


**Solutions to complex airway issues:
The role of interventional pulmonology**
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1

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Disclosures


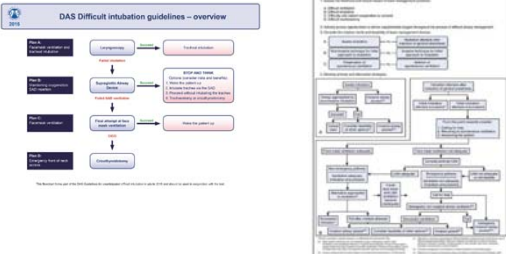
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2

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Management Of The Difficult Airway




3

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Management Of Complicated To Impossible Airway

When routine intubation can not secure the airway

- Advancing beyond the vocal cords isn't possible
- Standard intubation doesn't solve the problem





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Management of Difficult Airway

- Intubate with tracheostomy



5

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Management of Difficult Airway

- Patient with... comes in with...



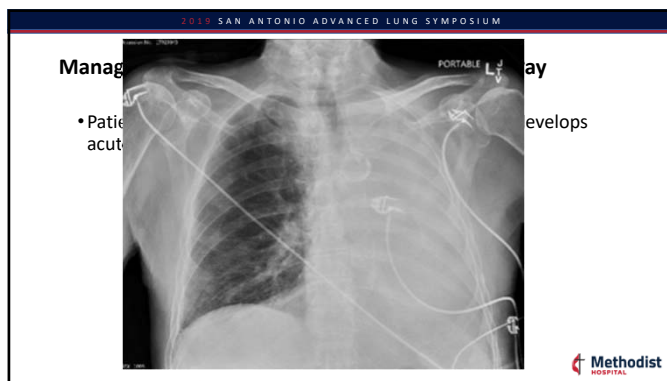
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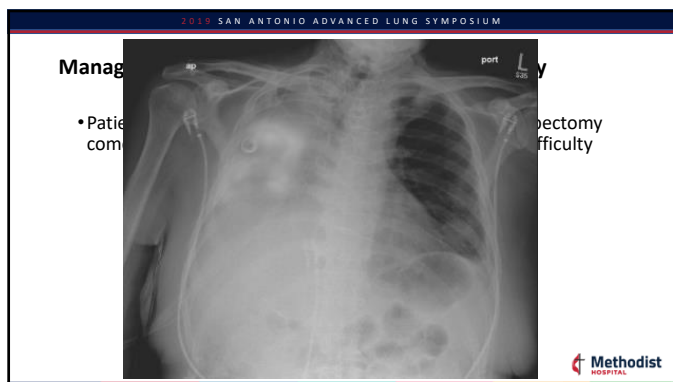
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8



9



10

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Management Of Complicated Airway

- Factors that determine optimal management plan
 - Patients overall clinical state and severity of airway compromise
 - How stable or unstable
 - What's the degree of obstruction
 - Does the airway problem explain the symptoms
 - What is our goal and can we achieve it?
 - What's the patients expectations
 - How likely am I to actually help

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Management Of Complicated Airway

- Should we intervene on highly compromised and symptomatic airways?
 - Most symptomatic malignant CAO patients see the most benefit
 - Greatest benefit with more proximal obstruction

* Dai DT, et al. Chest. 2015
 * Cavanna S, et al. Chest. 1996

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Management Of Complicated Airway

- Can we actually help?
 - 93% technical success and 48% symptomatic improvement for malignant CAO
 - More successful with endobronchial obstruction and stent placement
 - Similar survival for cancer patients without CAO versus **re canalized CAO**
 - Can even help **liberate from vent!**

* Dix DE, et al. Chest. 2015
* Cavaliere S, et al. Chest. 2006
* Verma A, et al. EB Open Res. 2018
* Choudhri PK, et al. Chest. 2006
* Murgu S, et al. Respiration. 2012

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Management Of Complicated Airway

- Factors that determine optimal management plan
 - Local expertise and resources for airway management
 - Interventional pulmonology program
 - Cardiothoracic surgery and ENT support
 - Anesthesiology support
 - ECMO program
 - Difficult Airway Response Team

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Capability For Advanced Airway Procedures

- Access to an interventional pulmonology program
 - Where is IP needed and where is it practiced
 - Who practices IP

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Where Is IP Practiced

- Destination of graduating IP fellows
 - 75% academic centers
 - 13% private-academic hybrid
- Typical IP programs
 - 72% new programs are academic
 - More than 80% are East Coast-Midwest

* Lee HL, et al. Ann Am Thorac Soc. 2015
* Kovatz KL, Ann Am Thorac Soc. 2015

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Where Is IP Practiced

* IP Practice Pattern, Salary & wRVU Survey 2016 - AABP

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Where Is IP Practiced

* IP Practice Pattern, Salary & wRVU Survey 2016 - AABP

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Where Is IP Needed

- Lung cancer in US
 - 234,000 cases annually with 154,000 deaths annually
 - About 6.8 million eligible for lung cancer screening
 - About 11% of screenings lead to invasive procedures
- Central airway obstruction
 - Up to 20% cases of lung cancer
 - Tracheal stenosis can occur in up to 30% post-tracheostomy, symptomatic in up to 5%

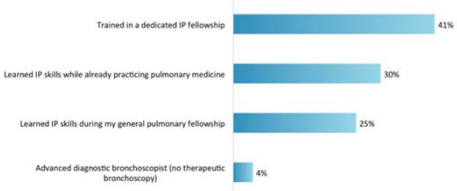
* Siegel RL, et al. CA Cancer J Clin, 2018
* Miller-Ruppman D, et al. Ann Thorac Surg, 2018
* Horwood S, et al. Ann Surg, 2000




19

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Who Practices IP



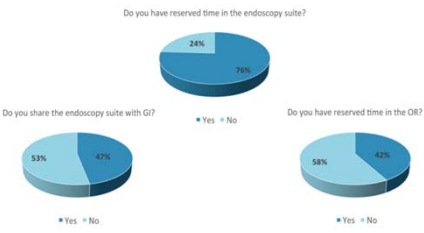
* IP Practice Pattern, Salary & wRVU Survey 2016 – AABP




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Who Practices IP



* IP Practice Pattern, Salary & wRVU Survey 2016 – AABP




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Benefits Of IP In Private Practice

- Filling gaps in delivery of care
 - Comprehensive management approach for thoracic malignancies
 - Timely and efficient care for growing patient population
- Supporting critical care service line
 - Tracheostomy and its complications
 - Managing the difficult to impossible airway




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ECMO Support For Complex Airway Management

- Stabilizing complex airway can be dangerous even with advanced airway capabilities
 - Patients typically critically ill, with other comorbidities (ASA III-IV)
 - Unable to lie supine
 - Induction and paralysis can lead to complete loss of airway
- ECMO as support for the complicated airway management
 - Clinically stabilizing the patient with critical airway
 - Peri-procedural support




23

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ECMO Support For Complex Airway Management

Study	Description	Findings and Highlights
Hoetzenecker et al, 2017	Review Article	Awake peripheral VV ECMO cannulation when induction a concern
Jung-Hoon et al, 2017	Retrospective Case Series 17 cases	ECMO supported SEMS placement successful for critical airway stenosis
Yoonki et al, 2013	Retrospective Case Series 19 cases	Successful short run VV ECMO as procedural support for tracheal CAO
Hinze J, 2012	Retrospective Case Series 6 cases	Allowed for lower FIO2 and prolonged apnea, helping laser / electrocautery
Wilms et al, 2012	Case Report	VA ECMO as ECLS for foreign body causing complete airway obstruction




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Difficult Airway Response Team

- Difficult airway response team (DART) and airway rapid response (ARR)
- Screening a potentially difficult airway
- Activating multidisciplinary team (Anesthesia, ENT, Trauma Surgeon, Pulmonologist)
 - Collaborative decision making
 - Assigned roles and responsibilities
 - Determine plan(s) for intervention



25


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Difficult Airway Response Team

Airway Emergencies – Flow Diagram

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    graph TD
        Start[Patient change in status → airway intervention needed → Meet ARR Criteria?] -- NO --> AnesthesiaStat[Anesthesia Stat  
Anesthesia attending & housestaff  
Rapid Response Coordinator  
Pharmacy  
Radiology  
Respiratory  
Portable Videolaryngoscope]
        Start -- YES --> AirwayRapidResponse[Airway Rapid Response  
Anesthesia Stat Resources  
PLUS  
Trauma Surgery Attending  
ENT Resident +/- Faculty  
Surgical airway tray  
Fiberoptic Bronchoscope]
        AirwayRapidResponse -- Failed Attempts --> UpgradeCall[Upgrade call]
        UpgradeCall --> AnesthesiaStat
        AirwayRapidResponse --> Multidisciplinary[Multidisciplinary bedside evaluation, discussion, and collaborative decision making  
Leadership designation & determination of who & how]
        Multidisciplinary --> PossibleInterventions[Possible Interventions]
        PossibleInterventions --> NoAirwayIntervention[No Airway intervention]
        PossibleInterventions --> Intubation[Intubation  
Nasal vs. oral vs. LMA  
Videolaryngoscopy vs fiberoptic  
ENT or Anesthesiology or both]
        PossibleInterventions --> ReplaceExistingTracheostomy[Replace Existing Tracheostomy]
        PossibleInterventions --> ToOR[To OR]
        PossibleInterventions --> BedsideSurgicalAirway[Bedside Surgical Airway]
        PossibleInterventions --> IntubationSurgicalAirway[Intubation : Surgical Airways  
Surgical Direct Laryngoscopy  
Rigid Bronchoscopy ; ECM]
        PossibleInterventions --> ENTorTrauma[ENT or Trauma]
    
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26

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Management Of Complicated Airway

- Achieving control of the airway
 - Standard ETT, Rigid bronchoscope, or Tracheostomy



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Management Of Complicated Airway

- Benefits of standard ETT intubation
 - Simple and quick
 - Don't need much additional resources or equipment







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Management Of Complicated Airway

- Benefits of rigid bronchoscopy
 - Control of oxygenation and ventilation
 - Therapeutic tool
 - Stents open airway
 - Conduit for additional therapeutic interventions
 - 'Coring' of central malignant lesion, dilation of stenotic segments
 - Easier control of bleeding






29

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Management Of Complicated Airway

- No surprises
 - Have well organized plan before approaching airway
 - Be aware of any technical limitations
 - Be aware of any complicating patient factors
- Anticipate problems
 - What is plan B, and C, and D...
 - How far are we willing and able to escalate support?
 - Who else needs to be aware and ready?



30

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Management Of Complicated Airway

- So the airway is secured... what now?
- Factors that determine optimal management plan
 - Patients overall clinical state
 - Degree of airway compromise
 - Local expertise and resources for airway management

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Management Of Complicated Airway

- Treating central airway obstruction

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Management Of Complicated Airways

A Few Cases From Our Experience With Complicated Airways

(a.k.a Creative Solutions For Terrifying Situations)

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Massive Airway Hemorrhage

- 72 man with advanced cardiomyopathy s/p LVAD implantation with percutaneously cannulated RVAD returning toward Lft main PA
- Developed persistent hemoptysis and Lft sided white out

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Massive Airway Hemorrhage

- Repeat clearance of clot material revealed persistent active bleeding from Lft lung with recurrent endobronchial obstruction
- Left lung remained whited out

What to do next?


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Massive Airway Hemorrhage

- Endobronchial blocking balloon directed beyond LMB take-off and deployed
- Circuit configuration was changed to relieve excess pulmonary flow
- Repeat airway exam following day showed clot / fibrin plug impaction of Lft bronchial airways extending proximally to ETT


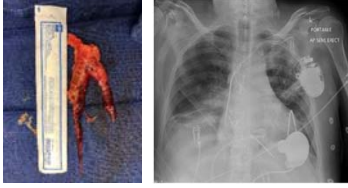


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Massive Airway Hemorrhage

- Bronchoscopic clearance using flexible cryoprobe to extract clots, eventually removing complete cast of lower trachea and central bronchi





38

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Central Airway Extrinsic Compression

- 61 woman with SCLC Dx 4 months prior, growing from beyond RLL segmental airways proximally into B1, as well as mediastinal LAD
- Started on chemotherapy



39



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Central Airway Extrinsic Compression

- Had underwhelming response to chemo and never recovered RML/RLL
- Developed progressive dysphagia
- Readmitted with worsening dyspnea and 'wheezing', breathless with minimal activity

- ▢ Bronchoscopy revealed near complete loss of lumen at LMB take-off

- ▢ What to do next?


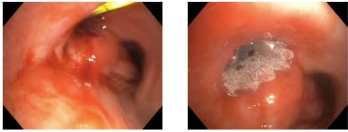


40

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Central Airway Extrinsic Compression

- Airway support with rigid bronchoscopy and jet ventilation
- Dilatation of LMB take-off with 8-10mm CRE endobronchial balloon
- Insertion of 10x40mm fully covered self expanding metallic stent (SEMS)





41

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Central Airway Extrinsic Compression

- Improved dyspnea and discharged to facilitate urgent XRT



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Intrathoracic Tracheal Stenosis

- 75 woman with morbid obesity (400 Lb/BMI 63), stage IV diastolic heart failure, CKD stage III, asthma, suffered cardiac arrest 6 months ago with subsequent tracheostomy and prolonged mechanical ventilation, eventually decannulated 3 months ago
- Experienced 4 weeks progressive DOE, unable to manage ADLs in the last week
- Also reported worsening 'hoarse voice' and constant 'wheezing'

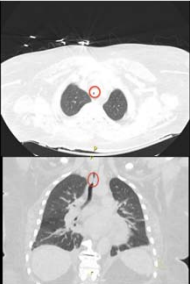
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Intrathoracic Tracheal Stenosis

- Admitted, found to be fluid overloaded with CHF exacerbation and AKI on CKD
- CT scan revealed area of stenosis in the mid trachea
- Approximately 20mm in length and < 5mm at its tightest
- Used BiPAP and Heliox to temporize while cardiac and renal status were optimized



What to do next?

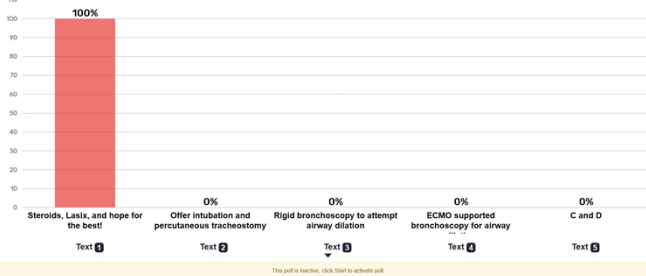
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Text your vote to: (205) 245-8623 - go to [swiftpolling.com](https://www.swiftpolling.com) & enter 8481

Intrathoracic Tracheal Stenosis: What should be the next step in management?



Management Option	Percentage
Steroids, Lasix, and hope for the best!	100%
Offer intubation and percutaneous tracheostomy	0%
Rigid bronchoscopy to attempt airway dilation	0%
ECMO supported bronchoscopy for airway	0%
C and D	0%

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Intrathoracic Tracheal Stenosis

- What should be the next step in management
 - A. Steroids, Lasix, and hope for the best!
 - B. Offer intubation and percutaneous tracheostomy
 - C. Rigid bronchoscopy to attempt airway dilation
 - D. ECMO supported bronchoscopy for airway dilation
 - E. C and D

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Intrathoracic Tracheal Stenosis

- Airway support with rigid bronchoscopy and jet ventilation
- Series of circumferential bands of granulation tissue and mucosal thickening encountered



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← Back Configure the look and feel of your poll and insert it Refreshing polls...

Instructions Only

Visualization type

Line bars Column Pie Chart

Color theme

Reset Add to slide


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Intrathoracic Tracheal Stenosis

- How should we treat this airway?
 - A. It's terrible! Get out while you can!
 - B. Dissect granulation tissue bands
 - C. Dilate using endobronchial balloon
 - D. Place tracheal stent
 - E. B and C
 - F. B and D
 - G. B and C and D




49

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Intrathoracic Tracheal Stenosis

- Small radial cuts made in granulation bands using Erbe cutting needle knife
- Dilatation to 10mm using 8-10mm CRE endobronchial balloon


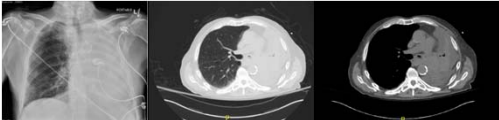


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Malignant Endoluminal Central Airway Obstruction

- 68y man with extensive tobacco Hx presented with worsening dyspnea and cough, found to have Lft infrahilar mass with LLL atelectasis
- While admitted had acute respiratory decline, with new complete Lft side whiteout and worsening hypoxia


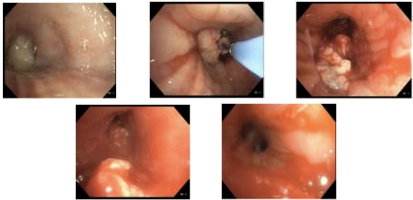


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Malignant Endoluminal Central Airway Obstruction

- Bronchoscopy found fungating mass in mid LMB
- Tumor debulking using flexible cryoprobe recannulated path to LUL





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Malignant Endoluminal Central Airway Obstruction

- Airway patency maintained with 10x40mm partially covered SEMS


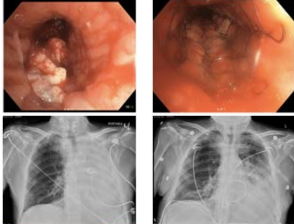


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Malignant Endoluminal Central Airway Obstruction

- Was able to discharge home for palliative chemo-XRT

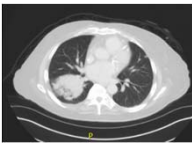



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Massive Airway Hemorrhage

- 61y man with anaplastic thyroid cancer, metastatic to lungs with recurrent massive hemoptysis due to RLL lesion, not amenable to angiographic intervention
- Underwent palliative RLL lobectomy to control hemoptysis





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Massive Airway Hemorrhage

- ▢ Returned 2 months later with recurrent hemoptysis and cough
- ▢ Found to have complete Rt side white out



- ▢ What to do next?




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Massive Airway Hemorrhage

- Taken for bronchoscopy with standard ETT for airway support
- Large adherent clot / fibrin plug found in BI also occluding RUL airways
- Extracted using flexible cryoprobe

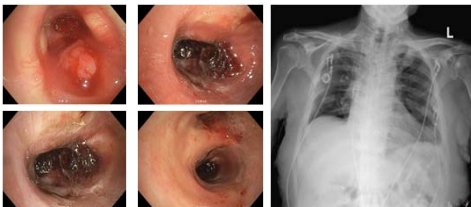




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Massive Airway Hemorrhage

- Friable areas of tumor infiltrating through lobectomy stump
- Bleeding controlled with argon plasma coagulation (APC)
- Discharged home to resume chemotherapy



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Subglottic Tracheal Stenosis

- 48y obese man with multiple medical issues and 2 prior tracheostomies, last decannulated 2 months before presenting with DOE and stridor
- Bronchoscopy revealed 5mm tracheal stenosis above 1st tracheal ring
- His INR was still slightly > 2 so intervention postponed 1-2 days
- Evening before procedure had clinical decline and respir failure with severe hypercapnea pCO2 > 90, pH < 7.2
- Too unstable to transport to bronchoscopy suite
- No immediate OR or ICU availability

- ▢ What to do next?

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How should we stabilize and secure the airway?

Text <input type="radio"/> Intubate with a small caliber ETT	0%
Text <input type="radio"/> emergency surgical cric/trach	0%
Text <input type="radio"/> Bronch under conscious sedation & dilation of airway	0%
Text <input type="radio"/> Bronch assisted percutaneous tracheostomy	0%
Text <input checked="" type="radio"/> A and D	100%
Text <input type="radio"/> C and D	0%

This poll is over. Use that to inform you!



60

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Subglottic Tracheal Stenosis

- How should we stabilize and secure the airway?
 - Attempt to intubate with a small caliber ETT
 - Attempt emergency surgical cric/tracheostomy
 - Bronchoscopy under conscious sedation and dilation of airway
 - Bronchoscopy assisted percutaneous tracheostomy
 - A and D
 - C and D**


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Subglottic Tracheal Stenosis

- IP team and equipment mobilized emergently to patients room
 - Everyone and everything were in place in < 20 minutes!




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Subglottic Tracheal Stenosis

- LMA placed to control airway above stenosis, now < 3mm
- Patient was well oxygenated
- Endobronchial dilation balloon catheter used to open airway to ~ 8mm
- Airway now stabilized to allow ventilation, and visualization for urgent percutaneous tracheostomy



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THANK YOU !!!

Questions?



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