NEET SS 2024 Diploma Radio Diagnosis Paper3 Question Paper with Solutions

| Time Allowed :3 Hours | Maximum Marks :100 | Total Questions :10 |

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The test is of 3 hours duration.

2. The question paper consists of 10 questions. The maximum marks are 100.

3. Each Question is of 10 marks.

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1. a) Ultrasound in evaluation of thyroid nodule.

Solution:

Step 1: Introduction to Ultrasound in Thyroid Evaluation.
Ultrasound is a non-invasive imaging modality widely used for the evaluation of thyroid nodules. It helps to differentiate between benign and malignant nodules based on characteristics like size, shape, borders, and internal features. Doppler ultrasound can also assess blood flow within the nodule.

Step 2: Key Features on Ultrasound.
- Benign nodules: These tend to be well-defined, with smooth borders, and often have a spongiform appearance.
- Malignant nodules: These are typically hypoechoic (darker) with irregular borders, microcalcifications, and possibly a central vascular pattern. The presence of enlarged lymph nodes may also be observed.

Step 3: Conclusion.
Ultrasound is an essential tool in the evaluation of thyroid nodules as it provides real-time, detailed images to guide clinical decisions, particularly in distinguishing benign from malignant lesions.

Quick Tip

Use ultrasound as the first-line imaging technique for evaluating thyroid nodules. Pay attention to the shape, borders, and internal structure to assess malignancy risk.

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1. b) Discuss the imaging findings of tubercular meningitis.

Solution:

Step 1: Introduction to Tubercular Meningitis.
Tubercular meningitis (TBM) is a severe form of central nervous system tuberculosis and can be fatal if not treated early. It primarily affects the meninges and brain, leading to hydrocephalus and other complications. Imaging plays a critical role in the diagnosis and monitoring of TBM.

Step 2: Imaging Findings in Tubercular Meningitis.
- CT Scan: On CT, TBM typically shows basal meningeal enhancement with hydrocephalus. The enhancement is most noticeable around the basal cisterns, which is characteristic of the disease.
- MRI: MRI is more sensitive than CT for detecting early changes. It reveals meningeal enhancement, especially along the convexity and basal cisterns, and may show signs of cerebral infarction or edema. In advanced cases, tuberculomas (small nodular masses) may be observed in the brain parenchyma.
- Other findings: Chronic TBM may lead to thickening of the meninges, hydrocephalus, and changes in the cortical and subcortical regions.

Step 3: Conclusion.
Imaging findings, especially on MRI and CT, are crucial for diagnosing tubercular meningitis. Early detection and monitoring through imaging are essential for appropriate treatment and management of the disease.

> **Quick Tip**
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> In cases of suspected tubercular meningitis, MRI is preferred over CT due to its higher sensitivity in detecting early changes such as meningeal enhancement.

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2. a) Enumerate the various posterior fossa brain tumors that can be found in children.

Solution:

Step 1: Understanding the Posterior Fossa.
The posterior fossa is a region at the back of the skull that contains important structures such as the cerebellum, brainstem, and cranial nerves. Brain tumors in this region are common in children and can cause a variety of symptoms like headaches, nausea, and ataxia.

Step 2: Types of Posterior Fossa Tumors in Children.
The following are common posterior fossa tumors found in children:

1. Medulloblastoma: This is the most common malignant tumor in the posterior fossa in children. It typically arises from the cerebellum and can cause hydrocephalus due to its location in the fourth ventricle. Medulloblastomas can metastasize to the spinal cord.

2. Ependymoma: Ependymomas are tumors that arise from the ependymal cells lining the ventricles of the brain. In children, they are commonly found in the fourth ventricle, leading to obstruction of cerebrospinal fluid (CSF) flow and hydrocephalus.

3. Astrocytoma: Astrocytomas in the posterior fossa are usually low-grade tumors that may occur in the cerebellum or brainstem. While they tend to grow slowly, they can cause significant symptoms due to compression of vital structures.

4. Brainstem Glioma: Brainstem gliomas are gliomas that occur in the brainstem, which is located in the posterior fossa. These tumors are often difficult to treat due to their location and proximity to vital neural pathways.

5. Cerebellar Hemangioblastoma: This is a rare, benign tumor often associated with von Hippel-Lindau syndrome. It originates from the blood vessels of the cerebellum and can cause ataxia and other neurological deficits.

6. Craniopharyngioma: Though more commonly found in the suprasellar region, craniopharyngiomas can sometimes extend into the posterior fossa. These are benign tumors that arise from pituitary remnants and can cause hydrocephalus.

Step 3: Conclusion.
The most common posterior fossa tumors in children include medulloblastoma, ependymoma, and astrocytoma. Each tumor has distinct features and treatment approaches. Early diagnosis through imaging (CT, MRI) is critical for management.

> **Quick Tip**
>
> Posterior fossa tumors in children often present with symptoms of increased intracranial pressure, such as headache and vomiting. Immediate imaging is crucial for diagnosis.

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2. b) Describe in brief the epilepsy protocol.

Solution:

Step 1: Understanding Epilepsy and its Management Protocol.
Epilepsy is a neurological disorder characterized by recurrent seizures. The management protocol for epilepsy aims to control seizures, improve the patient's quality of life, and prevent side effects. It involves a combination of medical, lifestyle, and sometimes surgical interventions.

Step 2: Key Elements of the Epilepsy Protocol.

1. Initial Assessment: The first step in the protocol is to assess the patient thoroughly. This includes a detailed history of the seizures, neurological examination, and appropriate investigations (EEG, MRI, or CT). The goal is to determine the type of epilepsy and identify any underlying causes.

2. Pharmacological Management: The mainstay of epilepsy treatment is antiepileptic drugs (AEDs). The choice of AED depends on the type of epilepsy and patient factors (age, comorbidities, side effects). Common AEDs include valproate, carbamazepine, lamotrigine, and levetiracetam.

3. Lifestyle Modifications: Patients are advised to avoid seizure triggers, such as lack of sleep, alcohol, and flashing lights. A healthy lifestyle, including proper sleep, diet, and stress management, is crucial.

4. Surgical Intervention: In cases of refractory epilepsy (where seizures are not controlled with medication), surgical options such as resective surgery (removal of the epileptogenic focus), deep brain stimulation (DBS), or vagal nerve stimulation (VNS) may be considered.

5. Emergency Management: In the event of a seizure, patients are advised to follow specific guidelines, such as ensuring safety (placing the person on their side), monitoring the duration, and seeking medical help if the seizure lasts longer than 5 minutes or if there are multiple seizures in a row.

6. Long-term Follow-up: Regular follow-up visits are essential for monitoring treatment efficacy, managing side effects, and adjusting the treatment plan as necessary. Epilepsy can often be controlled with the appropriate regimen, and many patients achieve seizure freedom with time.

Step 3: Conclusion.

The epilepsy management protocol involves a comprehensive approach starting with accurate diagnosis, followed by pharmacological management, lifestyle modifications, and possible surgical intervention in severe cases. With proper treatment, most patients can achieve good seizure control.

> **Quick Tip**
>
> In epilepsy management, it is important to tailor the treatment to the individual, taking into account the seizure type, age, and comorbid conditions. Regular follow-up is key to ensuring optimal control.

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3. a) Radiological evaluation of acute appendicitis.

Solution:

Step 1: Understanding Acute Appendicitis.
Acute appendicitis is a common condition that causes inflammation of the appendix, leading to abdominal pain and other symptoms. Early diagnosis is crucial to avoid complications like perforation. Radiological imaging plays a vital role in confirming the diagnosis, especially when clinical findings are ambiguous.

Step 2: Radiological Imaging Techniques for Acute Appendicitis.
1. Ultrasound (US): The first-line imaging modality in children and pregnant women due to its non-invasive nature. The key features of appendicitis on ultrasound include a non-compressible, enlarged appendix with a diameter greater than 6 mm, often with surrounding fluid or free air.

2. CT Scan (Computed Tomography): CT is highly sensitive and provides a detailed view of the appendix and surrounding structures. The findings in acute appendicitis typically include: - An enlarged, thickened appendix (¿6 mm in diameter). - Inflammation around the appendix, which may include fat stranding. - Presence of appendicoliths (calcified deposits in the appendix). - Perforation or abscess formation in advanced cases.

3. MRI (Magnetic Resonance Imaging): MRI is an alternative to CT, particularly in pregnant women or those who need to avoid radiation. MRI shows similar features to CT, such as an enlarged appendix, peri-appendiceal fluid, and fat stranding.

Step 3: Conclusion.
Radiological imaging, especially ultrasound, CT, and MRI, plays a critical role in diagnosing acute appendicitis. Timely imaging helps in confirming the diagnosis and avoiding unnecessary surgeries or complications.

> **Quick Tip**
>
> Use ultrasound as the first-line imaging technique for suspected acute appendicitis, especially in children and pregnant women. If the diagnosis is unclear, CT or MRI can provide more detailed information.

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3. b) X-ray features of sigmoid volvulus.

Solution:

Step 1: Understanding Sigmoid Volvulus.
Sigmoid volvulus occurs when the sigmoid colon twists around its mesentery, leading to bowel obstruction. It is a common cause of large bowel obstruction, especially in elderly patients. X-ray imaging is often used as an initial diagnostic tool.

Step 2: Key X-ray Features of Sigmoid Volvulus.
1. Coffee Bean Sign: The most characteristic X-ray finding in sigmoid volvulus is the "coffee bean" sign. This sign appears as a large, curved, gas-filled structure resembling a coffee bean, representing the distended sigmoid colon twisted on its mesentery.

2. Frontal View: On a frontal abdominal X-ray, the twisted colon appears as a distended, centrally located loop of bowel with a characteristic curved shape. The ends of the loop are often seen in the upper abdomen.

3. Inverted U-shape or Bird's Beak: In some cases, the X-ray may show an inverted U-shape or a bird's beak appearance at the site of the twist. This indicates where the sigmoid colon has rotated and narrowed at the point of torsion.

4. Bowel Obstruction Signs: In addition to the characteristic sigmoid appearance, there may be generalized signs of bowel obstruction such as dilated loops of bowel and absence of gas in the distal colon.

Step 3: Conclusion.
The X-ray features of sigmoid volvulus, particularly the coffee bean sign and the inverted U or bird's beak appearance, are key to diagnosing the condition. Prompt recognition on X-ray can help guide further management, such as decompression or surgery.

> **Quick Tip**
>
> The "coffee bean" sign is highly indicative of sigmoid volvulus on X-ray. Early identification can guide prompt decompression or surgical intervention.

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4. a) Emphysematous pyelonephritis.

Solution:

Step 1: Understanding Emphysematous Pyelonephritis (EPN).
Emphysematous pyelonephritis is a severe, life-threatening bacterial infection of the kidney characterized by the presence of gas in the renal parenchyma, renal pelvis, or perinephric space. It is most commonly associated with diabetes mellitus and urinary tract obstruction. Early diagnosis and treatment are crucial to avoid complications such as renal failure or sepsis.

Step 2: Radiological Features of Emphysematous Pyelonephritis.
1. CT Scan (Computed Tomography): The gold standard for diagnosing EPN, CT can show: - Gas formation within the renal parenchyma, renal capsule, or perinephric space. The gas may appear as bubbles or areas of low attenuation in the affected kidney. - Hydronephrosis, which can occur due to urinary obstruction. - Renal enlargement and poorly defined renal borders

due to inflammation. - Perinephric fat stranding and abscess formation in severe cases.

2. Ultrasound: While not as sensitive as CT, ultrasound may show: - Hyperechoic areas corresponding to gas collections in the kidney or surrounding tissue. - Renal enlargement and fluid collections suggesting abscess formation.

Step 3: Conclusion.
Emphysematous pyelonephritis is diagnosed based on clinical suspicion and confirmed by imaging, with CT being the most effective modality. Early identification and aggressive treatment, including antibiotics and sometimes surgical intervention, are essential for improving patient outcomes.

> **Quick Tip**
>
> CT is the best imaging modality for diagnosing emphysematous pyelonephritis, as it can directly visualize gas within the kidney and surrounding areas.

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4. b) Evaluation of suspected bladder injury on CT.

Solution:

Step 1: Understanding Bladder Injury.
Bladder injuries are often caused by blunt or penetrating trauma, and they can result in urinary extravasation, peritoneal contamination, and sepsis. CT imaging is commonly used to assess suspected bladder injuries, particularly in the setting of trauma.

Step 2: Radiological Evaluation of Bladder Injury on CT.
1. CT with Contrast (CTC): A CT cystogram with contrast is the gold standard for evaluating bladder injury. The steps are as follows: - Filling the bladder with contrast: The bladder is filled with a contrast agent (usually iodinated contrast), and a CT scan is performed. - Bladder Wall Rupture: A bladder rupture is suggested when there is contrast extravasation outside the bladder, seen as contrast leakage into the peritoneum or retroperitoneal space. - Intraperitoneal Rupture: Contrast material leaking into the peritoneal cavity suggests an intraperitoneal rupture. These injuries are more common and often associated with more severe trauma. - Extraperitoneal Rupture: If the contrast leaks into the surrounding soft tissues but does not enter the peritoneal cavity, it indicates an extraperitoneal rupture. These are often managed non-surgically.

2. Non-Contrast CT: If contrast is not available or there is contraindication for its use, a non-contrast CT may show: - Bladder wall thickening or distension, which can indicate injury. - Pelvic fractures or other associated injuries that can suggest bladder trauma.

3. Other Features to Look for on CT: - Hemoperitoneum or pelvic fluid collections may indicate bladder rupture. - Pelvic fractures and bladder neck or urethral injury should also be considered.

Step 3: Conclusion.
CT imaging, particularly with contrast, is a valuable tool for diagnosing bladder injuries. The presence of contrast extravasation, especially into the peritoneum, is a strong indicator of bladder rupture. Timely imaging and intervention are essential to prevent complications and guide treatment.

> **Quick Tip**
>
> Use a CT cystogram with contrast for the most accurate assessment of bladder injury. Look for contrast extravasation to confirm the diagnosis of bladder rupture.

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5. Discuss the imaging findings in primary intestinal lymphoma.

Solution:

Step 1: Understanding Primary Intestinal Lymphoma.
Primary intestinal lymphoma is a rare type of non-Hodgkin lymphoma that originates in the intestines, typically in the small bowel. It can present with a variety of gastrointestinal symptoms such as abdominal pain, weight loss, nausea, and gastrointestinal bleeding. Imaging is crucial for diagnosis, staging, and monitoring treatment response.

Step 2: Imaging Modalities Used in Primary Intestinal Lymphoma.
The following imaging techniques are commonly used to evaluate primary intestinal lymphoma:

1. CT Scan (Computed Tomography): CT is often the first-line imaging modality used to evaluate primary intestinal lymphoma. - Bowel Wall Thickening: One of the most common findings is thickening of the bowel wall, which can be circumferential or segmental, and is usually more prominent in the ileum or cecum. - Lymphadenopathy: Enlarged mesenteric or retroperitoneal lymph nodes may be seen, which are indicative of lymphoma involvement. - Mass Effect: In some cases, a mass effect from the tumor may cause bowel obstruction or displacement of adjacent structures. - Mesenteric Fat Stranding: This can be seen around the affected bowel, indicating inflammation or infiltration of lymphoma cells into the surrounding tissue. - Perforation or Ischemia: In advanced cases, CT may show complications such as bowel perforation or signs of ischemia, though these are less common.

2. MRI (Magnetic Resonance Imaging): MRI can provide additional information and is useful in evaluating soft tissue contrast. - Bowel Wall Enhancement: MRI often demonstrates bowel wall enhancement after contrast administration, which is a typical finding in lymphoma. - Mesenteric Involvement: MRI is sensitive for detecting mesenteric involvement and can show the degree of fatty infiltration, which is common in lymphoma. - Lymphadenopathy: MRI

also helps in visualizing enlarged lymph nodes and assessing their relationship to surrounding structures.

3. Endoscopy (Capsule Endoscopy and Colonoscopy): Endoscopy is valuable for obtaining direct visualizations of the intestinal mucosa. - Mucosal Nodules or Ulcerations: Endoscopy may reveal mucosal nodules, ulcers, or mass lesions. However, the diagnostic yield may be limited, as the tumor can be submucosal or deeply located in the bowel wall. - Capsule Endoscopy: Capsule endoscopy can be particularly helpful in detecting small bowel lesions that are difficult to visualize by traditional endoscopy.

4. PET-CT (Positron Emission Tomography - Computed Tomography): PET-CT is used for staging and assessing the metabolic activity of the lymphoma. - Increased FDG Uptake: PET-CT can detect areas of increased glucose metabolism, which is characteristic of malignant lymphoma. This modality is highly sensitive in detecting nodal and extranodal lymphoma involvement, including intestinal masses.

Step 3: Conclusion.
Imaging plays a pivotal role in diagnosing primary intestinal lymphoma, with CT and MRI being the most commonly used modalities. CT can reveal bowel wall thickening, mesenteric lymphadenopathy, and mass effects, while MRI offers superior soft tissue contrast. Endoscopy and PET-CT provide additional valuable information for diagnosis and staging.

> **Quick Tip**
>
> In primary intestinal lymphoma, CT is the initial imaging modality of choice to detect bowel wall thickening and lymphadenopathy. MRI is useful for detailed soft tissue evaluation.

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6. In imaging a case of acute ischemic stroke, discuss:

a) Imaging findings on CT head.

Solution:

Step 1: Understanding Acute Ischemic Stroke.
Acute ischemic stroke occurs when blood flow to a region of the brain is interrupted, leading to neuronal injury and infarction. The primary goal of imaging is to confirm the diagnosis, assess the extent of damage, and rule out other causes of neurological deficits such as hemorrhage. CT imaging is often the first modality used in suspected stroke cases.

Step 2: CT Imaging Findings in Acute Ischemic Stroke.
1. Early CT Findings (0-6 hours): - Normal CT: In the early stages of ischemic stroke, CT may appear normal. This is because changes due to ischemia may not be visible immediately on CT

scans. - Hypodensity: As ischemia progresses, the affected brain region may show hypodensity (darker areas), which indicates tissue infarction. This is usually not evident until 6-24 hours after the onset of symptoms. - Loss of gray-white matter differentiation: This is one of the first changes seen in acute ischemia, where the normal distinction between the gray matter and white matter becomes blurred due to cytotoxic edema.

2. Intermediate CT Findings (24-48 hours): - Well-defined Hypodense Area: The infarcted area becomes more clearly visible as it becomes hypodense (darker) compared to normal brain tissue. - Mass Effect: Swelling or edema within the infarcted area can cause a mass effect, leading to midline shift or compression of adjacent structures.

3. Late CT Findings (3-7 days): - Cystic Changes: In the later stages, infarcted tissue may undergo liquefaction, leading to the formation of cystic areas or an encephalomalacic cavity. - Atrophy: With chronic infarction, there can be atrophy or shrinkage of the brain tissue in the infarcted area, which is visible on follow-up CT scans.

Step 3: Conclusion.
CT is often the first imaging modality used to rule out hemorrhage and detect early ischemic changes. However, it may not show ischemic changes immediately, and follow-up imaging is important for assessing the full extent of the stroke.

Quick Tip

In acute ischemic stroke, CT is useful for detecting hemorrhage and early signs of ischemia, but it may not reveal ischemic changes until several hours after the onset. A follow-up CT or MRI may be needed for definitive assessment.

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6. b) The role of MRI.

Solution:

Step 1: Role of MRI in Acute Ischemic Stroke.
MRI is a more sensitive imaging modality for detecting acute ischemic stroke compared to CT. It can detect ischemic changes earlier, even within the first few minutes to hours after symptom onset. MRI is particularly useful for evaluating the extent of tissue damage and identifying the stroke subtype.

Step 2: MRI Findings in Acute Ischemic Stroke.
1. Diffusion-Weighted Imaging (DWI): - Early Changes: DWI is highly sensitive in the early detection of ischemia, showing restricted diffusion within minutes of the onset of stroke. This results in hyperintensity (bright areas) in the affected region, indicating cytotoxic edema and acute infarction. - Ischemic Penumbra: DWI can help identify the ischemic penumbra, which is the area around the core of infarction that is at risk but not yet irreversibly damaged. This is crucial for therapeutic decisions, especially in candidates for thrombolysis.

2. Fluid-Attenuated Inversion Recovery (FLAIR): - Delayed Changes: FLAIR imaging is sensitive to changes in the later stages of ischemia. It can show hyperintensity (bright areas) in the

affected brain regions as the edema and ischemia progress. - Infarct Progression: In the subacute and chronic stages of ischemic stroke, FLAIR imaging is useful for assessing the evolution of the infarct and its surrounding edema.

3. Magnetic Resonance Angiography (MRA): - Vascular Assessment: MRA is used to assess the patency of the arteries involved in ischemic stroke. It helps in visualizing the presence of large vessel occlusion, stenosis, or embolism, which are important for determining the stroke mechanism and treatment strategy.

4. Perfusion Imaging (MRP): - Cerebral Blood Flow Assessment: Perfusion MRI can assess cerebral blood flow and help differentiate between the ischemic core and the penumbra, which is important for treatment planning, especially for thrombolysis or thrombectomy.

Step 3: Conclusion.

MRI, particularly with techniques like DWI, FLAIR, and MRA, plays a key role in the early detection, characterization, and monitoring of acute ischemic stroke. It provides critical information about ischemic tissue and can guide therapeutic interventions. MRI is especially important in detecting stroke in the first few hours when CT may not show abnormalities.

Quick Tip

MRI, especially DWI, is the most sensitive imaging modality for detecting acute ischemic stroke. It provides early detection and detailed information about the ischemic tissue, which is essential for treatment planning.

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7. a) Discuss the CT imaging protocol in evaluating a case of renal cell carcinoma.

Solution:

Step 1: Introduction to Renal Cell Carcinoma (RCC).

Renal cell carcinoma (RCC) is the most common type of kidney cancer. Early diagnosis through imaging is crucial for staging, treatment planning, and assessing resectability. The most commonly used imaging modality for evaluating RCC is CT (Computed Tomography). The CT imaging protocol is essential for detecting the tumor, assessing its size, location, and extension, as well as evaluating the presence of metastasis.

Step 2: CT Imaging Protocol for RCC.

The standard CT protocol for evaluating renal cell carcinoma includes the following:

1. Non-contrast CT (Initial Imaging): - A non-contrast scan is performed to assess for the presence of renal masses, their characteristics, and any signs of calcification within the mass. RCC may present as a solid, heterogeneous mass without calcification, though cystic RCCs may have areas of calcification. - Non-contrast imaging also helps in evaluating the renal parenchyma and identifying any other structural abnormalities like hydronephrosis.

2. Contrast-enhanced CT (Enhanced Imaging): - Arterial Phase (Early Enhancement): The arterial phase is useful for detecting hypervascular tumors, which are common in RCC. RCC typically enhances early and shows rapid washout on later phases. - Venous Phase (Parenchymal

Phase): This phase is important for assessing the tumor's involvement with the renal veins or inferior vena cava (IVC) and helps in determining the extent of tumor invasion. - Delayed Phase (Excretory Phase): This phase is used to evaluate the excretory system and assess whether the tumor involves the collecting system, causing obstruction or invasion into the renal pelvis. - The contrast-enhanced imaging also helps in detecting any distant metastases, such as those to the lungs, liver, or lymph nodes.

3. 3D Imaging and Angiography (Optional): - In some cases, advanced imaging techniques like CT angiography or 3D reconstruction may be used to better assess the vascularity of the tumor and plan for possible surgical interventions, such as partial nephrectomy.

Step 3: Conclusion.
CT imaging plays a vital role in evaluating renal cell carcinoma, providing information about the tumor's size, vascularity, and involvement of adjacent structures, which is essential for staging and treatment planning. Contrast-enhanced imaging is particularly important for assessing tumor behavior and metastasis.

> **Quick Tip**
>
> A non-contrast CT is the first step in assessing renal cell carcinoma, followed by contrast-enhanced imaging to evaluate the vascularity and metastasis of the tumor.

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7. b) Describe the renal nephrometry score.

Solution:

Step 1: Introduction to the Renal Nephrometry Score (RNS).
The Renal Nephrometry Score (RNS) is a system used to objectively assess the complexity of renal tumors, particularly in the context of RCC, to guide treatment decisions, such as partial nephrectomy versus radical nephrectomy. It is based on multiple factors that relate to the tumor's size, location, and relation to surrounding structures.

Step 2: Components of the Renal Nephrometry Score.
The RNS is based on a combination of 4 key variables:

1. Tumor Size (T):
The size of the tumor is a key factor in assessing its complexity. Larger tumors are generally more complex and may involve more renal parenchyma.
- Score 1: Tumor 4 cm
- Score 2: Tumor 4-7 cm
- Score 3: Tumor ¿7 cm

2. Exophytic/Endophytic Component (E):
The extent to which the tumor grows outward (exophytic) or inward (endophytic) into the renal parenchyma affects its surgical complexity.
- Score 1: Exophytic (grows out of the kidney)
- Score 2: Endophytic (grows inward)

- Score 3: Mixed (both exophytic and endophytic)

3. Renal Sinus Involvement (S):
This measures the involvement of the renal sinus, which is important for assessing potential challenges during surgery.
- Score 1: No renal sinus involvement
- Score 2: Minimal renal sinus involvement
- Score 3: Significant renal sinus involvement

4. Contact with the Collecting System (C):
Tumors that are in contact with or invade the collecting system (renal pelvis or calyces) are more complex and challenging to remove.
- Score 1: No contact with the collecting system
- Score 2: Minimal contact with the collecting system
- Score 3: Invasion of the collecting system

Step 3: Calculating the Renal Nephrometry Score.
The scores for each of the four variables are summed to give a total nephrometry score, which ranges from 4 to 12. A higher score correlates with a more complex tumor, which may require a more aggressive surgical approach. The total score helps guide decisions on whether partial nephrectomy or radical nephrectomy is appropriate.

Step 4: Conclusion.
The renal nephrometry score is an objective and reliable method for assessing the complexity of renal tumors and aiding in surgical planning. It provides valuable information about the tumor's size, location, and involvement with surrounding structures, which is critical for deciding on the appropriate surgical approach.

> **Quick Tip**
>
> Use the renal nephrometry score to assess the complexity of RCC and guide surgical planning. Higher scores indicate more complex tumors that may require radical nephrectomy.

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8. a) Evaluation of fatty liver.

Solution:

Step 1: Understanding Fatty Liver.
Fatty liver, or hepatic steatosis, is a condition characterized by excessive fat accumulation within the liver cells. It is commonly seen in conditions such as obesity, diabetes, and chronic alcohol consumption. Imaging plays a crucial role in diagnosing fatty liver and assessing its severity.

Step 2: Imaging Techniques for Fatty Liver Evaluation.
1. Ultrasound (US): - First-line imaging: Ultrasound is the most commonly used initial imaging modality to evaluate fatty liver. It is non-invasive and readily available. - Findings: Fatty liver typically appears as a hyperechoic (brighter) liver compared to the kidney. There may be a loss of the normal distinction between the liver and the right kidney due to the increased fat content. - Limitations: Ultrasound may not be able to detect early or mild fatty liver and is less accurate in obese patients due to difficulty in penetration.
2. CT Scan (Computed Tomography): - Fatty Liver Sign: On a CT scan, the liver appears less dense than normal due to fat accumulation. It is often seen as a lower attenuation of the liver parenchyma compared to the spleen. - Limitations: While CT can detect fatty liver, it is not as sensitive as ultrasound or MRI and involves radiation exposure.
3. MRI (Magnetic Resonance Imaging): - MRI Proton Density Fat Fraction (PDFF): MRI, particularly with the use of PDFF, is the most sensitive method for quantifying liver fat content. MRI provides a non-invasive way to assess the degree of steatosis. - Findings: Fatty liver shows hyperintensity (bright areas) on MRI, especially in T1 and T2-weighted images. PDFF mapping allows for quantitative assessment of liver fat content, providing accurate evaluation of the severity of steatosis.
4. Liver Biopsy (for confirmation): - While imaging can diagnose fatty liver, a liver biopsy may be required to assess the degree of steatosis and to exclude other liver diseases, such as cirrhosis or liver fibrosis.
Step 3: Conclusion.
Ultrasound is the first-line imaging modality for evaluating fatty liver, while MRI provides the most detailed and accurate assessment. CT can be used, but it is less sensitive and involves radiation. Early diagnosis and appropriate follow-up are essential for managing fatty liver disease.

> **Quick Tip**
>
> Ultrasound is the most commonly used first-line imaging tool for diagnosing fatty liver. MRI with PDFF offers the most accurate assessment of liver fat content.

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8. b) Radiographic findings in hyperparathyroidism.

Solution:

Step 1: Understanding Hyperparathyroidism.
Hyperparathyroidism is a condition characterized by excessive secretion of parathyroid hormone (PTH), which leads to elevated blood calcium levels. The condition can be primary (due to a parathyroid adenoma or hyperplasia), secondary (due to chronic kidney disease), or tertiary (resulting from long-standing secondary hyperparathyroidism). Radiographic findings in hyperparathyroidism are mainly related to bone changes due to the effects of elevated PTH on bone metabolism.
Step 2: Radiographic Findings in Hyperparathyroidism.
1. Osteitis Fibrosa Cystica (OFC): - Classic finding: Osteitis fibrosa cystica is a hallmark

of long-standing hyperparathyroidism. It is characterized by subperiosteal bone resorption, particularly at the phalanges (fingers and toes), and may present with "salt and pepper" appearance in the skull. - Radiographic Appearance: Bone cysts, cortical thinning, and bone resorption are visible on X-rays, particularly in the hands, feet, and jaw.

2. Brown Tumors of Bone: - Findings: Brown tumors are osteolytic lesions caused by the accumulation of hemorrhagic and fibrous tissue in the bone due to hyperparathyroidism. They appear as well-defined, lytic lesions on radiographs, often in the pelvis, femur, and jaw. - Appearance: They have a characteristic "soap bubble" appearance due to the fibrous tissue, and may be mistaken for other bone lesions like giant cell tumors.

3. Renal Involvement: - Nephrocalcinosis: Hyperparathyroidism can lead to calcium deposition in the kidneys, seen as radiopaque areas on abdominal X-rays, particularly in the renal cortex. This is known as nephrocalcinosis. - Kidney Stones: Patients with hyperparathyroidism may also develop kidney stones, which appear as radiopaque areas on plain abdominal X-rays or on CT scans.

4. Subperiosteal Bone Resorption: - The most characteristic feature of hyperparathyroidism is subperiosteal bone resorption, which often affects the distal phalanges and can be seen as resorption of the bone cortex, leaving behind a "cupped" appearance at the bone margins.

Step 3: Conclusion.
Radiographic findings in hyperparathyroidism include osteitis fibrosa cystica, brown tumors, subperiosteal resorption, and nephrocalcinosis. These findings are useful for diagnosing and assessing the effects of chronic hyperparathyroidism on the skeletal system and kidneys.

> **Quick Tip**
>
> In hyperparathyroidism, look for osteitis fibrosa cystica and subperiosteal resorption on X-rays, particularly in the hands, feet, and jaw.

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9. a) PET-CT.

Solution:

Step 1: Introduction to PET-CT.
PET-CT (Positron Emission Tomography - Computed Tomography) is a hybrid imaging technique that combines the functional imaging of PET with the anatomical details of CT. This combination allows for both metabolic and structural evaluation of tissues and organs, providing a more comprehensive view of the disease process, especially in oncology, cardiology, and neurology. PET-CT is particularly useful in the detection, staging, and monitoring of cancer.

Step 2: How PET-CT Works.
1. PET Imaging: PET involves injecting a radiotracer (commonly fluorodeoxyglucose, FDG) into the patient, which accumulates in metabolically active tissues, such as tumors. The PET scanner detects gamma rays emitted by the tracer and generates images showing the metabolic activity of the tissues.

2. CT Imaging: CT provides detailed cross-sectional images of the body's internal structures, allowing for precise localization of abnormal metabolic activity identified by PET. The CT scan can also help assess the size and extent of any abnormalities.

3. Combination of PET and CT: The combination of PET and CT provides both functional and anatomical information. PET identifies areas of abnormal metabolism, while CT offers detailed structural information, improving the accuracy of diagnosis and staging.

Step 3: Applications of PET-CT.
1. Cancer Diagnosis and Staging: PET-CT is widely used in oncology to detect and stage cancers, assess the extent of metastasis, and guide treatment decisions. It is particularly effective in detecting small, otherwise undetectable tumors.

2. Treatment Monitoring: PET-CT is used to monitor treatment response, particularly in cancer patients, to determine whether a tumor is responding to chemotherapy, radiation therapy, or other treatments.

3. Cardiology: PET-CT is used to evaluate myocardial viability and assess coronary artery disease by showing areas of the heart muscle with reduced blood flow.

4. Neurology: PET-CT helps in the evaluation of neurological conditions such as Alzheimer's disease, epilepsy, and other neurodegenerative disorders by assessing brain metabolism.

Step 4: Conclusion.
PET-CT is a powerful imaging modality that provides both anatomical and functional insights, particularly in cancer diagnosis and treatment. The combination of metabolic and structural information improves the precision of diagnosis and enhances treatment planning.

> **Quick Tip**
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> PET-CT is particularly valuable in oncology for staging, detecting metastasis, and monitoring treatment response due to its ability to combine metabolic and anatomical imaging.

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9. b) Contrast enhanced mammography.

Solution:

Step 1: Introduction to Contrast Enhanced Mammography (CEM).
Contrast enhanced mammography (CEM) is an advanced imaging technique that combines traditional mammography with the use of contrast agents. CEM is particularly useful in the detection and characterization of breast cancer, especially in patients with dense breast tissue, where conventional mammography may not be as effective. By using iodinated contrast, CEM enhances the visibility of abnormal blood vessels and tissue perfusion, making it easier to iden-

tify malignant tumors.

Step 2: How Contrast Enhanced Mammography Works.

1. Traditional Mammography: CEM starts with a standard mammogram, where X-rays are used to capture images of the breast tissue. This provides an initial overview of the breast's anatomy and helps identify any abnormal areas, such as masses or microcalcifications.

2. Contrast Injection: A contrast agent (usually iodine-based) is injected into the patient's bloodstream, which is preferentially absorbed by tumors due to their higher vascularity. Malignant tumors often have increased blood flow and abnormal vascular patterns, making them more visible with contrast.

3. Contrast Enhanced Imaging: After the contrast injection, additional mammographic images are taken, highlighting areas of the breast with enhanced blood flow. These areas often correspond to tumors or abnormal tissues, allowing for better visualization of lesions that may not have been clearly seen in the non-contrast images.

Step 3: Applications of Contrast Enhanced Mammography.

1. Detection of Breast Cancer: CEM is particularly useful for detecting breast cancer in patients with dense breasts, where traditional mammography may miss smaller or subtle tumors. The contrast enhances the tumor's visibility, making it easier to distinguish from surrounding tissue.

2. Characterization of Tumors: CEM can help characterize lesions by highlighting areas with increased vascularity, which is often associated with malignancy. It can also be used to evaluate the extent of the disease, particularly in cases of invasive breast cancer.

3. Guiding Biopsy: CEM can be used to guide biopsy procedures by pinpointing the exact location of the abnormal tissue. The enhanced images provide better clarity, which improves the accuracy of the biopsy.

4. Supplement to MRI: While MRI is another imaging modality that uses contrast to evaluate breast cancer, CEM is often a more cost-effective and accessible alternative. It is particularly useful in patients who cannot undergo MRI due to contraindications such as pacemakers or claustrophobia.

Step 4: Conclusion.

Contrast enhanced mammography is an effective technique for improving breast cancer detection and characterization, especially in dense breast tissue. It combines the strengths of traditional mammography with the power of contrast imaging to provide clearer, more detailed images that can help guide diagnosis and treatment decisions.

> **Quick Tip**
>
> Contrast enhanced mammography is particularly useful in dense breasts and can enhance the detection and characterization of tumors that may be missed by conventional mammography.

10. a) Enumerate the various procedures that can be performed by an interventional radiologist in the management of hepatocellular carcinoma.

Solution:

Step 1: Understanding Hepatocellular Carcinoma (HCC).
Hepatocellular carcinoma (HCC) is the most common primary liver cancer, often arising in the context of chronic liver disease such as cirrhosis or hepatitis B/C infection. The management of HCC involves a multidisciplinary approach, and interventional radiology (IR) plays a critical role in the treatment of HCC, particularly in cases that are not amenable to surgery.

Step 2: Interventional Radiology Procedures for HCC.
1. Percutaneous Ablation Techniques: These procedures are used for localized tumors and are less invasive compared to surgery. The primary methods include: - Radiofrequency Ablation (RFA): RFA uses heat generated by high-frequency radio waves to destroy tumor tissue. It is commonly used for small, well-defined tumors that are not amenable to surgical resection. - Microwave Ablation (MWA): MWA uses microwave energy to generate heat and destroy tumor cells. It is often preferred for larger tumors or tumors located in challenging areas. - Cryoablation: Cryoablation involves freezing the tumor tissue using a cryoprobe. It is used when thermal ablation methods are contraindicated or when the tumor is located near vital structures.
2. Transarterial Chemoembolization (TACE): TACE is a highly effective procedure used to treat larger, inoperable tumors or those with vascular invasion. It involves selectively injecting chemotherapy drugs directly into the feeding arteries of the tumor, followed by embolization to block blood flow to the tumor, thus causing ischemic necrosis of the tumor.
3. Transarterial Radioembolization (TARE): TARE, or selective internal radiation therapy (SIRT), involves the infusion of radioactive microspheres into the tumor's blood vessels. The radiation emitted from the microspheres targets and kills tumor cells while minimizing damage to healthy liver tissue.
4. Transjugular Intrahepatic Portosystemic Shunt (TIPS): TIPS is a procedure used to manage portal hypertension in patients with cirrhosis and HCC. It involves creating a shunt between the portal vein and hepatic vein to reduce portal pressure, thereby improving liver function and potentially enhancing the effectiveness of other treatments.
5. Liver Biopsy and Tumor Staging via IR Guidance: Interventional radiologists can perform a percutaneous liver biopsy under imaging guidance (ultrasound or CT) to obtain tissue for diagnosis and to assess the tumor's characteristics, such as grade and molecular markers.
Step 3: Conclusion.
Interventional radiologists play an essential role in the management of hepatocellular carcinoma, particularly for patients who are not surgical candidates. Procedures like RFA, TACE, TARE, and TIPS can significantly improve survival and quality of life for patients with HCC.

Quick Tip

For patients with small, localized tumors, ablative techniques like RFA and MWA are often the preferred choice, while TACE and TARE are used for larger, more complex tumors or those with vascular invasion.

10. b) Indications of vertebroplasty.

Solution:

Step 1: Introduction to Vertebroplasty.

Vertebroplasty is a minimally invasive procedure used to treat vertebral compression fractures (VCFs) caused by conditions such as osteoporosis, trauma, or metastatic cancer. The procedure involves the injection of bone cement into the fractured vertebra to stabilize the bone and reduce pain.

Step 2: Indications for Vertebroplasty.

1. Osteoporotic Vertebral Compression Fractures: Vertebroplasty is commonly indicated for patients with osteoporosis who suffer from painful vertebral compression fractures that do not respond to conservative management (e.g., medications, bracing, physical therapy). It is particularly useful in patients who experience severe pain and disability from these fractures.

2. Pain from Vertebral Fractures due to Metastatic Disease: In patients with metastatic cancer to the spine, vertebroplasty can be used to provide pain relief and stabilize the vertebrae affected by metastatic lesions, improving quality of life in these patients.

3. Traumatic Vertebral Fractures: Vertebroplasty is indicated for patients with traumatic vertebral fractures that have failed to heal with conservative treatment. This includes fractures due to high-impact trauma or falls in elderly patients, particularly when there is significant pain and functional impairment.

4. Multiple Vertebral Fractures Leading to Spinal Instability: In cases where multiple vertebral fractures cause spinal deformity or instability, vertebroplasty may help restore structural integrity and alleviate pain, thereby improving spinal alignment and preventing further collapse.

5. Failed Conservative Treatment for Acute Vertebral Compression Fractures: If conservative treatments, including rest, pain medications, and bracing, fail to relieve the pain of an acute vertebral compression fracture, vertebroplasty can be considered for patients who are candidates for the procedure.

Step 3: Contraindications to Vertebroplasty.

While vertebroplasty is highly effective for many patients, it is contraindicated in the following situations: - Infection in the vertebral body or surrounding tissue. - Presence of a large spinal tumor or tumor that involves the vertebral body, where stabilization alone may not be sufficient. - Severe spinal deformity or instability that requires surgical intervention.

Step 4: Conclusion.

Vertebroplasty is an effective treatment for vertebral compression fractures, particularly in cases of osteoporosis, trauma, and metastatic disease. It is recommended for patients who have not responded to conservative treatment and experience significant pain or disability from their fractures.

> **Quick Tip**
>
> Vertebroplasty is most effective in relieving pain and improving function in patients with osteoporotic and metastatic compression fractures, particularly when conservative management fails.