ANAESTHESIA FOR THORACIC SURGERY

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Introduction :

- Thoracic surgery presents a unique set of physiological problems for the anesthesiologist. These include physiological derangements caused by placing the patient in the lateral decubitus position, opening the chest (open pneumothorax), and the need for one-lung ventilation.

Introduction :

Common indications for thoracic surgery include :

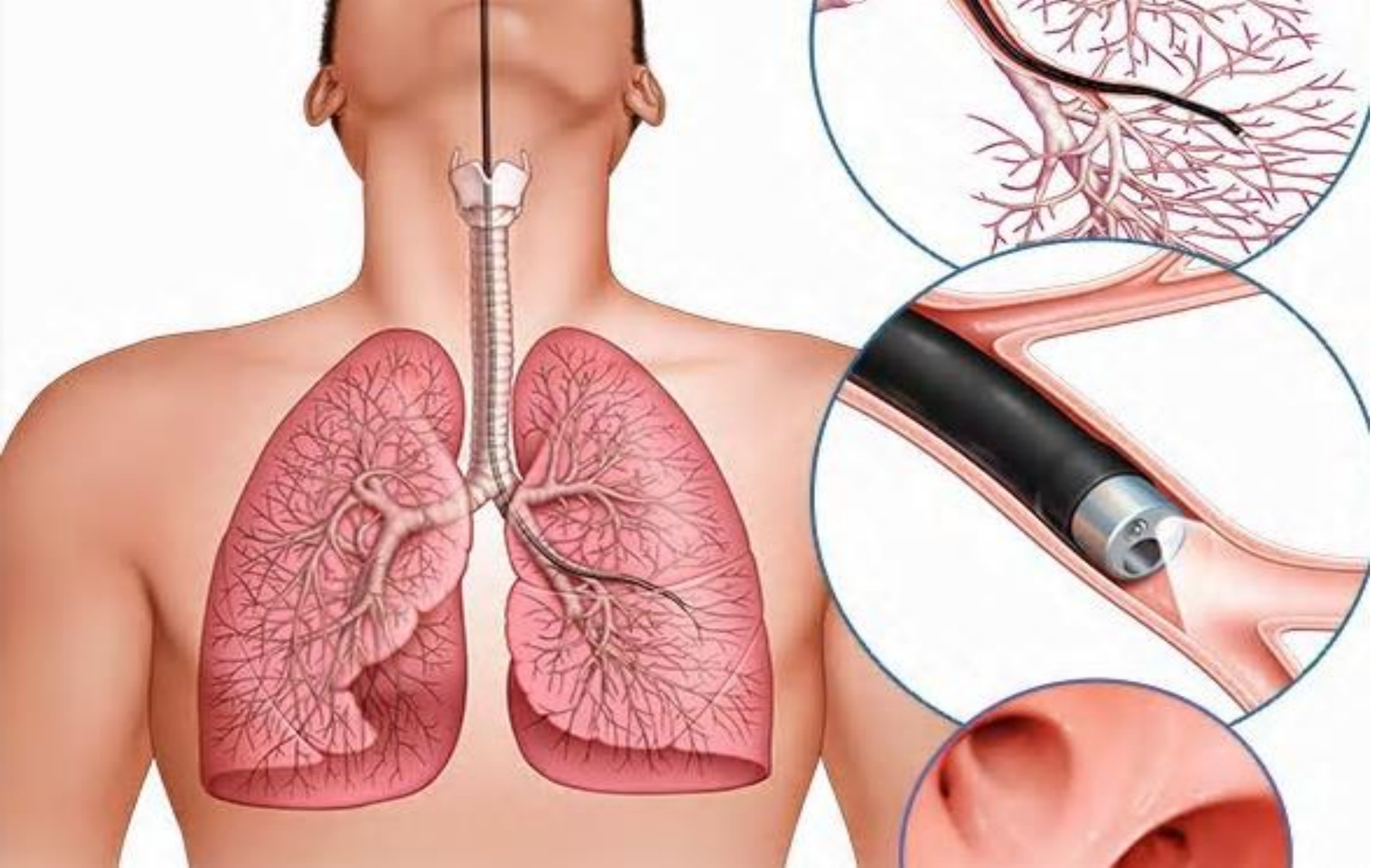
- malignancies (mainly of the lungs and esophagus)
- chest trauma
- esophageal disease
- and mediastinal tumors.

Diagnostic procedures such as bronchoscopy, mediastinoscopy, and open-lung biopsies are also common.

Introduction :

Particular anesthetic challenges of thoracic anesthesia :

- Control of airway during bronchoscopy.
- Protection of the airway in patients with esophageal disease, lung abscess, bronchopleural fistula or hemoptysis.
- Positioning a double-lumen tracheal tube to maintain anesthesia in the lateral position with the chest opened and one lung collapsed.
- Postoperative care of a patient after lung tissue resection.



BRONCHOSCOPY :

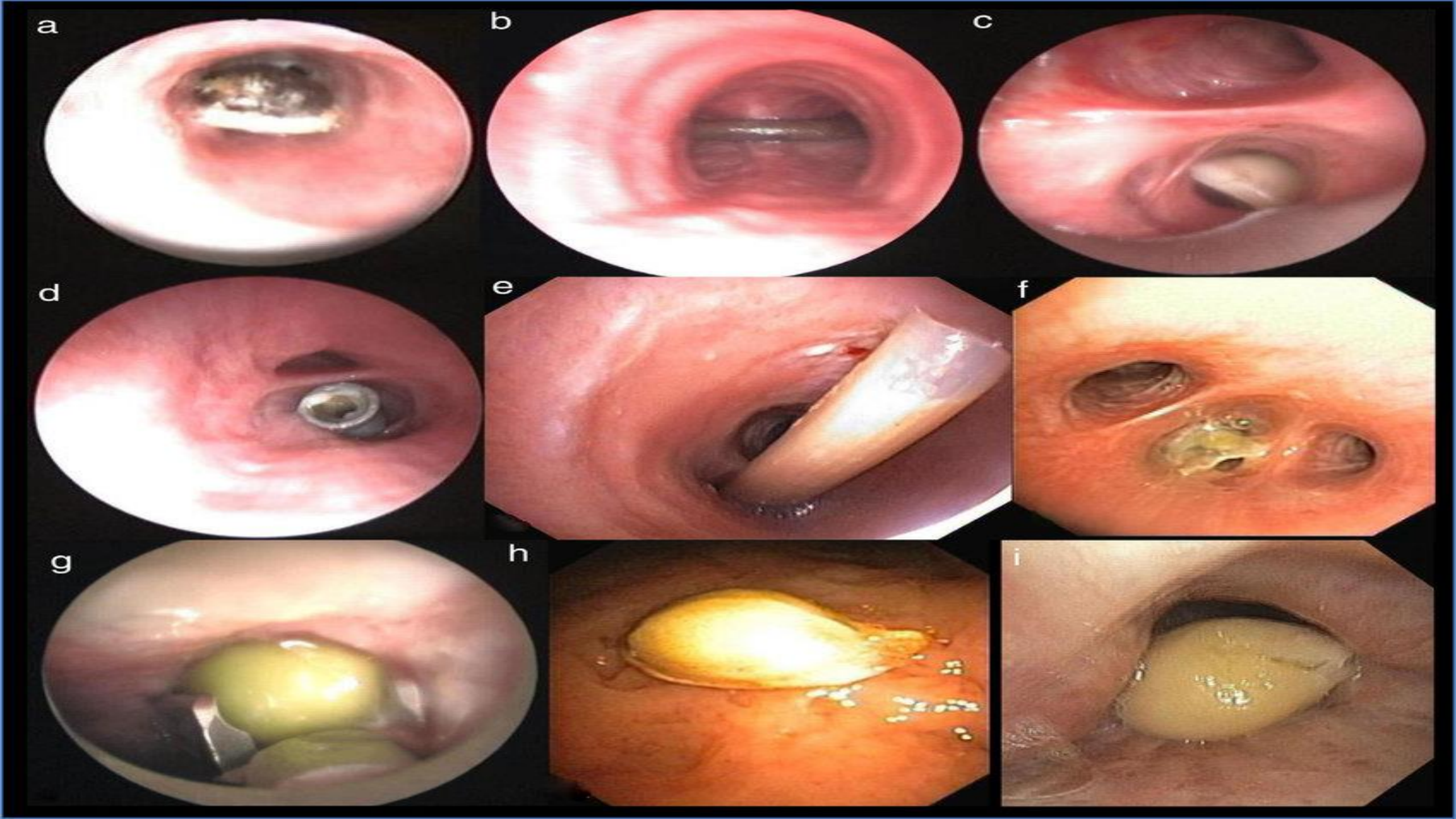
Rigid bronchoscopy may be for diagnostic or interventional procedures. The latter include stenting, lasering and removal of foreign bodies.

Bronchoscopy for a foreign body :

- Inhalation of a foreign body (FB) is a potentially life threatening event, with children in the age range **1 to 3 years** most at risk.

  Inhalation of an organic FB may result in airway hyperreactivity and mucosal oedema.

The occurrence of oedema in addition to the physical presence of the FB results in a rapid increase in airway resistance and hypoxia.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BRONCHOSCOPY :

Presentation :

- The presentation may be acute, with symptoms and signs of laryngeal or tracheal obstruction (cough, choking, respiratory distress, cyanosis, stridor, tachypnoea).
- The presentation may be more insidious, with chronic cough, chest infection.

BRONCHOSCOPY :

Presentation :

- The history may help in the diagnosis, for example sudden onset of respiratory distress while playing with small objects, but FB aspiration should be considered in every child presenting with cough or stridor, in the absence of clear symptoms and signs pointing to another etiology.
- Oesophageal FB may present with respiratory distress due to external compression of the trachea.

BRONCHOSCOPY :

Presentation :

Preparation, investigation and examination :

To a large extent this will be dictated by the clinical condition of the child. If time allows the usual preoperative assessment should be made, with particular attention to examination of the airway and chest. If the child is stable a chest radiograph may be helpful in localising the FB, although the **majority of FBs** will **not be radio-opaque.**

BRONCHOSCOPY :

Presentation :

Preparation, investigation and examination :

In the acute situation few other investigations are indicated. The patient should be starved according to the recommended guidelines, but this will clearly not be possible with acute respiratory distress.

- Sedative premedication should not be used.
- General anaesthesia will be required to perform bronchoscopy.

BRONCHOSCOPY :

Presentation :

Preparation, investigation and examination :

The anaesthetic machine and other equipment should be checked, especially suction equipment. A range of sizes of endotracheal tubes should be available, in case intubation is urgently required, bearing in mind that the presence of airway oedema reduces the tracheal diameter.

BRONCHOSCOPY :

Presentation :

Preparation, investigation and examination :

- Monitoring including pulse oximetry, ECG, non-invasive blood pressure, and capnography should be applied. Intravenous access should be secured prior to induction, but if the child is distressed this can be performed immediately after induction.
- Inhalational induction is recommended using either sevoflurane or halothane in 100% oxygen. Sevoflurane causes less airway irritation and is more cardiovascularly stable than halothane

BRONCHOSCOPY :

Presentation :

Preparation, investigation and examination :

- Spontaneous ventilation is recommended, although occasionally it might be necessary to assist ventilation with gentle mask ventilation.
- Spontaneous ventilation reduces the risk of hyperinflation of the lung and pneumothorax, and is also less likely to dislodge the FB distally.

BRONCHOSCOPY :

Presentation :

Preparation, investigation and examination :

- Intubation should not be performed prior to rigid bronchoscopy, due to the risk of dislodging or fragmenting the FB, with a risk of complete airway obstruction.

- If desaturation during bronchoscopy of one lung occurs, the bronchoscope can be withdrawn into the trachea to allow re-oxygenation of both lungs, before a further attempt at bronchoscopy is made.

BRONCHOSCOPY :

Presentation :

Preparation, investigation and examination :

- During bronchoscopy careful observation of chest movements should be made.
- After removal of the FB the airway can be maintained using a face mask, endotracheal tube or laryngeal mask.
- The anaesthetic is discontinued, 100% oxygen is administered, and the patient observed carefully until awake and extubated.

BRONCHOSCOPY :

Presentation :

Preparation, investigation and examination :

- Postoperatively, the child must be monitored for signs of stridor and airway obstruction due to oedema.
- Humidified oxygen is recommended for 24 hours
- Dexamethasone 250mcg/kg i.v. at induction followed by 100mcg/kg 6 hourly for 24 hours has also been recommended.

BRONCHOSCOPY :

Fiber-optic bronchoscopy :

Commonly, fiber-optic bronchoscopy is performed under topical anesthesia and sedation with midazolam or diazepam.

Opioids may be used in addition, but apnea must be avoided. A flexible fiber-optic scope may be passed via an endotracheal tube or laryngeal mask airway under general anesthesia

One-lung anesthesia :

In thoracic anesthesia, One lung ventilation **(OLV)** is the term used in thoracic anaesthesia to describe the ability to ventilate one of a patient's lungs, allowing the other one to collapse.

One-lung anesthesia: :

Indications for OLV :

There are 3 indications for OLV:

1- Improving surgical access:

It is much easier for a surgeon to carry out lung surgery, or oesophageal surgery, if a lung is collapsed.

- Adequate surgical access can be achieved for most lung resections and oesophago-gastrectomies without collapsing a lung simply by ventilating the patient with smaller tidal volumes and the surgeon using a retractor.

One-lung anesthesia: :

Indications for OLV :

1- Improving surgical access:

- Some surgery definitely needs OLV. Thoracoscopic surgery is impossible without collapsing a lung. This technique is known as video-assisted thoracoscopic surgery (VATS). It can be used to carry out procedures such as, lung biopsy, thoracic sympathectomy, inspection of lesions to decide operability, and even lung resection.

One-lung anesthesia: :

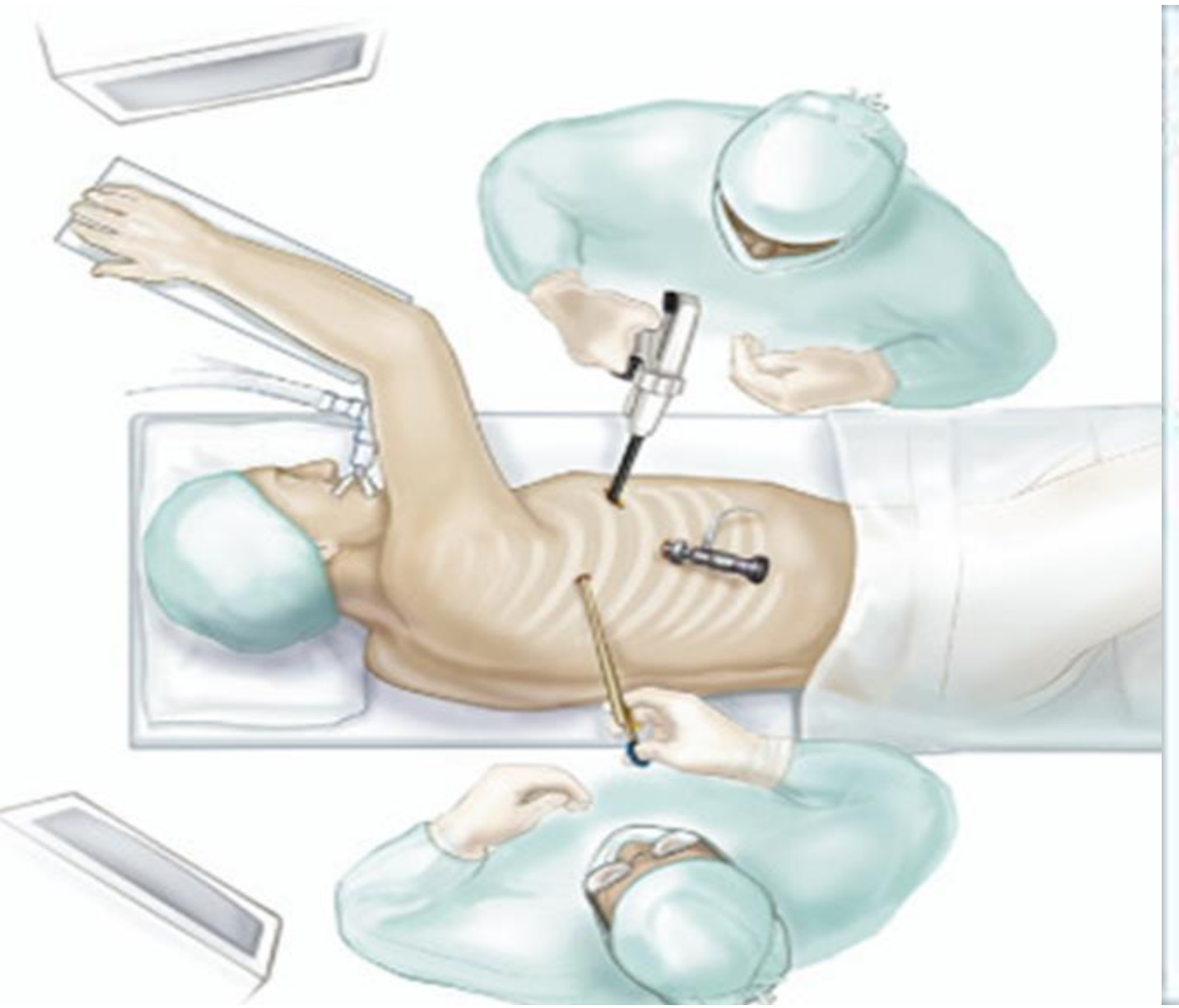
Indications for OLV :

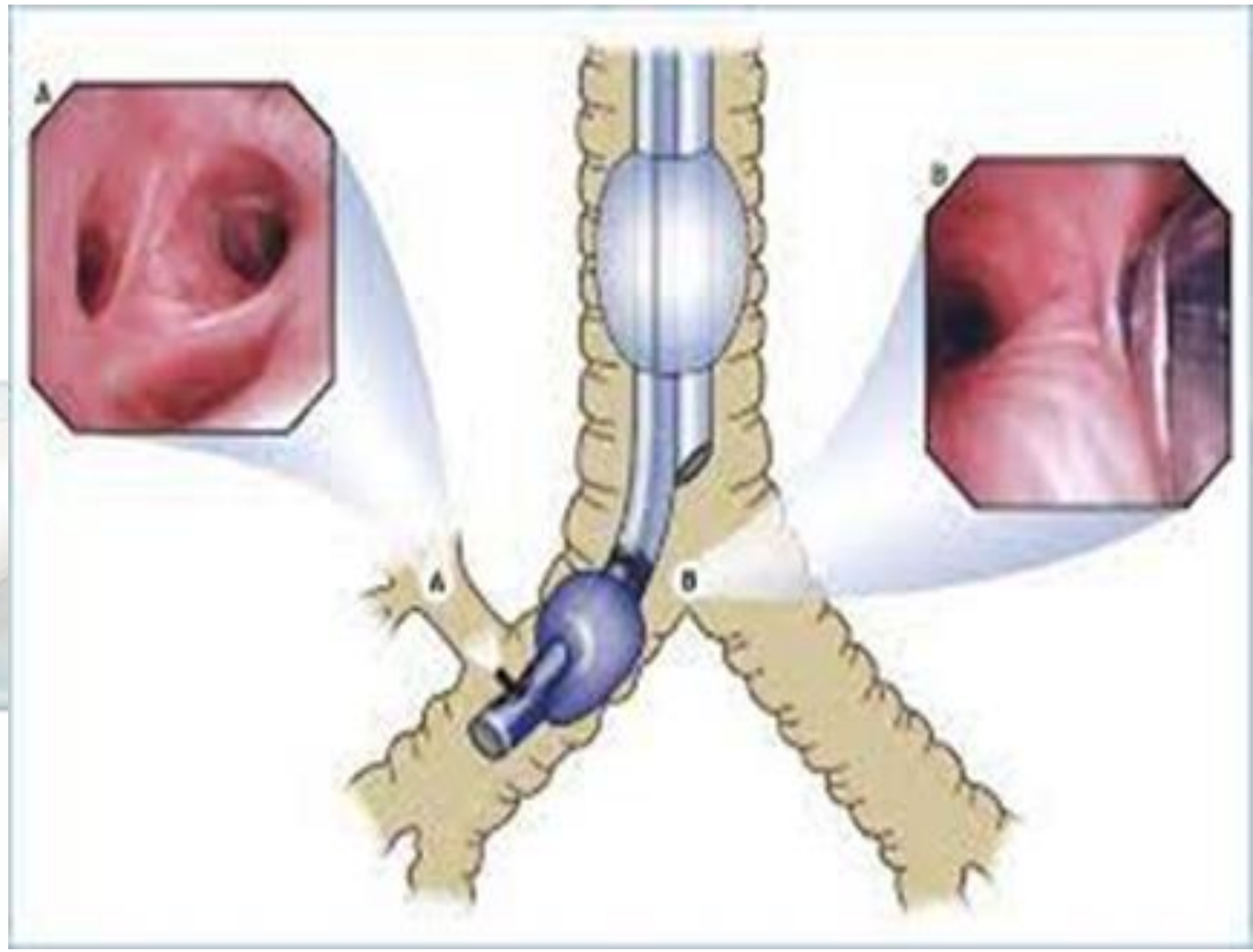
2- Lung protection :

OLV is indicated to protect the other lung from becoming contaminated by blood or pus in the diseased lung during surgery.

3- Intensive care ventilation :

If a patient has disease of one lung, it may be desirable to ventilate the lungs independently using two ventilators so that the normal lung is not subjected to high pressure required to ventilate an abnormal lung. An example of this is after a single lung transplant

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One-lung anesthesia:

Techniques for OLV :

There are 3 devices that can be inserted to achieve one lung ventilation:

a Double lumen tube, a Bronchial blocker, or a Single lumen tube

inserted beyond the carina.

One-lung anesthesia:

Indications for OLV :

Double lumen tubes :

are tubes with one lumen opening just above the carina and the other inserted into a main bronchus.

- **By clamping one lumen**, this occludes ventilation to the lung on that side. If one lumen is opened to the atmosphere, the lung can deflate and ventilation continued through the other lumen.
- **There are right and left sided tubes.**

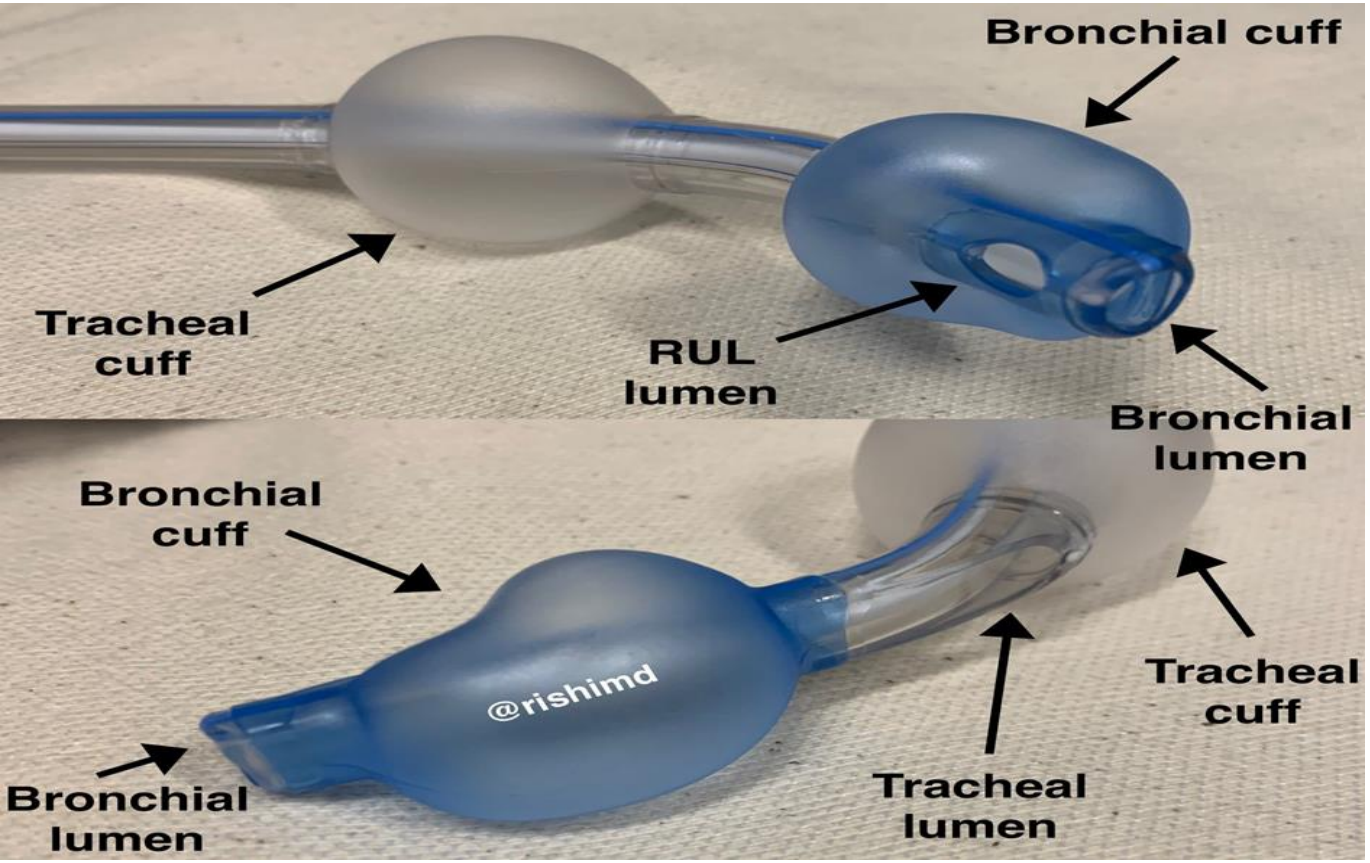
One-lung anesthesia: :

Indications for OLV :

Double lumen tubes :

- A **left sided tube can be used for most operations**.

  To insert a double lumen tube (DLT) the tip of the tube is inserted just through the vocal cords and then immediately rotated 90 degrees in the direction of the bronchus you are aiming to intubate. The tubes are bulky and can be **awkward** to place, particularly in dentulous patients. One lumen is clamped at a time and the chest auscultated to make sure that each lung can be collapsed. It is possible that the tube is achieving the desired clinical effect, but with a tiny movement becomes malpositioned.


Bronchial cuff
Tracheal cuff
RUL lumen
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BRONCHIAL
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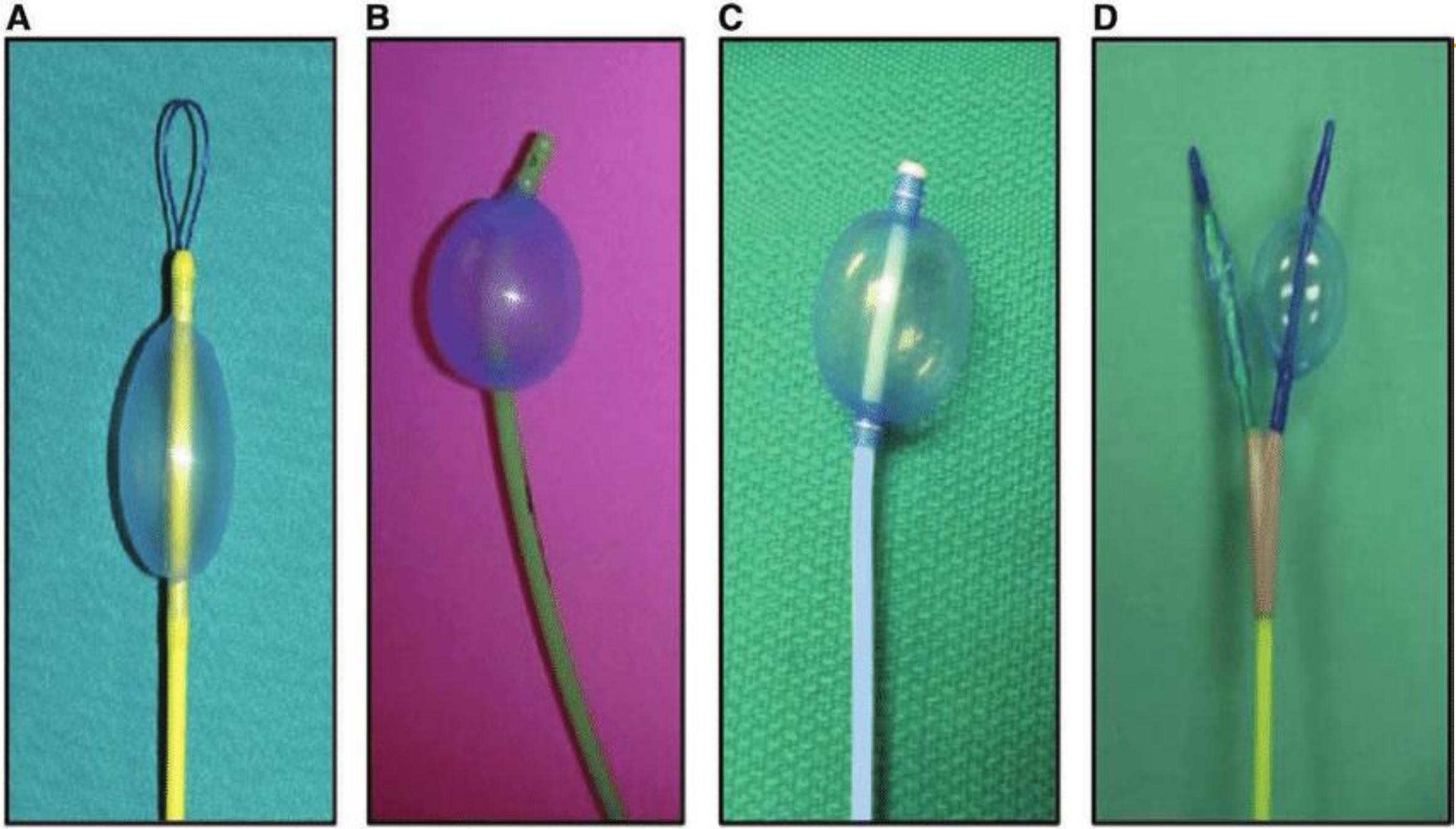
One-lung anesthesia: :

Indications for OLV :

A bronchial blocker :

is a device that is inserted into a conventially placed single lumen tube.

- It is useful when it is not possible to place a DLT or in situations where the patient has already been intubated with a single lumen tube. It has the appearance of a hollow bougie with a cuff.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One-lung anesthesia: :

Indications for OLV :

Single lumen tube :

The third way of achieving OLV is by use of a **single lumen tube** intentionally inserted 'too far' into a bronchus. This may be a good option in an emergency such as a left-sided chest stabbing if you fail to insert a DLT, and blood in the airway makes it impossible to use a bronchoscope.

One-lung anesthesia: :

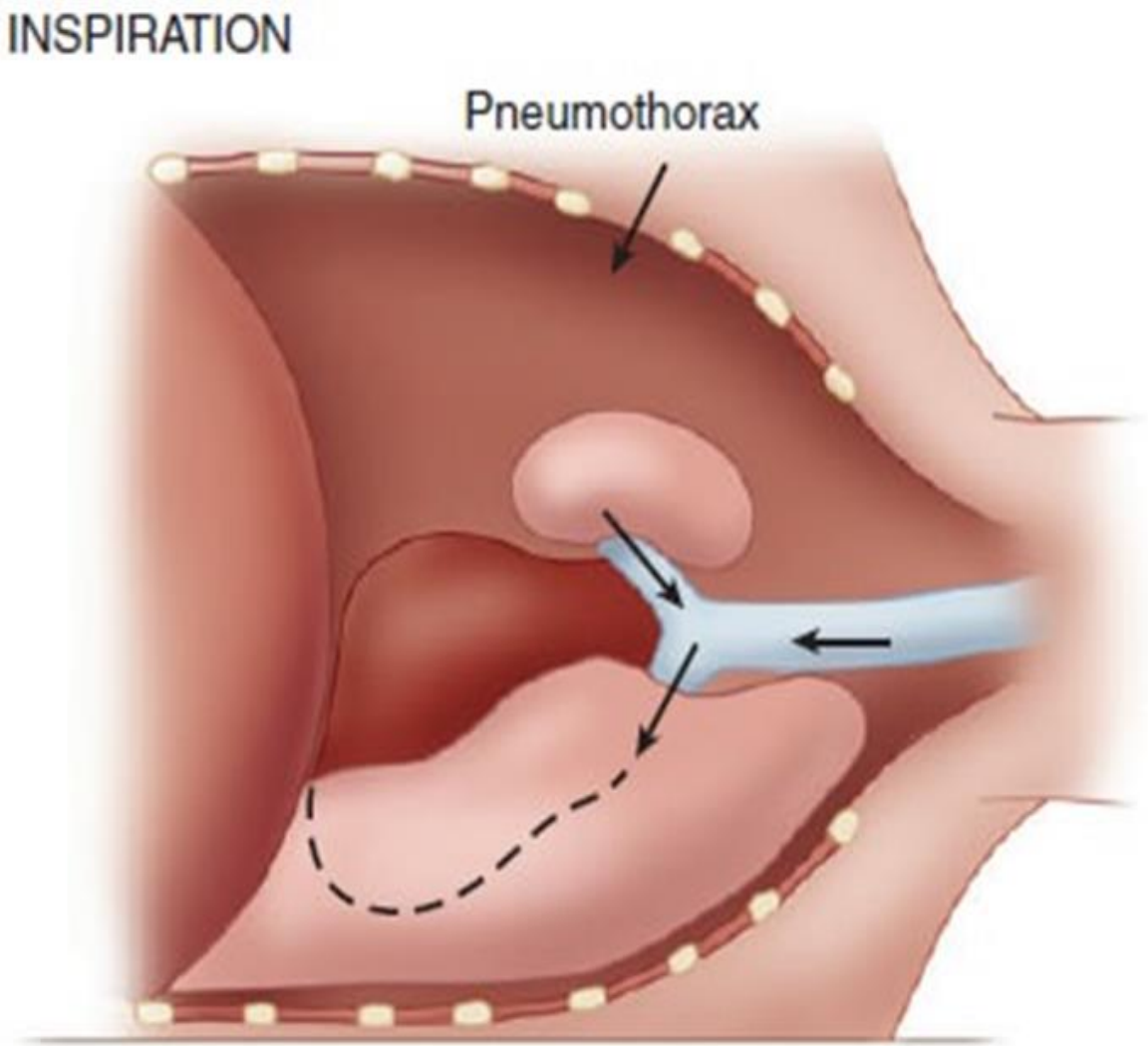
Physiology of lateral decubitus position :

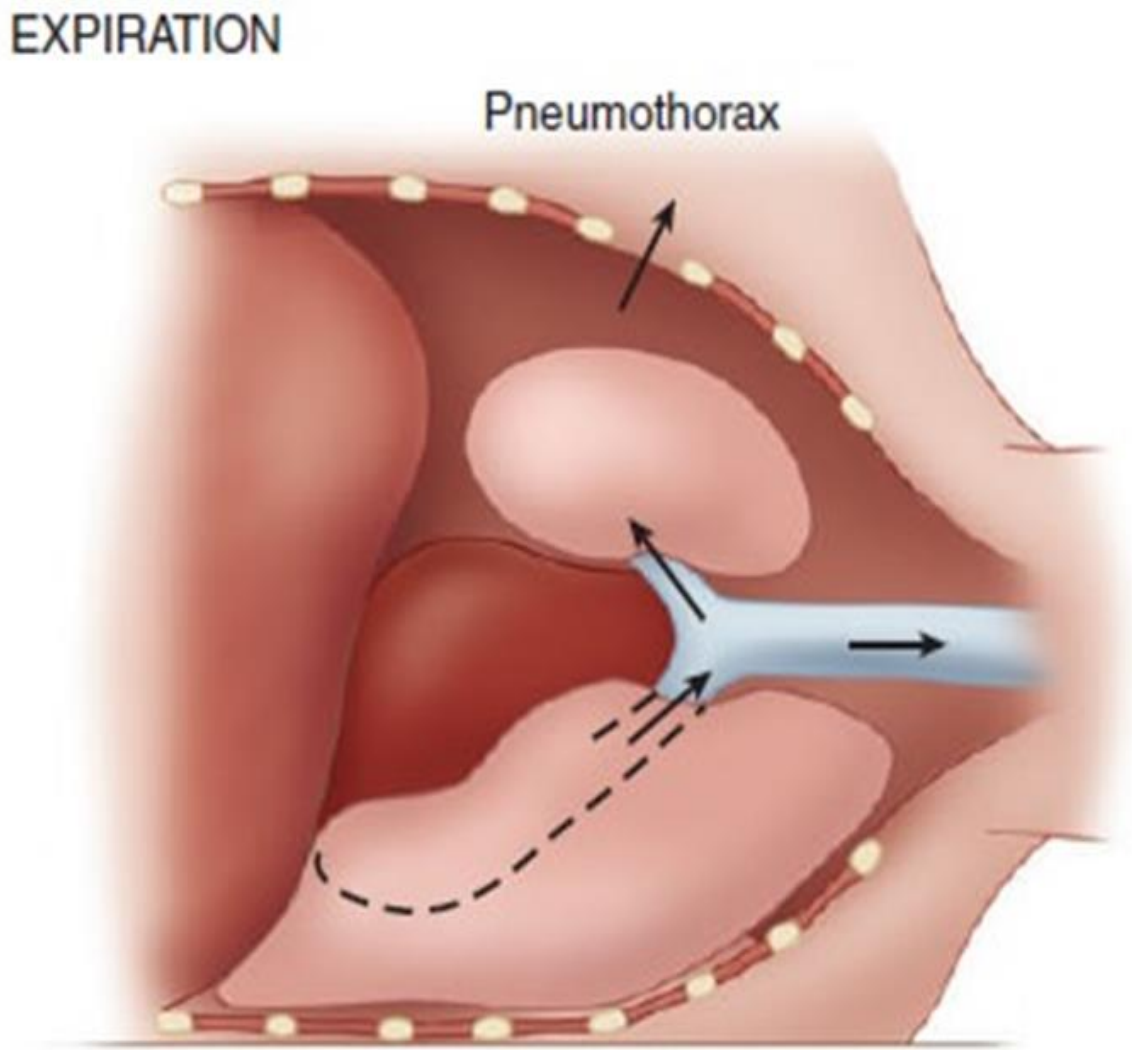
- As a simple view of lung physiology, when a patient is awake, the **dependent** part of a lung (regardless of the patient's position) has a greater blood supply than the nondependant part due to gravity.
- The **dependent** part is also preferentially ventilated compared with the non-dependent lung due to it being slightly more compressed than the non-dependant lung and therefore having a greater compliance.

One-lung anesthesia: :

Physiology of lateral decubitus position :

- The functional residual capacity (FRC) decreases as the diaphragm and chest muscles are paralysed. When the chest is opened, the top lung becomes even easier to ventilate as there is no restriction by the chest wall.
- Blood supply is still determined greatly by gravity. V/Q mismatch now occurs. This is even worse when the top lung is collapsed as there is then no ventilation to that lung,but there is still perfusion.


INSPIRATION
Pneumothorax


EXPIRATION
Pneumothorax

Overcoming hypoxia during OLV :

Because of the above changes in lung physiology, it is common for a patient to desaturate during OLV.

If this happens:

For sudden or severe desaturation:

– Convert to two-lung ventilation

Overcoming hypoxia during OLV :

For gradual desaturation:

1. Tell the surgeon early rather than waiting for the saturations to plummet. It may be that you have to reinflate the lung temporarily.
2. Turn the inspired oxygen up to 100%.
3. Make sure that the patient's blood pressure has not dropped as this may be the cause of desaturation.
4. Tube patency and position should be checked.
5. Secretions may be blocking the tube lumen.

Overcoming hypoxia during OLV :

6. Look at the capnograph trace. If it has changed, as a general rule the tube has moved.
7. Applying positive end expiratory pressure (PEEP) to the ventilated lung
8. Application of continuous positive pressure (CPAP) to the non-ventilated lung may help
9. Intermittent two-lung ventilation.
10. If these methods all fail, the collapsed lung must be reinflated and the patient ventilated with 100% oxygen.

Thoracotomy :

Median sternotomy

Median sternotomy in supine position is used for access to the

thymus, retrosternal goiters and anterior mediastinum;.

Thoracotomy :

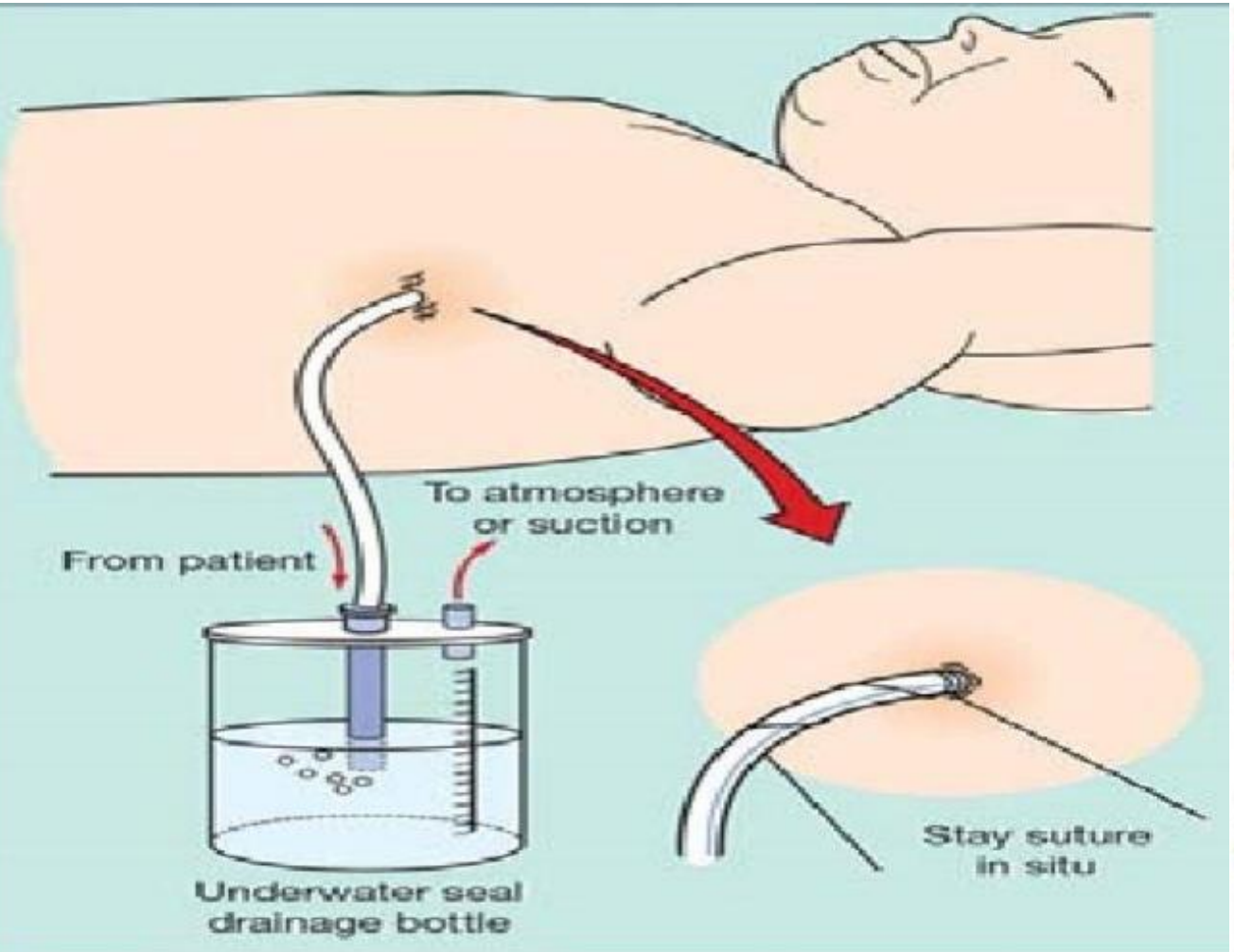
lateral thoracotomy :

lateral thoracotomy is used for most-other thoracic operations. Blood loss may be extensive, at least one large-bore cannula is essential. A central venous catheter allows venous pressure monitoring and more rapid drug delivery. The lungs should be fully expanded before closure. Residual air in the pleural cavity can be removed by an intrapleural drain connected to an underwater seal or a Heimlich flutter valve.

Thoracotomy :

lateral thoracotomy :

Accidental pneumothorax during thoracotomy can be caused, it is a risk during any operation near the pleura or where local blocks are performed in the region of the thorax. It may be a cause of cardiovascular collapse and be difficult to diagnose. Puncture of the lung itself will usually close spontaneously, but chest drains are usually required as a precaution.



Underwater seal drain

Heimlich flutter valve

Thoracotomy :

Postoperative considerations :

1) Postoperative hypoxemia: Patients who have undergone a thoracotomy will require oxygen in the immediate postoperative period for 24 hours and chest physiotherapy, factor may contribute postoperative hypoxemia are:

a) Pneumothorax: which it should be excluded by routinely postoperative chest radiograph.

b) Atelectasis.

c) Sputum retention

Thoracotomy :

Postoperative considerations :

d) Poor pain relief.

e) Fluid overload.

2) Cardiac arrhythmia: The most common one after thoracotomy is atrial fibrillation.

3) Torsion of remaining lobe: It is may occur after lobectomy. The presentation may be up to 2 weeks postoperatively. Chest radiology shows engorgement and increased density of the affected lobe. Resection of the affected lobe is usual.

Thoracotomy :

Postoperative considerations :

4) Herniation of the heart: Removal of pericardium together with lung resection, may allow the heart to be displaced from the mediastinum.

Cardiovascular collapse is usually profound. Emergency reexploration is required.

Pneumonectomy :

A lateral approach is usual, but the prone or supine positions may be used, a double-lumen tube is usual, but a single-lumen tube may be adequate (with or without a bronchial blocker).

When the chest is closed at the end of surgery, the remaining lung is fully inflated and the chest drain to the pneumonectomy space is clamped.

Clamps are released for 5 minutes every hour to ensure that no air blood or excess fluid accumulates in the pneumonectomy space.

Post-operative pulmonary edema carries a high mortality rate. It appears to be related to the perioperative use of blood products and higher ventilatory inflation pressures.

Pulmonary lobectomy :

There will be a large air leak and difficulty with ventilation unless one lung anesthesia is used. There will be considerable alveolar air leak afterwards, which decreases when IPPV is stopped. Low-pressure suction (-5 cmH2O) should be applied postoperatively to pleural drains to keep the lungs expanded.

Lung cyst and bullae :

Intermittent positive pressure ventilation (IPPV) and coughing may cause further distension of large cysts compress surrounding tissue or even a tension pneumothorax.

Early isolation of the cyst from ventilation with a double-lumen tube or bronchial clamp is desirable. Nitrous oxide may distend lung cysts because of its much greater solubility than nitrogen and should be avoided.

Accidental rupture of a pulmonary hydatid cyst into the bronchi during surgery risks dissemination of the disease. Endobronchial intubation is indicated.