جامعة المستقبل
كلية التقنيات الطبية

ANAESTHESIA FOR THORACIC SURGERY

مادة التخدير/ المرحلة الثالثة

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.

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.

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.

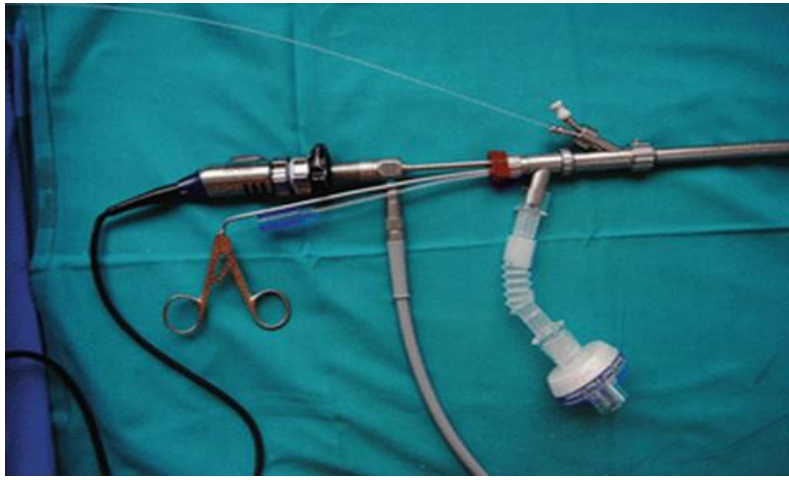
BRONCHOSCOPY

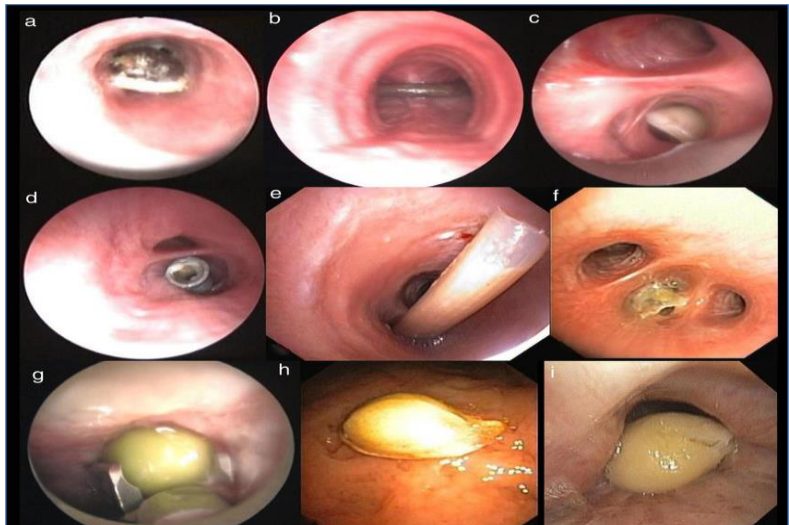
BRONCHOSCOPY

Rigid Bronchoscopy

Used for ***diagnostic*** and ***interventional*** procedures

- **Interventions** include:
  - Stenting
  - Lasering
  - Removal of foreign bodies
- Provides airway access and control under GA





BRONCHOSCOPY

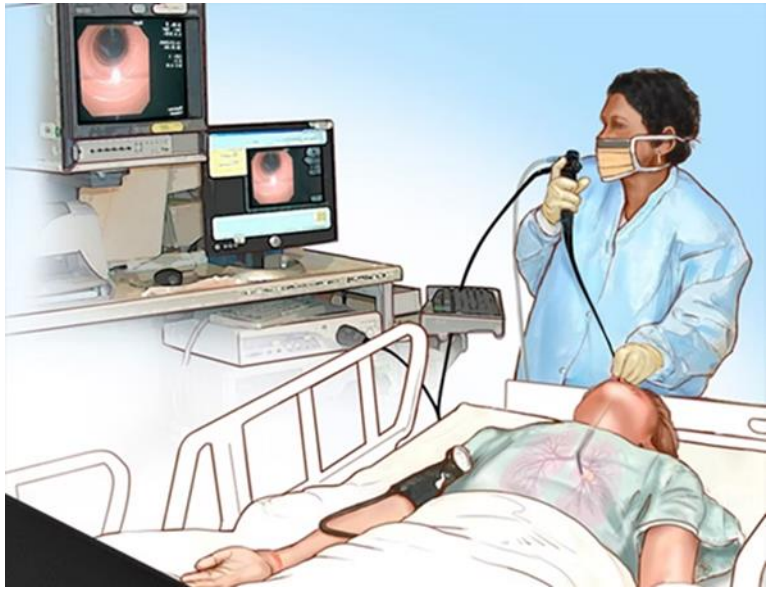
BRONCHOSCOPY

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



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.**

Clinical presentation

Acute signs:

- Cough, choking, respiratory distress
- Cyanosis, stridor, tachypnea

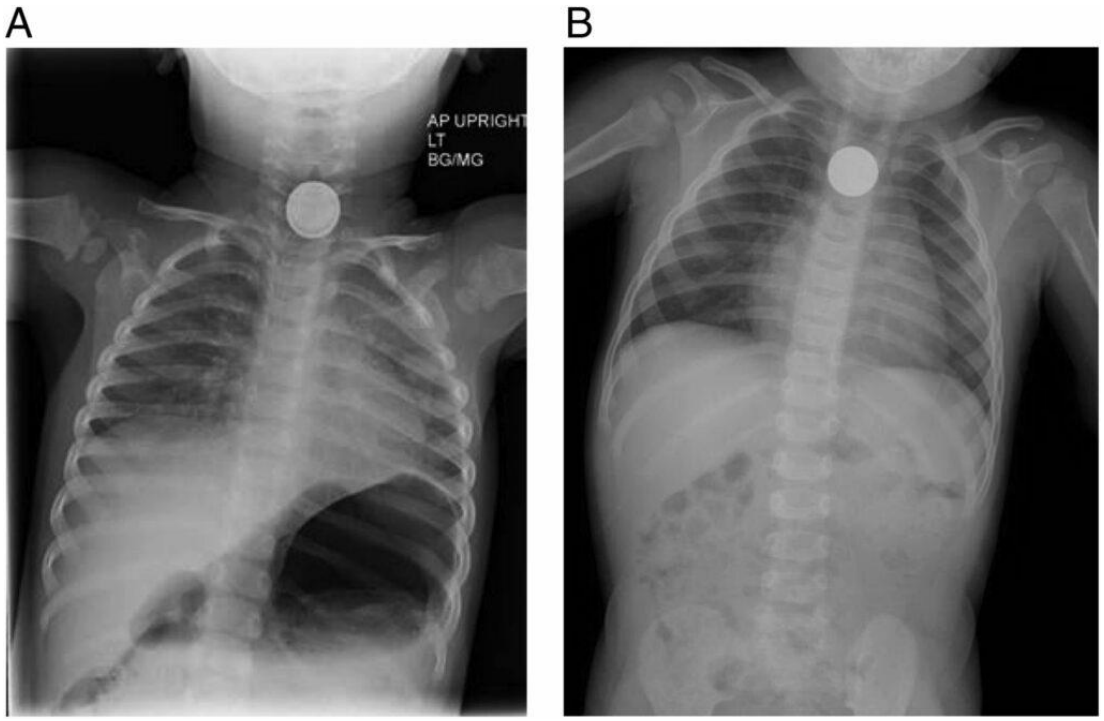
Insidious signs:

- Chronic cough, recurrent infections
- History of sudden distress while playing
- Consider FB in unexplained cough/stridor
- Esophageal FB → tracheal compression

Preparation & Investigations

Assessment depends on clinical condition

- **Examine** airway & chest
- **Chest X-ray** if stable (most FBs not radio-opaque)
- Starvation per guidelines if possible
- **No sedative** premedication
- **Emergency** → minimal investigations



Anaesthesia for Bronchoscopy

- **General anaesthesia** required
- Check **anaesthetic machine** & **suction**
- Prepare **various ETT sizes** (airway oedema ↓ diameter)
- **Full monitoring**: SpO_2, ECG, NIBP, capnography
- Secure IV access (post-induction if distressed child)

Anaesthesia for Bronchoscopy

- **General anaesthesia will be required to perform bronchoscopy**.
  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.
  Monitoring including pulse oximetry, ECG, noninvasive 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.
  Spontaneous ventilation is recommended, although occasionally it might be necessary to assist ventilation with gentle mask ventilation.

Anaesthesia for Bronchoscopy

- **Spontaneous ventilation** reduces the risk of hyperinflation of the lung and pneumothorax, and is also less likely to dislodge the FB distally.

  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.

Anaesthesia for Bronchoscopy

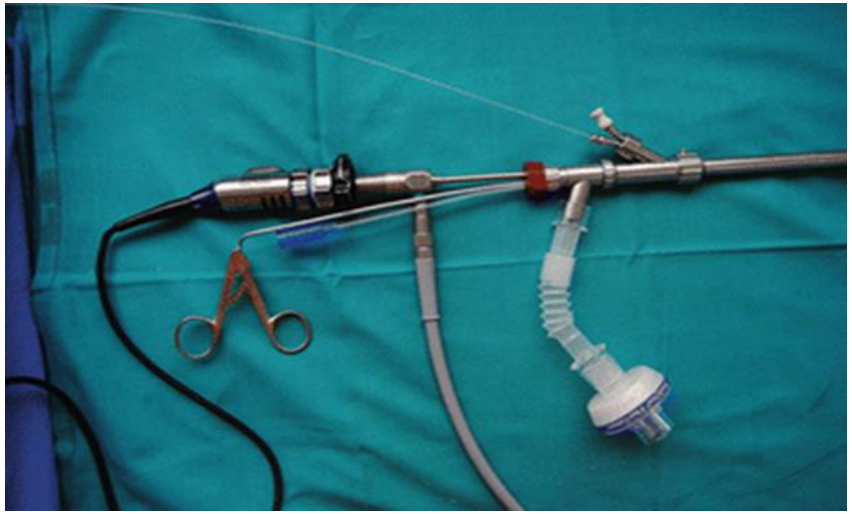
- **During bronchoscopy careful observation of chest movements should be made**.
  After removal of the FB the airway can be maintained using a face mask, endotracheal tube or laryngeal mask.
  The anaesthetic is discontinued, 100% oxygen is administered, and the patient observed carefully until awake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

Induction & Airway Plan

- **Inhalational induction**: **Sevoflurane** preferred (**less irritation**)
- **100%** oxygen
- Maintain **spontaneous ventilation**
- Gentle **assisted mask ventilation** if needed
- **Avoid** **intubation** → risk of FB displacement

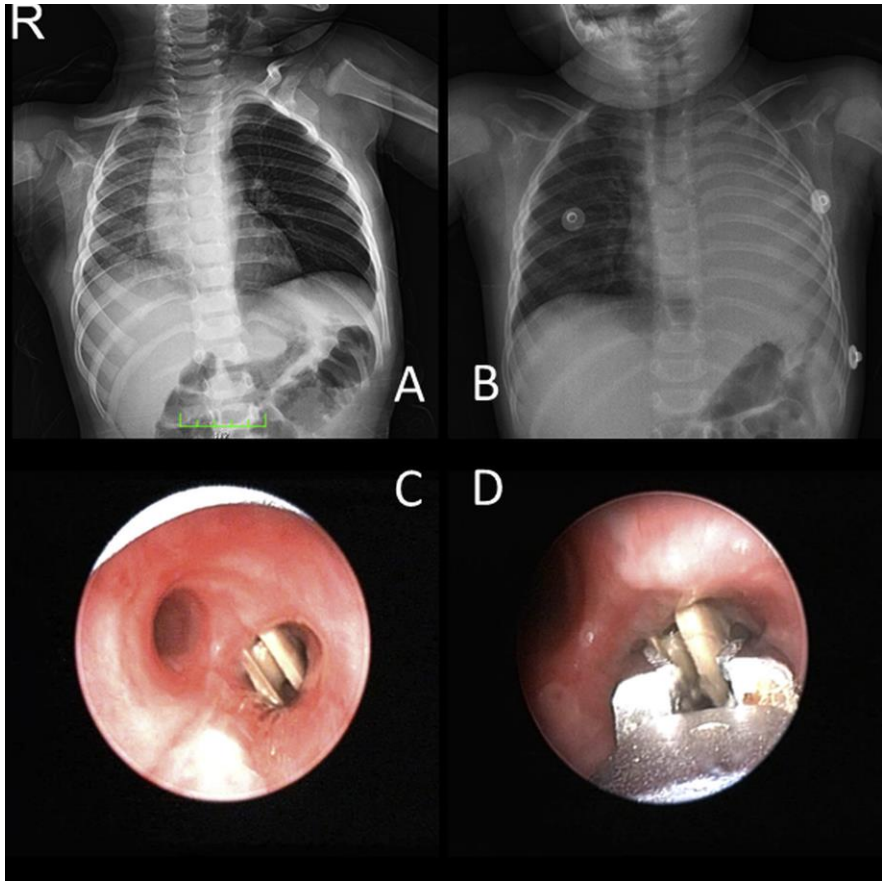
Technique During Bronchoscopy

- **Deep anaesthesia** before laryngoscopy (slow due to obstruction)
- **Spray larynx/trachea** with **lignocaine**
- Surgeon performs rigid bronchoscopy
- **Succinylcholine** may facilitate scope insertion
- Maintain anaesthesia via **T-piece to bronchoscope**
- **Monitor chest movement** to avoid hyperinflation/pneumothorax



Safety & Hypoxia Management

- **Avoid** prior intubation (FB may fragment or move distally)
- **If desaturation occurs:**
  - Withdraw bronchoscope to trachea
  - Re-oxygenate both lungs, retry
- Observe carefully for airway obstruction

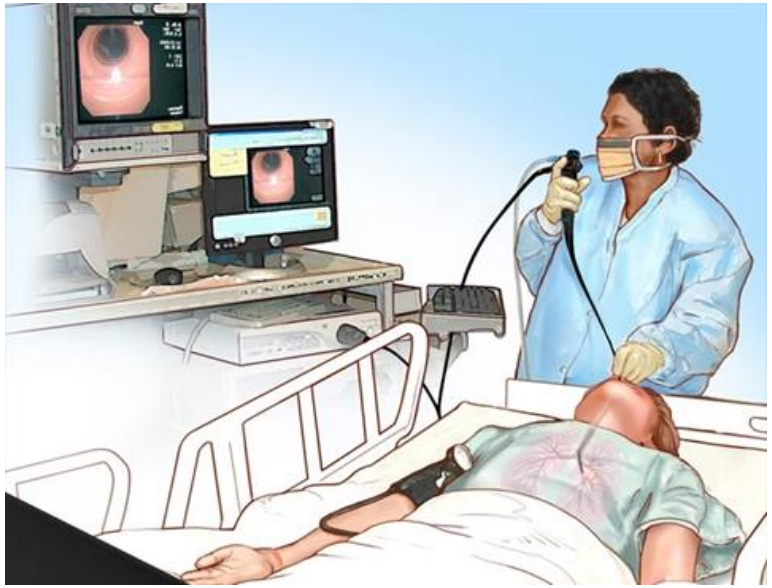


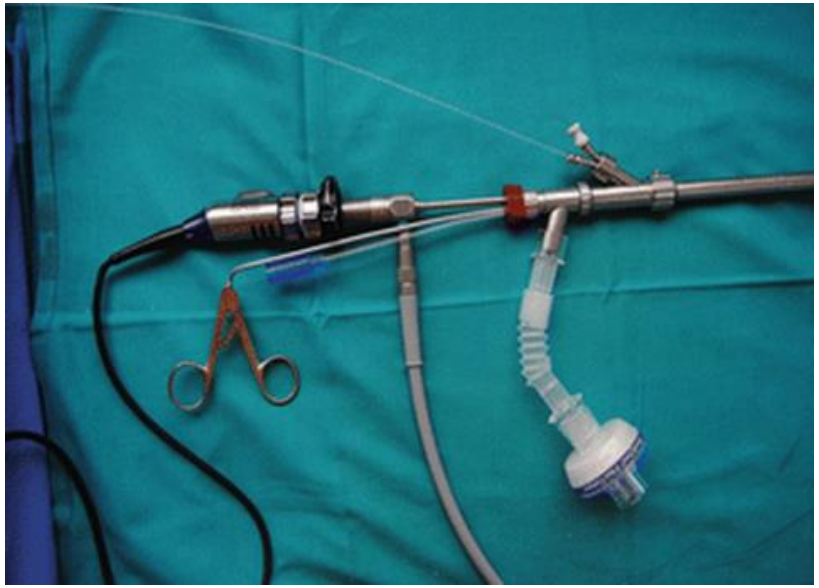
Post-Procedure Management

- Maintain airway with **mask / ETT / LMA**
- **100% oxygen** until awake & extubated
- **Monitor** for stridor & airway edema
- **Humidified O_2** for 24 hrs
- **Nebulised adrenaline** 1:1000 if stridor
- **Dexamethasone** 250 mcg/kg IV at induction, then 100 mcg/kg q6h × 24 hrs

Rigid vs Flexible Bronchoscopy

- Rigid bronchoscopy preferred
- Superior airway control
- Allows suction, FB removal, ventilation
- Flexible scope not recommended for FB extraction





ONE-LUNG VENTILATION

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**.

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**.

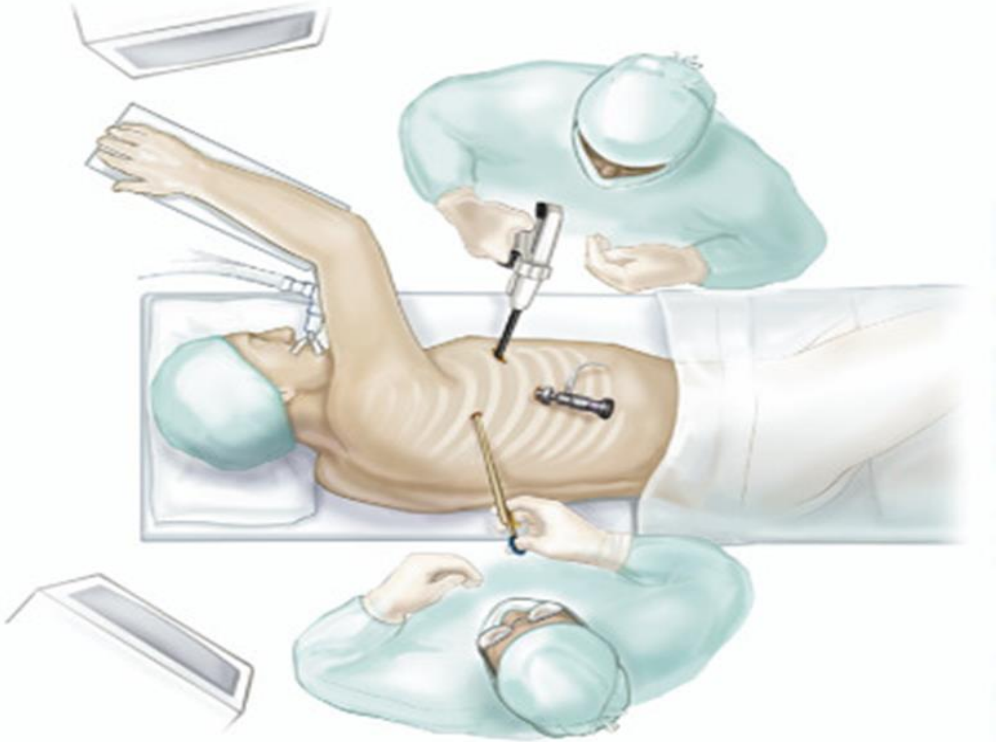
- **Adequate surgical access can be achieved for most lung resections** and oesophago-gastrectomies **without collapsing** a lung simply by ventilating the patient with smaller tidal volumes and the surgeon using a retractor.
- **Some surgery definitely needs OLV.** Thoracoscopic surgery is impossible 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.

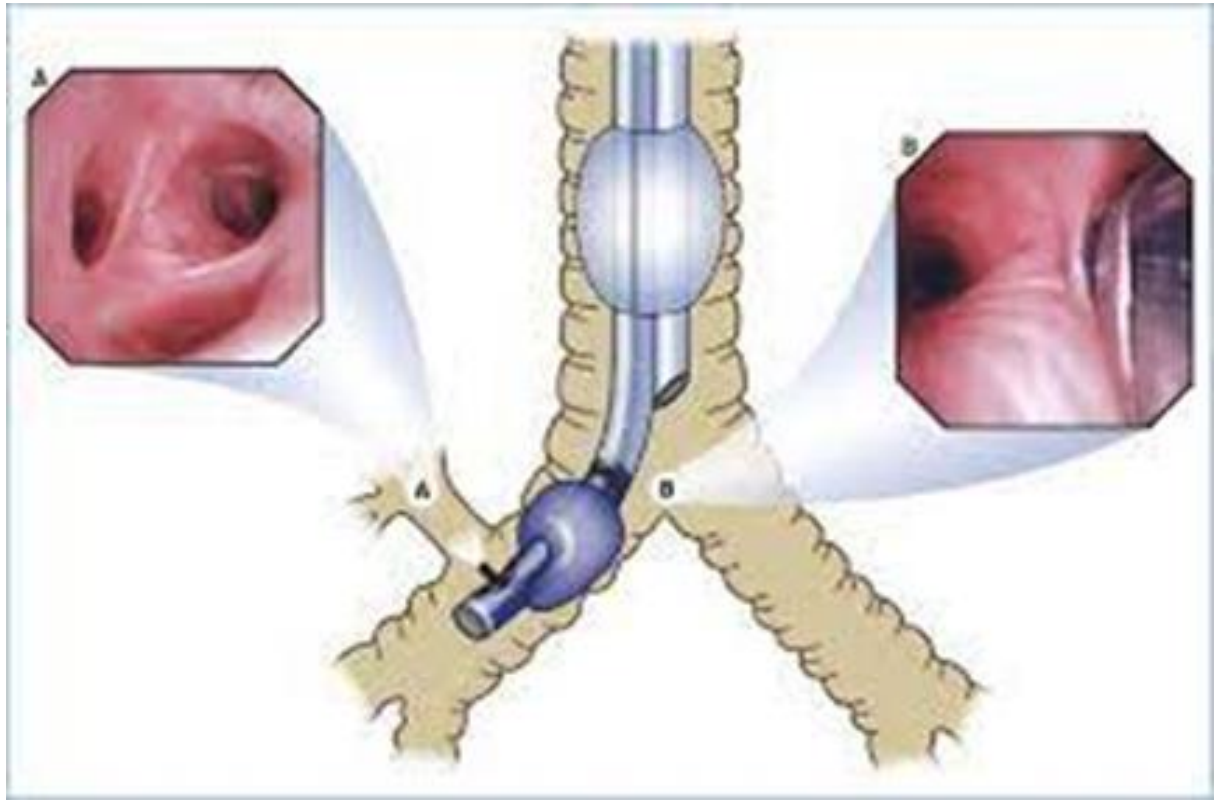
ONE-LUNG VENTILATION

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 **tow 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





Techniques for OLV

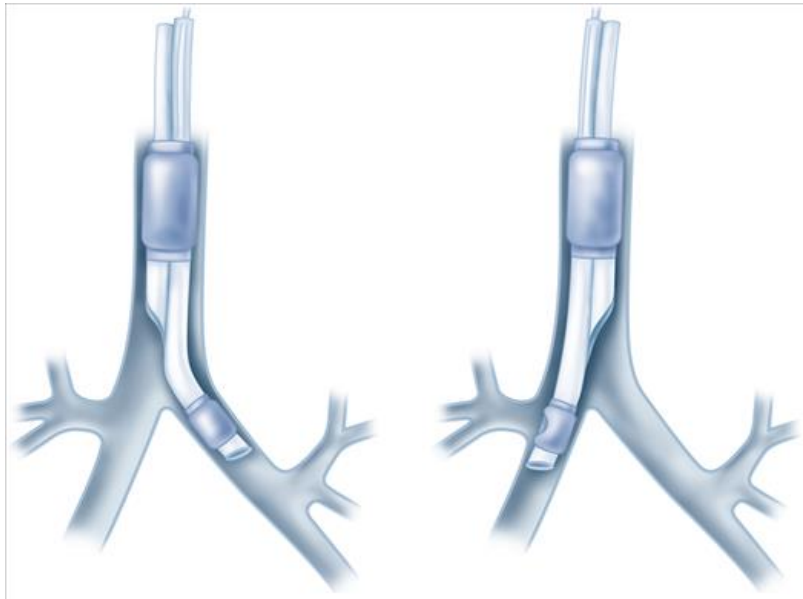
There are 3 devices that can be inserted to achieve one lung ventilation:

1. A double lumen tube,

2. A bronchial blocker, or

3. A single lumen tube inserted beyond the carina.

1. 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.

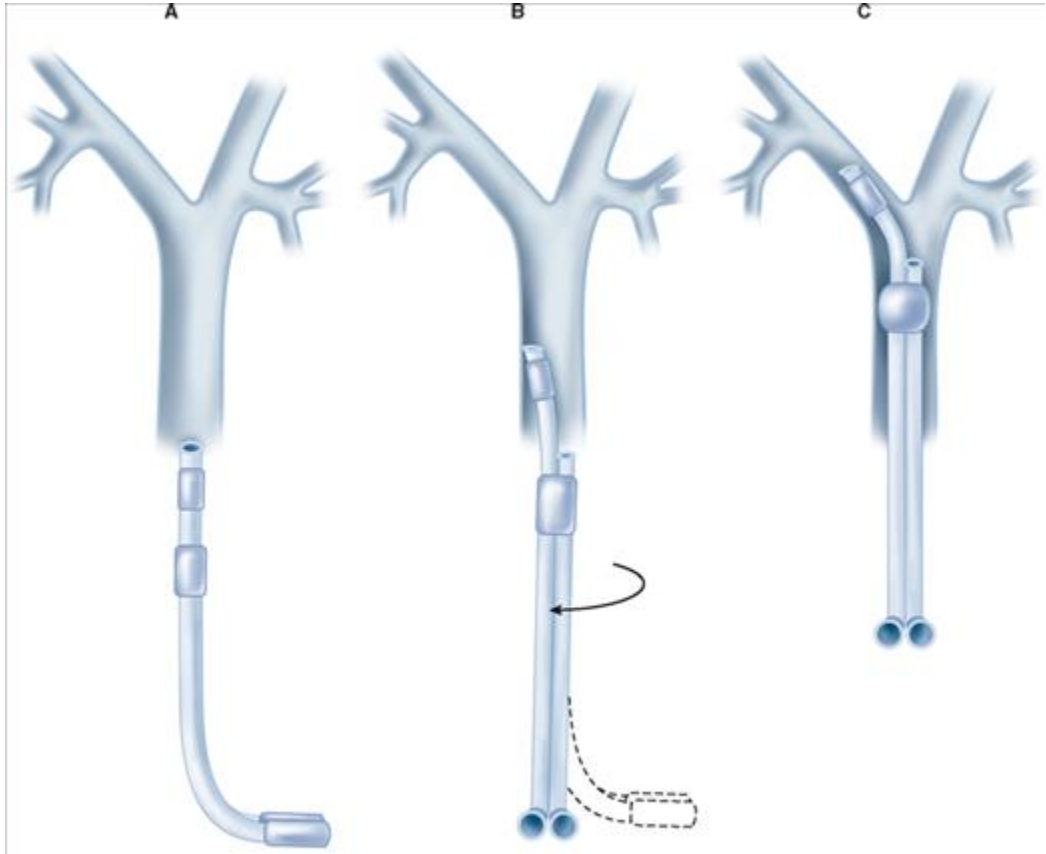
Techniques for OLV

There are right and left sided tubes.

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

To insert a double lumen tube (DLT):

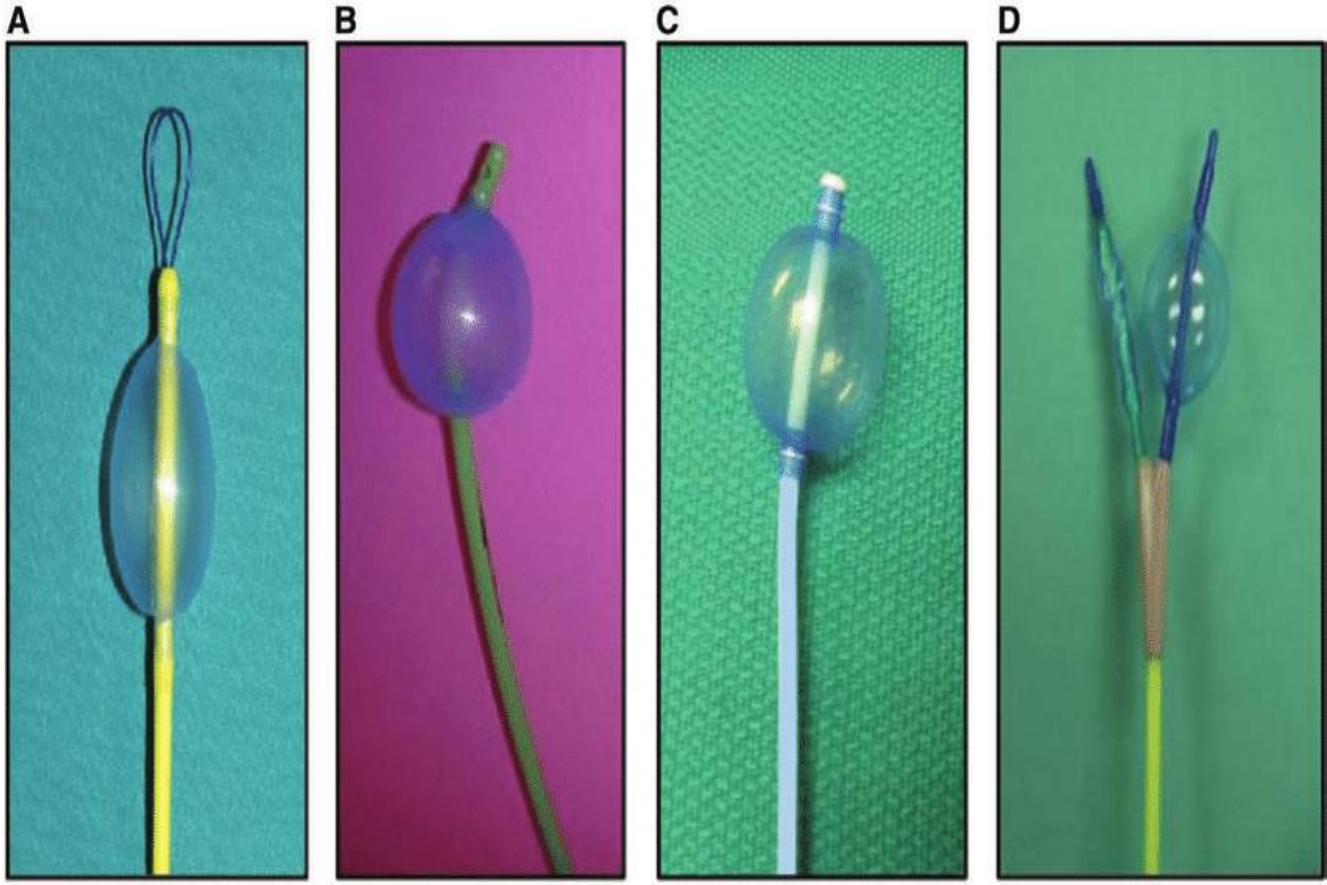
- the tip of the tube is inserted just through the vocal cords
- then immediately **rotated 90 degrees** in the direction of the **bronchus** you are aiming to **intubate**.
- The tubes are bulky and can be **awkward** to place, particularly in dentulous patients.
- **One lumen is clamped** at a time 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.



Techniques for OLV

2. A bronchial blocker is a device that is inserted into a conventially placed single lumen tube.

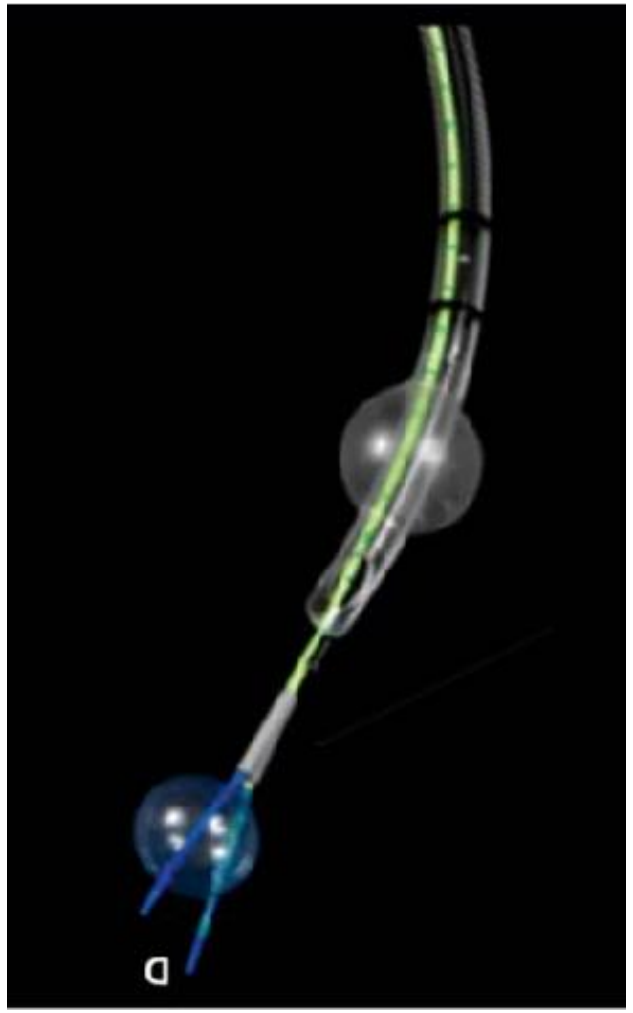
- **It is useful when it is not possible to place a DLT or in situations where the patient has already been intubated with a single lumen tube.** It has the appearance of a hollow bougie with a cuff.



Techniques for OLV

3. Single lumen tube

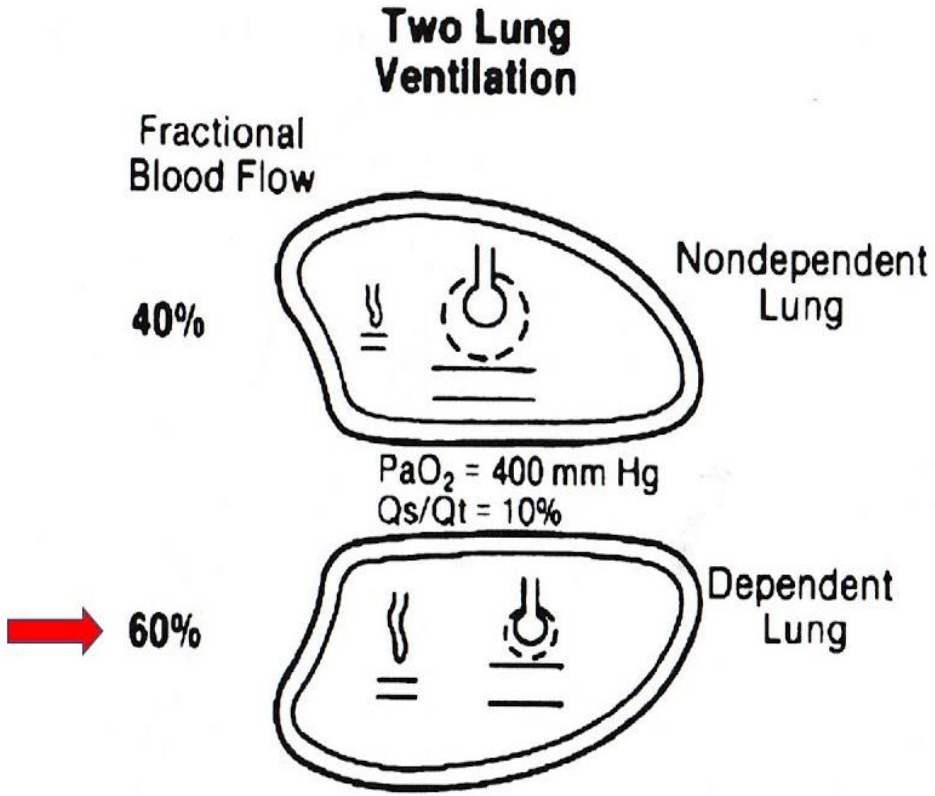
- The third way of achieving OLV is by use of a **single lumen tube** intentionally inserted ‘too far’ into a bronchus.
- This may be a good option in an emergency such as a left-sided chest stabbing if you fail to insert a DLT, and blood in the airway makes it impossible to use a bronchoscope.

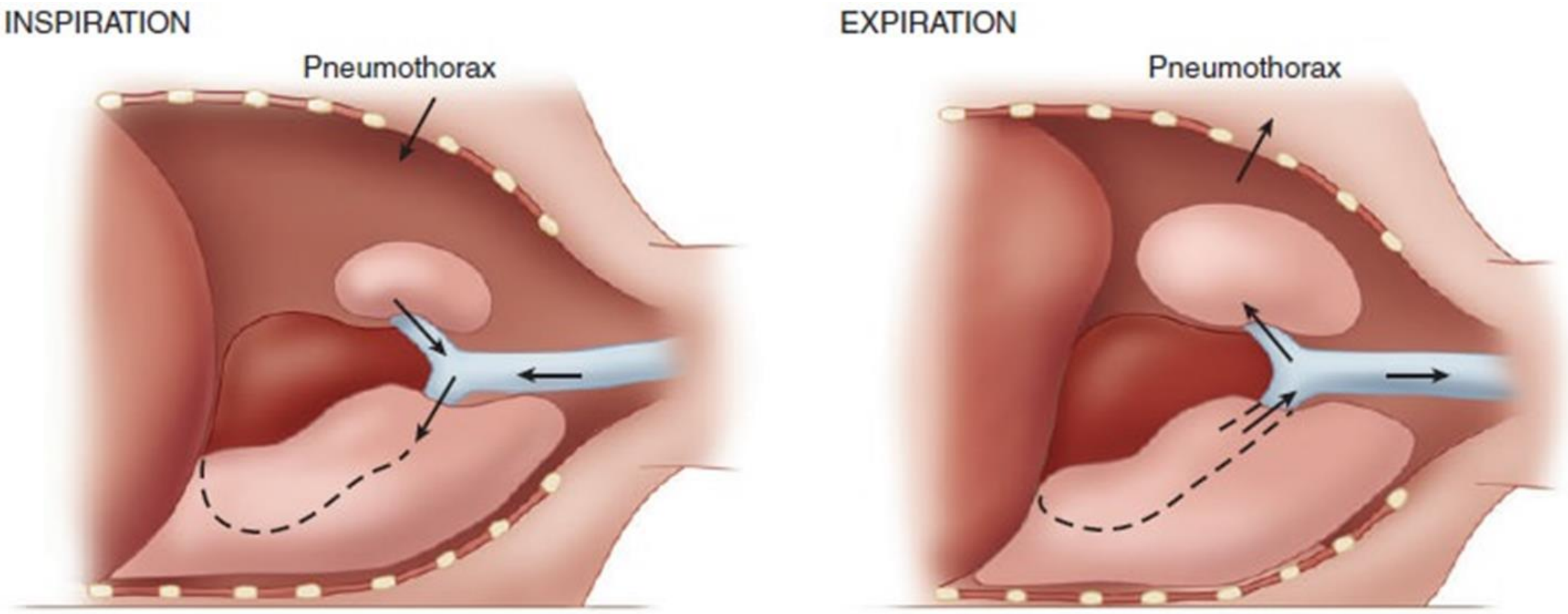


Physiology of OLV

As a simple view of lung physiology

- when a patient is awake, the **dependent** part of a lung has a **greater blood supply** than the nondependent 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-dependent lung**.
- The functional residual capacity (**FRC**) **decreases** as the diaphragm and chest muscles 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**.




INSPIRATION
Pneumothorax
EXPIRATION
Pneumothorax

Overcoming hypoxia during OLV

It is not uncommon for a patient to desaturate during OLV.
If this happens:

- Tell the surgeon early rather than waiting for the saturations to plummet.
- Turn the inspired **oxygen up to 100%.**
- Make sure that the patient's **blood pressure** has not dropped = desaturation.
- **Tube** patency and position should be checked.
- **Secretions** may be blocking the tube lumen.
- Look at the **capnograph** trace. = probably the tube has moved.
- Applying positive end expiratory pressure (**PEEP**) to the ventilated lung
- Application of continuous positive pressure (**CPAP**) to the non-ventilated lung may help
- If these methods all fail, the collapsed lung must be reinflated = ventilate with 100% oxygen.

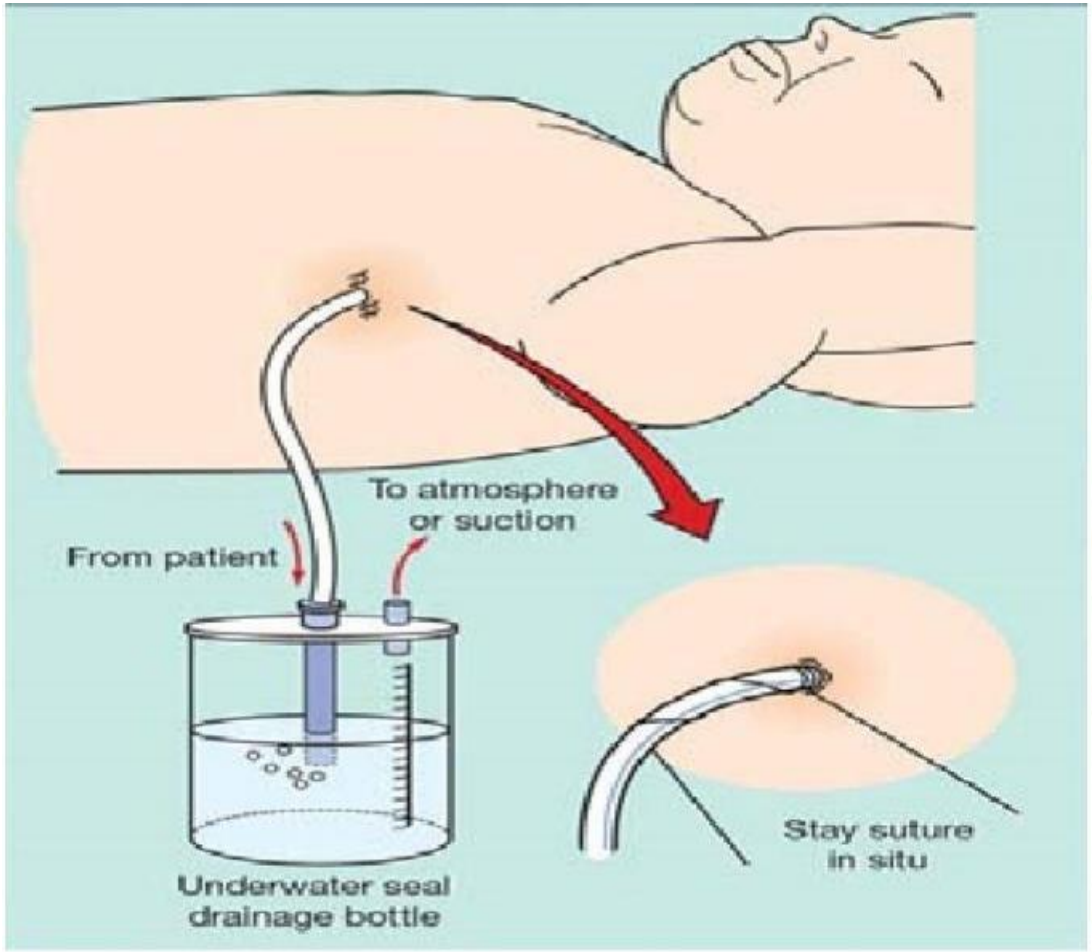
Thoracotomy

Median sternotomy in supine position is used for access to the thymus, retrosternal goiters and anterior mediastinum;
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.
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

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.

d) Poor pain relief.

e) Fluid overload

Postoperative considerations:

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.

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.

Pneumonectomy

Pulmonary lobectomy

There will be a large air leak and difficulty with ventilation unless onelung 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.


THANK YOU