Study of Bronchoalveolar Lavage Flow Cytometry Analysis in Diffuse Interstitial Lung Diseases
Isabel Rodriguez Martin

Peripheral Nodule Biopsy Using Electromagnetic Navigation Bronchoscopy and O-Arm O2 Imaging System
Jennifer Wong, Erhan H Dincer, Joseph C Keenan, Heidi Gibson, Roy J Cho

Bronchial Blocker to Achieve Hemostasis in a Patient Presenting with Hemoptyisis due to an Aortobronchial Fistula Variant
Sai Karan Vamsi Guda, Rahul Farwaha, Trent Peterson, Charleen Pham, Sharis Shimarian, Svetlana Villano, Paul Stewart, Syed Akbarullah, Lloyd Del Mundo, Jan Lester Pring, Kevin Tsui, Mark Mckenzie, Scott Silver

Bronchoscopic Resolution of a Broncho-Pleuro-Spinal-Subcutaneous Fistula Presenting as an “Air Hump”
David Abia-Trujillo, Juan C Garcia-Saucedo, Carlos Rojas, Sebastian Fernandez-Bussy

Oncologic ILD; In Need for an Early Diagnosis
D Abia-Trujillo, JC Garcia-Saucedo, H Baig, A Siddiqi, A Khoor, C Rojas, S Fernandez-Bussy

Airway Manifestations of Inflammatory Bowel Disease: A Case of Tracheo-bronchomalacia with Bronchial Stenosis
Faeq R Kukhon, David Abia-Trujillo, Sebastian Fernandez-Bussy

Use of a Covered Self-expanding Metal Airway Stent for Severe Dynamic Collapse within a Bronchial Aortic Graft Conduit in a Post-lung Transplant Patient
Rebecca Priebe, D. Kevin Duong, Avi Cohen, Michael J. Simoff, Javier Diaz, Labib Debiane, A.Rolando Peralta

Pneumothorax Predictors after BLVR with EBV based on quantitative fissure analysis; A Case Series.
David Abia-Trujillo, Juan C Garcia-Saucedo, Margaret M. Johnson, Neal M. Patel, Britney N. Hazelett, Sebastian Fernandez-Bussy

Too Much Make-Up: A Case of Foreign Body Aspiration
David Abia-Trujillo, John Moss

Novel Use of Cryobiopsy for the Diagnosis of Pulmonary Alveolar Proteinosis After Non-Diagnostic Transbronchial Forceps Biopsy
John R. Woytanowski, Nydia Martinez, Ihad Alshelli, Sajive Aleyas
Airway Myoepithelioma: A Misplaced Salivary Gland’s Tale
Hollie Saunders, David Abia-Trujillo, Andreas Khoor, Sebastian Fernandez-Bussy

A Total Disgrace: When Not to Use Uncovered Self-Expandable Metallic Stents
Garcia-Saucedo JC, Abia-Trujillo D, Fernandez-Bussy S.

Misplaced Voice Box: A Case of Foreign Body Aspiration
M Tatari, D Abia-Trujillo, H Fox, P Guru, C Venegas-Borsellino, R Hoffman, S Fernandez-Bussy

Efficacy of Large-volume Thoracentesis for Large Malignant Pleural Effusion
Victor Prado, Shasha X. Chan, Shashvat Sukhal, Sean B. Smith

Distal Airway Unique Metallic Foreign Body Removal with Ultrathin Flexible Bronchoscope and Fluoroscopy Under Local Anesthesia
Vinod Govindasaami, Koushik Muthuraja Mathivanan, T. Dhanasekar, B. Rajagopalan

Perpetual Airway Stent; A Case with Pseudomonas Aeruginosa Colonization.
Juan C Garcia-Saucedo, David Abia-Trujillo, Francisco Alvarez, Mathew Thomas, Sebastian Fernandez-Bussy

Pneumothorax Predictors after BLVR with EBV Based on Chest Computed Tomography: A Case Series
David Abia-Trujillo, Carlos Rojas, Margaret M. Johnson, Juan C Garcia-Saucedo, Neal M. Patel, Britney N. Hazelett, Sebastian Fernandez-Bussy

Female Gender May Be Associated with Increased Risk for COPD Exacerbation Immediately Following Endobronchial Lung Volume Reduction with Zephyr Valves
John R. Woytanowski, Ihab Alshelli, Sajive Aleyas

Management of Tracheobronchopathia Osteochondroplastica with Holmium Laser Therapy
Amelia A Khoei, Matthew M Nobari, George Z Cheng, Russel Miller

ECMO Supported Recanalization of Multifocal Critical Malignant Airway Obstruction
Ali Abedi, Napoleon Puente, Jeff Dellavolpe, Sebastian Melo

A Case of a Paraganglioma Presenting as a Middle Mediastinal Mass
Fatima J. Wong, Francis J. Turner

Unilateral Erector Spinae Plane Block is a Feasible Anesthetic for Pleuroscopy: A case series of our first 17 patients
Ashley Sharp, Galaxy Mudda, Matthias Braehler, Yaron Gesthalter

Ovarian Hyperstimulation Syndrome as Cause of Exudative Effusion: A Case Report
Shaikh M Noor, Ul Husnain, Javier Diaz Mendoza, Krishna Thavarajah
A Multicenter Feasibility and Efficacy Study of a Non-Opioid Based Pain Management Following Outpatient Medical Thoracoscopy
See-Wei Low, Ryan M. Kern, John J. Mullon, Darlene R. Nelson, Sebastian Fernandez-Bussy, Kenneth K. Sakata

Secrets Unlocked: A Tale of EBUS-TBNA
Samaher Hashim, Rania Farhat, Setu Patolia

Tracheobronchoplasty and Diaphragmatic Plication under VV ECMO for combined ECAC and Diaphragmatic Paralysis
Mehmet Tatari, David Abia-Trujillo, Margaret Johnson, Sebastian Fernandez-Bussy, Mathew Thomas

Bronchoscopic Removal of a Migrated Endovascular Coil: A Rare Complication of Coil Embolization
John Doan, Kavya Puchhalapalli, Parag Patel, Mario Gasparri, Jonathan S. Kurman, Bryan S. Benn

Neoplastic ILD: A Brushing Diagnosis
David Abia-Trujillo, Juan Garcia-Saucedo, John Moss

Next Generation Sequencing for Identification of Microorganisms in Pleural Fluid
Dagny Anderson, Eva Carmona Porquera

Accuracy and Safety of Utilizing Endobronchial Ultrasound-Guided Biopsy to Diagnose and Stage Bronchogenic Carcinoma invading the Pericardium
Nadir Siddiqui, Nazir Lone

Bronchial Stricture: Herbs Don’t Belong in Lungs
Abhijit Raval

Stenting of a malignant central airway obstruction caused by a poorly differentiated carcinoma a special consideration
Andres Chacon, Adam Wellikoff

Negative Pressure Aerosol Chamber – A Portable Barrier Device
Gustavo Cumbo-Nacheli, James Smith

Atypical Presentation of an Endobronchial Tumor. A Case Report of Tumor Debulking Followed by Upper Sleeve Lobectomy
Abhinav Mittal, Ankit Dhamija, Jason Lamb, Alper Toker

Catastrophic Hemorrhage Avoided with Robotic-Assisted Bronchoscopy
Steven Verga, Robert Marron, Gerard Criner
Study of Bronchoalveolar Lavage Flow Cytometry Analysis in Diffuse Interstitial Lung Diseases

Isabel Rodriguez Martin

**Background:** Diffuse interstitial lung diseases are an heterogenous group of respiratory diseases with difficult diagnosis. The study of bronchoalveolar lavage (BAL) by flow cytometry may define typical patterns in different diseases, providing some help in the differential diagnosis. The aim of this study has been to retrospectively analyze the clinical usefulness of flow cytometry analysis of the cellular and lymphocyte subpopulations.

**Methods:** We have studied 104 patients retrospectively. Subjects were diagnosed with interstitial lung disease during 2.5 years. BAL cellular analysis by flow cytometry, histology and CT scan were analyzed in different disease groups. Percentage of T cells, B cells, NK cells, CD4, CD8 and CD4/CD8 ratio were analyzed by flow cytometry as CD3+, CD19+CD4+, CD8+, CD3+CD4-CD8-, and CD3+CD16-CD56-.

**Results:** The low incidence the diffuse interstitial lung diseases in our area was confirmed (1/10000 per year). Idiopathic pulmonary fibrosis (30%), and sarcoidosis (16%) were the most frequent diagnosis. Lymphocytosis and CD4 CD8 ratio was the most useful parameter. Thus, this ratio was high in sarcoidosis and it was inverted in extrinsic allergic alveolitis. It was also low in the bronchiolitis obliterans organizing pneumonia. Neutrophils were the predominant population in idiopathic pulmonary fibrosis.

**Conclusion:** The study of BAL is helpful to discriminate between interstitial lung diseases.
Peripheral Nodule Biopsy Using Electromagnetic Navigation Bronchoscopy and O-Arm O2 Imaging System

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Introduction: With increased use of low-dose chest CT for lung cancer screening, more lung nodules are being identified than previous. The use of bronchoscopy for tissue sampling of these lung nodules have become popular given its low risk profile for post-biopsy pneumothorax and minimally invasive approach. In this case, we describe the use of the O-arm to offer real-time confirmation of the biopsy tool within the lesion, a technique not previously described in literature.

Case Summary: A 61 year old man with chronic obstructive pulmonary disease presented to the Interventional Pulmonary clinic at the University of Minnesota for a second opinion on a non-calcified, spiculated left upper lobe (LUL) nodule measuring 24 x 18 x 34 mm in size without mediastinal or hilar lymphadenopathy. A positron emission tomography-computed tomography scan demonstrated isolated fluorodeoxyglucose activity in the LUL nodule (SUV max 6.4). His degree of COPD and functional status precluded him from surgery, and he had previously undergone CT-guided transthoracic needle aspiration that only demonstrated necrotic material without evidence for malignancy. Given the concern for a false negative, decision was made to proceed with mediastinal and hilar lymph node sampling with endobronchial ultrasound and transbronchial needle aspiration (EBUS-TBNA) and repeat nodule biopsy with electromagnetic navigation with superDimension software (Medtronic, MN, USA) and radial EBUS (ENB+rEBUS). Given the nature of a repeat biopsy, the O-arm O2 imaging system was used to confirm tool-in-lesion as our institution does not have a cone-beam CT integrated into the procedural suite. Given that the O-arm is designed specifically to highlight bone density for orthopedic and neurosurgical procedures, a dry run was performed on an airway mannequin (TruCorp, N. Ireland) to assess its utility in pulmonary procedures. We were able to conclude that and came to the following conclusions: 1)the lung parenchyma is well visualized with high-definition protocol; 2)metal scatter was minimal from superDimension bed, chest leads, bronchoscopy, and Edge catheter; 3) O-arm cannot run live fluoroscopic imaging; and 4) a large room is necessary to facilitate positioning of the device.

On the day of the procedure, we proceeded with ENB+rEBUS of the culprit nodule. Local ultrasound confirmation showed an eccentric view but axial imaging with the O-arm confirmed the distal end of the rEBUS probe within the nodule. Final reconstructed images were obtained in 24 seconds. We performed multiple biopsies under C-arm fluoroscopic guidance as the O-arm did not have fluoroscopic capabilities. Final pathology showed necrotizing granuloma with negative cultures. EBUS-TBNA of stations 4R, 7, and 4L were performed and consistent with reactive lymphadenitis. Short term surveillance with Chest CT was recommended for likely infectious or inflammatory nodule.

Conclusion: We demonstrated that the O-arm can be used for real-time localization of a peripheral nodule and confirm tool-in-lesion when cone beam CT is not available. Although more experience will be required to improve the O-arm approach for use with tissue sampling of peripheral nodules, our initial experience looks promising.
Bronchial Blocker to Achieve Hemostasis in a Patient Presenting with Hemoptysis due to an Aortobronchial Fistula Variant

Sai Karan Vamsi Guda, DO, Rahul Farwaha, DO, Trent Peterson, DO, Charleen Pham, DO, Sharis Shimarian DO, Svetlana Villano DO, Paul Stewart, MD, Syed Akbarullah MD, Lloyd Del Mundo, DO, Jan Lester Pring, DO, Kevin Tsui, DO, Mark Mckenzie DO, Scott Silver, DO

Introduction: Aortobronchial fistulas (ABF) are a rare but known complication following aortic aneurysm repair. Patients often present with massive hemoptysis and require immediate stabilization along with prompt vascular surgical consultation.

Supportive measures are mainstay of treatment until surgical intervention can be performed. We present a case on the novel use of a bronchial blocker to achieve hemostasis from pulmonary hemorrhage refractory to conservative measures alone in an ABF variant, a pseudoaneurysm-bronchial fistula.

Case Presentation: This case report describes a 71-year-old female with a past medical history for a large type 1 aortic aneurysm status post repair who presented to valley hospital ED with a chief complaint of hemoptysis. Patient underwent stat CT imaging which revealed new findings of air within the native aneurysm wrap around the ascending interposition graft. The trachea was seen abutting the distal anastomosis of the graft. Further, two small pseudoaneurysms were visualized near the re-implantation site of the grafts. All of this was concerning for an ABF. Patient was intubated, sedated, and underwent emergent flexible bronchoscopy. Frank and clotted blood was appreciated throughout the entire right and left lobes. Active site of bleeding was identified in the posterior segment of the left upper lobe (LUL). Despite suctioning, saline flushes, epinephrine, and tranexamic acid, the bleeding remained difficult to control. Finally, the endotracheal tube was exchanged for a 6.5 UNIVENT, and unilateral bladder was introduced into the LUL and inflated. No extravasation of blood was seen around the inflated bladder confirming successful tamponade of the bleeding site. The patient was successfully stabilized further in the ICU until transfer to a higher level of care occurred for prompt vascular surgery.

Conclusion: Flexible bronchoscopy during the evaluation of hemoptysis proved useful in visualizing and evaluating ABFs, although exceptionally rare. Therapeutic approaches must be at hand if bleeding is identified. Given the nature of ABFs, bleeding may be difficult to control. When this occurs, we believe the use of a bronchial blocker is a reasonable approach to achieve hemostasis until surgical correction can be performed.
References:
Bronchoscopic Resolution of a Broncho-Pleuro-Spinal-Subcutaneous Fistula Presenting as an “Air Hump”

David Abia-Trujillo, Juan C Garcia-Saucedo, Carlos Rojas, Sebastian Fernandez-Bussy

**Introduction:** Endobronchial valves have been used in a wide variety of bronchoscopic procedures; most recently they have gained popularity given its use in bronchoscopic lung volume reduction; however, its use is certainly not limited to it. They have been used for the treatment of bronchopleural fistulas. We present a case in which endobronchial valves where used to successfully treat a fistula communicating the right upper lobe, pleural space, thoracic spine and subcutaneous tissue in a patient with metastatic lung cancer.

**Case Summary:** 58-year-old former smoker woman (40 pack/year) with pat medical history of stage IV squamous cell carcinoma status post chemo, radio and immunotherapy presented with metastatic involvement of her thoracic at the T3 level. She required a corteectomy with a spacer and stabilizing rods. Her post op course was complicated with right upper and intra-scapular chest pain associated with a depressible and tender mass in the posterior cervicothoracic spine.

Imaging results showed a fistula communicating the pleural space, the thoracic spine, and the adjacent subcutaneous tissue. The patient was deemed to have very high risk for surgical intervention and a bronchoscopic alternative was proposed. Two endobronchial Zephyr valves where deployed in the right upper lobe at the apical (RB1, 5.5 mm valve) and posterior (RB2, 5.5 mm Low Profile valve) segments. After 10 weeks of the bronchoscopic treatment the patient had a substantial clinical and radiographic improvement.

**Conclusion:** In patients with a high-risk surgical risk, the bronchoscopic deployment of endobronchial valves may represent a potential treatment. While this case report adds to the literature, an alternative treatment for Broncho-Pleuro-Spinal-Fistula more research is indeed needed to better define its therapeutic efficacy.
Endobronchial valves placed in the Apical (RB1) and Posterior Segments (RB2) of the right upper lobe.

Broncho-pleural-subcutaneous fistula

Resolution of pleural and subcutaneous gas
References:


Oncologic ILD; in need for an early diagnosis


Introduction: Interstitial lung diseases are common and often challenging to diagnose and treat. The lack of progress of a treatment for a presumed etiology should prompt the clinician to reevaluate the differential diagnosis and consider malignancy as a potential explanation for the presented clinical pattern. We describe a case of lung adenocarcinoma mimicking ILD with an unfortunate delayed recognition that resulted in catastrophic consequences for the patient.

Case description: 57 years-old former smoker woman with a 20 pack year history presented for second opinion for interstitial lung disease. She claimed no significant past medical history prior to her history of present illness. She complaint of progressive shortness of breath over the past year leading to dyspnea with activities of daily living such as showering or walking inside her house. Her dyspnea was associated with productive cough with less than a tablespoon of clear sputum production per day. No hemoptysis. Over the past year she had been admitted to the hospital in 4 different occasions and treated with antibiotics without significant improvement.

Spirometry suggested moderate restriction pattern with moderately to severely reduced diffusion capacity. Computed tomography of the chest showed diffuse ground-glass and interstitial thickening suggestive of a crazy paving pattern. The right upper lobe was the only lobe that was relatively spared. Bronchoscopic evaluation with bronchoalveolar lavage of the RB5 segment and transbronchial forceps biopsy of the RB9 segment showed lung adenocarcinoma with lepidic spread and papillary growth patterns.

Discussion: Neoplastic lepidic spread is a term used to describe a non-invasive growth along intact alveolar septa. Adenocarcinomas with a papillary pattern have shown poor prognosis. It has been more frequently associated with metastasis to lymph nodes, pleural invasion, intrapleural metastasis and non-smoking status. Given the aggressiveness of these type of growths early diagnosis is crucial to direct appropriate therapy and when the clinical suspicion is risen by a computed tomography trans bronchial forceps biopsy may be sufficient to obtain diagnosis without delaying treatment.
Figure 1: A, B, C: initial chest Computed Tomography. D, E, F Ten-month progression of the same findings. The lepidic portions of the adenocarcinoma correlate with the areas of ground glass attenuation, while the dense consolidated areas correspond to the invasive form.

Figure 2: H&E. Histologic examination shows the alveolar lining and true fibro vascular cores both lined by neoplastic cells consistent with a lepidic and papillary pattern respectively of adenocarcinoma.
Airway Manifestations of Inflammatory Bowel Disease: A Case of Tracheo-bronchomalacia with Bronchial Stenosis

Kukhon, Faeq R; Abia-Trujillo, David; Fernandez-Bussy, Sebastian

**Case Description:** Inflammatory Bowel Disease (IBD) is known to be a systemic disease which is not limited to the gastrointestinal tract. The respiratory system is not necessarily armored against this disease. IBD can present in a wide spectrum involving airways, pulmonary parenchyma, pleura, and pulmonary vasculature. We present a rare case of Tracheobronchomalacia (TBM) and bronchial stenosis in a patient with IBD.

**Introduction:** A 52 years old woman with past medical history mainly relevant for bronchiectasis, GERD, chronic hypoxemic respiratory failure in home O2 supplementation and known bronchial stenosis presented with worsening dyspnea and cough. She is known to have Ulcerative Colitis and Crohn Disease with multiple gastrointestinal complications that required proctocolectomy, small bowel resection and ileostomy. Given her airway stenosis, over the past two years, she had required multiple bronchoscopic interventions for serial pneumatic balloon dilation and Mitomycin instillation; last intervention 3 months prior to her presentation. Serology was positive for elevated perinuclear anti-neutrophil cytoplasmic antibody (p-ANCA) titers levels. Pulmonary function test showed a very severe obstruction with an FEV1 of 860 ml (27%) and minimal reduction in the diffusion capacity at 70%. Computed tomography (CT) of the chest showed bronchiectatic changes associated with diffuse bilateral tree-in-bud nodularity and mucus plugging. A circumferential thickening of the distal trachea extending along the left and right proximal mainstem bronchus was also noted. Bronchoscopic examination showed lateral (Saber-Sheath) TBM with dynamic lateral collapse, severe bronchomalacia in both mainstem bronchi and submucosal infiltration of the central airway involving the distal trachea all along the segmental level in a bilateral distribution. Right middle and lower lobe take off had an 80 % narrowing. Serial balloon dilation was performed with luminal improvement to about 50%. This was followed by 80 mg of methylprednisolone acetate submucosal injection and 0.2 mg/ml Mitomycin instillation. Significant amount of secretions was noted throughout the procedure.

**Conclusion:** IBD is known to cause pulmonary disease and has been noted in up to 25% of patients with Crohn’s disease and 6% with ulcerative colitis. Pathogenesis remains unclear however is thought to be related with inflammatory change, especially in the large airways. Pulmonary parenchymal disease and pulmonary embolism have also been reported. The most commonly abnormalities seen are bronchiectasis followed by acute and chronic tracheobronchitis, subglottic stenosis and fistula formation. Tracheobronchial stenosis is a rare airway manifestation of IBD with only few reported cases in the literature. In addition, no case reports describing trachea-bronchomalacia in association with IBD has been published.
**Figure 1:**

A) Lateral (Saber-Sheath) TBM with dynamic lateral collapse.
B) Bronchial Stenosis
C) Submucosal infiltration of the central and distal airway.
D) Ballooning of the stenosis
E) Post Mitomycin instillation
Use of a Covered Self-expanding Metal Airway Stent for Severe Dynamic Collapse within a Bronchial Aortic Graft Conduit in a Post-lung Transplant Patient

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Introduction: Airway stenting has become a widely accepted treatment for dynamic airway collapse. Although this treatment has primarily, if not exclusively, been utilized in native airways, the role for stenting in artificially constructed airways has not been previously reported. We present a case in which a covered self-expanding metal airway stent was utilized for severe dynamic collapse within a cadaveric aortic bronchial graft conduit in a post-lung transplant recipient with thoracic situs inversus.

Case summary: Fifty-three-year-old Caucasian male with thoracic situs inversus and end-stage pulmonary fibrosis underwent bilateral lung transplant on 12/17/2019. Due to his congenital condition in which there is a complete right-to-left reversal of the position of the thoracic organs (NIH), there was a substantial size mismatch between the donor and native lung at the anastomotic closure site of the left main stem bronchus. This subsequently led to a left bronchial dehiscence.

An open surgical repair was initially performed with the placement of a 4cm cadaveric abdominal aortic graft and creation of an omental flap for stabilization. Despite proper coverage and repair of the dehiscence, the patient continued to have left lung collapse due to mucus impaction resulting in impaired gas exchange and ventilator dependence. Interventional Pulmonology was consulted to evaluate the left bronchus conduit.

Bronchoscopic exam revealed complete end-expiratory dynamic collapse of the aortic graft conduit with retention of secretions in the distal airways. Due to the lack of structural stiffness of the graft conduit compared to a native bronchus, the decision was made to pursue stent placement to maintain conduit patency. Although metal stents are not recommended in benign disease, in this particular case, a fully covered metal stent was chosen in order to improve the dynamic collapse without disrupting the integrity of the conduit and for ease of removal if necessary.

The patient underwent successful deployment of a self-expanding metal stent (Bonastent 12x30mm) into the left aortic conduit graft with complete coverage of the collapsible segment of the left main stem bronchus. With the stent in place, the cadaveric aortic graft has remained patent and in stable position on follow-up bronchoscopic exams without any evidence of significant dynamic collapse. The patient was able to be liberated from the ventilator and has been without recurrent lung infections.

Discussion: To our knowledge, we present the first reported use of a metal airway stent to treat severe dynamic collapse within a cadaveric aortic bronchial graft conduit in a post-lung transplant patient with thoracic situs inversus. Although this case has unique clinical circumstances, it illustrates the potential use of metal airway stents in the treatment of dynamic collapse of non-native airways.
A. Left main stem bronchial aortic conduit
B. Dynamic collapse within the bronchial aortic conduit
C. Proximal end of the stent
D. Within the conduit after stenting
Pneumothorax Predictors after BLVR with EBV based on quantitative fissure analysis; A Case Series.

David Abia-Trujillo, MB, MD; Juan C Garcia-Saucedo, MD; Margaret M. Johnson, MD; Neal M. Patel, MD; Britney N. Hazelett, RN; Sebastian Fernandez-Bussy, MD

Introduction and background: Over the past years Bronchoscopic Lung Volume Reduction (BLVR) with Endobronchial Valves (EBV) has emerged as a potential treatment alternative for dyspnea attributed to air trapping and hyperinflation in patients with emphysema regardless of the emphysema’s homogeneity. Multiple trials have demonstrated improvement in pulmonary function tests and life quality. Some of them even raise the possible survival benefit. BLVR is indeed appealing however it has a risk high risk pneumothorax. This risk involves a potential risk of death. These patients’ demographics and clinical variables are certainly different and assuming all of the patients have the same risk for pneumothorax appears simplistic and may lead to underestimation of the risk of pneumothorax with the concomitant risks this englobes. In this retrospective case series, we analyzed the quantitative fissure analysis of 15 patients and identified common variable that may predict the risk of pneumothorax post BLVR with EBV.

Materials and Methods: A total of 15 charts of patients who underwent BLVR with EBV performed by the Interventional Pulmonology Department of Mayo Clinic Florida were reviewed. Demographical and Quantitative fissure analysis report data was retrieved in an encrypted data base for further analysis. We included all patients who underwent EBV placement for BLVR by the Interventional Pulmonology Department of Mayo Clinic Florida in the past year. We excluded those patients who underwent EBV for reasons other than BLVR. Data regarding lobe volumes matched to patients’ height including: absolute None Targeted Lobe Volume (NTLV), delta Target lobe volume (TLV) – (NTLV) and their ratio was analyzed. Destruction score of the different lobes was also evaluated. The shared characteristics are detailed below.

Results: The total cases performed and reviewed were 15 and of those 5 (33%) developed pneumothorax post BLVR with EBV. Of those pneumothorax cases 80% had in common 3 variables: Delta (TLV-NTLV)/Height (cm) of more than 5.42, (TLN/NTLV)/height (cm) more than 0.010, and NTLTV/Height (cm) less than 6.73. The only case who developed pneumothorax that did not meet the below described criteria had CT chest findings that conferred higher risk of pneumothorax irrespectively of the quantitative fissure analysis such as significant linear scaring in the non-targeted lobe. No correlation was observed regarding the destruction score or homogeneity of the targeted and non-targeted lobes.

Conclusion: Assuming all cases of BLVR with EBV have the same pneumothorax rate appears simplistic and may underestimate the risk of some patients who undergo BLVR with EBV. Currently predictors of pneumothorax after BLVR with EBV are lacking. Our retrospective case series was able to identify that 80 % of our pneumothorax cases had in common the following criteria: Delta (TLV-NTLV)/Height (cm) of more than 5.42, (TLN/NTLV)/height (cm) more than 0.010, and NTLTV/Height (cm) less than 6.73 more. While our sample is too small to be generalized this raises the possibility of establishing these three variables as potential pneumothorax predictors. More studies with a higher number of cases are needed.
Too Much Make-Up: A Case of Foreign Body Aspiration

David Abia-Trujillo MB, MD; John Moss, MD

Introduction: Foreign body aspiration (FBA) is a potential life threatening emergency. In adult patients those with psychiatric disorders and early/late adulthood compose the majority of the described cases. It is not uncommon for adults to present in a subtle or silent manner and a high index of suspicions is needed if risk factors are identified upon questioning. For non-emergent, non-life threatening presentations with foreign body objects located in the distal airway; flexible bronchoscopy remains the best diagnosis and treatment modality. We present an unusual case of foreign body aspiration and its retrieval.

Case Description: 42 years old woman with past medical history of bipolar disease presented to the emergency department for a 3-day history of nonproductive, persistent cough. Few nights prior to her presentation, while ingesting alcoholic beverages, she was betting money with her friends insisting she was able to insert a mascara brush into her nostril and pull it out through her mouth. The gambling went wrong. She reported no dyspnea, wheezing or hemoptysis. She did endorse mid-sternal pleuritic pain, worse with coughing and a foreign body sensation in her chest.

Physical Exam was unremarkable. Her bloodwork was relevant for an elevated white blood cell count of 14.7. Chest x-ray showed a 2.8 cm radiopaque foreign body in the left lower lobe.

Bronchoscopic evaluation showed a foreign body consisting of mascara brush just at the entrance of the LB6 segment. Extraction attempts with a wire loop were unsuccessful and eventually the foreign body was removed with forceps. The patient was kept in the hospital for local observation and eventually discharged home the next day.

Conclusion: Foreign body aspiration is a pathology that requires high index of suspicion if it does not present with life threatening symptoms. Potential risk factors include trauma, alcohol or drug intoxication, dysphagia or neurodegenerative diseases. The aspirated foreign body can be either organic or inorganic and it may impact the presenting symptoms. Frequent complications can be acute or recurrent pneumonias, lung abscess, bronchiectasis or hemoptysis. If a non-life-threatening flexible bronchoscopy is the preferred route as a variety of tools are available for extractions such as: retrieval baskets, grasping forceps, embolectomy-type balloons or cryotherapy probes. Physicians should remain vigilant in patients with psychiatric disorders and keep in mind the diagnosis of foreign body aspiration as the source of symptoms.
Figure 1: Chest X-ray pre and post foreign body extraction. Red circle showing a 2.8 cm radiopaque foreign body in the left lower lobe.

Figure 2: Bronchoscopic evaluation showed a foreign body consisting of mascara brush just at the entrance of the LB6 segment and same brush once extracted from the airway.
Novel Use of Cryobiopsy for the Diagnosis of Pulmonary Alveolar Proteinosis After Non-Diagnostic Transbronchial Forceps Biopsy

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Introduction: Pulmonary alveolar proteinosis (PAP) is a rare disease characterized by accumulation of surfactant in the alveolar spaces due to a disruption in surfactant homeostasis. While chest computed tomography (CT) often shows ground glass opacities superimposed on septal thickening (“crazy paving”), these findings are non-specific. Tissue sampling remains the gold standard for diagnosis. While transbronchial forceps biopsy is often sufficient, a minority of patients (10-30%) will require surgical biopsy for confirmation.

To date, there is no data about the safety or utility of transbronchial cryobiopsy in the diagnosis of PAP. To the best of our knowledge, there are only 3 published cases of PAP diagnosed with cryobiopsy. Here, we present a case of PAP diagnosed by cryobiopsy after non-diagnostic transbronchial forceps biopsy.

Case Summary: A 34-year-old female with mild-intermittent asthma presented to our clinic with shortness of breath and pleuritic chest pain for 12 months. Vital signs were within normal limits and physical exam was notable only for persistent cough throughout the encounter.

5 months prior, she was admitted to an outside facility where she was treated for community acquired pneumonia and asthma exacerbation. Infectious workup was unrevealing. A CT scan was done after failing to improve which showed multifocal ground-glass opacities consistent with pneumonitis. She underwent bronchoscopy which revealed no endoluminal abnormalities; both BAL and transbronchial forceps biopsy of the right lower lobe were non-diagnostic. She was discharged with oral antibiotics and prednisone, despite no clinical improvement.

CT scan was repeated at our facility which showed similar findings to previous, with some areas more evidently showing a “crazy paving” pattern. The patient underwent a second bronchoscopy with BAL and transbronchial cryobiopsy of the right lower lobe using an Erbe 1.9mm flexible cryoprobe. Pathology showed acidophilic, proteinaceous material in the alveolar spaces that stained positive with periodic acid Schiff (PAS) stain, consistent with PAP. Stains for fungi, mycobacteria, herpes and pneumocystis were negative. BAL cultures and studies were, again, unremarkable.

Subsequent workup revealed a positive GM-CSF antibody. The patient was managed conservatively and ultimately improved.

Discussion: Transbronchial cryobiopsy has emerged as an alternative to forceps biopsy in the diagnosis of interstitial lung disease (ILD). The use of cryobiopsy has been shown to be advantageous; diagnostic yields are superior to traditional forceps biopsy because much larger and more intact sample sizes are able to be obtained. Furthermore, lower complication rates compared to surgical lung biopsy have been observed.
PAP is a rare disease in which the diagnosis is most often made histologically. Approximately 10-30% of patients will require surgical lung biopsy due to non-diagnostic transbronchial forceps biopsy. To the best of our knowledge, this is the 4th known case in which the diagnosis of PAP was made with transbronchial cryobiopsy, and the 2nd of which was made in the setting of a non-diagnostic forceps biopsy.

When there is a high clinical suspicion, transbronchial cryobiopsy may be useful in the diagnosis of PAP. Further studies are needed to clarify its’ role in this rare disease

References:


Airway Myoepithelioma: A Misplaced Salivary Gland’s Tale

Hollie Saunders, David Abia-Trujillo, Andreas Khoor, Sebastian Fernandez-Bussy

Introduction: Central airway obstruction (CAO) is a possibly life-threatening condition with a wide range of potential etiologies. A neoplastic source is always high in the differential diagnosis list. Myoepithelial tumors are rarely found in the lungs as they arise most often from the salivary glands or breast. Due to the low incidence and rarity of these tumors affecting the airway their diagnostic approach and treatment are not well described in the current literature. We present a case of an atypical myoepithelioma resulting in central airway obstruction and the resolution of the case.

Case description: 43-year-old never smoker man, with no significant past medical history, presented after a prior emergency department visit for a three-week history of shortness of breath, cough and mild hemoptysis. A chest computed tomography (CT) showed a 2.4 cm endobronchial mass within the distal left mainstem bronchus (LMB) occluding the left upper lobe takeoff with associated left upper lobe atelectasis and mediastinal shift. Prior bronchoscopic sampling with needle and brushing showed spindle cells with atypia but with no mitotic activities. A second bronchoscopic intervention was performed and showed a non-necrotic pink/tan to tan/yellow endobronchial mass occluding 90% of the LMB lumen with a permeable left lower lobe opening. Under rigid bronchoscopy tumor debulking was performed using argon plasma and electrocautery snare. Successful resection was achieved restoring complete opening and permeability of the LMB, left upper and lower lobes. Pathology of the resected tissue revealed Spindle/epithelioid, vimentin positive cells with low mitotic activity most consistent with an atypical myoepithelioma. Bronchoscopic surveillance was performed at 15 and 90 days later with cryotherapy to the tumor base with minimal submucosal induration noted. Forceps biopsy in the last bronchoscopic intervention did show persistent Benign Carcinoid.

Discussion: As seen in this case, CAO is a life-threatening condition. It is defined as an airflow obstruction in the trachea and mainstem bronchi. Bronchoscopic evaluation is the gold standard for diagnostics and therapeutics. Once an endobronchial mass is seen, tissue sampling is a must to establish a definite diagnosis. Conventional and rigid bronchoscopy offer a wide arsenal of methods for these diagnostics (washing, brushing, and biopsy through needle aspiration or forceps) and therapeutics (Argon Plasma Cautery, Electrocautery Snare, and Cryotherapy). Rigid bronchoscopy entails an advantage over flexible bronchoscopy as it allows for debulking and repermeabilization of the airway in a more controlled setting. This attribute ty is very important when highly vascularized tumors are suspected such as myoepithelial tumors. These tumors are fortunately rare in the lungs. Their evidence is limited to few case reports. When arising in the salivary glands these tumors are often benign, as opposed to myoepithelial carcinomas. They can often be treated by resection alone. Management in the lungs, however, is less well documented and ranges from lobectomy to bronchoscopic excision. Our case contributes to the literature showing a possible treatment, when low mitotic activity, is endobronchial resection through rigid bronchoscopy, cryoablation and frequent bronchoscopic surveillance. More cases are needed to establish structured therapeutic guidelines.
FIGURE 1:

Interval significant improvement and near resolution of previous left upper lobe atelectasis from previously noted endobronchial tumor
FIGURE 2:

A-B: Endobronchial lesion located at the distal Left main stem
C-D: Status post resection of endobronchial lesion and APC
F: Follow-up visit at 90 days from endobronchial resection.
A Total Disgrace: When not to use Uncovered Self-Expandable Metallic Stents

Garcia-Saucedo JC, Abia-Trujillo D, Fernandez-Bussy S.

**Introduction:** Currently there are several types of airway stents available in the bronchoscopist’s armament. Each stent has its own advantages, disadvantages, and specific indication. Metallic-uncovered stents often provide immediate relief in patients with central airway obstruction (CAO). Their migration rate is low; they have a self-expandable diameter, and often are easier to deploy.

However, in the long term, they are associated with more stent-related complications than other types of stents; therefore, they are not considered the treatment of choice and in fact they are contraindicated nonmalignant airway obstruction. We present a case of patient with uncovered-metal stent-related after eighteen years of use.

**Case summary:** 61-year-old former smoker man with past medical history mainly relevant for relapsing polychondritis and rheumatoid arthritis presented to be evaluated for productive, intermittent cough and dyspnea on exertion. Eighteen years prior to his presentation he had undergone bronchoscopic intervention to deploy metallic stents for expiratory central airway collapse and some airway stenosis. He had one metallic stent placed in the mid to distal trachea, and another one in the left mainstem bronchus. He had been persistently in 5 mg of prednisone. Physical exam was unremarkable. New bronchoscopic evaluation showed fractured metallic stents with at least 50% of their surface embedded into the mucosa and submucosa with severe inflammation and granulation tissue at both ends partially occluding their internal diameter (figure 1). Severe bronchomalacia was also noted associated with submucosal infiltration of the right mainstem.

The granulation tissue was treated with argon plasma and systemic treatment of his rheumatologic disease with methotrexate. Unfortunately, patient was lost in follow up.

**Conclusion:** Metallic airway stents are highly useful; however, they are associated with higher rates of perforation, granulation tissue, and fracture. Therefore, their use should be limited and they should not be used for non-malignant conditions. If place for stent trial in expiratory central airway collapse, they should be utilized in patient in whom follow up for extraction is guaranteed since perpetuating their presence may have devastating consequences.
Figure 1:

A) Proximal portion of tracheal stent showing significant granulation tissue
B) Metallic stent embedding the mucosa and submucosa
C) Tracheal deformity despite stent
D) Granulation tissue at the proximal portion of the left main stem
E) Submucosal infiltration at the entrance of the right main stem bronchus
Misplaced Voice Box: a Case of Foreign Body Aspiration


Introduction: Foreign body aspiration (FBA) is a rare but potentially fatal condition. Bronchoscopy plays a major role in its diagnosis and treatment. Maintaining a patent airway that allows foreign body retrieval allowing ventilation and oxygenation is essential for successful treatment. In patients with laryngectomy the strategies for airway maintenance are limited and so the retrieval options. We present a case of a Tracheoesophageal Voice Prosthesis (TEP) and voice prosthesis presenting as a FBA in a patient with laryngectomy.

Case Summary: A 74-year-old male with a history of supraglottic squamous cell carcinoma status post laryngectomy with TEP and voice prosthesis placement presented to the emergency department with cough, shortness of breath, and increased sputum production. Earlier in the day, he had a voice prosthesis exchange from a 17 French, 10 mm to 20 French, 16 mm device with proper vocalization and no observed leaks. He was hemodynamically stable without respiratory distress on arrival. His physical examination revealed intact laryngectomy stoma surrounded with copious thin mucus secretions noted on the anterior neck and chest. The site of prior TEP showed granulation tissue and the voice prosthesis could not be visualized. Chest x-ray showed no foreign body in the chest; however, a Computed tomography (CT) of the chest was performed as suspicion for aspiration was high and showed the TEP within the right lower bronchus without lobar atelectasis. Bronchoscopic evaluation performed under moderate sedation and through the patient’s laryngectomy stoma showed the voice prosthesis wedged into the bronchus intermedius.

Successful extraction of the TEP was achieved with forceps and retrieval basket. Eventually otolaryngology placed a larger tracheoesophageal prosthesis and secured it with sutures. Patient was discharged home to be followed in outpatient.

Conclusion: TEP migration is rare but represents a risk for a potential foreign body that can be life threatening. Clinical presentations vary according to the extent of involvement of the airway. Both flexible and solid bronchoscopy remains the therapeutic options of choice. Patients may present with nonspecific symptoms ranging from shortness of breath, cough, and wheezing to acute respiratory failure. It does require a high degree of suspicion. Flexible bronchoscopy under moderate sedation in conjunction with forceps and a retrieval basket may be appropriate tools for treatment of FBA in patients with laryngectomy.
**FIGURE 1:**
A) Laryngectomy’s stoma access site  
B) CT Chest showing the voice prosthesis wedged into the bronchus intermedius (yellow arrow)

**FIGURE 2:**
A) The voice prosthesis wedged into the bronchus intermedius.  
B) Forceps tool used to dislodge the voice prosthesis prior to basket retrieval  
C) Retrieval basket used to grasp the voice prosthesis

**FIGURE 3:**
A) Bronchus intermedius post foreign body retrieval  
B) Voice prosthesis once retrieved outside the patient
Efficacy of Large-volume Thoracentesis for Large Malignant Pleural Effusion

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Introduction and Background: Large malignant pleural effusions (MPE) are common and can cause respiratory distress. Large-volume thoracentesis (LVT) is the most readily available initial procedure, but its efficacy for large MPE with acute respiratory symptoms is unknown.

Materials and Methods: We retrospectively reviewed LVT for MPE causing ≥50% opacification of the hemithorax in patients who presented with acute respiratory symptoms at a tertiary urban medical center from 2006 to 2019. LVT was defined as draining ≥1.5 liters. ImageJ software was used to calculate the percentage (%) of hemithorax opacification before and after drainage. Complete drainage was defined as a residual effusion <10% of the hemithorax. We catalogued volume removed and percent opacification of the hemithorax after LVT in order to correlate with outcomes, including need for repeat thoracentesis and definitive pleural procedures, i.e., tunneled pleural catheters (TPCs), chest tubes, or pleurodesis.

Results: We reviewed 76 LVT performed for large MPE. Median age was 55 (IQR 47 – 64), and 71% were male. The most common cause was lung cancer (35.5%). Median opacification of the hemithorax prior to LVT was 66% (IQR 55%–88%), and median volume drained was 1.6 (IQR 1.5–2.0) liters. Only 15.8% had ≥50% decrease in opacification, and 10.5% had complete drainage. The majority of patients (56.6%) required repeat thoracentesis and definitive pleural procedures were performed in 46.7%. No characteristics were associated with repeat thoracentesis, but lung cancer (OR 6.74, 95CI 1.93–23.46, p=0.003) and requiring ≥2 repeat thoracenteses (OR 9.88, 95CI 2.10–46.49, p=0.004) were associated with definitive pleural procedures. TPC was the most common definitive procedure (62.9% of definitive procedures; 46.1% of all cases). No variables were associated with length-of-stay or adverse outcomes.

Conclusion: Large MPE is common and requires thoughtful palliative management. Although LVT may avoid respiratory failure, it was not effective for definitive pleural drainage for large MPE since most patients required repeat thoracentesis, and almost half required more definitive pleural procedures.
<table>
<thead>
<tr>
<th>Patient Characteristics</th>
<th>Baseline Results</th>
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<tbody>
<tr>
<td>Age (years)</td>
<td>55 (47 - 64)</td>
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<tr>
<td>Age &gt;65 years</td>
<td>22.4%</td>
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<tr>
<td>Female</td>
<td>28.9%</td>
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<tr>
<td>Race</td>
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<td>African American</td>
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<td>Hispanic</td>
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<tr>
<td>Caucasian</td>
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<tr>
<td>Other</td>
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<tr>
<td>Effusion Characteristics</td>
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<tr>
<td>Massive</td>
<td>31.6%</td>
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<tr>
<td>Right-sided</td>
<td>65.8%</td>
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<tr>
<td>Initial diagnosis</td>
<td>31.6%</td>
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<tr>
<td>Duration (weeks)</td>
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<tr>
<td>Duration &gt;4 weeks</td>
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<tr>
<td>Volume drained</td>
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<td>First-time drainage</td>
<td>52.0%</td>
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<tr>
<td>Comorbidities</td>
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<tr>
<td>Anemia</td>
<td>24.3%</td>
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<td>Atrial fibrillation</td>
<td>10.5%</td>
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<tr>
<td>Chronic renal disease</td>
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<td>Cirrhosis</td>
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<td>Diabetes</td>
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<td>Heart failure</td>
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<td>Hypertension</td>
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<td>Obesity</td>
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<td>Cancer Types</td>
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<td>Adenocarcinoma NOS</td>
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<tr>
<td>Breast</td>
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<tr>
<td>Cervical</td>
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<tr>
<td>Hepatocellular</td>
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<td>Small cell</td>
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<td>Mesothelioma</td>
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<tr>
<td>Myeloma</td>
<td>3.9%</td>
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<tr>
<td>Ovarian</td>
<td>3.9%</td>
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**Distal Airway Unique Metallic Foreign Body Removal with Ultrathin Flexible Bronchoscope and Fluoroscopy Under Local Anesthesia**

Vinod Govindasaami, Koushik Muthuraja Mathivanan, T. Dhanasekar, B. Rajagopalan

**Introduction:** Tracheobronchial foreign body aspiration, in adults, is an unusual event but has the potential to cause significant morbidity and even mortality. The symptomatology of FBA depends upon the characteristics of foreign body and the severity of obstruction caused by it – rarely asymptomatic. Flexible bronchoscopy remains the procedure of choice for removal in adults but the usage of Ultrathin bronchoscopy for such indication is sparse in literature. Here, we report a case of distal airway foreign body removed successfully by Ultrathin flexible bronchoscopy under fluoroscopy guidance.

**Case Summary:** A 45-year-old female, with no prior medical history, was referred to our outpatient department due to an incidental finding of a metallic foreign body in the right lower lobe in chest x-ray. Computed tomography localized the foreign body to the anterior basal segment of right lower lobe with surrounding minimal fibrosis (Figure 1). Flexible fiberoptic bronchoscopy was carried out under local anesthesia. The adult FOB could not be negotiated beyond right lower lobe anterior basal segment orifice. Hence ultrathin pediatric FOB was introduced, and the anterior basal segment bronchus was entered – the subsegments were assessed.

One of the subsegment’s orifice was stenotic which was suspected to have FB within it, but even pediatric FOB could not be passed into it. Hence thin biopsy forceps were introduced into the stenotic subsegmental orifice under fluoroscopy guidance and the FB was confirmed to be in the subsegment and was grasped and removed with bronchoscope in toto (Figure 2). Immediately after the removal, adult bronchoscope was introduced to check for bleeding, but only minimal ooze was noted which was arrested with cold saline flushes. Foreign body removed (a nose stud screw) was examined to ascertain that it has been recovered in its entirety (Figure 3).

**Discussion:** We conclude that the ultrathin bronchoscope with fluoroscopy can be used for successful retrieval of distal airway metallic foreign bodies in adults.

![Figure 1: Chest x ray PA view (A) and Computed tomography sagittal (B) and coronal (C) views showing radio-opaque foreign body in the right lower lobe anterior basal segment.](image-url)
Perpetual Airway Stent; A Case with Pseudomonas Aeruginosa Colonization.


Introduction: Silicon and Hybrid Stents provide an almost immediate relief in patients with central airway obstruction and may be useful tools to treat patients with Tracheal Stenosis or Tracheobronchomalacia (TBM). Airway stenting is generally not considered a long-term therapy and is usually a bridge for other therapies unless it is used for palliation. In limited cases stents may be used indefinitely increasing their rate of complications and bacterial colonization. This case describes a nine-year use of an Airway Dynamic Y-Shape Hybrid Stent that had to be removed due to bacterial colonization.

Case Summary: A 70-year-old woman native from Dominican Republic presented with a remote history of respiratory failure. Ten years prior to her presentation she had an episode of respiratory failure that merited prolonged mechanical ventilation and eventually tracheostomy. After decannulation she had multiple episodes of respiratory distress for which bronchoscopic intervention such as Argon Plasma Coagulation, airway dilation with ballooning and Mitomycin C instillation failed to achieve meaningful improvement on her life quality; constantly impaired by dyspnea and cough. A Dynamic Y-Shape Hybrid Stent was placed in the distal trachea with significant improvement on her symptoms. She continued her life with daily nebulization’s to facilitate mucociliary function until the last year prior to her presentation in which the airway stent was colonized with Pseudomonas Aeruginosa leading to frequent respiratory exacerbations. The pseudomononal infection was unable to be eradicated despite multiple antimicrobial strategies.

New bronchoscopic intervention was performed and the stent was removed with rigid forceps. Expiratory Central Airway Collapse (ECAC) was noted in the form of both Concentric TBM and Dynamic Airway Collapse. Given the degree of airway inflammation decision was taken to proceed with pneumatic stenting through CPAP and frequent airway hygiene. Patient was discharged home with as needed airway dilation and no further need for pseudomonas treatment.

Conclusion: Silicone and Hybrid stents have some advantages and disadvantages when compared to uncovered metal stents. They tend to be more durable; they resist extrinsic compression, induce less granulation tissue and have less risk of fracture. Their disadvantages include higher risk mucociliary clearance impairment with the potential risk microbial colonization of the stent.

Once colonized removal is required if no medical therapy can achieve an appropriate clinical status.
Figure 1: A (Proximal) and B (Distal) Inside view of the Hybrid Stent. C) Mid-Trachea Post-Stent removal. D) Mid-Trachea on expiration evidencing ECAC. E) Stent removed

Pneumothorax Predictors after BLVR with EBV based on Chest Computed Tomography; A Case Series.

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Introduction and background: Over the past decade Bronchoscopic Lung Volume Reduction (BLVR) with Endobronchial Valves (EBV) has improved quality of life for patients who had been limited by dyspnea secondary emphysema and air trapping. BLVR portends a significant risk of pneumothorax (PTX). Predictors of PTX after BLVR with EBV are lacking and are needed to advance the safety and utility of this procedure. Potential predictors of PTX are thought to include the presence of pleural thickening, sub pleural cysts, bullae, reticulations, peripheral lesions, linear scarring, and apical scarring. However, evidence supporting these findings is lacking. In an effort to better understand the risk for PTX after BLVR, we reviewed our clinical experience.

Materials and Methods: This study was deemed “exempt” by the IRB committee. We prospectively collected data on all patients who underwent BLVR with EBV, between 1/1/2018 to 3/31/2020, at Mayo Clinic Florida. Demographics and testing variables pre and post BLVR were registered on an encrypted data base. All chest CT scans prior to BLVR with EBV were reviewed by a thoracic radiologist in two separate sessions. During the first session he was blinded regarding the development or not of pneumothorax posts BLVR and was only provided information regarding the targeted lobe with EBV placement. During the second evaluation he reviewed the chest CT scans of those patients who developed pneumothorax looking of common characteristics.

Results: A total of 15 charts were reviewed of which 33% (5/15) developed PTX post BLVR with EBV. Relevant CT findings in those who developed PTX included:

- 40% (2/5) of the patients who developed pneumothorax had sub pleural cystic changes in the non-targeted lobe.
- 40% (2/5) of the pneumothorax patients had a lung nodule: 20% (1/5) in the targeted lobe (5 mm) and 20% (1/5) in the non-targeted (12mm). Only 10% (1/10) of the patients who did not develop pneumothorax had a nodule (6mm) in the targeted lobe.
- The rate of apical scarring was slightly higher in the patients who developed a pneumothorax 60% (3/5) when compared to the one that did not develop it 50% (5/10).
- Reticulations and linear scarring did not have an obvious predominance.
- 60% (3/5) of the patients who developed pneumothorax had an overall scaring surface above 40,00 mm³ (74.652 mm³, 76, 640 mm³, and 44, 335 mm³)

Conclusion: Although limited by size, this data suggests limited utility of chest CT in predicting PTX after BLVR. An absolute predictor on the CT Chest that can envisage a pneumothorax post BLVR with EBV is lacking; however, sub pleural cystic changes in the non-targeted lobe may rise as possible future predictor. Overall, 40% of our patients who developed pneumothorax had cystic changes in the non-targeted lobe. No specific correlation was noted with other CT findings such as pleural thickening, bullae, reticulations, long nodules or scaring. Our ability to reach a generalizable conclusion is the limited by our small sample size and therefore more studies with larger population are needed to accurately predict pneumothorax post BLVR with EBV.
Table 1: CT chest findings noted in patients who underwent BLVR with EBV

<table>
<thead>
<tr>
<th>CT findings</th>
<th>All Patients</th>
<th>Patients who developed PTX</th>
<th>Patients who did not developed PTX</th>
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<tbody>
<tr>
<td>Sub pleural cyst</td>
<td>13 % (2/15)</td>
<td>40 % (2/5)</td>
<td>0 % (0/10)</td>
</tr>
<tr>
<td>Apical scarring</td>
<td>53 % (8/15)</td>
<td>60 % (3/5)</td>
<td>50 % (5/10)</td>
</tr>
<tr>
<td>Linear Scarring</td>
<td>100 % (15/15)</td>
<td>100 % (5/5)</td>
<td>100 % (10/10)</td>
</tr>
<tr>
<td>Reticulations</td>
<td>33 % (5/15)</td>
<td>20 % (1/5)</td>
<td>40 % (4/10)</td>
</tr>
<tr>
<td>Nodule</td>
<td>20 % (3/15)</td>
<td>40 % (2/5)</td>
<td>10 % (1/10)</td>
</tr>
<tr>
<td>Pleural Thickening</td>
<td>0.06% (1/15)</td>
<td>0</td>
<td>10 % (1/10)</td>
</tr>
<tr>
<td>Bullae</td>
<td>0 % (0/15)</td>
<td>0</td>
<td>0</td>
</tr>
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Figure 1: Sub pleural cystic lesions in the non-targeted lobe (yellow arrow)

Figure 2: Measurement of the non-targeted lobe scarring volume (85 mm, 2D) x height (104.9 mm, 2D) x thickness (7.5 mm, 2D).
Female gender may be associated with increased risk for COPD exacerbation immediately following endobronchial lung volume reduction with Zephyr valves

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Introduction: The emphysema phenotype of chronic obstructive pulmonary disease (COPD) is often associated with continual decline in lung function and quality of life despite optimal medical therapy and pulmonary rehabilitation. In patients with heterogenous emphysema, complete fissures and evidence of significant air trapping (residual volume >170% predicted), endobronchial lung volume reduction (ELVR) with 1-way (Zephyr) valves has been shown to improve lung physiology and quality of life despite several documented post-operative adverse events including pneumothorax, COPD exacerbation, pneumonia and hemoptysis. Because this is still a novel procedure, adverse outcomes and their associated risks are not well understood. We sought to explore the outcomes and demographics of patients undergoing ELVR with 1-way valves in our academic center in hopes that we may better understand risk factors associated with these particular events.

Methods: Retrospective chart analysis was performed on all adults (18+) who underwent Zephyr valve placement from the advent of our valve program at Cleveland Clinic Florida in May 2019 until December 1, 2019. A total of 19 subjects were included in the study. We examined multiple baseline demographic datapoints including gender, BMI and comorbidities. For our outcomes, we examined rates of pneumothorax, COPD exacerbation, pneumonia and hemoptysis in each patient at 3 days, 30 days and 60 days post-procedure.

Results: 47.3% (9/19) of subjects were male, 52.6% (10/19) were female. 68.4% (13/19) had atelectasis on follow up imaging, of which 15.4% (2/13) developed pneumothorax in the immediate post-op period (within 3 days). 26.3% (5/19) of patients required antimicrobials for pneumonia within 60 days: 5.2% (1/19) within 3 days, 15.7% (3/19) within 30 days and 26.3% (5/19) within 60 days. 15.7% (3/19) subjects had hemoptysis within 3 days, all of which were considered mild (<5cc). 47.4% (9/19) of subjects had a documented exacerbation of COPD at 60 days. 55.6% (5/9) of these occurred within 3 days of procedure; in this particular group, 100% of the subjects were female. Of the entirety of documented COPD exacerbations, the majority (66.7%) occurred in female subjects.

Conclusion: Our pneumothorax rate (15.4%) was comparable to other studies (7-23%). Exacerbation of COPD was the predominant adverse event in our cohort, occurring in 47.4% of subjects who underwent valve placement at 60 days. Our rate of COPD exacerbation is higher than other cited studies (23.7-42.3%). The majority of exacerbations occurred within the immediate post-operative period (3 days), of which, 100% of the subjects were female. A minority (33%) of documented COPD exacerbations occurred in male subjects. Based on this data, female gender may be a risk factor for COPD exacerbation after Zephyr valve placement, most notably within 3 days post-procedure. Given our small sample size, however, larger studies are needed to confirm our findings.
References:


Management of Tracheobronchopathia Osteochondroplastica with Holmium Laser Therapy

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Keywords: Tracheobronchopathia osteochondroplastica, holmium laser, respiratory mechanics

Abstract Introduction: Tracheobronchopathia Osteochondroplastica (TPO) is a rare, benign condition of the large airways that tends to affect mostly men.¹ 90% of cases are found incidentally on autopsy,² and 55% of living and affected patients do not experience disease progression following their diagnosis.³ The diagnosis can be made by bronchoscopic appearance alone⁴ with osseocartilaginous nodules originating from airway cartilage with sparing of the posterior non-cartilaginous membrane.¹⁵ Although the cause of TPO is unknown, metaplasia via chronic inflammation has been hypothesized.² These nodules lead to airway obstruction and persistent respiratory symptoms, including recurrent upper airway infections, hemoptyisis, and dyspnea.² While most cases do not require intervention or are treated conservatively,³ symptomatic lesions may require bronchoscopic intervention.⁷ While most bronchoscopists use Nd:YAG for debulking procedures, urologic data have shown that the Holmium:YAG laser is a much more effective tool for calcium stone fragmentation⁸. We report the use of bronchoscopy with Holmium:YAG laser to ablate lesions and to restore the airway lumen in a patient with TPO refractory to conventional treatments. This laser ablates osseous lesions through a fiber-optic network⁹ without inducing injury to surrounding soft tissues.¹⁰,¹¹

Case Summary: We present the case of a 62-year-old male with symptoms of dyspnea, wheezing, and recurrent pneumonias. Diagnostic bronchoscopy in 2015 demonstrated overgrowth of cartilaginous tissue, and the left mainstem was 90-100% obstructed secondary to cartilaginous overgrowth in various segments. Laser photocoagulation with the Nd:YAG laser was attempted with photo-desiccation along the most central overgrowths, which were not amenable to balloononing. Ultimately, debulking of calcium deposition in 2015 was unsuccessful, and the patient continued to experience dyspnea with exertion and at rest. Subsequent laser photocoagulation with Nd:YAG laser in 09/2019 was equally unsuccessful.

After careful review, the team considered holmium laser therapy which was known to be more successful with regards to debulking calcium in other medical specialties. In 11/2019, the patient underwent rigid bronchoscopy with Ho:YAG. The contact laser fiber was used in small
circumferential patterns and resulted in superficial cracking of cartilage with debulking achieved via rigid forceps. The team successfully recanalized the proximal trachea to 80% of normal airway and distal trachea to 60% of normal. The patient reported marked improvement in his symptoms of dyspnea and orthopnea post recovery. The procedure was successfully repeated in 12/2019 for completion of debulking of mainstem bronchi, and the patient reported continued improvement in his respiratory status.

**Conclusion:** This case highlights a novel treatment strategy in the interventional pulmonary field with regards to patients with refractory TPO. Ho:YAG lasers are well utilized in otolaryngology and urology specialties, and this case illustrates the utility of Ho:YAG therapy to cartilaginous calcifications within airways. While current literature notes photocoagulation and stenting as possible treatments for TPO, there is scarcity of treatment options for patients with this diagnosis. The holmium laser is a minimally invasive and potential therapeutic option that is safe and effective for dense calcified tissue. Following further investigation of therapeutic uses, patient comfort, and expense of holmium laser therapy in pulmonology, this technique may be considered alongside current first-line treatments.

**Image 1:**

![Initial bronchoscopy mid-trachea, prior to intervention](image_url)
Image 2:

Initial bronchoscopy distal trachea, prior to intervention

Image 3:

Initial bronchoscopy with ineffective Nd:YAG laser
Image 6:

Bronchoscopy mid-trachea, after Ho:YAG

Image 7:

Bronchoscopy distal trachea, after Ho:YAG
References


ECMO Supported Recanalization of Multifocal Critical Malignant Airway Obstruction

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Introduction: Malignant central airway obstruction often complicates the course of lung cancer and other malignancies metastasizing to the lungs, with as many as 20 percent of primary lung cancer patients eventually effected. Tumors and malignant lymphadenopathy can create obstruction by either one or a combination of direct invasion or extrinsic compression, with severity ranging from mild exercise related symptoms to catastrophic loss of airway. In the case of the latter, the often tenuous respiratory status of the patient can present a therapeutic dilemma between the need to intervene and the likelihood of exacerbating an already critical airway scenario. We describe a case of critical multifocal airway obstruction due to bronchogenic carcinoma with resulting respiratory failure.

Case Report: A 51 year-old formerly smoking woman with a diagnosis of stage IV squamous type non-small cell lung cancer 5 months ago, who had initially declined standard therapies despite a favorable ROS-1 mutation, presented with a 3 week history of progressive dyspnea. Symptoms in the days prior to hospital admission had increased to breathlessness even at rest, and soon progressed to respiratory distress requiring intubation and mechanical ventilation. Initial survey of airways following intubation revealed posterior extrinsic compression of the distal trachea causing greater than 90 percent obstruction at the level of the carina and bilateral main bronchial take-offs. Additional findings included more than 75 percent narrowing of the proximal 3 cm of left main bronchial lumen due to circumferential tumor invasion. Given the patients treatment naive status, and following extensive discussions with patient and her family, decision was made to offer intervention to address the cause of her respiratory failure with the hope of improving functional status as a bridge to anti-tumor therapies. Following multidisciplinary discussions, a plan was devised to preform VV-ECMO supported staged recanalization of the airway using a combination of silicone tracheal Y-stent and fully covered self-expanding metal stent (SEMS) at the left main bronchus. She was cannulated for VV-ECMO on intervention day 1, and underwent rigid bronchoscopy on intervention day 2 with deployment of tracheal Y-stent and left main bronchial SEMS. The patient was liberated from mechanical ventilation on the day of airway intervention, and weaned from ECMO and decannulated the following day. At the time of discharge from the hospital at approximately one week from admission, she was ambulatory and required no supplemental oxygen. Oncology consultation and plan was developed before discharge and the patient was immediately initiated on multimodal anti-tumor therapy with palliative radiation and combined standard and ROS-1 targeted chemotherapies.

Discussion: Critical airway stenosis presents a unique therapeutic scenario, where the required intervention often increases the risk of immediate clinical decline, and technical complexities are anticipated when the target of intervention is an already highly compromised airway. The use of ECMO as a periprocedural support in such complex cases can more readily provide opportunity for meaningful intervention where a positive outcome may have otherwise seemed unlikely.
A Case of a Paraganglioma Presenting as a Middle Mediastinal Mass

Fatima J. Wong, DO; Francis J. Turner, MD

Introduction: Mediastinal paragangliomas are uncommon neuroendocrine tumors that originate from the para-aortic sympathetic chain ganglia located predominantly in the anterior and middle mediastinum or the paravertebral ganglia in the posterior mediastinum\(^1\). They are often non-functional, and patients are asymptomatic due to lack of catecholamine production or secretion. These entities can be locally aggressive, growing invasively into surrounding structures such as the heart, major vascular structures, esophagus or trachea. Surgical resection is the treatment of choice followed by lifelong surveillance.

Case Summary: A 54 year old female with a 20-pack year smoking history presented with a mediastinal mass seen on a chest computed tomography (CT) scan demonstrating a 5.7 x 8 x 5 cm left sided heterogeneously enhancing middle mediastinal mass extending superiorly along the aortic arch without fat or calcific density. The patient had initially presented to her primary physician due to back pain that subsequently resolved spontaneously. She denied any cardiopulmonary symptoms and her vital signs and physical examination were unremarkable. A positron emission tomography (PET) scan was obtained which demonstrated that the mediastinal mass was hypermetabolic without any evidence of metastases. A CT guided needle percutaneous biopsy was then performed demonstrating features consistent with paraganglioma on the core biopsy sample.

The patient was referred to a cardiothoracic surgeon and underwent a left sided thoracotomy with resection of the mediastinal paraganglioma. At surgery the tumor was adherent to the posterior arch of the aorta, but able to be removed with careful dissection with the patient being discharged from the hospital without complications and has since been followed in our Thoracic Oncology clinic with plans to continue surveillance.

Discussion: Paragangliomas and pheochromocytomas have a combined incidence of approximately 500-1600 cases annually in the United States, with 2-12.5% of these cases located in the mediastinum\(^2\). Most of these tumors do not produce catecholamines and patients are often asymptomatic. However, some paragangliomas are malignant or functional, causing signs and symptoms such as hypertension, tachycardia, and diaphoresis\(^3\). The majority of these cases occur sporadically, occurring more commonly in women and presenting at a later age. Some patients, however, occur in association with hereditary conditions such as Multiple Endocrine Neoplasia type 2A/2B, von Hippel-Lindau syndrome, Neurofibromatosis type 1, or succinate dehydrogenase (SDH) mutation syndromes and at a younger age\(^2,3\).

Conclusion: CT scan or magnetic resonance imaging (MRI) are the preferred imaging modalities for these tumors. Typical features seen on CT scan include tumors demonstrating heterogeneous enhancement while MRI demonstrates high signal intensity on diffusion-weighted imaging. Pathologic findings for paraganglioma include “Zellballen” nests consisting of uniform round or oval cells with granular amphophilic or basophilic cytoplasm surrounded by vascular tissue\(^3,4\).
Surgical resection via thoracotomy is considered the treatment of choice, however, these cases may be complex owing to the proximity to major structures such as the heart, great vessels, esophagus and trachea. With the possibility of recurrence and synchronous neoplastic manifestations, aside from paranganglioma, lifelong surveillance and follow-up after resection is highly recommended.
Unilateral Erector Spinae Plane Block is a Feasible Anesthetic for Pleuroscopy: A case series of our first 17 patients

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Introduction: Since first introduced in 2016 for thoracic neuropathic pain1, Erector Spinae Plane Block (ESPB) has gained increasing popularity as an analgesic modality for various types of surgeries. At our institution, we recently began applying this regional technique to pleuroscopy, which is a minimally invasive endoscopic procedure that provides both a diagnostic and therapeutic modality for pleural disease2. Our standard of care for these patients has been either general anesthesia or monitored anesthesia care in combination with surgeon administered local anesthesia. However, patients undergoing pleuroscopy frequently have multiple comorbidities making them susceptible to periprocedural complications. In an attempt to decrease perioperative risk while enhancing postoperative analgesia, we implemented the use of ESPB as the primary anesthetic for patients undergoing pleuroscopy. We present our initial experience with single shot ESPB for patients undergoing pleuroscopy.

Methods/Approach: Institutional review board approval was obtained (#19-2934) and a retrospective chart review of patients who underwent interventional pleuroscopy with ESPB was done. All patients underwent rigid pleuroscopy. The level of ESPB blockade was decided upon in consultation with the interventionalist, after entry site was confirmed by ultrasound. A single injection of ropivacaine was administered to the appropriate transverse process under linear probe ultrasound guidance in the preoperative area in prone position. The appropriate transverse process was identified by counting the ribs and then scanning medially.

Results: Between 11/9/18 and 1/20/20, a total of 17 consecutive patients who underwent thoracic ESPB prior to pleuroscopy were included in this study. 13 out of the 17 patients received 20 ml of 0.5% ropivacaine. Two patients received lower volumes of 12.5 ml and 15 ml. Two patients received 30ml and 20ml of 0.35 % ropivacaine. Average opioid consumption (in oral morphine equivalents) intraoperatively and postoperatively were 20.7 mg and 9.0 mg, respectively. None of the patients required treatment for postoperative nausea and vomiting. Average postoperative subjective numerical pain score was 3.0 out of 10. There were no complications associated with ESPB.

Discussion/Conclusion: There have been several case studies aimed to show the analgesic efficacy of ESPB in patients undergoing video assisted thoracoscopic surgery 3,4. To our knowledge, there is only one other abstract describing the use of ESPB for pleuroscopy in eight patients, which used different local anesthetic regimens, different pleuroscopes (rigid or semi rigid), and included both single shot and catheter based ESPBs at the level of T55. In contrast, patients in our cohort received a standardized regional anesthesia approach and the
anesthesiologist worked with the interventionalist to match the level of the ESPB with that of the pleuroscopy. Not only were we able to target the exact dermatome to provide excellent anesthesia and analgesia, but by standardizing the type of pleuroscope we minimized variability in pain caused by use of different scopes. To our knowledge, our study is the largest case series describing the utility of ESPB for pleuroscopy and demonstrates its feasibility as the primary anesthetic for this procedure. We found ESPB to be safe and effective for this high acuity patient population.

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**Ovarian Hyperstimulation Syndrome as Cause of Exudative Effusion; A Case Report**

Shaikh M Noor Ul Husnain, Javier Diaz Mendoza, Krishna Thavarajah

**Introduction:** Isolated exudative pleural effusion is a rare presentation of ovarian hyperstimulation syndrome following in-vitro fertilization extraction with implantation. We hereby report the case of a 27-year-old female who presented with moderate pleural effusion following in-vitro fertilization extraction with implantation due to Ovarian Hyperstimulation syndrome.

**Case Summary:** A 27 y.o. female status post in vitro fertilization extraction with implantation presented to hospital with worsening shortness of breath and dyspnea on exertion for 4 days after implantation. Prior to IVF, patient was asymptomatic and in good health. No prior medical history. She initially presented with bilateral pleural effusions, right side worse than the left. In the ED she underwent thoracentesis, showing exudative effusion. However, due to rapid reaccumulation and symptoms she underwent chest tube placement on the right. Extensive workup was performed, including infectious and autoimmune, which were negative. CT PE was negative. Echo revealed small pericardial effusion, no signs of tamponade. CT abdomen pelvis also revealed no abnormalities. Due to persistent high output from chest tube, decision was made to transfer her to our hospital.

At time of transfer she was hemodynamically stable, afebrile, saturating well on room air. Only symptoms endorsed were right-sided chest pain near her chest tube and bilateral lower extremity swelling. Obstetrics team was consulted, they were concerned for OHSS. Initial B-HCG level was 6455 and transvaginal ultrasound showed at least one gestational sac with yolk sac seen in the uterus and massively enlarged ovaries displaying multiple cysts. A repeat B-HGC was 13756 and repeat transvaginal ultrasound showed two gestational sacs. She was also started on Synthroid 25mg daily to suppress TSH in the setting of IVF and on daily salt tablets. During this hospitalization, her chest tube drained less fluid each day and was subsequently removed.

Imaging showed resolution of bilateral pleural effusion and was subsequently discharged from the hospital.

**Conclusion:** Evaluation of a pleural effusion usually involves light’s criteria as first step in evaluation; whether it’s an exudate or transudate. If patient has an exudative effusion, attempts should be made to define etiology as Pneumonia, Cancer and PE accounts for most exudative effusions. However here we encountered an usual case of exudative effusion. Ovarian Hyperstimulation Syndrome (OHSS) is range of clinical features typically in setting of assisted conception techniques. It is an overreaction of the ovaries complicating pharmacological ovulation induction. Rarely other causes, such as the mutation of the follicle-stimulating hormone receptor may also be in the background. OHSS is an iatrogenic syndrome, which may, infrequently, become severe and even fatal. In the last two decades, has been accompanied by an increase in the cases of OHSS due increase in popularity of assisted reproductive technology. Its postulated increasing bHCG post IVF can cause increased VEGF thus leading to increased vascular permeability causing effusions and acute third-space fluid shift responsible for the development of ascites, and...
sometimes pleural or pericardial effusion. Supportive therapy, prophylaxis for venous thromboembolism and close monitoring are the main approach for the syndrome.

However, hospitalization or intervention should not be delayed for patients with severe symptoms or critical conditions.
A Multicenter Feasibility and Efficacy Study of a Non-Opioid Based Pain Management Following Outpatient Medical Thoracoscopy

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Introduction and background: Medical thoracoscopy (MT) is a minimally invasive procedure that is an alternative to video-assisted thoracoscopy (VATS) pleural biopsies. Prescription opioids are a major cause of the opioid epidemic. Currently, there are no guidelines on pain management post-MT. Adequate pain management may be accomplished by using a non-opioid based pain management strategy (NOBPMS). In a multicenter study, we assessed the feasibility and efficacy of a NOBPMS in patients who underwent MT.

Methods: Since August 2019, we included all patients from Mayo Clinic Rochester, Arizona and Florida who underwent an outpatient MT and pleural biopsies for undiagnosed recurrent exudative pleural effusion or radiographic pleural abnormalities. We excluded patients with chronic narcotic use or patients who were hospitalized immediately after MT. Post-MT, all patients were advised to take acetaminophen or nonsteroidal anti-inflammatory drugs (NSAIDs), as needed for pain. All patients received a telephone call on post-operative day (POD) 1 to assess their pain level. Pain scores ranged from 0-10 (0=no pain, 10=maximal pain). Patients received additional phone calls on POD 3 and/or on POD 5 if they rated the pain >5 on POD 1 or if the patient made contact with a healthcare provider for uncontrolled pain. The following data were collected: basic demographics, type and amount of sedation used, type and amount of local anesthetics used, type of biopsy tools used, size of pleural catheter insertion post-MT, procedural complications, pain scores, and type and dose of analgesics required post-MT. Mild pain was defined as 1-3, moderate pain as 4-6, and severe pain as 7-10. If severe pain was reported, a maximum of five tablets of hydrocodone-acetaminophen 5-300mg was prescribed.

Results: Twenty patients were included in this study. The mean age was 73 years and 50% were male. The two most common modalities to obtain pleural biopsies were utilization of flexible plus rigid cupped biopsy forceps (53%) and only cupped biopsy forceps (37%). All patients received moderate sedation with median doses of 2 mg midazolam, 100 mcg fentanyl, and 10 ml of 1% lidocaine. There were no procedural complications. Thirty five percent of the patients received a tunneled pleural catheter in the same setting and 65% had a small bore pigtail catheter which was removed prior to discharge. On POD 1, there were zero patients that reported severe pain. Fifteen percent rated their pain level as moderate, 75% rated their pain as mild and 10% reported no pain. Patients who rated their pain as mild or moderate also reported that the pain did not last longer than 24 hours post-MT. The three patients who rated pain as moderate also reported improved or resolution of pain with non-opioid analgesics. Sixty percent of the patients reported taking acetaminophen or nonsteroidal anti-inflammatory for the first 24 hours post-MT. Eighty five percent of the patients were able to resume their routine activities without limitations within 24 hours. Zero patients required prescription for opioids.

Conclusion: MT appears to be well tolerated with a NOBPMS. Further studies are needed to compare opioid and NOBPMS post-MT.
Secrets Unlocked: A Tale of EBUS-TBNA

Samaher Hashim, MD; Rania Farhat, MD; Setu Patolia, MD

**Introduction:** In the precision medicine era of lung cancer management Endobronchial ultrasound-guided transbronchial needle aspiration (EBUS-TBNA) has become an essential tool for evaluating patients, it obtains high-quality pathological samples with a low degree of invasiveness and shows excellent sensitivity, specificity and accuracy in the diagnosis of nodal metastasis of lung cancer.

**Case:** A 68-year-old male, 30-pack year smoker presented to the emergency department with altered mental status, dizziness, vertigo, tinnitus, nausea, vomiting, weight loss and productive cough. His symptoms have been worsening over 3 months prompting several hospital admissions however without a conclusive diagnosis. Physical examination was significant for halitosis, cachexia, scattered rhonchi, lethargy, somnolence, dysarthria, hypophonia, disconjugate gaze, bilateral rotatory nystagmus and impaired coordination bilaterally. He had intact motor power and no sensory deficit. Initial blood laboratories showed hyponatremia, hypokalemia, elevated white blood cells count and thrombocytosis. Electrolyte derangements rapidly corrected with IV fluid hydration and potassium replacement. CT head was normal, Brain MRI findings were consistent with chronic small vessel disease. A Lumber Puncture (LP) was performed revealing hazy cerebrospinal fluid with 21 nucleated cells, 98% lymphocytes, normal glucose, elevated total protein at 94, a negative paraneoplastic panel and negative cultures. Chest radiography showed no acute cardiopulmonary abnormality. CT Chest showed a 10 mm ground glass nodule in the lingula and mediastinal lymphadenopathy (figure 1). A decision to proceed with EBUS-TBNA was made, the subcarinal and left lower paratracheal lymph nodes were identified and targeted (figure 2). Pathology was consistent with Small Cell Lung Cancer (SCLC). Accordingly, the patient was diagnosed with limited stage small cell lung cancer (LS-SCLC). He then progressively deteriorated with respiratory failure requiring intubation and mechanical ventilation. Considering his classical paraneoplastic syndrome presentation (subacute cerebellar degeneration) and confirmed underlying malignancy, the diagnosis of paraneoplastic syndrome secondary to SCLC was confirmed and the patient was started on chemotherapy. No meaningful sustained clinical improvement was appreciated, subsequently the patient was discharged with hospice and died shortly after.

**Discussion:** SCLC is one of the deadliest forms of lung cancer due to its poor prognosis upon diagnosis, rapid doubling time, and affinity for metastasis. As 60–70% of patients with SCLC have disseminated disease upon presentation, it is imperative to determine the extent of disease burden for treatment. The aggressive nature of SCLC leaves physicians with a narrow window for discovering LS-SCLC. Despite advances in screening guidelines and modalities patients often fail to meet criteria and therefore go unnoticed before they present with metastatic disease. Given the possible shortcomings of screening modalities, physicians must rely on their clinical index of suspicion to help discover early disease. This includes a holistic approach to each patient, correlating possible early symptoms of presentation with abnormal lab values that could indicate a possible paraneoplastic syndrome. EBUS-TBNA as the initial investigation for this patient with suspected lung cancer, established the diagnosis and reduced the time to treatment decision which did not reflect in a meaningful benefit for our patient but may for others.
Figure 1: Contrast CT Chest: revealing a 10 mm ground glass nodule at the region of the Lingula and an enlarged subcarinal lymph node (arrow) visible on Lung window and very clear on mediastinal window.

Figure 2: Enlarged Subarcal and left lower paratracheal lymph nodes status post FNA.
Tracheobronchoplasty and Diaphragmatic Plication under VV ECMO for combined ECAC and Diaphragmatic Paralysis.

Mehmet Tatari, David Abia-Trujillo, Margaret Johnson, Sebastian Fernandez-Bussy, Mathew Thomas

Introduction: Expiratory Central Airway Collapse (ECAC) and diaphragmatic paralysis are two pathologic entities that represent a diagnostic and treatment challenge. Their true incidence is unknown given their wide spectrum on clinical presentation and the lack of pathognomonic signs. We present a case of a patient with major life quality limitations that underwent Tracheobronchoplasty and Diaphragmatic Plication for combined presentation of ECAC and diaphragmatic paralysis under venous-venous ECMO support.

Case Report: 54-year-old man with history of bronchiectasis and Parsonage Turner syndrome presented with worsening shortness of breath and recurrent pneumonias attributed to inability to fully expectorate his sputum burden. Physical Exam showed orthopnea and paradoxical breathing on the supine position as well as a restricted inspiratory effort. Pulmonary function testing showed severe restrictive physiology and relatively preserved diffusion capacity. Maximal respiratory pressures were very severely reduced. Computed tomography (CT) of the chest revealed bilateral diaphragmatic elevation associated with consolidative and atelectatic changes of both lower lobes, worse on the right side. Dynamic CT showed a pronounced forward displacement of the posterior tracheal wall at the distal trachea, left and right main stem bronchus and bronchus intermedius. Sniff test was unremarkable. Patient was treated with non-invasive positive pressure ventilation and aggressive airway clearance therapy without persistent improvement on his life quality. Further diagnostic workup was pursued with a dynamic bronchoscopy and showed severe ECAC. Stent trial was then performed and a significant improvement of his quality life questionnaires was noted. His Parsonage Turner syndrome was confirmed with electromyogram demonstrating bilateral phrenic neuropathy and left brachial plexus neuropathy with no movement of the diaphragms evident on ultrasound. He was not a candidate for diaphragmatic pacing. A first attempt of a combined tracheobronchoplasty and diaphragmatic plication was aborted for hypoxemic respiratory failure during single lung ventilation; therefore the surgical approach was then performed under venous-venous ECMO support. Central airway stabilization was achieved through an opened tracheobronchoplasty by suturing a knitted polypropylene mesh to the posterior membrane of the trachea and bilateral main bronchi. Under the same surgical procedure a right diaphragm plication was also performed. The left diaphragm plication was performed on a later surgery and was uneventful.

Outpatient follow up demonstrated a mayor improvement in his quality of live and dynamic bronchoscopy showed improvement in the degree of ECAC.

Discussion: ECAC and diaphragmatic dysfunction can coexist and contribute to additive symptoms of shortness of breath and quality of life disruption. Both are pathologic entities with mayor diagnostic and treatment challenges and therefore more studies are needed to better understand their relationship and coexistence. In severe cases the only treatment for these pathologic entities involves a surgical approach that can be limited by the overall functional status of the patient. On highly specialized centers, and supported by a multidisciplinary team a combined
surgical approach with tracheobronchoplasty and diaphragmatic plication may be performed under VV ECMO support as a treatment option. More research is indeed needed to further establish the association between ECAC and diaphragmatic dysfunction and their combined treatment.
Bronchoscopic Removal of a Migrated Endovascular Coil: A Rare Complication of Coil Embolization

Authors
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Introduction: Migration is a rare complication of endovascular coiling that may have disastrous consequences [1]. We report a case of a right middle lobe (RML) pulmonary artery (PA) embolization coil with endobronchial migration necessitating multidisciplinary management.

Case Summary: A 32-year-old male with a history of IV drug abuse underwent coil embolization of PA mycotic pseudoaneurysms. Hemoptysis resolved following embolization. Fourteen months later, the patient presented with a 3-week history of productive cough, fevers, chills, and hemoptysis. Chest x-ray (CXR) revealed consolidation in the RML and a coil overlying the right middle lung that extended centrally and cranially (Fig 1). CT chest confirmed erosion of a RML PA coil into an adjacent airway and migration into the trachea. A multidisciplinary consensus was to proceed with bronchoscopic removal and rapidly transition to surgical resection in case of severe hemorrhage. During the procedure, flexible bronchoscopy through a rigid bronchoscope showed the coil in the distal trachea (Fig 2A) and extending back to the RML lateral subsegment (Fig 2B). A flexible grasping forceps was used to remove the visible coil (61 cm), with no significant bleeding (Fig 2C). This was confirmed on intraoperative CXR (Fig 3A). The remaining coil segment was identified through a small perforation in the subsegmental airway. It appeared well-seated, tightly coiled, and without any surrounding hemorrhage (Fig 2D). A decision was made to leave it in place and closely monitor in the future. The patient was discharged the same day in stable condition. At his follow-up visit approximately seven weeks post procedure, the patient reported no further hemoptysis. Follow-up CXR showed a patent airway with no further migration of the remaining coils (Fig 3B).

Conclusion: This is the first reported case to employ minimally invasive interventional pulmonology techniques without needing other interventional tools to fragment the coil to safely extract it in one intact piece after migration into the airway [2,3,4,5,6,7]. A multidisciplinary team including interventional pulmonology, interventional radiology, and thoracic surgery developed a plan that would begin with a minimally invasive approach and rapidly and safely transition to a maximally invasive approach if needed. We suggest prioritizing these discussions in future cases to avoid delays in communication, facilitate collaborative care, and ensure the optimal patient outcome.
Figure Legends

Fig 1: Chest x-ray showing a migrated and uncoiled right middle lobe pulmonary pseudoaneurysm embolization coil.

Fig 2: Bronchoscopic images of the uncoiled coil. A. view in the distal trachea. B. view of the right middle lobe lateral segment before and C. after coil extraction. D. right middle lobe 5th generation bronchus with residual coil.
Fig 3: Post coil extraction representative chest imaging. A. chest x-ray showing interval removal of coil without residual coil in the airway immediately post-procedure before extubation. B. 7 week follow up chest x-ray showing no further migration of remaining coils.

References:
Neoplastic ILD; A Brushing Diagnosis

David Abia-Trujillo, Juan Garcia-Saucedo, John Moss.

**Introduction:** Interstitial lung disease (ILD) represents a challenging diagnosis on their acute presentation. Differential diagnosis is wide but malignancy should always remain in the differential especially if clinical history suggests high risk factors. We present a case in which brushing of the left upper lobe was able to clarify the diagnosis of lung adenocarcinoma when further bronchoscopic interventions were riskier in the presence of mechanical ventilation with moderately elevated positive end-expiratory pressure.

**Case description:** 69 years old man past medical history mainly relevant for COPD and hyperlipidemia presented with 6 months of progressive shortness of breath and cough. Prior to his presentation he had had multiple pneumonias and concern for interstitial lung disease. His respiratory status declined to the point he required endotracheal intubation and mechanical ventilation. CT scan of the chest on admission showed multifocal ground-glass airspace opacities associated to some reticulation. Findings were more pronounced on the right upper lobe, left upper lobe and left lower lobe. The findings appear to have worsened from prior CT scan of the chest. Patient had a PF ratio of 112 and a peep of 10. Infectious workup had been negative and he was empirically started on steroids. Given the lack of response bronchoscopic intervention was pursued for BAL and brushing in the LB3 segment. No trans bronchial biopsy was performed with the concern of the positive pressure. Pathology result was positive for non-small cell carcinoma favoring the diagnosis of lung adenocarcinoma.

**Discussion:** ILD represents a diagnostic challenge if they present with an acute presentation of hypoxemic respiratory failure. In severe cases patient will require mechanical ventilation and bronchoscopic strategies for diagnosis may be limited if elevated positive end-expiratory pressure is required. In this case cytology brush in the appropriate anatomic location was able to clarify the diagnosis. In high risk patients it may be alternative to other more invasive bronchoscopic techniques.
CT scan of the chest showing combined ground-glass pattern with some consolidation throughout the left lung. LB3 segment significantly involved.
Next Generation Sequencing for Identification of Microorganisms in Pleural Fluid

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**Background:** Next Generation Sequencing (NGS) is a massive parallel sequencing technology that has started to play an increasingly important role in oncology, pharmacogenetics, and microbiology. It has the potential to change workflows in the evaluation of suspected bone and joint infections, meningitis, infective endocarditis, and empyema, in which conventional culture has limited utility. In fact, the diagnostic yield of bacterial culture in pleural effusions thought to be infectious in etiology ranges from 18-33%. This retrospective study aimed to compare the diagnostic yield of NGS and bacterial culture in the evaluation of pleural effusions.

**Methods:** Subjects and controls were recruited from January 2017 to August 2019 with IRB approval. Subjects in whom there was a high clinical suspicion for complicated parapneumonic effusion or empyema were recruited from the Mayo Clinic Interventional Pulmonology inpatient consult service. Controls whose pleural effusions were thought to be non-infectious were recruited from the outpatient pleural practice. Aliquots of pleural fluid were obtained at the time of thoracentesis or pleural catheter insertion. Clinical characteristics, including patient demographics, pleural fluid chemistries, Gram stain and culture results, and antimicrobial usage prior to pleural fluid sampling, were obtained from the electronic medical record. NGS was performed by microbiology laboratory personnel blinded to the clinical data.

**Results:** A total of 26 subjects (mean age 70; 62% male) and 21 controls (mean age 69, 73% male) were recruited to the study. Antibiotic therapy was prescribed to 89% of subjects and 19% of controls prior to pleural fluid sampling. Gram stain or bacterial culture was positive in 7 of the 26 subjects. NGS identified one or more bacterial organism in 13 of the 26 subjects, which included the 7 subjects that had positive Gram stain or bacterial culture results. Gram stain or bacterial culture was performed on only 8 of the 21 controls and all returned negative. NGS identified one or more bacterial organism in 5 of the 21 controls, none of whom had conventional microbiologic studies performed. NGS rendered a sensitivity of 100%, specificity of 82.3%, positive predictive value of 68.4%, and negative predictive value of 100%. Total agreement between conventional bacterial culture and NGS was defined as both methods rendering negative results, both methods identifying the same microorganism, or detecting a mixed sequence in the setting of a polymicrobial culture. Partial agreement was identified as a single microorganism being detected on bacterial culture with a mixed sequence detected by NGS or a single microorganism detected by NGS with a polymicrobial culture. No agreement was defined as a negative culture with positive NGS result, positive culture with a negative NGS result, or the detection of a different genus between the two methods. There was total agreement in 67.7% of cases, partial agreement in 8.8% of cases, and no agreement in 23.5% of cases.

**Conclusion:** NGS increased the identification rate of microorganisms present in pleural fluid compared to bacterial culture. Further study is needed to better understand the rate of false positives prior to implementing this technology in the routine evaluation of pleural effusions.
Accuracy and Safety of Utilizing Endobronchial Ultrasound-Guided Biopsy to Diagnose and Stage Bronchogenic Carcinoma invading the Pericardium

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Introduction: A key part of effective treatment management of Squamous Cell Carcinoma is its histopathologic diagnosis and staging. Endobronchial ultrasound-guided transbronchial needle aspiration (EBUS-TBNA) is a highly sensitive and specific procedure in diagnosing and staging intrathoracic cancers. We are presenting a case that shows the accuracy and safety of utilizing EBUS to diagnose and stage bronchogenic carcinoma extending to the Pericardium.

Case Report: An 80-year-old male, with a history 100 pack year smoking, presented with an unintentional weight loss of 20 pounds in 2 months, associated with poor appetite and the ability to tolerate a liquid diet only.

His blood pressure was 171/92 with a pulse of 91 bpm. He was afebrile. His BMI was 14.7 kg/m2. On physical exam, he had decreased breath sounds in the left mid-lung. The same area was also dull on percussion accompanied by decreased vocal fremitus. On the neurologic examination, there were no focal deficits. Muscle strength was reduced generally.

He had a white-cell count elevation of 31.1/µl with neutrophilic predominance, without any bands or toxic granulations. Hemoglobin was 11.4 gm/dl, Platelet counts were 697/µ. His BUN was 24 mg/dl and creatinine were 1.4mg/dl. Blood and sputum cultures were negative. Chest X-ray showed a rounded density in the left middle lobe measuring around 5.7 x 6.6 cm2. CT-Scan of the Thorax without contrast showed a large, irregular mass in the lingula measuring around 6.4 x 5 x 5.7 cm3, which was at the least abutting the pericardium with a possibility of invasion through pericardium (figure 1 and 2). CT-Scan of the Abdomen and the Pelvis was also done to get a biopsy sample from the most accessible location for suspected lung cancer metastasis. However, it did not show any metastatic lesion.

Because of the risk of Pneumothorax, it was suggested that he was not a candidate for Interventional Radiology-Guided Biopsy. A bronchoscopy was then performed on the patient. In the Lingula, extrinsic compressions and distorted mucosa were seen. Lung mass was visualized under ultrasound, and biopsy was acquired (figure 3). There was minimal bleeding which was controlled with ice-cold saline. Brush biopsy of the Lingular segment and Bronchial Lavage was also obtained. There were no immediate or late complications from the procedure. Histology was positive for squamous cell carcinoma. TNM staging was T4N0M0 as there were no obvious metastases on CT scan of thorax and abdomen. The patient was lost to follow up.

Conclusion: Our case demonstrates the utility and safety of the use of EBUS in a patient with squamous cell carcinoma with possible invasion of the Pericardium. More comprehensive studies and comparisons to other modalities including CT-guided biopsy and Mediastinoscopies are required to be able to define it better.
Bronchial Stricture: Herbs Don’t Belong in Lungs

Abhijit Raval, MD

72 y.o. female who presents with a history of cough and congestion for 2 months. Patient treated with 2 rounds of antibiotic and a round of steroid but no major improvement. She is a non-smoker. No weight changes noted. She feels like she is having a lump in her throat which she is not able to clear up. She has no history of hemoptysis. No sick contacts. She has no pets. According to her, her son harvest mesh room in the house and apartment that she leaves quality of the air is extremely poor. She gave a hx of aspiration and some choking episodes which she was not sure, but after further history reported aspiration of diatomaceous earth a type of herb. She had normal white count. Normal IGE, hypersensitivity panel. CXR followed by CT chest was performed reported right lower lobe atelectasis. On physician examination patient had normal vital signs. Noted some focal wheezing in right lower lung field. Patient also noted to have sinus issues as well. Patient spirometry showed mild obstruction and given albuterol but did not improve. Due to persistent symptoms and lack of response to treatment with history of aspiration bronchoscopy was performed. Bronchoscopy noted with Right bronchus intermedius narrowing. No obvious foreign body noted but noted significant fibrotic changes with inflammation. Bronchial lavage and biopsy obtained, which was negative for malignancy. It showed some granulomatous inflammation showing foreign body reaction. It also grew aspergillus which was treated with voriconazole for 2 weeks. Patient underwent into interventional bronchoscopy requiring dilation with CRE balloon with 40cm/h20. Due to ongoing collapse self-expandable mini stent was placed over the wire method.

It was identified that aspiration of diatomaceous earth was associated with bronchial stricture. It is a rare condition and has not been reported to be caused by this herb in literature.

Diatomaceous earth is made from the fossilized remains of tiny aquatic organisms called diatoms. Their skeletons are made of a natural substance called silica. There are several products uses this in its production which includes wettable powders and pressurized liquids used in and outside the house in gardens, farms and pet kennels. There are several non–pesticide products use Diatomaceous earth includes foods, beverages, medicine, rubbers, herbal supplements as well. They are approved by FDA and are generally considered safe if ingested, but certainly aspiration of this product is quite deleterious. Due to content of silica it causes severe foreign body reaction, leading to granulomatous inflammation and that ultimately can lead to fibrosis in airway causing stricture formation as noted in our patient. In one study it was noted that inhalation of Diatomaceous earth in rats one hour every day was associated with 4 times increase in risk of cancer. Higher risk of lung cancer has also been noted with cumulative exposure to respirable crystalline silica dust as well.

So, it is strongly recommended that use of these products especially in dietary and household items should be strictly monitored by FDA.
Stenting of a malignant central airway obstruction caused by a poorly differentiated carcinoma a special consideration

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Introduction and background: Malignant central airway obstruction (CAO) by local extension of lung, pulmonary metastasis or from distant sites of origin is a common complication in patients with advanced malignant tumors. Among the benefits of airway stenting to restore the patency of the airways can be listed that is the most effective palliation for patients with disabling symptoms of dyspnea, it facilitates extubation in critically ill patients, and can be used as bridge therapy to the definite treatment of cancer, as 40% of lung cancer patients die due to complications resulting from locoregional disease. Poorly differentiated carcinomas accounts for approximately 1.25% percent of all invasive cancer diagnoses. It is now clear that appropriate clinical and pathologic evaluations, are critical as they are extremely responsive neoplasms, and some are curable with combination empiric chemotherapy with response rates from 25 to 45 percent, with a median OS ranging between approximately 7 and 10 months.

CAO due to poorly differentiated carcinoma, as in this case, are highly responsive tumors and the consideration of stent removal in these subset of patients should be arise as the probability of any stent related complication after 6 months has been shown it can be up to 94.3% with Dumon and 97.9% with Aerstent and further research is needed to determine the effects of stenting on survival in patients with malignant airway disease.

Case summary: A 53-year-old female with PMH of schizophrenia, seizure disorder, asthma, current smoker, and hypertension was admitted due to newly diagnosed lung mass complicated by sepsis in the setting of post-obstructive pneumonia, and acute hypoxic respiratory failure. She underwent elective intubation, and negative infectious workup including: streptococcus pneumoniae antigen, influenza A&B antigens, legionella urinary antigen, mycoplasma pneumoniae IG M, HIV, MRSA nares, bronchial pneumocystis DFA negative, sputum grew candida albicans/tropicalis, and her respiratory cultures from bronchoscopies, AFB/fungal where all negative.

She was treated with broad spectrum therapy vancomycin, cefepime broaden to meropenem, metronidazole, fluconazole, and steroids. Her first bronchoscopy with endobronchial biopsy was non diagnostic for which she was re-intubated where a second bronchoscopy with tumor debulking, balloon dilation (3 were completed to a diameter of 8), and EBUS was performed. During the procedure significant mediastinal lymphadenopathy was appreciated in station 7 with extension towards the mass. At this time, she was unable to be extubated due to obstruction causing collapse of the left lung. Further, characterization with CT revealed left hilum and subcarinal infiltrative soft tissue mass measuring 4.5 x 2.5 cm, with narrowing of the left mainstem bronchus, lobar branches, and the left hilar pulmonary venous structures. Also, a complete consolidation of the left lower lobe with volume loss, favor post obstructive atelectasis was noted. During a third bronchoscopy a 12 x 30 mm bronchial stent was placed into the airway.
under fluoroscopic guidance with the guidewire placed into the left lower lobe to prevent further respiratory collapse requiring re-intubation. Results from both brushings/BAL showed: Atypical cells with abundant acute inflammatory cells, and a final cytopathology reported malignancy consistent with poorly differentiated carcinoma. Final staging was performed based on mass size (4.5 cm), on lymph node metastasis (malignancy on subcarinal station 7 FNA), and in the absence of distant metastasis on CT of the brain-abdomen-pelvis. Staged this tumor as 2bN2T0. Mass also had a non-pulmonary specific immunoprofile (Tumor cells been positive for CK7, CAM5.2 and Pankeratin). Finally, patient was not able to be extubated so further tracheostomy was performed, and at evaluation by radiation oncologist deem her candidate for palliative chemotherapy-radiation, and to perform PET/CT once her general condition improves.

**Conclusion:** Malignant CAO usually requires airway stenting for palliation therapy, or as bridge therapy but the importance of establish the histopathologic diagnosis is evident in the subset of poorly differentiated carcinomas as they are highly responsive tumors to empiric chemotherapy, and the long term stent related complications can be minimize with early stent removal depending in tumor response.

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**Figure 1. CXR 2/3/2020** Endotracheal tube in place, tip of the tube 2.5 cm above the carina. Left lower lobe opacity, small effusion and/or airspace disease. Patchy right lower lobe infiltrate and trace right pleural effusion.
**Figure 2. CT WITHOUT CONTRAST 2/3/2020** Left pleural effusion with left lower lobe consolidation. Right middle and lower lobe patchy consolidation. With endobronchial obstruction. Left hilum and subcarinal infiltrative soft tissue density/mass, with associated left bronchial airway and pulmonary venous narrowings. Associated left lower lobe total consolidation and volume loss, favor post obstructive atelectasis.

**ECHOCARDIOGRAM 2/5:** Left ventricle: Size was normal. EF was estimated to be 55 %. Grade 1 diastolic dysfunction. Right ventricle: Systolic pressure/RVSP was moderately increased at 67 mmHg. Mild to moderate TR. The respirophasic change in diameter was less than 50%.

**US NECK 2/7 WITH:** Evidence of DVT in the left internal jugular, subclavian, axillary, and brachial veins.
Figure 3. CT CHEST WITH CONTRAST BEFORE STENT PLACEMENT 2/10 There is infiltrative soft tissue density (4.5 x 2.5 cm) within the left hilum and the subcarinal position. There is resultant narrowing of the left mainstem bronchus and lobar branches, and of the left hilar pulmonary venous structures. There is associated complete consolidation of the left lower lobe with volume loss, favor post obstructive atelectasis.

Figure 4. CXR 2/13 Post stent placement on left main bronchi.
CXR 2/1 POST Tracheostomy placement. CT abdomen/pelvis with contrast With no evidence of metastatic disease. CT HEAD with no CT evidence for acute intracranial pathology.

**CYTOPATHOLOGY 2/7/20**
A. STATION 7; FINE NEEDLE ASPIRATE: Positive for malignant cells, carcinoma.
B. LEFT MAINSTEM ENDOBRONCHIAL MASS; BRUSHINGS: Atypical cells present
C. LEFT MAINSTEM MASS; FINE NEEDLE ASPIRATE: Positive for malignant cells, carcinoma (see comment).
D. LEFT MAINSTEM; BRONCHOALVEOLAR LAVAGE AND WASHINGS: Positive for malignant cells

**COMMENT:** Sections show sheets of malignant epithelioid cells with extensive necrosis. No morphologic evidence of gland formation, mucin production, keratinization or intercellular bridges is seen. Tumor cells are positive for CK7, CAM5.2 and Pankeratin, a non-specific immunoprofile. Based on morphology and immunohistochemical stains the tumor is best characterized as **Poorly Differentiated Carcinoma.** Site specific markers (lung, gastrointestinal, mammary) as well as neuroendocrine markers are negative.
In the setting of Covid19 pandemic, proceduralists could be exposed to noxious airborne particles that pose a significant health risk. While SARS-COV-2 is usually transmitted through droplets, certain procedures such as bronchoscopy could aerosolize viral particles and infect HCW present in the room. With appropriate use of PPE this risk is greatly decreased. We designed a “negative pressure aerosol chamber”, inspired on the ISOPODs and earlier isolation boxes previously described in Asia. These devices theoretically facilitate an additional layer of protection of healthcare workers and limit bioaerosol spread.

Given its characteristics, this innovative chamber proved to be a valuable portable resource particularly for bronchoscopy – although many benefits from its use on extubation, transfers and non invasive ventilation is suggested.

To further the benefits of such boxed described by other authors (1), we conceived several features that enhance its capabilities. These include: 1) 50L chamber; 2) an adapter for wall or portable suction (generating negative flows of 50-70L/min); 3) Closed access ports for securing bioaerosol containment, and flaps for enhancing seal. Four stainless steel grommets have been attached at the base of the device to assist in attaching to the bed; 4) This chamber is reusable.

Different construction material to facilitate durability, portability, decontamination and enhanced visibility; 5) Versatility that allows for negative flow/pressure to be used in situations that include transport-transfer, extubation, and aerosol generating procedures as bronchoscopy, tracheostomy, HFNC/CPAP/Bipap (particularly beneficial for facilities with limited resources as PPE or negative pressure rooms); 6) Customizable access ports, suggested two at the head, and two on each size. Width can be customized to accommodate effective seal for different bed/mattress sizes (ranges 20.5” for OR tables to 36.5” for ICU beds).

In preliminary testing, our negative pressure isolation chamber has been demonstrated to: 1) allow for expeditious intubation (mean intubation times of 15.1 seconds +/- 5 seconds – see addended table); 2) containment of bioaerosol (on trials with ultraviolet light as fluorescent powder was nebulized within the chamber – see addended figure); 3) evacuation of contained aerosol at 6 minutes with negative flows of 50L/min (with viral filter in line for wall suction or with HEPA filters for portable suction systems); 4) resistant material to various external factors that could impair chamber integrity.
This chamber should not be used in lieu of CDC recommendations for HCW PPE and best evidence available to limit exposures.

We believe that these upgrades to the previously described device will enhance its benefits, with minimal although key modifications to facilitate efficacy.

Instructional on suggested use for intubation, extubation and transport can be found in appendix 1.
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Atypical Presentation of an Endobronchial Tumor. A Case Report of Tumor Debulking Followed by Upper Sleeve Lobectomy.

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DISCLOSURES: None

INTRODUCTION: Optimal management of malignant central airway tumors requires a meticulous pre-operative evaluation including functional status, extent of tumor invasion, and the ability to manage potential complications. We present a case of an older male who presents with chronic cough and is found to have right mainstem endobronchial squamous cell carcinoma. The patient undergoes rigid bronchoscopic tumor debulking and cryotherapy with follow up imaging concerning for residual disease prompting curative surgical resection made possible by early tumor debulking.

CASE DESCRIPTION: A 75-year-old male former smoker who presents with 2 months of nonproductive cough. Initial workup includes computed tomography (CT) that shows a right mainstem endobronchial lesion (Figure 1a). Three weeks later, he develops worsening shortness of breath prompting admission and repeat CT with new adjacent bronchial wall thickening (Figure 1b). Patient’s pulmonary function tests (PFTs) show severe obstruction and mildly reduced diffusion capacity (DLCO) (Table 1). Rigid bronchoscope is used to core out the endobronchial tumor followed by cryotherapy to treat any residual right mainstem bronchus involvement. Pathologic evaluation confirms squamous cell carcinoma (SCC), moderately differentiated; however, most fragments are superficial limiting accurate depth of invasion assessment. Patient is discharged with outpatient Positron Emission Tomography (PET) one month later revealing hypermetabolic soft tissue at right mainstem bronchus suspicious for residual malignancy. Repeat PFTs show complete normalization of obstruction and DLCO (Table 1). He then underwent right robotic upper sleeve lobectomy, lymphadenectomy, and right lower lobe superior segment wedge resection which showed invasive 1 x 0.9 x 0.2cm squamous cell carcinoma (Figure 2) with 0/11 positive lymph nodes, resulting in stage of T2, N0, M0 diagnosis s/p curative excision.

DISCUSSION: Central airway obstruction related to endobronchial malignancy is one of the most difficult oncological complications to manage. Tumor invasion has dramatic implications for pre-operative planning and patient prognosis. Central airway endobronchial malignancy can
cause airflow limitations which can impact the ability of patients to tolerate treatments like chemotherapy. Cryotherapy employs freeze-thaw cycles using extreme cold to cause desiccation and tissue destruction which minimizes damage to tissues with lower water content like cartilage and fibrous tissues. This helps reduce risks of bleeding or airway perforation.

This patient presented with subacute symptoms and radiographic evidence of limited endobronchial lesion. Initial operative intervention with rigid bronchoscopic debulking and empiric cryotherapy could reasonably be expected to yield curative results.

However, given uncertainty of tumor invasion, we opted for close follow up with PET that demonstrated concern for residual tumor presence. Interestingly, his repeat PFTs (Table 1) showed marked improvement in his respiratory mechanics which correlated with symptom improvement. This allowed him to safely undergo curative lobectomy.

This case highlights the need to maintain vigilance in following patients who undergo “curative” endobronchial interventions.

**CONCLUSION:** The role of tumor debulking and cryotherapy in managing endobronchial squamous cell carcinoma has potential benefits of improving functional status and enhance candidacy to a wider array of treatment modalities like surgery or chemotherapy. Further studies are needed to define debulking in managing malignant central airway obstructions.

**REFERENCES:**

**Figure 1.** CT Coronal images showing right mainstem endobronchial lesion. A) is the initial non-contrasted CT showing limited stalk (Blue arrow) and normal surrounding airways. Conversely, B) is a contrasted CT obtained 3 weeks later that shows more significant attachment to the posterior right mainstem with significant bronchial wall thickening extending from right hilum to right lower lobes which is NOT appreciated on initial CT.

**Figure 2.** Surgical specimen from right robotic converted open upper sleeve lobectomy with forceps exposing right mainstem bronchus sleeves.
**Table 1: Pulmonary Function Tests performed before and after tumor debulking.** Pre-operatively patient exhibits severe obstruction and mild reduction in diffusion capacity which both normalize after debulking. The Flow-Volume Loops before tumor debulking show pre-bronchodilator loops in red ink and post-bronchodilator loops in blue ink. This pre-operative flow volume loop displays a classic scalloped appearance indicative of obstructive ventilatory defect that does NOT have the typical flattening of the expiratory phase expected in an intrathoracic obstructive impairment likely related to unilateral obstruction. Interestingly, the follow up flow volume loops after tumor debulking show return to near normal prebronchodilator loops (shown in red with predicted/expected measures indicated by black circles).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Before Tumor Debulking</th>
<th>After Tumor Debulking</th>
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<tbody>
<tr>
<td>FVC</td>
<td>1.79 L (69% predicted)</td>
<td>2.92 L (100% predicted)</td>
</tr>
<tr>
<td>FEV1</td>
<td>1.04 L (54% predicted)</td>
<td>2.02 L (90% predicted)</td>
</tr>
<tr>
<td>Ratio</td>
<td>58 (LLN 64)</td>
<td>69 (LLN 64)</td>
</tr>
<tr>
<td>Bronchodilator Response</td>
<td>Significant (&gt;12% and</td>
<td>Not tested</td>
</tr>
<tr>
<td></td>
<td>200mL)</td>
<td></td>
</tr>
<tr>
<td>TLC</td>
<td>5.07 L (94% predicted)</td>
<td>5.34 L (99% predicted)</td>
</tr>
<tr>
<td>RV</td>
<td>2.90 L (129% predicted)</td>
<td>2.53 L (112% predicted)</td>
</tr>
<tr>
<td>DLCO</td>
<td>62</td>
<td>94</td>
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</tbody>
</table>

***FVC (Forced Vital Capacity); FEV1 (Forced Expiratory Volume in 1st second), Ratio (FEV1/FVC), TLC (Total Lung Capacity), RV (Residual Volume), DLCO (diffuse capacity of lung for carbon monoxide).***
Catastrophic Hemorrhage Avoided with Robotic-Assisted Bronchoscopy

Steven Verga, Robert Marron, Gerard Criner

Introduction: Lung cancer accounts for greater than 18% of all cancer related deaths worldwide making early diagnosis critical.1 The recent Nelson Trial and the older National Lung Screening demonstrated a benefit to screening for lung cancer as it led to a 24% and 20% reduction in mortality, respectively. 2,3 The benefits of screening, however, are mitigated by the risks of false positive findings leading to invasive testing which may have complications. The Nelson Trial reported a false positive rate of 1.2% (264 nodules) resulting in further imaging and diagnostic procedures.2 Currently, the main diagnostic modalities for lung nodules include: computed tomography (CT)-guided Transthoracic needle aspiration (TTNA), surgical resection, and advanced bronchoscopy (i.e. virtual bronchoscopic navigation (VBN), ultrathin bronchoscopy, linear/radial endobronchial ultrasound (EBUS), robotic bronchoscopy). Compared to TTNA, advanced bronchoscopy has significantly fewer complication. Rate of pneumothorax, in particular, is lower with advanced bronchoscopy with a rate of 1.5-3.1% versus 20% with TTNA.4,5 The reduction in complications, however, comes with a lower diagnostic yield with a bronchoscopic yield of 71-88% versus nearly 90% for TTNA.4,6,7 We present a case where catastrophic hemorrhage was avoided with the utilization of robotic-assisted bronchoscopy when biopsy of a peripheral lung nodule.

Case Summary: A 62-year-old female with history of centrilobular emphysema, active nicotine dependence (19 pack-year history), positive anti-cardiolipin antibody, and stage IIA invasive mammary carcinoma status-post lumpectomy with adjuvant radiation on aromatase inhibitor therapy who presents after an incidental lung nodule was discovered on CT scan when enrolled in the COPDGene Study. The nodule was characterized as a stable 1-centimeter pure ground glass opacity. With significant smoking and a history of breast cancer the patient was referred for virtual bronchoscopic navigation with the Ion robotic-assisted bronchoscopy platform with concurrent Dual Cone-Beam CT. At a 7th generation airway a pulsating blood vessel at 9 o’clock position adjacent to the nodule was identified; potentially avoiding a catastrophic hemorrhage while at the same time diagnosing the patient with low-grade adenocarcinoma on cytology.

Conclusion: The integration of robotic-assisted bronchoscopy helps make the diagnosis of peripheral lung nodules a safe and accurate technique and in our case allowed visualization of the airway deep in the lung periphery. Currently there are two robotic bronchoscopic systems on the market; Ion by Intuitive and Monarch by Auris. A small study conducted in Costa Rica demonstrated the diagnostic yield of the Monarch system to be 93% in a sample of 15 patients.8 A larger prospective study is needed to evaluate the benefit of robotic bronchoscopy, possibly with a concurrent dual cone-beam CT augmentation system, and if it minimizes adverse events while providing a diagnostic yield approaching that of TTNA.
References