Revista Mexicana de Anestesiología

Volumen *Volume* **28** **Suplemento** *Supplement* **1** **2005**

Artículo:

Practical management of one-lung anesthesia

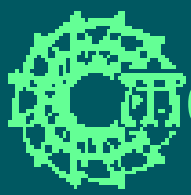
Derechos reservados, Copyright © 2005:
Colegio Mexicano de Anestesiología, AC

Otras secciones de este sitio:

- Índice de este número
- Más revistas
- Búsqueda

Others sections in this web site:

- *Contents of this number*
- *More journals*
- *Search*



edigraphic.com

Revista Mexicana de Anestesiología

CONFERENCIAS MAGISTRALES
Vol. 28. Supl. 1 2005
pp S54-S64

Practical management of one-lung anesthesia

David J. Cook, M.D.*

* Associate Professor of Anesthesiology. Mayo Clinic College of Medicine, Rochester, MN, USA.

GOALS

- Indications and options for achieving lung isolation
- Preoperative assessment and physiology
- Management and practical problem solving
- Analgesia for thoracic surgery

INDICATIONS FOR ONE-LUNG VENTILATION

Absolute

1. Isolation of each lung to prevent contamination of a healthy lung
   a. Infection (abscess, infected cyst)
   b. Massive hemorrhage
2. Control of distribution of ventilation to only one lung
   a. Bronchopleural fistula
   b. Bronchopleural cutaneous fistula
   c. Unilateral cyst or bullae
   d. Major bronchial disruption or trauma
3. Unilateral lung lavage
4. Video-assisted thoracoscopic surgery

Relative

1. Surgical exposure – high priority
   a. Thoracic aortic aneurysm
   b. Pneumonectomy
   c. Upper lobectomy
2. Surgical exposure – low priority
   a. Esophageal surgery
   b. Middle and lower lobectomy
   c. Thoracoscopy under general anesthesia

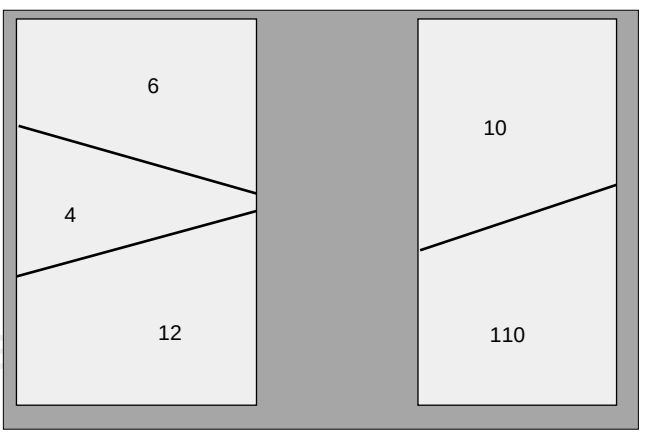
SURGICAL INDICATIONS

- Vast majority of thoracic surgery is for lung cancer
- Except for video thoracoscopy, one-lung anesthesia is usually optional
- Decision to proceed should be based on relative benefit and ability to tolerate single lung ventilation

PREOPERATIVE ASSESSMENT

- Asymptomatic patient, good exercise capacity- no screening
- Respiratory mechanics
- Cardiopulmonary reserve
- Lung parenchymal function
- Respiratory mechanics: FEV_1
- Cardiopulmonary reserve:
  VO_2 max (2 flights stairs)
- Lung parenchymal function - DLCO
  capillary alveolar surface area
  ($PaO_2 > 60$, $CO_2 < 45$ mmHg)

LUNG ANATOMY

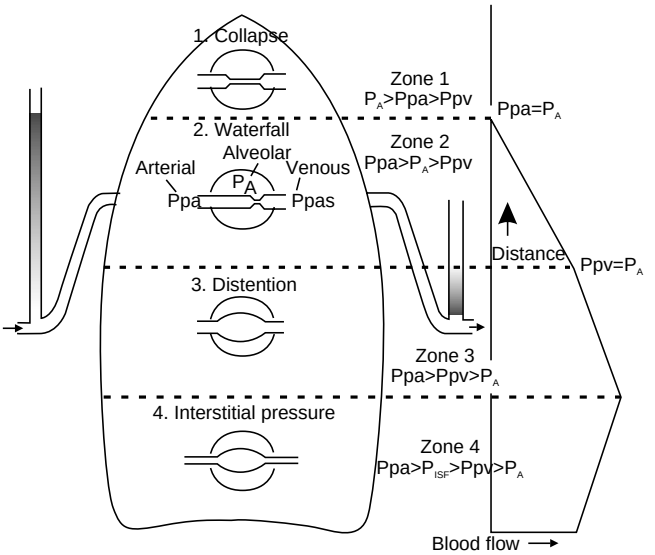


Lobe sub-segmental anatomy helps predict the postoperative FEV_1 and DLCO

POSTOPERATIVE FEV_1

- > 40% Few and minor respiratory complications
- < 30% Majority require postoperative mechanical support
- 30-40% Outcome dependent on secondary factors
  Comorbid conditions and fitness
  Airway secretions/inflammatory processes
  Perioperative fluid balance/mechanical features
  Thoracic analgesia

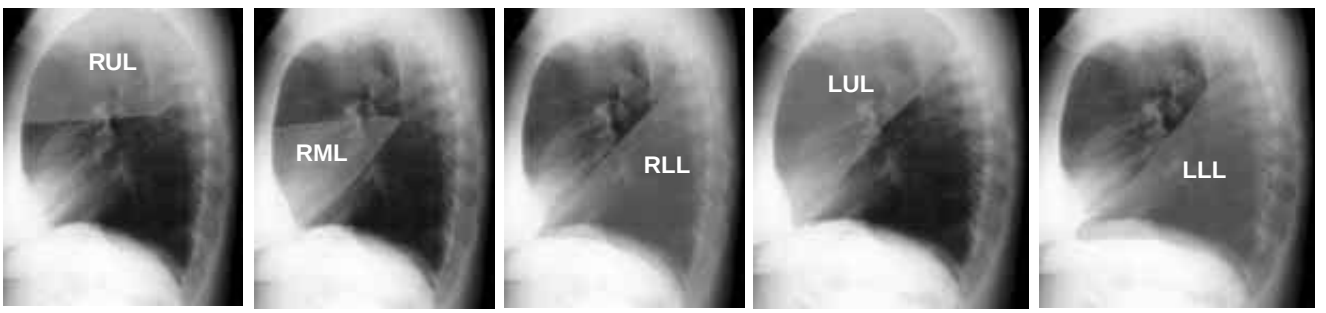
The four zones of the lung



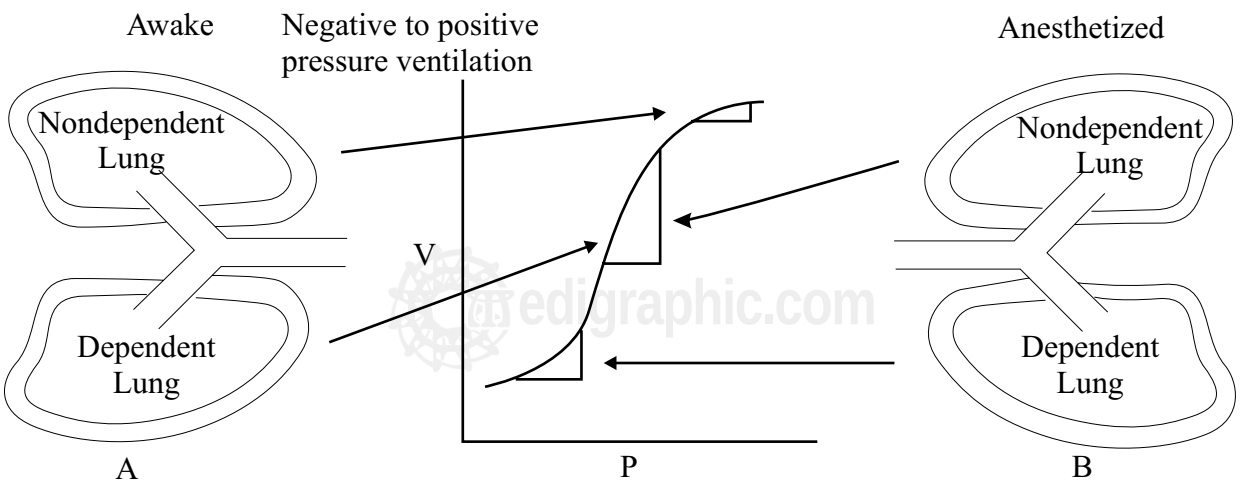
LUNG ANATOMY

Ventilation and perfusion

- Majority of perfusion to dependent lung zones
- Majority of ventilation to non-dependent lung zones
- Gradient of V/Q matching throughout the lung



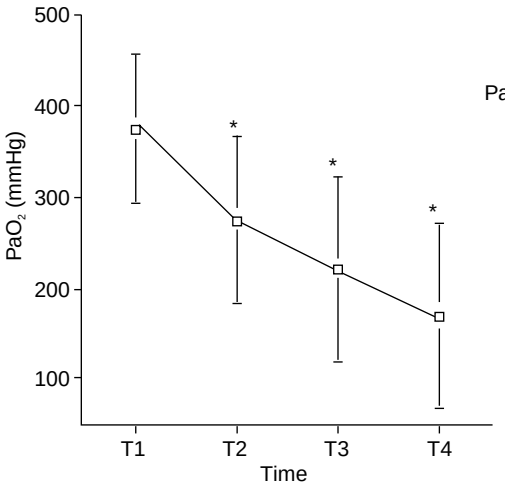
DISTRIBUTION OF VENTILATION



edigraphic.com

With one-lung ventilation, perfusion of non-ventilated lung results in a large shunt

Alveolar-arterial (A-a) gradient reduced by hypoxic pulmonary vasoconstriction

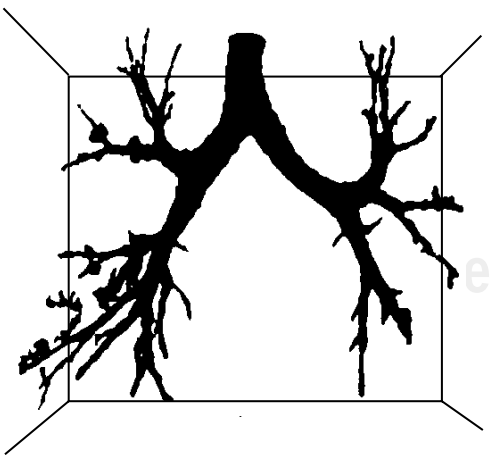


Guenoun T. JCTVA 2002;16:202

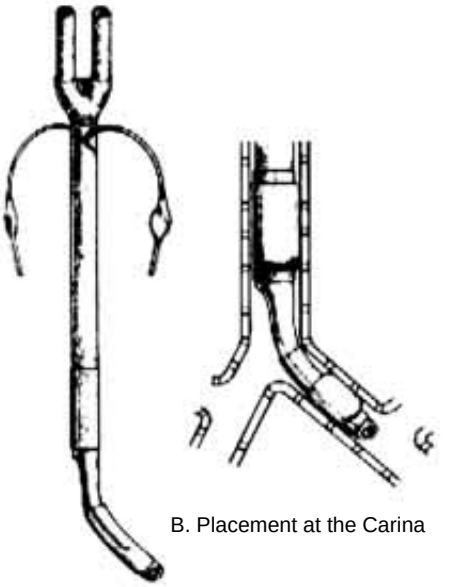
OPTIONS FOR LUNG ISOLATION

- Double lumen ETT
- Single lumen tube and endobronchial blocker
  Integrated (Univent tube)
  Stand alone blocker (Fogerty catheter)
  Hybrid (Arndt endobronchial system)
- Endobronchial intubation
- Intermittent ventilation

BRONCHIAL ANATOMY

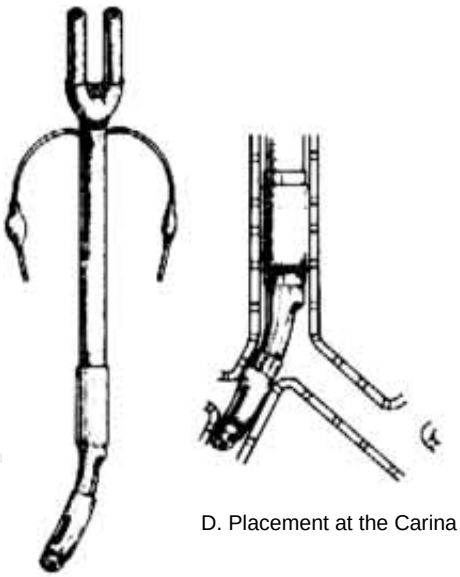


DOUBLE-LUMEN ENDOTRACHEAL TUBES



B. Placement at the Carina

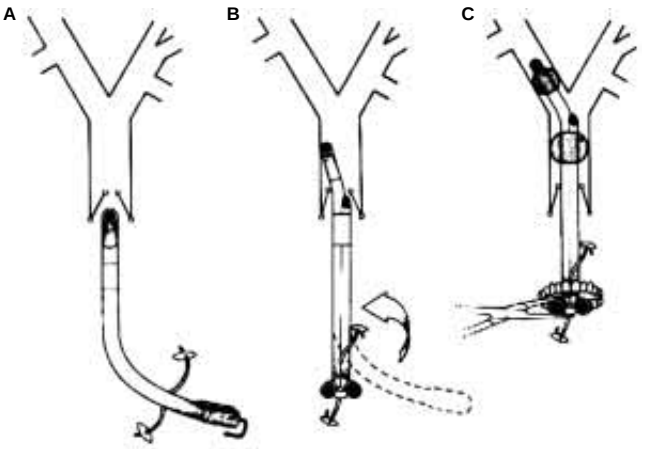
A. Left Robertshaw tube



D. Placement at the Carina

C. Right Robertshaw tube

DOUBLE-LUMEN ETT PLACEMENT



CONFIRMING ENDOBRONCHIAL INTUBATION

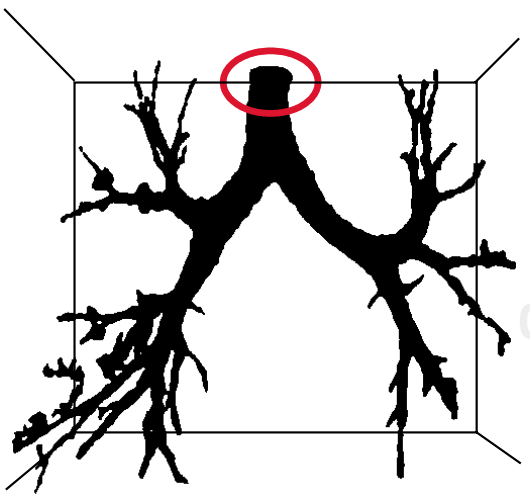
- Auscultation (left sided tube)

  Both sides open, listen to right, then left
  Clamp endotracheal lumen, inflate endobronchial cuff
  listen to left then right (use large TV of same size)

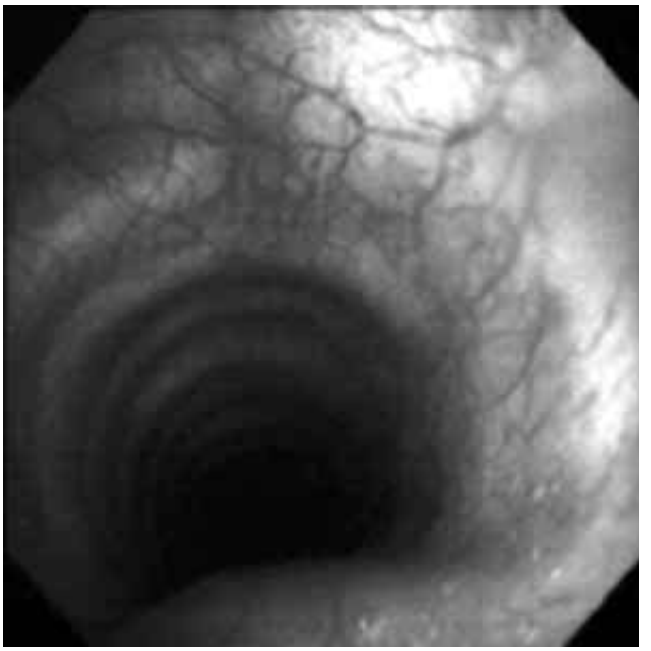
  Auscultation not completely reliable
  Up to 48% still require adjustment
  Auscultation may be impractical or of poor quality
  Confusing if tube misplaced

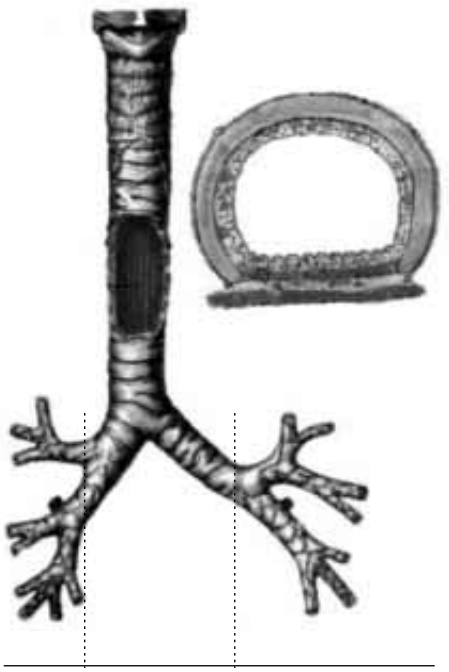
- Fiberoptic bronchoscopy

BRONCHIAL ANATOMY

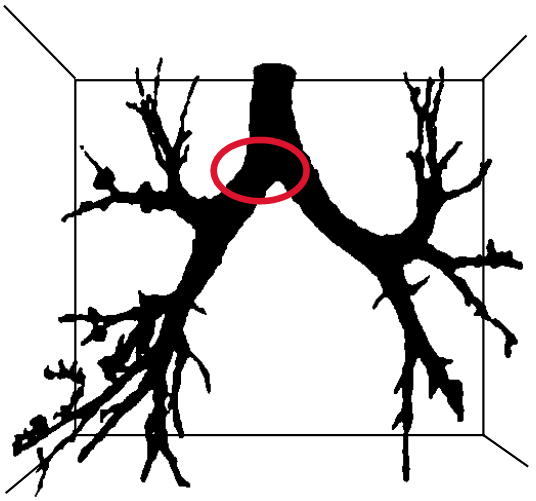


Trachea:
Membranous and Cartilaginous

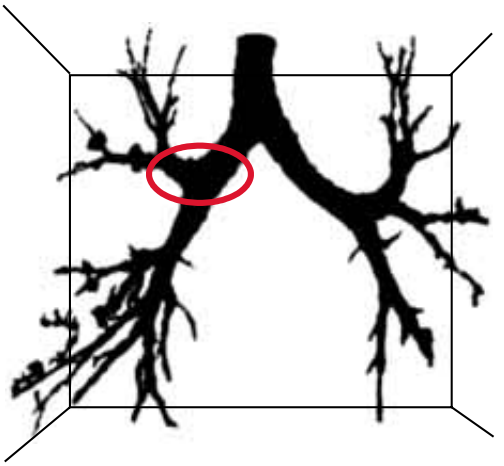




BRONCHIAL ANATOMY

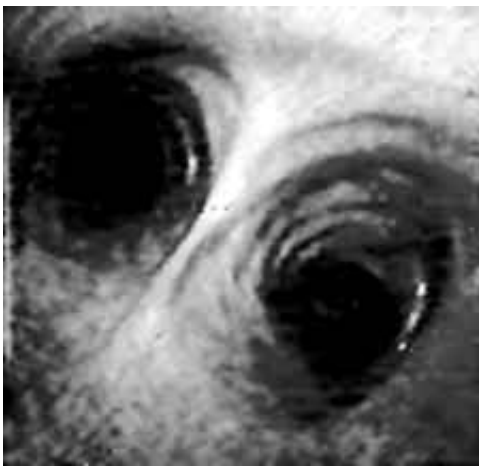


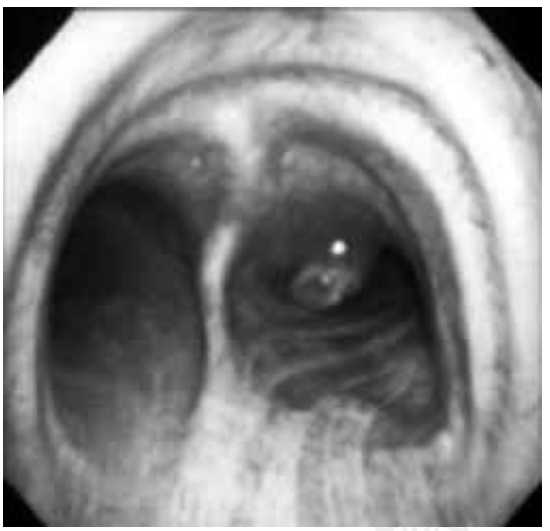
About 2 cm from the carina, the R main bronchus divides to the R upper lobe bronchus and the bronchus intermedius

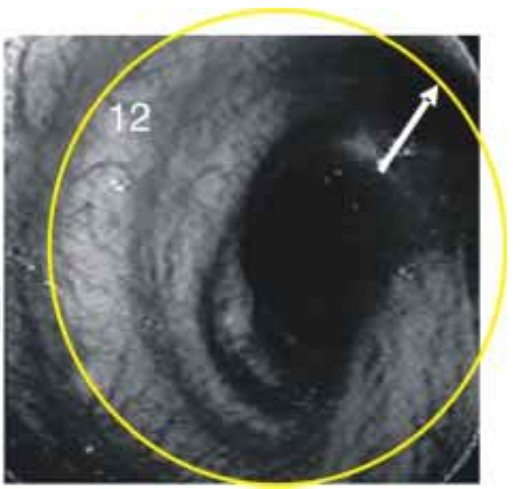


Carina

- Acuity of carinal angle
- Striations of membranous trachea
- Lesser acuity of right mainstem bronchus





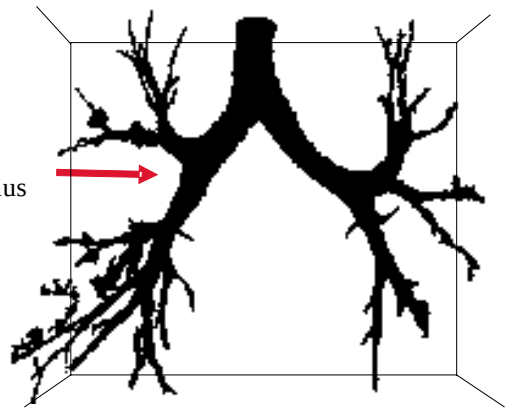


edigraphic

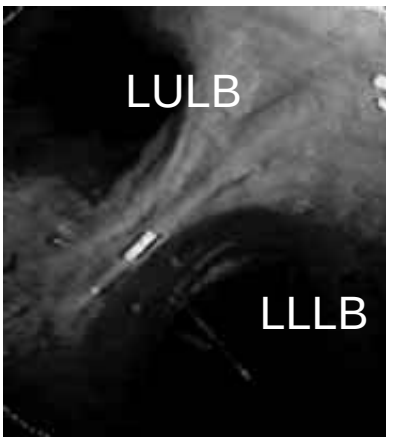
BRONCHIAL ANATOMY

Carina and right upper lobe takeoff

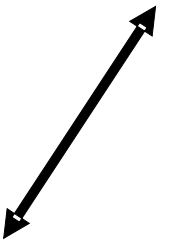
BRONCHIAL ANATOMY



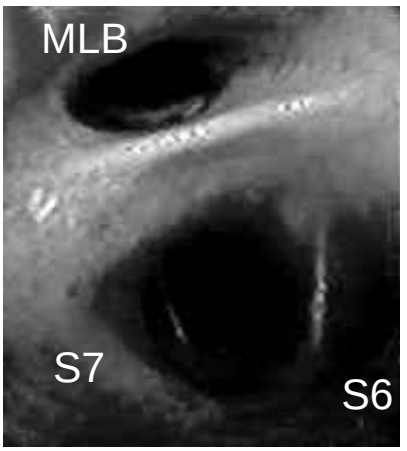
Right, middle, and lower bronchi



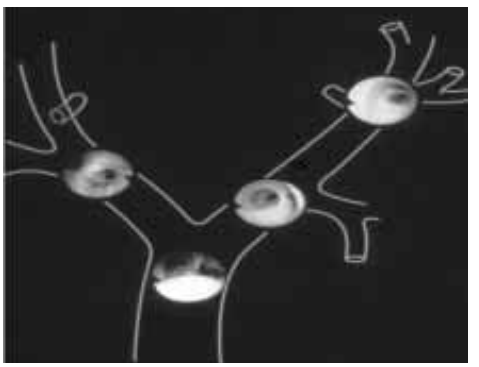
Left upper and lower bronchi



Summary of critical bronchoscopic anatomy

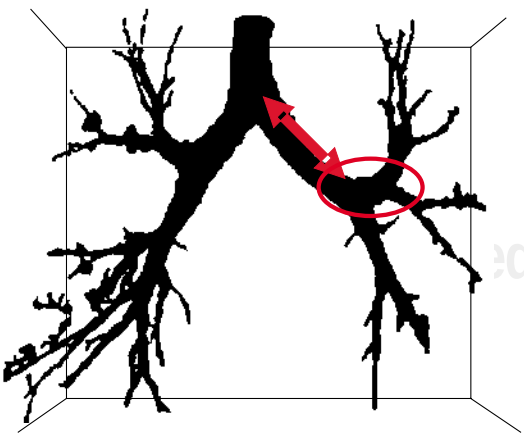


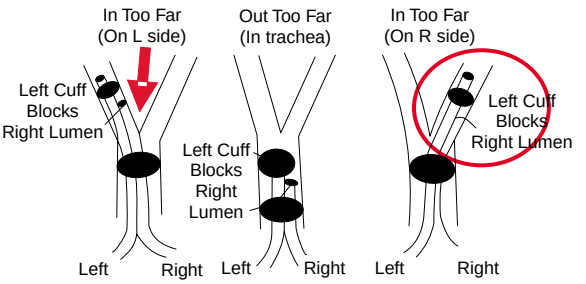
Bronchus intermedius divides into the middle lobe bronchus and the lower lobe bronchus



DOUBLE-LUMEN TUBE MISPLACEMENT

BRONCHIAL ANATOMY

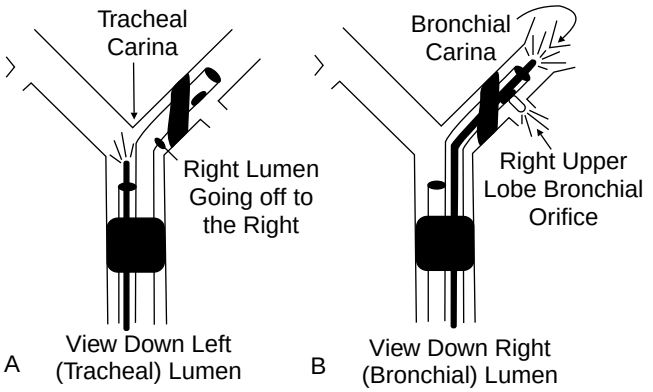




Procedure	Breath Sounds Heard		
Clamp Right Lumen Both Cuffs Inflated	Left	Left and Right	Right
Clamp Left Lumen Both Cuffs Inflated	None or Very ↓↓	None or Very ↓↓	None or Very ↓↓
Clamp Left Lumen Deflate Left Cuff	Left	Left and Right	Right

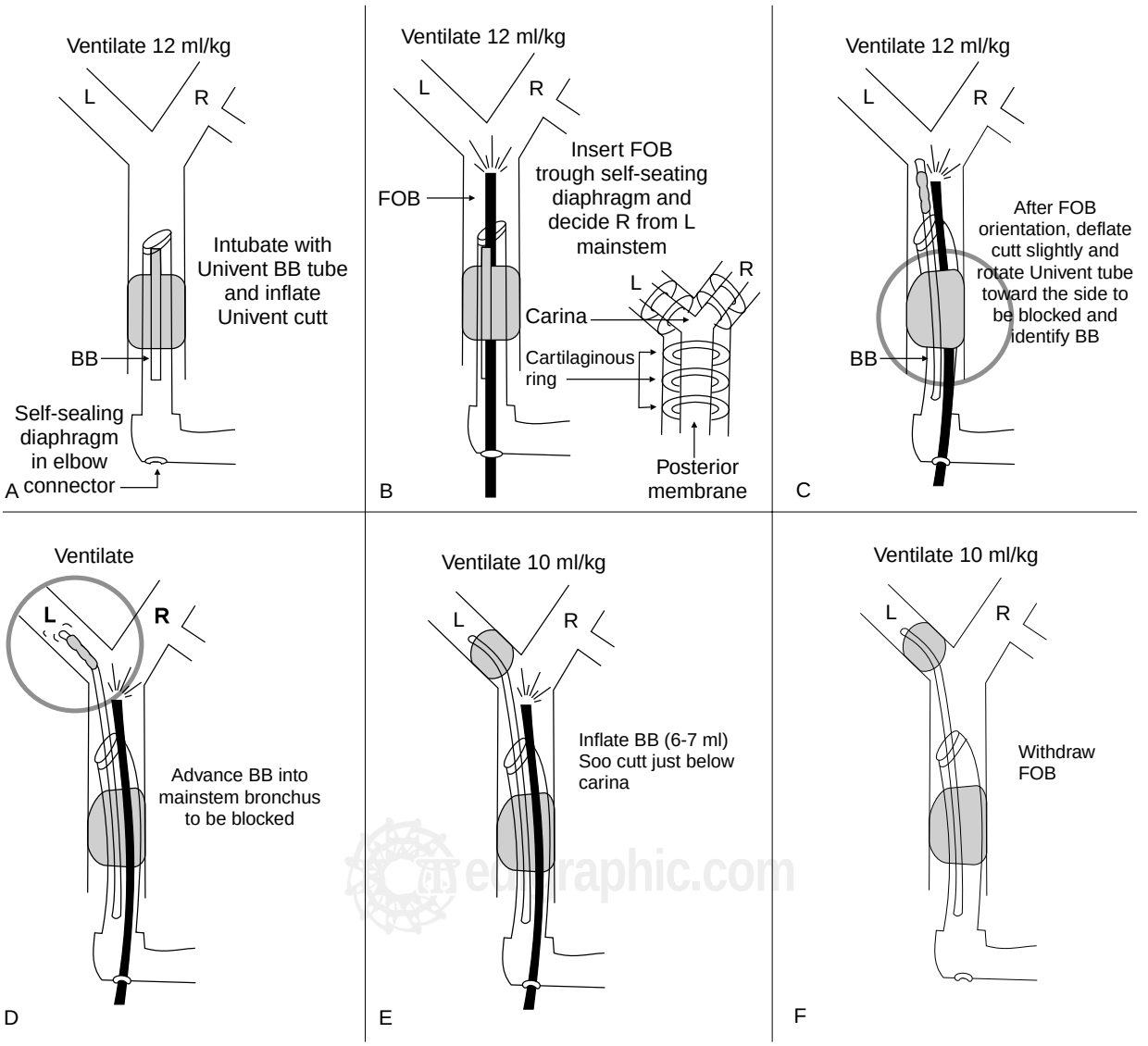
edigraphic.com

RIGHT DOUBLE-LUMEN ENDOTRACHEAL TUBE

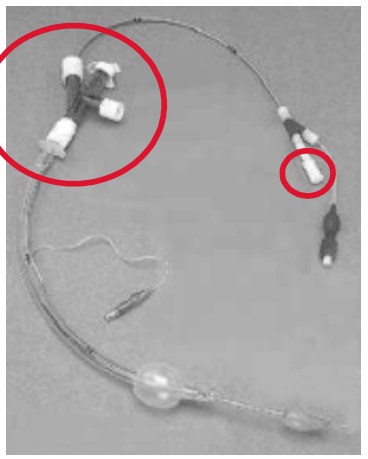


UNIVENT OR "FUJI" TUBES

- Integrated blocker
- Lesser curvature
- Blocker is vented and angulated
- Blocker position can be "fixed" sizes???

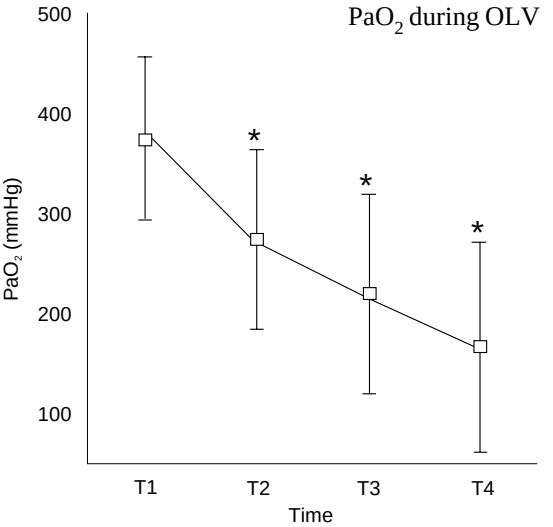


elsevier graphic.com



Arndt Endobronchial Blocker system

- Unique proximal adapter
- Blocker independent, vented, and has wire loop
- Blocker position can be "fixed"



Arndt Endobronchial blocker system

Bronchoscopic guided blocker

ONE-LUNG ANESTHESIA: GOALS IN RESPIRATORY MECHANICS

- Limit inspiratory driving pressure < 20 (PIP - PEEP) = IDP
- Limit PIP < 35-40 cm H_2O
- Frequent manual lung recruitment maneuvers (CPAP at 30-40 cm H_2O for 30 seconds)

RR < 25 breaths/minute

ONE-LUNG ANESTHESIA: PRACTICAL CONSIDERATIONS

- May be benefit to pressure controlled ventilation
- Adjust I:E ratios as indicated
- Watch for breath stacking: inadequate expiratory time
- If hypotension occurs go to manual ventilation to assess possible contribution of ventilatory mechanics
- If anesthetic is volatile based, give i.v. agents if interrupting ventilation
- Hypercarbia better tolerated than hypoxia

ONE-LUNG ANESTHESIA: PRACTICAL CONSIDERATIONS

- For DLTs endobronchial portion should not be occlusive without the cuff up
- Dbl lumen tubes tend to migrate outward on lateral positioning
- Assess adequacy of isolation and oxygenation before it is critical

INCREASED RISK FOR ONE-LUNG HYPOXEMIA

- High A-a gradient with two lung ventilation when in lateral position
- V/Q scan showing high proportion of ventilation or perfusion to operative lung
- Right sided lung surgery
- Good preoperative spirometry (FEV_1 or FVC) (pts with airflow limitation develop auto-PEEP)

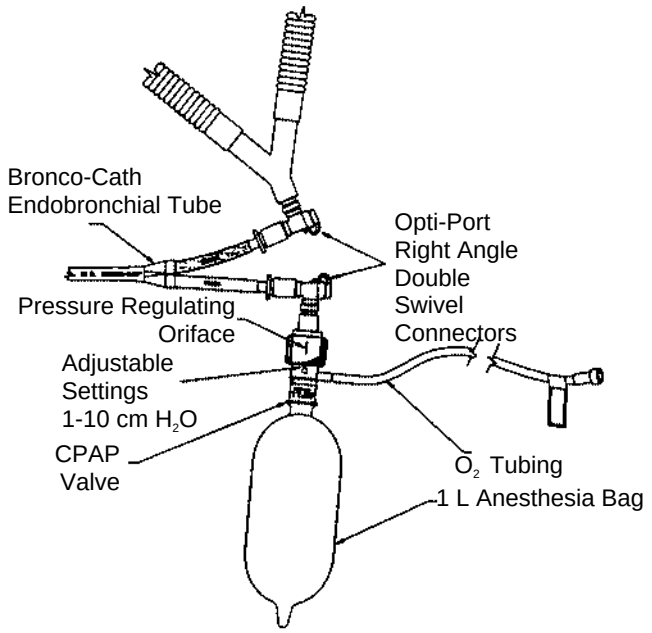
edigraphic.com

IMPROVING ONE-LUNG OXYGENATION

- 5-10 cm of CPAP to non-ventilated lung
- 5 cm PEEP to ventilated lung
- Recruitment maneuvers
- Intermittent ventilation
- Lobe isolation

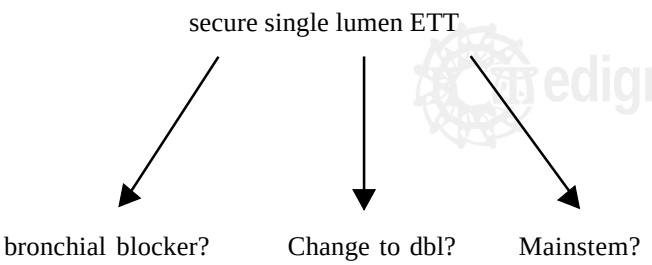
IMPROVING OXYGENATION: CPAP

Prior to major vascular surgery, coronary-



LUNG ISOLATION IN THE DIFFICULT AIRWAY

- Assess requirement for lung isolation (intraoperative and postoperative considerations)
- If dbl ETT impractical:



RIGHT *VS* LEFT-LUNG SURGERY?

- More lung to use if surgery is left-sided
- More options for right -sided ventilation
  - Left endobronchial dbl lumen ETT
  - Single lumen tube with left bronchial blocker
  - Single lumen right endobronchial intubation
- Better respiratory mechanics, easier secretion control if surgery is left-sided

THE RIGHT UPPER LOBE

- Limits ability to achieve adequate ventilation and oxygenation with right endobronchial intubation
  42-26 (20 left and 6 right upper) = 14 (33%)
- If right sided surgery and a blocker is placed it is frequently dislodged

POSTOPERATIVE MANAGEMENT

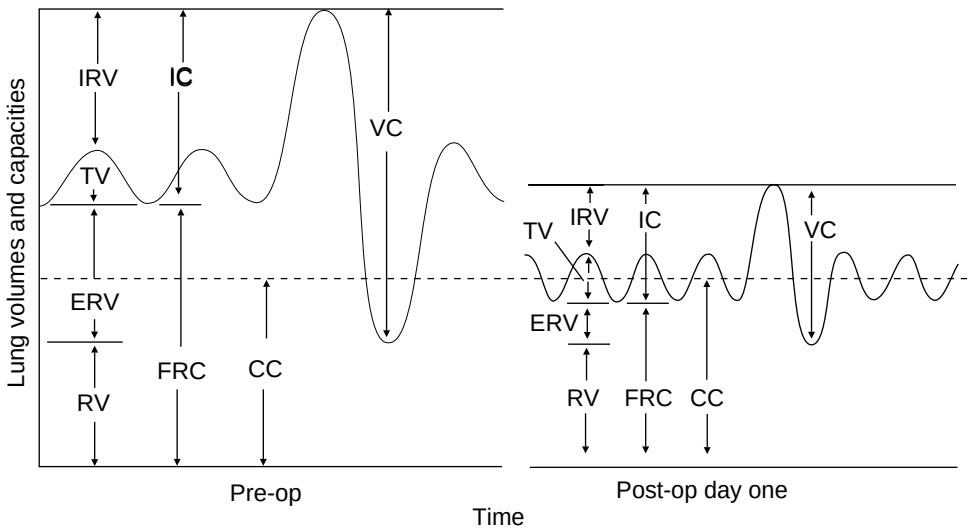
- Determine predicted postoperative FEV1
- Extubation and postoperative status must be considered in choosing an isolation strategy
- Goal: extubate directly from double lumen ETT
- If anticipate postoperative mechanical ventilation, single lumen tube with bronchial blocker usually better than tube change

POSTOPERATIVE ANALGESIA

- Analgesia is fundamental to extubation and postoperative ventilatory mechanics
  Narcotic-based analgesia
  Intercostal/paravertebral blocks
  Interpleural local anesthetics
  Lumbar epidurals
- Thoracic epidural analgesia with PCA supplementation

edigraphic.com

POSTOPERATIVE PAIN AND RESPIRATORY MECHANICS



EPIDURAL INFUSIONS FOR THORACOTOMY

	Thoracic catheter	Lumbar catheter
Fentanyl	30-50 μg/h	Not recommended
5 μg/ml		
10 μg/ml		
Hydromorphone	30-50 μg/h	40-80 μg/h
5 μg/ml		
10 μg/ml		
Morphine	300-500 μg/h	400-800 μg/h
100 μg/ml		
Bupivacaine 0.075%	All	Not recommended

edigraphic.com

Inpatient, Adult — **Order Set**

MAYO CLINIC

Epidural Analgesia

Orders apply to adult patients (15 years of age and older).
Mark the ☒ for desired orders. If ☐ are blank, order is inactive. All pre-printed doses are based on normal renal and hepatic function and must be assessed for adjustment against the individual patient's renal and hepatic function and for interactions with other medications.

Name
Clinic Number
Room Number

Height: cm Weight: kg Age:
Allergy module reviewed. ☐ No additional allergies identified, **or**
Choose one: ☐ Additional allergies identified and MICS Allergy module updated, **or**
☐ Additional allergies. List (include reaction): please update MICS Allergies.

ALERTS

All epidural solutions and additives must be preservative free.
Prior notification of the Inpatient Pain Catheter Service is required before administration of:
- Warfarin (Coumadin), intravenous Heparin, low molecular weight Heparin, thrombolytics or glycoprotein IIb/IIIa receptor inhibitor agents and all anticoagulants excluding subcutaneous Heparin.
- Opiates, sedatives or hypnotics not included within this order set.

Prescribers, write on the order that you have discussed with Inpatient Pain Catheter Service when writing orders for opiates, sedatives, hypnotics, Warfarin (Coumadin), intravenous Heparin, low molecular weight Heparin, thrombolytics, glycoprotein IIb/IIIa receptor inhibitor agents and all anticoagulants excluding subcutaneous Heparin.
NOTE to Primary Service: New orders must be written for opiates and benzodiazepines, as applicable, when epidural treatment has ended.

Important: This area must be completed.
(This section is a record of dose administered, not an order, and does **not** replace formal procedure documentation in patient record.)

1. **Patient received epidural loading dose (circle one):** Intraoperatively or Postoperatively **given at** _____ **hours** on _____ (date).
   Indicate medication(s) administered by circling and noting dose below:
   Fentanyl (Sublimaze®): _____ mcg (50 – 100 mcg) Morphine (Duramorph®): _____ mg (3 – 6 mg)
   Hydromorphone (Dilaudid®): _____ mg (0.2 – 1 mg) Other: _____ None: _____
   Note: The anesthesiologist must call the appropriate service below to confirm dose given and/or catheter placement.
   Inpatient Pain Catheter Service SMH 127-05369 **Inpatient Pain Catheter Service RMH 127-07447** **Obstetric (OB) Anesthesiology RMH 127-04846**
   Inpatient Consult Service SMH 127-05552 **Inpatient Pain Consult Service RMH 127-05447**
   ☐ Check here to indicate no infusion planned and catheter removed prior to dismissal to floor.

2. Check product, concentration, and catheter location and specify rate in correct column for continuous epidual infusion.		Thoracic/Upper Abdomen Surgery		Lower Abdomen/Pelvic/ Lower Extremity Surgery
		☐ Thoracic Catheter	☐ Lumbar Catheter	☐ Lumbar Catheter
☐ Fentanyl (Sublimaze®)	☐ **5** mcg/mL ☐ **10** mcg/mL	mcg/hr (30 – 50 mcg/hr)	Not recommended	mcg/hr (40 – 80 mcg/hr)
☐ Hydromorphone (Dilaudid®)	☐ **5** mcg/mL ☐ **10** mcg/mL	mcg/hr (30 – 50 mcg/hr)	mcg/hr (40 – 80 mcg/hr)	mcg/hr (40 – 80 mcg/hr)
☐ Morphine (Duramorph®)	☐ **100** mcg/mL	mcg/hr (300 – 500 mcg/hr)	mcg/hr (400 – 800 mcg/hr)	mcg/hr (400 – 800 mcg/hr)
Add Bupivacaine (Marcaine®)	**0.075%**	☐	Not recommended	☐*

*If **lumbar catheter** infusing Bupivacaine (Marcaine®), contact Inpatient Pain Catheter Service or OB Anesthesiology, as applicable, prior to ambulation. Otherwise, ambulate with assistance as required.

3. Following epidural loading dose, monitor respiratory rate every 1 hour for 12 hours, then resume respiratory rate checks standard for patient care unit.
   ☐ Pulse oximetry for hours following epidural loading dose.
4. Ketorolac (Toradol®) **(Select one)**
   ☐ Discontinue all Ketorolac (Toradol®) orders.
   ☐ Continue Ketorolac (Toradol®) as ordered by primary service.
   ☐ 15 mg IV/IM every 6 hours as needed for 4 doses maximum (if not breast feeding). If also ordered by primary service, discontinue primary service's orders for Ketorolac (Toradol®).
   ☐ 30 mg IV/IM every 6 hours as needed for 4 doses maximum (if not breast feeding, age is less than 65 years, weight is 50 kg or greater, serum creatinine is less than 1.5, and urine output is 600 mL/day or greater).
   If also ordered by primary service, discontinue primary service's orders for Ketorolac (Toradol®).
5. For itching: **(Select one)**
   ☐ Diphenhydramine (Benadryl®) 25 mg orally or 12.5 mg IV every 6 hours PRN (oral route preferred).
   ☐ Nalbuphine (Nubain®) 5 mg IV every 4 hours times 2 doses PRN.
   ☐ Naloxone (Narcan®) IV infusion 20 mcg/hour PRN for 8 hours once.
6. For insomnia: **(Select one medication and one dosage strength)**
   ☐ Zolpidem (Ambien®) orally every bedtime PRN.
   ☐ 5 mg **OR** ☐ 10 mg
   ☐ Diphenhydramine (Benadryl®) orally every bedtime PRN.
   ☐ 25 mg **OR** ☐ 50 mg
   If ineffective, contact Pain Catheter Service or OB Anesthesiology as applicable.
7. ☒ For respiratory rate less than 8 breaths per minute or if patient is unarousable, give 0.2 mg Naloxone (Narcan®) IV once, apply oxygen and notify Inpatient Pain Consult Service or OB Anesthesiology as applicable.
8. ☒ For nausea/vomiting, follow Postoperative Nausea and Vomiting Protocol for Adults (MC1156-213). If physician needed, please call Inpatient Pain Catheter Service or OB Anesthesiology, as applicable, if epidural in place.
9. For urinary retention: Obtain bladder scanning and catheterization orders from primary service or refer to existing protocol if available.
10. ☒ **Discontinue all opiate and benzodiazepine orders except those within this order set.** Contact Inpatient Pain Catheter Service or OB Anesthesiology, as applicable, if patient has scheduled benzodiazepine orders other than those included within this order set.
11. If pain rated greater than 4 or greater than comfort goal, or if difficult to arouse during 24 hour period after epidural loading dose or any time when epidural catheter is in place, please call Inpatient Pain Catheter Service or OB Anesthesiology, as applicable. Otherwise, contact primary service.
12. ☒ The orders within this order set are active during epidural treatment only. **Discontinue these orders when epidural treatment has ended.**
13. Other:

Prescriber's Signature: Prescriber's Pager #: Service Pager #:
Prescriber's Printed Name: Date: Time:

Part 1 – Pharmacy Part 2 – Nursing Part 3 – Order Book

This order set has been developed to reflect the practice patterns of the clinicians who wrote it. It sets forth recommendations as to practice, not rigid rules.

© 2004 Mayo Foundation for Medical Education and Research. All rights reserved.
MC1156-82rev0104

Sample Sample Sample Sample Sample Sample