Thoracic Challenges: Case Presentation

Dalia A Banks MD, FASE
Clinical Professor , University of California San Diego
Vice Chair of Cardiovascular Anesthesia Academic Affairs
dabanks@health.ucsd.edu

DISCLOSURE
NONE

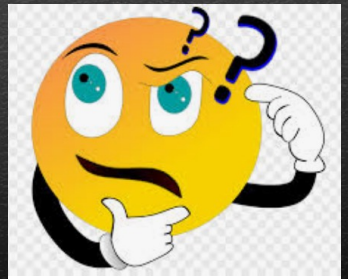
LERANING OBJECTIVES

At the conclusion of this activity, participants should be able to:

- Describe different lung isolation strategies for OLV via tracheostomy
- Describe OLV strategies for fresh tracheostomy stoma versus long-term stoma
- Describe advantages/disadvantages of BB versus DLT in patient with tracheostomy
- Tracheal Tear Management

CLINICAL CASE

- Jim is a 50-year-old 5 foot 5 inch male smoker with COPD and newly diagnosed lung cancer
- He has a history of supraglottic cancer and had a permanent tracheostomy following a total laryngectomy
- He is scheduled to undergo a video-assisted thoracoscopy (VAT) lobectomy for a two-centimeter mass located in the left upper lobe lung parenchyma
- How do you proceed?

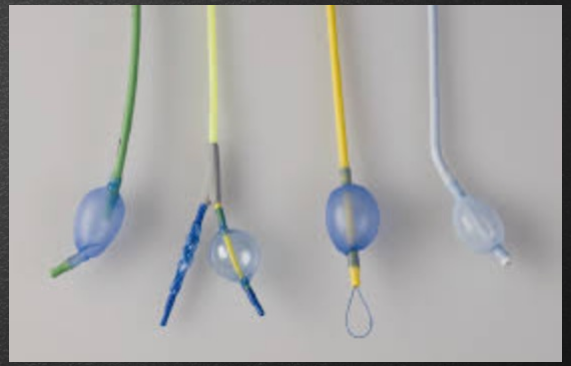


What are your options for lung isolation in patients with a tracheostomy?

- Devices used to manage the airway

1. Double lumen Tube (DLT)
2. Single-lumen endotracheal tube (SLT)
3. Shiley cuffed low pressure tracheostomy tube
4. Bronchial blocker (BB)
   - Cohen tip-deflecting blocker (Cook Medical)
   - EZ-Blocker (Teleflex Medical)
   - Arndt wire-guided bronchial blocker

     (Cook Medical, Bloomington, IN)
   - Fuji Uniblocker (Fuji Systems, Copenhagen, Denmark)



Commonly used airway techniques for OLV in setting of a tracheostomy stoma

1. Bronchial blocker (BB) through a SLT placed through stoma or orotracheally
2. BB through cuffed low pressure tracheostomy tube (Shiley)
3. BB directly through tracheostomy stoma
4. BB through a laryngeal airway mask inserted orally
5. Endobronchial SLT contralateral to the surgical site
6. DLT through tracheostomy stoma or orotracheally
7. 1 of 2 SLTs as modified DLT
8. SLT with enclosed BB (uninvent tube)

Original Article

Lung Isolation Techniques in Patients With Early-Stage or Long-Term Tracheostomy: A Case Series Report of 70 Cases and Recommendations

Javier H. Campos*, Eli D. Musselman, Satoshi Hanada, Kenichi Ueda

Department of Anesthesia, University of Iowa Health Care, Iowa City, IA

J.H. Campos et al. /Journal of Cardiothoracic and Vascular Anesthesia 33 (2019) 433-439

RETROSPECTIVE STUDY

- Retrospective study looking at 3,225 charts who had thoracic surgery involving OLV
- 70 patients were identified who had a tracheostomy
- Two groups identified:
    a. Fresh tracheostomy < 7 days (Six cases)
    b. Long term tracheostomy > 7 days (64 cases)
- Patients with long term stoma were managed as follows
    a. 38 cases a SLT with BB used intraluminal or extraluminal
    b. 15 cases Shiley tracheostomy tube with BB
    c. 7 cases endobronchial SLT
    d. 4 cases DLT (3 through tracheostomy, 1 orotracheal)

Early-Stage Tracheostomy versus Long-Term Tracheostomy

- Fresh Tracheostomy < 7 days
  - It's defined a stoma that has been in place within 7 days of device insertion
- Complications that can occur due to fresh tracheostomy:
  - Airway can be lost while attempting to remove the Shiley tube
  - Swelling and trauma to surrounding tissue may affect seal of the Shiley balloon
  - Risk of establishing a false tract, which can produce subcutaneous emphysema
- Recommendation:

  BB through a cuffed tracheostomy tube rather than through a SLT

Long-term Tracheostomy > 7 days

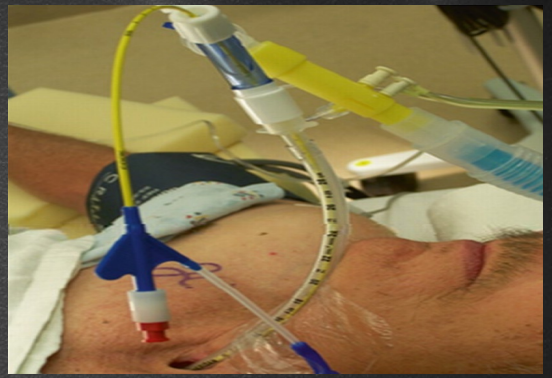
- Recommendation:
  - SLT via tracheostomy stoma
  - Verify with fiberoptic bronchoscopy (size 3.5-4.2mm OD) to ensure tip of the tube at least 2 to 3 cm above the tracheal carina
  - Bronchial blocker placed intraluminal
  - Extraluminal if the SLT tube size is too small to fit fiberoptic and BB together
  - Shiley tracheostomy, tube sizes ranged from size 6 to 8 mm ID

J.H. Campos et al. /Journal of Cardiothoracic and Vascular Anesthesia 33 (2019) 433-439

Arndt wire-guided BB

Cohen tip-deflecting blocker

BB through SLT



J. H. Campos et al. /Journal of Cardiothoracic and Vascular Anesthesia 33 (2019) 433-439

Advantage and Disadvantage of BB

- Advantage of BB
  - Size of the BB (7 or 9 Fr), which can accommodate placement into an adult airway
  - There is no need to remove the Shiley tracheostomy tube
  - Easy to use either directly through the Shiley tracheostomy tube or SLT
  - Independent bronchial blocker can be advanced through the endotracheal tube or extraluminally
  - A center channel of the BB can be used to administer O2 or continuous positive airway pressure or suction
- Disadvantage of BB
  - High incidence of malpositions
  - Small suction channel
  - Conversion from single to bilateral then single-lung ventilation, can be challenging
  - Easy dislodgment

J.H. Campos et al. /Journal of Cardiothoracic and Vascular Anesthesia 33 (2019) 433-439

Advantage and Disadvantage of Double Lumen Tube

- Advantage of DLT
  - Easy and quicker to place
  - Absolute isolation
  - Better position, less likely to displace
  - More effective suction
- Disadvantage of DLT
  - Too long, rigid and bulky
  - Small stoma size leading to significant under sizing
  - Shortened upper airway
  - Difficult angle of entry
  - Increase incidence of Trauma

J.H. Campos et al. /Journal of Cardiothoracic and Vascular Anesthesia 33 (2019) 433-439

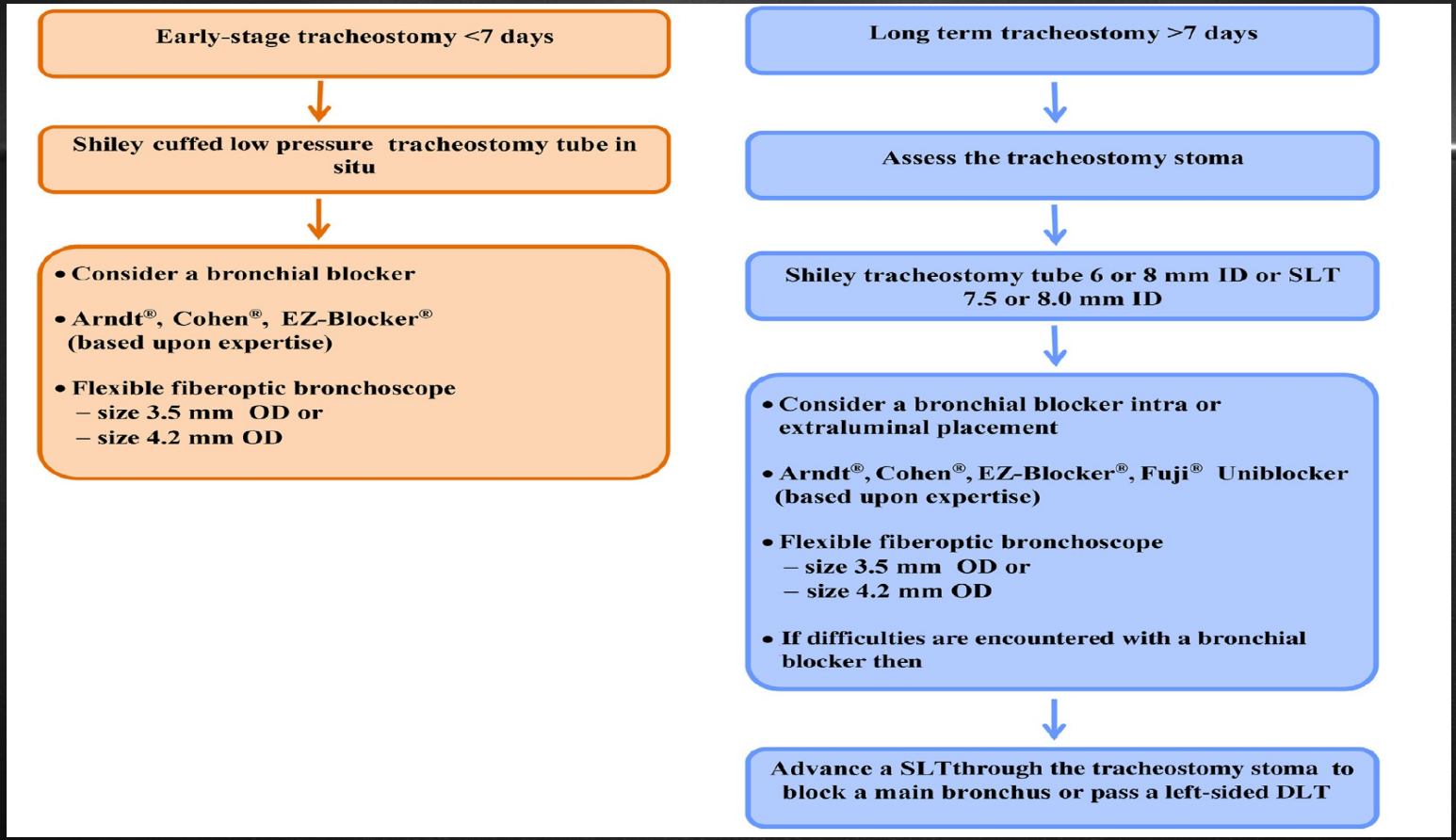
Endobronchial Intubations

➢ Endobronchial intubations with SLT:

In the Campos et al study 10% of patients were managed with SLT placed endobronchially

➢ Disadvantage of this technique

- ❖ In cases requiring Left Lung isolation
  - ❖ Endobronchial placement of SLT in the Rt main stem may occlude the orifice of the right upper lobe
    - ❖ Hypoxemia
    - ❖ Ischemic injury from an overinflated cuff
    - ❖ Deflation of the left lung might be problematic and slow
    - ❖ Re-inflation of the left lung requires manipulation of SLT in the tracheobronchial tree
    - ❖ Size of the SLT, too big can lead to injury or too small --- migration into lobar bronchus



J.H. Campos et al. /Journal of Cardiothoracic and Vascular Anesthesia 33 (2019) 433 439

CLINICAL CASE

- A 73-year-old female with a history of adenocarcinoma of the lung status post left upper lobectomy, who now presents with a right upper lobe lesion. She is scheduled to undergo right VATS lobectomy
- PMHx: Hypertension on ACE inhibitor and hypercholesterolemia on Statin
- Normal Vital signs
- Airway exam: Normal
- Pt is brought to the OR, standard ASA monitors applied
- GA induced with Propofol, fentanyl and Rocuronium

- Direct laryngoscopy with MAC 3 blade, grade 1 view. Immediately after bronchial cuff passes through the vocal cords, a fiber optic bronchoscope is passed through the bronchial lumen of the DLT
- The FOB is then advanced down to the carina and into the left mainstem bronchus. At this point the DLT is advanced over the FOB and into with left mainstem bronchus without resistance
- The FOB is then passed down the tracheal lumen to visualize the bronchial cuff inflation in the left mainstem bronchus just below the level of the carina.
- Single lung ventilation is initiated. Patient placed in lateral position with right side up. ETT position checked again after the patient was repositioned and was unchanged.
- An extra peripheral Intravenous catheter and an arterial line placed after induction.

- Approximately one hour into the case the surgeon notes mediastinal air in right hemithorax with unclear etiology concerning for pneumomediastinum

Differential Diagnosis:

- Esophageal rupture
- Tracheal injury
- Bowel rupture
- Iatrogenic after thoracoscopic surgery

Bronchoscopy → posterior split injury extending from carina into proximal left bronchus

OMG!

Tracheal rupture after endotracheal intubation: a literature systematic review☆ FREE

Eduardo Miñambres, Javier Burón, Maria Angeles Ballesteros, Javier Llorca, Pedro Muñoz, Alejandro González-Castro ✉

European Journal of Cardio-Thoracic Surgery, Volume 35, Issue 6, 1 June 2009, Pages

- Systematic review and meta-analysis of 182 cases of postintubation tracheal rupture (PiTR) published in the literature
- Rare - PiTR is of 1/20,000 intubations[6], 0.05% to 0.37% of all orotracheal intubations in last decade.
- 15% of iatrogenic PiTR are from emergency intubations
- 22% mortality, often delayed diagnosis

RISK FACTORS FOR TREACHEAL INJURY

Mechanical

- emergent intubation-3x increase in death
- multiple attempts
- inexperienced
- ETT introducers protrude beyond tip
- overinflated cuff
- repositioning without deflation of cuff
- inappropriate size ETT/DLT
- significant cough, movements of the head & neck while intubated

Anatomical

- congenital tracheal abnormalities
- weakness of the pars membranosa
- COPD
- diseases that alter the position of the trachea
- chronic use of steroids
- advanced age (mean 60.7)
- female sex (85.7%)

Why Females Are more Prone to Tracheal Injury?

- The majority of case series showed female predominance, mean age 50 y/o
- Smaller tracheal diameter, short stature
- One case series showed females were older than 50y/o & height was shorter than 160 cm
- In females the assumption is that a membranous trachea is less firm in women than in men

How is a tracheal rupture/tear formally diagnosed?

1. Clinical suspicion
2. CT imaging
3. Bronchoscopy still remains the “gold standard
4. In intubated patients, the cuff of the ETT may obscure the injury

   careful withdrawal of the ETT under bronchoscopic guidance

Conti M, Pougeoise M, Wurtz A, Porte H, Fourrier F, Ramon P, *et al*. Management of postintubation

Most Common site for Post-intubation Tracheal Rupture(PiTR)

- Typically, longitudinal lacerations of the posterior membranous trachea
- Tear typically occurs within 2.5 cm of Carina
- Fiberoptic bronchoscopy to confirm and examine extent
- Symptoms:
  - subcutaneous air
  - pneumomediastinum, pneumothorax
  - pneumoperitoneum
  - hemoptysis
  - ventilated patients→ a persistent air leak
  - self-ventilating patients →respiratory distress

Airway rupture from double-lumen tubes

Brett G. Fitzmaurice, MD, Jay B. Brodsky, MD
Department of Anesthesiology, Stanford University School of Medicine, Stanford, CA, USA

Journal of Cardiothoracic and Vascular Anesthes

Fitzmaurice and Brodsky reviewed 33 case reports in 1999:

1. Found that **overinflation** of the bronchial (sometimes tracheal) cuff was the main culprit for airway rupture in **most** of the cases.

2. **Left bronchus** was most frequent site of injury.

3. **Red rubber DLTs** injuries occurred more often with large DLTs, while PVC(Mallinckrodt) tube injuries occurred more often with smaller tubes and none with size 41.

What is the difference between DLT size of 35 vs 39?

A. Width only

B. Width and length of DLT

C. Width and distance between bronchial cuff and tracheal cuff

GO BIG:

- Less air in bronchial cuff
- Less incidence of dislodgement
- Suctioning
- Less resistance

GO SMALL:

- Easier to place
- Fits all
- Less edema/trauma

SIZING- DLTs controversial

Passes easily through glottis
Height, gender

Brodsky- DLT size based on trac
from the PA CXR measured at th
clavicle.

Chow- left mainstem bronchial d
a CT scan 1-2 mm of carina

Per Slinger 2003 Red Journal; h
≤160 cm 35F, >160 cm 37F, men
39F, >170 cm 41F

SMALLER IS NOT BETTER!

Choice of Left Double-Lumen
LT)

ted left chus (mm)	DLT size	Outside diameter (mm) Main body	Left lumen
2.2	41Fr	14–15	10.6
0.9	39Fr	13–14	10.1
0.2	37Fr	13–14	10.0
9.5	35Fr	12–13	9.5

asured from chest radiograph.
acheal width (mm) × 0.68.
ronchoCath (Mallinckrodt Medical, Inc., St.

or the main body of the tube (DLT) and for the
cifications are provided by manufacturer.

ft double-lumen tube size: a formula to estimate left-bronchial width. J Clin Anesth 2005; 17: 267-70.
Chow MYH, Liam BL, Thng CH, et al: Predicting the size of a double-lumen endobronchial tube using computed tomographic scan measurements of the left main bronchus diameter. Anesth Analg 1999;

DLT vs BB

Journal of Cardiothoracic and Vascular Anesthesia

A systematic review and meta-analysis on 13 RCTs (364 patients) comparing BBs and DLTs between 1996 - 2013.

DLTs were quicker to place (mean difference 51 seconds; p = 0.02)
DLTs were less likely to be incorrectly positioned ([OR] 2.70; 95% CI 1.18-6.18, p = 0.02)
BBs were associated with fewer patients having:

- a postoperative sore throat (OR 0.39, 95% CI: 0.23-0.68, p = 0.000
- less hoarseness (OR: 0.43,95%, CI 0.24-0.75, p = 0.003),
- fewer airway injuries than DLTs. (OR 0.40, 95% CI 0.21-0.75, p = 0.005)

Clayton-Smith, Ana et al. A Comparison of the Efficacy and Adverse Effects of Double-Lumen Endobronchial Tubes and Bronchial Blockers in Thoracic Surgery: A Systematic Review and Meta-analysis of Randomized Controlled Trials

What is the management for post -intubation tracheal injury?

- Traditionally managed surgically, high peri-op mortality
- Gomez-Caro et al. looked at 33 tracheobronchial injuries, 18 of which were iatrogenic. All 18 iatrogenic treated conservatively.

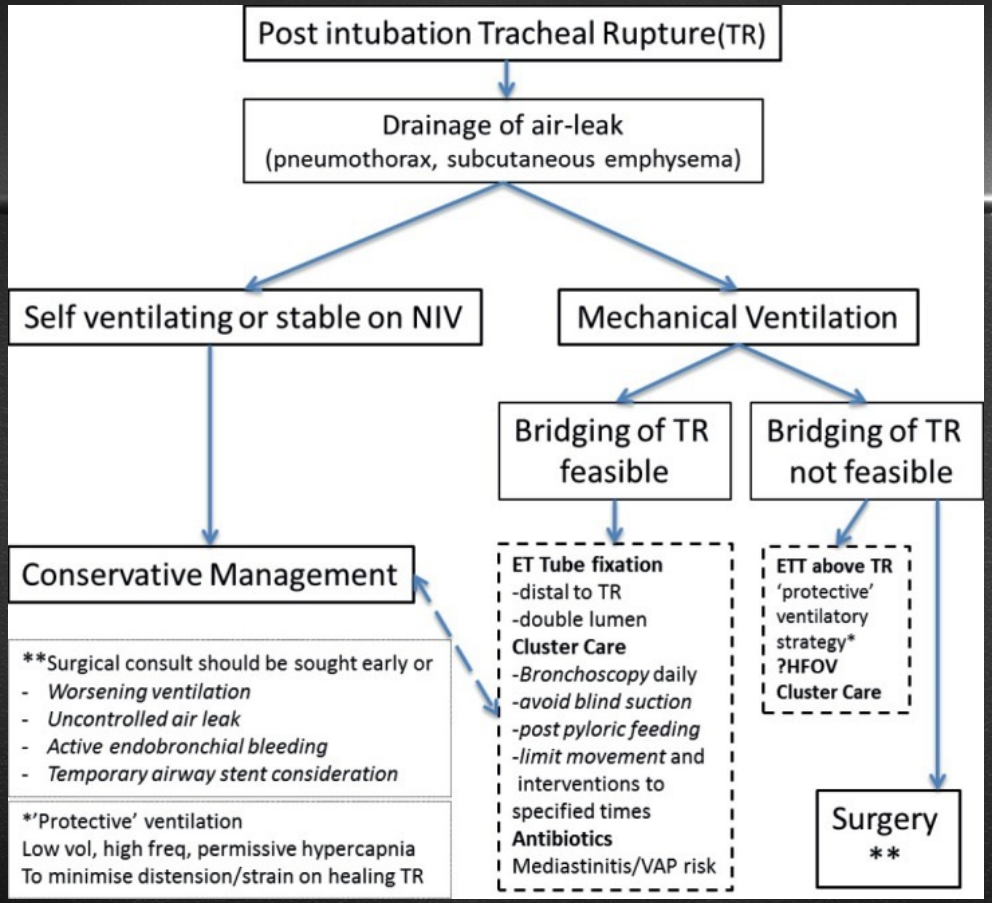
Summary: Conservative management for iatrogenic tracheobronchial rupture is effective regardless of production, size, or site of the injuries.

Gómez-Caro Andrés, Abel et al. Successful Conservative Management in Iatrogenic Tracheobronchial Injury
The Annals of Thoracic Surgery 2005; Volume 79 , Issue 6 , 1872 – 1878.

Gomez Caro, et al.

Guidelines for non-operative management:

1. Vital sign stable
2. No evidence of esophageal injury
3. No evidence of difficulty with mechanical ventilation if intubation is needed
4. No development of subcutaneous or mediastinal emphysema
5. No signs of sepsis related to iatrogenic bronchial injury (ITBI)



Endoscopic or conservative management of postintubation tracheal membrane laceration. Wurtz A, Benhamed L, Hysi I, Conti M.Annals of Thoracic Surg. 2011 May;91(5):1654-5;

Tracheal lacerations after endotracheal intubation: a proposed morphological classification to guide non-surgical treatment☆, ☆☆ FREE

Giuseppe Cardillo ✉, Luigi Carbone, Francesco Carleo, Sandro Batzella, Raffaelle Dello Jacono, Gabriele Lucantoni, Giovanni Galluccio

European Journal of Cardio-Thoracic Surgery, Volume 37, Issue 3, 1 March 2010, Pages 581–587, https://doi-org.ezp.welch.jhmi.e-

Level I – mucosal or submucosal tracheal involvement without mediastinal emphysema and without esophageal injury, tracheal tear less than or equal to 2 cm.***CONSERVTIVE***

Level II – tracheal lesion up to the muscular wall with subcutaneous or mediastinal emphysema without esophageal injury or mediastinitis; ***CONSERVTIVE***

Level IIIA – complete laceration of the tracheal wall with esophageal or mediastinal soft-tissue hernia without esophageal injury or mediastinitis; ***MAYBE CONSERVTIVE***

Level IIIB – any laceration of the tracheal wall with esophageal injury or mediastinitis, Full thickness tear > 4 cm ***SURGERY***

"It is our opinion that the depth of tracheal injury represents the most important determinant in achieving the goals of surgical repair "

CONSERVATIVE MANAGEMENT

- Avoid sequalae such as mediastinitis so early broad-spectrum antibiotics
- Regular bronchoscopy
- ETT external fixators will minimize possible disruption to the tracheal tear
- Low pressure ventilation, avoid coughing and straining with appropriate sedation/analgesic regimens
- Spontaneous Ventilation *preferred*
- Avoiding NG tubes in the presence of full thickness tracheal tears (tracheoesophageal fistulas).
- No enteral feeds until ruled out esophageal injury

SUMMARY

PiTR is rare event with high mortality and known risk factors

Bronchial blockers, double lumen tubes (DLT), EZ-blockers™ have known advantages, disadvantages

Conservative management of PiTR is feasible in certain situations

Multidisciplinary approach with surgeons, anesthesiologists, intensivists for management.


Thank You, Thank You!
dabanks@ucsd.edu
Questions