NEET SS 2024 DrNB Surgical Oncology Paper 3 Question Paper and Solutions

Time Allowed :3 Hours	**Maximum Marks :**100	**Total questions :**10

1(a). Discuss mediastinal staging for non-small cell lung cancer.

Solution:

Mediastinal staging is a critical part of the diagnostic process for non-small cell lung cancer (NSCLC). It helps in determining the extent of the disease and guides treatment decisions. The goal of mediastinal staging is to assess if the cancer has spread to lymph nodes in the mediastinum or other distant sites.

Step 1: Imaging Techniques for Mediastinal Staging:

1. **CT Scan:** A contrast-enhanced chest CT is the most commonly used method to identify enlarged lymph nodes and assess their size and location. It helps in the initial assessment of the mediastinum.
2. **PET Scan:** Positron Emission Tomography (PET) scanning is useful for identifying metabolically active nodes that may not be enlarged on CT. PET scans can detect metastasis to lymph nodes and distant organs.
3. **Endobronchial Ultrasound (EBUS):** EBUS is a minimally invasive procedure used to visualize and biopsy lymph nodes in the mediastinum. It allows for accurate staging and is often performed along with bronchoscopy.
4. **Mediastinoscopy:** This is a surgical procedure where a scope is inserted through an incision in the neck to obtain lymph node samples from the mediastinum for pathological examination. It is often used when EBUS cannot provide a definitive diagnosis.

Step 2: Lymph Node Stations in Mediastinal Staging:

Lymph nodes are classified into different stations based on their location in the mediastinum. Commonly assessed stations include:

- **Station 4:** Lymph nodes located in the lower mediastinum, near the carina.

- **Station 7:** Subcarinal nodes located beneath the carina.
- **Stations 2 and 3:** Lymph nodes located on the left side of the mediastinum, near the aortic arch.
- **Stations 10 and 11:** Peribronchial nodes located closer to the bronchi.

Step 3: Staging Systems:

The TNM (Tumor, Node, Metastasis) staging system is used to classify the extent of lung cancer. Mediastinal staging focuses on the N stage, which refers to the involvement of regional lymph nodes.

- **N0:** No regional lymph node involvement.
- **N1:** Involvement of ipsilateral bronchial or hilar lymph nodes.
- **N2:** Involvement of ipsilateral mediastinal or subcarinal lymph nodes.
- **N3:** Involvement of contralateral mediastinal or hilar lymph nodes, or supraclavicular nodes.

> Quick Tip
>
> Mediastinal staging should always include a combination of imaging techniques and biopsy to accurately determine lymph node involvement and guide treatment decisions.

(b). Describe the palliative management of advanced urinary bladder malignancy.

Solution:

Palliative management of advanced urinary bladder malignancy focuses on improving quality of life, managing symptoms, and providing comfort to patients with metastatic or locally advanced disease who are not candidates for curative treatment.

Step 1: Symptom Control:

1. **Pain Management:** Pain relief is a critical component of palliative care for advanced bladder cancer. This can be achieved with opioid analgesics (e.g., morphine) for severe pain or NSAIDs for mild pain.
2. **Hematuria Management:** Hematuria is a common symptom in advanced bladder cancer. Intravesical therapies like bladder irrigation, or systemic chemotherapy, can help control

bleeding. In some cases, blood clot removal or cystostomy may be necessary.

3. **Urinary Obstruction:** For patients with urinary retention or hydronephrosis, catheterization, stent placement, or nephrostomy tubes may be used to relieve obstruction and improve renal function.

4. **Incontinence Management:** For patients with incontinence, absorbent pads, urinary catheters, or surgical diversion may be considered to improve comfort and hygiene.

Step 2: Chemotherapy and Targeted Therapy:

Although chemotherapy is not curative in advanced bladder cancer, it can be used for palliation to shrink tumors, relieve symptoms, and slow disease progression. Common agents used in palliative chemotherapy include cisplatin and gemcitabine.

1. **Immunotherapy:** Immune checkpoint inhibitors like pembrolizumab and nivolumab may be used in patients with advanced bladder cancer who have failed chemotherapy. These drugs help stimulate the immune system to target and destroy cancer cells.

2. **Radiation Therapy:** Radiation therapy can be used palliatively to relieve pain from bone metastases, treat obstructive symptoms, or shrink tumors causing obstruction or bleeding.

3. **Targeted Therapy:** Targeted therapies such as FGFR inhibitors may be used in specific cases based on the genetic profile of the tumor.

Step 3: Psychosocial Support:

Palliative care also involves addressing the emotional, psychological, and spiritual needs of the patient. Support from social workers, psychologists, and palliative care teams is essential for patients and their families to cope with the emotional and mental strain of advanced cancer.

> Quick Tip
>
> Palliative management in advanced urinary bladder malignancy focuses on symptom control, emotional support, and maintaining quality of life, with a focus on pain management and urinary symptom relief.

2(a). Techniques for margin assessment after tumor resection.

Solution:

Margin assessment after tumor resection is a crucial step in oncologic surgery to ensure complete tumor removal and reduce the risk of recurrence. The goal is to confirm that the resected tissue has no residual tumor cells at the surgical margin, which can be a potential source of local recurrence.

Step 1: Intraoperative Techniques:

- **Frozen Section Analysis:** During surgery, frozen section analysis is commonly performed. A portion of the resected tissue is rapidly frozen and stained, allowing pathologists to examine the margins for tumor cells. This technique enables immediate decision-making regarding additional tissue removal if cancerous cells are present at the margins.
- **Touch Preparation:** A touch preparation involves pressing the resected tissue against a slide, which is then stained for rapid evaluation. This technique is less common than frozen section but can be useful for quick margin evaluation.

Step 2: Postoperative Techniques:

- **Permanent Section Analysis:** After surgery, the tissue is sent for permanent sectioning, where the tumor and surrounding tissue are processed and examined under a microscope. This is the most definitive method for margin assessment, providing a clear evaluation of whether the resection was complete.
- **Margins and Risk of Recurrence:** The presence of tumor cells at the margin, especially if the tumor is within 1 mm of the margin, is associated with a higher risk of recurrence. Additional resection or adjuvant therapy may be required based on the findings.

Step 3: Imaging Techniques:

- **Intraoperative Imaging:** Techniques such as intraoperative ultrasound (IOUS) and positron emission tomography (PET) scans are used in some surgeries to provide real-time imaging of the tumor's boundaries, ensuring that the margins are clear. This can be particularly useful in abdominal or deep tissue surgeries.

Quick Tip

Margin assessment is essential in oncologic surgery, with techniques like frozen section and permanent section analysis being critical to ensuring complete tumor removal and reducing recurrence risk.

(b). Management of metastatic neuroendocrine tumor of pancreas.

Solution:

Metastatic neuroendocrine tumors (NETs) of the pancreas are rare but can present with challenging management decisions due to their indolent nature and tendency to metastasize to distant organs. The management of metastatic pancreatic NETs typically involves a multimodal approach, including surgical resection, medical therapy, and targeted treatments.

Step 1: Surgical Management:

- **Surgical Resection:** If the metastatic lesions are isolated and surgically resectable, surgery is often the first treatment. For localized metastases, such as those in the liver, resection may be curative, provided that complete removal is possible.
- **Cytoreductive Surgery:** In cases with widespread metastasis, cytoreductive surgery is performed to remove as much of the tumor mass as possible to alleviate symptoms and improve the efficacy of subsequent treatments.

Step 2: Medical Management:

- **Somatostatin Analogs:** The use of somatostatin analogs, such as octreotide or lanreotide, can help control symptoms by inhibiting hormone secretion (e.g., insulin, glucagon) and can also slow tumor growth in patients with metastatic disease.
- **Chemotherapy:** Chemotherapy with drugs like streptozocin and 5-fluorouracil (5-FU) can be used in patients with high-grade pancreatic NETs or those with rapidly progressing disease. Combination chemotherapy regimens may also be considered.

Step 3: Targeted Therapy:

- **Targeted Agents:** In patients with progressive disease, targeted therapies such as everolimus (an mTOR inhibitor) or sunitinib (a tyrosine kinase inhibitor) may be used. These therapies target specific molecular pathways involved in tumor growth and are often used for advanced or refractory cases.

Step 4: Liver-directed Therapies:

- **Radiofrequency Ablation (RFA):** For metastatic pancreatic NETs with liver involvement, RFA can be used to ablate tumors that are not amenable to surgical resection.
- **Transarterial Chemoembolization (TACE):** TACE involves the infusion of chemotherapy agents into the liver tumor blood supply, followed by embolization to block the blood flow to the tumor. This can help shrink liver metastases and provide symptom relief.

Step 5: Surveillance and Follow-up:

- **Monitoring:** After initial treatment, regular surveillance is necessary to monitor for tumor recurrence. This includes imaging studies such as CT scans, MRI, and functional imaging with somatostatin receptor scintigraphy (SRS) or PET scans.
- **Management of Symptoms:** Symptom management includes controlling hormone secretion (e.g., using somatostatin analogs for carcinoid syndrome) and managing any complications from metastatic disease, such as pain or obstructive symptoms.

> Quick Tip
>
> Managing metastatic pancreatic NETs requires a combination of surgical, medical, and targeted therapies, with personalized treatment plans based on the extent of the disease and patient condition.

3(a). Discuss the adjuvant therapy for GIST.

Solution:

Gastrointestinal stromal tumors (GISTs) are the most common mesenchymal tumors of the gastrointestinal tract. Adjuvant therapy for GISTs aims to reduce the risk of recurrence after surgery, particularly in patients with high-risk tumors.

Step 1: Surgical Resection:

The primary treatment for localized GISTs is complete surgical resection. Ensuring clear surgical margins is essential to minimize the risk of recurrence. In cases of inoperable or metastatic GISTs, systemic therapy is indicated.

Step 2: Adjuvant Imatinib (Gleevec):

Imatinib is a tyrosine kinase inhibitor and is the cornerstone of adjuvant therapy for GISTs. It works by inhibiting the KIT protein, which is commonly mutated in GISTs. The use of imatinib after surgical resection significantly reduces the risk of recurrence in high-risk patients.

1. **Duration of Therapy:** Adjuvant imatinib is typically administered for 3 to 5 years following surgery, depending on the risk of recurrence and the size and mitotic index of the tumor.
2. **Risk Stratification:** Patients with tumors greater than 5 cm, high mitotic rate, or aggressive features are considered high-risk and benefit the most from adjuvant imatinib.

Step 3: Alternative Therapies:

For patients with imatinib-resistant GISTs, alternative tyrosine kinase inhibitors such as sunitinib or regorafenib may be considered. These drugs can be used in patients with metastatic disease or those who experience progression while on imatinib.

Step 4: Monitoring:

Patients undergoing adjuvant therapy should be regularly monitored with imaging and clinical assessments to detect early signs of recurrence or disease progression.

> **Quick Tip**
>
> Adjuvant imatinib therapy significantly improves the survival rate in high-risk GIST patients after surgical resection and is typically given for 3-5 years postoperatively.

(b). Biochemical diagnostic assessment of pheochromocytoma.

Solution:

Pheochromocytomas are rare tumors that originate from the adrenal medulla and secrete catecholamines (epinephrine, norepinephrine). The biochemical diagnostic assessment for pheochromocytoma is crucial for confirming the diagnosis and guiding treatment.

Step 1: Measurement of Catecholamines:

1. **24-Hour Urinary Catecholamines:** The gold standard for diagnosing

pheochromocytoma is the measurement of urinary excretion of catecholamines (including norepinephrine, epinephrine, and dopamine) and their metabolites (e.g., vanillylmandelic acid (VMA) and metanephrines). Elevated levels indicate the presence of a pheochromocytoma.

2. **Plasma Free Metanephrines:** Plasma metanephrines (both normetanephrine and metanephrine) are highly sensitive and specific biomarkers for pheochromocytoma. A high plasma level of free metanephrines is diagnostic in most cases.

3. **Serum Catecholamines:** In some cases, direct measurement of serum catecholamines may be useful, although it is less commonly used than urinary tests or plasma metanephrines.

Step 2: Imaging Studies:

Once biochemical confirmation is obtained, imaging studies are used to locate the tumor. These include:

1. **CT Scan or MRI:** These are commonly used to detect adrenal tumors. A contrast-enhanced CT scan of the abdomen is the first-line imaging modality for identifying adrenal pheochromocytomas.

2. **MIBG Scintigraphy:** Metaiodobenzylguanidine (MIBG) scintigraphy is a sensitive imaging technique for detecting pheochromocytomas, especially in cases where the tumor is extra-adrenal or metastatic.

Step 3: Confirmation of Diagnosis:

A positive diagnosis of pheochromocytoma is made when elevated catecholamine levels are accompanied by characteristic imaging findings. In some cases, genetic testing may also be performed, especially for hereditary pheochromocytomas associated with conditions like MEN2 (Multiple Endocrine Neoplasia type 2).

> **Quick Tip**
>
> Plasma metanephrines are considered the most sensitive and reliable test for diagnosing pheochromocytoma, while 24-hour urine collection for catecholamines and VMA provides confirmatory evidence.

4(a). Acellular dermal matrix and its application.

Solution:

Acellular dermal matrix (ADM) is a tissue scaffold derived from human or animal dermis that has undergone a process to remove cellular components, leaving behind the extracellular matrix. This matrix provides a framework that promotes cell infiltration, angiogenesis, and tissue regeneration, making it useful in various medical applications.

Step 1: Preparation of Acellular Dermal Matrix:

ADMs are prepared by decellularizing dermal tissue through various methods such as chemical treatment or enzymatic digestion. The process removes cellular components, including fibroblasts, keratinocytes, and endothelial cells, while preserving the structural components of the extracellular matrix, such as collagen, elastin, and glycosaminoglycans.

Step 2: Applications of Acellular Dermal Matrix:

ADMs have diverse applications in the field of medicine, particularly in wound healing and tissue engineering. Some common uses include:

- **Wound Healing and Skin Grafts:** ADMs are frequently used in burn victims and patients with chronic wounds, providing a scaffold for new tissue formation and accelerating the healing process.
- **Breast Reconstruction:** ADM is used as a supportive material during breast reconstruction surgery, often after mastectomy, to provide structure and support for the newly formed tissue.
- **Soft Tissue Repair:** ADMs are applied in cases of soft tissue defects or hernias to promote tissue regeneration and integration with the surrounding tissues.
- **Periodontal and Oral Surgery:** In oral and maxillofacial surgeries, ADMs are used for gum regeneration and other soft tissue repairs.

Step 3: Advantages of Acellular Dermal Matrix:

- **Reduced Rejection Risk:** Since the matrix is acellular, the risk of immune rejection is minimized, making it suitable for patients with different tissue types.
- **Promotes Tissue Regeneration:** The extracellular matrix facilitates the infiltration of host cells, promoting natural tissue regeneration and integration.
- **Versatility:** ADMs can be used in a wide range of applications, from wound healing to soft tissue repairs.

Quick Tip

Acellular dermal matrix is an excellent material for supporting tissue regeneration and wound healing, offering reduced immune rejection and promoting tissue integration.

(b). Self-expanding metallic stents and its application.

Solution:

Self-expanding metallic stents (SEMS) are cylindrical mesh-like devices made of metal, typically stainless steel or nitinol, which are used to keep a lumen open in the body. These stents are inserted into blocked or narrowed passageways, such as the esophagus, biliary ducts, or blood vessels, to restore normal function by preventing further obstruction.

Step 1: Mechanism of Action:

Self-expanding metallic stents are designed to expand once deployed into the targeted area. Nitinol, a common material for SEMS, is a shape-memory alloy that expands at body temperature, providing consistent and reliable support to the surrounding tissues. The stents are typically compressed to fit into a catheter during insertion and then expand once in place.

Step 2: Applications of Self-expanding Metallic Stents:

- **Esophageal Stenosis:** SEMS are commonly used to treat esophageal strictures caused by cancer, benign disease, or chronic inflammation. They can be inserted via endoscopy to maintain the patency of the esophagus.
- **Biliary Obstruction:** In patients with biliary obstructions, such as those caused by tumors, SEMS can be used to keep the bile ducts open, allowing bile to flow freely and relieve symptoms.
- **Colorectal Strictures:** SEMS are also used for the management of colorectal obstructions, including those caused by cancer or Crohn's disease.
- **Tracheal and Bronchial Stenosis:** In cases of airway narrowing, such as from tumors or chronic inflammation, SEMS can be used to maintain airway patency.

Step 3: Advantages of Self-expanding Metallic Stents:

- **Minimally Invasive:** SEMS are inserted using minimally invasive procedures like endoscopy or fluoroscopy, reducing the need for major surgery.

- **Effective in Long-Term Patency:** Once deployed, SEMS provide long-term support for the affected area, reducing the risk of re-obstruction.
- **Versatility:** SEMS can be used in a variety of locations in the body, including the esophagus, biliary tree, and airways, making them a versatile treatment option.

Step 4: Risks and Complications:
- **Migration:** In some cases, the stent may migrate from its original position, leading to loss of efficacy or injury to surrounding tissues.
- **Infection:** There is a risk of infection, particularly in patients with weakened immune systems.
- **Tissue Overgrowth:** The stent may become occluded due to tissue overgrowth or the formation of scar tissue, necessitating removal or replacement.

Quick Tip

Self-expanding metallic stents are an effective treatment option for a variety of luminal obstructions, offering a minimally invasive approach with long-term patency. However, care must be taken to manage potential complications like migration and tissue overgrowth.

5(a). Discuss the role of sentinel node biopsy in gynecological malignancies.

Solution:

Sentinel node biopsy (SNB) is a procedure used to determine if cancer has spread to the lymph nodes. It is increasingly used in the staging and management of gynecological malignancies, particularly in endometrial and cervical cancers.

Step 1: Definition and Purpose:

The sentinel node is the first lymph node that drains the tumor area, and it is the most likely site of metastasis. The purpose of sentinel node biopsy is to identify whether the cancer has spread to the lymph nodes and to avoid the need for more extensive lymph node dissection in cases where the cancer has not spread.

Step 2: Indications in Gynecological Cancers:

1. **Cervical Cancer:** In early-stage cervical cancer, sentinel node biopsy is used to evaluate lymph node involvement without performing a full lymphadenectomy. It helps guide further treatment decisions, such as the need for radiation therapy.

2. **Endometrial Cancer:** For endometrial cancer, sentinel node biopsy is increasingly being used for patients with high-risk features to determine if the cancer has spread to lymph nodes. This approach helps reduce the risk of complications associated with full lymph node dissection.

3. **Ovarian Cancer:** In ovarian cancer, sentinel node biopsy is being investigated as a potential tool for staging and determining the extent of lymph node involvement, although it is not yet widely used.

Step 3: Technique:

The procedure involves injecting a radioactive tracer and/or dye near the tumor site to identify the sentinel lymph nodes. These nodes are then removed and examined for the presence of cancer cells. If cancer is found in the sentinel node, further lymph node removal may be required.

Step 4: Benefits and Limitations:

1. **Benefits:** Sentinel node biopsy offers a less invasive option with fewer complications and faster recovery times compared to full lymphadenectomy. It also provides accurate staging information.

2. **Limitations:** Sentinel node biopsy may fail to identify all affected nodes, leading to false negatives. It is most accurate in early-stage cancers and may be less reliable in advanced stages.

Quick Tip

Sentinel node biopsy is a valuable tool in gynecological cancer management, offering less invasive staging and accurate assessment of lymph node involvement, particularly in early-stage cancers.

(b). Describe cancer immunotherapy and its predictive markers.

Solution:

Cancer immunotherapy is a treatment that uses the body's immune system to fight cancer. It has revolutionized cancer treatment by harnessing immune checkpoint inhibitors, cancer vaccines, and monoclonal antibodies to target cancer cells.

Step 1: Types of Cancer Immunotherapy:

1. **Immune Checkpoint Inhibitors:** These drugs block checkpoint proteins, such as PD-1, PD-L1, and CTLA-4, that prevent immune cells from attacking cancer cells. Common examples include pembrolizumab (Keytruda) and nivolumab (Opdivo), which are used in cancers like melanoma, lung cancer, and kidney cancer.
2. **Monoclonal Antibodies:** These are antibodies designed to target specific antigens on cancer cells. For example, trastuzumab (Herceptin) targets HER2-positive breast cancer cells.
3. **Cancer Vaccines:** Vaccines like the HPV vaccine (Cervarix, Gardasil) help prevent cancers caused by viral infections, while therapeutic vaccines like BCG (used in bladder cancer) stimulate the immune system to attack cancer cells.

Step 2: Predictive Markers in Immunotherapy:

1. **PD-L1 Expression:** The expression of PD-L1 on tumor cells or immune cells is a key predictive marker for response to immune checkpoint inhibitors. Tumors with high PD-L1 expression are more likely to respond to drugs like pembrolizumab and nivolumab.
2. **Tumor Mutational Burden (TMB):** TMB refers to the number of mutations in a tumor's DNA. A higher TMB is associated with a better response to immunotherapy, as it leads to the production of more neoantigens that the immune system can target.
3. **Microsatellite Instability (MSI):** MSI-high tumors, often found in colorectal and endometrial cancers, are more likely to respond to immune checkpoint inhibitors, making MSI a useful marker in predicting treatment efficacy.
4. **CTLA-4 Expression:** High expression of CTLA-4 can indicate a poor response to immunotherapy, but blocking this checkpoint with drugs like ipilimumab can improve treatment outcomes.

Step 3: Mechanism of Action:

Immunotherapy works by stimulating the immune system to recognize and destroy cancer cells. It can also prevent tumors from evading immune surveillance by blocking inhibitory signals that normally suppress immune responses.

Step 4: Side Effects:

Although effective, immunotherapy can cause immune-related adverse events, including inflammation of healthy tissues (e.g., colitis, hepatitis, pneumonitis). These side effects require careful monitoring and management.

> **Quick Tip**
>
> Cancer immunotherapy, combined with predictive markers like PD-L1 expression and TMB, allows for more personalized treatment plans and can lead to significant improvements in patient outcomes.

6(a). Describe the management of chylous fistula after neck dissection.

Solution:

A chylous fistula is a rare complication that can occur after neck dissection, where lymphatic fluid leaks from the lymphatic vessels into the surrounding tissues. This condition is most often seen after dissection of the cervical lymph nodes, particularly when the thoracic duct is inadvertently injured.

Step 1: Diagnosis:

The diagnosis of chylous fistula is typically confirmed by the presence of chyle (milky white fluid) draining from the wound. The fluid can be analyzed for its high triglyceride content, which is a characteristic feature of chyle. Imaging techniques such as lymphangiography, CT, or MRI may be used to identify the source of the leak and the extent of the lymphatic injury.

Step 2: Conservative Management:

- **Dietary Modifications:** The first line of management is dietary modification, specifically a low-fat diet with medium-chain triglycerides (MCTs). This allows for the absorption of fats through the portal circulation, bypassing the injured lymphatic vessels.

- **Drainage and Compression:** Placing a drain in the surgical site can help to collect the leaking chyle. Additionally, compression bandages or garments can be applied to reduce the formation of chylous fluid and promote closure.

- **Octreotide Therapy:** Octreotide, a somatostatin analog, can be used to reduce lymphatic flow and promote closure of the fistula. It is administered subcutaneously and has been shown to reduce the drainage of chyle in some cases.

Step 3: Surgical Management:

If conservative measures fail or the chylous fistula persists for more than 4-6 weeks, surgical intervention may be required. Surgical options include:

- **Ligation of the Thoracic Duct:** In cases where the thoracic duct is identified and exposed, direct ligation can be performed to stop the leakage of chyle.
- **Fistula Repair:** A repair of the lymphatic vessel or a transposition of nearby tissues to close the fistula may also be necessary. A lymphaticovenous anastomosis can also be considered in some cases.

Step 4: Postoperative Care and Monitoring:

Postoperative care involves monitoring the patient for signs of infection, maintaining nutritional support, and ensuring that the chylous fistula resolves. The patient may need long-term follow-up to ensure that there is no recurrence of the fistula.

> Quick Tip
>
> Chylous fistulas may resolve with conservative management, but surgical intervention is often needed for persistent or large leaks.

(b). Management of osteoradionecrosis in oral cancer patients.

Solution:

Osteoradionecrosis (ORN) is a serious complication that can occur in patients with head and neck cancer who have undergone radiation therapy. It involves the death of bone tissue due to the damaging effects of radiation, leading to infection, pain, and loss of function.

Step 1: Diagnosis:

The diagnosis of osteoradionecrosis is based on clinical symptoms and imaging. Patients typically present with pain, swelling, and exposed bone in the oral cavity or jaw. Radiographic imaging (CT or panoramic X-rays) may show areas of bone loss, sclerosis, and sequestration. Biopsy may be required for definitive diagnosis.

Step 2: Conservative Management:

- **Antibiotics:** In mild cases, broad-spectrum antibiotics are administered to control infection.
- **Hyperbaric Oxygen Therapy (HBOT):** HBOT is used to enhance tissue oxygenation and promote bone healing. It is considered a useful adjunct in the management of ORN, especially in cases that are not amenable to surgery.
- **Oral Care:** Good oral hygiene and the use of antiseptic mouthwashes (e.g., chlorhexidine) can help reduce the risk of infection. The patient should be monitored closely for signs of infection or worsening necrosis.

Step 3: Surgical Management:

For patients with more severe ORN or those who do not respond to conservative measures, surgical intervention may be necessary:

- **Resection of Necrotic Bone:** If the necrosis is extensive, resection of the affected bone may be performed to prevent the spread of infection.
- **Reconstruction:** After resection, reconstruction of the jaw or facial structures may be needed, often using bone grafts or free flaps to restore function and appearance.
- **Osteotomy or Stabilization:** In some cases, the use of osteotomy to remove affected tissue or stabilization with plates and screws may be required.

Step 4: Prevention:

Prevention of ORN is crucial, especially in patients undergoing radiation therapy. Pre-radiotherapy dental evaluation, removal of infected teeth, and avoidance of trauma to irradiated bone are essential strategies to reduce the risk of ORN.

> **Quick Tip**
>
> Early detection and management of osteoradionecrosis are key to preventing severe complications, and hyperbaric oxygen therapy has been shown to improve outcomes in some patients.

7(a). What are solitary pulmonary nodules (SPNs)?

Solution:

A solitary pulmonary nodule (SPN) is a discrete, well-defined round or oval lesion in the lung, usually less than 3 cm in size, which is surrounded by normal lung parenchyma. SPNs are often found incidentally on chest radiographs or CT scans and can be benign or malignant.

Step 1: Characteristics of SPNs:

- SPNs are typically asymptomatic, and the majority are discovered incidentally during imaging for other reasons.
- The size of the nodule, its growth rate, and the patient's risk factors (e.g., smoking history, age, previous cancer) are critical in determining the likelihood of malignancy.

Step 2: Differential Diagnosis:

1. **Benign Causes:** Most SPNs are benign and may be due to infectious granulomas (e.g., tuberculosis), hamartomas, or inflammatory lesions.
2. **Malignant Causes:** Malignant SPNs are most commonly due to primary lung cancer (e.g., non-small cell lung cancer), metastatic tumors, or lymphoma. The risk of malignancy increases with the size of the nodule, age of the patient, and smoking history.

Step 3: Evaluation of SPNs:

- The initial evaluation of an SPN includes a detailed history, clinical examination, and imaging studies. A contrast-enhanced chest CT is typically performed to assess the size, location, and characteristics of the nodule (e.g., spiculated edges, calcification pattern).
- If the nodule is suspicious for malignancy, further investigation may include biopsy (e.g., CT-guided needle biopsy) or positron emission tomography (PET) scan.

> **Quick Tip**
>
> Size, growth rate, and the presence of risk factors such as smoking history are important factors in assessing the risk of malignancy in solitary pulmonary nodules (SPNs).

(b). With the help of a flow-chart describe the diagnostic and therapeutic algorithm of SPNs.

Solution:

The diagnostic and therapeutic approach to SPNs involves assessing the risk of malignancy, imaging, and, in some cases, biopsy or surgical resection. The following flow-chart outlines the algorithm for managing SPNs:

Step 1: Initial Evaluation:

- History and physical examination, including risk factors such as age, smoking, or history of cancer.
- Initial chest X-ray or CT scan to identify and characterize the nodule (size, edges, calcification).

Step 2: Risk Stratification:

- Low risk (e.g., small, non-growing nodule in a young, non-smoker): Follow-up with serial imaging (CT scan) over time.
- High risk (e.g., large, spiculated, growing nodule in an older smoker): Further evaluation with PET scan, biopsy, or surgical resection.

Step 3: Management Based on Risk:

- Benign nodule (low risk, stable): No further intervention, periodic imaging.
- Suspicious or malignant nodule (high risk, growing, PET positive): Surgical resection or biopsy for histological diagnosis and staging.

Step 4: Follow-up and Monitoring:

- Regular follow-up imaging (CT scan) at appropriate intervals for stable or benign nodules.
- For malignant or suspected malignant nodules, treatment options include surgery, radiation, or chemotherapy based on biopsy results.

> **Quick Tip**
>
> In high-risk patients, a biopsy or PET scan is essential to determine the malignancy of SPNs, whereas low-risk patients can often be monitored with periodic imaging.

(c). Make a flow chart showing management of ground-glass opacities in the lung.

Solution:

Ground-glass opacities (GGOs) on imaging represent areas of partial lung opacity that may be benign or indicative of early lung disease. The management of GGOs depends on their size, growth rate, and other characteristics.

Step 1: Initial Evaluation:

- Chest CT scan to identify GGOs and assess their size, location, and characteristics (e.g., associated nodules, consolidation, vascular changes).
- Detailed history to assess risk factors, such as smoking, exposure to environmental toxins, or family history of lung cancer.

Step 2: Risk Assessment:

- Small, stable GGOs with no significant changes over time: Regular follow-up with imaging (CT) at 6-12 months intervals.
- Larger, persistent, or growing GGOs: High suspicion for malignancy, consider biopsy or further imaging (e.g., PET scan, MRI).

Step 3: Management Based on Risk:

- Benign GGOs (stable, no growth): Monitor with periodic CT scans every 6-12 months.
- Suspicious GGOs (growing, persistent): Consider biopsy or surgical resection for histological diagnosis.
- Malignant GGOs (based on biopsy results or PET scan): Proceed with appropriate treatment options, including surgery, chemotherapy, or radiation therapy.

> **Quick Tip**
>
> Stable, non-growing ground-glass opacities are typically benign and can be monitored, while growing GGOs require further investigation to rule out malignancy.

8(a). Multivariate analysis.

Solution:

Multivariate analysis is a statistical technique used to analyze the relationship between multiple variables at the same time. It is commonly used in medical research, including cancer studies, to examine how various factors or predictors affect an outcome, such as survival or treatment response.

Step 1: Types of Multivariate Analysis:

- **Multiple Linear Regression:** This technique models the relationship between a dependent variable and multiple independent variables, assuming the relationship is linear. It is used when the outcome variable is continuous (e.g., blood pressure, tumor size).
- **Logistic Regression:** Used when the dependent variable is binary, such as the presence or absence of disease (e.g., survival vs. death, cancer recurrence vs. no recurrence).
- **Survival Analysis (Cox Proportional Hazards Model):** This model is used to explore the effect of multiple variables on time-to-event outcomes, such as the time to cancer recurrence or death. It allows researchers to estimate hazard ratios and account for censored data.

Step 2: Key Applications in Cancer Research:

- **Identifying Risk Factors:** Multivariate analysis can help identify risk factors for cancer progression, recurrence, or metastasis by simultaneously considering variables like age, sex, genetic mutations, and treatment history.
- **Predictive Modeling:** By analyzing a combination of clinical, genetic, and demographic variables, multivariate analysis can help develop predictive models for patient outcomes, guiding clinical decision-making.

Step 3: Advantages:

- **Accounts for Confounders:** Multivariate analysis can control for confounding variables, helping researchers isolate the true effect of a variable of interest.
- **Handles Complex Data:** It allows for the analysis of multiple factors and their interactions, providing more comprehensive insights compared to univariate analysis.

Step 4: Limitations:

- **Multicollinearity:** If the independent variables are highly correlated, it can make the interpretation of results difficult and lead to unreliable estimates.
- **Overfitting:** If too many variables are included, the model may become overfitted, reducing its generalizability to new data.

Quick Tip

Multivariate analysis helps account for multiple variables at once, allowing for more accurate conclusions in cancer research, especially when evaluating complex interactions between risk factors and outcomes.

(b). Survival analysis methods in cancer patients.

Solution:
Survival analysis is a statistical method used to analyze the time to an event, such as death, disease progression, or recurrence, and is widely used in cancer research to assess patient prognosis and the efficacy of treatments.
Step 1: Key Methods in Survival Analysis:
- **Kaplan-Meier Estimator:** This non-parametric method is used to estimate the survival function from time-to-event data. It produces a Kaplan-Meier curve that shows the probability of surviving at different time points. The method accounts for censored data (patients who are lost to follow-up or do not experience the event during the study).
- **Log-Rank Test:** This test is used to compare the survival distributions of two or more groups. For example, it can be used to compare survival rates between different treatment groups in a clinical trial.
- **Cox Proportional Hazards Model:** This semi-parametric method is used to assess the effect of multiple variables on survival, considering factors like age, treatment type, and genetic markers. It estimates hazard ratios, which indicate the relative risk of an event occurring in one group compared to another.
Step 2: Applications in Cancer Research:
- **Survival Analysis in Clinical Trials:** Survival analysis is crucial in clinical trials to determine the efficacy of new cancer treatments, as it allows researchers to compare the survival of patients who received the treatment versus those who did not.
- **Predicting Patient Outcomes:** By identifying factors that affect survival, such as tumor type, stage, and treatment, survival analysis helps predict patient outcomes and guide treatment decisions.

Step 3: Advantages:

- **Handles Censored Data:** One of the strengths of survival analysis is its ability to handle censored data, where patients are lost to follow-up or do not experience the event during the study period.
- **Provides Prognostic Information:** Survival analysis can provide valuable prognostic information for clinicians, helping them tailor treatment plans to individual patients based on their estimated survival chances.

Step 4: Limitations:

- **Assumptions of the Cox Model:** The Cox model assumes that the hazard ratios are constant over time, which may not always hold true in real-world data.
- **Interpretation Challenges:** While survival analysis provides valuable insights, the results can be complex and require careful interpretation, especially when dealing with multiple interacting variables.

> Quick Tip
>
> Survival analysis methods, such as the Kaplan-Meier estimator and Cox proportional hazards model, are essential tools in cancer research to evaluate patient prognosis and compare treatment effectiveness.

9(a). Discuss the current status of cancer registry in India.

Solution:

Cancer registries are crucial for understanding the burden of cancer, identifying high-risk populations, and formulating appropriate healthcare strategies. In India, the cancer registry system plays a pivotal role in cancer surveillance, providing critical data on incidence, mortality, and survival rates.

Step 1: National Cancer Registry Program (NCRP):

The National Cancer Registry Program (NCRP) is the main organization for cancer data collection in India. It is managed by the Indian Council of Medical Research (ICMR) and aims to collect reliable data on the incidence of cancer across the country. The NCRP includes multiple population-based cancer registries (PBCRs) and hospital-based cancer registries (HBCRs) throughout India.

Step 2: Key Cancer Registries:

1. **Population-Based Cancer Registries (PBCR):** These registries collect data on cancer incidence from specific geographic areas. Major PBCRs are located in cities like Bangalore, Mumbai, and Kolkata, with the goal of capturing representative data for larger populations.
2. **Hospital-Based Cancer Registries (HBCR):** These registries focus on collecting data from cancer patients attending specific hospitals. They are an essential resource for evaluating treatment outcomes and patient demographics.
3. **Urban and Rural Coverage:** While urban areas have relatively comprehensive coverage, rural areas are underrepresented, which may lead to underestimation of the cancer burden in these populations.

Step 3: Challenges in Cancer Registration in India:

1. **Incomplete Reporting:** A significant proportion of cancer cases, especially in rural areas, go unreported due to lack of access to healthcare services.
2. **Data Quality:** Data collection in India faces challenges related to inconsistent reporting, variable quality of data, and lack of uniformity in data classification.
3. **Resource Constraints:** The cancer registry system in India suffers from limited funding, infrastructure, and trained personnel, particularly in remote areas.

Step 4: Current Status and Improvements:

India has made significant strides in improving its cancer registry system, with more hospitals and institutions participating in national registries. Advances in technology, such as electronic data collection and centralization of data, have improved data accuracy and accessibility.

Quick Tip

Cancer registries in India are vital for cancer surveillance and improving healthcare delivery, but greater coverage in rural areas and improvements in data quality are needed for more accurate cancer burden assessment.

(b). Metronomic therapy in cancer.

Solution:

Metronomic therapy refers to the administration of low-dose chemotherapy on a frequent, continuous basis with the goal of minimizing side effects while inhibiting tumor angiogenesis and growth. Unlike traditional chemotherapy, which uses higher doses in cycles, metronomic therapy focuses on providing a steady, low-dose treatment to reduce tumor growth and metastasis.

Step 1: Mechanism of Action:

Metronomic chemotherapy works by inhibiting angiogenesis, the process by which tumors develop blood vessels to supply nutrients. The low doses of chemotherapy drugs used in metronomic therapy target endothelial cells that form the blood vessels, making them less capable of supporting the tumor. In addition, it modulates the immune system and induces cell death in tumor cells, especially those that are resistant to conventional high-dose chemotherapy.

Step 2: Common Drugs Used in Metronomic Therapy:

1. **Cyclophosphamide:** One of the most commonly used drugs in metronomic therapy, often combined with other agents. It acts by interfering with DNA replication in rapidly dividing cells.
2. **Methotrexate:** Methotrexate, a folate antagonist, is used in low doses for its anti-angiogenic effects.
3. **Capecitabine:** A prodrug of 5-fluorouracil (5-FU), which is used in combination with other agents to treat various cancers, particularly breast cancer.
4. **Vinblastine:** Another chemotherapy agent used in metronomic regimens for its ability to inhibit angiogenesis and tumor cell proliferation.

Step 3: Advantages of Metronomic Therapy:

1. **Reduced Toxicity:** Since the drug doses are much lower than traditional chemotherapy, patients experience fewer side effects, improving quality of life.
2. **Chronic Treatment:** Metronomic therapy can be used continuously, allowing for long-term management of cancer.
3. **Improved Response in Resistant Cancers:** Metronomic therapy has shown promise in

cancers that are resistant to conventional chemotherapy, such as metastatic breast cancer and gliomas.

Step 4: Clinical Application:

Metronomic therapy is used in both solid tumors and hematological cancers. It is often used in combination with other therapies, such as immunotherapy, targeted therapy, or radiotherapy, to enhance its effectiveness. Clinical trials continue to explore its potential in various cancer types.

> **Quick Tip**
>
> Metronomic chemotherapy offers a promising alternative to traditional high-dose chemotherapy, with reduced toxicity and potential efficacy in treating resistant cancers.

10(a). Transoral robotic surgery.

Solution:

Transoral robotic surgery (TORS) is a minimally invasive surgical technique that utilizes robotic systems, such as the da Vinci Surgical System, to perform surgeries through the mouth. This approach is primarily used for the treatment of head and neck cancers, especially for tumors of the oropharynx, tongue base, and larynx.

Step 1: Technique:

In TORS, the surgeon uses robotic instruments inserted through the mouth to perform the surgery, eliminating the need for external incisions. The robotic system provides enhanced visualization through a high-definition 3D camera and offers increased precision and dexterity compared to traditional surgery. The system's flexible instruments can navigate through small and intricate spaces in the throat, allowing for precise tumor excision.

Step 2: Indications for TORS:

TORS is commonly used in the following situations:

- **Oropharyngeal Cancer:** TORS is often used for treating cancers of the tongue base, tonsils, and soft palate.
- **Laryngeal Cancer:** For early-stage laryngeal cancers, TORS can be used as a less invasive

alternative to traditional open surgery.

- **Benign Tumors:** It is also effective for the removal of benign tumors, such as papillomas, cysts, or fibromas, in the head and neck region.
- **Recurrent Cancer:** TORS can be used in patients with recurrent cancer following prior radiation therapy or other treatments, as it minimizes the need for external incisions and scar tissue formation.

Step 3: Advantages of TORS:

- **Minimally Invasive:** No external incisions are made, leading to less postoperative pain, faster recovery, and minimal scarring.
- **Improved Visualization:** The robotic system provides high-definition, magnified 3D views of the surgical area, improving accuracy and reducing complications.
- **Shorter Hospital Stay:** Patients undergoing TORS typically have a shorter hospital stay compared to traditional open surgery, allowing for faster return to normal activities.
- **Preservation of Function:** The technique allows for precise resection of tumors while preserving surrounding critical structures such as nerves and blood vessels, reducing the risk of functional impairment.

> Quick Tip
>
> Transoral robotic surgery is a revolutionary technique for treating head and neck cancers, offering minimal invasiveness, faster recovery, and improved precision.

(b). Ablative therapy for liver tumors.

Solution:

Ablative therapy refers to a range of minimally invasive procedures used to treat liver tumors by destroying or shrinking the tumors without the need for surgical resection. These therapies are often used in patients with liver cancer (hepatocellular carcinoma, HCC) or metastases who are not candidates for surgery due to tumor location, number, or underlying liver disease.

Step 1: Types of Ablative Therapy:

- **Radiofrequency Ablation (RFA):** RFA is the most commonly used ablative technique. It uses high-frequency electrical currents to generate heat, which is applied to the tumor via a needle electrode inserted percutaneously or during laparoscopy. The heat destroys the tumor tissue by coagulation.
- **Microwave Ablation (MWA):** Similar to RFA, MWA uses electromagnetic waves to heat and destroy tumor cells. MWA is more effective for larger tumors and offers faster ablation compared to RFA.
- **Cryoablation:** This technique uses extreme cold (cryoprobes) to freeze and destroy the tumor tissue. It is particularly useful for tumors located near critical structures where heat-based therapies may cause injury.
- **Percutaneous Ethanol Injection (PEI):** PEI involves injecting pure ethanol directly into the tumor, leading to dehydration and cell death. It is most effective for smaller tumors and is commonly used in resource-limited settings.
- **Laser Ablation:** Laser ablation uses light energy to generate heat and destroy tumor cells. This is less commonly used but may be an option for specific tumor locations.

Step 2: Indications for Ablative Therapy:

- **Small Liver Tumors:** Ablation is most effective for tumors that are less than 3-5 cm in diameter. It is commonly used for hepatocellular carcinoma and metastases from colorectal cancer.
- **Patients Unfit for Surgery:** Ablative therapies are a good option for patients who are not surgical candidates due to comorbidities, poor liver function, or the location of the tumor.
- **Palliative Treatment:** For patients with advanced cancer or multiple tumors, ablative therapy can provide symptom relief by reducing tumor burden and improving quality of life.

Step 3: Advantages of Ablative Therapy:

- **Minimally Invasive:** Ablative therapies are performed percutaneously or through small incisions, resulting in minimal trauma, shorter recovery times, and reduced hospital stays.
- **Effective for Small Tumors:** These therapies are highly effective for small tumors and offer good tumor control in carefully selected patients.
- **Palliative Benefit:** Even in advanced cases, ablation can shrink tumors, relieve symptoms, and improve survival in some patients with liver cancer.

Step 4: Limitations and Complications:

- **Tumor Size and Location:** Ablative therapies are generally less effective for large tumors or tumors located near large blood vessels or vital organs, as heat or cold may not reach all parts of the tumor.
- **Recurrence:** There is a risk of tumor recurrence after ablation, particularly in larger tumors. Follow-up imaging is necessary to monitor for recurrence.
- **Infection and Bleeding:** Like any procedure involving needle insertion, there is a risk of infection or bleeding at the ablation site.

Quick Tip

Ablative therapies like RFA and MWA are valuable treatment options for small liver tumors and patients not suitable for surgery, offering a minimally invasive way to manage liver cancer.