3-D Printed Silicone Stent for Malignant Central Airway Obstruction
J.E. Howe, M.T. Wayne, T. Gildea, J. De Cardenas

A case matched comparison of patient and nodule characteristics before and after implementation of perioperative lung nodule localization for minimally invasive thoracic surgery
Maxwell Diddams, Jason Long, Jason Akulian

A Case of Asymptomatic Mediastinal Lymphadenopathy Showing Mantle Cell Lymphoma in a Patient Positive for Antineutrophil Cytoplasmic Antibodies
Hira Irfan, Pranay Korpole, Prabhat Sinha

A Case of Pulmonary Hyperinfection Syndrome with Strongyloides Stercoralis Diagnosed with Navigational Bronchoscopy-guided Transbronchial Biopsy
Nicholas J. Rohrhoff, Herminieh Aramin, George Z. Cheng, Russell J. Miller, Matthew M. Nobari

A Case of Recurrent Lung Cancer with Different Sub-types
Christina Salmon, Patrisha Shelley, Umair Gauhar

A Challenging Case of Tracheal Stenosis with Failed Balloon Dilatations
Muath Alsharif, Akshay Kohli, Rajagopal Sreedhar, Omar Abdul fattah

A Chance at Another Breath: The use of patient-specific custom Y stents for the treatment of complicated airway stenoses following lung transplantation
Naina Sawal, Michael Reid, Janani Reisenauer, John Mullon, Kelly Pennington, Ryan Kern

A Masquerading Pulmonary Metastasis of Urothelial Carcinoma
Sruti Brahmandam, Umair Gauhar

A Proof of Concept for a Novel Treatment of Lung Abscess
Jaskiran Khosa, Wei Shen

A Prospective Observational Pilot Study of 25 G Endobronchial Ultrasound Transbronchial Needle Aspiration Needle in Patients with Intrathoracic Adenopathy: Preliminary Report
Matsuo So, Samir Kumar, Christian LoCascio, Udit Chaddha

A Rare Asthma Impostor: Endobronchial Granular Cell Tumor in a Young Patient
Milind Bhagat, Fatima Wong, Paul Branca
A Rare Presentation of Pleural Epithelioid Hemangioendothelioma with Scoliosis
Sydney Higgins, Alejandro Aragaki-Nakahodo, Divya Sharma, Patrick Kosciuk

A Real Paradigm Shift in the Making: CBCT Bronchoscopy Replacing CT Guided Transthoracic Needle Biopsies
Krish Bhadra

An Atypical Presentation of Pleural Tuberculosis
Daniel K. Yu, Lisa Jarnigan, Francisco Marquez, Matt Borchart, Raed Alalawi

An Uncommon Cause of Tracheal Obstruction
Alberto A. Goizueta, Christopher Chang, Fnu Aakash, Georgie A. Eapen

An Unusual Case of Pulmonary Amyloidosis Causing Pleural Effusion Diagnosed with Pleuroscopy
Bharat Singh Bhandari, Nauman Khan, Kha Dinh, Pushan Jani

Benign Bronchogenic Endotrachel Cyst in an Adult Presenting with Airway Obstruction
Lisa Saa, David Perez-Ingles, Elyce Sheehan, Akshu Balwan

Bilateral Diffuse Uveal Melanocytic Proliferation: More than Meets the Eye?
Caitlin Batzlaff, Michal Reid, Joanne (Eunhee) Yi, John Mullon, Ryan Kern

Bulbous Emphysema: Hybrid Treatment with Monaldi Procedure and Endobronchial Valves
Matthew McCoy, Mehboob Kalani, Amber McCoy, Kumar Gaurav, Jon Kiev, Manish KC, Ashish Maskey

Case Report: Don’t “Spring” to Conclusions: Unilateral Wheezing Does Not Equate to Asthma
Vanessa Josef, David Perez-Ingles, Akshu Balwan

Chest Tube Care Education: A quality improvement workshop for non-pulmonary providers in the management of chest tube complications on medical wards.
Michelle Zur, David Wu, Daniel Condit, Anil Magge, Adnan Majid, Omar Ibrahim

Close Watch Leads to Clean Catch: Acinar Adenocarcinoma with Pulmonary Coccidioidomycosis
Jyotimayee Lenka, Billie Ann Bixby

Closure of TEF by Using a PFO Occluder Device
Aristides J. Armas Villalba, Phillip Ong

Combined EBUS-TBNA and EUS-B-FNA for Diagnosis of Multiple Lung Cancers: Case Report
Juan P. Uribe, Anil Magge, Adnan Majid, Paul A. VanderLaan, Abduljabbar Dheyab

Complications from Seldinger Chest Tubes: Many Things Can Go Wrong
R. Naaman, S. Kashyap, C. Kapp, K. Haas
Complications of Tunneled Pleural Catheters in Medically Non-Insured vs. Medically Insured Patients
Walid Hadid, Qusay Haydour, Rabih Bechara

Max T. Wayne, Muhammad Sajawal Ali, Elliot Wakeam, Fabien Maldonado, Lonny B. Yarmus, Hallie C. Prescott, Jose De Cardenas

Demographic and Lesion Characteristics in the First 443 Subjects Enrolled in a Multicenter Observational Real World Bronchoscopy Study: Interim Results from TARGET

Device Safety Assessment of Transbronchial Microwave Ablation of Normal Swine Peripheral Lung Using Robotic-Assisted Bronchoscopy
Hector De Leon, Kevin Royalty, Louie Mingione, David Jaekel, Sarvesh Periyasamy, David Wilson, Paul Laeseke, William C. Stoffregen, Tim Muench, John P. Matonick, Grzegorz L. Kaluza, Gustavo Cipolla

Differences in the Perception of the Research Coordinator Role Between Coordinators and Interventional Pulmonologist Investigators: the UROC-IP Survey
Lance Roller, Robert J. Lentz, Fabien Maldonado

Durability of the Effectiveness and Safety of the Spiration® Valve System for Single Lobe Treatment of Severe Heterogenous Emphysema: 24-month follow-up in the EMPROVE study
G.J. Criner, A. Delage, K.G. Voelker, S. Martel

Durvalumab as a possible cause of Vanishing Bronchus Syndrome, case series of five patients
Abdulrahman Katabi, Jaineet S. Chhabra, Joseph A. Chirico, Yousef Shweihat

EBUS Diagnostic Yield in Hilar vs. Mediastinal Lymph Nodes in Sarcoidosis
Naeman Mahmood, Steven Wolf, Raj Dash, Xiaofei Wang, Scott L. Shofer, Coral Giovacchini, Michael Dorry, Kamran Mahmood, Momen M. Wahidi

Endobronchial Stent Malposition in the Posterior Mediastinum
Bharat Singh Bhandari, Manish K. Patel, Kha Dinh, Pushan Jani

Endobronchial Treatment, Expanding Role in Treatment for Carcinoid Tumors. A Case Series.
David Perez-Ingles, Vanessa Josef, Akshu Balwan

Endobronchial Valve Placement and Ogilvie’s Syndrome - A Rare Complication
Priscilla Yee, Wasif Shamsi, Tempest moore, Toribiong Uchel, Maria Cirino-Marcano

Endoscopic Removal of Aspergilloma
Elaine Dumoulin
Eosinophilic Granulomatosis with Polyangiitis and Diffuse Alveolar Hemorrhage Meets Pulmonary Fibrosis and Emphysema: A Case Necessitating Intrapulmonary Recombinant Factor VIIa and Multiple Thoracostomies
Allen Lavina, Sikander Khan, Jinesh Mehta

Fourth Time the Charm
Jennifer D. Duke, Roberto Benzo, Eric Aguirre, Janani Reisenauer, Ryan Kern, David Midthun

Highlighting Two Cases of Bronchial Carcinoid Tumor Successfully Treated with Different Bronchoscopic Techniques
Jennifer C. Pharr, Ekaterina Yavarovich

Incidental Endobronchial Hamartoma Causing Asymptomatic Left Upper Lobe Ball Valve Effect
Kamel Gharaibeh, Janaki Deepak, Van Kim Holden, Faria Nasim

Initial Safety Results from a Phase 1 Trial of Robotically Delivered, Neoadjuvant, Intratumoral Cisplatin for Early Stage, Resectable, Non-Small Cell Lung Cancer

Interventional Pulmonology Approach to Eradicating Metastatic Carcinoid
Jalal Damani, Robert Holladay

Intrapleural Tranexamic Acid Therapy in Hemothorax With Persistent Bleeding
Wm. Tyler Smith, Xia Ranran, Hilary DuBrock, David Midthun

Management of Pneumomastia and Bronchopleural-Subcutaneous Fistula via Endobronchial Valve Placement
Grant Senyei, Matthew Nobari, A. Rolando Peralta, Russell Miller, Anuja Vyas, Mark Onaitis, George Cheng

Medical thoracoscopy in loculated parapneumonic effusion: A case report
G. Emasoga, N. Valizadeh, R. Arancibia

Mounir-Kuhn Syndrome: The Role of Custom Stents
Irene Riestra Guiance, Michal Reid, Ryan Kern, Jeremy Clain

Multimodal bronchoscopy in the diagnosis of rapidly growing pulmonary nodules
Ashley M. Scott, Billie A. Bixby

Never too old for congenital problems
Irene Riestra Guiance, Joseph Marion, Mark Norton, David Midthun

Novel Treatment of Persistent Air Leak in a Patient with Post COVID-19 Mucormycosis
Lindsey Morris, Prarthna Kulandaisamy
Percutaneous Tracheostomy, an Ever-evolving Bedside Procedure
Daniel Hernandez-Rojas, Sebastian Fernandez-Bussy, Kate Walsh, Alejandra Yu Lee-Mateus, Rocio Castillo-Larios, Sai Priyanka Pulipaka, David Abia-Trujillo

Prevalence of Non-Cystic Fibrosis Bronchiectasis in Expiratory Central Airway Collapse
Sai Priyanka Pulipaka, Sushil Kumar Sonavane, Rolf Grage, Alejandra Yu Lee-Mateus, Daniel Hernandez-Rojas, Rocio Castillo-Larios, David Abia-Trujillo, Sebastian Fernandez-Bussy, Margaret Johnson

Recurrent Pulmonary Alveolar Proteinosis Manifestations after Multiple Whole Lung Lavages and Concurrent Anti-GMCSF Therapy
Hira Irfan, Chenchen Zhang, Adnan Majid, Mihir Parikh

Recurrent Respiratory Papillomatosis causing airway obstruction
Bharat Singh Bhandari, Kha Dinh, Andrew G. Tritter, Pushan Jani

Reducing Hospital Admissions in Patients with Malignant Pleural Effusion-A Quality Improvement Study
Rebecca Cloyes, Susan Vasko-Wood, Chelsea Mohrman, Carolyn Presley, Enambir Josan, Christine Eastep, Nicholas Pastis, Alberto Reveo, Christian Ghattas, Jasleen Pannu

Robotic Assisted Navigation Bronchoscopy: A Meta Analysis of Diagnostic Yield and Complications
Fahim Pyarali, Niv Hakami, George Chaux

Role of Next Generation Sequencing with Percepta Brushing in Reclassifying Lung Nodule Work Up
Abhijit Raval

Spray Cryotherapy in Benign Tracheal Stenosis: A Single-Center Six Year Experience
Ankush P. Ratwani, Evan Schwartz, Lance Roller, See-Wei Low, Robert J. Lentz, Alexander Gelbard, Otis B. Rickman, Fabien Maldonado

Successful Treatment of Bronchovascular Fistula with Amniotic Membrane Allograft
David Perez-Ingles, Chakravarthy Reddy, Akshu Balwan

Successful use of spiration valves in conjunction with pectoralis major muscle flap to treat persistent bronchopleural fistula caused by post-operative wedge resection of cocci empyema.
Daniel K. Yu, Lisa Jarnigan, Francisco Marquez, Matt Borchart, Raed Alalawi

Symptomatic Accessory Cardiac Bronchus
Prince Ntiamoah, Atul C Mehta, Thomas R Gildea

Synovial Sarcoma Presenting As Obstructive Tracheal Mass
Rosina Schiff, Mitchell W. Waters, Zachary S. Depew

TB or not TB
Maykel Irandost, Raed Alalawi

The Geometrical Evaluate for the Difficulty of Reaching Lung Lesions by Electromagnetic Navigational Bronchoscopy
Masahito Naito, Melani Lighter, Matthew Pommerening, Nobuhiko Hata, Hitashi Tsukada
The Use of Robotic Assisted Bronchoscopy in the Diagnostic Evaluation of Peripheral Pulmonary Lesions; A Paradigm Shift

The Utility of Point of Care Ultrasound (POCUS) in Navigational Bronchoscopy Guided Biopsy
S. Khauli, B. Boer

To Investigate the use of Airway Contrast to Objectively Measure Anastomotic Diameter in Lung Transplant Patients: Single-Center Pilot Study
Monica Kakol, Katie Capp, Joseph Keenan, Jennifer Wong, Abbie Begnaud, Erhan Dincer, Roy Cho

Tool-in-lesion Characteristics of Diagnostic and non-Diagnostic Robotic Assisted Bronchoscopy Cases
Jefferson Chambers, Timothy LeClair

Tracheobronchial tear, Unusual Complication caused by CP-EBUS
Fatima Ali, Victoria Reimer, Rajeshkumar Patel

trūFreeze® Spray Cryotherapy Patient Registry: Initial Pulmonary Report
Robert Browning, Ashutosh Sachdeva, Scott Parrish, Kei Suzuki, Luis Rojas, Costas Bizekis

Usefulness of confocal laser endomicroscopy in the real-time diagnosis of lung tumors in a low income country: A retrospective case series
Efrain Sanchez-Angarita, Galo Chang, Zoraya Novoa, Elvis Matheus

Using Robotic Assisted Navigation Bronchoscopy for Mixed Density Pulmonary Lesions: A retrospective review from a single center
Fahim Pyarali, Alexander Leung, George Chaux, Taryne Imai

Utilization of robot-assisted navigational bronchoscopy in the retrieval of a distal foreign body
Michelle Miles, Thomas Marston, Brian Boer, Keenan Taylor

Ventilator Parameters and Outcomes Associated with Pneumothorax in Mechanically Ventilated Covid-19 Patients
Muhammad Daniyal Hashmi, Hafsa Abdulla, Amreeta Vashti Sharma, Daniel R. Ouellette, Alaa Abu Sayf

Wh”Air” Did it Come From? : An unusual case of subcutaneous emphysema and pneumomediastinum post-EBUS-TBNA
Jon Mullholand, Madhav Chopra, Jennifer Toth
3-D Printed Silicone Stent for malignant central airway obstruction

Authors: J. E. Howe MD1, M.T. Wayne MD1, T. Gildea MD2 J. De Cardenas MD1,3.

1Division of Pulmonary and Critical Care Medicine, University of Michigan Health System, Ann Arbor, MI
2 Department of Pulmonary Allergy and Critical Care Medicine & Transplant Center, Cleveland Clinic, Cleveland, OH
3 Section of Thoracic Surgery, University of Michigan Health System, Ann Arbor, MI

Introduction: As many as 30% of patients with lung cancer will develop malignant central airway obstruction (mCAO). Three-dimensional (3D) stents have been scarcely reported for treatment of malignant CAO. We report the first clinical application of a custom 3D printed silicone Y-stent for a patient with active cancer with mCAO.

Case Description: 48-year-old male with metastatic renal cell carcinoma with right upper lobe metastasis that progressed despite thoracoscopic resection in 2019 and radiation therapy in 2020. He presented with dyspnea from a large right-sided hilar mass that occluded the right mainstem bronchus. He underwent rigid bronchoscopy with tumor debulking and placement of an Ultraflex 12x40mm covered stent given extrinsic compression of the right mainstem bronchus despite of tumor debridement. At follow-up, patient endorsed ongoing dyspnea and chest CT demonstrated almost complete collapse of the stent due to external compression by the tumor. A customized patient-specific silicone Y-stent was designed using the patient’s CT scan and 3D volumetric reconstruction. In context of normal left sided bronchial anatomy, the Y design was selected to prevent stent migration. On repeat bronchoscopy, there was near complete collapse of the right mainstem bronchus of the existing covered metal stent (Figure 1). Following stent removal, the new custom 3D Y stent was deployed (Figure 2). Post-procedure, the patient noted immediate improvement. Follow-up CT chest one month later demonstrated stable stent position and continued patency.

Conclusion: 3D printed silicone stent placement for mCAO is feasible and, in this case, demonstrated superior stability and radial patency by comparison to conventional metallic stent.
Figure 1. (A) Initial view at the level of the distal trachea. (B) Closer view of the right main stem bronchus with extrinsic compression by the right upper lung mass. Note minimal granulation tissue at the level of the proximal edge of the metallic stent.

Figure 2. (A) Internal view from the new custom 3-D stent at the level of the main carina. (B) Internal view of the stent on the right sided bronchi with full patency of the right mainstem, right middle and lower lobes. (C) Printed custom 3-D Y silicone stent. (D) Design of the custom 3D stent using Vision Air Stent architect software.
A case matched comparison of patient and nodule characteristics before and after implementation of perioperative lung nodule localization for minimally invasive thoracic surgery.

Authors: Maxwell Diddams, Jason Long and Jason Akulian

Background: Advances in thoracic imaging has improved the identification of small solitary pulmonary nodules (sSPN) that represent early curable disease. The transition from open thoracotomy (OT) to video/robotic assisted minimally invasive thoracic surgery (MITS) have improved surgical morbidity, however MITS may limit the surgeon’s ability to detect sSPN resulting in the need to convert to OT or resection failure.

Methods: We conducted a retrospective chart review of patients who underwent MITS for resection of SPN at a quaternary care medical center to compare nodule, patient, and surgical procedure characteristics before and after the implementation of perioperative localization. Marking was accomplished via electromagnetic navigation transthoracic localization of nodules (EMTTNL) in the operating room immediately prior to either video- or robotic-assisted thoracoscopic surgery (VATS/RATS). Primary outcomes evaluated were nodule size, distance from pleura, and consistency.

Results: We identified 74 EMTTNL cases and 74 cases performed with MITS alone prior to the introduction of EMTTNL. The use of EMTTNL was associated with the resection of significantly smaller nodules when compared to MITS alone (13.1mm vs 15.1mm, p=0.05) primarily driven by a decrease in nodule size for VATS with EMTTNL (11.8mm vs 15.1mm, p=0.015). No significant difference was noted between EMTTTLN and MITS when comparing patient demographics, nodule (depth, consistency, or location) or procedural characteristics. Patients who underwent RATS were significantly older than those who underwent VATS (57 years vs 68 years, p<0.0001) without significant differences in nodule characteristics or surgical complications.

Conclusions: Perioperative EMTTNL was associated with the resection of significantly smaller nodules suggesting improved surgeon confidence procedural success. Patients in whom RATS was employed were on average a decade older. These findings are limited by selection bias but suggest EMTTNL may improve the resection of sSPN in older populations.
A case of Asymptomatic Mediastinal Lymphadenopathy showing Mantle Cell Lymphoma in a Patient Positive for Antineutrophil Cytoplasmic Antibodies

Authors: Hira Irfan¹, Pranay Korpole¹, Prabhat Sinha¹
¹Pulmonary and Critical Care Medicine, Ascension Providence Hospital, Michigan

Introduction: Mantle cell lymphoma (MCL) is a rare non-Hodgkin lymphoma with indolent and aggressive phenotypes, which may present with extensive lymphadenopathy (1). Antineutrophil cytoplasmic antibody (cANCA) is an autoantigen strongly associated with granulomatosis with polyangiitis (GPA) (2). It is overexpressed in several hematological malignancies (HM) because it has a role in navigating immune response (2). A retrospective study has estimated 5.2% of vasculitides to be associated with HMs. Only a handful of cases have reported paraneoplastic ANCA-associated vasculitides in MCL (2,3,5). All of these had significant renal involvement at presentation, and one had concurrent pulmonary hemorrhage. In contrast, we hereby present an asymptomatic case of mediastinal lymphadenopathy secondary to MCL, with elevated cANCA serology.

Case description: We describe a case of a 67-year-old male with PMH of skin basal cell carcinoma, upper lobe emphysema, and tobacco and asbestos exposure, who presented with mediastinal lymphadenopathy on screening low-dose CT scan of chest (Figure 1). Serology was positive for Quantiferon-TB and cANCA titer of 1:1280. Endobronchial ultrasound (EBUS) guided transbronchial needle aspiration (TBNA) and transbronchial needle forceps (TBNF) biopsy of subcarinal and right lower paratracheal lymph nodes (LN) was performed. Right lower paratracheal LN EBUS-TBNA showed MCL with flow cytometry positive for population of kappa light chain restricted, CD5 positive, and CD200 negative B-cells. Neoplastic cell positivity for PAX-5, CD5, and BCL-1, and TBNF biopsy from both LNs also supported the diagnosis. Bone marrow aspirate showed minimal marrow involvement by MCL. Urine analysis was negative for proteinuria and serum creatinine remined within normal limits.

Conclusion: Our case highlights a rare association between cANCA and MCL in a patient with asymptomatic mediastinal lymphadenopathy. Early detection of elevated cANCA levels in such patients can impact patient prognosis and increase infection risk (2). Further research might assist in recognizing cANCA as potential target therapy in HM.
Figure 1: (A) Largest subcarinal lymph node which measures 2.2 x 3.9 cm on initial low dose CT scan of chest.  (B) Lung window at similar level to A.

References:

1. Lynch DT, Koya S, Acharya U. Mantle Cell Lymphoma. [Updated 2022 Feb 1]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-
A Case of Pulmonary Hyperinfection Syndrome with Strongyloides stercoralis Diagnosed with Navigational Bronchoscopy-guided Transbronchial Biopsy

Nicholas J. Rohrhoff, MD1, Hermineh Aramin, MD2, George Z. Cheng, MD,PhD3, Russell J. Miller, MD1,3 Matthew M. Nobari, MD3

1 Department of Pulmonary, Sleep, and Critical Care Medicine, Naval Medical Center San Diego, San Diego California
2 Department of Pathology, Division of Cytopathology, University of California San Diego, San Diego California
3 Department of Medicine, Division of Pulmonary, Critical Care and Sleep Medicine, University of California San Diego, San Diego California

Introduction: Prevalence of strongyloidiasis in the United States has been reported between 0 and 6.1%.1 In select recent immigrant populations and U.S. military veterans of conflicts in Southeast Asia, rates are much higher.2 In immunocompetent patients, pulmonary strongyloidiasis presents with allergic/eosinophilic infiltrates or asthma whereas manifestations of pulmonary hyperinfection in the immunocompromised can include lung abscess, cavitary lung disease, fibrosis, diffuse alveolar hemorrhage and acute respiratory distress syndrome (ARDS), with or without concomitant bacterial pneumonia.3 In patients with impaired cell-mediated immunity, the mortality rate of pulmonary hyperinfection syndrome has been reported to be as high as 86%.4 The diagnosis is usually made by identification of larvae in sputum, bronchial brushing, tracheal aspirate and/or bronchoalveolar lavage.5

Case Description: A 72-year-old retired U.S. Navy Master Chief Petty Officer with past medical history of hematopoietic stem cell transplant presented to the hospital with cough and dyspnea. He denied gastrointestinal symptoms. Remote travel history included multiple deployments to Southeast Asia while on active duty. Chest radiograph showed multifocal opacities concerning for infection. CT scan showed bilateral lower lobe consolidations (Image 1). Initial infectious evaluation included sputum analysis as well as bronchoscopy with bronchoalveolar lavage. No infectious etiology was identified from either sample. Over the next week, the pulmonary consolidations increased in size while chest symptoms and hypoxemia persisted. Electromagnetic navigational bronchoscopy with transbronchial biopsy of the right-sided consolidation was performed under general anesthesia. Cytopathologic examination of the tissue sample revealed larvae consistent with Strongyloides stercoralis (Image 2). Aerobic, anaerobic, and fungal cultures of the biopsy specimen were negative. The patient was treated with Ivermectin with improvement in chest symptoms, resolution of hypoxemia, and discharged from the hospital.

Conclusion: To our knowledge, we describe the first case of pulmonary strongyloidiasis diagnosed using transbronchial biopsy via navigational bronchoscopy.
References


A case of recurrent lung cancer with different sub-types

Authors: Cristina Salmon, MD, Patrisha Shelley, DO, Umair Gauhar, MD
University of Louisville, Department of Pulmonary, Critical Care and Sleep Medicine

Introduction: Non-Small Cell Lung Cancer (NSCLC) is the most common type of lung cancer in the United States. Within this category a few types are well known and reported, however there is a small percentage of rare sub-types. We present a case of Pulmonary Carcino-Sarcoma (PCS).

Case presentation: A 71- years old with prior metastatic lung Adenocarcinoma treated with chemotherapy 7 years prior and 50-pack year smoking history presented to the emergency room with complaints of productive cough, poor appetite, and fatigue.

The patient had undergone a cancer surveillance Computed Tomography (CT) scan 6 months prior to presentation, which had shown slight right upper lobe bronchial wall thickening but no other abnormalities. It had been decided at that time to monitor the abnormality with a follow up CT. Repeat CT was obtained on current presentation demonstrating near-complete consolidation of the right upper lobe along with an airway filling defect.

He was treated with antibiotics for post-obstructive pneumonia and underwent flexible bronchoscopy, which revealed a large fungating mass arising from the right upper lobe and extending to right mainstem bronchus. Flexible bronchoscopy with tumor debulking using electrocautery snare and cryoprobe were performed. Specimen was sent to surgical pathology.

Pathology demonstrated an “admixture” of cell types: pleomorphic large cells with anaplastic nuclei with “mesenchymal” and “epithelial” component, consistent with carcino-sarcoma.

Discussion: PCS is a rare sub-type of NSCLC. It is characterized microscopically by the presence of malignant epithelial and sarcomatous mesenchymal elements, as in this case. Diagnosis can be challenging given that the sample might not contain both components hence a large tissue sample must be obtained.

In this case, CT findings of bronchial wall thickening could be indicative of early tumor growth. Tumors causing airway obstruction tend to be diagnosed sooner, therefore, have better prognosis when compared to peripheral tumors.

References:
1. Liangdong Sun, Jie Dai, Xujun Wang, Gening Jiang, Diego Gonzalez-Rivas, Jiong Song, Peng Zhang, Pulmonary carcinosarcoma: analysis from the Surveillance, Epidemiology and End Results database, Interactive CardioVascular and Thoracic Surgery Volume 30, Issue 1, (January 2020)
2. Li, Xin, Di Wu, Hongyu Liu, and Jun Chen. Pulmonary Sarcomatoid Carcinoma: Progress, Treatment and Expectations. Therapeutic Advances in Medical Oncology, (January 2020).
A Challenging Case of Tracheal Stenosis with Failed Balloon Dilatations

**Authors:** Muath Alsharif, MD\(^1\), Akshay Kohli, MD\(^1\), Rajagopal Sreedhar, MD\(^1\), Omar Abdulfattah, MD\(^1\)

\(^1\)Southern Illinois University School of Medicine, Division of Pulmonary and Critical Care Medicine, Springfield, Illinois

**Introduction:** Tracheal stenosis is a rare but potentially fatal complication of tracheostomy. Only 1-2% of these cases become symptomatic. We report a case of an incidental thyroid malignancy finding in a patient with tracheal stenosis masking as COPD exacerbation.

**Case summary:** A 56-year-old man with morbid obesity (BMI -46kg/m\(^2\)) and a history of tracheostomy after tonsillectomy, who had recurrent prior admissions for COPD exacerbation presented with worsening shortness of breath and an audible inspiratory and expiratory wheeze. He reported using CPAP for more than 16 hours a day to relieve his symptoms. Physical exam was significant for stridor without any wheezing in the lower airways. Evaluation with flexible bronchoscopy revealed significant tracheal stenosis around the stoma site. Vocal cords looked normal. CT scan of the neck and chest with IV contrast revealed narrowing of the subglottic oropharynx with enlarged left lobe of thyroid gland measuring up to 2.8 cm with possible invasion to the left paratracheal region. Fine needle aspiration (FNA) showed papillary thyroid carcinoma. He subsequently underwent rigid bronchoscopy but serial balloon dilation was unsuccessful. An area of extrathoracic lesion impeding the airway was noted. On surgical exploration, only the left thyroid lobe tumor was removed due to the tumor extending into the left lateral trachea along with tracheoesophageal groove and obscuring the left recurrent laryngeal nerve for which a shave resection was performed. Subsequently, balloon dilatation was successfully completed with minimal resistance. Tissue pathology confirmed extension of the tumor with positive margins. Tracheal resection was deemed to be high risk and was not performed.

**Conclusion:** Tracheal stenosis is a clinical entity that often requires interventional bronchoscopy before surgery is considered. Malignancy as the cause of tracheal stenosis can be easily overlooked and can be the cause of bronchoscopic balloon dilatation failure from compression effect.
A Chance at Another Breath: The use of patient-specific custom Y stents for the treatment of complicated airway stenoses following lung transplantation

Authors: Naina Sawal, Michael Reid, Janani Reisenauer, John Mullon, Kelly Pennington, Ryan Kern

Introduction: Airway stenosis management following lung transplantation is technically challenging. Current treatment options focus on using a variety of different modalities including rigid bronchoscopy, microknife electrocautery, laser, balloon dilation, and stent placement; however, these strategies are often ineffective for complicated airway stenoses. We report our initial experience with patient-specific custom silicone Y stents for the management of complicated airway stenoses after lung transplantation.

Case Description: From December 2021 to March 2022, four custom silicone Y stents were created for management of airway stenoses in patients post-lung transplantation. All patients had undergone a combination of prior therapeutic bronchoscopy with variations of microknife electrocautery, laser, and balloon dilation. Unfortunately, improvements in dyspnea and lung function were only temporary as documented by their forced expiratory volume (FEV1). Traditional stenting was attempted in patient 1, however, placement resulted in an obstruction of the right upper lobe bronchus due to complex bronchus intermedius anatomy and the proximity of the anastomosis to the first right carina (RC1). The remaining patients had a similarly distorted anatomy and traditional stents were felt to be inadequate for the treatment of their complicated airway stenoses. Using uploaded CT images, the desired patient-specific stent dimensions were constructed with 3-D software (VisionAir, Cleveland, OH). After the shape was created, a 3-D printed mold was made which allowed for the fabrication of the silicone Y stent. All stents were then successfully implanted using rigid bronchoscopy and post-procedural spirometry demonstrated significant improvement in FEV1.

Discussion: Though experience is limited, patient-specific custom Y stents may be another useful tool for the management of airway complications in lung transplant patients. These patients often have complex anatomy and this patient series illustrates how this new technology can potentially provide an effective solution, particularly when other treatment modalities have failed.
<table>
<thead>
<tr>
<th>Patient #1</th>
<th>Bilateral/Idiopathic Pulmonary Fibrosis</th>
<th>4mm</th>
<th>Distal left mainstem bronchus (LC2), left lower lobe</th>
<th>Proximal: 11.2/13.2mm, 11.2/13.2mm x 16.6mm</th>
<th>0.81</th>
<th>1.72</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Distal upper: 7.7/9.7mm, 6.8/8.8mm x 18.2mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Distal lower: 6.7/8.7mm, 6.7/8.7mm x 15.5mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Branch 1 &amp; Branch 2: 8.9/10.9mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient #2</td>
<td>Bilateral/Idiopathic Pulmonary Fibrosis</td>
<td>7mm</td>
<td>Distal left mainstem bronchus, left lower lobe</td>
<td>Proximal: 16.4/18.4mm, 14.2/16.2mm x 23.6mm</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Distal upper: 6.4/8.3mm x 15.1mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Distal lower: 7.7/9.7mm, 7.0/9.0mm x 15.4mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Branch 1 &amp; 2: 9.0/11.0mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient #3</td>
<td>Single/Idiopathic Pulmonary Fibrosis</td>
<td>6mm</td>
<td>Bronchus intermedius (RC2), right lower lobe</td>
<td>Proximal: 9.0/11.0, 8.5/10.5, 8.0/10.0mm x 24.9mm</td>
<td>1.35</td>
<td>1.75</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Distal upper: 6.0/8.0mm, 6.6/8.6mm x 15.2mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Distal lower: 6.0/8.0mm,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient #4</td>
<td>Bilateral/Combined Pulmonary Fibrosis and Emphysema</td>
<td>6.2mm</td>
<td>Right upper lobe, bronchus intermedius</td>
<td>Proximal: 15.0/17.0mm x 16.1mm</td>
<td>1.58</td>
<td>2.49</td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------------------------------------</td>
<td>------</td>
<td>----------------------------------------</td>
<td>---------------------------------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Distal upper: 10.0/12.0mm, 8.6/10.6 x 23.7mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Distal lower: 7.0/9.0mm, 7.0/9.0mm x 21.6mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Branch 1 &amp; 2: 14.4/16.4mm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1: (Top) Patient #2 stent model. Larger number corresponds to sphere external diameter, smaller number corresponds to sphere internal diameter. (Bottom) Patient #2 stent.
Figure 2: (Left) Patient #2 airway stenosis of left lower lobe. (Right) Patient #2 left lower lobe after stent placement.
A Masquerading Pulmonary Metastasis of Urothelial Carcinoma

Authors: Sruti Brahmandam, MD and Umair Gauhar, MD

Introduction: Cavitary nodules are a rare pulmonary manifestation of urothelial carcinoma. We present a challenging case of pulmonary metastasis of urothelial carcinoma presenting as cavitory lesions.

Case Summary: A 66-year-old male with history of COPD, OSA, and BPH was admitted thrice over eight months for recurrent pneumonias. Initial CXR imaging demonstrated hazy opacity over the right middle lobe. Patient underwent bronchoscopy with bronchoalveolar lavage (BAL) of right middle lobe. Microbiology was positive for mycobacterium lentiflavum. Due to worsening dyspnea and persistent productive cough, repeat CT imaging three months later showed worsening cavitary multifocal pneumonia with new lesions in left upper lobe and right apical lung. Therefore, repeat bronchoscopy with transbronchial biopsy and BAL was performed. Cultures were negative for any type of malignancy, fungal or mycobacterium infections; histopathology of the transbronchial biopsy showed chronic inflammation and focal emphysematous changes. Repeat CT imaging eight weeks later showed several cavitary nodules decreased in size or resolved, but subsequent imaging one month later showed progression of pulmonary opacities. BAL of the right lower lobe was positive for galactomannan assay. He was started on voriconazole for aspergillosis treatment. Patient was admitted three months later with acute hypoxic respiratory failure and hematuria. Repeat BAL showed malignant cells but was negative for fungal or mycobacterium infections. He then underwent VATS with right lower lobe and pleural biopsy. Right lower lobe biopsy was positive for high grade metastatic urothelial carcinoma.

Conclusion: M. lentiflavum is a rare, newly discovered non tuberculosis mycobacterium (NTM) species. One study showed 8% of immunocompromised patients with M. lentiflavum had evidence of probable pulmonary infection. This is a unique case of M. lentiflavum where NTM infection was the initial presentation with eventual diagnosis of metastatic urothelial carcinoma. In the setting of unresolving opacities, malignancy should be considered despite cultures showing an infectious process.


A Proof of Concept for a Novel Treatment of Lung Abscess

Authors: Jaskiran Khosa, MD and Wei Shen, MD

Introduction: We present an innovative proof of concept demonstrating treatment of a multiloculated non-communicating lung abscess with selective pulmonary lobe isolation using an endobronchial blocker. This technique can facilitate drainage and treatment as a bridge to percutaneous drainage in resource limited settings.

Case Summary: A 37-year-old male veteran with history of amyotrophic lateral sclerosis status post tracheostomy for respiratory neuromuscular weakness and recurrent aspiration events presented to the Veterans Affairs Medical Center emergency department with several weeks of cough, fevers, and shortness of breath. Computed tomographic (CT) imaging of the chest revealed multiple loculations in the left basal lung. Upfront placement of multiple indwelling pleural catheters for percutaneous drainage with multiple walled off loculations was felt to be technically challenging per Interventional Radiology. We deployed the adult fiberoptic bronchoscope through the diaphragm of the bronchoscopy port of the Arndt Endobronchial blocker with adapter to advance the bronchoscope to the each subsegment (anterior, lateral, and posterior subsegmental bronchi) while the patient was ventilated with 100% oxygen. This technique allowed for therapeutic drainage of the lung abscess and improvement in clinical symptoms. The patient was treated with broad spectrum antibiotics and eventually was discharged home on low flow oxygen via trach mask.

Conclusion: This case highlights that in resource limited settings without access to electromagnetic navigation, the use of the Arndt Endobronchial Blocker set described here allows for focused targeting of the segmental bronchus in lung abscesses. This improvisational technique facilitated additional time for more optimal treatment either percutaneously or surgically with the multi-disciplinary team between Interventional Radiology and Thoracic Surgery. Our novel approach for use of an instrument directed to drainage of distal subsegmental basal airway segments with accuracy is a feasible adjunctive to percutaneous drainage through the pleural surface for lung abscesses.
A Prospective Observational Pilot Study of 25 G Endobronchial Ultrasound Transbronchial Needle Aspiration Needle in Patients with Intrathoracic Adenopathy: Preliminary Report

Authors: Matsuo So, Samir Kumar, Christian LoCascio and Udit Chaddha

Background: The accurate assessment of mediastinal lymph node (LN) metastasis is critical to accurately stage and consequently, treat lung cancer. The diagnostic accuracy of endobronchial ultrasound-guided transbronchial needle aspiration (EBUS-TBNA) has been reported to be 88-93% with 21 gauge (G) and 22 G needles. Emerging data for larger 19 G needles demonstrate similar yields. However, evidence for the smaller 25 G needles is not robust. In addition, no prospective studies have been conducted to investigate the sample adequacy of 25 G EBUS-TBNA needles for genetic and PD-L1 testing in patients with lung cancer.

Methods: We prospectively recruited patients who underwent EBUS-TBNA using the Olympus Vizishot 2 25 G needle for diagnostic sampling of intrathoracic lymph nodes for either suspected lung cancer, or nodal staging of known lung cancer. A total of 27 LN stations were sampled in 13 patients. Rapid on-site evaluation (ROSE) was performed by a dedicated cytopathology technician to report sample adequacy. Patient demographic data, the number of passes required to obtain an “adequate” sample, the number of total passes performed, and the final cytopathology results were recorded. PD-L1 total proportion score (TPS) and next-generation sequencing (NGS) results (SEMA4) were recorded if clinically indicated in patients with lung cancer.

Results: Thirteen patients with intrathoracic adenopathy were included in this study. A diagnosis, as was obtained in all 13. Six (46.1%) patients were diagnosed with lung cancer, 1 with breast cancer, 2 with sarcoidosis, and 4 with benign reactive adenopathy. ROSE was utilized at 22 of the 27 LN stations sampled. Sampling at 20 (90.9%) LN stations that were evaluated on-site was determined to be “adequate”. Only 1 pass was needed to obtain an “adequate” sample at 18 (81.8%) LN stations. The median number of total passes at each LN station was 3 (range 2-7). PD-L1 and NGS testing was indicated in 5 patients, and in all 5, samples had a sufficient amount of cells to determine the same.

Conclusion: Intrathoracic LNs can be sampled utilizing the Olympus Vizishot 2 25-G EBUS-TBNA needle with high diagnostic accuracy, with a good first pass success to obtain an “adequate” sample. The determination of tissue adequacy for PD-L1 and NGS testing with this needle needs continued prospective recruitment of a larger number of patients.
A Rare Asthma Impostor: Endobronchial Granular Cell Tumor in a Young Patient

Authors: Milind Bhagat, Fatima Wong and Paul Branca

Introduction: Granular cell tumors (GCTs) are benign tumors of Schwann cell origin, usually seen in breast, tongue or skin with peak incidence in middle age. Pulmonary GCTs are extremely rare and usually benign, with a tendency for recurrence. A preference for upper lobes and bronchus intermedius has been described. Patients can present with symptoms similar to obstructive airway disease such as asthma because of involved location and secondary mechanical effects.

Case Summary: A 17-year-old Caucasian male, non-smoker but using smokeless tobacco, was referred to Pulmonology due to “difficult asthma” manifesting as exertional dyspnea, wheeze and excessive rescue inhaler use. Pulmonary Function Tests revealed a mild obstructive ventilatory defect, but significant bronchodilator reversibility. Flow-volume loops suggested a possible upper airway obstruction. CT scan of the chest was unremarkable. Flexible bronchoscopy revealed a partially obstructing right upper lobe polypoid mass and multiple excisional endobronchial biopsies were taken, which decreased the bulk of the mass. Microscopic examination of the biopsy revealed subepithelial proliferation of bland spindled to polygonal cells with round to oval nuclei and abundant eosinophilic granular cytoplasm, consistent with a diagnosis of GCT. As the patient continued to have symptoms, a repeat bronchoscopy (Figure 1) was done by Interventional Pulmonary (IP) with mechanical debridement and contact cryotherapy ablation of the RUL mass (Figure 2). He showed near resolution of his respiratory symptoms following the procedure.

Conclusion: This case of a rare endobronchial tumor emphasizes the importance of considering airway lesions in the differential diagnosis of difficult asthma and spotlights the role of IP. Due to its slow growth and tendency to recur, a surveillance bronchoscopy is recommended once every year for the first 5 years.

Image 1. Bronchoscopic view of the endobronchial lesion seen in the right upper lobe.

Image 2. Bronchoscopic view of the previous lesion post debridement and cryoablation.
A Rare Presentation of Pleural Epithelioid Hemangioendothelioma with Scoliosis

Higgins, Sydney1; Aragaki-Nakahodo, Alejandro2; Sharma, Divya3; Kosciuk, Patrick2
1Department of Internal Medicine, University of Cincinnati Medical Center, Cincinnati, Ohio
2Department of Pulmonary and Critical Care Medicine, University of Cincinnati Medical Center, Cincinnati, Ohio
3Department of Pathology, University of Cincinnati Medical Center, Cincinnati, Ohio

Introduction: Epithelioid hemangioendothelioma (EHE) is a rare vascular tumor of intermediate malignant potential. The pleural variant is seen infrequently and is aggressive. We describe the diagnostic challenges of pleural EHE and an acquired scoliosis.

Case Summary: A 52-year-old gentleman with current smoking and 45 pack-years presented with back pain. CT angiogram demonstrated a 10 x 12 mm left upper lobe lesion and large pleural effusion with pleural nodularity. Pleural fluid was exudative and histopathology was positive for calretinin, CD68 and WT-1, while MOC-31 and BER-EP4 were negative.

Medical thoracoscopy depicted nodularity alongside adhesions in the basilar portion of lung and pleura (Figure 1A). Thick, white plaque-like areas were seen overlying the apex. Cells were positive for vascular markers CD31 and CD34. Combined morphology and immunoprofile were characteristic of EHE (Figure 1B). Patient was treated with pazopanib as he was not a surgical candidate. Progression of the pleural-based tumor resulted in acquired scoliosis (Figure 2A and 2B). He passed away five months into treatment from an infectious pericardial effusion.

Conclusion: Pleural EHE is a rare vascular malignancy. It is difficult to detect as presenting symptoms and cytological analysis of pleural fluid are often nonspecific. Average age of presentation is 45.7 years with a 2:1 ratio of male preponderance. Survival is less than one year (Salijevska et al., 2015). The 2015 World Health Organization classification report supports diagnosis of EHE with positive endothelial markers CD31, CD34 and ERG on tissue biopsy (Galateau-Salle et al., 2016). Thangaiah et al. retrospectively examined pleural fluid of EHE patients which revealed CAMTA1 positivity. CAMTA1 is not routinely performed on pleural effusions but may become a diagnostic identifier of EHE. We also suggest that malignancy originating at the pleural surface can be a cause of acquired scoliosis.

Works Cited:


---

Figure 1.

A. Basilar nodularity with multiple adhesions during medical thoracoscopy.
B. H&E 60X: Epithelioid endothelial cells with glassy eosinophilic cytoplasm and uniform ovoid vesicular nuclei (arrow)

Figure 2.

A. CT Chest following medical thoracoscopy after IPC removal with significant rib space narrowing.
B. Progression of primary pleural malignancy resulting in acquired left-sided scoliosis.
A Real Paradigm Shift in the Making: CBCT bronchoscopy replacing CT guided Transthoracic Needle Biopsies

**Author:** Krish Bhadra, MD

**Background:** Cone beam CT image guided bronchoscopy has garnered significant interest among interventional pulmonologists. Compared to digital tomosynthesis, CBCT images allow for superior acquisition of volumetric data and provide a gold standard for bronchoscopic intra-operative 3D visualization. CBCT images are less prone to motion artifacts and less likely to result in false positives due to atelectasis and hemorrhage. CBCT imaging reduces CT-to-body divergence and can increase workflow efficiency. Early studies with experienced users suggest that the diagnostic yield with cone beam CT imaging is as high as 92% to 94%.

In this single center community hospital, single operator study, we examine the impact of CBCT technology in terms of procedural volume on both cone beam CT bronchoscopic biopsy and interventional radiology transthoracic biopsy rates for peripheral lung lesions and its overall impact on medical and radiation treatments and thoracic surgical volumes. We also analyzed tumor registry data from 2012-2020, assessed stage shifting on local lung cancer rates.

**Methods:** We retrospectively review data from 2012-2021 and compare the rates per calendar year of CT screening, CT guided transthoracic needle aspirates (both FNA and core biopsies), medical oncology chemotherapy treatment (1 course of therapy for patient), radiation therapy (1 course of therapy per patient), and thoracic surgical volume for lung cancer rates.

**Results:** From 2015 to 2021, CT screens increased from 72 to 3313 scans (+4501%). Total interventional pulmonology procedures increased from 326 to 754 (131%) and navigation procedures increased from 49 to 472 (+876%). See figure 1. From 2012 to 2021, medical oncology treatments from 166 to 243 patients (+46%) radiation oncology treatments 133 to 373 (+180%), interventional radiology CT-TTNA of lung lesions decreased from 170 to 88 (-48%) and surgical volume decreased from 95 to 88 (-7%). Stage 1 and 2 disease in 2012 was 41.6% and 2020 to 45.5% (+3.9%) and Stage IV disease decreased from 35.3% to 24.9% (-10.4%).

**Conclusion:** The advent of CBCT image guided bronchoscopy demonstrated significant growth in procedural volume and a decrease in interventional radiology volume. To our knowledge, this is the first study to confirm that CBCT guided bronchoscopy may become the procedure of choice compared to CT guided transthoracic needle aspirate for peripheral lung lesion biopsy.
CT guided TTNA vs Navigational Bronchoscopy

Calendar Year

CT guided TTNA
Navigational Bronchoscopy
2018-2020 CHI Memorial Lung Cancer Trends with the Introduction of CBCT Bronchoscopy

- Stg I
- Stg II
- Stg III
- Stg IV
- Unk, n/a
An atypical presentation of pleural tuberculosis

**Authors:** Daniel K. Yu, Lisa Jarnigan, Francisco Marquez, Matt Borchart and Raed Alalawi

**Introduction:** Globally, tuberculosis remains the most common cause of exudative pleural effusions within both endemic countries and the HIV population. Pleural disease can be a manifestation of either primary tuberculosis (TB) or reactivated TB and primarily affects younger patients. However, in non-endemic countries, it typically manifests in older patients as reactivated TB. We present a case of primary pleural tuberculosis in an elderly patient with remote history of TB risk factors.

**Case Summary:** A 63-year-old male with recently diagnosed stage IV prostate cancer on radiation and androgen deprivation therapy, presented with four months of dyspnea and fatigue. He also endorsed more recent productive cough without fevers. He previously lived in the Philippines and was incarcerated 30 years prior. Admission labs were notable for a normal white blood cell count with mild lymphopenia. CT chest revealed a loculated right-sided pleural effusion, and mild ground glass opacities without cavitation in the bilateral upper lobes. Bedside thoracentesis revealed an exudative, lymphocytic predominant effusion with an adenosine deaminase (ADA) of 102.2 (<9.2 U/L). Serology QuantiFERON-TB plus was positive. He underwent a medical thoracoscopy showing light yellow pleural fluid with thin white loculations and had adhesion lysis with parietal pleural biopsy. Pathology revealed necrotizing granulomas without evidence of metastasis, and pleural fluid studies were positive for Mycobacterium tuberculosis.

**Conclusion:** Our case highlights the importance of comprehensive evaluation of pleural effusions with thoracentesis and medical thoracoscopy. Medical thoracoscopy plays an integral role in diagnosing low prevalence diseases like TB with atypical presentations. In cases of atypical, unclear lymphocytic predominant exudative pleural effusions, early medical thoracoscopy should be pursued.
An Uncommon Cause of Tracheal Obstruction

Authors: Alberto A. Goizueta, Christopher Chang, Fnu Aakash and Georgie A. Eapen

Introduction: Extramedullary plasmacytoma (EP) is a plasma cell neoplasm that presents as an extraosseous lesion comprised of monoclonal plasma cells in a patient with multiple myeloma. EP accounts for approximately 4% of all plasma cell neoplasms and most of the lesions are localized to the head and neck. We present a case of EP in the trachea causing a persistent cough that resolved after removal.

Case Summary: This is a 63-year-old woman with multiple myeloma treated with chemotherapy, stem cell transplant, and CAR T-cells who presented with a non-productive cough for 3 weeks. The patient denied any shortness of breath, hemoptysis, chest pain, fever, or chills. Her vital signs were normal and on physical exam, she was breathing comfortably with a mild inspiratory stridor. Routine serum laboratory tests and chest radiograph were unremarkable. A computed tomography of the chest was then performed showing a new rounded 1.8 cm soft tissue lesion in the mid anterior trachea. She subsequently underwent rigid bronchoscopy revealing a large fleshy polypoid endoluminal mass arising from the anterior wall of the trachea obstructing 90% of the lumen which was then debulked with an electrocautery snare and fulgurated with argon plasma coagulation at the base (Figure 1). Pathological evaluation reported findings of plasma cell myeloma with anaplastic/plasmablastic morphology (Figure 2). Following tumor debulking the patient's cough resolved and she has remained asymptomatic. She is scheduled to receive radiation to the tracheal lesion and continue systemic therapy.

Conclusion: EP of the trachea is extremely uncommon but can present as an airway emergency if it obstructs the central airways. Bronchoscopic intervention can provide a safe and effective technique to obtain a diagnosis, relieve the obstruction, and obtain localized disease control. This case reports a tracheal EP and the multidisciplinary approach, including bronchoscopy, to effectively treat this rare disease.
An unusual case of Pulmonary Amyloidosis causing pleural effusion diagnosed with Pleuroscopy

Authors: Bharat Singh Bhandari, MD; Nauman Khan, MD; Kha Dinh, MD; Pushan Jani, MD
1- Department of Pulmonary and Critical Care, The University of Texas Health Science Center at Houston

INTRODUCTION: Amyloidosis is extracellular tissue deposition of fibrils composed of low molecular weight subunits of a variety of proteins. Many types of amyloidosis are known including AA, AL and ATTR types. [1] Here we present a rare case of pulmonary amyloidosis involving the pleura causing pleural effusion.

CASE: An 82-year-old high functioning female with past medical history of AL type primary amyloidosis (Dx 2014) and chronic systolic heart failure presented to the hospital with a mechanical fall. Initial imaging studies showed multiple pelvic fractures and a moderate to large right sided pleural effusion. She underwent closed reduction and percutaneous fixation of her pelvic fractures. Post-procedure course was complicated by persistent hypoxia. Right sided thoracentesis was then performed with removal of 1000cc of serosanguinous pleural fluid. Fluid analysis revealed exudative effusion. To evaluate for the cause of exudative pleural effusion the patient underwent pleuroscopy with pleural biopsies and chest tube placement. Biopsy was consistent with amyloidosis. Patient was subsequently discharged to a rehab facility.

DISCUSSION: Pulmonary manifestations of amyloidosis are variable, including tracheobronchial infiltration, persistent pleural effusions, parenchymal nodules (amyloidomas) and pulmonary hypertension. [2] Persistent pleural effusions develop in 1 to 2 percent of patients with systemic amyloidosis and appear to be caused by pleural infiltration with amyloid deposits. It can be challenging to differentiate between pleural effusion caused by amyloid-induced cardiomyopathy and pulmonary amyloidosis. Treatment entails management of primary disease and in some cases pleural catheter placement. [3]
Fig 1.0 – Chest Xray showing moderate to large right sided pleural effusion

Fig 2.0 – Pleural biopsy, Congo red stain in light (left) and polarized (right) microscope showing apple green birefringence consistent with amyloidosis.
### Table 1.0 – Thoracentesis fluid studies.

<table>
<thead>
<tr>
<th>Fluid Analysis</th>
<th>Protein gm/dl</th>
<th>Albumin gm/dl</th>
<th>LDH units/L</th>
<th>Cell Count /mm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pleural Fluid studies</td>
<td>3.7</td>
<td>1.8</td>
<td>70</td>
<td>WBC-1137 (82% lymphocytes)</td>
</tr>
<tr>
<td>Serum</td>
<td>5.5</td>
<td>2.0</td>
<td>130</td>
<td></td>
</tr>
</tbody>
</table>

### References

Benign bronchogenic endotracheal cyst in an adult presenting with airway obstruction

**Authors:** Lisa Saa MD¹, David Perez-Ingles MD², Elyce Sheehan MD², Akshu Balwan MD³

1. University of New Mexico, Department of Internal Medicine
2. University of New Mexico, Department of Pulmonary and Critical Care
3. University of New Mexico, Department of Interventional Pulmonology

**Introduction:** Bronchogenic cysts, often found in the mediastinum, are benign congenital abnormalities arising from aberrant development of foregut. Bronchogenic cysts are typically located in the mediastinum. There is no prior reference for a completely endotracheal bronchogenic cyst in an adult.

**Case Summary:** A 39-year-old female with morbid obesity and hypertension presented with 3 months of progressively worsening dyspnea on exertion, cough with sputum production, and hypoxia secondary to rhinovirus pneumonia. CT chest showed tracheal stenosis and nodular tissue protruding in the upper thoracic airway (Figure 1, Panel A) without apparent mediastinal involvement. Patient had no prior history of tracheal instrumentation. This lesion could be traced back to CT images from 2005 but appeared to have progressed. Bronchoscopy showed a bilobed submucosal lesion in the trachea with 40% narrowing of the lumen (Figure 1, Panel B). Subsequent therapeutic bronchoscopy revealed the cystic nature of the lesion upon endobronchial biopsy with mucoid secretions. Cryoablation and marsupialization of the bilobed lesion was performed (Figure 2, Panel A). Pathology was consistent with a benign epithelial-lined cyst. Patient was considered high risk for surgical intervention. Follow-up bronchoscopy at 3 months revealed mild thickening of the mucosa in the mid trachea at the site of the tracheal cyst, and the cyst remained open (Figure 2, Panel B).

**Conclusion:** Although usually symptomatic, bronchogenic cysts in adults can be found incidentally. In our patient, the first evidence of the cysts was seen 16 years prior to becoming symptomatic. If asymptomatic cysts are left untreated, they can continue to enlarge, become symptomatic, or have hemorrhagic or malignant conversion. This is the first reported case on an entirely endotracheal epithelial cyst successfully managed with bronchoscopic intervention. Patient will continue to undergo bronchoscopic surveillance. It is unclear whether this is a separate clinical entity or anomalous presentation of a bronchogenic cyst.
Figure 1 – Panel A: Computerized tomography of the chest showing tracheal lesions
Panel B: Initial bronchoscopic appearance showing a bilobed lesion casing

Figure 2 – Panel A: Post intervention bronchoscopy image
Panel B: Surveillance bronchoscopy image
Bilateral Diffuse Uveal Melanocytic Proliferation: More Than Meets The Eye?

Authors: Caitlin Batzlaff MD, Michal Reid MD, Joanne (Eunhee) Yi MD, John Mullon MD, Ryan Kern MD

1. Department of Pulmonary and Critical Care Medicine, Mayo Clinic, Rochester, MN
2. Department of Pulmonary and Critical Care Medicine, Interventional Pulmonary, Mayo Clinic, Rochester, MN
3. Department of Laboratory Medicine and Pathology, Mayo Clinic, Rochester, MN

Introduction: Bilateral diffuse uveal melanocytic proliferation (BDUMP) is a rare ocular paraneoplastic disorder with 59 reported cases in the literature. BDUMP is caused by growth of benign melanocytes in the uvea. This typically presents as progressive vision loss with multiple nevi identified on examination of the retinal pigment epithelium. Visual symptoms classically herald identification of a primary malignancy, providing a window of opportunity for early diagnosis.

Case Summary: A 72-year-old gentleman with bilateral diffuse uveal melanocytic proliferation (Figure 1), initially diagnosed in 2016, presented to the Interventional Pulmonary Clinic for further evaluation of subacute, progressive loss of voice & shortness of breath with new, left greater than right pleural effusions. CT chest was notable for left mediastinal mass versus adenopathy extending into the left hilum, nodularity along the dome of the left hemidiaphragm, bilateral pleural effusions, and stable solid & sub-solid pulmonary nodules. Prior biopsy of station 10L revealed benign lymphoid tissue. Thoracenteses at outside facilities were bloody in appearance, but no records were available for review. Given the history of BDUMP and recurrent, left, serosanguinous pleural effusion with no previous malignancy identified, extensive work up was obtained to include PET-CT, brain MR, echocardiogram, left thoracoscopy with pleural biopsies & placement of tunneled pleural catheter. Pleuroscopy demonstrated scattered areas of pleural nodularity which were biopsied (Figure 2). Pathology resulted as metastatic adenocarcinoma consistent with lung primary. He was subsequently diagnosed with stage IV, PDL-1 positive primary lung adenocarcinoma.

Conclusion: Bilateral diffuse uveal melanocytic proliferation is a rare ocular paraneoplastic disorder that should prompt diligent investigation for primary malignancy.

Figure 1 Numerous melanocytic lesions with uveal proliferation, consistent with BDUMP
Figure 2 Scattered areas of pleural nodularity, some in clusters, noted on pleuroscopy
Bullous emphysema: Hybrid treatment with Monaldi procedure and endobronchial valves

Authors: Matthew McCoy, Mehboob Kalani, Amber McCoy, Kumar Gaurav, Jon Kiev, Manish KC, Ashish Maskey

Department of Thoracic Surgery, Pulmonary and Critical Care, University of Kentucky, Lexington.

Introduction: Endobronchial valves (EBV) have emerged as a treatment of choice for select patients with various conditions such as severe chronic obstructive pulmonary disease (COPD) and bronchopleural fistula (BPF). The Monaldi Procedure historically was used to slowly decompress post-tuberculosis or post-pulmonary abscess with a chest tube. Today, the Monaldi procedure is rarely used in the treatment of large and debilitating bullous emphysema with viable underlying lung parenchyma. We present a case report of a man with massive bilateral bullous emphysema who underwent bilateral Monaldi procedures complicated by severe bilateral BPF.

Case Report: We present a case of a 47-year-old male former tobacco and cocaine user with a past medical history of COPD, who initially underwent bilateral Monaldi procedures complicated by bilateral BPF. Subsequently, bilateral EBV were placed in the upper lobes stopping the leak. The chest tubes were removed and on imaging, the bullae shrank significantly. Symptomatically he improved from wheelchair on 2 liters nasal cannula to having the ability to walk independently and exercise. His pulmonary function tests showed remarkable improvement with an FEV1 of 1.74L now compared to 0.77L, 7 months pre-procedure. On six-minute walk, he was able to walk 600 feet without oxygen on and without desaturation.

Discussion: This patient showed drastic improvement in both of his surgical complication and functional status after the EBV placement. It is difficult to discern if this patient’s dyspnea improved from the Monaldi procedure or from the lung volume reduction from EBV replacement. Perhaps the EBV would have been an upfront better choice in relieving patient dyspnea and decreasing morbidity. However, he would not have been a traditional candidate for valve placement for lung volume reduction. Normally these valves would have been removed a few weeks post-resolution of BPF.
Case Report: Don’t “Spring” to Conclusions: Unilateral Wheezing Does Not Equate to Asthma.

Authors: Vanessa Josef, David Perez-Ingles and Akshu Balwan

Introduction: Most cases of airway foreign body are diagnosed readily from a clinical history of acute respiratory distress, especially in children; but some cases are indolent and present later in life [1]. Often, tracheobronchial aspiration is mistakenly diagnosed for an obstructive lung disease or an exacerbation of it [2]. We present the case of an adult, pregnant, female who was admitted to our hospital for an acute asthma exacerbation. She was incidentally found to have a metallic object in her airway that had been present for over two decades but went undetected due to lack of chest imaging. Our patient underwent flexible bronchoscopy with conversion to rigid bronchoscopy to remove the object.

Case Presentation: A 30-year-old female G2P1001 currently at 17 weeks of gestation with significant past medical history of mild intermittent asthma, obstructive sleep apnea on continuous positive airway pressure therapy, gastroesophageal reflux disease, and morbid obesity presents with complaints of worsening dry cough for approximately one month. Her cough was associated with left-sided chest tightness and wheezing, and dyspnea that slightly improved with albuterol and she was subsequently admitted for acute asthma exacerbation. Chest radiography was concerning for a foreign body in the left main bronchus, however no prior imaging was available for comparison. Patient endorsed swallowing a small spring from a pen at the age of 9 but denies any respiratory symptoms at that time. A metallic spring in the proximal left main bronchus was confirmed by CT thorax without contrast (Figure 1). The foreign object (Figure 2) was removed using flexible and rigid bronchoscopy. Her symptoms resolved and she was discharged the following day.

Conclusion: Our case illustrates how crucial physical exam and appropriate imaging are to the timely diagnosis and retrieval of foreign bodies.
Figure 1 – Coronal image of CT chest showing metallic object in the left mainstem bronchus.
Figure 2 – Panel A - Bronchoscopic image showing a spring in the airway
Panel B - Bronchoscopic image showing granulation tissue and airway stenosis at the distal end of the spring.
Chest tube care education: A quality improvement workshop for non-pulmonary providers in the management of chest tube complications on medical wards

Authors: Michelle Zur, DO, David Wu, DO, Daniel Condit, MD, Anil Magge, MD, Adnan Majid, MD, Omar Ibrahim, MD

Introduction: Pulmonary and critical care specialists are often called to address issues regarding chest tubes on the medical wards. It was felt that with some training and education, internal medicine providers could become more adept at troubleshooting common chest tube problems. The purpose of this project was to implement a workshop aimed to improve knowledge and confidence of non-pulmonary providers regarding function and management of chest tubes.

Methods: Internal medicine providers at UConn Health were given a lecture on chest tube function and management of common problems. Prior to this lecture, participants were given a pre-test to gauge their comfort managing patients with chest tubes and their clinical knowledge on troubleshooting chest tube complications. Following the lecture, participants were given a post-test consisting of questions aimed to assess their perceived increase in confidence with chest tube management, and the same knowledge questions from the pre-test to assess their improved clinical knowledge.

Results: Participants included 73.9% house staff of varying PGY levels (n=17) and 26.1% attending internal medicine physicians (n=6). They were asked to qualify their level of comfort managing chest tube complications, talking to patients/families about complications and talking to advanced providers such as pulmonologists. On the pre-test, 0%, 12.5%, and 26.1% responded comfortable; 26.1%, 33.3%, and 30.4% responded neutral; 47.8%, 33.3%, and 30.4% responded uncomfortable; and 26.1%, 20.8%, and 13.4% responded very uncomfortable, respectively. On post-test, when asked their level of comfort regarding the above, 0%, 13.0%, and 14.3% answered about the same; 73.9%, 56.5%, and 64.3% answered a bit more comfortable; 26.1%, 30.4%, and 21.4% much more comfortable, respectively. On the knowledge-based portion, participants’ average score on the pre-test was 2.8 out of 7 total points (SD±1.3). After the lecture, participants scored an average 5.1 out of 7 points (SD±1.3) which was statistically significant (p=0.0000001). When asked if this workshop was helpful to their practice 4.4% answered neutral, 47.3% agreed, and 47.3% strongly agreed.

Discussion: Following this workshop there was statistically significant improvement in baseline knowledge of chest tube function and management of common problems. Additionally, there was improvement in perceived confidence of internal medicine providers’ ability to take care of patients with chest tubes. Futures studies could aim the effect of this workshop on a larger cohort of providers and expand it to include advanced practitioners and nurses.
Close Watch Leads to Clean Catch: Acinar Adenocarcinoma with Pulmonary Coccidioidomycosis

**Authors:** Jyotirmayee Lenka, MD, Billie Ann Bixby, MD
Department of Pulmonary and Critical Care Medicine, University of Arizona, Tucson, AZ, USA

**Introduction:** We present a case of diagnosis and management of a suspicious lung nodule in a patient with active pulmonary coccidioidomycosis.

**Case:** A 61-year-old former smoker with COPD and pulmonary coccidioidomycosis, was seen in our interventional pulmonary clinic for a slow growing part solid left upper lobe (LUL) nodule. 2 years ago, he had been diagnosed with pulmonary coccidioidomycosis, and was on Fluconazole. He was asymptomatic and reported compliance with antifungal therapy. His paternal grandfather had lung cancer. He underwent bronchoscopy with EBUS FNA where mediastinal lymph node (LN) histopathology revealed coccidioidomycosis spherules; no malignancy was detected. On re-review of imaging, this part-solid part-ground-glass 6mm LUL nodule (averaged on max long-axis and max short-axis dimensions), had been present prior to diagnosis of pulmonary coccidioidomycosis; and its radiographic appearance was concerning for slow growing adenocarcinoma spectrum lesion. Another large 1.9cm LUL pleural based nodule was noted to be stable, likely post-inflammatory. On PET-CT, the part solid nodule was mildly FDG avid (SUV 1.7). We recommended wedge resection. PFTs showed moderate obstruction with moderate reduction in diffusion capacity; it was assessed he could tolerate potential lobectomy with post-op DLCO of about 49%. Pre-op planning entailed, using Veran navigational bronchoscopy, percutaneous needle localization and dye-marking of part-solid nodule, followed by same day VATS, wedge resection and LN dissection. Histopathology revealed a 1.8cm adenocarcinoma, with acinar and lepidic patterns, grade 2/4, 0.9cm invasive component, with tumor free margin and negative mediastinal LN. The pleural based nodule showed granulomatous inflammation with coccidioides spherules. TNM staging was pT1N0M0, thus no further treatment was indicated. Patient is doing well at 2 months follow up.

**Conclusion:** Knowledge of lung nodule radiographics, adequate clinical assessment and a collaborative approach between interventional pulmonary and thoracic surgery teams is required to aid early detection of lung cancer and improve outcomes.
CT chest coronal (left) and axial (above) views, 0.75mm cuts; showing small part solid LUL nodule, large solid pleural based LUL nodule.

PET-CT coronal view, showing mildly FDG avid LUL nodule

PET-CT axial view, showing densely FDG avid hilar and mediastinal lymph nodes
Closure of TEF by using a PFO occluder device

Authors: Aristides J. Armas Villalba and Phillip Ong

Introduction: A diagnosis of tracheosephagaeal fistula (TEF) in the setting of esophageal malignancy carries a high mortality with a median survival of <3 months\(^1\). Surgical repair is often not an option. Endoscopic options such as airway and esophageal stenting may result in significant sequelae\(^2\). We report the use of a patent foramen ovale (PFO) closure device in the treatment of this condition.

Case Description: A 72-year-old male with esophageal cancer underwent transhiatal esophagectomy 4 years ago. This was complicated by an anastomotic leak with subsequent strictures, which was managed with esophageal stenting. These had frequent episodes of migration and need for repositioning. A small TEF developed 1.5 years ago, and this was managed with esophageal interventions. The patient had frequent admissions for aspiration pneumonitis with severe weight loss, and inability to tolerate oral intake. A rigid bronchoscopy was performed, and the esophageal stent was noted to be eroding through the mid-trachea, resulting in a fistula 5 mm in diameter. An 18mm Amplatzer PFO occluder was deployed across the fistula (Figure 1 and 2). The patient was then placed on strict post-jejunal feeding. Ten months after, the patient can tolerate oral feeding, gained weight, and is now back to work without functional limitations. He has not had an admission for aspiration pneumonitis.

Conclusion: Management of TEF can be difficult, and endoscopic management commonly includes stenting. Stenting strategy (dual, esophageal, or airway) is controversial and brings their own concerns for further erosion, migration, and airway compromise\(^2\). However, prevention of crossover of secretions into the airway is essential. We report the successful off-label use of a PFO occluder in the management of TEF. This option can prevent the known complications inherent to stenting including migration and extension of the fistula due to the radial force of self-expandable stents either in the airway or esophagus.

References:
Fig. 1 TEF midtrachea. Esophageal stent eroding into the airway.

Fig. 2 Amplatzer PFO occluder device viewed from the trachea (panel A) and from the esophagus (panel B)
Combined EBUS-TBNA and EUS-B-FNA for Diagnosis of Multiple Lung Cancers: Case Report

Authors: Juan P. Uribe, MD, Anil Magge, MD, Adnan Majid, MD, Paul A. VanderLaan, MD, PhD, Abduljabbar Dheyab, MD

Introduction: The distinction between multiple synchronous primary lung cancers (SPLC) and intrapulmonary metastases is often difficult but is extremely important for the prognosis and therapeutic approach of these patients. The estimated incidence of synchronous lung cancers, as reported in various clinical series, ranges from 0.2% to 8% been increasing in the recent years because of the development of early detection techniques resulting in a longer period of patient survival.

Case Summary: We report a case of a 57-year-old male, heavy smoker, that consulted to the clinic due to progressive cough, without hemoptysis or weight loss. Imaging revealed a mass with central necrosis in the left lower lobe, and an additional spiculated mass in the medial right lung apex. A Combined approach was used with EBUS-TBNA and EUS-B-FNA for sampling and staging. Pathology revealed poorly differentiated lung adenocarcinoma in the LLL and high-grade neuroendocrine tumor in the RUL. In this case report we showed that the combined approach should be considered in selected patients for mediastinal staging, confirmation of extra-thoracic metastasis, or for parenchymal lesions around the esophagus, especially in the setting of suspicious lung nodule with potential SPLC.

Conclusion: EBUS-TBNA followed by EUS-B-FNA should be considered in selected patients for mediastinal staging, confirmation of extra-thoracic metastasis, or for parenchymal lesions that appear to about the esophagus especially in the setting of suspicious lung nodule with potential SPLC.
Figure 1. Bronchoscopy Report. EBUS examination of lymph nodes 4R, 7, 4L and superior bronchus of the LLL. (1) LLL endobronchial Lesion and NBI. (2) 4R TBNA (3) 7 TBNA. (4) 4L TBNA. (5) LLL Mass TBNA (6) RUL lung nodule EUS-B-FNA. (7) Top row: Left Lower Lobe. Poorly differentiated lung adenocarcinoma. Epithelioid tumor cells with moderate amounts of cytoplasm and immunohistochemical positivity for TTF-1 and Napsin-A (patchy), but negative staining for synaptophysin. Bottom row: Right Upper Lobe: High-grade neuroendocrine carcinoma. In contrast to the tumor morphology of the LLL mass, these tumor cells demonstrate significantly less cytoplasm, hyperchromatic nuclei with coarse chromatin, and associated tumor necrosis. Immunohistochemical stains show the tumor cells to be positive for TTF-1 and synaptophysin, but negative for Napsin-A. A Mib-1/Ki-67 proliferation marker was positive in up to approximately 40% of tumor cells. All panels taken at 400x original magnification.
COMPLICATIONS FROM SELDINGER CHEST TUBES: MANY THINGS CAN GO WRONG

Authors: R. Naaman1, S. Kashyap1, C. Kapp1, K. Haas1

1 University of Illinois at Chicago, Division of Pulmonary, Critical Care, Sleep and Allergy

Introduction: Seldinger-type small bore thoracostomy tubes have become increasingly popular in recent years to treat pneumothorax and pleural fluid collections. Although considered less invasive to large-bore surgical thoracostomy tubes, Seldinger-type small-caliber thoracostomy tubes can have various complications.

We present two cases of less common complications that can occur with Seldinger tube thoracostomy.

Case 1: 73 year-old man with esophageal cancer underwent esophagectomy and later developed bilateral pleural effusions. The interventional pulmonary service was consulted for evaluation. The proceduralist performed a left side tube thoracostomy using the Seldinger technique. As the guidewire was being drawn back, more force was required than anticipated to remove it and unknowingly the distal end of the guidewire broke off. The broken guidewire tip remained in a distal chest tube port and was not recognized on chest radiography for multiple days (image 1). Once identified, the chest tube was removed along with the broken wire still within the chest tube. No harm was done to the patient.

Case 2: 35 year-old healthy man presented to the hospital with shortness of breath after sustaining trauma to his chest during a basketball game. His chest imaging showed a moderate size left-sided pneumothorax and a Seldinger ‘pigtail’ thoracostomy tube was inserted in the emergency department. Repeat chest imaging failed to demonstrate pneumothorax improvement and lack of ‘pigtail’ coiling in the distal tube (image 2). Bedside evaluation on the medicine floor revealed the stiffening stylet still within the chest tube with improper drainage connection. Upon stylet removal, brisk air evacuation was noted and proper drainage connection was obtained. Subsequent imaging showed ‘pigtail’ coiling of the chest tube and eventual resolution of the pneumothorax.

Conclusion: Small-bore chest tube placement using Seldinger technique is associated with different types of complications. Continuous clinical and radiographic assessment is required to assess for expected response and to evaluate for potential complications.
Image 1. Broken guidewire connected to left-side chest tube distal port.
Image 2. Left-sided chest tube with stiffening stylet in place.
Complications of tunneled pleural catheters in medically non-insured vs medically insured patients.

Authors: Walid Hadid, MD, Qusay Haydour, MD, and Rabih Bechara, MD

Background: Malignant pleural effusion (MPE) is a complication of advanced malignant disease. Tunneled pleural catheters (TPCs) are a common option in managing MPE. TPCs related complication has been reported anywhere from 1% to 21%. It has been well known that socioeconomic status has an impact on health care and worsen of outcome. In retrospective study, we compared TPCs complications between Medically insured patient (MIPs) and Medically Non-insured patients MNIPs.

Methods: Data obtained from three sites (Medical College of Georgia, Morehouse School of Medicine and Cancer Treatment Centers of America). All individual centers secured local ethics committee approval from their respective institutional review boards. Individual consent was waived because of the study’s retrospective nature. Patients with MPEs managed with TPCs placement between January 1, 2015, and April 8, 2018, were reviewed. MPE was defined as cytological proof of malignancy within the pleural space. A TPC-related complication was defined as either an isolated superficial infection (catheter- site cellulitis), a deep pleural infection (purulent pleural fluid and/or a positive fluid Gram stain or culture with signs and/or symptoms consistent with pleural infection) requiring systemic antibiotics, and TPC malfunction despite patency tested by adequate irrigation.

Results: We included 85 patients in our analysis. 51 patients were MIPs and 34 MNIPs. All patients had MPE and received TPCs at outpatient setting. Table1 shows types of malignancy associated with MPE in our study.

Catheter-related complications in MIPs: 1 patient (2%) had plugged TPC and required instillation of intrapleural tPA,. 1 patient developed pleural infection. 1 patient developed erythema and 1 patient developed crepitus without drainage at site of insertion, both patients did not required intervention.

Catheter-related complications in MNIPs: Four patients (12%) had plugged TPC. Superficial infection developed in 8 patients (23% ) Importantly, we also looked at the TPC-related complications in both groups and compared them across various pathologies. Patients with primary lung malignancy (one patient) 1.7% of MIPs had complications, (4 patients)11.7% of MNIPs had complications (Odds ratio 0.143, 95% CI [0.010-2.012]). Patients with breast malignancy 3.4% (2 pt) of MIPs had complications and 17.6% (6) of MNIPs had complications (Odds ratio 0.037, 95% CI [0.003-0.548]). In all other cancers as a composite 3% (1 pts) of MIPS had complications and 5.8% (2pts) of MNIPS had complications. Calculated relative risks RR = 9 ( p=0.0026) for complication required intervention after comparing both group.

Conclusion: Medically non-insured patients have increased risk of complications post TPCs placement.
<table>
<thead>
<tr>
<th>Tumor Type</th>
<th>MIP group</th>
<th>NIP group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenocarcinoma of lung</td>
<td>11 (22%)</td>
<td>6</td>
</tr>
<tr>
<td>Invasive ductal carcinoma of breast</td>
<td>16 (31%)</td>
<td>12</td>
</tr>
<tr>
<td>Renal cell carcinoma</td>
<td>7 (14%)</td>
<td>4</td>
</tr>
<tr>
<td>NSCLC</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Colon/appendix carcinoma, cholangiocarcinoma, gastric carcinoma</td>
<td>4 patients (1 of each)</td>
<td>2 gastric</td>
</tr>
<tr>
<td>Pancreatic carcinoma</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Pancreatic neuroendocrine, DLBCL of mediastinum, malignant melanoma, unknown primary, Ossifying fibromyxoid tumor at Lt chest wall</td>
<td>5 cases (1 of each)</td>
<td></td>
</tr>
<tr>
<td>Ovarian cancer</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td>34</td>
</tr>
</tbody>
</table>
Current practices in airway stent management: a survey of providers

Authors: Max T. Wayne, MD; Muhammad Sajawal Ali, MBBS, MS; Elliot Wakeam, MD, MPH; Fabien Maldonado, MD; Lonny B Yarmus, DO; Hallie C. Prescott, MD, MSc; Jose De Cardenas, MD

Background: Over 30% of patients treated with an airway stent experience a stent-related complication, such as migration, occlusion, or fracture. There are variety of strategies to help reduce complications (e.g., mucolytic medications, mucus clearance devices, surveillance imaging, surveillance bronchoscopy), but high-quality data on their efficacy is lacking. Given the limited data and lack of guidelines on prevention of post-stent complications, it is unclear how commonly post-stent therapies and surveillance imaging or bronchoscopy are used in practice. We sought to understand how providers manage airway stents post-insertion and determine the extent to which practice varies.

Methods: We performed a nationwide survey of US practitioners who place airway stents. Electronic surveys were sent via REDCap to all members of the American Association of Bronchology and Interventional Pulmonology and the General Thoracic Surgical Club. The survey captured data on provider demographics, practice setting, stent volume, and practitioners’ standard post-stent practices (if any) including the use of medications, mucus clearance devices, surveillance imaging, and surveillance bronchoscopy.

Results: Among 841 email addresses that successfully received the survey, 83 individuals completed the survey, the majority of whom practice in an academic (n=36, 56.6%) or community setting (n=16, 19.3%) (Table 1). Providers had diverse training backgrounds (n=37, 47.4% IP fellowship; n=18, 23.1% thoracic surgery; n=23, 29.5% other stent training) and years of experience (35.6% within 5 years of completing stent training, 20.6% 5-10 years, 13.7% 11-15 years, and 30.1% more than 15 years out of training). There was significant variation in stent management practices, with 58 (69.9%) respondents prescribing at least one medication, including nebulized hypertonic saline (39.8%), nebulized albuterol (36.1%), nebulized normal saline (28.9%), guaifenesin (26.5%), and nebulized ipratropium (13.3%) (Figure 1). Among providers who prescribed medications, 12.1% (n=7) routinely prescribed 4 or more medications (Figure 1). A minority of practitioners prescribed a mucus clearance device (n=16, 19.3%) or obtained routine surveillance CT scans for asymptomatic patients (n=17, 20.5%). About half (n=39, 47.0%) performed routine surveillance bronchoscopy but timing varied, with 46% (n=18) performing within 4 weeks and 21% (n=8) performing at least 9 weeks after insertion (Figure 1). 9.6% routinely replaced their stents. Most providers prescribed the same regimen regardless of stent type (79.7%) or indication for stent placement (83.8%).
Conclusion: Among a national cohort of practitioners who place airway stents, there is significant heterogeneity in post-stent management. Further studies are needed to identify which, if any, of these strategies improve patient centered outcomes.

Figure 1: Post-insertion stent management strategies

Figure 1 Legend: Among 83 providers who completed the survey, 58 prescribed at least one medication. Among those prescribing medications, 19% prescribed only 1 medication, 36% prescribed 2 medications, 33% prescribed 3 medications, and 12% prescribed 4 or more medications. The most prescribed medication was nebulized hypertonic saline (39.8%), followed by nebulized albuterol (36.1%), nebulized normal saline (28.9%), guaifenesin (26.5%), nebulized ipratropium (13.3%), inhaled corticosteroid (2%), and MDI ipratropium (1%). While nearly half of responding providers perform routine surveillance bronchoscopy, timing of bronchoscopy varies, from within 4 weeks in 46% of those performing to after 9 weeks in 21% of those performing.
### Table 1: Provider characteristics (N=83)

<table>
<thead>
<tr>
<th>Provider characteristics</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender, %</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>6.9%</td>
</tr>
<tr>
<td>Male</td>
<td>89.0%</td>
</tr>
<tr>
<td>Other (includes missing and prefer not to respond)</td>
<td>4.1%</td>
</tr>
<tr>
<td>Training</td>
<td></td>
</tr>
<tr>
<td>IP</td>
<td>47.4%</td>
</tr>
<tr>
<td>Thoracic Surgery</td>
<td>23.1%</td>
</tr>
<tr>
<td>Other (including during pulmonary fellowship, a course, mentorship)</td>
<td>29.5%</td>
</tr>
<tr>
<td>Practice setting</td>
<td></td>
</tr>
<tr>
<td>University</td>
<td>56.6%</td>
</tr>
<tr>
<td>Community</td>
<td>19.3%</td>
</tr>
<tr>
<td>Single-specialty group</td>
<td>4.8%</td>
</tr>
<tr>
<td>Multi-specialty group</td>
<td>4.8%</td>
</tr>
<tr>
<td>Other (includes community cancer center, staff model HMO, retired)</td>
<td>3.6%</td>
</tr>
<tr>
<td>Missing</td>
<td>12.0%</td>
</tr>
<tr>
<td>Current job/position</td>
<td></td>
</tr>
<tr>
<td>IP</td>
<td>59.0%</td>
</tr>
<tr>
<td>Thoracic surgeon</td>
<td>26.5%</td>
</tr>
<tr>
<td>Pulmonologist</td>
<td>15.7%</td>
</tr>
<tr>
<td>Critical Care</td>
<td>12.1%</td>
</tr>
<tr>
<td>Advanced bronchoscopist</td>
<td>6.0%</td>
</tr>
<tr>
<td>Years in practice</td>
<td></td>
</tr>
<tr>
<td>&lt;5</td>
<td>35.6%</td>
</tr>
<tr>
<td>5-10</td>
<td>20.6%</td>
</tr>
<tr>
<td>11-15</td>
<td>13.7%</td>
</tr>
<tr>
<td>16+</td>
<td>30.1%</td>
</tr>
<tr>
<td>Stent procedures in average month</td>
<td></td>
</tr>
<tr>
<td>&lt;1</td>
<td>38.6%</td>
</tr>
<tr>
<td>1-4</td>
<td>45.8%</td>
</tr>
<tr>
<td>5-8</td>
<td>9.6%</td>
</tr>
<tr>
<td>&gt;8</td>
<td>6.0%</td>
</tr>
<tr>
<td>Most commonly inserted type of stent</td>
<td></td>
</tr>
<tr>
<td>Covered metal stents</td>
<td>68.9%</td>
</tr>
<tr>
<td>Silicone stent</td>
<td>21.6%</td>
</tr>
<tr>
<td>Other including uncovered metal stents, hybrid stents</td>
<td>9.5%</td>
</tr>
</tbody>
</table>

*IP=interventional pulmonologist*
Demographic and Lesion Characteristics in the First 443 Subjects Enrolled in a Multicenter Observational Real World Bronchoscopy Study: Interim Results from TARGET:

**Authors:** S Murgu, D Sterman, K Yasufuku, A Chen, B Laxmanan, J Connelly, M Xiao, S Rafeq, G Silvestri.

**Background:** Robotic assisted bronchoscopy (RAB) is the newest approved technology for diagnosis of pulmonary lesions. The objective of this analysis is to describe baseline demographic and lesion characteristics and localization in an ongoing large observational real-world study of RAB.

**Methods:** The multicenter, single-arm, prospective, observational study of robotic-assisted bronchoscopy with biopsy using the MONARCH platform (Auris Health, Redwood City, CA) is designed to evaluate the safety and diagnostic accuracy of the platform in a broad range of patients with pulmonary lesions. Enrolled subjects ≥ 21 years old with Lung lesions, 8 mm to 50 mm in size, requiring bronchoscopic diagnosis were included. Subjects were followed at 7 days post-procedure with non-malignant results followed per standard of care until a definitive diagnosis is made. In this report, subject demographics and lesion characteristics are reported and using descriptive statistics.

**Results:** In this interim analysis, 443 subjects were enrolled across 18 sites (CBCT used in 12.2% of cases). Mean age of 68.1 years (SD 10.36), 56.4% female, 78.8% current or former tobacco users, 41.0% with history of COPD. Mean lesion size was 20.9mm (SD 9.79) (median 18.5mm) with 58.2% ≤ 20mm. 12.7% of lesions were (subsolid or pure ground glass).

Mean distance to closest pleural surface was 9.4mm (SD 11.65). 52.9% of lesions were ≤ 5mm from the pleura with 37.9% of lesions on a pleural surface. Bronchus sign was present in 59.8%. Distribution of lesions in lung zones were: 48.0% peripheral zone, 41.1% middle zone and 10.9% proximal zone. Successful navigation to the virtual target lesions was achieved 97.5% of the time. Radial EBUS confirmation was obtained in 91.9% of cases (46.6% concentric and 53.4% eccentric).

**Conclusions:** In this interim analysis of a large multicenter prospective real world observational RAB diagnostic study, baseline demographic characteristics are generally consistent with other studies of bronchoscopy, though there is an increase in proportion of semi-solid lesions being biopsied as well as lesions closer to the pleura. R-EBUS confirmation was achieved in the vast majority of cases with an almost even split between concentric and eccentric views.
Device Safety Assessment of Transbronchial Microwave Ablation of Normal Swine Peripheral Lung Using Robotic-Assisted Bronchoscopy

**Authors:** Hector De Leon¹, Kevin Royalty², Louie Mingione², David Jaekel³, Sarvesh Periyasamy⁴, David Wilson⁵, Paul Laeseke⁵, William C. Stoffregen⁶, Tim Muench¹, John P Matonick¹, Grzegorz L. Kaluza⁷, Gustavo Cipolla¹.

¹ Ethicon, Inc. Johnson & Johnson, Raritan, NJ, USA
² NeuWave Medical, Inc. Madison, WI, USA
³ Auris Health, Inc. Redwood City, CA, USA
⁴ University of Wisconsin School of Medicine and Public Health, Madison, WI, USA
⁵ Schneck Pulmonology, Schneck Medical Center. Seymour, IN, USA
⁶ Northstar Preclinical and Pathology Services, LLC. Lake Elmo, MN, USA
⁷ CRF Skirball Center for Innovation. Orangeburg, NY, USA

**Background:** Transbronchial microwave ablation (tMWA) is a novel approach for the management of lung oligometastatic disease and selected patients with primary non-small cell lung carcinoma (NSCLC). This work aimed to assess the safety of tMWA using the NEUWAVE™ FLEX Microwave Ablation System (NeuWave Flex) and robotic-assisted bronchoscopy (RAB) with the Auris Monarch Platform (Auris Monarch) (Ethicon, Inc., Raritan, NJ) in a swine model of tMWA.

**Methods:** Acute, subacute, and chronic safety assessments of computed tomography (CT)-guided, RAB tMWA were performed using the NeuWave Flex (for tissue ablation) and the Auris Monarch (for visualization) devices in a GLP study. Intraoperative fluoroscopy and CBCT imaging were used to assess and monitor probe position. tMWA was performed in peripheral normal lung parenchyma of 17 Yorkshire swine (40-50 kg) split into three groups. The acute group (day 0, n=5) received 4 tMWAs at 100 W for 1, 3, 5, and 10 min in 4 different lung lobes. Subacute and chronic groups (days 3 and 30, n=6 each) received one tMWA (100 W, 10 min). CT scans were taken immediately before and after tMWA, and CT-based volumetric analysis of the ablation site was conducted at termination on days 0, 3, and 30. Procedural- and device-related adverse events (AEs) were documented for all groups during the entire observation period (intraoperative to 30 days post-ablation).

**Results:** The study was completed without any major procedural complications. No postprocedural AEs including death, pneumothorax, hemothorax, or pleural effusions were observed in any animal. Histopathologic evaluation showed no gross or histological findings suggestive of downstream thromboembolism in any organ. Post-ablation CT scans revealed ground-glass opacities in all ablation zones. Cavitation, a phenomenon described as the presence of gas within the ablation areas, was observed in CT images of three 3-day (3/6) and two 30-day (2/6) animals. No signs of cavitation were
observed in CT scans of acute animals. CT-based volumetric estimates of ablation zones in the acute group showed an increase in volume as ablation time increased indicating a time-dependency over the ablation time range examined (1-10 min). Ablation volumes on days 3 and 30 were larger than post-ablation measurements on day 0 in the same animals.

**Conclusion:** The NeuWave Flex and Auris Monarch devices were safely used to perform single or multiple RAB tMWAs. The preclinical device and procedural safety profile of RAB tMWA supports its use in clinical trials to treat patients with oligometastatic disease or primary NSCLC.
Differences in the Perception of the Research Coordinator Role between Coordinators and Interventional Pulmonologist Investigators: the UROC-IP Survey

Authors: Lance Roller, MS1 Robert J Lentz, MD1,2,3; Fabien Maldonado, MD1,2

1: Division of Allergy, Pulmonary and Critical Care Medicine Vanderbilt University Medical Center, Nashville, TN; 2: Department of Thoracic Surgery, Vanderbilt University Medical Center, Nashville, TN; 3: Veterans Affairs Medical Center, Nashville, TN

Background: Study coordinators are essential to the conduct of high-quality clinical research. Despite their central position within research groups, their role is often poorly defined and their contributions underrecognized. We developed a survey to assess the landscape of responsibilities, scope of work, job satisfaction, and career opportunities for study coordinators and in order to propose possible strategies to improve team dynamics.

Methods: An online survey (REDCap) was distributed via email to the membership of the American Association of Bronchology and Interventional Pulmonology. Inclusion was current or recent participation in research as an investigator or research coordinator (or similar title). Data pertaining to perceptions of coordinator training, responsibilities, and retention were obtained. Visual Analog Scales (VAS) with 0 indicating no agreement and 100 indicating maximal agreement with a given statement were used. Between group comparisons with chi-square and student’s t-test were performed for categorical and continuous variables, respectively (JASP 0.16.1, Amsterdam, Netherlands).

Results: Data was obtained from 32 coordinators and 40 investigators (overall n=72). Coordinators were 90% female (vs. 17% investigators), most with masters or bachelor’s degree backgrounds (n=11, 34% each), working in research groups with median 3 coordinators. Training modalities coordinators relied upon to learn their jobs differed from investigator perceptions of their training, with coordinators indicating significantly more training from senior coordinators within their group (81%), training from online sources (75%), and self-directed training (56%) than investigators perceived (Table 1). Only 43% of investigators reported directly training their coordinators and 20% were unsure how their coordinators were trained. There were also significant differences between coordinator and investigator perception of measures related to coordinator retention and satisfaction, with coordinators indicating lower mean VAS scores (less agreement) on statements related to coordinators feeling well-respected, that their work is appreciated, there is sufficient time to do their work, and that they work collaboratively with and are respected by the investigators they work with (Table 1, Figure 1). Overall coordinator satisfaction with their jobs was neutral (VAS mean 55) and both coordinators and investigators disagreed that coordinators were adequately paid.

Conclusions: These data suggest substantial differences in perceptions and practices related to interventional pulmonology research coordinator training and issues related to coordinator retention and satisfaction, with greater reliance on fellow coordinators and the internet for training than investigators advise or realize while perceiving themselves as less respected and working less collaboratively with investigators than investigators perceive.
Table 1. Differences in the perception of the study coordinator role and training between coordinators and investigators.

<table>
<thead>
<tr>
<th>Training</th>
<th>Mean VAS or percent “yes”</th>
<th>Mean difference</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct from investigator</td>
<td>34%</td>
<td>43%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>From senior coordinator</td>
<td>81%</td>
<td>50%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Online training</td>
<td>75%</td>
<td>33%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Self-teaching</td>
<td>56%</td>
<td>8%</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

| Coordinators...               |                           |                 |              |         |
| Have autonomy                 | 70                        | 69              | 0.9          | -11.6 to 13.1 | 0.8     |
| Are well-respected            | 40                        | 61              | 21.2         | 7.4 to 35.0  | 0.003   |
| Have responsibilities of multiple people | 90                | 83              | 6.5          | -0.9 to 13.8 | 0.08    |
| Paid adequately               | 37                        | 45              | 7.3          | -8.7 to 23.4 | 0.4     |
| A high turnover position      | 70                        | 72              | 1.6          | -10 to 13.3  | 0.8     |
| Work is appreciated           | 50                        | 78              | 28.2         | 15.3 to 41.1 | <0.001  |
| Able to explore own research interests | 53                | 67              | 14.3         | -0.7 to 29.4 | 0.06    |
| Enough time to do the work    | 33                        | 61              | 28.0         | 13.5 to 42.4 | <0.001  |
| Have a collaborative role with investigators | 68            | 84              | 16.1         | 5.4 to 26.9  | 0.004   |
| Have a close working relationship with investigators | 72            | 82              | 9.8          | -2.7 to 22.3 | 0.12    |
| Respected by investigators     | 68                        | 87              | 19.0         | 6.3 to 31.7  | 0.004   |
| Well-structured work environment | 45                        | 61              | 16.1         | 2.0 to 30.2  | 0.03    |
| Are satisfied with their job  | 55                        | 63              | 14.1         | 1.6 to 26.6  | 0.03    |

a VAS 0-100 scale; higher numbers indicate greater agreement with statement
b Percent of investigators indicating they train their coordinators with this modality, or coordinators indicating they trained using this modality
c Chi square (training modalities); student’s t-test (VAS scores)
The coordinator has enough time to get all their work done. The coordinator has a collaborative role with their PI and Co-investigators.
Durability of the Effectiveness and Safety of the Spiration® Valve System for Single Lobe Treatment of Severe Heterogenous Emphysema: 24-month follow-up in the EMPROVE study

Authors: G.J. Criner¹, A. Delage², K.G. Voelker³, S. Martel⁴, for the EMPROVE Trial Investigator Group
¹Temple University, Philadelphia, Pennsylvania, ²University Sherbrooke, Sherbrooke, Canada, ³Sarasota Memorial Hospital, Sarasota, Florida, ⁴Laval University, Quebec, Canada

Background: Bronchoscopic Lung Volume Reduction (BLVR) using endobronchial valves is now an accepted standard of care option for select patients with severe emphysema who have evidence of little to no collateral ventilation. Several randomized controlled trials with 12-month data exist, yet there are no comparative data between BLVR-treated and non-treated patients with longer follow-up of both groups. We report the 24-month interim results of the EMPROVE study, a 5-year open-label, randomized, controlled trial, conducted at 31 centers in the US and in Canada, to assess the effectiveness and safety of the Spiration® Valve System (SVS) in patients with severe heterogenous emphysema.

Methods: 141 patients were randomized in a 2:1 allocation to SVS treatment (n=97) and a control (n=44) group. Per protocol, adjustments to change or optimize valve placement were not allowed after 6 months. COVID impacted annual visits (365 window) and not all subjects were able to complete all evaluations.

Results: An improvement in FEV₁ in the SVS-treated group was maintained at 24 months compared with the control group (0.087L, p=0.014, n=71 and 30 for SVS and control, respectively) (Figure 1A). Additionally, significant improvement in patient symptoms was maintained in the SVS-treated group compared with the control group; mMRC at 0.62 points (p=0.001, n=73 and 31 for SVS and control, respectively) (Figure 1B) and SGRQ at -6.69 points (p=0.037, n=76 and 32 for SVS and control, respectively) (Figure 1C). Adverse events between 12- and 24-months were not different between the treatment and control groups. There were no deaths in both groups. Acute exacerbation of COPD occurred in 31.5% and 32.3% of SVS and control, respectively. Pneumothorax rate was 2.7% in SVS group and 0.0% in control group. There was one device failure, in which an anchor fractured but the device remained in place. No devices migrated or were expectorated.

Conclusion: The EMPROVE 24-month interim results are the first from a BLVR randomized controlled trial that includes a rigorous comparison of treatment and control groups up to 24 months. The durability of the benefit of SVS valve treatment is demonstrated by statistically significant and clinically meaningful improvements in lung function, dyspnea, and quality of life. Additionally, the safety profile remains good with minimal device issues.

**Figure 1. Improved functional capacity of lung and health-related quality of life in severe heterogenous emphysema patients treated with SVS.** Participants were randomized into SVS treatment and control. (A) Forced expiration volume (FEV1) was examined at 1 month (p<0.001), 3 months (p<0.001), 6 months (p<0.001), 12 months (p<0.001) and 24 months (p=0.014) as indicated. (B) mMRC Dyspnea scale demonstrated significant improvements in SVS treatment group at 1 month (p<0.001), 3 month (p<0.001), 6 months (p<0.001), 12 months (p=0.001) and 24 months (p=0.001). (C) SGRQ showed significant improvement at all timepoints: 1 month (p<0.001), 3 months (p<0.001), 6 months (p<0.001), 12 (p<0.001) and 24 months (p=0.037). Data are presented as line graph with mean ± SE. Statistical analysis was conducted in the R statistical language (version 4.1.2; R Foundation for Statistical Computing).
Durvalumab as a possible cause of Vanishing Bronchus Syndrome, case series of five patients

Authors: Abdulrahman Katabi¹, Jaineet S. Chhabra², Joseph A. Chirico², Yousef Shweihat¹

1 Marshall University Joan C. Edwards School of Medicine, Division of Pulmonary & Critical Care
2 Marshall University Joan C. Edwards School of Medicine

Introduction: Vanishing Bronchus Syndrome (VBS) is a known complication of lung transplantation. We are presenting five patients with non-small cell lung cancer who developed VBS after receiving Durvalumab with radiation therapy. To our knowledge, VBS has not been reported before as a suspected side effect of Durvalumab.

Cases summary: We present five patients (a 60-year-old male, a 73-year-old male, a 64-year-old female, a 69-year-old female, and an 84-year-old male) who were diagnosed with non-small cell lung carcinoma and received immunotherapy in the form Durvalumab during their course of therapy, which consisted of radiation therapy in all patients. Within a range of 1-6 months (mean 3.2 months, median 3 months) of treatment with Durvalumab; they started experiencing respiratory symptoms with radiological picture evidence of VBS on Chest CT scans (see CT image). VBS was diagnosed in those patients bronchoscopically (see bronchoscopy image) within a range of 4-21 months (mean 12.7 months, median 13 months). One out of those five patients was experiencing deterioration in his respiratory symptoms and was treated with endobronchial stenting with improvement in his symptoms. The other four patients did not receive stenting due to inability to recruit the airways or due to chronic stable symptoms or patient’s preference. We speculate that Durvalumab potentiates the scarring process in the cartilage/airways treated with radiation therapy resulting in VBS due to radionecrosis. We think it can be prevented by stenting if diagnosed before it is complete.

Conclusion: VBS has been noticed in patients treated with Durvalumab when combined with radiation and it was treated successfully with endobronchial stenting in one case.
EBUS Diagnostic Yield in Hilar vs. Mediastinal Lymph Nodes in Sarcoidosis

Authors: Naeman Mahmood, Steven Wolf, Raj Dash, Xiaofei Wang, Scott L Shofer, Coral Giovacchini, Michael Dorry, Kamran Mahmood, Momen M Wahidi

Background: Endobronchial ultrasound (EBUS) is currently considered the modality of choice for biopsy of thoracic lymph nodes to establish the diagnosis of sarcoidosis. However, it is unknown if the yield of EBUS transbronchial needle aspirate (TBNA) is different between hilar versus mediastinal lymph nodes. This study was designed to compare the diagnostic yield of EBUS-TBNA between the two lymph node zones.

Methods: This is a retrospective study which included all patients who underwent EBUS-TBNA of thoracic lymph nodes and were found to have non-necrotizing granulomatous inflammation consistent with the diagnosis of sarcoidosis between January 2015 to March 2021 at a single tertiary care hospital.

Results: Two hundred twenty-six patients underwent EBUS-TBNA. The median age with interquartile range (IQR) was 54 (43-63). Most patients were female (61.5%); 48.7% were white, and 44.7% were black. Only 4.9% of the patients smoked and 2.7% vaped.

A total of 144 hilar and 255 mediastinal nodes were biopsied. The diagnostic yield of EBUS-TBNA for non-necrotizing granulomas from hilar vs. mediastinal nodes was 60.4% vs. 63.5%, univariate odds ratio–OR of 0.87 (0.62-1.22), P-value for difference using generalized estimating equation=0.42. More passes increased the yield with univariate OR of 1.22 (1.02-1.45), P =0.03. Increasing age decreased the yield with univariate OR of 0.96 (0.94-0.98), P <0.01. There was no difference in diagnostic yield when considering node or needle size, gender of the patient, race or smoking status.

Conclusion: There was no significant difference in diagnostic yield of EBUS-TBNA for non-caseating granulomas consistent with sarcoidosis in hilar versus mediastinal lymph node stations.

REFERENCES:

ENDOBRONCHIAL STENT MALPOSITION IN THE POSTERIOR MEDIASTINUM

AUTHORS: Bharat Singh Bhandari, MD; Manish K Patel, MD; Kha Dinh, MD; Pushan Jani, MD

INTRODUCTION: Endobronchial stents have been commonly used to treat airway obstruction secondary to various benign and malignant causes. Various known complications include stent-malposition, stent-fracture, stent migration, airway perforation, infections, and bleeding. [1] Here we present a rare and unusual case of stent malposition in the posterior mediastinum.

CASE: A 69-year-old male with past medical history of COPD and hypoxemic brain injury during childhood s/p tracheostomy followed by decannulation presented with shortness of breath. CT scan of the chest revealed diffuse irregular thickening of the trachea, concerning for malignancy. Initial inspection flexible bronchoscopy showed a friable circumferential mass causing near complete occlusion and the carina was not visualized. Following this patient developed significant hypoxia requiring veno-venous ECMO support. Rigid bronchoscopy was then performed. Gradual tumor debridement was done using cryotherapy probe and mechanical dissection using rigid alligator forceps. Following debridement, a Y silicone stent (5cmX4cmX4 cm) was loaded and deployed. Post-procedure chest Xray showed the stent not in appropriate position. This was confirmed with a chest CT which revealed malposition of the stent in the posterior mediastinum. Repeat rigid bronchoscopy revealed a defect in the left mainstem through which the stent had slipped into the posterior mediastinum. The stent was then retrieved through the same defect and readjusted into position. The defect was well covered with the stent. Tracheal mass biopsy revealed squamous cell carcinoma. Patient was eventually weaned off of ECMO, underwent tracheostomy and was discharged with outpatient oncology follow up.

DISCUSSION: Although stent-migration to distal or proximal locations is known [2], literature on malposition in the mediastinum is lacking. As per our literature search, we report the first case of stent malposition in the posterior mediastinum. In retrospect, perhaps deployment under fluoroscopy rather than blind deployment could have prevented malposition.
Fig 1.0 Chest Xray showing stent malposition and ECMO cannulas.

Fig 2.0 Chest CT showing endobronchial stent in the posterior mediastinum.

References:

Endobronchial Treatment, expanding role in treatment for Carcinoid Tumors. A Case series

Authors: Perez Ingles, David; Josef, Vanessa, Balwan, Akshu.
University of New Mexico School of Medicine, Albuquerque, NM; Department of Internal Medicine, Division of Pulmonary and Critical Care.

Introduction: Pulmonary carcinoid tumors are a family of Neuroendocrine Tumors (NET). They are often centrally located, predominantly intraluminal without invasion of adjacent tissues, considered low-grade malignancies. Surgical resection is the treatment of choice, bronchoscopic procedures have emerged as parenchyma sparing alternative. We present three cases of patients with carcinoid tumors treated with bronchoscopic therapy.

Case descriptions:

Case #1: A 69-year-old male patient, former smoker, was found to have endoluminal lesion on low dose screening chest CT (Fig. 1). Bronchoscopy revealed a LUL polypoidal lesion at LC2 carina which was ablated with Argon Plasma Coagulation (APC). Histopathology revealed a well-differentiated NET (Classic Carcinoid). Sampled mediastinal lymph nodes were negative for malignancy. Surveillance bronchoscopies did not reveal any evidence of recurrence on endobronchial biopsy.

Case #2: A 46-year-old female patient with a history of asthma presented with recurrent pneumonia and hemoptysis over the past year. A CT chest revealed a 1.5 cm occlusive lesion located in the right lower lobe bronchus. Bronchoscopy confirmed the occlusive tumor originating at RC2 carina, (Fig. 2) which was effectively resected using electrocautery snare and APC. Pathology was positive for Low-Grade Neuroendocrine Tumor (Carcinoid). Patient is under active surveillance.

Case #3: 72-year-old Male patient with History of CAD, COPD, former smoker, was evaluated for a persistent cough. CT chest revealed a 1.2 cm right sided endobronchial lesion on CT chest. Bronchoscopy revealed a partially occlusive tumor near RC2 carina. This lesion was effectively resected using electrocautery snare and monopolar probe for tissue destruction. Patient is under active surveillance.

Conclusion: Bronchoscopic therapy can provide a useful adjunct to other modalities in a multi-disciplinary team-based approach to management of carcinoid tumors in selected patients with comorbidities or anatomical considerations requiring extensive resection or possible pneumonectomy. Our patients are under active surveillance to detect any recurrence.
Figure 1: Near occlusive Left Lower Lobe Bronchus polypoidal tumor consistent with well differentiated Neuroendocrine Tumor.

Figure 2: Right Lower Lobe Bronchus polypoidal near occlusive lesion consistent with Low-Grade Neuroendocrine Tumor.
Endobronchial Valve Placement and Ogilvie’s Syndrome - A Rare Complication

AUTHORS: Priscilla Yee, DO, Wasif Shamsi, MBBS/MD, Tempest Moore, MD, Toribiong Uchel, MD and Maria Cirino-Marcano, MD

INTRODUCTION: Bronchoscopic lung volume reduction (BLVR) through endobronchial valve (EBV) placement is a treatment for select patients with severe chronic obstructive pulmonary disease (COPD) to reduce hyperinflation. Patients experience improvement in their quality of life, lung function, and exercise capacity. The most common complications include pneumothorax, persistent cough, hemoptysis, and recurrent pneumonias. Ogilvie’s syndrome has not been associated with this procedure. In this case, we present Ogilvie’s syndrome as a complication of EBV placement.

CASE SUMMARY: A 77-year-old male with severe COPD presented for evaluation for BLVR. The patient underwent bronchoscopy with balloon occlusion, and the patient’s right upper and middle lobes were found to be appropriate for EBV placement. Three valves were placed in the right upper lobe and two in the right middle lobe. There were no immediate complications, and the patient was admitted for observation. The day after his procedure, the patient complained of nausea and constipation. Abdominal imaging showed moderate stool burden. Over the following days, the patient received an aggressive bowel regimen without improvement. Subsequent imaging demonstrated large bowel dilation consistent with Ogilvie’s syndrome. Despite nasogastric tube placement for decompression, the patient had worsening abdominal distension and pain, resulting in alveolar hypoventilation. Severe hypercapnia with encephalopathy ensued, and the patient was intubated. The patient continued to decompensate with signs concerning for abdominal compartment syndrome including shock, severe lactic acidosis, and acute renal failure, eventually leading to cardiac arrest. Though return of spontaneous circulation was achieved after cardiopulmonary resuscitation, the patient was transitioned to comfort care and died.

CONCLUSION: The most common complications of BLVR include pneumothorax, granulation tissue formation, recurrent pneumonia, COPD exacerbation, hemoptysis, and chronic cough. Ogilvie’s syndrome is rare and has not been associated with the procedure. Awareness of this potential complication is essential for early management to reduce morbidity and mortality.


Endoscopic Removal of Aspergilloma

**Author:** Elaine Dumoulin

This is a case report of an endoscopic removal of aspergilloma. The patient was immunosuppressed due to Granulomatosis with polyangiitis on Rituximab. He was presenting with significant symptoms of cough and hemoptysis as well as progressive increase in shortness of breath. He was not a surgical candidate due to his comorbidities. He received 3 months of voriconazole with no radiological or clinical improvement. He underwent an endoscopic removal of the aspergilloma. This was done in the operating room under general anesthesia through a regular size 8 endotracheal tube. The procedure lasted about one hour. The cavity was free of mycetoma at the end of the procedure. The patient continued the voriconazole for 1 month after the procedure and then stopped due to side effect of the medication. On follow up, the patient was free of any symptoms, the hemoptysis resolved as well as his cough. Interestingly, his radiologic images improved. There was a reduction in the volume of the cavity and scaring where the aspergilloma was previously sitting. The patient tolerated the procedure well and did not need any admission to the hospital. There was no bleeding. This is one case of a series of 15 endoscopic removal of aspergilloma performed in Calgary, Canada. The fascinating features are the actual decrease in the cavity size post removal of the mycetoma, the resolution of symptoms and the absence of recurrence on follow up. For this patient, there is so far 24 months with no recurrence. It appears to be a safe procedure in patients that are not surgical candidates and a promising alternative.

**Figure 1 a and b**
Computed tomography of the chest pre and post endoscopic removal of aspergilloma

**Background:** Intracavitary pulmonary aspergilloma is a devastating chronic fungal infection with a high mortality rate if left untreated. Aspergillomas occur when *Aspergillus* spp gains access to a pre-existing lung cavity formed secondary to a variety of disease processes such as tuberculosis, sarcoidosis, bronchiectasis, chronic pulmonary obstructive disease and malignancy. A dense mass of hyphae and mucous within the cavity causes a chronic inflammatory response that not only fails to clear the infection but also provides nutrients that allow the organism to survive in a dense hyphae mass. Without definitive therapy, death from aspergilloma can occur from massive hemoptysis, cachexia or secondary infections.
The patient presented in this case report was immunosuppressed due to Granulomatosis with polyangiitis on Rituximab. He was presenting with significant symptoms of cough and hemoptysis as well as progressive increase in shortness of breath.

**Method:** Patient was assessed by thoracic surgery and was not a surgical candidate due to his comorbidities. He received 3 months of voriconazole with no radiological or clinical improvement. He underwent an endoscopic removal of the aspergilloma. This procedure was done in the operating room under general anaesthesia through a regular size 8 endotracheal tube. The procedure lasted about one hour. The cavity was free of mycetoma at the end of the procedure after mechanical debulking through the working channel of flexible bronchoscope. The patient continued the voriconazole for 1 month after the procedure and then stopped due to side effect of the medication.

**Result:** On follow up, the patient was free of any symptoms, the hemoptysis resolved as well as his cough. Interestingly, his radiologic images improved. There was a reduction in the volume of the cavity and scaring where the aspergilloma was previously sitting. The patient tolerated the procedure well and did not need any admission to the hospital. There was no bleeding.

**Conclusion:** This is one case of a series of 15 endoscopic removal of aspergilloma performed in Calgary, Canada. The fascinating features in this case are the actual decrease in the cavity size post removal of the mycetoma, the resolution of symptoms and the absence of recurrence on follow up. For this patient, there is so far 24 months with no recurrence.
It appears to be a safe procedure in patients that are not surgical candidates and a promising alternative.
Eosinophilic Granulomatosis with Polyangiitis and Diffuse Alveolar Hemorrhage Meets Pulmonary Fibrosis and Emphysema: A Case Necessitating Intrapulmonary Recombinant Factor VIIa and Multiple Thoracostomies

Authors: Allen Lavina MD¹, Sikander Khan MD¹, Jinesh Mehta MD²
1 Cleveland Clinic Florida, Internal Medicine
2 Cleveland Clinic Florida, Respiratory Institute

Introduction: Eosinophilic granulomatosis with polyangiitis (EGPA) is an anti-neutrophil cytoplasmic antibody (ANCA)-associated vasculitis (AAV). Diffuse alveolar hemorrhage (DAH) is an associated complication that carries a high mortality. Our case highlights the management of EGPA complicated by ventilator-induced barotrauma with concomitant DAH treated with activated recombinant factor VII (rFVIIa).

Case Description: 55 year old male was hospitalized for hemoptysis. His CT chest was significant for pulmonary fibrosis with centrilobular emphysema. On hospitalization day #2 (HD 2), he was intubated followed by bronchoscopy which revealed diffuse bleeding; DAH was confirmed with serial lavages lacking color change. Subsequently, he developed a right pneumothorax refractory to placement of two 8-French chest tubes. This progressed to a tension pneumothorax resolved with insertion of a 28-French chest tube connected to wall suction. Persistent bloody secretions prompted repeat bronchoscopies with rFVIIa. On HD 5, 50mcg/kg rFVIIa was divided into 5 portions and instilled throughout all lobes. On HD 14, this was repeated with 80mcg/kg rFVIIa. Meanwhile, his workup would reveal a positive pANCA and anti-MPO consistent with EGPA for which he underwent stepwise therapies starting with pulse dose steroids, plasmapheresis, and then Rituximab. He was extubated on HD 33 and ultimately discharged with plans for a steroid taper and Mepolizumab.

Conclusion: DAH is most commonly associated with AAV. It is a life-threatening emergency that often requires intubation. As such, our case highlights a risk versus benefit scenario where increased intra-alveolar pressure combined with pre-existing lung disease imparts a high mortality risk with mechanical ventilation. Fortunately, complications in our patient were remediated with thoracostomies. Furthermore, bronchoscopy with bronchoalveolar lavage remains the gold standard diagnostic for DAH, and at times, is considered treatment. However, there is growing evidence in the hemostatic effect of intrapulmonary rFVIIa in this scenario and our patient’s course provides support for its inclusion in the clinician’s armamentarium.
**Top:** Pulmonary fibrosis most prominent posteriorly, subpleural honeycombing with centrilobular emphysema

**Bottom:** Moderate-to-Large right pneumothorax with right chest wall subcutaneous emphysema and right lung atelectasis
Fourth time the charm

**Authors:** Jennifer D. Duke MD¹, Roberto Benzo MD¹, Eric Aguirre NP¹, Janani Reisenauer MD², Ryan Kern MD¹, and David Midthun MD¹

¹ Division of Pulmonary and Critical Care Medicine, Mayo Clinic Rochester MN

² Division of Thoracic Surgery, Mayo Clinic Rochester MN

**Introduction:** We present a patient with emphysema who three times achieved lobar collapse with bronchoscopic valve placement only to regain volume; final occlusion was achieved by placing valves in series.

**Case Description:** A 64-year-old woman with alpha-1 antitrypsin deficiency, a 10-pack year smoking history, requiring 6 L/minute of oxygen presented for bronchoscopic lung volume reduction evaluation.

Her pulmonary functions showed severe obstruction with a FEV1 21% predicted and residual volume of 240% predicted. Chest CT showed extensive basilar-predominant emphysematous changes and perfusion imaging showed markedly decreased perfusion to left lower lobe.

After demonstration of lack of collateral ventilation, she had an endobronchial valve placed in each of LB6, 7, 8, 9 and 10. She felt immediately improved and CXR showed volume loss, but she developed a left-sided pneumothorax managed with a chest tube, blood patch, and tube removal. Improvement was again achieved; however, she was readmitted one week later with lobar reexpansion with a left-sided pleural effusion and underwent pigtail placement and revision of the valves in LB7 and LB10. Excellent clinical response correlated again with volume loss. Three months later she again developed dyspnea with reexpansion at which time the valve from LB7 was removed and replaced, again resulting in marked clinical improvement and reduction in volume of the left lower lobe.

One month later she had abrupt return of dyspnea and CT showed LLL reexpansion. At bronchoscopy, all the valves appeared in good position, so a size 9 Spiration valve was placed in the common bronchus below LB6 proximal to the basilar valves. She felt immediate improvement and CT at one month showed complete left lower lobar atelectasis. She remains dramatically improved eight months following her last bronchoscopy.

**Conclusion:** Patients with reexpansion after complete volume loss may benefit from having valves placed in series to promote lobar occlusion.
July 2020 (preplacement)

August 2021 (post)
Highlighting Two Cases of Bronchial Carcinoid Tumor Successfully Treated with Different Bronchoscopic Techniques

Authors: Jennifer C. Pharr, Ekaterina Yavarovich

Introduction: Bronchopulmonary typical carcinoid tumors account for <1% of pulmonary malignancies. They are slow growing and rarely metastasize, however can cause airway obstruction.1 We present two cases of young females with carcinoid tumors that underwent bronchoscopic debulking, with different techniques, as a core component of management.

Case Summary: 1) A 24-year-old female, never smoker with history of intermittent asthma, presented with cough. She was treated with multiple courses of antibiotics and steroids for presumed unresolving pneumonia. CT-chest revealed an obstructing endobronchial lesion in the right bronchus intermedius measuring 1.5x1cm with collapsed right lower lobe. Rigid bronchoscopy demonstrated a smooth tumor originating superior to RB6, extending into the bronchus intermedius with 100% obstruction. The tumor was debulked with forceps and bleeding was controlled with APC. Pathology was consistent with typical carcinoid tumor. Thoracic surgery then performed curative resection. Given the technical difficulty of the tumor’s location and inability to achieve negative margins, a robotic bi-lobectomy of the RML and RLL was performed. The patient tolerated the procedure well.

2) A 36-year-old female, never smoker with history of ovarian mucinous carcinoma status-post salpingo-oophorectomy presented after staging CT-chest demonstrated a non-obstructing 10-mm endobronchial lesion at the left upper lobe carina. The patient underwent bronchoscopy utilizing electrocautery snare to completely remove the polypoid lesion with thin stalk originating at the orifice of the lingula. Pathology was consistent with typical carcinoid tumor. Further surgical management is pending treatment plan for the ovarian carcinoma.

Conclusion: Typical carcinoid tumors are important to consider in young patients who have incidentally found bronchial obstructing lesions. Different bronchoscopic approaches for removal can be used, to not just diagnose, but to palliate symptoms and as a bridge to surgery. Surgical resection is the definitive treatment modality of choice with excellent long-term prognosis.

References:
Incidental Endobronchial Hamartoma Causing Asymptomatic Left Upper Lobe Ball Valve Effect

Authors: Kamel Gharaibeh¹, Janaki Deepak¹, Van Kim Holden¹, Faria Nasim¹

1- Division of Pulmonary and Critical Care Medicine, University of Maryland School of Medicine, Baltimore, Maryland

Introduction: Lung hamartomas are most common benign tumors of the lung which are consisting of multiple mesenchymal cell lines like cartilage, bone, fat and muscle tissue. Majority of pulmonary hamartomas are found in the peripheral parenchymal lung and usually asymptomatic. Endobronchial hamartomata are exceedingly rare but often symptomatic as it causes chronic cough, recurrent pneumonia, and dyspnea.

Case summary: 69-year-old male patient with history of right eyelid squamous papilloma, alcohol abuse disorder, alcoholic cirrhosis, psoriasis, and lower extremity deep vein thrombosis (on apixaban), who was found to have incidental left upper main stem bronchus nodule causing atelectasis and air trapping. Pan CT was done as a workup of severe anemia to rule out malignancy. Patient denied any respiratory symptoms. CT of the chest showed focal opacification/nodule of a left upper lobe (LUL) bronchus at the level of the left hilum measuring 2.2 x 1.1 cm with subsegmental atelectasis and air trapping. PET didn’t show abnormal FDG uptake, metabolic evidence of lymphadenopathy or distant metastasis. Flexible bronchoscopy showed endobronchial tumor located 2-3 cm distal to the orifice of the LUL bronchus causing near-complete obstruction of the LUL (ball valve effect). A P190 scope was used to pass beyond the mass which showed patent distal airways. Then, a 15mm snare electrocautery was used to remove a large piece of the mass followed by cryoextraction with complete removal of tumor, resulting in a complete patent airway. Histopathology revealed pulmonary hamartoma.

Conclusion: We report a rare, unique presentation of asymptomatic Endobronchial hamartoma that is causing significant radiological findings and near-complete air obstruction with ball valve effect, which was successfully removed using snare electrocautery and cryoextraction. Endobronchial hamartoma should be considered as potential causes of endobronchial lesions causing airway obstruction. Although endobronchial hamartomas are benign, early resection is recommended to prevent post obstructive lung injury.
C, D: Histopathology images of the LUL endobronchial lesion show the presence of a benign pulmonary lesion composed of hyaline cartilage, fibroadipose tissue, and bland spindle cells in myoid stroma. These findings are consistent with Pulmonary Hamartoma.

A-B: Bronchoscopy images showing smooth endobronchial nodule in left upper lobe

Figure A, Cross computed tomography image: endobronchial nodule in the left upper lobe with air trapping and atelectasis

Figure B, Coronal computed tomography image: endobronchial nodule in the left upper lobe with air trapping
Initial Safety Results from a Phase 1 Trial of Robotically Delivered, Neoadjuvant, Intratumoral Cisplatin for Early Stage, Resectable, Non-Small Cell Lung Cancer

Authors: C. Matthew Kinsey MD, MPH¹ Vitor Mori PhD², Bernard F. Cole PhD³, Ya Tuo², Sarah Wagner NP¹, Pamela C Gibson MD³, Scott Anderson MD³, Kelly Butnor MD³, James Spivey BS MBA⁴, Lisa Pierre PhD⁴, Stewart Bates PhD⁵, Peter A. Kaufman MD⁵, Farrah B. Khan MD⁵, Mitch Norotsky MD⁶, Hannah Kooperkamp MD⁶

1. Vermont Lung Center, Division of Pulmonary and Critical Care, University of Vermont, Burlington VT
2. Department of Mathematics and Statistics, University of Vermont, Burlington VT
3. Department of Pathology, University of Vermont, Burlington VT
4. Lung Cancer Initiative, Johnson and Johnson Global External Innovation, New Brunswick, NJ
5. Hematology and Oncology Division, University of Vermont, Burlington VT
6. Division of Cardiothoracic Surgery, University of Vermont, Burlington VT

Background: For early-stage, resectable, lung cancer, neoadjuvant chemotherapy improves survival. However, when it is delivered intravenously neoadjuvant chemotherapy results in significant rates of adverse events. Intratumoral chemotherapy has the potential to capture the benefits of neoadjuvant IV chemotherapy while minimizing systemic toxicity and may be delivered at the time of diagnosis.

Methods: We initiated a 3+3 dose ranging study (IRB: UVM 00001001; NCT04809103; FDA approval: IND 151593). Patients ≥ 18 years old, ECOG PS ≤1, suspected NSCLC were eligible for enrollment. All cases were reviewed by a Cardiothoracic surgeon to determine resectability. Lesion volume was determined by semi-automated segmentation (www.chestimagingplatform.org). During the procedure, systematic mediastinal staging via endobronchial ultrasound (Olympus America, Center Valley PA) is first performed with rapid on-site cytopathology (ROSE) to confirm the absence of mediastinal metastasis. All lesions were accessed robotically using the Auris Monarch Platform (Auris Health, Redwood City CA). Following ROSE confirmation of NSCLC and acquisition of all clinically required tissue, cone beam CT (O-arm, Medtronic, Minneapolis MN) was used to verify needle location within the lesion. Delivery of intratumoral cisplatin is then performed over 30 seconds. Another cone beam CT is performed to assess for complications. Participants are monitored for pre-defined adverse events at 24h, 1 week, and 2 weeks post-delivery. Any adverse events ≥ CTCAE 3 are considered dose-limiting. All participants proceeded to surgery.

Results: Three patients met all eligibility criteria and received intratumoral cisplatin at the first dose level. All treated cancers were located in the outer 1/3 of the lung. Mean tumor volume was 4.0 mL. In 2 of 3 cases diagnosis, staging, and treatment were performed in the same procedure. One patient had a prior diagnosis. CBCT before delivery resulted in needle repositioning in 2 of the cases. Neither airway nor parenchymal extravasation was identified for any of the cases. There were no procedural related complications. None of the participants experienced a Grade III adverse event.

Conclusions: Data from the initial dosing cohort support the safety and feasibility of robotically delivered treatment of early-stage peripheral lung cancer with intratumoral cisplatin. The trial has moved to the second dosing cohort. CBCT is necessary to position the needle near the centroid of the lesion.
Interventional Pulmonology Approach to Eradicating Metastatic Carcinoid

Authors: Jalal Damani, DO and Robert Holladay, MD

Carcinoid tumor can occur focally and be indolent in nature. It can also affect multiple organ systems and managing diffuse disease can be challenging. We present a challenging case of metastatic carcinoid that was successfully eradicated using multimodality treatment that involved Chemo-Radiation and endobronchial ablative treatment using photodynamic therapy (PDT).

A 68-year-old male with history of stage IA Adenocarcinoma in the left upper lobe (LUL) 10 years ago for which he underwent LUL lobectomy. Patient then underwent surveillance CT scans every 6 months for 3 years and then underwent yearly CT scans with persistence of remission. Then 1 year ago, he developed mild hemoptysis for which he underwent bronchoscopy that detected multiple friable nodular lesions throughout the airway. Biopsy revealed Carcinoid tumor. A Dototate PET scan revealed metastatic carcinoid affecting bone, bone marrow, mediastinal lymph nodes and airways. He had been having progressive shortness of breath. Patient underwent bronchoscopies with tumor debulking followed by ablation. Ablative techniques utilized were PDT followed by argon plasma coagulation. The remaining endobronchial lesions were further ablated with PDT again with full resolution of endobronchial carcinoid lesions. Concomitantly, patient received Lutetium Dototate therapy for his extrapulmonary metastatic carcinoid lesions. He received this combination of Chemo-Radiation along with endobronchial ablative therapies over span of 6 months. Patient tolerated this combination of therapy very well with resolution of endobronchial and extrapulmonary lesions as seen on follow-up Dototate scans. Patient currently denies shortness of breath and hemoptysis.

Metastatic Carcinoid can be relentless causing significant symptoms burden ranging from pain due to bone metastasis to hemoptysis from endobronchial lesions. A thorough evaluation utilizing Dototate scan is of utmost importance to be able to capture any extrapulmonary disease. A multimodality approach involving Chemo-Radiation and endobronchial ablative therapy offered by Interventional Pulmonology is an adequate approach to combating metastatic carcinoid.
DOTOTATE SCAN SHOWING PULMONARY AND EXTRAPULMONARY CARCINOID METS

Avid lesions seen in lungs, mediastinum, bone and bone marrow
BRONCHOSCOPIES PERFORMED OVER 6 MONTHS

Left main stem endobronchial carcinoid lesions ablated by Photodynamic therapy (PDT)
Post Argon Plasma Coagulation
LUL stump endobronchial carcinoid lesions ablated by Photodynamic therapy (PDT)
Intrapleural Tranexamic Acid Therapy in Hemothorax With Persistent Bleeding

Authors: Wm. Tyler Smith, MD¹; Xia Ranran, PharmD, BCCCP²; Hilary DuBrock, MD¹; David Midthun, MD¹

¹ Division of Pulmonary and Critical Care Medicine, Mayo Clinic, Rochester, MN
² Department of Pharmacy, Mayo Clinic, Rochester, MN

Introduction: Hemothorax has traditionally been treated with tube thoracostomy in conjunction with aggressive resuscitation, and embolization or surgical intervention if bleeding persists³. We present a case in which intrapleural tranexamic acid (TXA) was used for hemostasis in a non-surgical patient with persistent bleeding and no clear target for embolization.

Case Summary: A 52-year-old man with decompensated alcohol-related cirrhosis was admitted for weakness and chest pain after a fall at home. Evaluation found a small left pleural effusion and acute left-sided fractures of ribs 9-12. On hospital day 10, he became more encephalopathic with a 4-gram decrease in hemoglobin since admission and repeat chest X ray that showed a large effusion. Bedside thoracentesis revealed frank blood (hematocrit 18%, serum 19%) and a 14 Fr pigtail catheter was placed with evacuation of 2L of bloody fluid over one hour. Thoracic surgery was consulted, and the patient was deemed to not be a surgical candidate due to ongoing coagulopathy and end stage liver disease. Angiography did not reveal a source of extravasation. He developed hemorrhagic shock requiring vasopressors, 6 units of packed red cells, 1 unit of FFP, 1 unit of platelets, 10 mg vitamin K, and 2 units of pooled cryoprecipitate over the next 24 hours. Due to persistent hemorrhage, intrapleural TXA, 3g in 50 mL, was instilled and clamped for 1 hour². Subsequent chest tube output decreased and became serous over several days with concurrent decrease in transfusion needs. He ultimately died 16 days later while still hospitalized following a spontaneous retroperitoneal bleed and transition to comfort focused care.

Conclusion: Intrapleural TXA may serve as an adjunct to resuscitative therapies in hemothorax for patients who are not surgical candidates and without an identifiable source for embolization at angiography.

References:

Management of Pneumomastia and Bronchopleural-Subcutaneous Fistula via Endobronchial Valve Placement

AUTHORS: Grant Senyei, MD1, Matthew Nobari, MD1, A. Rolando Peralta, MD1, Russell Miller MD1, Anuja Vyas, MD2, Mark Onaitis, MD3, George Cheng MD, PhD1

1UC San Diego Health Division of Pulmonary, Critical Care and Sleep Medicine  
2Sharp Rees-Stealy, San Diego, California  
3UC Sand Diego Health Division of Cardiothoracic Surgery

INTRODUCTION: Bronchopleural-subcutaneous fistulas are rare sequelae of lung cancer treatment. The presence of recurrent infections in areas of previous radiation therapy or surgical resection increases the risk of fistula formation. Bronchoscopic management of these fistulas is required when affected tissue is not amenable to surgical repair.

CASE SUMMARY: A 73 year-old female with a history metastatic colon cancer to the lungs status-post radiofrequency ablation and right lower lobe resection 20 years ago presented with 6 months of shortness of breath, productive cough and palpable right sternal mass. CT imaging revealed a draining fistula emanating from the right middle lobe (RML) bronchus terminating through the chest wall (Figure 1). Bronchoalveolar lavage of the fistula tract revealed infection with *Proteus mirabilis* for which she was treated. She then underwent an uncomplicated right anterolateral thoracotomy with excision of the fistula tract revealing a defect near the orifice of the RML bronchus. This defect was unable to be closed via direct suture repair due to surrounding fibrotic tissue, so a pectoralis flap was placed to promote healing. Pathologic evaluation did not reveal malignancy within the excised fistula tissue. The patient subsequently re-presented with intermittent pneumomastia. She underwent bronchoscopy with placement of a Spiration size 6.0 endobronchial valve (Olympus) in the RML, however she had recurrent pneumomastia after coughing (Figure 2). Repeat bronchoscopy was performed during which Fibrin Sealant Tisseel solution (Baxter) was instilled into the RML orifice and the endobronchial valve was upsized to a Spiration size 7.0 valve. The right breast was decompressed percutaneously. 2-month interval CT showed resolution of pneumomastia. The endobronchial valve was removed after 4 months without recurrence of pneumomastia on follow up.

CONCLUSION: In this case, we describe the effective management of a persistent bronchopleural-subcutaneous fistula resulting in pneumomastia via temporary endobronchial valve placement.
Figure 1. Pre-operative axial CT images showing bronchopleural/softcutaneous fistula.

Figure 2. Recurrent pneumomastia after endobronchial valve placement. (A) Axial CT image showing pneumomastia and endobronchial valve (blue arrow). (B) Physical exam showing pneumomastia (white arrows).
Medical thoracoscopy in loculated parapneumonic effusion: A case report

Authors: G. Emasoga¹, N. Valizadeh², and R. Arancibia²

¹One Brooklyn Health, Brookdale Hospital Medical Centre, Brooklyn, New York; ²State University of New York Downstate Medical Centre, Brooklyn, New York.

Corresponding author’s email: drgloryemasoga@gmail.com

Introduction: Loculated parapneumonic effusions separated by fibrous tissue are challenging to evacuate with conventional chest tubes. If left untreated, they carry a high morbidity and mortality rate. Medical thoracoscopy is a minimally invasive procedure used in the management of pleural diseases including parapneumonic effusions not amenable to conventional therapy. We report a case of a young man with a loculated parapneumonic effusion treated with medical thoracotomy.

Case Summary: A 47-year-old Latino male presented to the emergency room with a 2-day history of left-sided chest pain and dyspnea that worsened on exertion. A Computed tomography angiography (CTA) of the chest revealed a large left-sided sub-pulmonic loculated effusion with collapse of the lingula. Initially, an 8-Fr pigtail catheter failed to evacuate the cavity. Initial pleural studies showed an exudative pleural fluid with parapneumonic characteristics (LDH 528 U/L, elevated WBCs, and low glucose). Another 14-Fr pigtail catheter was placed in a different locule draining only 150cc. tPA/DNase was instilled with no further pleural fluid drainage. Repeat imaging showed persistent effusion with multiple locules. He remained febrile and hypoxemic requiring increased oxygen supplementation via high flow nasal cannula with FiO2 of 90%. Medical thoracoscopy was performed with inspection of the left pleural space. The soft adhesions were lysed with flexible forceps and locules broken and a total of 300cc pleural fluid was drained. A 20-Fr chest tube was placed in the pleural cavity post-procedure. The patient showed significant improvement clinically and was discharged home after two days.

Conclusion: Medical thoracoscopy is a safe and effective modality for prompt treatment of early fibrinopurulent stage of parapneumonic effusion and its use should be promoted as a first-line therapy option as it leads to reduced length of stay and an accelerated improvement of symptoms.
Mounier-Kuhn Syndrome: The Role of Custom Stents

Authors: Irene Riestra Guiance MD, Michal Reid MD, Ryan Kern MD, Jeremy Clain MD.

Mounier-Kuhn syndrome is a rare form of tracheobronchomegaly characterized by an abnormal dilation of the trachea and bronchi due to the loss of elastic fibres associated with smooth muscle layer thinning or atrophy. It causes expiratory airway collapse leading to dyspnea, inability to clear secretions and recurrent infections.

We present a case of a 50-year-old man diagnosed at age 27 with Mounier-Kuhn syndrome after recurrent infections and a compatible CT. His course was a progressive one characterized by worsening airway infections and severe left mainstem bronchial malacia that eventually became nearly flat and severely stenotic. Due to recurrent pneumonias, patient underwent a rigid bronchoscopy with placement of a 14x40mm silastic left main bronchus stent in 2011. One year later, the stent migrated into the trachea and was replaced by a 15x40 mm stent. Two years later, evaluation of worsening fatigue and dyspnea showed migration and partial obstruction of the stent with intense mucus plugging. The stent was replaced with a modified 16x60mm modified to aerate upper lobe but, but within a week the stent migrated into the trachea and was removed. Due to anatomy, he was not offered further stenting at the time. Eight years later, a bronchoscopy for evaluation of focal opacities showed a dramatically abnormal trachea with widespread tracheomalacia of the central airway and a severely partially stenotic and malacic left mainstem. A patient-specific custom silicone Y-stent was created and placed with substantial symptomatic improvement. It was slightly modified and a replaced 5 months later. The patient is stable nearly 1 year after custom stenting with no issues of migration.

Tracheobronchomegaly is a difficult condition to treat, even more so in the setting of significant tracheal and bronchial malacia and stenosis. In a patient with recurrent stent migration, a custom Y stent may be considered in the setting of abnormal anatomy to prevent migration and other complications from stenting.
Figure A: 3-D model of patient’s bronchial tree from most recent CT of the chest. Trachea and with significant diverticula and a severely stenosed and flattened left mainstem. A left mainstem Y stent model created to perfectly fit the patient’s airway (purple).

Figure B.1: Severe stenosis of the left mainstream bronchus with granulation tissue at the medial aspect of the proximal left mainstem.  Figure B.2: Left mainstem post custom Y stent placement is now patent.
Multimodal bronchoscopy in the diagnosis of rapidly growing pulmonary nodules

Authors: Ashley M. Scott MD, Billie A. Bixby

Introduction: Multimodal bronchoscopy enabled expeditious diagnosis of this patient’s rapidly progressive disease.

Case description: A 57-year-old male never-smoker with gastroesophageal reflux disease (previously healthy otherwise) presented with subacute cough productive of green sputum, which did not improve after a ten-day course of doxycycline. He denied fevers, chills, and night sweats but endorsed 30-pound unintentional weight loss over the prior two months. He resides in Tucson, AZ and frequently visits Mexico. He denies prior incarceration, homelessness, known exposure to tuberculosis, or family history of cancer. He formerly worked in construction but is currently a photographer. Vitals were sound on presentation, SpO2 96%. Complete blood count with differential, basic metabolic and liver profiles were unremarkable (except for mild hyponatremia). CT chest revealed numerous pulmonary nodules, a cavitary right lower lobe (RLL) mass, and no significant lymphadenopathy. CT of the abdomen and pelvis revealed retroperitoneal adenopathy and portal vein thrombus. During his four-day hospitalization, he underwent extensive infectious workup (see table). He received seven days of cefdinir and azithromycin. He continued to worsen. 1.5 weeks after hospital discharge, he presented for bronchoscopy, SpO2 90%. Bronchoscopy with bronchoalveolar lavage (BAL), electromagnetic navigation (assisted by transbronchial biopsy), endobronchial biopsies of left mainstem bronchus (LMSB) nodules, and linear endobronchial ultrasound was performed (see table). This was complicated by post-procedural hypoxemia, which resulted in a week-long hospital stay. His nodules grew rapidly on repeat imaging. He was discharged on supplemental oxygen (5 LPM). Ultimately, the LMSB endobronchial biopsies and RLL mass navigational and transbronchial biopsies yielded a poorly differentiated adenocarcinoma.

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial sputum cultures</td>
<td>No growth</td>
</tr>
<tr>
<td>Fungal sputum cultures</td>
<td>No growth</td>
</tr>
<tr>
<td>Mycobacterium tuberculosis polymerase chain reaction, sputum</td>
<td>Negative</td>
</tr>
<tr>
<td>Acid-fast bacillus stains and cultures (three)</td>
<td>Negative, no growth</td>
</tr>
<tr>
<td>Quantiferon Gold</td>
<td>Negative</td>
</tr>
<tr>
<td>Legionella antigen</td>
<td>Negative</td>
</tr>
<tr>
<td>Cryptococcus antigen</td>
<td>Negative</td>
</tr>
<tr>
<td>Aspergillus antigen</td>
<td>Negative</td>
</tr>
<tr>
<td>Beta-D-glucan</td>
<td>Negative</td>
</tr>
<tr>
<td>Coccidioides IgM</td>
<td>Negative</td>
</tr>
<tr>
<td>Coccidioides IgG</td>
<td>Indeterminate</td>
</tr>
<tr>
<td>Test</td>
<td>Result</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Repeat <em>Coccidioides IgM</em></td>
<td>Negative</td>
</tr>
<tr>
<td>Repeat <em>Coccidioides IgG</em></td>
<td>Negative</td>
</tr>
<tr>
<td>Human immunodeficiency virus</td>
<td>Negative</td>
</tr>
<tr>
<td>Right middle lobe BAL fluid</td>
<td>Rare Gram-positive cocci, lymphocytic-</td>
</tr>
<tr>
<td></td>
<td>predominant fluid. Cytology unrevealing</td>
</tr>
<tr>
<td>Lingular BAL fluid</td>
<td>Rare Gram-positive cocci, lymphocytic-</td>
</tr>
<tr>
<td></td>
<td>predominant fluid. Cytology unrevealing</td>
</tr>
<tr>
<td>Endobronchial ultrasound-guided imaging</td>
<td>Lymph node 1 cm in diameter. Lymphocytes</td>
</tr>
<tr>
<td>and biopsy of lymph node station 4R</td>
<td>typical of lymphoid tissue</td>
</tr>
<tr>
<td>Endobronchial ultrasound-guided imaging</td>
<td>Lymph node 1 cm in diameter. Lymphocytes</td>
</tr>
<tr>
<td>and biopsy of lymph node station 7</td>
<td>typical of lymphoid tissue</td>
</tr>
<tr>
<td>Left mainstem endobronchial biopsies (four</td>
<td>Poorly-differentiated adenocarcinoma,</td>
</tr>
<tr>
<td>passes)</td>
<td>likely of upper gastrointestinal origin</td>
</tr>
<tr>
<td>Combined navigational and transbronchial</td>
<td>Poorly-differentiated adenocarcinoma,</td>
</tr>
<tr>
<td>biopsies of the right lower lobe mass</td>
<td>likely of upper gastrointestinal origin</td>
</tr>
<tr>
<td>(ten passes)</td>
<td></td>
</tr>
</tbody>
</table>

*Image 1: CT chest*
Conclusion: Despite subacute symptomatology plus lack of strong risk factors, this patient was diagnosed with metastatic adenocarcinoma. Although BAL under moderate sedation would have been a lower-risk initial study, only navigational and endobronchial biopsies yielded his diagnosis; performance of multimodal bronchoscopy minimized number of procedures and expedited diagnosis.
Never too old for congenital problems

Authors: Irene Riestra Guince MD, Joseph Marion MD, Mark Norton MD, David Midthun MD

Introduction: Chylothorax is typically treated conservatively with dietary changes, somatostatin or octreotide infusions and repeat thoracentesis unless output is >2L after two days of optimal therapy. We present a case of chylothorax due to congenital lymphangiectasia that required IR and surgical intervention for high pleural fluid output and trapped lung.

Case description: A 61-year-old male was admitted with four months of progressive dyspnea and new large pleural effusion. He had a history of chronic left lower extremity lymphedema and congenital chyluria secondary to left renal lymphangiectasia previously surgically corrected. His only pulmonary history was a benign apical mass 10 years prior. Chest CT showed a large left pleural effusion with rightward mediastinal shift. Pleural fluid appeared milky; studies demonstrated a chylous lymphocytic exudate (pH 7.8, total protein 3.9, LDH 159, triglycerides 519, glucose 92, 84% lymphocytes and negative flow cytometry). An 10F pigtail catheter was placed, resulted in a persistent ex vacuo pneumothorax and high daily output (>9L in 10 days) despite starting octreotide infusions and low-fat diet. Lymphangiogram showed extensive dilated anomalous lymphatic channels, a central obstruction of the terminal thoracic duct with lymphangiectasia, peribronchial lymphatic drainage and a leak arising from the short segment of the thoracic duct. Via cannulation of the thoracic duct from supraclavicular access, he underwent successful cyanoacrylate embolization of the anomalous mediastinal lymphatic channels and the thoracic duct. Pleural fluid output markedly diminished, yet he underwent a left thoracotomy and left sided decortication for trapped lung.

Conclusion: Chylous pleural effusions are uncommon, and management may require multidisciplinary approach. New understanding of lymphatic dynamics and flow patterns allow aggressive lymphatic interventions via minimally invasive procedures to work in tangent with current interventional pulmonology therapy to improve long-term outcomes and potentially resolve chylothorax. Our case shows the importance of a multidisciplinary approach in the management of chylothorax.
Figure A: Transnodal lymphangiography was performed via right inguinal lymph node access using 25-gauge needles and Lipiodol (Guerbet, Villepinte, France). Direct puncture of the cisterna chyli was performed with fluoroscopic guidance and a 22-gauge needle, and antegrade/retrograde thoracic duct access was gained via the left basilic vein
**Figure B:** The thoracic duct and anomalous mediastinal lymph channels were embolized with cyanoacrylate glue.
Novel Treatment of Persistent Air Leak in a Patient with Post COVID-19 Mucormycosis

Authors: Lindsey Morris, Prarthna Kulandaisamy

Introduction: We present a rare case of post COVID-19 mucormycosis complicated by the development of bronchopleural fistula (BPF) and persistent air leak (PAL) treated by novel approach with endobronchial valve (EBV) placement for palliation.

Case Summary: Patient is a 49-year-old female with ANCA vasculitis on chronic immunosuppression, end-stage renal disease, diabetes, and recent COVID-19 infection who presented with dyspnea and cough with brown sputum. CT chest revealed a left lower lobe pulmonary abscess, and broad-spectrum antibiotics were started. Her course was complicated by left pneumothorax requiring chest tube placement, respiratory failure requiring mechanical ventilation, fungemia, and fungal empyema (Rhizopus species).

She had a significant PAL requiring continuous suction. Repeat imaging identified a left upper lobe (LUL) BPF, but she was deemed not a surgical candidate. She was taken for bronchoscopy for localization of fistula using balloon occlusion technique (Figure 1). Endobronchial valves were placed in the LUL and lingula with near-complete resolution of leak (Figure 2). Following the procedure, she tolerated water seal and plan was made for transfer to hospice. Unfortunately, due to worsening clinical status from fulminant fungemia, the patient subsequently expired.

Conclusion: Bronchopleural fistula is a rare complication of necrotizing pneumonia. PAL is an unfortunate sequela, particularly in the setting of positive pressure ventilation. Initial management is typically conservative utilizing ventilator strategies to reduce flow across the pleural defect, treating underlying infection, and optimizing nutrition.

Surgical repair remains the gold standard for treatment when conservative measures fail, but many critically ill patients are not surgical candidates. In our patient, the placement of EBV's resulted in marked improvement in PAL. EBV placement should be considered as an alternative therapy to facilitate chest tube weaning in refractory PAL cases.

Percutaneous Tracheostomy, an Ever-evolving Bedside Procedure

Authors: Daniel Hernandez-Rojas, Sebastian Fernandez-Bussy, Kate Walsh, Alejandra Yu Lee-Mateus, Rocio Castillo-Larios, Sai Priyanka Pulipaka, David Abia-Trujillo

Background: Percutaneous dilational tracheostomy (PDT) is one of the most frequently performed procedures in the ICU. Numerous articles and guidelines have emerged regarding safety strategies and protocols. This study aims to analyze the outcome of PDT in our institution and to discuss the novel implementations in the current literature that could potentially improve our outcomes.

Method: A retrospective, single-center study evaluated the outcomes of 192 patients who underwent bedside PDT in Mayo Clinic Florida over three years, between June 2018 and June 2021. The primary outcomes were time from mechanical ventilation to tracheostomy placement, time to tracheostomy downsizing and decannulation, and length of stay (LOS). The secondary outcomes focused on complication rates and mortality at the first-year mark.

Results: All 192 patients underwent bedside PDT in the ICU. Indications for tracheostomy were categorized as prolonged intubation (77%), airway protection/neurological (11.5%), and facilitation of ventilatory support (11.5%). Median days on mechanical ventilation were 24.5. The rate of downsizing before discharge was 57.3%, and the median days to downsize was 15. Over the three years, the decannulation rate was 39.6%, and the median days to decannulate were 28. Median ICU days were 24, and the median total LOS was 36.

The overall mortality rate was 46.4%. Out of 89 patients, 81 (42.7%) died in the first year, five (5.6%) in the second year, and two (1.9%) in the third year. Causes of mortality was acute respiratory failure (32.6%), neurological complication (23.6%), post-transplant (14.6%) and COVID-19 complications (13.1%).

We categorized tracheostomy placement as early or late with a 10-day cut-off. A total of 122 patients underwent early tracheostomy, and 70 patients underwent late tracheostomy. We found a significant difference between early and late tracheostomies in median days on mechanical ventilation (21 vs. 29 $p<.001$) and in median total LOS (34 vs. 41 $p=.04$). No significant difference in complication rates was found between early and late (31.1% vs. 25.7% $p=.51$). A clinically significant decreased in mortality between early and late (40% vs. 55.7%) tracheostomies was found, with no statistical significance ($p=.052$).

Conclusion: PDT is a relatively safe bedside procedure performed in the ICU. Early tracheostomy yielded a significant difference in decreasing days on mechanical ventilation and LOS. However, no statistical difference was evidenced in mortality compared to previous studies. We hypothesize that continuous outcome analysis, novel safety strategies, and protocols may improve patient-centered outcomes.
Prevalence of Non-Cystic Fibrosis Bronchiectasis in Expiratory Central Airway Collapse

Authors: Sai Priyanka Pulipaka, Sushil Kumar Sonavane, Rolf Grage, Alejandra Yu Lee-Mateus, Daniel Hernandez-Rojas, Rocio Castillo-Larios, David Abia-Trujillo, Sabastian Fernandez-Bussy, and Margaret Johnson

Background: Expiratory central airway collapse (ECAC) is defined by excessive dynamic motion of the posterior tracheobronchial membrane or anterolateral cartilage during exhalation. ECAC commonly coexists with COPD, asthma, GERD, and obstructive sleep apnea. ECAC association with bronchiectasis is yet to be documented. Common conditions for non-cystic fibrosis (non-CF) bronchiectasis in adults are post infective, COPD, connective tissue disease, immunodeficiency, asthma. Our study aims to evaluate the occurrence of bronchiectasis in patients with ECAC as the primary outcome and the correlation between the severity of bronchiectasis and the severity of ECAC as a secondary outcome.

Methods: A retrospective single-center study evaluated 166 patients diagnosed with ECAC using dynamic bronchoscopy in Mayo Clinic Florida, from June 2019 to December 2020. Two radiologists analyzed chest computed tomography (CT) scans to evaluate the presence of and severity of bronchiectasis using the Brody Scoring System. Additional features such as presence of bronchial wall thickening, tree in bud densities, emphysema, cavitation, interstitial lung disease was also noted. A subgroup analysis of 20 patients was performed to evaluate the inter reader variability of bronchiectasis score and its association with ECAC severity.

Results: Out of the 166 patients diagnosed with ECAC through dynamic bronchoscopy, 58 patients (35%) presented bronchiectasis in their CT scans. Patients with ECAC were divided into severe ECAC (n=64) if they underwent a stent trial and non-severe ECAC (n=102). Of the 64 patients with severe ECAC, 20 patients (31.25%) were diagnosed with bronchiectasis, and 44 patients (68.75%) had no evidence of bronchiectasis. Of the 102 patients with non-severe ECAC, 38 (37.25 %) had bronchiectasis. The preliminary subgroup analysis of the association between ECAC severity and bronchiectasis reported a mean bronchiectasis score of 12.5 in severe ECAC and a mean of 9 in non-severe ECAC. The inter reader correlation for the bronchiectasis score was 0.83, implying almost perfect agreement. We hypothesize a stronger association with a more significant number of patients further in the project.

Conclusion: The prevalence and correlation of severity of non-CF bronchiectasis in ECAC patients may be significant. Although larger cohorts are necessary, evaluating bronchiectasis in patients diagnosed with ECAC may help improve patient outcomes when treating these potentially coexisting diseases.
Recurrent Pulmonary Alveolar Proteinosis Manifestations after Multiple Whole Lung Lavages and Concurrent Anti-GMCSF therapy

Authors: Hira Irfan¹, Chenchen Zhang², Adnan Majid², Mihir Parikh²

¹Ascension Providence Hospital, Michigan, USA
²Beth Israel Deaconess Medical Center, Boston, USA

Introduction: Pulmonary alveolar proteinosis (PAP) is a rare disorder involving alveolar accumulation of surfactant (1). Variants in adults mostly include autoimmune (90%) and those secondary to inhaled toxins or hematologic disorders (2, 3). Management of PAP involves whole lung lavage (WLL) and inhaled or subcutaneous granulocyte colony stimulating factor (GM-CSF) therapy (2,3). Reported mean number of WLL required per patient in five years is 2.5 +/- 1.5 (4). Greater than 70% of patients are reported to be free from recurrent PAP at 7 years after first WLL (5). Hereby, we describe a challenging case of autoimmune PAP with rapid recurrence of disease, requiring three WLLs during a span of 14 weeks, on GM-CSF therapy, and requiring extracorporeal membrane oxygenation (ECMO) support during each WLL.

Case description: A 57-year-old male immigrant from Brazil, with history of tobacco and cocaine use, schistosomiasis, and Covid-19 infection (20 months prior to first WLL) presented with cough and foamy sputum production. Diagnosis of PAP was made based on PAS-positive milky bronchoalveolar lavage fluid, and positive serum anti–GMCSF antibodies. He underwent three rounds of WLL, and intolerance of single lung ventilation necessitated VV ECMO support each time (Figure 1 and 2). Table 1. states the volumes of lavage fluid used and timelines of each WLL. Oxygenation improved after first session of WLL, however, he continued to require high-flow nasal canula (HFNC). Subsequent WLL was performed, and patient was weaned down to 3-4 L nasal canula. Repeat chest Xray in 3 months showed significant progression of disease (Figure 1). Nebulized recombinant GM-CSF therapy was started approximately 4 weeks prior to third WLL, which was subsequently performed.

Conclusion: We describe a unique case of PAP with a challenging treatment course, highlighting the need for further research on standardized therapeutic guidelines, and reproducible outcomes in these patients.

<table>
<thead>
<tr>
<th>WLL side and number</th>
<th>Volume of lavage fluid (L)</th>
<th>Days after initial WLL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left 1st</td>
<td>23</td>
<td>0</td>
</tr>
<tr>
<td>Right 1st</td>
<td>23</td>
<td>1</td>
</tr>
<tr>
<td>Right 2nd</td>
<td>17</td>
<td>12</td>
</tr>
<tr>
<td>Left 2nd</td>
<td>24</td>
<td>13</td>
</tr>
<tr>
<td>Right 3rd</td>
<td>27</td>
<td>96</td>
</tr>
<tr>
<td>Left 3rd</td>
<td>30</td>
<td>97</td>
</tr>
</tbody>
</table>

Table 1. Volumes of lavage fluid used in each Whole Lung Lavage and number of days subsequent lavage sessions were performed after first WLL
Figure 1: A and B demonstrate the CT scan findings at initial presentation before whole lung lavage. C and D show reaccumulation of proteinaceous material before third whole lung lavage. E and F compare Chest Xray after third second whole lung lavage (E) and before third whole lung lavage (F).
**Figure 2:** Lavage fluid collected during each whole lung lavage procedure. A shows aliquot during 1st left-sided lung lavage. B shows first and last aliquot of 1st right-sided lung lavage. C shows first and last aliquot of 2nd left-sided lung lavage. D shows third and last aliquot of 2nd right-sided lung lavage. E shows second and last aliquot of 3rd right-sided lung lavage.
Recurrent Respiratory Papillomatosis causing airway obstruction

AUTHORS: Bharat Singh Bhandari¹, MD; Kha Dinh¹, MD; Andrew G. Tritter², MD; Pushan Jani³, MD

¹- Department of Pulmonary and Critical Care,
The University of Texas Health Science Center at Houston
²- Department of Otorhinolaryngology – Head & Neck Surgery
The University of Texas Health Science Center at Houston

INTRODUCTION: Recurrent respiratory papillomatosis (RRP) is a benign disease caused by the human papilloma virus (HPV), characterized by the appearance of papillomatous lesions anywhere in the aerodigestive tract. Usual culprits are HPV6 and HPV11. [1] Here we present a case of RRP causing near complete obstruction of the trachea.

CASE: A 36-year-old-male with past medical history of asthma and recurrent respiratory papillomatosis s/p excision in 2013 and 2014 presented to the hospital for shortness of breath, intermittent hemoptysis, worsening hoarseness, and cough ongoing for the last 3 months. Physical examination revealed biphasic stridor inspiratory > expiratory. Initial fiberoptic laryngoscopy showed multiple non-obstructive ball valving papillomatous lesions along the false vocal cords. CT scan of the neck showed multiple protruding lesions in the trachea with luminal narrowing. A hybrid rigid bronchoscopy was planned by both interventional pulmonary and the otorhinolaryngology teams. Moderate amount of supraglottic papillomatosis and a large bulk in the mid and distal trachea at the level of the carina with a nearly completely obstructive conglomeration of papilloma was noted. Mid tracheal papilloma was debrided using the microdebrider followed by distal tracheal papilloma debridement using the blade of the rigid bronchoscope and APC. Patient tolerated the procedure well and was discharged with an outpatient follow up.

DISCUSSION: RRP is usually acquired in children via contact from infected secretions in the birth canal while in adults infection may occur following oral sex. RRP is usually restricted to larynx but occasionally may aggressively spread to the nasopharynx, tracheobronchial tree and even the pulmonary parenchyma [2]. Diagnosis is confirmed via histopathology showing benign squamous epithelial stratification. Treatment entails surgical excision of the papilloma. Medications including interferon, antiviral agents (acyclovir, ribavirin, cidofovir) and retinoids have been tried but without exceptional success. [3]
Fig 1.0 CT scan of the Neck showing multiple protruding lesions in the trachea with luminal narrowing.

Fig 2.0- Papillomatosis before and after debridement.

References

Reducing Hospital Admissions in Patients with Malignant Pleural Effusion-A Quality Improvement Study

Authors: Rebecca Cloyes, APRN-CNP, Susan Vasko-Wood, RRT, Chelsea Mohrman, RN, Carolyn Presley, MD, Enambir Josan, MD, Christine Eastep, RN, Nicholas Pastis, MD, Alberto Revelo, MD, Christian Ghattas, MD, & Jasleen Pannu, MD

Background: Malignant pleural effusions (MPE) can cause severe dyspnea leading to greater than 125,000 hospitalizations per year and estimated annual hospital charges of greater than $5 billion. Timely insertion of tunneled pleural catheters (TPC) is associated with fewer inpatient days, emergency department visits, and pleural procedures. We conducted a quality improvement (QI) study to reduce hospital admissions of patients with MPE related to delayed TPC insertions.

Methods: We utilized the DMAIC improvement cycle tool (Define, Measure, Analyze, Improve, and Control) to guide our study processes. Key stakeholders were surveyed, including main referring practices (thoracic and breast oncology, general pulmonary), allied staff (procedural suite staff, respiratory therapists, nurses), and interventional pulmonology (IP) staff to help identify the underlying causes and solutions. For baseline performance data, we conducted a retrospective chart review on patients who underwent TPC placement in our IP service between July 1, 2020, and December 31, 2020. These results’ root cause was performed to arrive at the most relevant intervention followed by post-intervention analysis.

Results: At baseline, 37/50 patients were admitted at some point for dyspnea secondary to MPE before TPC placement. They had 53 total hospital admissions, 1.06/per patient, and 207 total inpatient days, averaging 4.14 days/per patient. The initial survey revealed delays in scheduling with the IP team and late clinical presentation of patients were the most frequent cause of delays. The topmost interventions suggested were to triage all referrals for MPE by IP providers and closer follow-up of patients following initial thoracentesis that diagnoses MPE.

We launched a two-step intervention. In the first phase (August 1, 2021, through October 31, 2021), IP advanced practice providers (APP) reviewed referrals for MPE with the scheduling team and triaged based on urgency. We added a close follow-up call after seven days of initial thoracentesis in the second phase (December 1, 2021, to March 31, 2022). Results are summarized in Table 1.

Conclusions: Our interventions showed trends toward fewer hospital admissions and fewer inpatient days for patients with MPE in IP service. Systems to ensure these interventions stay consistent are being put in place. Prospective research trials would be needed to establish the benefit and generalizability of these interventions.
<table>
<thead>
<tr>
<th></th>
<th>Pre-Intervention</th>
<th>Post-Intervention (total)</th>
<th>Post-Intervention (phase 1)</th>
<th>Post-Intervention (phase 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>37/50 (74%)</td>
<td>25/47 (53%)</td>
<td>16/30 (53%)</td>
<td>9/17 (53%)</td>
</tr>
<tr>
<td>Hospital admission for dyspnea related to pleural effusions (N)</td>
<td>53</td>
<td>32</td>
<td>19</td>
<td>13</td>
</tr>
<tr>
<td>Average admissions per patient</td>
<td>1.06</td>
<td>0.68</td>
<td>0.63</td>
<td>0.76</td>
</tr>
<tr>
<td>Inpatient days</td>
<td>207</td>
<td>92</td>
<td>57</td>
<td>35</td>
</tr>
<tr>
<td>Average inpatient days per patient</td>
<td>4.14</td>
<td>1.96</td>
<td>1.9</td>
<td>2.06</td>
</tr>
</tbody>
</table>
Robotic Assisted Navigation Bronchoscopy: A Meta Analysis of Diagnostic Yield and Complications

Authors: Fahim Pyarali, MD, MPH1; Niv Hakami, MD1; George Chaux, MD1
1Division of Pulmonary and Critical Care, Cedars Sinai Medical Center

Background: Lung cancer is one of the most common malignancies worldwide, and the detection of pulmonary nodules have increased with expanded screening. Robotic assisted navigation bronchoscopy is a novel procedure to biopsy lung nodules, with initial reports demonstrating good diagnostic accuracy. We aimed to evaluate pooled estimates of diagnostic yields and complication rates with robotic assisted navigation bronchoscopy by performing a meta-analysis of the available literature.

Methods: Three databases were queried for this study, including PubMed, EmBase, and Web of Science. Search keywords included lung nodule or lung lesion, and robot-assisted navigation or robotic bronchoscopy. The resulting abstracts were reviewed by two investigators. Analyses were performed using random effects models.

Results: 91 articles were reviewed, of which 31 articles were selected for full-text review. 13 articles, comprising 1117 patients and 1154 nodules, were included in the final analysis. Most studies (n=11) were performed in the United States. 8 out of 12 studies (66.6%) included mostly female patients. Mean ages ranged from 63.2 - 68.4 years (n=6). Average size of the nodules ranged between 12.2mm - 25.0mm, and median size ranged between 14.0mm - 26.0mm. The majority of patients (54% - 92%) had a current or prior smoking history (n=5). Eight studies (61.5%) used the Ion Intuitive platform, while 5 studies used the Auris Monarch platform. Two studies reported using cone beam computed tomography (CBCT), while one study reported using augmented fluoroscopy. Most studies (n=10) reported using radial endobronchial ultrasound in conjunction with robotic bronchoscopy. The pooled diagnostic yield (n=11) was 85.0% (95% CI 78.8 - 90.3%). A meta-regression found no statistically significant difference in diagnostic yields between studies that reported using CBCT versus studies that did not report using CBCT (p=0.23). The pooled pneumothorax rate was 1.31% (95% CI 0.43- 2.49%, n=13) and the pooled bleeding rate was 0.03%.

Conclusion: This meta-analysis demonstrates that the diagnostic yield for patients with pulmonary nodules undergoing robotic assisted navigation bronchoscopy is high, with a pooled diagnostic yield of 85%. This is higher than reported with conventional bronchoscopy and electromagnetic navigation without robotic assistance. Our study demonstrated no difference in diagnostic yield with CBCT, though few studies reported using this imaging modality. The rates of pneumothoraces and bleeding appear low across all studies. When available, clinicians should consider utilizing robotic bronchoscopy to biopsy pulmonary nodules.
ROLE OF NEXT GENERATION SEQUENCING WITH PERCEPTA BRUSHING IN RECLASSIFYING LUNG NODULE WORK UP.

AUTHOR: Abhjit Raval, MD

PURPOSE: In last century carcinoma of the lung has progressed from an uncommon and obscure disease to the most common cancer in the world and the most common cause of death from cancer. With newer recommendation from national lung cancer screening for patient age between 50-80 years with 15 pack smoking hx, there will be several new nodules detected. Our goal from this study is to identify role of PERCEPTA to help to reclassify malignancy risk in intermediate risk nodules to improve Diagnostic algorithm. It is estimated that approximately 360,000 bronchoscopies are performed each year to evaluate lung nodules. Up to 60% of lung cancer bronchoscopy results are inconclusive. In the event of that Genomic sequencing classifier like Percepta can be useful to further characterize risk to avoid unnecessary testing.

This study is single center experience in use of percepta to reclassify intermediate nodules and optimize diagnostic resources.

METHODS: We used retrospective real world single center analysis for intermediate risk lung nodules in 30 patients. For intermediate risk lung nodule that were classified based upon mayo lung nodule risk calculator. For non-diagnostic biopsy specimen Percepta analysis was sent to further characterize the nodule risk for malignancy. We analyzed how many patients were reclassified compared to mayo risk calculator, individual physician Gustavo and final data from percepta analysis.

RESULTS: Out of 30 patients classified as intermediate per mayo risk calculator, 13 patients remained to be intermediate risk and were allowed for further work up based upon their risk profile.

8 patients were reclassified in the high-risk group. 9 patients were classified in low-risk group. So, 56.6% patient were reclaimed based upon Percepta analysis.

CONCLUSION: Based upon these results we conclude that Percepta classifier has helped our lung nodule work up algorithm. Not to mention that all the nodules that were classified as low risk did not required further work up likely ct guided fine needle aspiration which runs risk of 25-30% pneumothorax or even surgical lung biopsy. Nodule that was classified as high risk were put through more appropriate work up to avoid missing false negative bronchoscopy result.

CLINICAL IMPLICATION: Percepta GSC was validated in a prospective, multicenter, blinded study on a combined cohort of 412 patients from AEGIS I, AEGIS II and PERCEPTA Registry. All patients met inclusion criteria and had an inconclusive bronchoscopy. Bronchoscopy is frequently used for evaluation of pulmonary lesions, but its sensitivity for detecting lung cancer can be limited. A bronchial genomic classifier (Percepta) has been validated to improve the sensitivity and negative predictive value of bronchoscopy for lung cancer diagnosis. When bronchoscopy is inconclusive, Percepta can identify patients who can be considered for CT surveillance instead of undergoing another invasive diagnostic procedure. A bronchial genomic classifier can reduce the number of unnecessary invasive procedures that are performed following an inconclusive bronchoscopy for suspect lung cancer. Within the physician assessed intermediate pre-test risk patient subset, who had an inconclusive bronchoscopy and were classified by Percepta as low risk, we observed a significant reduction in additional invasive procedures compared to the pre-test management plan. Additional data will help further determine the ultimate clinical utility of the test.

Authors: Ankush P. Ratwani, MD*; Evan Schwartz, MD**; Lance Roller, MS*; See-Wei Low, MD*; Robert J. Lentz, MD*; Alexander Gelbard MD***; Otis B. Rickman DO*; Fabien Maldonado, MD*.
*Department of Allergy, Pulmonary and Critical Care. **Department of Internal Medicine. ***Department of Otolaryngology.

Introduction: Benign airway stenosis (BAS) leads to significant pulmonary morbidity and mortality. The truFreeze spray cryotherapy (STERIS, Mentor, OH) system is currently cleared for airway interventions. A prior version of the device was associated with a relatively high risk of pneumothorax. Few studies have reported safety data and general practice patterns with this new device.

Methods: A retrospective chart review was performed in our electronic health record (EHR) of patients with benign airway stenosis who underwent SCT (Vanderbilt IRB #211567). Basic demographics were collected. We collected information on stenosis characteristics, device use, and endoscopic interventions from the operative notes. Safety was evaluated based on adverse events that occurred intraoperatively and within seven days of the procedure.

Results: Thirty-two patients underwent 56 procedures with SCT from 2015 to 2021. The median age was 49.5 (IQR 25.1-63.5). 25 (78.1%) of patients were female. The most common cause of BAS was idiopathic subglottic stenosis in 8 patients (25%). Gastroesophageal reflux disease and obesity were the most common comorbidities in 12 (37.5%) and 14 (43.8%) patients, respectively. Fifty patients (89.3%) had a laryngeal mask airway as the initial airway conduit. SCT was used via a flexible bronchoscope in 52 cases (92.9%) and rigid bronchoscopy in 4 (7.1%). The most common spray pattern was two sprays before dilation and one after. The proceduralist performed a 10 second spray time in 55.6% (30 out of 54) before additional procedures and 72.7% (24 out of 33) after. Passive venting occurred in all cases. All patients underwent balloon dilation. Twenty-five patients (45.5%) underwent radial incision, and 4 (7.3%) had an intraoperative steroid injection. There was only one episode of pneumothorax which was identified intraoperatively and required chest tube placement. This patient had a high glottic pathology felt to have limited gas egress, increasing the risk of barotrauma. There was no significant bleeding event, air embolism, airway tears, or unplanned admission for those who underwent the procedure.

Conclusions: SCT with adequate passive venting appears to be a safe adjunctive treatment of BAS with a low rate of complications.
Successful treatment of Bronchovascular Fistula with amniotic membrane allograft

Authors: David-Perez Ingles MD1, Chakravarthy Reddy MD2, Akshu Balwan MD1

1. University of New Mexico, Department of Interventional Pulmonology
2. University of Utah, Department of Pulmonary and Critical Care

Introduction: Broncho-vascular fistula (BVF) are likely to be fatal if left untreated with a reported mortality of 100%. Iatrogenic fistulas have been reported after surgical resection, lung transplantation, or radiation therapy. Available treatment modalities include surgical resection or endovascular therapy. We report our case of successful bronchoscopic palliation and treatment of BVF.

Case: A 51 year-old male was admitted with large volume hemoptysis. Medical history was notable for Stage IIIb(T4N2M0) squamous cell carcinoma of the right perihilar region s.p definitive chemotherapy and radiation therapy (IGRT 60Gy) completed 1 months prior. Bronchoscopy identified a blue pulsatile vascular structure with no active bleeding but old blood in the vicinity (Figure 1, Panel A). Review of CT angiogram confirmed presence of broncho-vascular fistula in the same region (Figure 1, Panel B). Patient was not a candidate for surgical or endovascular intervention due to anatomical concerns and comorbidities. Based on prior case reports, and lack of any available treatment options for impending life-threatening bleeding, decision was made to pursue bronchoscopic stenting with addition of a dehydrated human amnion/chorion membrane allograft (EPIFIX, Mimedx, Marietta, GA) to aid healing at the site of fistula and prevent ingrowth into the stent. Endobronchial ultrasound confirmed the vascular nature of the lesion (Figure 1, Panel C). Patient was intubated with rigid bronchoscope. The allograft was placed at the desired location and SEM stent was deployed over the graft to hold it in place (Figure 2, Panel A,B). Bronchoscopy was repeated at 2 weeks and 6- 8 weekly afterwards. Stent was removed at 6 months with good healing of underlying tissue. (Figure 2, Panel C)

Conclusion: This case highlights a possible approach to bronchoscopic management of BVF. Further research is needed for similar approaches to treat this potentially fatal disease. The patient has done remarkably well and has had no recurrence of symptoms.

Figure 1:
Panel A: Bronchoscopic images showing the potential site for broncho-vascular fistula.
Panel B: CT angiogram showing the area of interest with loss of airway integrity.
Panel C: Radial USG confirming the immediate proximity of vessel (arrow).
Figure 2:
Panel A: Graft placed in the airway
Panel B: Stent deployed over the graft to hold it in place
Panel C: Granulation tissue at the site of fistula after stent removal in 6 months
Successful use of spiration valves in conjunction with pectoralis major muscle flap to treat persistent bronchopleural fistula caused by post-operative wedge resection of cocci empyema.

**Authors:** Daniel K. Yu, Lisa Jarnigan, Francisco Marquez, Matt Borchart, Raed Alalawi

**Introduction:** Management of multi-lobar cavitary coccidiomycosis is complicated with high morbidity and mortality. Lobectomy and wedge resection, when attempted, can be complicated by post operative bronchopleural fistula (BPF) given the necrotic lung parenchyma. Eloesser flap, an invasive thoracic procedure, is sometimes used in management of these cases. We describe a novel case of a right upper lobe (RUL) lobectomy and right lower lobe (RLL) segmentectomy for cavitary coccidiomycosis complicated by BPF successfully repaired via combined spiration valves and pectoralis major muscle flap.

**Case Summary:** A 55-year-old female without past medical history developed fluconazole resistant cavitating pulmonary coccidiomycosis of the right upper lobe and superior segment of the right lower lobe. She underwent a right thoracotomy with right upper lobectomy and partial segmentectomy of the RLL superior segment. Post-operatively, she developed a persistent BPF. She had three spiration valves placed to the RLL, unfortunately her BPF recurred, and the valves were removed. She was then taken for a pectoralis major muscle flap of the right lower lobe superior segment. However, she developed a cutaneous fistula at the prior chest tube site, and there was difficulty in maintaining the muscle flap position due to the forced air movement through both the bronchopleural and cutaneous fistulas. Three spiration valves were again placed in the RLL to limit airflow and allow the pectoralis major muscle flap to adhere to the BPF site. The BPF subsequently resolved, and both her chest tubes and spiration valves were removed.

**Conclusion:** Our case is novel in that it demonstrates an alternative multimodal approach to treatment of unresolving post-surgical bronchopleural fistula using both endobronchial valve placement and muscle flap occlusion. This case highlights the importance of interventional pulmonology and thoracic surgery collaboration in the management of these complicated cases.
Symptomatic Accessory Cardiac Bronchus

Authors: Prince Ntiamoah, Atul C Mehta, Thomas R Gildea

Introduction: The accessory cardiac bronchus is a congenital anatomical variant that originates from the medial aspect of the right main-stem bronchus or, less frequently, from the bronchus intermedius and heads medially and caudally toward the heart, most frequently ending in a blind pouch. It is more common in the females with an incidence of 0.08–0.5% in the general population. Most cases are asymptomatic, but productive cough and hemoptysis can develop if it gets complicated by infection or a tumor. We present a patient with symptomatic accessory cardiac bronchus.

Case summary: A 23-year-old man nonsmoker was referred for recurrent episodes of pneumonia over the past two years. At presentation, he had productive cough and intermittent hemoptysis. He had completed multiple courses of cyclical antibiotics for confirmed pneumonia.

He had a past medical history of ventricular septal defect (with spontaneous closure), bicuspid aortic valve and asthma like symptoms since childhood. He had multiple normal pulmonary function tests over the years and no significant occupational history. Physical exam was unremarkable at presentation. Laboratory tests were also unrevealing.
**Figure 1A:** High-resolution computed tomography revealed an anomalous opening from the medial aspect of the bronchus intermedius, headed caudally toward the heart.

<table>
<thead>
<tr>
<th>Image</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Larynx</td>
</tr>
<tr>
<td>2</td>
<td>Trachea</td>
</tr>
<tr>
<td>3</td>
<td>Trachea - No TBM</td>
</tr>
<tr>
<td>4</td>
<td>Right mainstem bronchus</td>
</tr>
<tr>
<td>5</td>
<td>Bronchus intermedius - cardiac bronchus</td>
</tr>
<tr>
<td>6</td>
<td>Bronchus intermedius - no vascularity on NBI</td>
</tr>
<tr>
<td>7</td>
<td>Bronchus intermedius</td>
</tr>
<tr>
<td>8</td>
<td>Right lower lobe bronchus - mucous within airways in lower lobes</td>
</tr>
<tr>
<td>9</td>
<td>Bronchus intermedius - saline within cardiac bronchus</td>
</tr>
</tbody>
</table>

**Figure 1B:** Bronchoscopy confirmed the presence of a large accessory bronchus arising from the bronchus intermedius with no vascularity on narrow band imaging

Once diagnosis was made, conservative versus surgical management was discussed with patient and he decided to pursue the former. He has remained asymptomatic after his bronchoscopy.
Synovial Sarcoma Presenting As Obstructive Tracheal Mass

Authors: Rosina Schiff, DO, Mitchell W. Waters, MD and Zachary S. Depew, MD, FCCP, DAABIP

Introduction: Synovial Sarcoma is an exceedingly rare form of primary tracheal tumor. Diagnosis typically involves biopsy of the lesion via bronchoscopy, and the gold standard in management involves complete surgical resection with negative margins and preliminary debulking, especially in cases of airway obstruction.

Case Summary: We present the case of a 21-year-old male with no past medical history evaluated for three weeks of worsening shortness of breath. His vital signs were normal, but he was visibly in respiratory distress with tripping and use of accessory muscles. Computed tomography angiography confirmed a five-centimeter mass nearly completely occluding the trachea with associated esophageal involvement and pneumomediastinum. Rigid bronchoscopy tumor debulking with subsequent silicone stent insertion due to residual extrinsic compression. Pathology revealed a spindle cell neoplasm deemed to be a poorly differentiated synovial sarcoma. His symptoms resolved after the procedure, and he was discharged with outpatient oncology follow up. Surveillance bronchoscopy was completed the following week and the stent was in good position. Several days later he had sudden massive hemoptysis resulting in respiratory arrest with subsequent anoxic encephalopathy and life support was eventually withdrawn.

Conclusion: Primary tracheal synovial sarcoma is extremely rare, with few known cases. There is no specific staging system for tracheal sarcoma and no clear guidelines for diagnosis and management. Debulking before definitive surgical resection is usually required to improve respiratory distress in cases of airway obstruction, and this is a generally safe and effective procedure. Our patient required airway stent deployment as a bridge therapy to maintain airway patency, a technique commonly used in malignant airway obstructions. Although primary tracheal synovial sarcoma is incredibly rare, the initial management is similar to other malignant airway obstructions. Adjuvant chemoradiotherapy is advised for high-grade sarcomas once definitive airway management has been accomplished.

References:
1. Mediastinal Tumors: Causes, Symptoms, Diagnosis & Treatments. Cleveland Clinic. https://my.clevelandclinic.org/health/diseases/13792-mediastinal-tumor
TB or Not TB?

Authors: Maykel Irandost MD, Raed Alalawi MD

Introduction: Coccidioidomycosis is a granulomatous disease caused by the soil-dwelling dimorphic fungus, which may cause lower respiratory tract and systemic symptoms. We present a case of pulmonary coccidioidomycosis with military pattern on CT imaging.

Case Description: A 51-year-old male with no significant past medical history presented with chronic cough, daily fever, and night sweats for duration of 3 months. Patient reported unintentional weight loss of 16 lbs. Patient immigrated from Mexico 20 years ago, currently works as landscaper in Arizona. On physical examination, patient was afebrile with oxygen saturation of 95% on ambient air; lungs were clear to auscultation without increased work of breathing or respiratory distress. Computed tomography (CT) of the chest revealed miliary distribution of pulmonary nodules with left perihilar consolidative area with multiple cavitary changes. Coccidiomycosis serology and sputum acid fast stains for tuberculosis were initiated. Three sputum acid-fast stains were negative. On bronchoscopy, the Tracheobronchial tree was free of endobronchial lesions. Transbronchial biopsies and bronchoalveolar lavage were obtained. Microbiology cultures were positive for Coccidioides species. Cocci serology were positive with titers >1:256. Remaining of infectious work up was negative. Biopsies were negative for malignancy. Patient was started on fluconazole with out-patient follow-up with pulmonology and infectious disease. Patient had significant improvement of his symptoms on his 30-day follow-up visit.

Discussion: Coccidioidomycosis (valley fever) is a granulomatous disease caused by inhalation of airborne spores of soil-dwelling dimorphic fungus Coccidioides immitis or Coccidioides posadasii. The early manifestations of valley fever are similar to those of other causes of community-acquired pneumonia with lower respiratory tract and systemic symptoms. Miliary coccidioidomycosis is seen with hematogenous or lymphatic spread and the development of multiple small granulomas throughout the lungs and other organs. Commonly anti-fungal drugs used to treat are itraconazole and fluconazole.
The Geometrical Evaluate for the Difficulty of Reaching Lung Lesions by Electromagnetic Navigational Bronchoscopy

Authors: Masahito Naito M.D., Ph.D., Melani Lighter M.D., Matthew Pommerening, M.D., Nobuhiko Hata Ph.D., Hisashi Tsukada M.D, Ph.D.

Background: The tortuous tight turn of bronchi makes it difficult for the bronchoscope to reach the lung lesions. This study evaluated the differences between reachable and unreachable lesions with the electromagnetic navigational bronchoscope intervention (EMNB) in geometrical and clinical aspects.

Methods: This is a retrospective cohort analysis of 264 consecutive EMNB performed by a single surgeon between January 2018 and October 2021. The procedure was performed under general anesthesia using a 6.2 mm outer diameter bronchoscope without utilizing the radial EBUS and fluoroscopy. Univariate analysis was performed to analyze the difference between reachable and unreachable lung lesions for clinical factors analysis. The geometric curvature value parameter was analyzed by 3D CT Slicer module. The curvature value was defined as the reciprocal of the circle's radius that passes through three points in n-dimensional Euclidean space. The curvature value was quantified as the unit radius/cm.

Results: Univariate analysis identified the presence of the bronchus sign as a factor associated with reaching the lung lesions in non-diagnostic lesions (p = 0.0091). There was no significant difference in lesion size and location between reachable and unreachable lesions. A 71 (16%) lesion could not be reached by the EMNB. The curvature value of the bronchial branch could be computed for 57 of 71 navigation unreached lesions. The mean curvature value of the bronchial branch with unreachable lung lesions was 631.8 rad/cm (316.7-1287.6).

Conclusion: In non-diagnosed lesions, CT bronchus sign was significantly different between reachable and unreachable lung lesions with EMNB. In addition, there is a possibility that the curvature value in non-diagnostic lesions in this study can be applied to predict the difficulties of reaching the lung lesion with EMNB.
The Use of Robotic Assisted Bronchoscopy in the Diagnostic Evaluation of Peripheral Pulmonary Lesions; A Paradigm Shift

Authors: S.T. Hussain¹, H.A. Hammad¹, M. Parmar², Samid Farooqui¹, J. M. Reinersman³, F.A. Chaudry¹.

¹ Department of Pulmonary & Critical Care, University of Oklahoma, Oklahoma city, OK, United States.
² Department of Internal Medicine, University of Oklahoma, Oklahoma city, OK, United States.
³ Department of Thoracic & Cardiovascular Surgery, University of Oklahoma, Oklahoma city, OK, United States.

Rationale: Despite recent advances, diagnostic evaluation of peripheral pulmonary lesions (PPL) continues to pose a clinical challenge and diagnostic yield of various image guided and bronchoscopy modalities remains low. Furthermore complications such as pneumothorax and airway bleeding are a major concern with such procedures. Recently released robotic assisted bronchoscopy (RAB) platforms are still in the early phase of exploration and serve as a new diagnostic tool for the evaluation of PPLs. We describe our early experience of shape-sensing robotic assisted bronchoscopy (SS-RAB) at The Oklahoma University of Health Sciences Center (OUHSC).

Specific Aims: We aim to describe the diagnostic yield and safety profile of robotic assisted bronchoscopy for peripheral pulmonary lesion.

Methods: We present a descriptive analysis of our experience with the Shape- Sensing Ion™ endoluminal platform for minimally invasive peripheral lung biopsy. Using Ion’s PlanPoint™ software, navigation pathways to the target lesion were created using pre-procedure CT scans. During bronchoscopy Ion’s™ ultra-thin robotic catheter, which has a 3.5 mm outer diameter and a 2.0 mm working channel, was navigated along the pre-planned path. Radial endobronchial ultrasound (R-EBUS) was used to confirm the lesion location and fluoroscopy was utilized for obtaining transbronchial biopsies. Custom-designed flexible needles which can pass through the catheter even in tortuous airways and range from 21 G to 23 G were used to obtain biopsies alongside conventional biopsy tools. Rapid on-site evaluation (ROSE) was used in all cases.

Results: The study describes the first twenty (20) patients undergoing shape-sensing robotic assisted bronchoscopy (SS-RAB) at our institute. The mean lesion size was 1.4 cm. Early performance trend reveals an overall diagnostic yield of 85%. The diagnostic yield for lesions < 1 cm and lesions 1-2 cm was 88%. The overall yield of 85% may further increase as the lesions of two patients who had negative results on biopsy have been regressing on follow up imaging and may represent true negatives. No pneumothorax, excessive bleeding or any other adverse events were observed during the procedure. All patients were discharged on same day of procedure.

Conclusions: Our experience reveals that SS-RAB can successfully be used to navigate to very small peripheral lesions with a higher diagnostic yield and better safety profile as compared to conventional bronchoscopy and image guided modalities. Our results are consistent with and comparable to limited available data on RAB for PPL currently available worldwide. However larger prospective studies are needed to further characterize the true diagnostic yield of RAB and describe rare potential complications.
The Utility of Point of Care Ultrasound (POCUS) in Navigational Bronchoscopy Guided Biopsy

Authors: S. Khauli MD, B. Boer MD, PhD
1Pulmonary and Critical Care Medicine, University of Nebraska Medical Center, Omaha, NE

Introduction: Sampling of peripheral lung nodules via bronchoscopy presents many challenges for the proceduralist. Image-guided bronchoscopic techniques have been developed to aid in navigation, confirmation of position, and adequate sampling of peripheral lesions. Electromagnetic navigation bronchoscopy (ENB) is one of the most commonly used. One limitation is the inability to visualize the targeted nodule in real-time while the biopsy is being performed. We present a case where POCUS was implemented for real-time visualization of a pleural-based nodule while performing ENB-guided biopsy.

Case: A 73-year-old-male with COPD and a heavy smoking history was referred for evaluation of a lung nodule. CT chest demonstrated a 2.6 x 2.1 cm pleural-based spiculated nodule in the left upper lobe and no pathologic-appearing adenopathy (Figure 1). PET-CT showed high FDG uptake within the nodule (SUV = 14.1) and no other suspicious sites. The patient underwent combined endobronchial ultrasound (EBUS) staging and ENB-guided biopsy of the nodule. EBUS revealed enlarged lymph nodes at station 4R and 7, measuring 10 mm and 15 mm respectively. Both nodes were sampled and negative for malignancy via rapid-on site evaluation (ROSE). Next, we used the Veran ENB platform and an Olympus P-190 bronchoscope with tip-tracked tools to navigate successfully to the nodule (Figure 1). Needle aspirate, brushing, and forceps biopsies were obtained. POCUS was utilized to visualize biopsy tools within nodule in real-time and to rule-out pneumothorax (Figure 2). ROSE confirmed non-small cell lung cancer, subsequently finalized as squamous cell carcinoma.

Conclusion: ENB guided biopsy is lower risk than transthoracic or surgical biopsy but is limited by decreased ability to navigate to and acquire adequate tissue specimens. Implementing POCUS during ENB-guided biopsy of pleural-based nodules a non-invasive, cost-effective method to confirm accurate location of biopsy tools in real-time. POCUS can increase diagnostic yield and decrease complication rates such as pneumothorax.
To Investigate the use of Airway Contrast to Objectively Measure Anastomotic Diameter in Lung Transplant Patients: Single-Center Pilot Study

AUTHORS: Monika Kakol, MD Katie Capp, MD, Joseph Keenan, MD, Jennifer Wong, MD, Abbie Begnaud, MD, Erhan Dincer, MD and Roy J. Cho, MD

BACKGROUND: Airway stenosis is the most common anastomotic complication following lung transplantation. In 2016, ISHLT published guidelines to improve consistency of reporting airway complications; however, these rely on the bronchoscopist’s subjective assessment. There are limited practical methods to provide an objective intra-operative measurement for airway stenosis. We have previously reported our experience using airway contrast. In this study, we propose feasibility to measure the anastomotic diameter with airway contrast to provide an objective measure of airway diameter in lung transplant patients.

METHODS: Any lung transplant patient undergoing surveillance and/or therapeutic bronchoscopy using fluoroscopy were eligible for the study. Patients with history of contrast allergy were excluded. For each patient, both anastomotic and normal airway diameters were measured visually by one of our Interventional Pulmonary (IP) staff/fellow. The visual diameters were based on a percent stenosis. The objective measurements with contrast were measured by a different IP staff who was blinded to the eyeball measurements. Our contrast solution was Isovue-200® which was diluted to a 50:50 ratio with 0.9% saline. Under live fluoroscopy, 5-10cc of contrast was injected proximal to the anastomosis and the images were recorded. Using the viewing software, the measurement tool was calibrated to the scope diameter. The anastomotic site was measured using both staple-line or narrowest diameter visualized by contrast. The diameter for normal airway was defined as the proximal portion of to the anastomotic site.

RESULTS: A total of 34 anastomotic sites were evaluated (Mean Age 57-years old, 65% Men). The mean post-transplant days was 894-days. Mean spirometry included predicted FEV1 of 61±16%, FVC of 67±14%, and DLCO of 76±25. The visual assessment identified an average percent stenosis of 17±16. Contrast-assisted measured range was 5.1mm to 16.5mm with an average percent stenosis of 20±15. The average volume of contrast used was 11±4cc’s. There were no immediate adverse effects to the contrast.

CONCLUSION: This pilot study demonstrated feasibility for using airway contrast to measure anastomotic diameter in lung transplant patients. Both methods were similar on average; however, the contrast method was able to provide an objective measurement in mm which would be helpful to follow longitudinally than a subjective percentage of stenosis. Although we had few patients in the moderate stenosis range; the contrast method may offer a more consistent and accurate measurement compared to the visual method. Future studies including larger sample size and randomization will be needed to corroborate our findings.
Tool-in-lesion Characteristics of Diagnostic and Non-diagnostic Robotic Assisted Bronchoscopy Cases

Authors: Jefferson Chambers, DO and Timothy LeClair, MD

Background: Robotic assisted bronchoscopy is increasingly used by interventional pulmonologists to diagnose pulmonary nodules and masses. Intraprocedural, three-dimension imaging is frequently paired with robotic assisted bronchoscopy to confirm tool-in-lesion prior to obtaining tissue. Despite rates of tool-in-lesion confirmation approaching one hundred percent, the corresponding diagnostic yield is less impressive. Little is known about this discordance between tool-in-lesion and diagnostic yield. One potential explanation could be the position of the aspirating needle within the lesion. The purpose of our study is to assess whether an aspirating needle positioned at the periphery, versus the center of a lesion at the time of biopsy could result in lower diagnostic yield.

Methods: Single center, retrospective review of all patients undergoing robotic assisted bronchoscopy with intraprocedural O-arm computed tomography. Images obtained during the procedure were reviewed to determine if tool-in-lesion had been achieved. The tool-in-lesion images were then classified as peripheral or central placement. Cases with no intra-procedural three-dimensional imaging were excluded.

Results: 30 non-diagnostic and 90 diagnostic cases are included. Of the non-diagnostic cases, tool-in-lesion was located peripherally in 11 (37%), centrally in 13 (43%), and unconfirmed in 6 (20%) cases. Positive cases had tool in lesion confirmed 97% of the time (87 of 90), with a central location in 64 (71%) and peripheral location in 24 (26%) cases.

Conclusions: A centrally located tool-in-lesion occurred much more frequently in cases which obtained a diagnosis. However, in non-diagnostic cases, the central and peripheral tool-in-lesion frequency was nearly identical. While tool-in-lesion location may play a role in diagnostic yield, there are likely other factors at play such as, lesion location and size, needle size, and number of aspirations. Future studies are needed to better understand these variables.
Tracheobronchial tear, Unusual Complication caused by CP-EBUS

Authors: Ali Fatima DO1 Reimer Victoria DO1 Patel Rajeshkumar MD2

1 Rowan University School of Osteopathic Medicine. Jefferson Health of NJ 18E Laurel Rd Stratford, NJ 08084
2 Jefferson Abington Hospital 1 200 Old York Rd, Abington, PA 19001

Endobronchial ultrasound transbronchial needle aspiration (EBUS-TBNA) has become a standard procedure to diagnose and stage lung cancers in a minimally invasive way. Being able to recognize complications from EBUS-TBNA and how to resolve them are critical. The following case discusses a rare complication, a left mainstem tracheobronchial tear caused by trauma from the convex probe ultrasound bronchoscope (CP-EBUS).

An 81-year-old female with history of squamous cell neck cancer diagnosed on left neck lymph node biopsy underwent positron emission tomography/computed tomography for staging. A right upper lobe nodule, right hilar and mediastinal lymph nodes were identified as being 2-fluro-2-deoxy-D-glucose (FDG) avid. Bronchoscopy with EBUS-TBNA was performed. Initial airway inspection showed narrowing of the bronchus intermedius due to tumor compression and friable mucosa was noted in the left mainstem. Complete lymph node surveillance was done with CP-EBUS and Station 12L, 4L and 7 were noted to be enlarged and biopsied. Repeat airway inspection showed a new 8mm tear in the left mainstem on the lateral wall. A ConMed VIABIL 10mm x 40mm stent was placed over the tear. Post procedure chest x-ray was negative for pneumothorax and pneumomediastinum. Stent was removed 12 days later and repeat inspection showed the left mainstem tear had healed. Pathology was positive for adenocarcinoma, lung primary.

Although EBUS-TBNA is regarded as a safe procedure. It is important to be aware of complications that can occur. A survey study in Japan showed in 7,345 cases, complication rate of EBUS-TBNA was 1.23% with bleeding, infection, and pneumothorax being the most common. Based on literature review, tracheobronchial tears are a rare complication. It was most likely caused by trauma using the CP-EBUS in an area of friable tissue. Our case also highlights the importance of doing an airway exam before and after EBUS bronchoscopy to identify complications and reduce morbidity.
TrūFreeze® Spray Cryotherapy Patient Registry: Initial Pulmonary Report

**Authors:** Robert Browning, MD, Ashutosh Sachdeva, MD, Scott Parrish, MD, Kei Suzuki, MD, Luis Rojas, MD, and Costas Bizekis, MD

**Background:** Spray Cryotherapy (SCT) was initially developed in 1999 for endoscopic GI use in the esophagus and transitioned to airway use by pulmonologists and thoracic surgeons over the next decade. In 2012, a multi-institutional retrospective review of selected airway use of the “G2” SCT device reported promising treatment results and unique operating characteristics but also a high complication rate. Later that year, a redesigned SCT device with improved uniformity of spray and adjustable flow rate of liquid nitrogen (trūFreeze®, US Endoscopy) received FDA clearance and was introduced in the U.S. to improve safety and efficacy of the technology. In 2013, a prospective multi-institutional registry using the trūFreeze® SCT system was formed to collect efficacy, safety, and specific selection patient data.

**Methods:** Prospective, multi-center registry (2013-2021) with active monitoring and detailed procedural data collected for up to 5 years of follow up for patients treated using the trūFreeze® spray cryotherapy device in the central airways and pleura. Major exclusion criteria included tracheoesophageal or bronchopleural fistula, current untreated pneumothorax, and any patients not candidates for bronchoscopy.

**Results:** 64 patients were enrolled in the registry who underwent 114 SCT procedures. 27(42%) were male and 37(58%) were female. Airway disease included 47(73%) malignant and 17(27%) benign etiologies. Of the malignant cases, 68% were advanced stage or metastatic disease. SCT was used in treating 14 different cancer types with the majority identified as lung cancer (30% squamous cell, 23% adenocarcinoma) followed by renal cell carcinoma (11%). Rigid bronchoscopy was used in 48% of cases. SCT freeze time per spray of each freeze cycle ranged from 5 to 10 seconds with 86% of sprays being 5 seconds in duration. During each procedure, the number of cycles of SCT used varied from 1-8 cycles with 94% using 1-4. In 10% of cases, SCT was used to treat tissue adjacent to silicone and silicone covered stents. SCT was used to control endobronchial bleeding in 30% of cases and reported to have complete success in 91% of these cases. Of the 114 SCT cases performed there were 2 reportable adverse events, one unrelated and one unlikely related to the SCT treatment.

**Conclusions:** Initial analysis of this unique longitudinal prospective cohort treated with the trūFreeze® system demonstrates that SCT using passive ventilation can be safely and effectively used in the treatment strategies of both benign and malignant pulmonary diseases.
Usefulness of confocal laser endomicroscopy in the real-time diagnosis of lung tumors in a low income country: A retrospective case series

Authors: Efrain Sanchez-Angarita, Galo Chang, Zoraya Novoa and Elvis Matheus

Introduction: Probe based Confocal Laser Endomicroscopy (pCLE) is a novel technique that allows to identify in real time characteristic patterns produced by lung cancer with an adequate agreement with histopathological studies.

Objectives: To describe pCLE findings during flexible bronchoscopy in patients with centrally located and peripheral lung tumors

Methods: We included 10 patients diagnosed with lung tumors who underwent flexible bronchoscopy between December 2021-March 2022. Prior to biopsies, endomicroscopy was performed before a fluorescein administration. The images and videos were obtained through the Cellvizio system.

Results: All patients were male, with an average age of 64 years, 3 former smokers. The indication for bronchoscopy was peripheral tumors (7/10), central cavitated tumors (2/10) and hemoptysis (1/10). The most frequent finding was infiltration of the mucosa with extrinsic compression and pleomorphic cells. In all patients (8/10) in whom patterns of cell destruction suspected of malignancy were identified (Image 1) the diagnosis of lung cancer (4 adenocarcinoma, 3 small cell lung cancer) was confirmed (Image 2).

Conclusion: The pCLE is a useful tool that allows to identify in real time areas suggestive of malignancy, serving as a guide for biopsies in bronchoscopy, thus optimizing the histological diagnosis of patients with lung tumors.

Fig. 1: Lung adenocarcinoma with (pCLE)  Fig. 2: Corresponding histological section
**Using Robotic Assisted Navigation Bronchoscopy for Mixed Density Pulmonary Lesions: A retrospective review from a single center**

**Authors:** Fahim Pyarali, MD, MPH\(^1\); Alexander Leung, MD\(^2\); George Chaux, MD\(^1\); Taryne Imai, MD\(^2\)

\(^1\)Division of Pulmonary and Critical Care, Cedars Sinai Medical Center; \(^2\)Division of Thoracic Surgery, Cedars Sinai Medical Center

**Purpose:** Tissue sampling for the diagnosis of pulmonary nodules has become increasingly important with the expansion of lung cancer screening. Robotic assisted navigation bronchoscopy is a novel technique used to biopsy lung nodules, with initial reports showing encouraging results. However, many of these studies focus on solid nodules. We report our experience with using robotic bronchoscopy for the diagnosis of nodules of mixed density.

**Methods:** We reviewed cases where robotic bronchoscopy was performed in our institution from January 2020 to December 2021. The Ion Intuitive robotic bronchoscopy platform was used, in conjunction with fluoroscopy and radial endobronchial ultrasound at the discretion of the provider. Patient demographic information, radiographic data, and pathology was extracted from the medical record. Odds ratios were calculated using logistic regression analysis.

**Results:** A total of 40 mixed density lesions in 40 patients were biopsied using robotic bronchoscopy. 60% of patients were female (n=24) and median age was 74 years (67 - 79 years IQR). 23 patients (57.5%) reported a history of smoking. The median lesion size, measured at its maximum on any axis, was 22.5 mm (15.0 - 26.0 mm IQR). Most nodules were peripheral (n=24, 60%), while 35% were considered middle (n=14), and 5% (n=2) were considered central. Diagnostic yield was 87.5% from specimens obtained, including either cytology or tissue pathology (n=35). The most common diagnosis was malignancy (42.5%, n=17), followed by infections (30%, n=12). The odds of having a negative diagnostic specimen was 2.3 times higher when the lesion was less than 10mm (95% CI 0.31 - 17.3). Patients with a bronchus sign were more likely to have a diagnostic procedure, but this difference was not statistically significant (100% with bronchus sign vs. 84.8% without bronchus sign). Cultures obtained from the procedure were largely negative (n=25, 62.5%), but 3 cultures grew mycobacterium avium-intracellulare. There were no episodes of bleeding or pneumothorax. Only two patients subsequently required a CT guided or surgical lung biopsy following robotic bronchoscopy.

**Conclusion:** Our experience demonstrates a high diagnostic yield when using robotic bronchoscopy for the evaluation of patients with pulmonary nodules of mixed density. The procedure appears to be safe in this population, with our experience demonstrating zero complications. The high incidence of neoplasms in this study may indicate that patients with mixed density pulmonary nodules may benefit from early biopsy.
Utilization of robot-assisted navigational bronchoscopy in the retrieval of a distal foreign body

Authors: Michelle Miles, DO; Thomas Marston, MD; Brian Boer, MD, PhD; Keenan Taylor, MD

Department of Pulmonary and Critical Care Medicine, University of Nebraska Medical Center, Omaha, NE

Introduction: Robot-assisted bronchoscopy (RAB) has been widely adopted for sampling of peripheral pulmonary nodules due to advances in technology that allow for precise localization of target lesions and navigation via small peripheral airways. Here, we present the novel use of RAB to retrieve a titanium dental implant from a distal basilar segment of the right lower lobe.

Case Summary: An 85-year-old male presented after aspiration of a 2.5 x 27 mm dental peg used for tooth implants. Flexible bronchoscopy performed at outside hospital failed to localize foreign body (FB). CT scan confirmed linear metallic FB in a distal subsegment of the right lower lobe within 1 cm of the pleura and diaphragm. Airway mapping was performed, and the patient was intubated for planned procedure. RAB was utilized to navigate to the distal posterior aspect of the lateral basilar segment of the right lower lobe and the FB position was confirmed with fluoroscopy (Figure 1). Under fluoroscopic guidance, an initial attempt at retrieval with forceps was unsuccessful due to inability to firmly grasp proximal aspect of the FB. An endobronchial retrieval basket was then utilized to ensnare the FB and facilitate retrieval to the proximal right mainstem (Figure 2). Robotic bronchoscope was removed, and a standard therapeutic bronchoscope was used in conjunction with a retrieval basket to remove the FB via the endotracheal tube. The patient was subsequently extubated without complication.

Conclusion: Aspirated FBs in adults are most commonly found in the right main bronchus or bronchus intermedius. They rarely travel to the distal basilar segments and such cases often require surgical removal if flexible or rigid bronchoscopy fails to identify and remove the object. As demonstrated in our case, the use of robot-assisted navigational bronchoscopy is a less invasive alternative for challenging cases of distal FB aspiration.
Figure 1: Screen capture from robot-assisted bronchoscopy showing fluoroscopic view of robot catheter advanced to proximal edge of FB (right) and visual confirmation of FB (bottom left)

Figure 2: Traditional bronchoscopic view of FB after RAB retrieval to proximal right mainstem bronchus
References:


Ventilator Parameters and Outcomes Associated with Pneumothorax in Mechanically Ventilated Covid-19 Patients

Authors: Muhammad Daniyal Hashmi, Hafsa Abdulla, Amreeta Vashti Sharma, Daniel R. Ouellette and Alaa Abu Sayf

Background: Pneumothorax (PTX), pneumomediastinum (PM) and subcutaneous emphysema (SQE) as markers of barotrauma are noted to complicate cases of coronavirus disease 2019 (COVID-19) in critically ill patients. Previous studies noted a higher rate of barotrauma (15%) in patients with COVID-19 compared with other mechanically ventilated patients, but factors associated with this are not completely understood. Here we aim to describe patient and ventilator characteristics associated with barotrauma in COVID-19 patients.

Methods: We performed a retrospective study on patients with confirmed PCR testing for COVID-19 requiring invasive mechanical ventilation (IMV), between March 2020 to May 2021. Data collected included baseline demographics, illness severity based on Sequential Organ Failure Assessment (SOFA) score, set ventilator parameters with resulting patient dependent measurements for first 7 days of IMV in patients with barotrauma and a comparator group without barotrauma. Parametric data were analyzed using chi-square and t-test for categorical and linear variables, respectively, whereas Fisher’s exact test and Mann-Whitney U used for nonparametric data. All tests were two-tailed and p-value < 0.05 was considered statistically significant.

Results: A total of 83 subjects were included (mean age 66.5+/−15.8; male 60.2%; SOFA: 9.4+/−4.2) of which 36.1% suffered barotrauma (PTX 70%; PM 33%; SQE 13%) detected at mean of 6.7 days. Both groups did not differ significantly by age, gender, body mass index or use of non-invasive positive pressure prior to intubation. Mode of IMV (volume targeted in 92% overall), set or resulting tidal volume (428+/−59 ml) and positive end-expiratory pressure (12+/−5.4 cmH20) did not differ significantly between both groups during days 1 to 7. Patients with barotrauma had significantly higher peak airway pressures (mean, 32.9 vs 27.1 cmH20; p<0.001) and lower dynamic compliance (median, 22.7 vs 28.1 ml/cmH20; p=0.009) on day 1 of IMV and this difference persisted till day 5 of IMV. Intubation was needed significantly earlier in hospitalization (median, 2 vs 6 days; p=0.04) and days requiring IMV to death or extubation was significantly higher (mean, 19.1 vs 9.9 days; p<0.001) in the barotrauma group.

Conclusion: Critically ill COVID-19 patients requiring IMV with poor lung compliance are at substantial risk of development of barotrauma and this condition is associated with significantly longer duration of need for IMV.
Wh”Air” Did it Come From? : An unusual case of subcutaneous emphysema and pneumomediastinum post-EBUS-TBNA.

Authors: Jon Mullholand, MD ¹, Madhav Chopra, MD ², and Jennifer Toth, MD²

¹ Department of Medicine, Penn State Milton S. Hershey Medical Center, Hershey, Pennsylvania
² Department of Medicine, Division of Pulmonary, Allergy and Critical care, Penn State Milton S. Hershey Medical Center, Hershey, Pennsylvania

Introduction: Endobronchial Ultrasound with Transbronchial Needle Aspiration (EBUS-TBNA) is an extremely safe, minimally invasive procedure with the most common complications being bleeding, arrythmias or hypoxia. We present an unusual case of subcutaneous emphysema and pneumomediastinum post EBUS-TBNA.

Case: An 84-year-old male with a 60 pack-year smoking history and stage T1b adenocarcinoma presented for (EBUS-TBNA). He underwent the procedure without issues. He underwent a complete mediastinal and hilar survey. Only the station 7 lymph node was present and thus sampled with four passes (Figure 1). He recovered from the procedure and met all criteria for discharge.

At home, he had a persistent non-productive cough. His wife observed redness in his face, neck swelling and changes in his voice. He went to the nearest emergency room for further medical evaluation and ultimately transferred back to our facility. A computed tomography (CT) scan of the chest and neck showed significant subcutaneous emphysema as well as pneumomediastinum. He denied chest pain, shortness of breath, difficulty breathing or controlling his secretions. He stayed overnight for observation.

After discharge, repeat CT imaging (Figure 2) showed complete resolution. His biopsy results showed no evidence for metastatic disease with adequate lymph node sampling.

Discussion: Pneumomediastinum and subcutaneous emphysema are documented rare complications of EBUS-TBNA and associated with airway trauma, necrotic or infected tissue or severe cough intra-procedurally. In this case, there was no obvious trauma and adequate tissue sampling achieved. General and local anesthesia minimized intra-procedure cough. The Macklin effect, in which air dissection along the broncho-vascular sheaths results in air entering the mediastinal and subcutaneous planes, was the likely etiology. Asymptomatic patients require observation though in severe cases surgical intervention maybe necessary. This case highlights the importance of educating patients about this rare potential complication in order to avoid treatment delay.