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Question: 1

Radiation damage to the body happens at which of the following levels:

- A. Infrastructure level
- B. Diagnostic level
- C. Attenuation level
- D. Subcellular level

Answer: D

Explanation:

Radiation damage to the body primarily occurs at the subcellular level. This means that the damage is inflicted directly on the components within the cells, such as DNA, RNA, proteins, and cell membranes. When radiation penetrates the body, it has the energy to ionize molecules, which can create free radicals. These free radicals are highly reactive and can cause breaks in the DNA strands or damage other cellular structures.

The subcellular damage is critical because DNA holds all the genetic instructions necessary for the development and function of living organisms. When radiation causes DNA damage, it can lead to mutations, which may result in cells malfunctioning, becoming cancerous, or dying. The effects of radiation at the subcellular level can subsequently influence the entire cellular system, potentially leading to broader tissue and organ damage if the exposure is significant and widespread.

The visibility of radiation damage usually becomes apparent when it has affected millions of cells, leading to symptoms and health issues that can be clinically observed. This might include skin burns, radiation sickness, or increased risk of cancers, which are manifestations of the extensive cellular damage initiated at the subcellular level. Although the initial damage starts small, its amplification through cellular systems leads to significant health problems.

Radiation damage, therefore, is not only about the immediate destruction caused by the initial exposure but also about the long-term biological changes that can lead to chronic health issues. Understanding that radiation affects the body primarily at the subcellular level helps in devising protective measures and treatments that target and mitigate these microscopic interactions to prevent larger scale damage to tissues and organs.

Question: 2

Which of the following is associated with inherent filtration?

- A. Offsets
- B. Oil in the x-ray tube's housing
- C. Densitometer
- D. Gas combined with superconducting magnets

Answer: B

Explanation:

Inherent filtration in x-ray imaging systems, particularly in mammography, involves the use of materials within the x-ray tube assembly to selectively absorb lower energy x-rays before they reach the patient. This process is essential as it enhances the quality of the image by reducing the level of noise and improving the contrast, making the diagnosis more accurate and safer by reducing unnecessary radiation exposure to the patient.

The primary components involved in inherent filtration include the oil in the x-ray tube's housing, the glass or metal of the x-ray tube's exit port window, and other structural materials of the tube. The oil in the x-ray tube's housing is particularly crucial because it serves multiple roles. Not only does it act as a coolant to help manage the heat generated within the x-ray tube, but it also contributes to the filtration process. The oil absorbs some of the softer, less penetrating x-rays emitted by the x-ray source. This absorption of lower energy photons effectively filters out undesirable radiation that does not contribute to the image quality but could increase the radiation dose to the patient.

Other elements that contribute to inherent filtration include the x-ray tube's exit port window, which is typically made of glass or beryllium. Beryllium is preferred in many modern systems because it has a higher transparency to x-rays, thus reducing the amount of filtration and allowing for a more efficient passage of higher energy photons that are useful for imaging. Additionally, components like the collimator and mirror assembly also play a role in shaping and directing the x-ray beam, while the compression plate used in mammography compresses the breast tissue and reduces the thickness that x-rays must penetrate, thereby optimizing image quality and minimizing the dose.

Contrastingly, other options listed in the question such as gas combined with superconducting magnets (associated with MRI systems and their cryogenics for cooling), densitometers (used for measuring optical density of x-ray films), and offsets (related to stereotactic biopsy procedures for precise tissue sampling) are not related to inherent filtration in x-ray systems. These components serve entirely different purposes in their respective fields and are not involved in the filtration of x-rays within an x-ray tube assembly. This makes "Oil in the x-ray tube's housing" the correct answer regarding components associated with inherent filtration in x-ray imaging systems.

Question: 3

A radiologic technologist should know that oxygen is delivered by what type of device:

- A. Venous drainage system
- B. Reservoir
- C. Nasal cannula
- D. Bolus

Answer: C

Explanation:

A radiologic technologist, a professional involved in imaging techniques for diagnosis, must also be familiar with basic medical equipment including devices used for oxygen delivery. Oxygen therapy, which is crucial in various medical conditions to ensure adequate tissue oxygenation, can be

administered through different types of devices. These devices are broadly categorized into high flow and low flow systems, depending on their ability to provide a controlled oxygen concentration. High flow devices are designed to deliver a specified and consistent concentration of oxygen regardless of the patient's breathing pattern. These include devices like air entrainment masks, which mix air and oxygen precisely to achieve a targeted oxygen concentration. On the other hand, low flow devices supply oxygen at a rate that does not necessarily meet the patient's total breathing needs. The actual amount of oxygen inhaled can vary depending on the patient's breathing rate and depth. Among the low flow devices, the nasal cannula is one of the most commonly used. It consists of a lightweight tube with two prongs that are placed in the nostrils. This setup allows the delivery of oxygen directly into the nasal passage, which is then inhaled into the lungs. The simplicity and comfort of the nasal cannula make it suitable for long-term use in patients who need supplemental oxygen. Other forms of low flow devices include various types of masks, such as simple face masks, aerosol masks, rebreathing, and non-rebreathing masks, each tailored for specific patient needs based on the required oxygen levels and the efficiency of their respiratory mechanisms. Therefore, when asked about the type of device used for delivering oxygen, a radiologic technologist should be knowledgeable about these options. Specifically, a nasal cannula is a correct response in the context of common, less invasive, and easily manageable oxygen delivery systems in various healthcare settings. Understanding these tools is essential for technologists to ensure comprehensive patient care, even though their primary responsibilities lie within imaging.

Question: 4

A private or civil injustice that may involve an injury refers to:

- A. Reasonable cause
- B. Due care
- C. Criminal law
- D. Tort

Answer: D

Explanation:

A tort is classified as an intentional tort or an unintentional tort. A tort happens when an individual feels that he or she has been wronged or suffered an injury through other methods beside a breach of contract. Also, with a tort, an individual has sustained an injury and the individual who caused the injury was at fault. The individual who has been injured can seek damages or monetary compensation for the injury.

An intentional tort involves misconduct that is intentional or done on purpose. Examples of an intentional tort may include false imprisonment, libel, battery, assault, slander and invasion of privacy. An unintentional tort is categorized as malpractice and negligence.

A tort has four essential elements that have to be proven: duty - where a professional did not provide care that is reasonable, the breach of duty, an injury and the injury was due to the breach of duty (where the professional did not provide adequate care to patient and this inadequate care injures the patient).

Further, reasonable cause is performing care that is acceptable. Then, due care is the act of providing adequate care and adhering to a patient's or individual's right. Criminal law is a form of law that focuses on societal conduct.

Question: 5

The technologist places the patient in an upright position during a chest x-ray of the lungs and the heart to prevent:

- A. Engorgement of the pulmonary vessels
- B. Extension of the thorax
- C. Placement of an intravenous catheter
- D. Full inspiration

Answer: A

Explanation:

During a chest x-ray, it is crucial to position the patient correctly to ensure an accurate and clear image of the thoracic structures such as the lungs, heart, and diaphragm. The standard practice is to have the patient in an upright position, whether standing or sitting. This specific positioning plays a significant role in preventing the engorgement of pulmonary vessels, which can occur if the patient is in a supine or horizontal position.

Engorgement of the pulmonary vessels refers to the abnormal accumulation of blood in the vessels of the lungs. This can happen due to various reasons, including gravitational effects when a person is lying down. In the supine position, gravity causes more blood to pool in the lung vessels, which can lead to an apparent increase in the size and density of these vessels on an x-ray image. This pooling can obscure or alter the appearance of lung tissues and potentially mask or mimic pathological changes, leading to inaccurate interpretations.

By positioning the patient upright, gravity assists in pulling the blood towards the lower extremities, reducing the blood volume in the thoracic vessels. This results in a more normal distribution and appearance of the pulmonary vessels in the chest x-ray. The diaphragm, which is the primary muscle of respiration situated below the lungs, also moves downward more effectively when the patient is upright. This movement increases the thoracic cavity's space, allowing a better expansion of the lungs and a clearer view of the lower lung fields, which is essential for diagnosing conditions affecting these areas.

Additionally, an upright position during a chest x-ray facilitates the free movement of any fluids in the thoracic cavity, such as pleural effusions (fluid accumulation around the lungs), to the lowest parts of the chest cavity. This makes the fluids easier to detect and accurately assess, which is crucial for correct diagnosis and treatment planning.

In summary, the technologist places the patient in an upright position during a chest x-ray primarily to prevent the engorgement of pulmonary vessels, ensuring a clearer and more accurate depiction of the heart and lungs. This positioning also aids in better diaphragmatic movement and fluid displacement, contributing to a comprehensive evaluation of the thoracic structures.

Question: 6

Coronary heart disease is best described as:

- A. Plaque accumulation in the coronary arteries

- B. Debulking of the arteries
- C. Fluid collection in the pericardium
- D. Blood regurgitation of the heart valves

Answer: A

Explanation:

Coronary heart disease (CHD), also known as coronary artery disease, primarily results from the accumulation of plaque in the coronary arteries. This condition is a leading cause of death worldwide and is primarily driven by lifestyle factors and genetics.

Plaque is composed of fat, cholesterol, calcium, and other substances found in the blood. Over time, these substances can deposit along the inner walls of the coronary arteries, which are the major blood vessels responsible for supplying oxygen-rich blood to the heart muscle itself. This process is known as atherosclerosis. Initially, as plaque starts to build up, the arteries become narrower, reducing the blood flow to the heart and subsequently decreasing the oxygen available to it.

As the condition progresses, the risk of complete blockage or a heart attack increases. Plaque deposits can rupture, leading to the formation of a blood clot that can block the flow of blood. A complete blockage can cause a portion of the heart muscle to be starved of oxygen, a condition known as a myocardial infarction, or more commonly, a heart attack.

Symptoms of CHD may include angina (characterized by chest pain on exertion), shortness of breath, and in severe cases, heart attack. However, not all individuals with CHD will experience noticeable symptoms, which can make this disease particularly dangerous as it may go undiagnosed until a severe event like a heart attack occurs.

Management of CHD involves lifestyle modifications such as diet and exercise, medications that may include aspirin, statins, or beta-blockers, and in some cases, surgical interventions such as angioplasty or coronary artery bypass grafting (CABG). These treatments aim to reduce the symptoms, slow the progression of the disease, and prevent future cardiovascular events such as heart attacks.

It is important to distinguish CHD from other heart-related conditions like fluid collection in the pericardium (pericardial effusion), blood regurgitation of the heart valves (valvular heart disease), and debulking of the arteries, which are different in their pathogenesis and clinical management.

Understanding the specific nature and treatment of CHD is crucial for effective disease management and improving patient outcomes.

Question: 7

Which of the following is a form of radiopharmaceutical material that is inhaled, injected or orally ingested into the body for a nuclear medicine test?

- A. Tracer
- B. Becquerel
- C. SI unit
- D. Atomic transformer

Answer: A

Explanation:

The correct answer to the question is "Tracer." This is because a tracer is a type of radiopharmaceutical material that is specifically designed to be injected, inhaled, or orally ingested into the body for the purpose of conducting a nuclear medicine test.

Tracers are crucial in nuclear medicine because they allow doctors to observe the function of various organs and tissues within the body. A tracer contains a radioactive isotope or a fluorescent compound, which acts as a marker. This marker emits signals in the form of gamma radiation, which can be traced and monitored.

Once administered, the tracer travels to a targeted area or organ in the body, depending on its chemical composition. For example, certain tracers might accumulate in bone tissue, while others might be absorbed by the thyroid gland. The radioactive isotopes in the tracer emit gamma radiation, which is then detected by special imaging equipment, such as a gamma camera.

The gamma camera captures this radiation and converts it into images that provide detailed information about the structure and function of the organ being examined. This is particularly useful for diagnosing diseases, monitoring the progression of conditions, or evaluating the effectiveness of a treatment.

It is important to note that tracers are designed to emit a very low level of radiation, which is generally considered safe for patients. The radioactive elements in tracers have a short half-life, meaning they decay rapidly and lose their radioactivity, minimizing exposure to the patient.

In summary, tracers are a fundamental component of nuclear medicine, providing valuable diagnostic information through the use of radioactive isotopes or fluorescent compounds, which can be safely administered and monitored within the human body.

Question: 8

When a dual energy x-ray absorptiometry is performed, the term that describes the statistical results of a change in bone mineral density is known as:

- A. Real change
- B. Bilateral measurements
- C. Standard scoring
- D. Relative bone risk values

Answer: A

Explanation:

When a dual energy x-ray absorptiometry (DXA) is performed, the term that describes the statistical results of a change in bone mineral density is known as "Real change". This term is significant as it indicates whether the observed change in bone mineral density (BMD) from one DXA scan to another is actual and not just due to measurement errors or variations.

Dual energy x-ray absorptiometry (DXA) is a method used primarily to evaluate bone mineral density, an important factor in diagnosing osteoporosis and assessing fracture risk. DXA uses two X-ray beams at different energy levels which are absorbed by bones differently. By analyzing the absorption patterns, it provides a detailed image of bone density.

Precision in DXA measurements is crucial as it impacts the reliability of the diagnosis and monitoring of bone health over time. Precision in this context refers to the reproducibility of the BMD results when the same person is retested on the same machine by the same operator under identical conditions. Lower variability (or higher precision) in the measurement assures greater confidence that any change in BMD is real and not due to errors.

The concept of "real change" is determined by the precision of the DXA device, quantified typically by the standard deviation (SD) of repeated measurements. The smaller the SD, the higher the precision, indicating that the instrument can detect smaller changes in BMD between different scans reliably. Additionally, the coefficient of variation (CV), which is the SD divided by the mean BMD, provides a normalized measure of precision.

To conclude, in the context of DXA scans, the term "real change" is used to describe a statistically significant difference in bone mineral density that exceeds the variability inherent in the measurement process. This term helps clinicians and researchers distinguish between true changes in bone density and variations that might arise from measurement inaccuracies, thereby aiding in effective clinical decision-making regarding bone health management.

Question: 9

Which of the following is an indication for duplex scanning?

- A. Afebrile infarction
- B. Internal infraction
- C. Muscle claudication
- D. Deep vein thrombosis

Answer: D

Explanation:

The question inquires about the appropriate clinical indication for utilizing duplex scanning among several options. The correct answer is 'Deep vein thrombosis'. To understand why, it's important to first understand what duplex scanning entails and how it works in the context of different medical conditions.

Duplex scanning is a medical imaging technique that combines traditional ultrasound with Doppler ultrasound technology. This combination allows for the visualization of the structure of blood vessels and organs, as well as the flow of blood through these vessels. The 'duplex' part of the name refers to the two modes of ultrasound used: B-mode or real-time imaging of the structure, and Doppler mode, which detects the movement of blood within the vessels.

The main utility of a duplex scan in the context of deep vein thrombosis (DVT) lies in its ability to detect abnormalities in blood flow and to examine the physical characteristics of the veins. DVT is a condition characterized by the formation of a blood clot in a deep vein, usually in the legs. This clot can block blood flow and cause swelling, pain, and complications such as pulmonary embolism if the clot travels to the lungs.

During a duplex scan for DVT, the sonographer applies a handheld device called a transducer to the skin over the suspected area. This device emits sound waves that bounce off the blood vessels, and the returning echoes are translated into an image. The ultrasound can show if a vein is compressed or has a clot, as veins with clots do not collapse under the pressure of the ultrasound probe, unlike healthy veins. Additionally, the Doppler component of the scan evaluates the velocity and direction of blood flow in the vein. In DVT, blood flow is typically absent or significantly reduced in the area of the clot.

Comparatively, conditions like afebrile infarction, internal infarction, and muscle claudication do not typically utilize duplex scanning as the primary diagnostic tool. Afebrile infarction and internal infarction generally refer to areas of tissue death due to lack of blood supply, commonly diagnosed with other imaging modalities such as MRI or CT scans, which can provide detailed information about the affected

organs and tissues. Muscle claudication, which is pain caused by exercise due to inadequate blood flow, is more often assessed initially through patient history and physical examination, and possibly later with other forms of imaging or functional tests to assess arterial flow.

Therefore, among the options provided, 'Deep vein thrombosis' is the correct indication for a duplex scan. This tool is critical in the timely and accurate diagnosis of DVT, helping to prevent the potential severe complications of this condition.

Question: 10

Which of the following changes a function in the body?

- A. Peristalsis
- B. Drug
- C. Bolus
- D. Ampule

Answer: B

Explanation:

The question asks which of the following changes a function in the body, with the options being peristalsis, drug, bolus, and ampule. The correct answer is "drug." Here's an expanded explanation for why "drug" is the correct answer and why the other options do not fit:

Drugs are substances that, when introduced into the body, interact with the body's biological systems to induce changes. These can be therapeutic or harmful, depending on the nature of the substance and the manner of its use. Drugs can alter physiological functions through various mechanisms, such as influencing neurotransmitter levels in the brain, changing cardiovascular activities, or modulating the immune system. The effects can be widespread or targeted to specific organs or systems. This capacity to change or modify bodily functions makes drugs distinct in their impact on the body compared to the other options given.

Peristalsis, on the other hand, is a natural process in the body. It involves the rhythmic contractions of the muscles in the gastrointestinal tract to move food along the digestive system. Peristalsis is a normal bodily function, not an external agent that induces change in the body's functions.

Bolus refers to a mass of chewed food at the point of swallowing or a dose of a substance administered intravenously. While the bolus itself is something introduced into the body, it does not inherently change body functions. Instead, it is part of the normal process of digestion or, in the case of medical procedures, just a method of delivery. When used in the context of medicine (e.g., a bolus of drugs), the drug within the bolus would be the agent effecting change, not the bolus itself.

Ampule refers to a sealed glass or plastic container used to hold a liquid, usually a drug. The ampule itself is merely a packaging method and does not affect body functions. The contents of an ampule may be a drug that changes body functions, but the ampule as an object has no biological impact.

Therefore, among the listed options, only "drug" is appropriate as it directly correlates to changes in body functions through chemical interactions. The other options either describe processes or methods of containment and delivery that do not inherently alter bodily functions.

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