Before Starting

- Did you complete a screening form?
- Sign the consent form
Learning Objectives

At the end of the presentation, participants will be able to:

• Discuss the purpose of lung isolation
• Various lung isolation techniques
• Advantages and disadvantages of the different techniques
• Describe the anatomic structures that are visualized during one-lung isolation
• Physiology of one-lung ventilation
• Manage hypoxemia during one-lung ventilation
Before Proceeding
Take the Pre-test on D2L
Lung Isolation

• The ability to isolate and ventilate one of the lungs
• It is an essential skill set for the anesthesiologist
• One lung ventilation is required:
  – To facilitate surgical exposure for non-cardiac operations in the chest
  – For minimally invasive cardiac surgery
  – In disease processes affecting one lung to prevent soiling from the contralateral lung
Indications

**Absolute**
- Protection of one lung from the other lung (contamination with blood, pus, lavage fluid, etc.)
- Reduction of flow through a broncho-pleural or broncho-pleural cutaneous fistula
- Severe unilateral lung disease
- Surgical exposure in video-assisted thoracoscopy procedures

**Relative**
- Surgical exposure with deflation of one lung
- Thoracic aortic surgery
- Mediastinal surgery
- Esophageal surgery
- Pulmonary resection (lobectomy or pneumonectomy)
Anatomy
Trachea

• Arises from the cricoid cartilage and extends to the carina
• Composed of 18 to 22 C-shaped cartilaginous rings anterolaterally
• The ends of each "C" are linked posteriorly by the superficial membranous wall and the trachealis muscle
• The length of the adult trachea averages 12 cm
• The cricoid cartilage forms the narrowest portion of the airway (in adults)
Anatomy

Tracheal Rings
Anterior

Longitudinal Fibers
Posterior

Tracheal mucosa

Fibromuscular posterior wall

Tracheal cartilages
Carina

• The part where the trachea bifurcates into the right and left mainstem bronchi
• Right mainstem bronchus lies in a more vertical plane
  – Length is 1.9 cm in men and 1.5 cm in women
• Left mainstem bronchus lies in a more horizontal plane
  – Average length is 4.9 cm in men and 4.4 cm in women
Lungs

- The left lung is 10% smaller than the right.
- Less shunt when left lung is collapsed.
Normal Ventilation

- Ventilation and perfusion are well matched anatomically
- Dependent portions of the lungs receive both greater blood flow (a result of gravity) and greater ventilation (from gravitational effects on lung compliance)
One Lung Ventilation

- The initiation of OLV stops all ventilation to one lung
- The dependent lung receives almost the same minute ventilation as both lungs
- Which creates an obligatory 50% R–L shunt through the nondependent lung
- Because CO₂ is easily diffusible, PaCO₂ and ETCO₂ may change very little
Minimizing this Shunt

- Flow to the nondependent lung is decreased by gravity
  - 40% of CO to nondependent lung
  - 60% to dependent lung
- HPV decreases BF by half
  - 20% of CO to nondependent
  - 80% dependent lung
- Surgical compression decreases shunt even further
Hypoxic Pulmonary Vasoconstriction (HPV)

• Is triggered in response to an alveolar oxygen partial pressure (PaO$_2$) less than 100 mmHg
• Improves ventilation perfusion matching
• Reduces shunt flow through the non-ventilated lung by 40 to 50% during OLV
• Moderates the degree of hypoxemia
• Alveolar hypoxia triggers the pulmonary vessels to constrict, directing blood away from non-ventilated areas to better ventilated segments
One Lung Ventilation
Isolation Devices

- Double-lumen Tubes (DLT)
  - Most common device
  - R- or L-sided with the longer lumen projecting into main stem bronchus that bears its name
  - There are several limitations to its use
- Bronchial Blockers (BB)
  - Involves blockade of a mainstem bronchus to allow lung collapse distal to the occlusion
  - Technology is on the increase
  - In some specific clinical situations it can offer more advantages over the DLTs
Left-sided Double-lumen Tubes

• Generally easier to position because of the longer left main stem bronchus
• Provide a greater margin of safety
• Most suitable device for the majority of elective cases
Right-sided Double-Lumen Tubes

- Have an extra port in the bronchial limb to allow right upper lobe ventilation
- Anatomic variations in the origin of the right upper lobe make right-sided tubes more difficult to place
- More likely to be dislodged
- May be associated with either right upper lobe collapse or air trapping via a ball-valve effect
Indications for Right-sided DLTs

- Left pneumonectomy
- Anatomic abnormalities in the left main stem bronchus including
  - Tumor
  - Extrinsic compression
  - Tracheobronchial disruption
Placement

- Techniques
  - Blind technique
  - Fiberoptic directed technique
- Confirmation
  - Auscultation
  - Fiberoptic bronchoscopy
- Both cuffs should be fully inflated to provide a good seal
- Evidence strongly suggests that auscultation alone is unreliable in confirming proper DLT placement
Difficulties with DLTs

- Malpositioning necessitates periodic reconfirmation of appropriate placement via bronchoscopy
- Difficulties with the DLT arise when
  - Tube diameter is not appropriate for the patient
  - One or both cuffs fail to fully occlude the designated main stem or tracheal lumen
- Lack of objective guidelines to choose a properly sized tube
- Left sided DLT that is too small requires a large endobronchial cuff volume, which might increase the chances of malposition (herniation)
Bronchial Blockers
Involves using a balloon catheter inflated to occlude the mainstem bronchus to allow lung collapse distal to the occlusion. Technology is on the increase. In specific clinical situations it can offer advantages over the DLTs.
Advantages of BBs

• Useful for difficult intubations
• Patient who is already intubated
• Risk of reintubation after surgery
• Patient with tracheostomies
Types
Univent
Uniblocker
Arndt
Endobronchial Blocker
EZBlocker
Managing Hypoxemia on OLV

- Administer 100% oxygen
- Check ventilator, circuit and catheter mount
- Clear secretions and debris by suctioning dependent lung
- Check tube position
- Adjust TV and RR as necessary
Managing Hypoxemia on OLV

- Apply CPAP or entrain oxygen to nondependent Lung
- Perform recruitment maneuver and apply PEEP to dependent lung
- Revert to two lung ventilation
- Clamp nondependent pulmonary artery
- Address hemodynamic status
Keys to Success in OLV

- Understand the physical details of DLTs and BBs and select them appropriately
- Use the FOB! – optimize conditions (antisialagogue, suction)
- Know the tracheobronchial anatomy
- Employ a “just seal” test
- Identify problems early
- Ensure good communication with the surgeon
Instructional Video on OLV with BB
Bronchoscopy in a Patient