Obesity, Obstructive Sleep Apnea (OSA), and Thoracic Anesthesia

Jay B. Brodsky, MD

Professor (Anesthesiology)
Stanford University Medical Center
Stanford, California

Jbrodsky@stanford.edu

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Disclosure

Ambu, DK
Airway Management Advisory Board

Goals and Objectives

- Learn the advantages and disadvantages of bronchial blockers (BB) and double-lumen tubes (DLT); Which is the best lung separation technique for your patient .
- Use of airway exchange catheters (AEC) for thoracic patients with difficult airways.
- Identify and manage obese thoracic surgical patients with Obstructive Sleep Apnea (OSA).
- Select the best technique(s) for postoperative pain management for the obese thoracic surgical patient.

INDICATIONS

LUNG SEPARATION/ISOLATION ("absolute")

Protect healthy lung

hemorrhage, empyema, lung lavage

Special procedures

broncho-pleural fistula, bronchial disruption,
giant bullae or cysts, broncho-pulmonary lavage

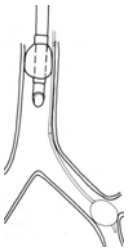
SELECTIVE LUNG COLLAPSE ("relative")

Improve Surgical Exposure

Thoracic Surgery: Lung and mediastinum
General Surgery: Esophagus
Cardiac Surgery: Heart and great vessels
Orthopedic Surgery: Spinal column – thoracic approach
Neurosurgery: Nerves and sympathetic chain

Lung Isolation and Selective Collapse

Double-lumen tube



Bronchial blocker

The DLT vs BB "Controversy"

- Gayes JM. Pro: One-lung ventilation is best accomplished with the Univent endotracheal tube. J Cardiothorac Vasc Anesth (1993) 7:108-112
- Cohen E. Pro: The new endobronchial blockers are preferable to double-lumen tubes for lung isolation. J Cardiothorac Vasc Anesth (2008) 22: 920-924
- Neustein SM. Pro: Bronchial blockers should be used routinely for providing one-lung ventilation. J Cardiothorac Vasc Anesth (2015) 29: 234-6
- Slinger P. Con: The Univent tube is not the best method of providing one-lung ventilation. J Cardiothorac Vasc Anesth (1993) 7: 108-112
- Slinger P. Con: The new endobronchial blockers are preferable to double-lumen tubes for lung isolation. J Cardiothorac Vasc Anesth (2008) 22: 925-929
- Brodsky JB. Con: A bronchial blocker is not a substitute for a double-lumen endobronchial tube. J Cardiothorac Vasc Anesth (2015) 29: 237-239

- For most patients either a DLT or BB can be safely used – the choice is one of personal preference
- No significant differences in the quality of lung isolation
- Both have advantages in specific clinical situations

Anesthesiologists should be skilled in both techniques

Clayton-Smith A, et al. A comparison of the efficacy and adverse effects of double-lumen endobronchial tubes and bronchial blockers in thoracic surgery: A systemic review and meta-analysis of randomized controlled trials. J Cardiothor Vasc Anesth (2015) 29: 955-966

Once the trachea is intubated lung collapse is ***ALWAYS*** possible!

Single-lumen Tube (ETT) or SGA (LMA)

Bronchial Blocker (BB)

Airway Exchange Catheter

Airway Exchange Catheter (AEC)

Double-lumen Tube (DLT)

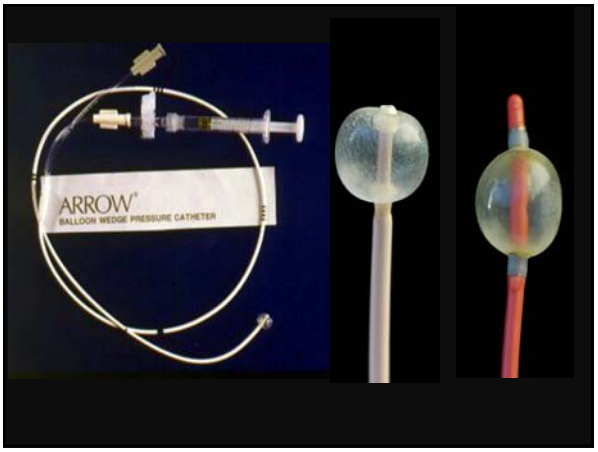
Bronchial Blockers: Advantages

• Can be used with any endotracheal tube (oral, nasal, tracheostomy) or LMA

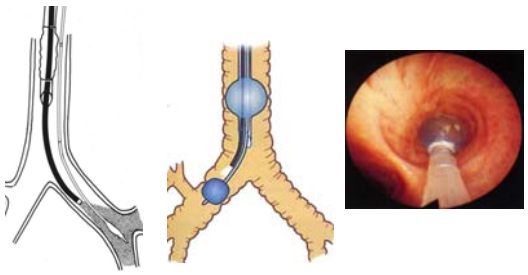
• Not necessary to change to ETT if ***potential*** or ***planned*** postoperative ventilation ("difficult airway")

• Allows selective lobar blockade

• ETT fits in very small adult airways; technique of choice in pediatrics

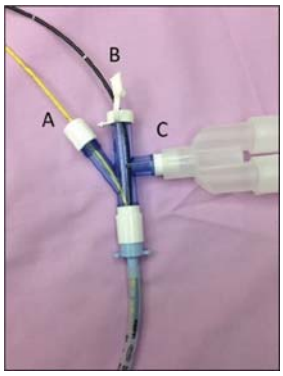


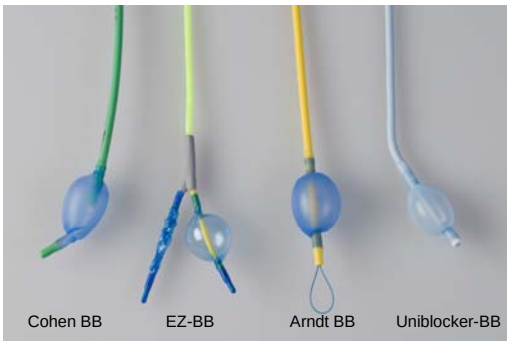
Fiberoptic Bronchoscopy



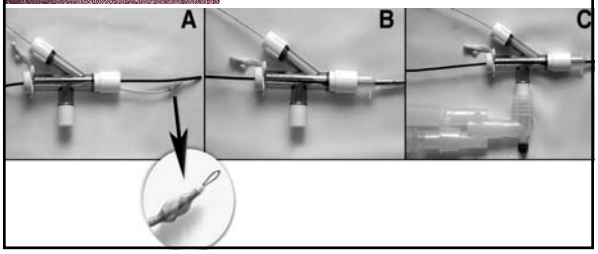
Oxorn D. Use of fiberoptic bronchoscope to assist placement of a Fogarty catheter as a bronchial blocker. Can J Anaesth (1987) 34: 427-8.

Multiport Adaptor

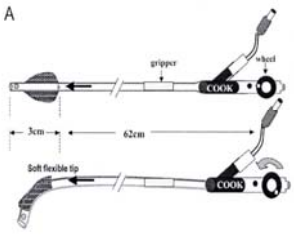




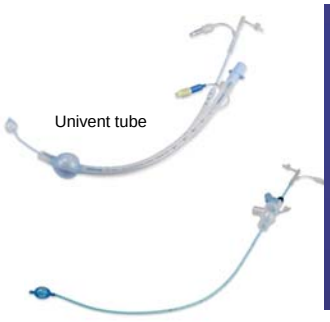
Arndt® (Wire loop (WEB) control)
FOB control positioning
Balloon not visualized

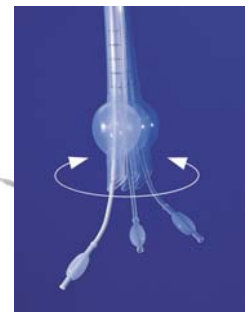


Cohen® (Torque control)
BB position observed with FOB
Ability to reposition BB

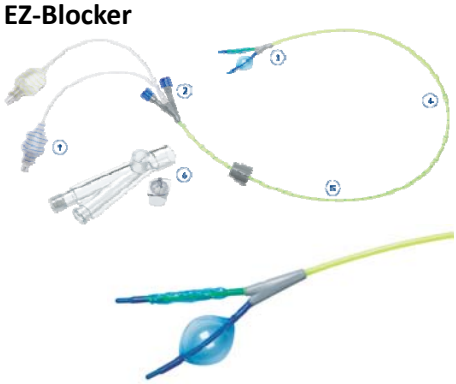


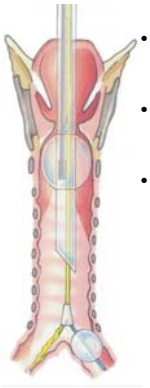
Uniblocker





EZ-Blocker





- Minimal risk of dislocation
- Same EZ-Blocker can isolate either lung
- Allows either lung to be collapsed and re-expanded (sequential isolation) during surgery

Brodsky JB, et al. Sequential bilateral lung isolation with a single bronchial blocker. Anesth Analg Case Reports (2013) 1: 17-18

EZ-Blocker is only BB that can be placed "blindly" without bronchoscopy

- Use in very small ETT (no pediatric FOB available)
- During emergencies ("blind" without FOB)
- When airway cannot be visualized ie hemorrhage

Miller CA, Sabhlok S, Brodsky JB. "Blind" placement of a bronchial blocker in a patient with a difficult airway. J Cardiothorac Vasc Anesth. 2013 Oct;27(5):e61-2.

Bronchial Blocker - Contraindications

- **Bronchial Obstruction**
  - Extrinsic – tumor, nodes, aortic aneurysm (left)
  - Intrinsic – tumor, stenosis
- **Procedure on Bronchus**
  - Broncho-pleural fistula, Sleeve resection,
  - Single-lung transplant

DLT can always be positioned in the opposite bronchus

Tracheal Or Carinal Origin Of Right-upper Lobe Bronchus

(5% population)

BB cannot collapse entire right lung

Double-lumen Tubes

- Two tubes molded together
- Short lumen ends in the trachea
- Longer lumen ends in either the right or left main bronchus

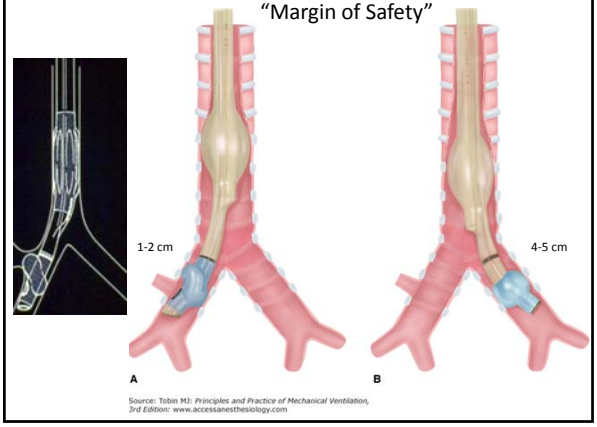
(1950) Carlens

(1962) Robertshaw

Plastic Double-lumen Tubes

Portex Sheridan Mallinckrodt Rusch Maquet Parker
Covidien

"Margin of Safety"



Source: Tobin MJ: *Principles and Practice of Mechanical Ventilation, 3rd Edition:* www.accessanesthesiology.com

What is a Difficult Airway? *

"… difficult airway …. situation in which an anesthesiologist experiences *problems* with (a) *face mask ventilation* and/or (b)*tracheal intubation*" **

ASA Task Force: Practice Guidelines for the Management of the Difficult Airway. Anesthesiology 1993; 78: 597-602

- * <1993 "**difficult airway**" was called "**difficult intubation**"
- ** 2013 - difficulty with SGA placement/ventilation added

Difficult Airway

Obesity (mask ventilation, DL)

+

OSA (MV, laryngoscopy)

+

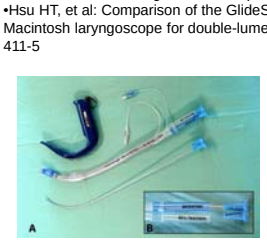
Thoracic Surgery (special tubes)

Double-lumen Tube – Laryngoscopy

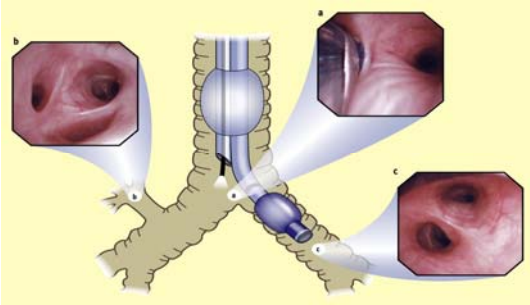
Bullard Laryngoscope
Shulman GB, et al: Double lumen tube placement with the Bullard laryngoscope. Can J Anaesth 1999; 46: 232-4
WuScope
Smith CE, et al: Fiberoptic laryngoscopy (WuScope) for double-lumen endobronchial tube placement in two difficult-intubation patients. Anesthesiology. 2000; 93: 906-7
Yu HD, et al: Usefulness if the WuScope to facilitate double-lumen endotracheal tube placement in patients with ankylosing spondylitis. Chang Gung Med J. 2011; 34: 218-23
Pentax Airway Laryngoscope
Poon KH, et al: The Airway Scope for difficult double-lumen tube intubation. J Clin Anesth. 2008; 20: 319
Suzuki A, et al: Double lumen tube placement with the Pentax-Airway Scope. Can J Anaesth. 2007; 54: 853-4
McGrath
Purugganan RV, et al: Video laryngoscopy versus direct laryngoscopy for double-lumen endotracheal tube intubation: a retrospective analysis. J Cardiothorac Vasc Anesth 2010; 26: 845-6
LMA C Trach
Karabiyik L: Placement if a double-lumen tube using LMA C Trach and an exchanger catheter in difficult airway intubation – A case report. Korean J Anesthesiol 2012; 62: 565-7
Airtraq
Hirabayashi Y, et al: The Airtraq laryngoscope for placement of double-lumen endobronchial tube. Can J Anaesth. 2007; 54: 955-7
Salazar H, et al: Double lumen tube insertion in awake patients through the AirTraq layryngoscope in 2 cases of expected difficult airway. Rev Esp Anestesiol 2011; 58: 315-7
Wasem S, et al: Comparison of the Airtraq and the Macintosh laryngoscope for double-lumen tube intubation: a randomised clinical trial. Eur J Anaesthesiol 2013; 30: 180-6
Onrubia X, et al: Use of GlideScope for double lumen endotracheal tube insertion in an awake patient with difficult airway. Rev Esp Anestesiol Reanim 2013; epub
Bonfils Intubation Fiberscope
Bein B, et al: Using the Bonfils intubation fiberscope with a double-lumen tracheal tube. Anesthesiology. 2005; 102: 1290-1
Lighted Stylets (Trachlight)
Chen KY, et al: Double-lumen endobronchial tube intubation in patients with difficult airways using Trachlight and a modified technique. Anesth Analg. 2007; 105: 1425-6
O'Connor CJ, et al: Use of lighted stylets to facilitate insertion of double-lumen endobronchial tubes in patients with difficult airway anatomy. J Clin Anesth. 2006; 18: 616-9
Scanzillo MA, et al: Lighted stylet for placement of a double-lumen endobronchial tube. Anesth Analg. 1995; 81: 205-6
Watanabe R: Modified long Trachlight wand for a double-lumen endobronchial tube. J Anesth. 2004; 18: 144-5
Clarus Video System/OptiScope
YR, et al: The use of the Clarus Video System for double-lumen endobronchial tube intubation in a patient with a difficult airway. Korean J Anesthesiol 2013; 65: 85-6
Yang M, et al: Double-lumen tube tracheal intubation using a rigid video-stylet: a randomised controlled comparison with the Macintosh laryngoscope. Br J Anesth 2013; epub

Glidescope

•Chen A, et al: Glidescope-assisted double-lumen endobronchial tube placement in a patient with an unanticipated difficult airway. J Cardiothorac Vasc Anesth. 2008; 22: 170-2
•Hernandez AA, et al: Using a Glidescope for intubating with a double lumen endotracheal tube. Can J Anaesth. 2005; 52: 658-9
•Bustamante S, et al: Sequential rotation to insert a left double-lumen endotracheal tube using the Glidescope. Can J Anaesth 2010; 57: 282-3
•Hsu HT, et al: Comparison of the GlideScope® videolaryngoscope and the Macintosh laryngoscope for double-lumen tube intubation, Anaesthesia 2012; 67: 411-5



Bussieres JS, et al. A customized stylet for Glidescope® insertion of double lumen tubes. Can J Anesth 2012; 59: 424-5

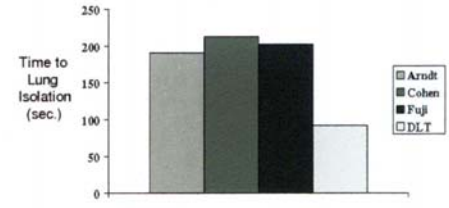


Blue bronchial cuff immediately below carina in main-bronchus

No obstruction of upper-lobe bronchus

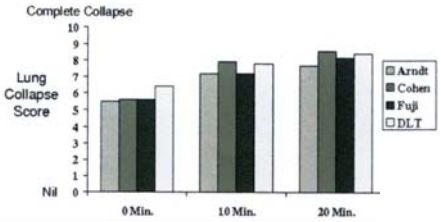
Campos JH: Curr Opin Anaesthesiol 2009; 22: 4-10

Time to lung isolation (seconds)



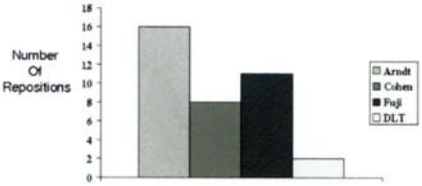
Narayanaswamy M, et al. Choosing a lung isolation device for thoracic surgery: A randomized trial of three bronchial blockers versus double-lumen tubes. Anesth Analg 2009; 108: 1097-101

Quality of lung collapse over time



Narayanaswamy M, et al. Choosing a lung isolation device for thoracic surgery: A randomized trial of three bronchial blockers versus double-lumen tubes. Anesth Analg 2009; 108: 1097-101

Number of Repositions



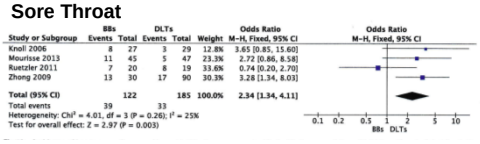
- DLT or BB not in correct position fails to isolate the lung
  - Lung will re-expand and interfere with surgery
  - Inflated BB balloon in trachea obstructs ventilation to both lungs
  - Healthy non-operated lung can be contaminated

Narayanaswamy M, et al. Choosing a lung isolation device for thoracic surgery: A randomized trial of three bronchial blockers versus double-lumen tubes. Anesth Analg 2009; 108: 1097-101

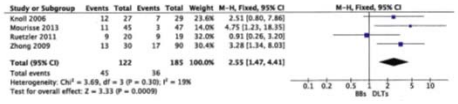
DLT	Bronchial Blocker
• Increased risk of serious airway (tracheal and/or bronchial) trauma due to rigidity and diameter of DLT	• Less risk of trauma since BB inserted through a standard ETT

Airway Injury

Sore Throat



Hoarsenes



Clayton-Smith A, et al. A comparison of the efficacy and adverse effects of double-lumen endobronchial tubes and bronchial blockers in thoracic surgery: A systemic review and meta-analysis of randomized controlled trials. J Cardiothor Vasc Anesth (2015) 29: 955-966

Postoperative Ventilation - **Double-lumen Tube**

Ventilate with DLT or Exchange for ETT

Deflate bronchial cuff

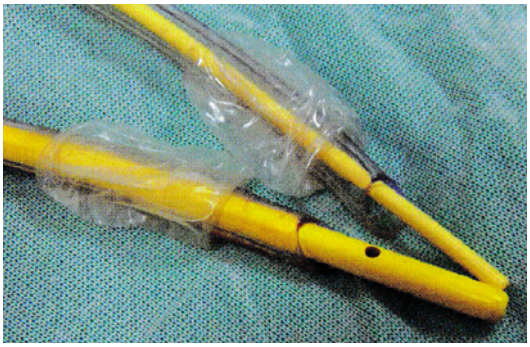
or

Deflate both cuffs

Pull DLT above carina

Re-inflate tracheal balloon

AEC with relatively large o.d. /DLT with relatively small i.d.



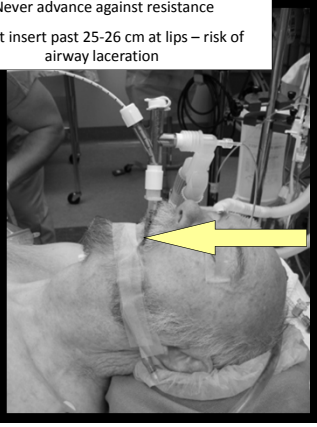
Mort TC and Surette A-M. Airway Management, Anesthesiology News 2017-18

Lubricate the AEC

Test the fit between the AEC and tube before attempting tube exchange

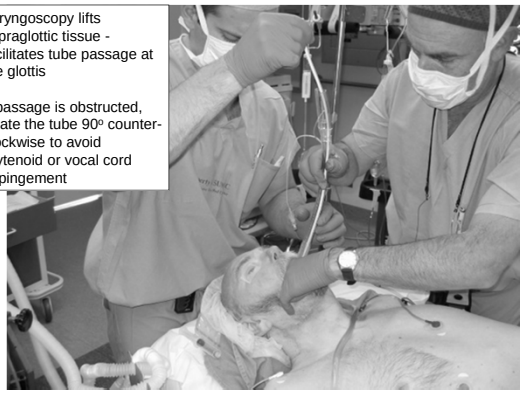
Never advance against resistance

Do not insert past 25-26 cm at lips – risk of airway laceration



Laryngoscopy lifts supraglottic tissue - facilitates tube passage at the glottis

If passage is obstructed, rotate the tube 90º counter-clockwise to avoid arytenoid or vocal cord impingement



Conclusion Of Surgery - **Bronchial Blocker**

- Withdraw BB
- Ventilate through ETT

Favors DLT

- **Displacement less frequent**
- **CPAP easily applied**
- **Allows suctioning before re-inflation of operative lung**
- **Lungs can be re-expanded and collapsed during surgery**
- **Used for operations on contra-lateral lung if main bronchus is obstructed**
- faster and easier to place – "blind" placement possible
- more rapid lung deflation
- sequential surgery
- technique when lung isolation absolutely essential (eg bronchopulmonary lavage)
- "split lung" ventilation in ICU

Favors BB

- **Placed through ETT or LMA**
- **"Difficult airway" or when DLT impossible to use**
- **Can be used "in situ" ETT (no need to change to DL**
- **Better when tube exchange dangerous, especially if postoperative ventilation needed**
- multiport adaptor allows ventilation during placement
- less potential for serious airway trauma
- allows selective lobar isolation
- small airways and pediatrics

Obstructive Sleep Apnea (OSA)

– Increased sensitivity to respiratory depressant effects of anesthetics and opioids

– Increased sensitivity to laryngo-pharyngeal dilator muscle tone to anesthetics and opioids

"Difficult airway" and OSA

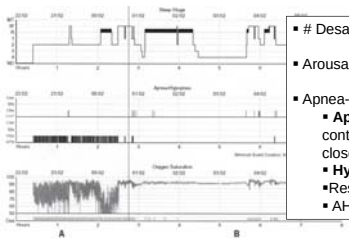
70 - 90% of all patients scheduled for bariatric surgery have OSA

Increased amount of pharyngeal tissue

Obstruction during mask ventilation

Increased tracheal intubation and extubation difficulties

Polysomnography (PSN) - "Sleep Study"



- # Desaturations (SpO2 > 4%)/hr
- Arousal Index (AI) - clinically or by EEG
- Apnea-Hypopnea Index (AHI) (events/hr)
  - **Apnea** – no airflow >10s despite continued efforts to breath against a closed airway
  - **Hypopnea** – airflow <50% for >10s
  - Respiratory Disturbance Index (RDI)
  - AHI + AI

National Sleep Study (Polysomnography) Procedure Pricing Summary

National Minimum Price	$1,150 (Lebanon, PA)
National Average Price	$2,625
National Maximum Price	$5,800 (Durant, OK)

Sleep Study (Polysomnography) Cost Averages Around the Country

Phoenix, AZ Sleep Study (Polysomnography) Cost Average	$2,400
Washington, DC Sleep Study (Polysomnography) Cost Average	$2,475
Philadelphia, PA Sleep Study (Polysomnography) Cost Average	$2,850
Houston, TX Sleep Study (Polysomnography) Cost Average	$2,475
Miami, FL Sleep Study (Polysomnography) Cost Average	$2,625
Dallas, TX Sleep Study (Polysomnography) Cost Average	$2,400
Chicago, IL Sleep Study (Polysomnography) Cost Average	$2,625
Los Angeles, CA Sleep Study (Polysomnography) Cost Average	$2,850
New York, NY Sleep Study (Polysomnography) Cost Average	$3,100
Atlanta, GA Sleep Study (Polysomnography) Cost Average	$2,475

American Society of Anesthesiologists Task Force on Perioperative Management of patients with obstructive sleep apnea. **PRACTICE GUIDELINES FOR THE PERIOPERATIVE MANAGEMENT OF PATIENTS WITH OBSTRUCTIVE SLEEP APNEA**

Anesthesiology 2006; 104:1081-93

A. Clinical signs and symptoms suggesting the possibility of OSA

1. Predisposing physical characteristics
   a. BMI 35 kg/m^2 [95th percentile for age and gender]*
   b. Neck circumference 17 inches (men) or 16 inches (women)
   c. Craniofacial abnormalities affecting the airway
   d. Anatomical nasal obstruction
   e. Tonsils nearly touching or touching in the midline

STOP-BANG Questionnaire for Obstructive Sleep Apnea (OSA)

SNORE:	Do you snore loudly? (Snoring heard through closed door)
TIRED:	Do you feel tired, sleepy, fatigued, during daytime?
OBSERVED:	Has anyone seen you stop breathing during sleep?
BLOOD PRESSURE:	Do you have or are you being treated for high blood pressure?
BMI:	Is your BMI > 35kg/m^2?
AGE:	Are you older than 50?
NECK CIRCUMFERENCE:	Is your neck circumference > 40 cm? Size 16 collar
GENDER:	Are you a male?

+3 probable OSA
+5 high likelihood OSA

Chung F, et al. Screening for obstructive sleep apnea before surgery: why is it important? Current Op Anaesthesiol (2009) 22: 405-11

"Safe" Sleep Disordered-Breathing Anesthetic Guidelines: Perioperative management of the obese surgical patient. Anaesthesia (2015)

- Avoid general anesthesia and sedatives where possible
- Use short acting opioid agents
- Use "depth of anesthesia" monitors to keep agents at minimum
- Use neuromuscular monitoring to maintain block and ensure complete reversal
- Maximal use of local anesthetics and multimodal opioid-sparing agents for postoperative analgesia
- Maintain the head-up position and monitor oxygen saturation postoperatively

Consensus Statement:
J Society for Obesity and Bariatric Anaesthesia
Obstetric Anaesthetist's Association
Royal College of Anaesthetists
British Association of Day Surgery
Resuscitation Council (UK)
Difficult Airway Society
Association of Anaesthetists of Great Britain & Ireland

"Restrictive" fluid management in thoracic surgery

(1984) **Post-Pneumonectomy Pulmonary Edema (PPE)**

10 cases of fatal acute lung injury following pneumonectomy

"….the most important thing we (the surgeon) can do in terms of recognizing this problem (PPE) is to …. ***watch our anesthetists as they start loading the patient up with fluids … don't let them drown the patient***"

Zeldin RA, et al. Postpneumonectomy pulmonary edema. J Thorac Cardiovasc Surgery 1984; 87: 359-365

(1999) …… It is not clear whether PPE is caused by excessive perioperative intravenous fluid as previously thought

Slinger P (1999) Post-pneumonectomy pulmonary edema: is anesthesia to blame? Curr Opin Anaesthiol 12: 49-54

Acute Lung Injury (ALI) - risk factors

- Preoperative alcohol abuse **(p < 0.0001)**
- High intraoperative ventilatory pressure **(p = 0.001)**
- Extent of lung resection **(p = 0.002)**

  (pneumonectomy 7.4% *vs* pulmonary resection 1.9%)
- ***"Excessive"*** fluid infusion **(p = 0.023)**

Licker M, et al (2003) Risk factors for acute lung injury after thoracic surgery for lung cancer. Anesth Analg 97: 1558-65

Possible Mechanisms PPE

- Ischemia-reperfusion injury
- Oxidative stress injury
- Pulmonary capillary stress failure
- **Ventilator-induced acute lung injury (VALI)**

Baudouin SV (2003) Lung injury after thoracotomy. Br J Anaesth 91: 132-42

Hypotension associated with TEA…..is largely due to an unmasking of underlying **hypovolemia**……and can usually be alleviated with ***appropriate*** fluid replacement.”

McGovern I, et al (2007) Pain relief after thoracotomy. Brit J Anaesth 98: 844-5

Restrictive (limited) fluid management for thoracic surgical patients results in hypovolemia and impaired tissue perfusion

Risk of acute kidney injury after lung resection is 6-24%

• Recent findings question the relationship between fluid administration and ALI after lung resection

• Growing interest in tissue hypo-perfusion resulting from ***inadequate*** fluid resuscitation and acute kidney injury after lung resection

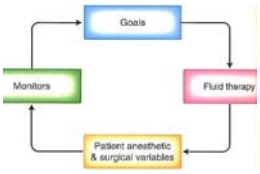
• Recommend Goal-directed (GD) fluid therapy

Assaad S, et al (2013) Fluid management in thoracic surgery. Curr Opin Anaesthesiol 26: 31-39

Goal Directed (GD) Fluid Management

Monitor for Inadequate Perfusion

• Non-invasive blood pressure
• Dynamic A-line BP and respiratory variability
• Pulse oximetry respiratory variability
• Stroke Volume Variation (SVV)
• Urinary output
• CVP, PAP, TEE, CI,
• Intraoperative lab data
ABG, Lactate



GOAL Directed (GD) Fluid Replacement

Meta-analysis 23 GD trials (**non-thoracic** surgery)
GD vs Liberal or vs restrictive fluid therapy
GD groups all received **more** fluid than restrictive groups

GD Replacement (using hemodynamic parameters)
- Less pneumonia
- Less renal complications
- Earlier return of bowel movement
- Shorter hospital stay

Corcoran T, et al (2012) Perioperative fluid management strategies in major surgery: a stratified met-analysis. Anesth Analg 114: 640-51

Fluid Guidelines for Thoracic Surgery

Use **Goal Directed** fluid replacement

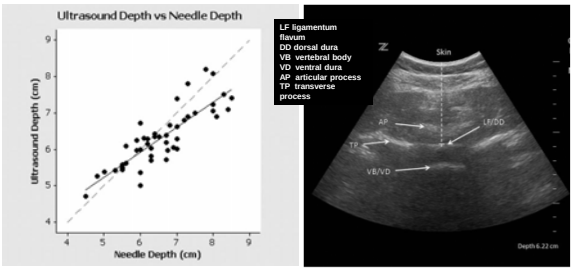
Monitor hemodynamic parameters (ABG)

- **Crystalloids** – limit average adult to < 2.0 L during procedure (< 3.0 L during POD #1)
- **Colloids** – if additional fluid needed to maintain cardiovascular stability and renal function (intra-operatively and post-operatively)
- **Blood** - replace blood loss with blood

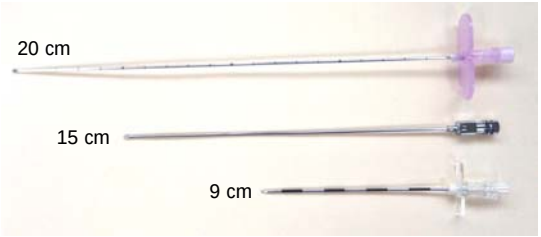
If increased tissue perfusion needed give additional fluids based on GD data

Slinger PD. **PRO**: **Every postthoracotomy patient *deserves thoracic epidural analgesia***. J Cardiothorac Vasc Anesth (1999) 13:350-4

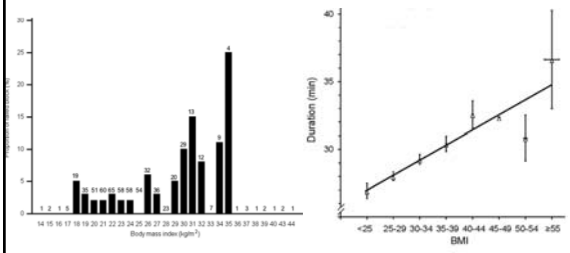
Ultrasound imaging used to measure depth to epidural space



Balki M, et al. Ultrasound imaging of the lumbar spine in the transverse plane: The correlation between estimated and actual depth of the epidural space in obese parturients. Anesth Analg 2009; 108: 1876-81



During epidural placement the frequency of (a) multiple attempts,(b) vascular cannulation, (c) "wet" tap, and (d) failed block increases with increasing BMI



Epidural catheter can pull out > 1 cm
Advance > 4 cm into epidural space

	Body Mass Index (kg/m²)		
	<25 n = 46	25–30 n = 116	>30 n = 92
Change FLEX to UP (cm)	0.23 ± 0.17	0.33 ± 0.28	0.38 ± 0.30*
Change UP to LAT (cm)	0.48 ± 0.41	0.51 ± 0.41	0.69 ± 0.68†
Change FLEX to LAT (cm)	0.67 ± 0.42	0.75 ± 0.48	1.04 ± 0.69†
Ranges of Change FLEX to LAT (cm)	0–1.9	0–2.72	0.11–4.28

Hamilton et al. Changes in the position of epidural catheters associated with patient. Anesthesiology. 1997; 86:778-84

Epidural Analgesia

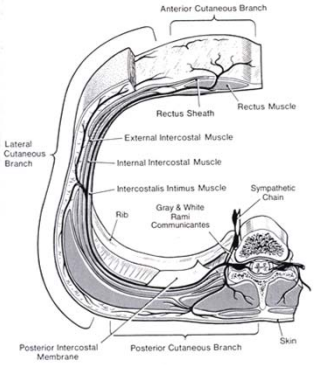
- Urinary retention
- Nausea
- Pruritis
- Hypotension (intraoperative)
- Neurologic Injury
  - Trauma during placement
  - Epidural hematoma
  - Epidural abscess
- Motor block – delays ambulation?
- Hypotension – delays ambulation
- Respiratory Depression
- Failed block
- Dural Puncture
  - High block
  - Spinal headache

Grant RP. **CON**: **Every postthoracotomy patient deserves *thoracic* epidural analgesia**. J Cardiothorac Vasc Anesth (1999) 13:350-4

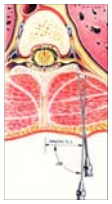
No evidence of major advantage for TEA
- TEA has rare (but serious) risks
- TEA only for high-risk patients

Recommend Intercostal nerve block (ICN) + opioid PCA + NSAIDs (multimodal analgesia)

Paravertebral Block (ICN block)



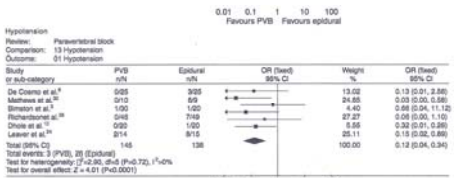
- Intercostal nerves are not enveloped by fascial sheath
- Also blocks sympathetic ganglia, posterior intercostal rami, nerves to costovertrebral joints



Meta-analysis:

Paravertebral Block (PVB) vs **Thoracic Epidural Analgesia (TEA)**

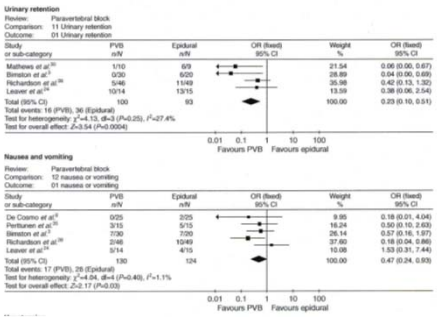
Hypotension following thoracotomy



FAVORS PVB **FAVORS TEA**

Davies RG et al (2006) A comparison of the analgesic efficacy and side-effects of paravertebral vs epidural blockade for thoracotomy – a systematic review and meta-analysis of randomized trials. Br J Anaesth 96: 418-426

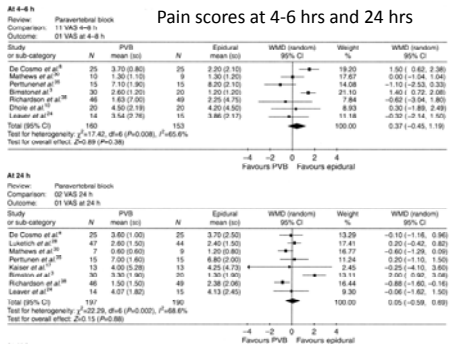
Paravertebral Block (PVB) vs Thoracic Epidural Analgesia (TEA)



Davies RG et al (2006) A comparison of the analgesic efficacy and side-effects of paravertebral vs epidural blockade for thoracotomy – a systematic review and meta-analysis of randomized trials. Br J Anaesth 96: 418-426

Postoperative Analgesia

Pain scores at 4-6 hrs and 24 hrs



Davies RG et al. (2006) A comparison of the analgesic efficacy and side-effects of paravertebral vs epidural blockade for thoracotomy – a systematic review and meta-analysis of randomized trials. Br J Anaesth 96: 418-426

Post-Thoracotomy Analgesia

• Systemic opioids: Patient-controlled intravenous short-acting opioid analgesia (PCA)

• Neuraxial opioids + local anesthetic: Thoracic epidural analgesia (TEA)

• Local anesthesia:
- **Paravertebral block (PVB, single or continuous)**
- Percutaneous or direct intercostal nerve block (ICN)
- Infiltration of chest wall incision sites
- Interpleural administration (bolus or continuous infusion) through chest tube or catheter

+

• **Multi-modal analgesia**:
- Non-steroidal anti-inflammatory drugs (NSAIDs)
- i.v. lidocaine, ketamine
- i.v. or p.o. acetaminophen
- alpha-2 agonists
- TENS

Do morbidly obese patients tolerate one-lung ventilation?

- In the lateral decubitus position?
- In the supine position?

Anesthesiology 57:132–134, 1982 Reprinted from ANESTHESIOLOGY, Vol. 57, No. 2, August 1982

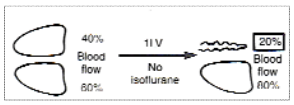
One-lung Anesthesia in Morbidly Obese Patients

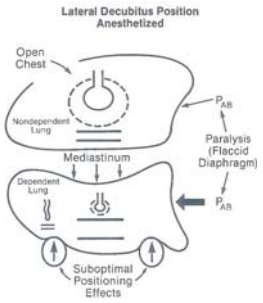
JAY B. BRODSKY, M.D.,* JANET WYNER, M.B., CH.B.,* JAN EHRENWERTH, M.D.,* RONALD C. MERRELL, M.D.,† ROY B. COHN, M.D.‡

TABLE 2. Arterial Oxygen Tensions (Mean ± SE) in Group 1 (Abdominal) and Group 2 (Thoracic) Gastric Stapling Patients

	$P_{a_{O_2}}$ (mmHg)	
	Group 1 (n = 8)	Group 2 (n = 8)
Preoperative (room air)	77.6 ± 1.6	79.0 ± 1.5
Range	(57–98)	(66–96)
Intraoperative (100 per cent O_2)*	318.3 ± 11.5	130.3 ± 7.5
Range	(195–443)	(72–230)
Postoperative (room air)		
Day 1	64.9 ± 1.2	60.9 ± 1.0
Range	(56–76)	(48–75)
Day 2	62.3 ± 1.0	58.6 ± 1.0
Range	(51–67)	(47–72)

One-Lung Ventilation





Benumof JL. Anesthesia for Thoracic Surgery. 2nd Ed.WB Saunders Co, 1995

Volume Controlled One-Lung Ventilation

(Controversy 2006)

Protective Low Volume Ventilation

Slinger P. **Pro**: Low tidal volume is indicated during one-lung ventilation. Anesth Analg. 2006;103: 268-70

Conventional High Volume Ventilation

Gal TJ. **Con**: Low tidal volumes are indicated during one-lung ventilation. Anesth Analg. 2006;103: 271-3

"Protective OLV" minimizes VALI

Volume controlled OLV
Low tidal volume (4-6 ml/kg/IBW)
Dependent-lung PEEP
Lowest FiO_2 (to maintain SpO_2)
Recruitment maneuvers dependent lung
Low ventilatory pressure

Della Rocca G, et al. Acute lung injury in thoracic surgery. Curr Opin Anaesthesiol. 2013; 26: 40-6

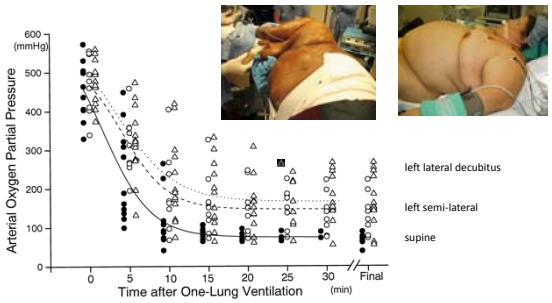
"Conventional" OLV (VT 10 ml/kg, FiO_2 1.0 + 0 PEEP)
vs
"Protective" OLV (VT 6 ml/kg, FiO_2 0.5. + 5 cmH_20 PEEP)

- PaO_2 and PaO_2/FiO_2 higher in conventional group
- Interleukin-6 and malondialdehyde increased in both groups/**No differences** between groups
- No differences in post-operative abnormalities or CXR

- **NO ADVANTAGE TO "PROTECTIVE" OLV**

Ahn HJ, et al. Comparison between conventional and protective one-lung ventilation for ventilator-assisted thoracic surgery. Anaesth Intensive Care 2012; 40: 780-8

Position and PaO_2 During OLV



Watanabe et al: Sequential changes of arterial oxygen tension in the supine position during one-lung ventilation. Anesth Analg. 2000; 90:28-34

Obstructive Sleep Apnea