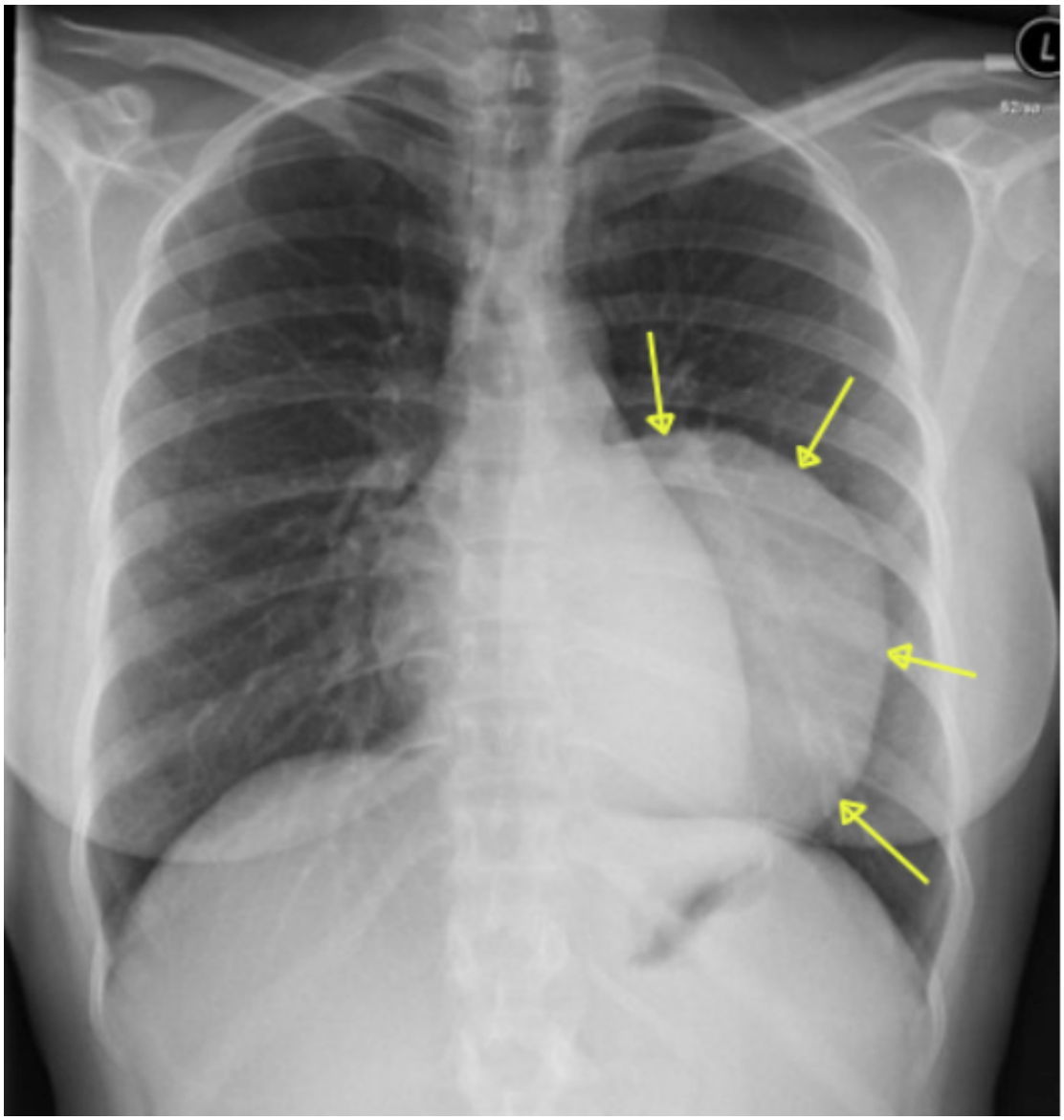
Previous exam questions in X-ray, nuclear imaging and MRI



In this chest X-ray image we see an abnormal shadow that looks like a tumor (arrows). A solid tumor and
the heart have about the same X-ray density. What does it mean that we can see the contour of the heart

through the tumor?
A. The shadow must have a different density from the heart, and ergo, is not a tumor.

B. The possible tumor must lie outside the chest
C. The two structures must lie at different levels (front to back) in the chest
D The shadow is an artifact

What is the reason Technetium can be used for imaging of so many different organs? A Because technetium is so reactive, it will react with molecules in most cells when injected
B Because Technetium emits so many different wavelengths, depending on the tissue

composition, making it possible to select the wavelengths from different tissues with adjustment of the gamma camera

C Because technetium has different isotopes with affinity for different tissues
D Because technetium is so reactive, it can be bound to many different chemical compounds that have affinity for different tissues

Conventional nuclear imaging uses technetium as the radiation source. What makes ^{99}technetium so versatile in functional imaging of so many different organ systems?

A) Because it is water soluble, and will permeate the water in all body parts
B) Because it is a small molecule that readily permeates all cell membranes, thus being

present in all organs
C) Because it is highly reactive, and can be bound to many different chemical substances with different affinity to different cells.
D) Because it has a short half life (6 hours)

What is the principle of PET (positron emission tomography) scan?
A Gamma rays are emitted directly by a radioisotope injected into the body, and are detected by a ring of detectors around the patient. The concentration of the isotope is mapped by the intensity of radiation in the cross section.
B Positrons are emitted by a radioisotope injected into the body, and are detected by a ring of detectors around the patient. The concentration of the isotope is mapped by the intensity of radiation in the cross section.
C Positrons are emitted by a radioisotope injected into the body, travels only a micro distance before being annihilated by collision with an electron. This produces two gamma photons in opposite directions that are detected by a ring of detectors around the patient. The concentration of the isotope is mapped by the intensity of radiation in the cross section.
D Positive alpha particles are emitted directly by a radioisotope injected into the body, and are detected by a ring of detectors around the patient. The concentration of the isotope is mapped by the intensity of radiation in the cross section.

Electrons are the primary energy source in X-ray imaging, causing secondary electromagnetic radiation when they hot the anode. Pet scan also utilizes electromagnetic radiation (γ rays) for imaging, but hhe primary energy source is a particle. Which?

A) Proton

B) Electron

C) Neutron

D) Positron

Which hardware component in an MR system enables spatial encoding of the signal?
A The main superconducting magnet.
B The radiofrequency antennas/coils.

C The gradient coils.

D The shimmy coils.

A child has been wounded by steel fragments from a cluster bomb. Which of these imaging methods should definitely not be used to locate the fragments in the body for safety reasons?
A Ultrasound

B X-ray
C MRI
D Nuclear imaging

And which method would be best from a diagnostic point of view?

A Ultrasound
B X-ray
C MRI

D Nuclear imaging

What happens to the signal intensity in an MR Image when you increase the echo time (TE)?
A: Signal intensity will increase.

B: Signal intensity will decrease.
C: Signal intensity will remain unchanged.
D. Signal intensity will decrease or increase depending on the relaxation time (T2) of the tissue.

What is the origin of the signal in clinical magnetic resonance imaging?

1) Iron ions.
2) Hydrogen nuclei (protons).
3) Water molecules.

4) Injected magnetic particles.

In an MR machine, energy input (RF pulse) results in net magnetization of the nuclei. The loss of this energy is called relaxation, and results in signal output that is used for imaging.
What do we mean by T1-relaxation in MRI?
A The regrowth of longitudinal magnetization towards the thermal

equilibrium value.
B The loss in phase coherence after application of an rf-pulse.
C The loss in transverse magnetization.
D The loss of longitudinal magnetization when applying an rf-pulse.

And why is T1 different from T2?
A The regrowth of longitudinal magnetization depends on the difference in energy states of the “up” and “down” states.
B The regrowth of longitudinal magnetization also depends on “in-phasing” of the magnetic longitudinal magnetic vectors.

C The loss of transverse magnetization is due not only to regrowth of longitudinal magnetization, but also dephasing of the rotation of transverse magnetic vector.
D The RF pulse is always applied in the transverse direction, resulting in an asymmetry between longitudinal and transverse magnetization.