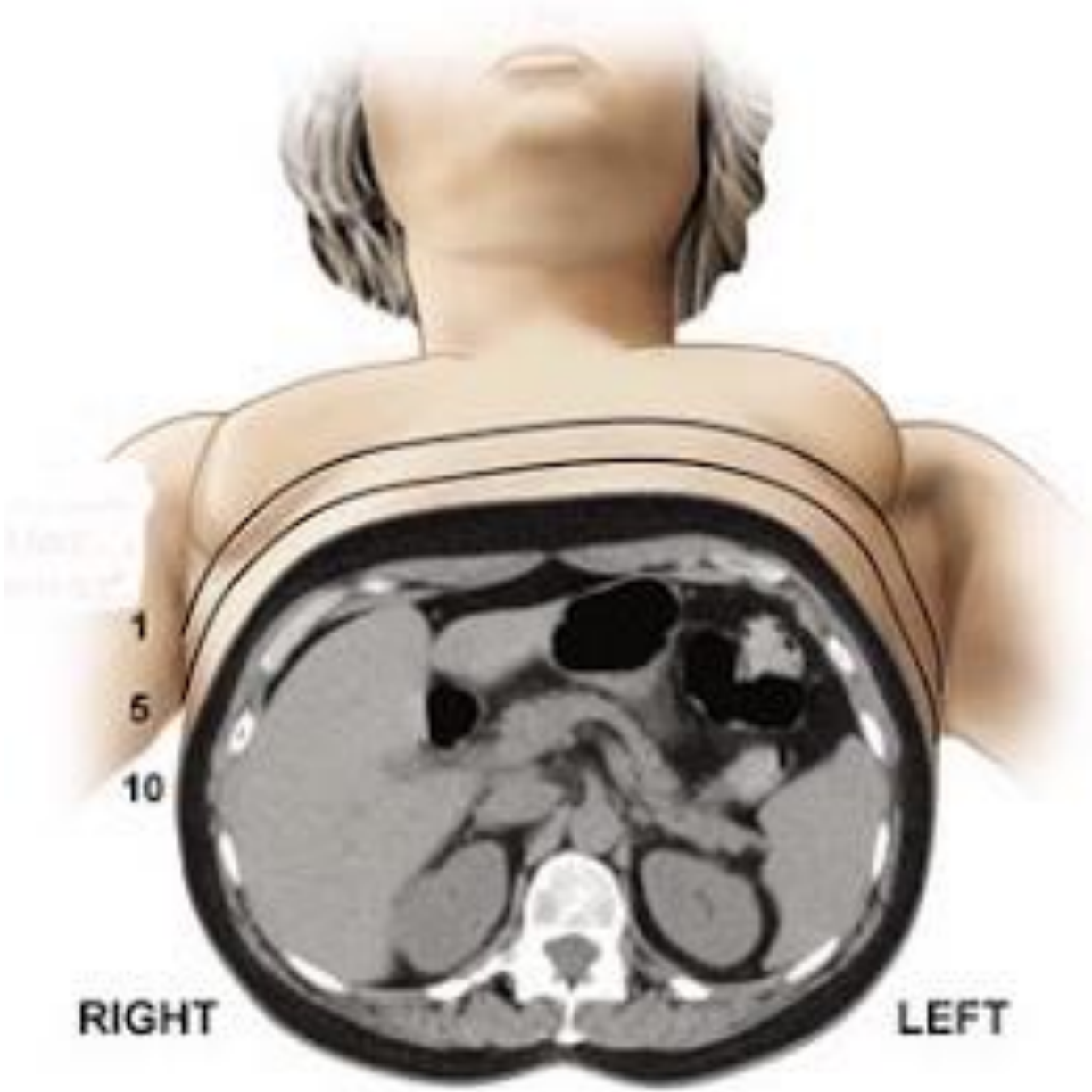


Frontal = CORONAL

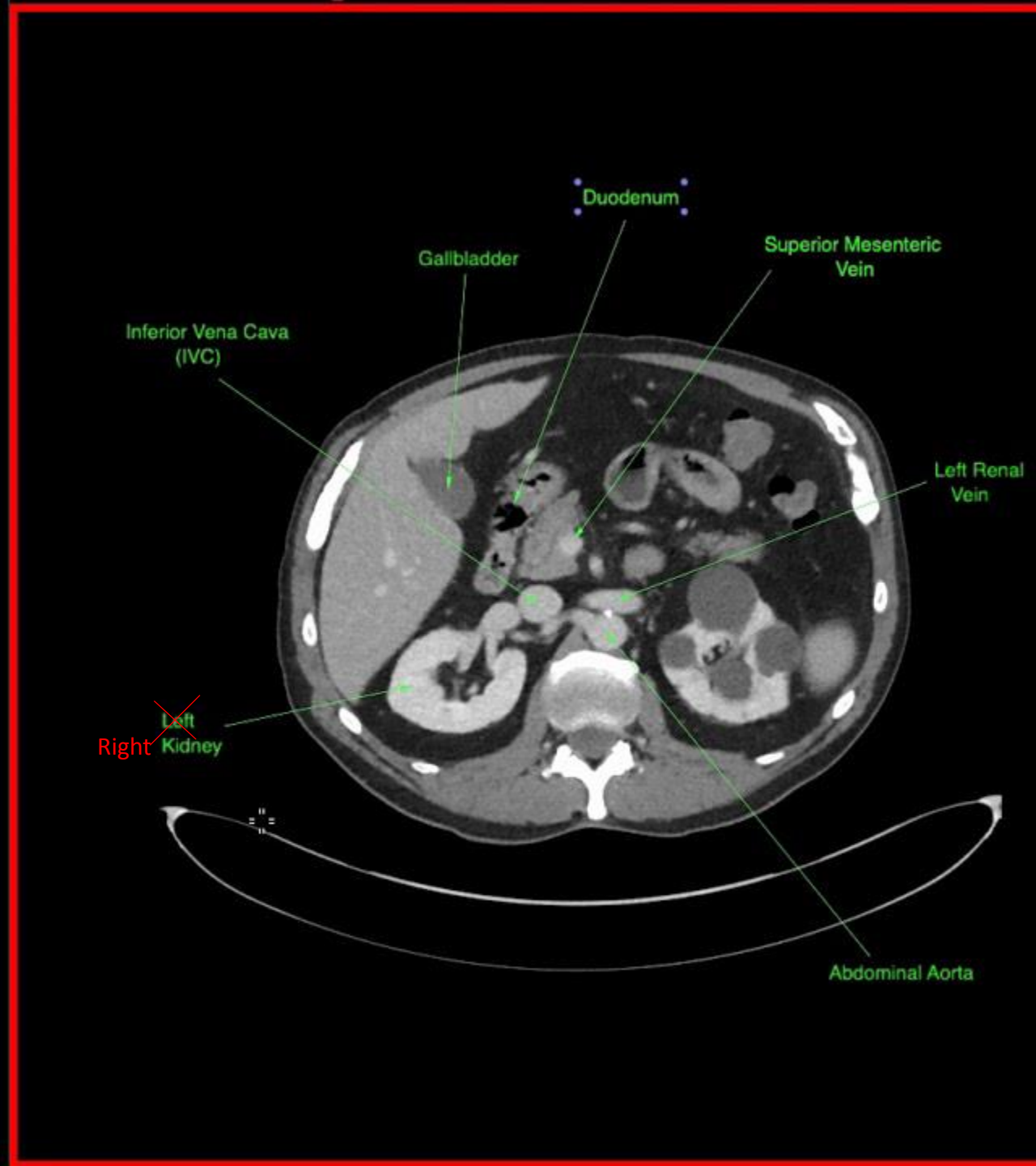


SAGITTAL



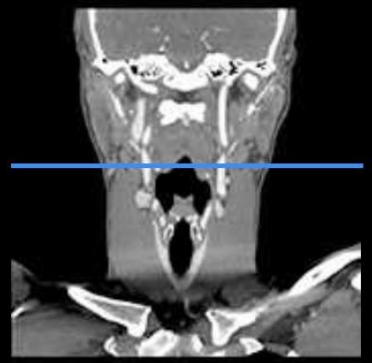


CT scans are viewed from below

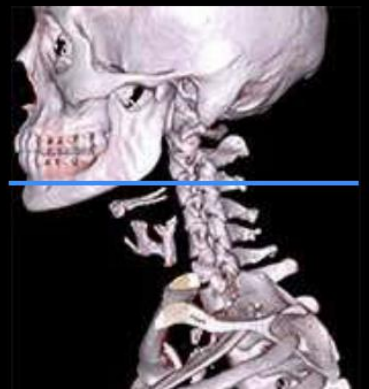

Duodenum
Gallbladder
Superior Mesenteric Vein
Inferior Vena Cava (IVC)
Left Renal Vein
Left Kidney
Right
Abdominal Aorta

Sagittal

Coronal

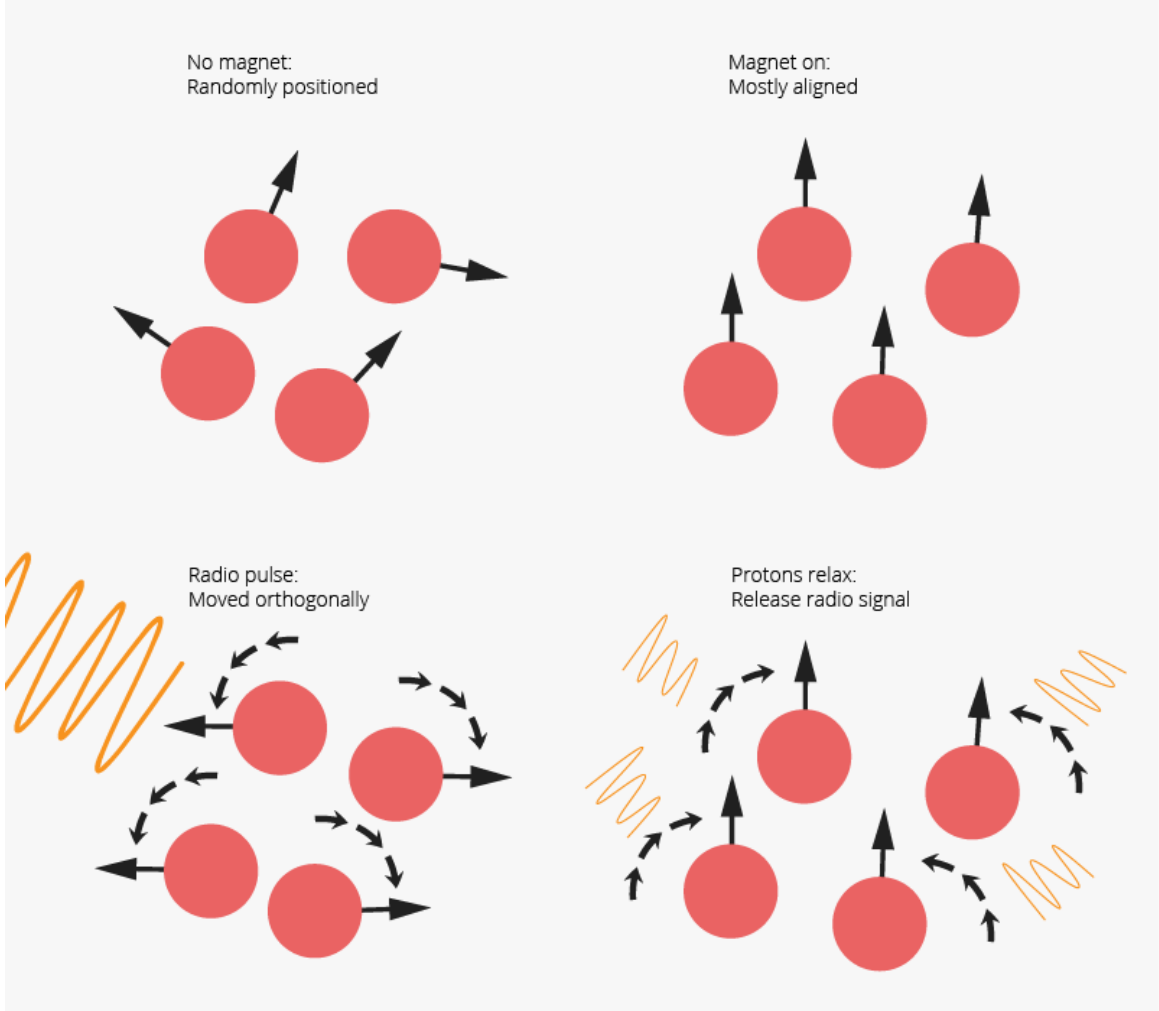


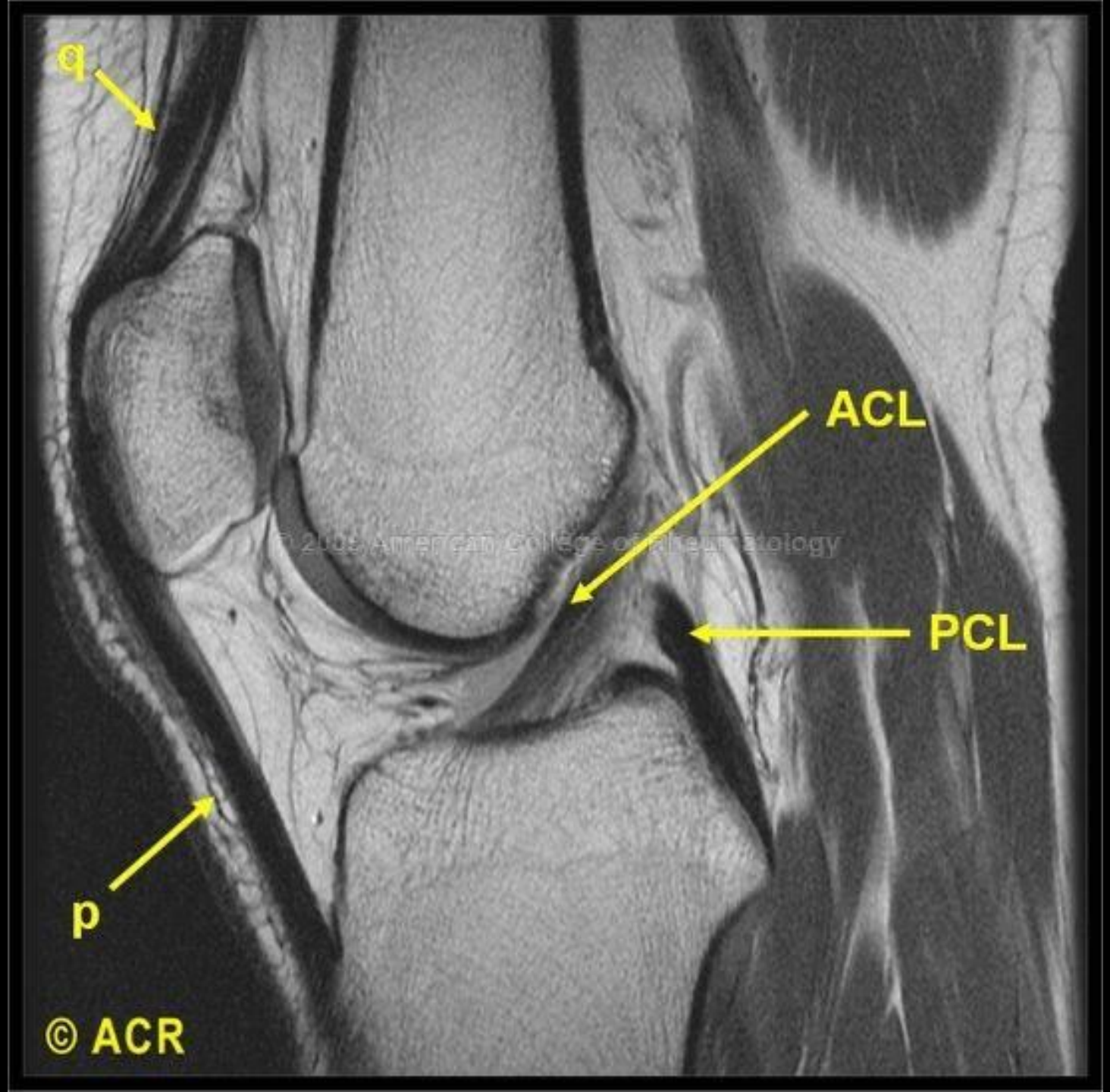
3D



Magnetic resonance imaging (MRI)

- Physics is completely different from X-ray/CT. Planes and views are the same as CT.
- Revision from biophysics
  - hydrogen atoms have a **charge** and a **spin —>** moving electrical charge = electric current
  - electric currents induce magnetic fields —> each hydrogen atom in our body has its own little magnetic field
- Our body is 60% of water and water has two hydrogens (H_2O) —> MRI is good to see tissues with more water in them = **soft tissues**
- MRI is used to see ligaments, muscles, nerves, parenchyme and stroma of organs, etc..
- —> preferred for **brain**, **pelvis**
- Not used for bones (not enough water)

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PCL
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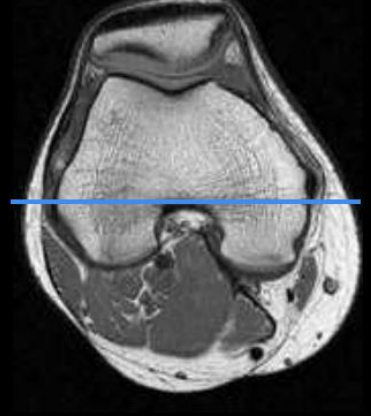
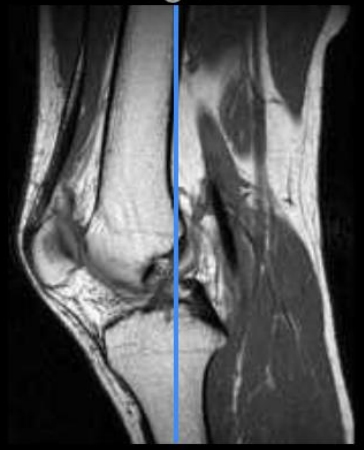
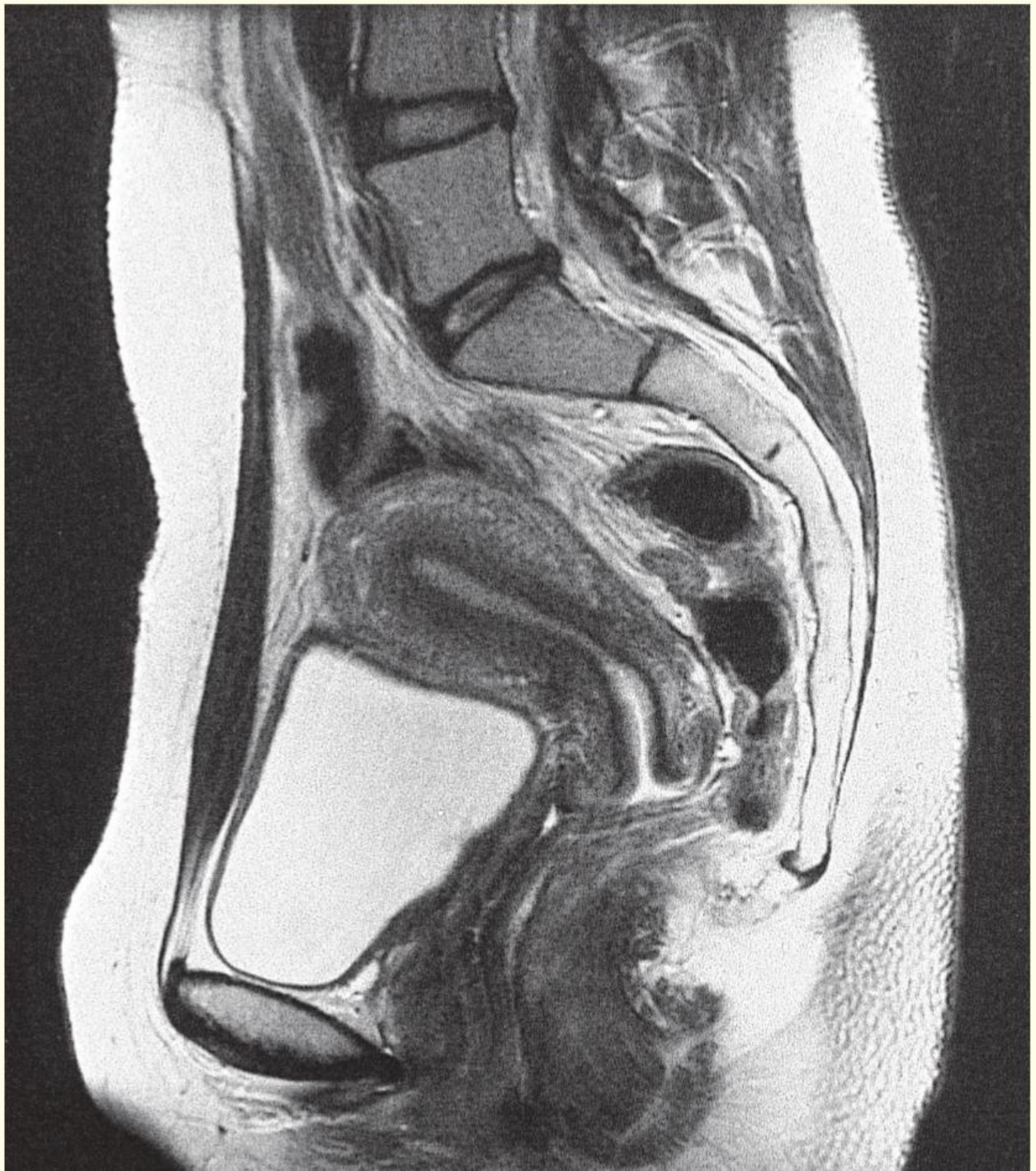
© ACR

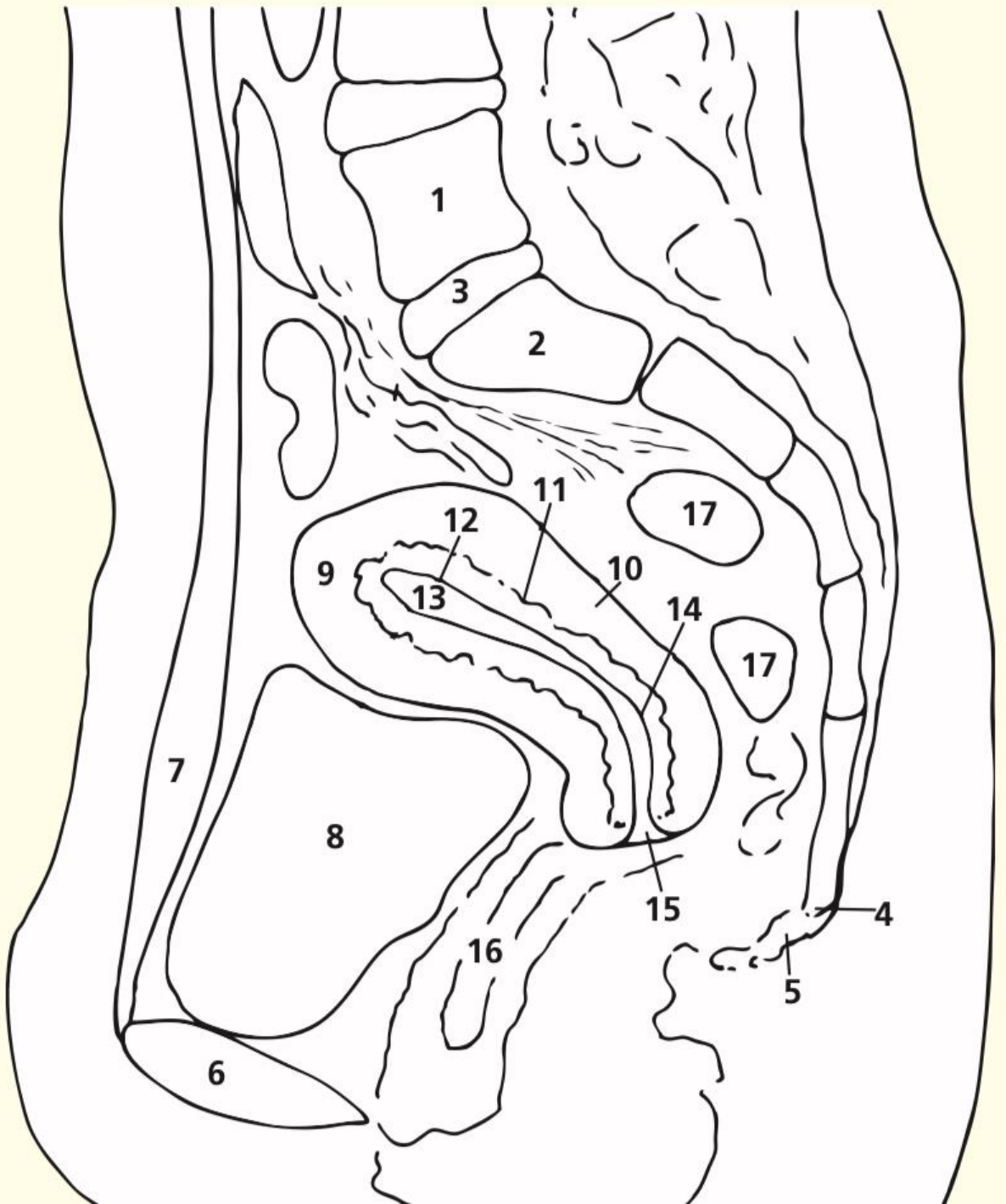


Sagittal



3D

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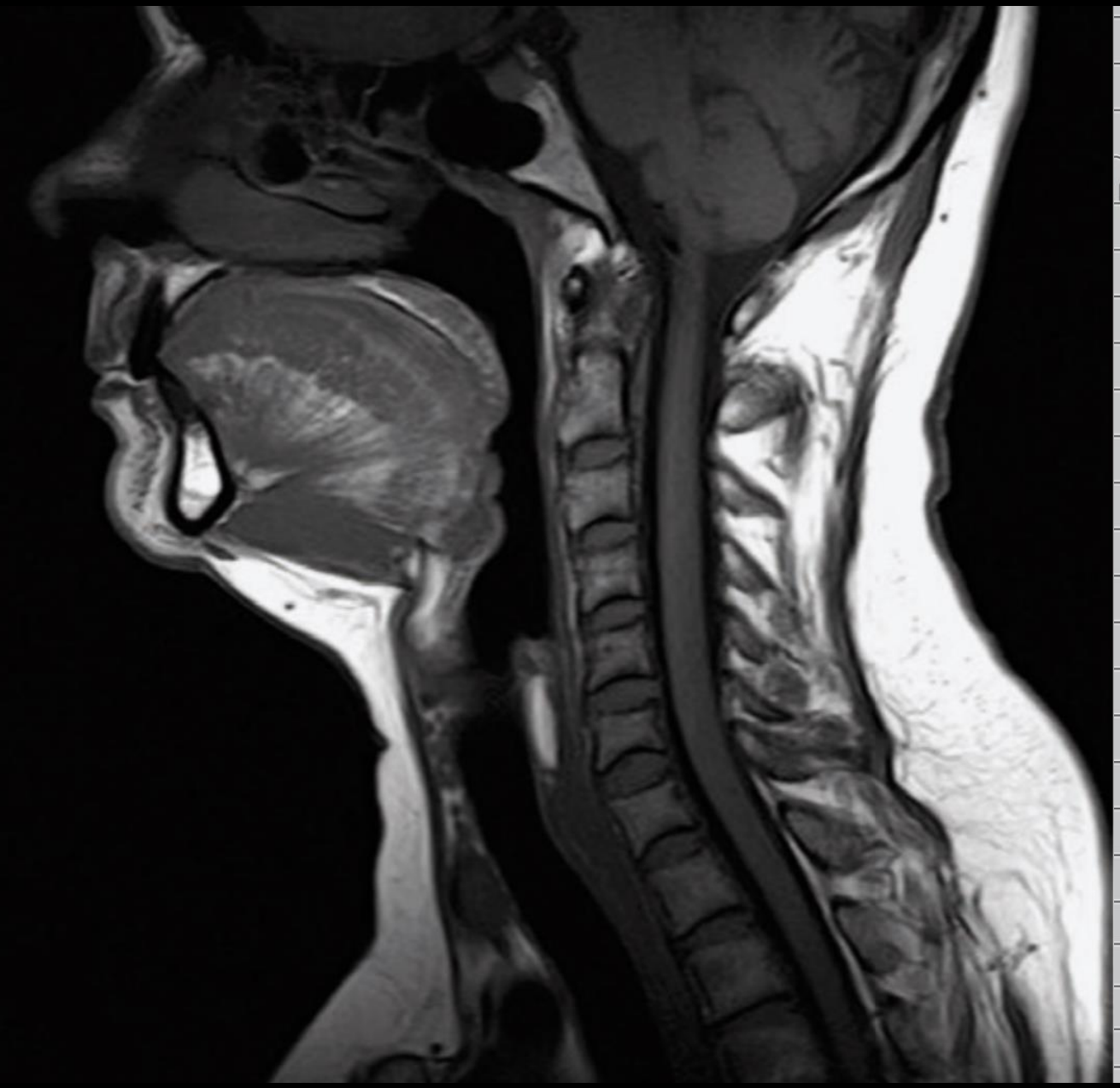
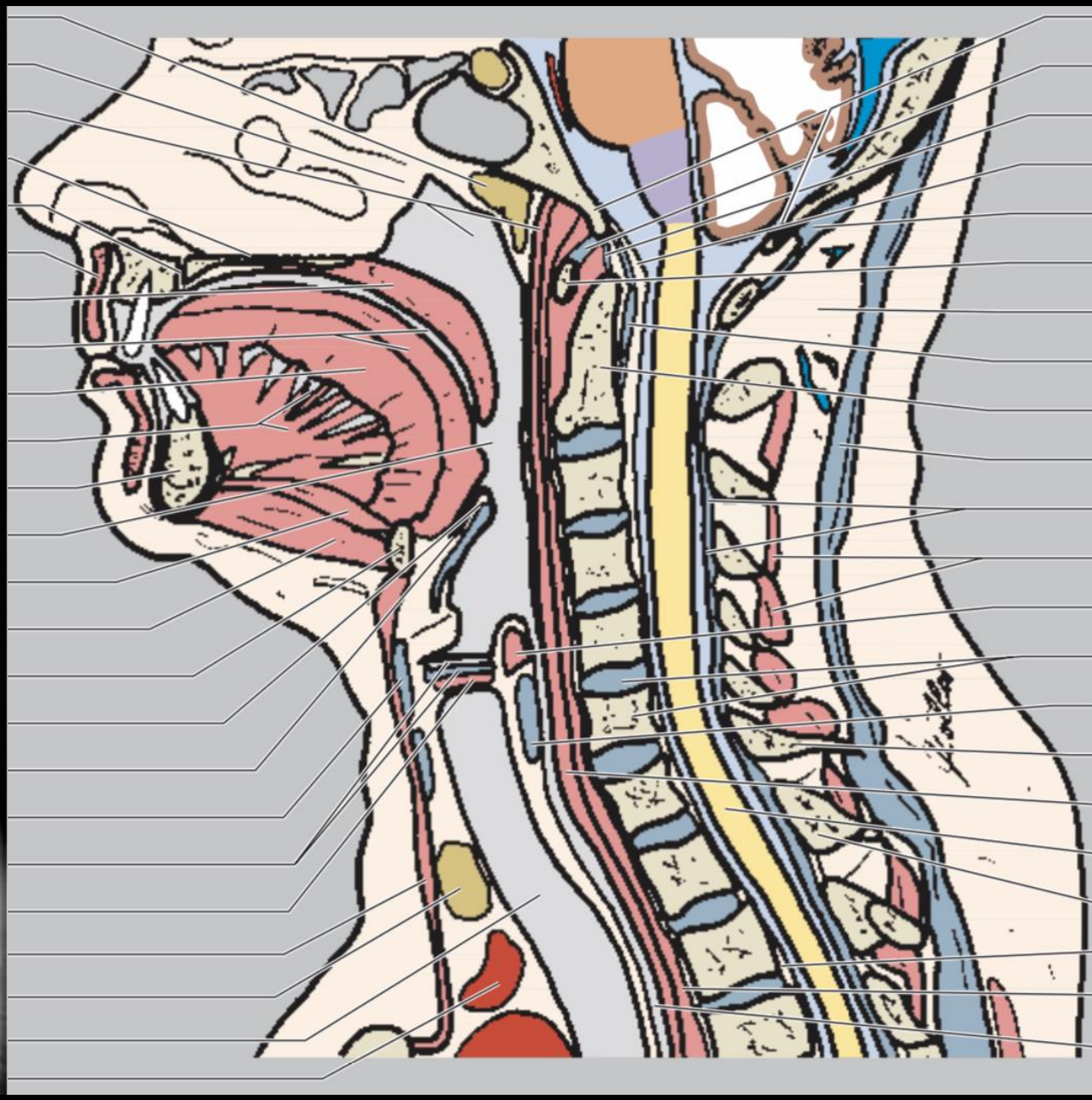
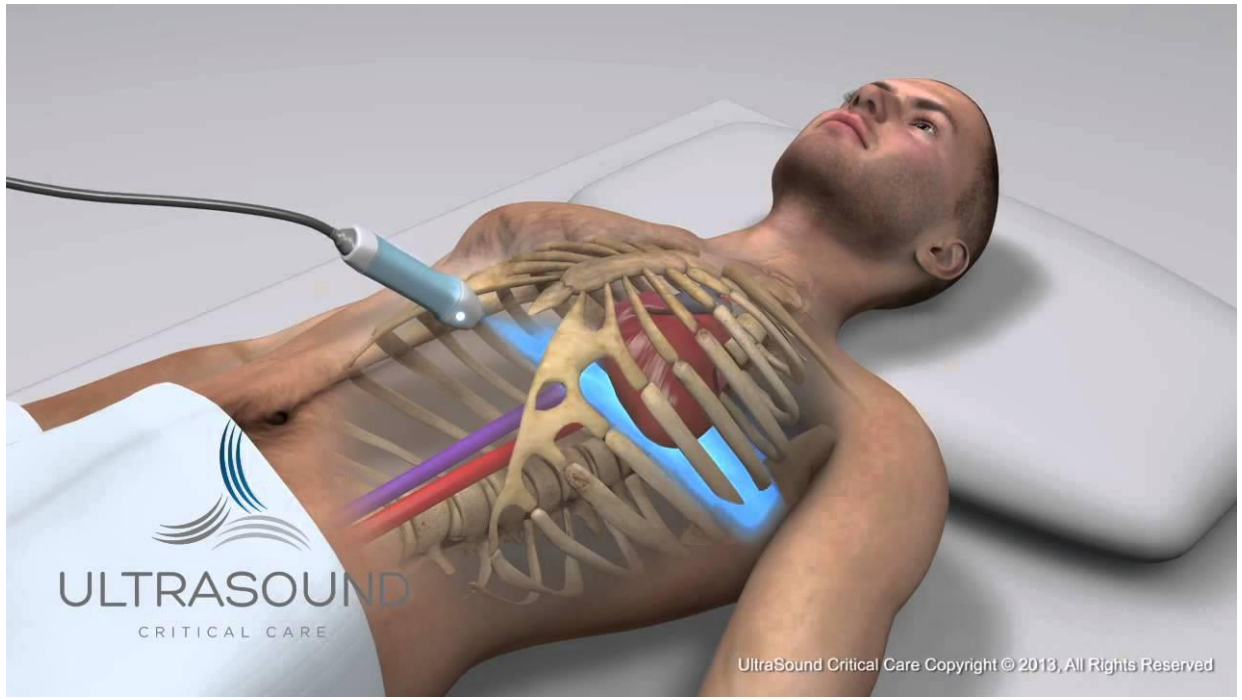
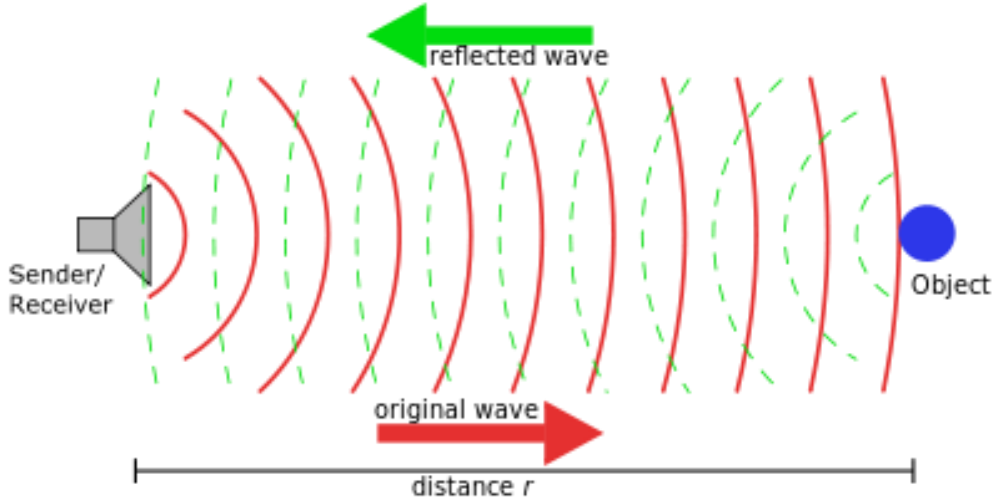
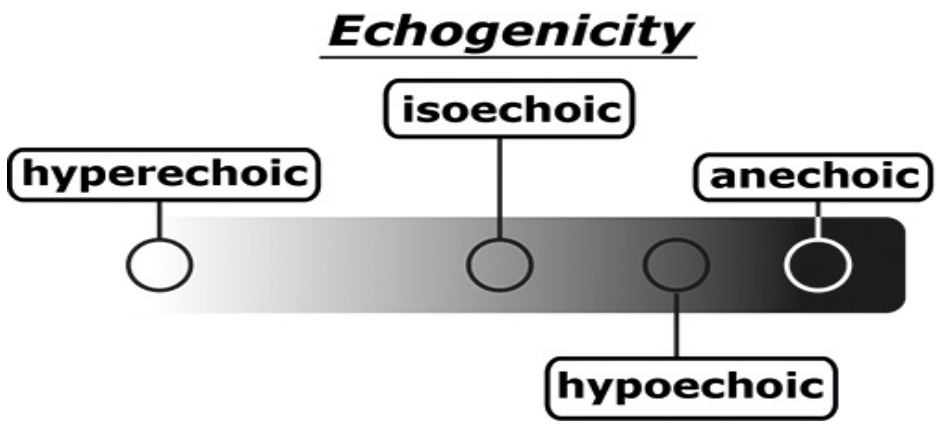




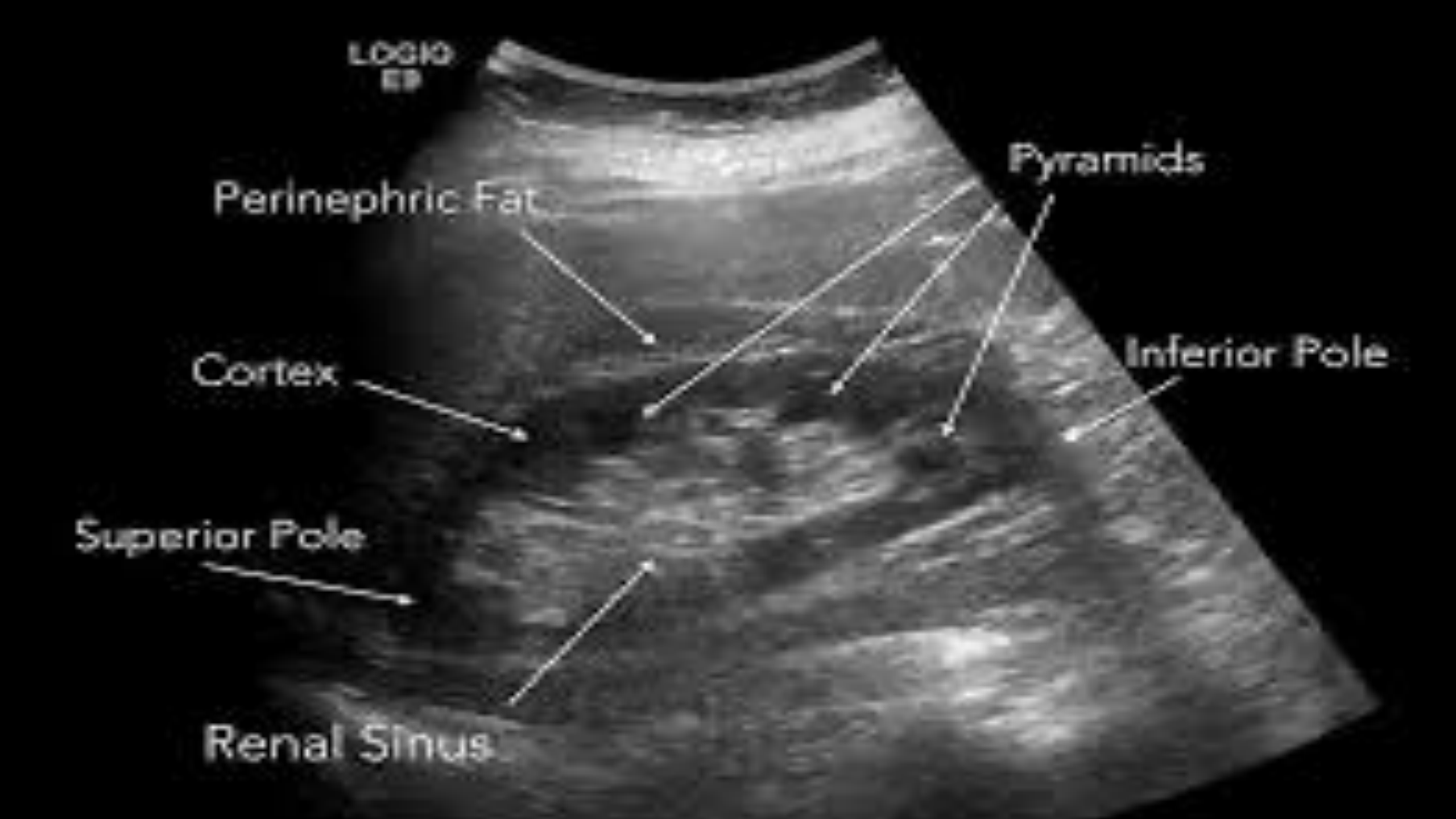
Ultrasound


ULTRASOUND
CRITICAL CARE
UltraSound Critical Care Copyright © 2013, All Rights Reserved


reflected wave
Sender/
Receiver
Object
original wave
distance r


Echogenicity
isoechoic
hyperechoic
anechoic
hypoechoic


Extrahepatic Bile Duct
Right Lobe of Liver
Gallbladder
Portal Vein
Hepatic Vein
R Hemidiaphragm
IVC


LOGIQ
E9
Perinephric Fat
Pyramids
Cortex
Inferior Pole
Superior Pole
Renal Sinus


CRL
CRL 6.81 cm
GA 12w4d 71.6%

Summary

- Recognize the **method** you see —> know what to **focus on**
- Radiology = atlas in real life
- Know your **cross sections** and you’ll be fine!

Thank you for your attention