NEET SS 2024 DrNB Thoracic Surgery Paper 3 Question Paper and Solutions

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

1(a). Covid-19 pneumonia and situations which require surgical intervention.

Solution:
Covid-19 pneumonia is a severe respiratory infection caused by the SARS-CoV-2 virus, often leading to acute respiratory distress syndrome (ARDS) and multiorgan failure in severe cases. While the majority of cases can be managed with supportive care, some situations require surgical intervention.

Step 1: Indications for Surgical Intervention:
Surgical intervention may be required in the following situations:
1. **Lung Collapse or Pneumothorax:** In cases of severe pneumothorax or tension pneumothorax, a surgical procedure such as chest tube placement or surgical repair is required to re-expand the lung.
2. **Empyema or Lung Abscess:** Superinfection or the development of a lung abscess as a complication of Covid-19 pneumonia may require drainage, either percutaneously or surgically.
3. **Tracheostomy:** In patients with prolonged mechanical ventilation and poor weaning potential, a tracheostomy may be performed to facilitate long-term ventilation and airway management.
4. **Pulmonary Embolism:** If Covid-19 leads to the development of pulmonary embolism with associated hemodynamic instability, surgery or interventional procedures like thrombolysis or thrombectomy may be needed.
5. **Severe Fibrotic Changes:** In some cases of long-standing severe pneumonia, fibrotic changes may necessitate lung resection for better management of the patient's breathing and quality of life.

Quick Tip

Surgical interventions in Covid-19 pneumonia are reserved for complications such as pneumothorax, lung abscess, or severe pulmonary embolism that cannot be managed conservatively.

(b). Role of ECMO in management of Covid-19 pneumonia.

Solution:

Step 1: Introduction to ECMO:

Extracorporeal membrane oxygenation (ECMO) is a life-saving procedure used to provide prolonged cardiac and respiratory support to patients whose heart and lungs are severely compromised. In the case of Covid-19 pneumonia, ECMO is utilized when conventional mechanical ventilation and other supportive therapies fail to improve oxygenation and gas exchange.

Step 2: Indications for ECMO in Covid-19 Pneumonia:

ECMO is considered in the following situations:

1. **Severe ARDS:** Patients with ARDS due to Covid-19 pneumonia who fail to respond to mechanical ventilation or proning.

2. **Refractory Hypoxemia:** When blood oxygen levels remain dangerously low despite maximal ventilator support.

3. **Cardiac Arrest or Shock:** In patients with severe cardiac dysfunction or shock, ECMO can help support both cardiac and respiratory functions.

4. **Failure to Wean from Mechanical Ventilation:** If the patient cannot be weaned off mechanical ventilation after a prolonged period, ECMO can help facilitate recovery.

Step 3: ECMO Technique:

During ECMO, blood is drawn from the patient's body, oxygenated through a membrane oxygenator, and then returned to the body. ECMO can be delivered in two main configurations:

1. **Venovenous (VV) ECMO:** Provides respiratory support by circulating blood through a circuit that involves the venous system only. It is used when the primary issue is respiratory

failure.

2. **Venoarterial (VA) ECMO:** Provides both cardiac and respiratory support by drawing blood from the venous system and returning it to the arterial system. It is used when there is significant cardiac failure alongside respiratory failure.

Step 4: Complications of ECMO:

While ECMO can be life-saving, it comes with risks such as:

- **Bleeding complications:** Due to the use of anticoagulation during ECMO.
- **Infection:** Due to the prolonged use of catheters and cannulas.
- **Organ failure:** Due to prolonged support and complications arising from ECMO itself.

Step 5: Outcome and Prognosis:

ECMO offers survival benefits in Covid-19 pneumonia patients with severe ARDS and refractory hypoxemia. However, its use is associated with significant morbidity, and patients may require long-term rehabilitation.

Quick Tip

ECMO is a critical intervention for patients with severe respiratory and cardiac failure in Covid-19 pneumonia, but it requires careful patient selection and management to prevent complications.

2(a). Endobronchial ultrasound.

Solution:

Endobronchial ultrasound (EBUS) is a minimally invasive imaging technique that combines bronchoscopy with ultrasound to evaluate the lungs and surrounding structures. It is particularly useful in assessing mediastinal and hilar lymph nodes, as well as identifying lung masses and tumors.

Step 1: Technique:

During EBUS, a specialized bronchoscope with an ultrasound probe at its tip is inserted into the airways. The ultrasound probe emits high-frequency sound waves that produce real-time images of the bronchial walls and nearby structures. EBUS can be combined with fine needle aspiration (FNA) to obtain tissue samples for biopsy.

Step 2: Indications:

EBUS is mainly used for:

- **Evaluation of Mediastinal Lymph Nodes:** EBUS is highly effective for staging lung cancer by assessing the mediastinal and hilar lymph nodes. It helps identify any lymph node enlargement, a critical factor in determining the stage of cancer.
- **Lung Tumors and Masses:** EBUS allows for accurate localization and identification of lung tumors or masses, especially those located near the bronchial tree.
- **Biopsy:** EBUS with FNA can be used to obtain tissue samples from lesions or lymph nodes for histological diagnosis, which is less invasive than traditional methods like mediastinoscopy.

Step 3: Advantages:

EBUS offers several advantages, including its ability to visualize structures that are difficult to access with conventional bronchoscopy, its relatively low complication rate, and the ability to perform biopsies in real-time, avoiding the need for more invasive procedures.

> Quick Tip
>
> EBUS provides a highly effective way to evaluate the lungs and surrounding structures in real-time, offering a safer alternative to more invasive diagnostic techniques.

(b). Virtual bronchoscopy.

Solution:

Virtual bronchoscopy (VB) is a non-invasive imaging technique that uses 3D CT scan data to create virtual images of the bronchial tree. It allows for a detailed, three-dimensional reconstruction of the airways without the need for actual bronchoscopy.

Step 1: Technique:

In virtual bronchoscopy, a high-resolution CT scan is performed to obtain detailed images of the chest and airways. These images are then processed using specialized software to generate 3D reconstructions of the bronchial tree. Virtual bronchoscopy allows for a detailed evaluation of the airway lumen, bronchial walls, and surrounding structures.

Step 2: Indications:

VB is used in the following scenarios:

- **Preoperative Assessment:** Virtual bronchoscopy is particularly useful for assessing airway anatomy before surgical interventions, particularly in cases of obstructive lesions, tumors, or structural anomalies.
- **Evaluation of Airway Obstructions:** VB is effective for visualizing the location and extent of airway obstructions, such as tumors, foreign bodies, or strictures.
- **Assessing Bronchial Tree in Pulmonary Disease:** It is used for evaluating bronchial changes in diseases such as chronic obstructive pulmonary disease (COPD), asthma, or bronchiectasis.

Step 3: Advantages and Limitations:

The primary advantage of virtual bronchoscopy is that it is non-invasive and does not require the insertion of a bronchoscope into the airways. It provides 3D reconstructions of the airways, which aids in diagnosis and preoperative planning. However, it is limited in its ability to visualize soft tissue structures, and it cannot perform biopsy or therapeutic procedures like traditional bronchoscopy.

> Quick Tip
>
> Virtual bronchoscopy is a valuable non-invasive imaging technique for preoperative assessment and evaluating airway structures, but it cannot replace traditional bronchoscopy for diagnostic sampling or therapeutic interventions.

3(a). Molecular markers in lung carcinoma.

Solution:

Molecular markers are important in diagnosing and managing lung carcinoma. They provide critical insights into the tumor's behavior and help tailor treatment strategies. The key molecular markers in lung carcinoma include:

Step 1: Genetic Mutations:

1. **EGFR Mutations:** Epidermal Growth Factor Receptor (EGFR) mutations are commonly found in non-small cell lung cancer (NSCLC), especially in adenocarcinomas. These mutations are targeted by EGFR inhibitors such as erlotinib or gefitinib.
2. **ALK Rearrangements:** Anaplastic Lymphoma Kinase (ALK) gene rearrangements are found in some NSCLC cases, particularly in younger, non-smokers. Crizotinib and other ALK inhibitors are used for treatment.
3. **KRAS Mutations:** KRAS mutations are associated with poor prognosis in NSCLC. While no direct therapies are available for KRAS mutations, they guide the understanding of cancer behavior.
4. **BRAF V600E Mutation:** This mutation is found in a small percentage of lung cancers, and specific BRAF inhibitors like dabrafenib can be used to target this mutation.
5. **ROS1 Rearrangements:** ROS1 gene fusion is seen in some patients with lung cancer, and targeted therapy with crizotinib can be effective.

Step 2: Protein Expression:

1. **PD-L1 Expression:** High levels of Programmed Death-Ligand 1 (PD-L1) expression on tumor cells are used to predict the benefit of immune checkpoint inhibitors like pembrolizumab and nivolumab.
2. **CEA (Carcinoembryonic Antigen):** Elevated CEA levels are seen in many patients with lung cancer, though it is not specific. It can be useful for monitoring response to treatment and detecting recurrence.

Step 3: Other Biomarkers:

1. **VEGF (Vascular Endothelial Growth Factor):** VEGF is involved in angiogenesis and may be elevated in NSCLC. Targeting VEGF pathways can help in controlling tumor growth.
2. **TP53 Mutations:** TP53 mutations are commonly found in various cancers, including lung carcinoma, and are associated with poor prognosis.

Quick Tip

Molecular testing is crucial for selecting appropriate therapies in lung cancer, especially EGFR, ALK, and PD-L1 testing, which guide the use of targeted therapies and immunotherapy.

(b). Strategy for management of lung carcinoma guided by molecular markers in lung carcinoma.

Solution:

The management of lung carcinoma has significantly improved with the use of molecular markers, which help guide therapy based on the genetic and molecular profile of the tumor. The strategy involves the following steps:

Step 1: Initial Assessment and Molecular Testing:

All patients diagnosed with non-small cell lung cancer (NSCLC) should undergo molecular testing to identify genetic mutations and biomarkers such as EGFR, ALK, ROS1, BRAF, and PD-L1 expression. This testing is typically done using techniques like PCR, immunohistochemistry, and next-generation sequencing (NGS).

Step 2: Targeted Therapy:

Once the molecular profile of the tumor is determined, targeted therapies can be selected:

1. **EGFR Mutations:** If the tumor has EGFR mutations, patients are treated with EGFR tyrosine kinase inhibitors (TKIs) like erlotinib or osimertinib.
2. **ALK and ROS1 Rearrangements:** Crizotinib and other targeted therapies are used for tumors with ALK or ROS1 rearrangements.
3. **BRAF Mutations:** For tumors with the BRAF V600E mutation, BRAF inhibitors like dabrafenib and MEK inhibitors like trametinib are used in combination.

Step 3: Immunotherapy:

For patients with high PD-L1 expression, immune checkpoint inhibitors such as pembrolizumab, nivolumab, or atezolizumab can be used to enhance the immune system's ability to target and destroy cancer cells.

Step 4: Combination Therapy:

For patients who are not suitable for targeted therapy or immunotherapy, combination therapy involving chemotherapy and immunotherapy may be used. This approach is especially useful in patients with low PD-L1 expression or those with aggressive disease.

Step 5: Monitoring and Follow-Up:

Patients on targeted therapies or immunotherapy should undergo regular imaging and molecular testing to monitor treatment response and detect emerging resistance. If resistance occurs, alternative therapies based on the evolving molecular profile may be considered.

Step 6: Clinical Trials:

Patients with advanced or refractory lung cancer may be eligible for clinical trials testing novel targeted agents or immunotherapies.

> Quick Tip
>
> Molecular testing should be performed early in the diagnosis of lung cancer, as it significantly influences treatment choices and outcomes, allowing for personalized therapy.

4(a). Live donor lung transplantation.

Solution:

Live donor lung transplantation is a rare and specialized procedure where a portion of the lung from a living donor is transplanted into a recipient with end-stage lung disease. It is an alternative when cadaveric donor lungs are unavailable or when waiting lists are long.

Step 1: Indications for Live Donor Lung Transplantation:

- **Shortage of Organ Donors:** The most common reason for considering live donor lung transplantation is the shortage of cadaveric donor organs.
- **Pediatric and Small Adult Recipients:** Live donor lung transplants are more frequently performed in pediatric and small adult patients where the lung size match is critical.
- **Urgency and Acute Conditions:** In urgent situations, where a recipient's condition is deteriorating rapidly, a live donor lung transplant can provide timely treatment.

Step 2: Donor and Recipient Selection:

The donor must be healthy with no history of smoking, lung disease, or respiratory infections. Ideally, the donor's lung size and anatomy should be compatible with the recipient. In general, the procedure involves removing one lobe of the lung from the donor, usually the lower lobe, and transplanting it into the recipient.

Step 3: Surgical Procedure:

The donor and recipient undergo surgery simultaneously. The donor's lung lobe is removed through an incision, and the lung is transplanted into the recipient. This surgery requires careful planning to ensure both the donor and recipient recover properly, and the recipient receives enough lung volume to maintain normal respiratory function.

Step 4: Risks and Challenges:

- **Donor Risks:** Risks to the living donor include complications from lung resection, such as infection, bleeding, and reduced lung function post-surgery.
- **Recipient Risks:** For the recipient, the main risks include graft rejection, infection, and complications related to the surgical procedure. Long-term survival depends on the proper function of the transplanted lung and management of immune suppression.

> **Quick Tip**
>
> Live donor lung transplantation offers an alternative to deceased donor transplants, but it involves significant risks to both the donor and recipient. Careful donor selection and post-operative monitoring are crucial.

(b). Immunosuppressive therapy in lung transplantation.

Solution:

Immunosuppressive therapy is critical in lung transplantation to prevent rejection of the transplanted lung. It involves the use of drugs that suppress the recipient's immune system to reduce the risk of immune-mediated graft rejection. However, these drugs also increase the risk of infection and malignancy.

Step 1: Purpose of Immunosuppressive Therapy:

- **Preventing Acute Rejection:** The primary goal is to prevent acute rejection episodes, which are caused by the immune system attacking the transplanted lung as foreign tissue.
- **Long-term Graft Survival:** Immunosuppressive therapy helps maintain the function of the transplanted lung over the long term and prevents chronic rejection (bronchiolitis obliterans syndrome).

Step 2: Common Immunosuppressive Drugs:

- **Corticosteroids:** These are used initially to control rejection and inflammation. However,

long-term use can lead to side effects such as osteoporosis, diabetes, and infections.
- **Calcineurin Inhibitors (Tacrolimus, Cyclosporine):** These drugs inhibit T-cell activation and are the cornerstone of immunosuppressive therapy. They are essential for both acute and chronic rejection prevention.
- **Antimetabolites (Mycophenolate Mofetil, Azathioprine):** These drugs inhibit the proliferation of T-cells and B-cells, reducing immune system activation. They are often used in conjunction with calcineurin inhibitors.
- **mTOR Inhibitors (Sirolimus, Everolimus):** These are used to inhibit T-cell proliferation and provide an alternative for patients who cannot tolerate calcineurin inhibitors.

Step 3: Monitoring and Adjusting Immunosuppressive Therapy:
Immunosuppressive drug levels must be closely monitored to balance the risk of rejection with the risk of infection. Regular blood tests are used to adjust the dosages to ensure optimal therapeutic levels. The aim is to minimize toxicity while preventing rejection.

Step 4: Side Effects and Risks:
- **Infections:** Immunosuppressive therapy increases the risk of bacterial, viral, and fungal infections. Prophylactic antimicrobials are often used during the early post-transplant period.
- **Cancer:** Chronic immunosuppression increases the risk of malignancies, particularly skin cancers, lymphoma, and Kaposi's sarcoma. Regular screening and sun protection are recommended.
- **Renal and Hepatic Toxicity:** Some immunosuppressive drugs can cause kidney or liver damage, and renal function needs to be monitored.

> Quick Tip
>
> The main challenge in immunosuppressive therapy is balancing the prevention of rejection with minimizing side effects such as infections and cancer. Close monitoring is essential.

5(a). 3-D printing in thoracic surgery.

Solution:

3-D printing has emerged as a revolutionary technology in thoracic surgery, offering a wide range of applications that enhance preoperative planning, improve patient outcomes, and assist in complex procedures. The main uses of 3-D printing in thoracic surgery include:

Step 1: Preoperative Planning:

3-D printed models of the patient's thoracic anatomy can be created from CT or MRI scans. These models allow surgeons to better understand the complexities of the patient's condition, such as tumors, structural anomalies, or vascular abnormalities. It enables improved visualization and planning for surgery, especially in challenging cases.

Step 2: Surgical Simulation:

Surgeons can use 3-D printed models to practice procedures beforehand, especially in complex cases. This simulation allows for improved accuracy, reduces operative time, and enhances surgical confidence. It is particularly useful in lung resection, complex vascular surgeries, and thoracic trauma.

Step 3: Patient-Specific Implants:

For patients who require reconstructive surgery, 3-D printing can be used to create customized implants tailored to the patient's unique anatomy. This is particularly useful for chest wall reconstruction and thoracic organ transplantation.

Step 4: Education and Training:

3-D printing is also useful in medical education. Students and residents can learn about thoracic anatomy and surgery through hands-on practice with 3-D printed models, providing a deeper understanding of spatial relationships and surgical techniques.

Step 5: Postoperative Care:

Post-surgery, 3-D models can be used to track the healing process, especially in complex reconstructions. These models allow clinicians to assess the fit and function of implants and evaluate postoperative complications.

> **Quick Tip**
>
> 3-D printing enhances surgical precision and outcomes by allowing for better preoperative planning, simulation, and creation of patient-specific implants.

(b). Artificial intelligence in thoracic surgery.

Solution:

Artificial intelligence (AI) is increasingly being integrated into thoracic surgery, revolutionizing many aspects of patient care, from diagnosis to postoperative management. The primary applications of AI in thoracic surgery include:

Step 1: Diagnostic Assistance:

AI-powered algorithms, especially those using deep learning techniques, can assist in interpreting medical imaging such as chest X-rays, CT scans, and MRIs. AI can help detect early signs of diseases such as lung cancer, pulmonary embolism, or pneumonia with high accuracy, reducing diagnostic errors and aiding early intervention.

Step 2: Surgical Planning and Robotics:

AI is used to develop personalized surgical plans by analyzing imaging data and other patient-specific factors. Additionally, robotic systems enhanced with AI can assist surgeons in performing minimally invasive procedures with precision, such as robotic-assisted lung resections or biopsies.

Step 3: Risk Prediction and Decision-Making:

AI models can analyze large datasets of clinical and demographic information to predict surgical outcomes, such as the risk of complications or survival rates. These models help guide clinical decision-making, particularly in high-risk patients or complex surgeries.

Step 4: Postoperative Monitoring:

AI can be used to monitor patients post-surgery, analyzing vital signs and patient data to detect early signs of complications like infections, respiratory failure, or bleeding. AI systems can alert healthcare providers to potential issues, allowing for prompt intervention.

Step 5: Education and Training:

AI can assist in surgical training by providing simulation-based learning experiences for medical students and residents. These AI-driven simulators can replicate complex surgical procedures and provide feedback on technique and performance, improving education and skill development.

Quick Tip

AI is transforming thoracic surgery by improving diagnostic accuracy, enhancing surgical precision, and providing better postoperative monitoring, ultimately improving patient outcomes.

6(a). Uni-portal VATS lobectomy.

Solution:

Uni-portal video-assisted thoracoscopic surgery (VATS) lobectomy is a minimally invasive procedure used to remove a lung lobe for the treatment of lung cancer, emphysema, or other lung diseases. It involves making a single small incision, usually about 3-4 cm in size, through which the surgeon inserts a thoracoscope (camera) and instruments to perform the surgery.

Step 1: Technique:

In uni-portal VATS lobectomy, the procedure is performed through a single incision, typically at the 5th or 6th intercostal space. The surgeon introduces the thoracoscope and other surgical instruments through this single incision. The lung is resected by carefully removing the affected lobe, while minimizing damage to surrounding tissues.

Step 2: Indications:

Uni-portal VATS lobectomy is typically indicated for:

- **Lung Cancer:** It is commonly performed for early-stage non-small cell lung cancer (NSCLC) when the tumor is located in one lobe of the lung.
- **Benign Lung Disease:** It can also be used for benign lung diseases such as emphysema or bronchiectasis when a lung lobe requires removal.
- **Other Thoracic Diseases:** Occasionally, it is used for other thoracic conditions such as pulmonary metastases.

Step 3: Advantages:

- **Reduced Recovery Time:** As the surgery is minimally invasive, recovery time is significantly reduced compared to traditional open lobectomy.
- **Smaller Incision:** The smaller incision results in less postoperative pain and better

cosmetic outcomes.

- **Shorter Hospital Stay:** Most patients can go home within 2-3 days after the surgery.
- **Improved Postoperative Function:** Shorter recovery times allow for better postoperative lung function and faster return to normal activities.

> **Quick Tip**
>
> Uni-portal VATS lobectomy is an excellent option for patients requiring lobectomy but seeking minimal invasiveness, offering quick recovery and reduced postoperative discomfort.

(b). Robotic lobectomy of lung.

Solution:

Robotic lobectomy of the lung is a type of minimally invasive surgery where a robot-assisted system is used to perform a lobectomy. This procedure combines the precision and dexterity of robotic technology with the benefits of minimally invasive surgery.

Step 1: Technique:

In robotic lobectomy, the surgeon makes small incisions, typically three or four, through which robotic arms and instruments are inserted. The robotic system provides a three-dimensional, high-definition view of the surgical area, allowing for greater precision in dissection and resection of the lung lobe. The surgeon controls the robotic arms from a console, using a joystick and pedals to manipulate the instruments.

Step 2: Indications:

Robotic lobectomy is indicated for similar conditions as traditional lobectomy:

- **Lung Cancer:** It is most commonly performed for patients with early-stage lung cancer, especially non-small cell lung cancer (NSCLC).
- **Other Lung Diseases:** It can be used for benign conditions like emphysema, infections, or pulmonary metastasis when the affected lung lobe requires removal.
- **Recurrent Pulmonary Diseases:** It is also beneficial for patients who have previously undergone thoracic surgery and require further treatment.

Step 3: Advantages:

- **Precision and Control:** Robotic surgery offers improved precision and better visualization, which can lead to less blood loss and fewer complications.
- **Minimally Invasive:** Similar to uni-portal VATS, the robotic approach involves smaller incisions, resulting in less pain, reduced scarring, and faster recovery.
- **Enhanced 3D Visualization:** The surgeon is provided with a high-definition, 3D view of the surgical field, which enhances the ability to navigate complex anatomical structures.
- **Quicker Recovery:** Patients often experience less postoperative pain, shorter hospital stays, and quicker returns to normal activities compared to traditional open surgery.

> **Quick Tip**
>
> Robotic lobectomy allows for precise and controlled removal of the lung lobe with minimal invasiveness, leading to quicker recovery and improved outcomes for patients.

7(a). Pathophysiology of respiratory failure secondary to flail chest.

Solution:

Flail chest is a severe condition resulting from multiple rib fractures, leading to paradoxical chest wall motion. This significantly impairs respiratory mechanics and can result in respiratory failure.

Step 1: Mechanism of Injury:

Flail chest occurs when multiple adjacent ribs are fractured in at least two places, resulting in a free-floating segment of the chest wall. This disrupts the normal integrity of the thoracic cage and impairs ventilation.

Step 2: Paradoxical Chest Wall Motion:

In flail chest, the injured section of the chest wall moves in the opposite direction to the rest of the thoracic cage during breathing. During inspiration, the flail segment is sucked inward while the rest of the chest wall expands. Conversely, during expiration, the flail segment bulges outward while the rest of the chest wall contracts.

Step 3: Impaired Ventilation:

The paradoxical motion prevents effective expansion of the lungs, leading to a reduction in tidal volume and impaired gas exchange. This can result in hypoxemia, hypercapnia, and respiratory acidosis. The compromised ventilation also contributes to atelectasis and a lack of proper airway clearance.

Step 4: Respiratory Failure:

The inability of the lungs to expand adequately due to chest wall instability results in respiratory failure. The body compensates by increasing the respiratory rate and working harder to achieve ventilation, which can eventually lead to fatigue and failure of the respiratory muscles, requiring mechanical ventilation.

Step 5: Associated Injuries:

Flail chest often occurs in conjunction with other serious injuries, including pulmonary contusions, hemothorax, and pneumothorax, which exacerbate respiratory failure. The combined effects of these injuries further complicate management and prognosis.

> Quick Tip
>
> Management of flail chest requires stabilization of the chest wall, optimization of ventilation, and management of associated injuries to prevent respiratory failure.

(b). Novel techniques for stabilization of ribs in flail chest.

Solution:

The stabilization of ribs in flail chest is crucial to restore normal chest wall motion, improve ventilation, and prevent respiratory failure. Several novel techniques have been developed to address these issues.

Step 1: Surgical Stabilization of Rib Fractures:

1. **Plating System:** Rib plating involves the use of titanium or stainless steel plates to stabilize fractured ribs. This technique is increasingly used in severe cases of flail chest, as it restores normal chest wall mechanics and reduces the paradoxical movement of the flail segment. It is particularly beneficial for patients with multiple rib fractures and severe pain.

2. **Intramedullary Rods:** Another technique involves the use of intramedullary rods to

stabilize rib fractures. This less invasive technique can be used in cases with fewer fractures and helps provide stability to the chest wall while avoiding the risks associated with plating.

3. **Stabilizing Devices:** Recently, innovative stabilizing devices have been designed to provide external support to the fractured ribs. These devices are particularly useful in patients who are not surgical candidates or those who have complex injuries that cannot be treated with traditional methods.

Step 2: Non-Surgical Stabilization Techniques:

1. **External Ventilatory Support:** Non-invasive ventilation or positive pressure ventilation (such as CPAP or BiPAP) may be used to assist with lung expansion and reduce the work of breathing in patients with flail chest. While this does not directly stabilize the chest wall, it helps to maintain adequate oxygenation and prevent respiratory failure.

2. **Chest Wall Binding:** Although less commonly used today, binding the chest wall with a compression bandage was traditionally used to reduce the paradoxical movement of the chest wall. However, it is less effective than surgical stabilization and is not routinely recommended.

Step 3: Pain Management:

Effective pain management is critical for rib fracture stabilization, as uncontrolled pain can hinder respiratory effort and increase the risk of respiratory failure. Regional anesthesia, such as nerve blocks (e.g., intercostal nerve block or thoracic epidural anesthesia), is often employed in combination with other stabilization techniques.

Step 4: New Techniques and Research:

Research into robotic-assisted surgery and minimally invasive procedures for rib stabilization is ongoing. These techniques aim to reduce the risks and recovery time associated with traditional surgery, offering more options for patients with severe flail chest.

> **Quick Tip**
>
> Surgical stabilization of the ribs with plating or intramedullary rods is the most effective method to treat flail chest, improving outcomes by restoring normal chest wall movement and reducing respiratory complications.

8(a). Surgical technique of VATS decortication.

Solution:

Video-assisted thoracoscopic surgery (VATS) decortication is a minimally invasive procedure performed to treat conditions like chronic empyema, pleural adhesions, and other diseases that lead to the formation of fibrous tissue (pleural peel) around the lungs. This procedure is aimed at removing the thickened pleural tissue, allowing the lung to expand fully and improve respiratory function.

Step 1: Patient Preparation:

The patient is placed in a lateral decubitus position with the affected side up. General anesthesia is administered, and a double-lumen endotracheal tube is inserted to facilitate one-lung ventilation. The patient is closely monitored throughout the procedure.

Step 2: Insertion of Ports:

VATS decortication involves creating 2 to 3 small incisions on the chest wall, typically between the ribs, to insert the thoracoscope and instruments. The surgeon visualizes the pleural cavity and lung surface using the thoracoscope. The camera provides a high-definition view of the pleura and the extent of the fibrous peel.

Step 3: Decortication:

Using specialized instruments, the surgeon carefully removes the thickened pleural tissue (fibrous peel) from the surface of the lung. This is done using a combination of sharp dissection, cauterization, and mechanical resection. The goal is to achieve complete removal of the pleural peel while avoiding damage to the underlying lung tissue.

Step 4: Postoperative Management:

After decortication, the lung is inspected for adequate expansion, and any air leaks are addressed. A chest tube is placed to drain any fluid or air from the pleural cavity. The patient is closely monitored for complications such as bleeding, infection, or recurrence of pleural thickening.

Quick Tip

VATS decortication is a minimally invasive procedure that offers the benefits of reduced recovery time, less postoperative pain, and faster return to normal activities compared to traditional open surgery.

(b). Surgical sealants for management of air leaks.

Solution:

Surgical sealants are used in the management of air leaks, particularly after lung resection, to prevent the escape of air from the lung into the pleural cavity. Air leaks are common after thoracic surgery, and sealants are used to provide immediate closure, minimize the risk of prolonged air leaks, and avoid the need for additional procedures.

Step 1: Types of Surgical Sealants:

- **Fibrin Sealants:** Fibrin-based sealants, such as Tisseel or Evicel, are the most commonly used. These sealants consist of fibrinogen and thrombin, which, when mixed, form a clot that seals the air leak. They are effective in promoting hemostasis and providing a barrier to air and fluid leaks.
- **BioGlue:** BioGlue is a tissue adhesive composed of bovine-derived serum albumin and glutaraldehyde. It is used to seal air leaks and promote adhesion of tissues, providing immediate closure and reducing the need for further intervention.
- **Synthetic Polymers:** These sealants are made of materials such as polyethylene glycol or cyanoacrylate and are used for sealing air leaks, particularly in cases of smaller or persistent leaks. These materials form a strong, durable seal over the leak site.

Step 2: Technique of Application:

- The surgical site is prepared, and the surgeon identifies the location of the air leak. In most cases, the air leak is caused by a small hole or tear in the lung parenchyma after surgery, and it can be visualized using a bronchoscope or intraoperative assessment.
- The chosen sealant is then applied directly to the site of the air leak. The surgeon may use an applicator to evenly distribute the sealant, ensuring that the area around the leak is fully covered.

- Once applied, the sealant forms a protective barrier that helps to stop the air leak and promotes tissue healing.

Step 3: Postoperative Care:

After the sealant is applied, a chest tube is usually placed to allow any residual air or fluid to drain from the pleural cavity. The patient is monitored for recurrence of air leaks, and regular chest imaging is performed to ensure that the lung is expanding properly and that there is no persistent air leak.

> **Quick Tip**
>
> Surgical sealants, such as fibrin glue or BioGlue, provide an effective means to manage air leaks following lung surgery, reducing complications and shortening recovery time.

9(a). Hyperhidrosis.

Solution:

Hyperhidrosis is a condition characterized by excessive sweating beyond what is necessary to regulate body temperature. This condition can occur in localized areas or be generalized.

Step 1: Types of Hyperhidrosis:

1. **Primary (Essential) Hyperhidrosis:** This is the most common form and occurs without any underlying medical conditions. It typically affects the palms, soles, underarms, and face. The exact cause is unknown but is believed to involve overactivity of the sympathetic nervous system.

2. **Secondary Hyperhidrosis:** This form is caused by an underlying medical condition such as obesity, hyperthyroidism, diabetes, infections, or neurological conditions. It may also be a side effect of medications.

Step 2: Clinical Features:

- Sweating occurs without any clear trigger, or in response to minimal stimuli such as emotional stress or slight physical exertion.
- It typically involves localized areas like the armpits, hands, feet, and face, but can also be generalized.

- The sweating may be severe enough to cause discomfort, interfere with daily activities, and lead to social embarrassment or anxiety.

Step 3: Diagnosis:

The diagnosis of hyperhidrosis is primarily clinical, based on the patient's history and symptoms. There are no specific tests, but certain techniques may be used to assess the severity, including the starch-iodine test or the gravimetric test.

Step 4: Treatment Options:

1. **Topical Antiperspirants:** Aluminium chloride-based antiperspirants are often the first-line treatment for localized hyperhidrosis.
2. **Oral Medications:** Anticholinergic drugs, such as oxybutynin or glycopyrrolate, can help reduce sweating by blocking acetylcholine at sweat glands.
3. **Iontophoresis:** A non-invasive procedure where a mild electrical current is used to reduce sweat production in the palms and soles.
4. **Botulinum Toxin Injections:** Botox can block the release of acetylcholine and reduce sweating for several months.
5. **Surgical Treatment (Sympathectomy):** For severe cases that do not respond to other treatments, thoracic sympathectomy may be considered to remove or interrupt the sympathetic nerves responsible for excessive sweating.

Quick Tip

For localized hyperhidrosis, first-line treatment includes topical antiperspirants, while systemic treatments or surgical options are reserved for more severe cases.

(b). Thoracoscopic sympathectomy.

Solution:

Thoracoscopic sympathectomy is a minimally invasive surgical procedure used to treat hyperhidrosis by interrupting the sympathetic nerve pathway that causes excessive sweating.

Step 1: Procedure Overview:

In this procedure, a small incision is made in the chest, and a thoracoscope (a small camera) is inserted to visualize the sympathetic nerves. The surgeon either clips, cuts, or destroys a portion of the sympathetic chain that innervates the sweat glands in the affected area.

Step 2: Indications:

Thoracoscopic sympathectomy is indicated for patients with severe, localized hyperhidrosis who have not responded to conservative treatments like antiperspirants, oral medications, or Botox injections. It is most commonly used for palmar, axillary, and facial hyperhidrosis.

Step 3: Benefits:

1. **Minimally Invasive:** This procedure is less invasive than traditional surgery, with smaller incisions and quicker recovery times.
2. **High Success Rate:** It offers long-term relief from excessive sweating in the affected areas, with many patients experiencing significant improvement after surgery.
3. **Quick Recovery:** Most patients are able to resume normal activities within a few days to weeks after the procedure.

Step 4: Risks and Complications:

1. **Compensatory Sweating:** Some patients may develop increased sweating in other areas, such as the back or thighs, after surgery.
2. **Pneumothorax:** There is a small risk of air leakage into the chest cavity, which may require further intervention.
3. **Nerve Injury:** Injury to other nearby nerves may cause complications such as Horner's syndrome (ptosis, miosis, and anhidrosis of the face) or changes in sensation.

Step 5: Postoperative Care:

Postoperative care involves managing any discomfort, monitoring for complications such as pneumothorax, and advising the patient on managing any compensatory sweating. Most patients require follow-up visits to assess the success of the procedure.

Quick Tip

Thoracoscopic sympathectomy is an effective option for patients with severe hyperhidrosis unresponsive to other treatments, though it is important to discuss potential side effects like compensatory sweating.

10(a). Pleuro-cutaneous window.

Solution:

A pleuro-cutaneous window is a surgical procedure in which a communication is established between the pleural cavity and the skin. This technique is most commonly used in the treatment of pleural effusion, particularly when there is no response to medical treatment or when the pleural effusion is recurrent. The window allows the effusion to drain out through the skin, providing relief from symptoms and preventing further accumulation of fluid.

Step 1: Indications:

- **Chronic Pleural Effusion:** In cases of chronic pleural effusion that do not respond to drainage or other interventions, a pleuro-cutaneous window may be created.
- **Recurrent Effusions:** This procedure is also indicated for patients with recurrent pleural effusions that persist despite repeated thoracentesis or pleurodesis.
- **Complications from Malignancy:** In patients with malignancies causing pleural effusions, a pleuro-cutaneous window can provide long-term drainage and symptomatic relief.

Step 2: Technique:

The procedure typically involves the following steps:

- A small incision is made in the skin, usually in the lateral chest wall or near the mid-axillary line.
- The pleural space is accessed by dissection through the chest wall, and the pleural cavity is opened.
- A portion of the pleura is then removed or punctured, allowing the pleural fluid to drain through the skin. The opening is typically left open to allow continuous drainage of the fluid.
- A dressing is placed over the incision site to manage any leakage and prevent infection.

Step 3: Postoperative Care:

After the procedure, the patient will need to be monitored for signs of infection or complications such as bleeding or air leaks. The drainage site should be kept clean and dry, and the patient may require follow-up visits to monitor the drainage and ensure that no further pleural effusion develops.

Quick Tip

Pleuro-cutaneous window is a palliative treatment for chronic or recurrent pleural effusions and can provide relief for patients who are not candidates for more invasive procedures.

(b). Protection of OT personnel during surgery for tuberculosis.

Solution:

Protection of operating theatre (OT) personnel during surgery for tuberculosis (TB) is essential to prevent the transmission of the disease, as TB is primarily spread through airborne droplets. Strict infection control measures are required to protect healthcare workers and minimize the risk of nosocomial transmission.

Step 1: Use of Personal Protective Equipment (PPE):

- **N95 Respirators:** All OT personnel must wear N95 respirators, which are designed to filter out airborne particles, including Mycobacterium tuberculosis. These should be worn by everyone in the operating room, including surgeons, nurses, and anesthetists.
- **Protective Clothing:** Gowns, gloves, and eye protection should be worn to minimize the risk of contact with contaminated surfaces. Surgical drapes and face shields are also recommended during procedures that may produce aerosolized particles.

Step 2: Airborne Infection Control:

- **Negative Pressure Rooms:** The operating room should be a negative pressure room to ensure that contaminated air is expelled from the room and does not circulate to other areas of the hospital.
- **Proper Ventilation:** The operating room should have adequate ventilation with a high turnover of fresh air to dilute and remove potentially contaminated air.
- **Aerosolized Particles:** During surgery, the creation of aerosolized particles (e.g., during intubation, suctioning, or cauterization) can increase the risk of transmission, so extra precautions should be taken.

Step 3: Patient Isolation:

- **Preoperative Screening:** TB screening should be performed on all patients before surgery.

If the patient has active TB, the surgery should be delayed until they are no longer infectious, if possible.

- **Isolation:** Patients with active pulmonary TB should be isolated in a well-ventilated room before and after surgery to prevent the spread of airborne particles. The use of a surgical mask for the patient is essential to prevent contamination.

Step 4: Postoperative Measures:

- **Environmental Cleaning:** After surgery, the operating room should undergo thorough cleaning with appropriate disinfectants to eliminate any residual bacterial contamination.
- **Monitoring of Healthcare Workers:** OT personnel should be regularly monitored for symptoms of TB, and any potential exposure should be followed by appropriate testing, including a tuberculin skin test (TST) or interferon-gamma release assay (IGRA).

> **Quick Tip**
>
> Stringent infection control measures, including the use of PPE, negative pressure rooms, and patient isolation, are essential to protect OT personnel during surgery for tuberculosis.
