

The Practical Approach to Bronchoscopy

The 4-Box Framework for Clinical Decision-Making

15 Clinical Case Scenarios



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Bronchoscopy Education Project Series

bronchoscopy.org

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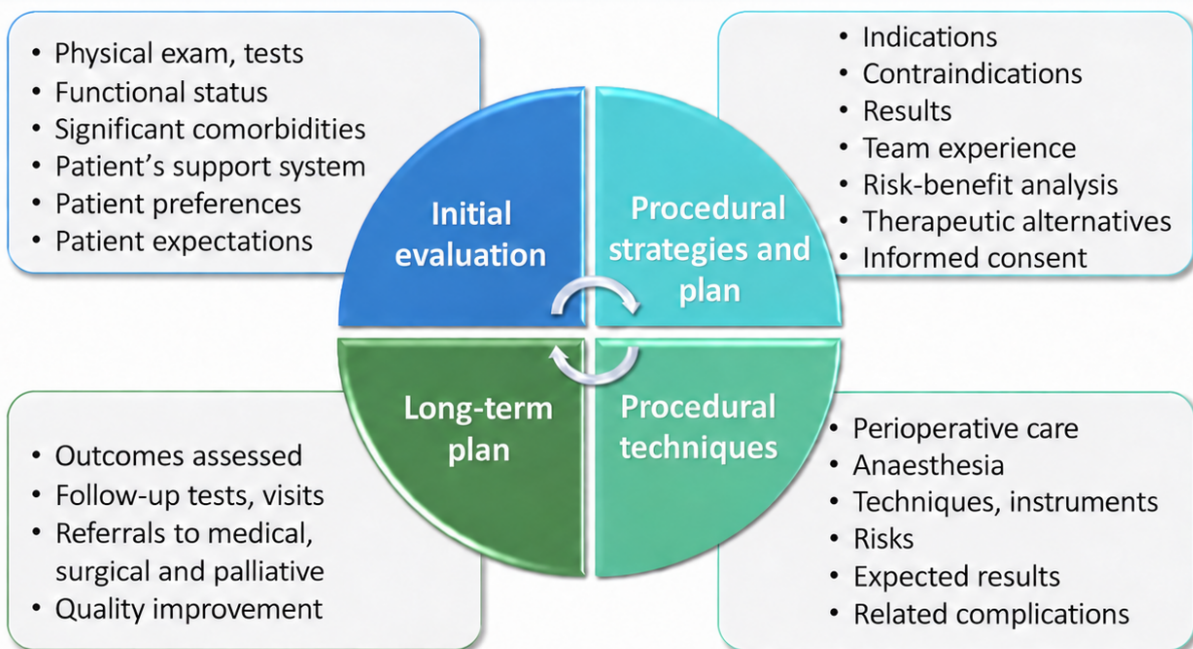
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The 4-Box Approach to Procedural Decision-Making

The 4-Box Approach to Procedural Decision-Making



Ethical and clinical judgment: What values, competing obligations, communication issues, or system pressures influence this decision?

Using the 4-Box Approach

The 4-Box Approach helps learners and instructors work together to improve clinical judgment and depth of knowledge by organizing the information, choices, techniques, and follow-up that shape procedural care.

Initial evaluation

- Physical examination, diagnostic tests, and functional status
- Significant comorbidities
- Patient support system
- Patient preferences and expectations

Procedural strategies

- Indications, contraindications, and possible outcomes
- Operator and team experience
- Risk-benefit analysis and therapeutic alternatives
- Informed consent

Procedural techniques and results

- Perioperative care and anesthesia
- Techniques and instrumentation
- Procedural risks and anatomic dangers
- Expected results and related complications

Long-term plan

- Outcomes assessment
- Follow-up tests, visits, and procedures
- Referrals to medical, surgical, and palliative care
- Quality improvement

LEARNING GOALS

- Improve clinical judgment and depth of knowledge in strategy and planning, execution, and response to procedure-related adverse events or complications.
- Integrate cognitive, technical, affective, and experiential knowledge in a patient- and family-focused care environment.
- Gather accurate patient information and communicate effectively with patients, families, and other health care professionals.
- Justify management decisions using clinical data, scientific evidence, information technology, and experience.
- Address ethics, informed consent, and outcomes across the range of possible procedural results.

ORIGINS AND EDUCATIONAL CONTEXT

The Practical Approach was inspired by the four-box method of clinical ethics developed by Albert R. Jonsen, Mark Siegler, and William J. Winslade. That method uses structured case analysis to bring clinical facts, patient preferences, quality of life, and contextual considerations into ethical decision-making. The present framework adapts the organizing logic of four-box analysis to procedural decision-making in bronchoscopy.

The original Practical Approach was also developed in accordance with Accreditation Council for Graduate Medical Education (ACGME) competency guidelines. It explicitly supports professionalism by incorporating ethics, informed consent, communication, and consideration of outcomes. ACGME competency information: acgme.org.

Case Overview

The 15 scenarios use the 4-Box framework to connect patient context, procedural planning, technical choices, complications, and follow-up.

Case	Clinical problem	Bronchoscopic focus	Decision-making theme
1	Febrile neutropenia and bilateral infiltrates	BAL / TBLB / TBNA	Diagnostic yield vs. procedural risk
2	Tracheobronchial aspergillosis and tracheal stenosis	Airway infection / stenosis	Intervention in an infected airway
3	Malignant right main bronchial obstruction	Laser / stent	Restoring airway patency
4	Left-sided mediastinal mass	TBNA / endobronchial sampling	Sampling strategy and anatomic risk
5	Lung mass with subcarinal adenopathy	Transcarinal needle aspiration	Technique, bleeding and specimen acquisition
6	Esophageal cancer invading trachea	Rigid bronchoscopy / laser / stent	Airway rescue and procedural feasibility
7	COPD, lung cancer and paratracheal node	EBUS-TBNA	Staging strategy and procedural planning
8	Left paratracheal node, station 4L	EBUS-TBNA	Imaging-based planning and vascular anatomy
9	Small mediastinal node with lung nodule	EBUS-TBNA	Consent, staging and specimen quality
10	Subcarinal node, station 7	EBUS-TBNA	CT planning and interpretation of granulomas
11	Right paratracheal node, station 4R	EBUS-TBNA	Nodal anatomy and CT planning
12	Malignant pleural effusion	Bronchoscopy / palliative planning	Role of bronchoscopy and palliation
13	Advanced lung cancer with diffuse infiltrates	BAL / TBLB / consent	Diagnostic value and accessible consent
14	Bronchiectasis	CT / bronchoscopy	Etiology, infection and indications
15	Post-intubation tracheal stenosis	Airway assessment / treatment	Selecting among therapeutic options

Work through each case using the 4-Box framework before considering the discussion questions.

The scenarios are designed to prompt clinical reasoning rather than simple recall. Consider the patient, the procedural strategy, the technical choices and risks, and the longer-term plan before deciding what you would do.

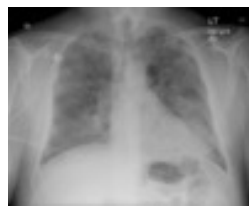
COMPANION LEARNING RESOURCES

Selected case discussions and procedure videos corresponding to these scenarios are available through Bronchoscopy Academy in the playlist "The Practical Approach to Bronchoscopy."

Flexible Bronchoscopy with Bronchoalveolar Lavage for Diagnosis

AA is a 64 year old retired physician has been admitted to your hospital with change in mental status, a recent history of chemotherapy for lymphoma, fever, and diffuse, bilateral pulmonary infiltrates. He smoked one pack per day for twenty years but quit 15 years ago. He is married (his wife is a nurse), and has two children, one of whom is a medical doctor who lives nearby. The patient's physical examination shows lower extremity edema, an erythematous rash on his back, decreased breath sounds bilaterally and occasional right sided expiratory wheezing. His neurologic examination is normal. He is oriented, but not always alert. Oxygen saturation is 90% on 3 liters by nasal canula, blood pressure is elevated heart rate is 110 beats per minute. Arterial blood gases show normal pCO₂ and pH. His medications include aspirin 325 mg, clopidogrel (Plavix), which was stopped three days ago because of a lumbar puncture which was negative), prednisone, and Atorvastatin calcium (Lipitor). His past medical history also includes hypertension, a right coronary artery stent placed six months ago, migraine headaches, and uneventful cholecystectomy five years ago.

The chest radiograph reveals diffuse bilateral infiltrates with a ground glass pattern in the right upper and left lower lobes, as well as a widened carina. A computer tomography scan with contrast confirms these findings, and also shows enlarged subcarinal adenopathy. The oncology consultant is concerned about recurrent or persistent lymphoma, but cannot exclude a new neoplasm (the subcarinal adenopathy is a new finding). The infectious disease consultant is concerned about a pulmonary infection, especially because the patient's recent blood work shows prolonged neutropenia secondary to chemotherapy and normal platelet counts.



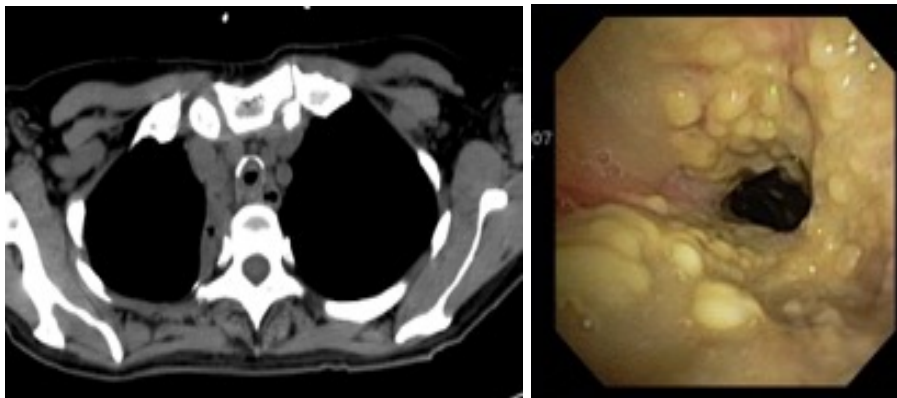
After addressing items of the four boxes, briefly respond to the following questions:

1. What are the arguments for and against performing transbronchial lung biopsy in this scenario?
2. What are the arguments for and against performing transcarinal needle aspiration in this scenario?
3. What medications warrant extra precautions to prevent bronchoscopy-related bleeding?
4. What would you do if physicians requesting the procedure insist on a biopsy even if you believe it is not immediately warranted?
5. What procedure(s) would you perform?

H.Colt

Tracheobronchial Aspergillosis with Tuberculosis Tracheal Stenosis

dyspnea and chest pain. She had a history of pulmonary tuberculosis 35 years prior and was treated with antituberculous medications for 2 years. Post-tuberculosis tracheal stenosis was diagnosed 10 years ago and was treated with laser and dilation... Patient has been on inhaled fluticasone twice daily for several years. She had bilateral wheezes and stridor on neck auscultation. White blood cell count was 7,600 cells/ μ l, with 91% neutrophils. Chest radiograph and computed tomography scan showed narrowing of the airway in the mid trachea. She also had a collapsed right upper lobe and mid tracheal stenosis of 7 mm diameter. Flexible bronchoscopy showed white pseudomembranes covering the vocal cords and the entire trachea to the carina, extending down the posterior membrane of the left main bronchus. There was circumferential narrowing of the mid trachea to 7 mm. The right upper lobe bronchus was closed from old TB. Biopsy of pseudomembranes revealed *Aspergillus*. The patient is single and travels widely. She wants to return to work as soon as possible.



After addressing items of the four boxes, briefly respond to the following questions:

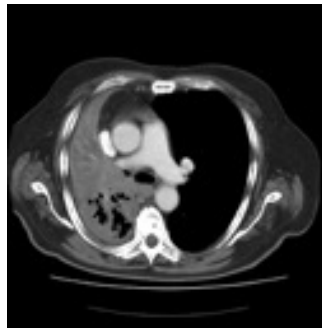
1. Describe the various airway findings of tracheobronchial aspergillosis.
2. Identify advantages and disadvantages of airway stent insertion in patients with tracheal stenosis and active airway infections.
3. Describe the various medical treatment modalities for Tracheal bronchial *Aspergillus* infection.

H.Colt

Flexible and Rigid Bronchoscopy with Nd:YAG Laser Resection and Silicone Stent Insertion for Complete Right Main Bronchial Obstruction

CC is a 69 year old factory worker who has had a thirty pound weight loss over the past four months, and has increasing dyspnea on exertion and at rest. One month ago he was diagnosed with squamous cell carcinoma of the lung, and has now been noted to have complete right lung atelectasis radiographically. He has been transferred to your hospital with increasing shortness of breath and resting hypoxemia (Oxygen saturation can be maintained greater than 92% on 2 liters oxygen via nasal canula). He smokes one pack per day for forty years but quit recently. He is divorced and has two adult children with whom he lives. He has no advance directives and has not considered resuscitation measures. He wishes to undergo systemic treatment for his lung cancer and believes that he can be cured if his symptoms can be relieved. The patient's physical examination shows decreased breath sounds on the right. His neurological examination is normal. Blood pressure and heart rate are normal. His past medical history is unremarkable.

The chest radiograph reveals opacification of the right hemithorax. The computed tomography scan shows right lung collapse, and flexible bronchoscopy reveals complete obstruction of the right main bronchus with extrinsic compression, bronchial wall infiltration, and an exophytic mass protruding from the posterior wall of the distal aspect of the trachea just at the entrance of the right main bronchus. Nd:YAG laser resection and possible stent insertion is planned.



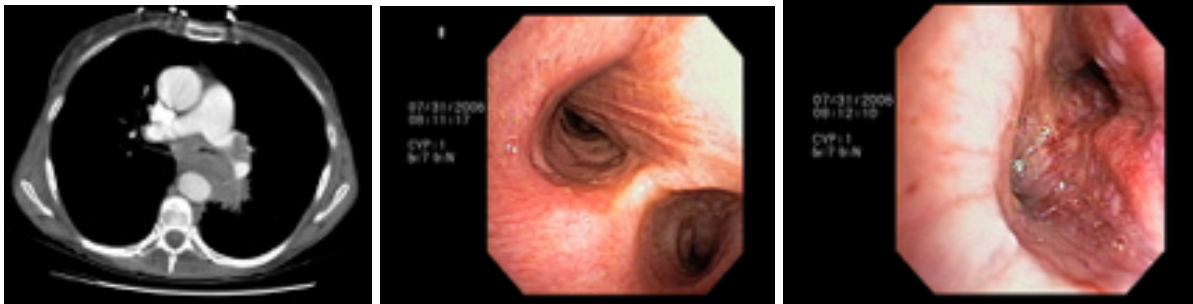
After addressing items of the four boxes, briefly respond to the following questions:

1. What is Power Density and how does it affect procedural technique in this scenario?
2. What are the anatomic dangers to be considered in this case?
3. What kind of survival is expected in a case such as this if the procedure is successful in restoring airway patency?

H.Colt

Flexible Bronchoscopy with Transbronchial Needle Aspiration of a Left-Sided Mediastinal Mass

DD is a 70 year old female, with severe emphysema admitted with COPD exacerbation. She has no allergies. Physical examination revealed decreased breath sounds on the left, with diffuse expiratory wheezing. The patient lives alone and has no family. Chest radiograph revealed large mediastinal mass. CT scan showed extrinsic mass with extrinsic compression of the distal left main bronchus. Bronchoscopy showed widened carina, narrowing of the mid and distal left main bronchus and abnormal infiltrated mucosa at the spur between the lingula and left lower lobe bronchus (LC2). During bronchoscopy, transbronchial needle aspiration was performed through the posterior wall of the mid-distal left main bronchus at the area of the mediastinal mass. On-site cytology was positive for small cell lung cancer.



After addressing items of the four boxes, please consider the following:

1. What are the advantages of performing TBNA versus brushing and endobronchial biopsy of this abnormal airway?
2. As it applies to this case, what are some of the potential dangers of transbronchial needle aspiration through the posterior wall of the mid-distal left main bronchus? How would you have approached this case?

Flexible Bronchoscopy with Transcarinal Needle Aspiration

EE is a 71 year old male smoker with a three month history of cough and increasing shortness of breath. Physical examination reveals decreased breath sounds bilaterally. Laboratory studies, including complete blood count, platelets, and chemistries are normal. He has a history of moderately severe chronic obstructive pulmonary disease and coronary artery disease but no history of myocardial infarction. Chest radiograph reveals a right upper lobe mass and subcarinal adenopathy. The patient is married and lives with his wife. His advance directives state no resuscitation in case of cardiac arrest and he wishes no mechanical ventilation or other means of prolonging life support should he be in a comatose or irreversibly dying state. He wishes to undergo systemic treatment for lung cancer should this be diagnosed.



After addressing items of the four boxes, briefly respond to the following questions:

1. Describe three ways to protect a flexible bronchoscope from damage during needle aspiration?
2. Describe three different techniques that can be used to perform transbronchial needle aspiration?
3. What techniques might be used in case of bleeding during transbronchial needle aspiration?

H.Colt

Rigid Bronchoscopy with Laser Resection and Stent for Esophageal Cancer Invading the Trachea

FF is a 70 year old truck driver with a history of severe rheumatoid arthritis, dysphagia, and shortness of breath. He has been recently diagnosed with esophageal cancer and has a gastric feeding tube in place. He has not yet had therapy because increasing dyspnea prompted flexible bronchoscopy which revealed an exophytic mass with necrosis from the posterior wall of the trachea extending along a distance of 3 cm, beginning 5 cm above the main carina and ending 7 cm below the vocal cords (see photo). Physical examination reveals limited range of the neck motion, severe rheumatoid changes of the hands. The patient has no teeth and wears dentures. Oxygen saturation is 90% on 2 liters nasal canula. Karnofsky performance score is 70. Laboratory data are normal. Chest radiograph and computed tomography scan show a large esophageal mass with extrinsic compression of the mid trachea causing 80% obstruction. Medical history also includes emphysema with an FEV1 of 40% predicted. The patient is accompanied by his elderly wife who hopes that her husband will live until their 50th wedding anniversary in four months.



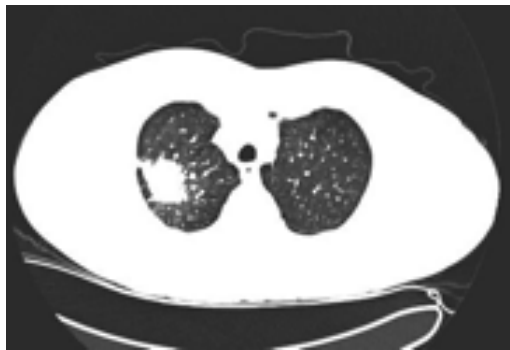
After addressing items of the four boxes, please consider the following:

1. List three potential complications of rigid intubation. How might the limited range of neck motion affect your decisions?
2. What are the benefits and dangers of laser resection in this case?
3. If you cannot intubate the patient with the rigid bronchoscope what will you do?
4. What treatment would you recommend for the patient's esophageal cancer? Why?

H.Colt

Endobronchial Ultrasound for a Right Paratracheal Node in a Patient with COPD and Cancer

GG is a 67 year old male with a 50 pack- year history of smoking developed cough and weight loss (15kg) for six months. His Vital signs revealed a blood pressure of 160/80mmHg, heart rate 90/min, body temperature 37.2°C and respiratory rate 18/min. The Physical examination shows prolonged expiratory breath sounds and egophony in right upper lung field. He is a retired electrician and lives with his wife. He has no advance directives. He desires all available active treatment modalities if diagnosed with cancer. Laboratory data reveal WBC 8000 (neutrophil 81%, lymphocyte 2%), Hemoglobin 13 gm/dl, Platelets 310,000/mm³. Arterial blood gas analysis showed pH 7.45, PaCO₂ 50 mmHg, PaO₂ 64 mmHg on 2L oxygen/min via nasal canula). Pulmonary function tests revealed FEV1- 1.6 L (49% predicted), DLCO- 50% predicted. A computer tomography scan of the chest showed a 3 cm right upper lobe mass and a 1 cm right paratracheal lymph node that is PET negative. The CT guided transthoracic needle aspiration of the right upper lobe mass positive for non-small cell lung cancer.



After addressing items of the four boxes, please consider the following:

1. Describe each step in the performance of EBUS-TBNA.
2. Describe principles and use of endobronchial Doppler ultrasound
3. Describe the relationship between PET negative lymph node size and malignancy.

Endobronchial Ultrasound: Planning EBUS-TBNA of a Left Lower Paratracheal Node (Station 4L)

HH is a 69 year-man with a 120 pack –year history of smoking who presents with cough. A Computed tomography of the chest shows a 2.5 X 2 cm left upper lobe mass and a 1.5 cm left paratracheal lymph node. The patient is referred for diagnosis and staging. You are to contact the referring physician with results after the procedure.

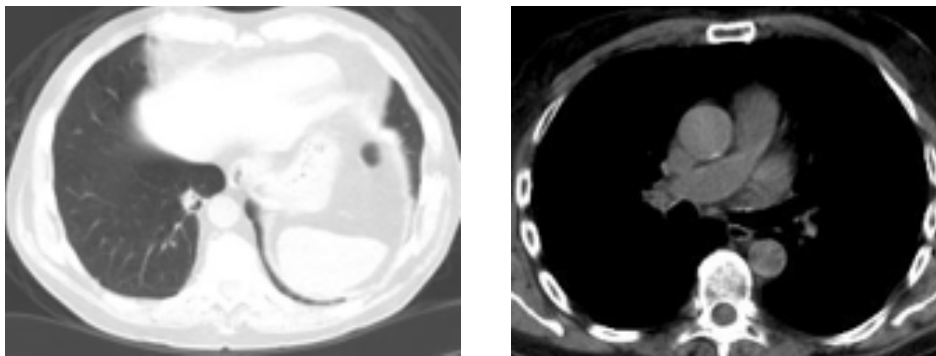


After addressing items of the four boxes, please consider the following:

1. Describe the yield of EBUS-TBNA versus conventional TBNA at station 4L.
2. Describe how the coronal view of a computed tomography scan can be used to help plan the procedure.
3. Identify 4L and surrounding vascular structures using EBUS.

EBUS-TBNA for Lymph Nodes Less Than 1 cm in a Patient with a Solitary Pulmonary Nodule

He is a 55 year old man with 1.5 cm solitary pulmonary nodule in the mediobasal segment of right lower lobe which was incidentally noted while he was undergoing CT of the abdomen for nephrolithiasis. The scan show a 1.5 cm RLL spn, 5.5 SUV on PET and a 7 mm subcarinal lymph node on CT which is not PET avid. He has no risk factors for cancer. Vital signs are normal. Physical exam is unremarkable. CBC, coagulation and chemistry panel, and spirometry are normal. PPD is negative. He is an attorney specializing in real estate law. He lives with his wife and 1 child. He has no advanced directives. He desires all available treatment options in case he has lung cancer.

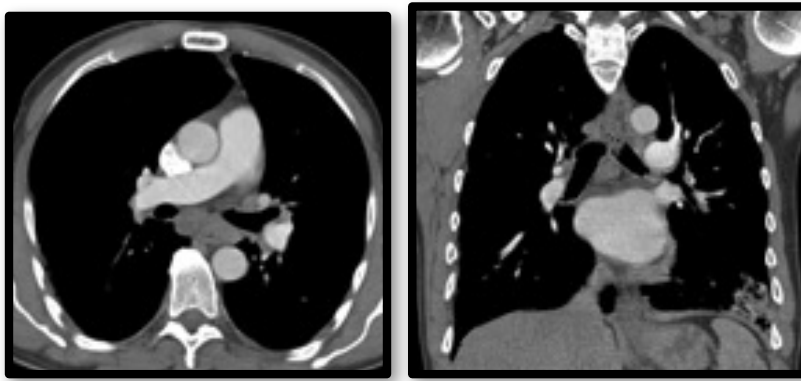


After addressing items of the four boxes, please consider the following:

1. Describe major elements of informed consent.
2. Describe the current evidence about staging CT/PET negative mediastinal lymphadenopathy in patients with known or suspected lung cancer.
3. List three reasons for a poor sample on smear.

Endobronchial Ultrasound: Planning EBUS-TBNA of a Subcarinal Lymph Node (Station 7)

JJ is a 72 year old male with a 25 pack-year history of smoking who presents with cough. His past medical history is that of COPD (FEV1 40% predicted) and right toe amputation for melanoma 5 years earlier. A computed tomography shows a 2.5 X 2.7 cm subcarinal lymph node. The PET scan shows increased activity (SUV max 6). The patient is referred for diagnosis, and has a follow-up appointment with his doctor next week.



After addressing items of the four boxes, please consider the following:

1. Describe how the coronal view of a computed tomography scan can be used to help plan the procedure.
2. What is the yield of EBUS-TBNA versus conventional TBNA for Sarcoidosis.
3. Describe the clinical implications of granulomatous inflammation detected on nodal histology.

Endobronchial Ultrasound: Planning EBUS-TBNA of a Right Lower Paratracheal Lymph Node (Station 4R)

KK A 77 year-man with a 50 pack-year history of smoking presents with abnormal chest radiograph performed preoperatively for hernia repair. The computed tomography shows a 1.5 X 1 cm right upper lobe nodule and a 1.4 cm right lower paratracheal lymph node. He has no past medical history and is in excellent health. The patient is referred for tissue diagnosis.

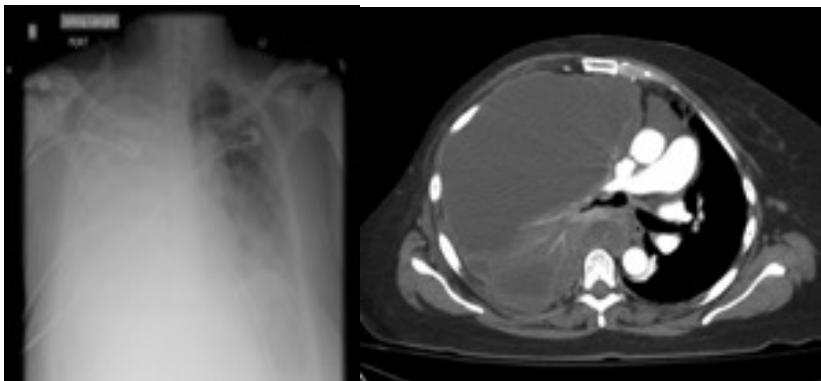


After addressing items of the four boxes, please consider the following:

1. Define the borders of station 4R and justify this definition.
2. Describe how sagittal view of a computed tomography scan is used to plan EBUS-TBNA at station 4R.

Malignant Pleural Effusion with Opacification of the Right Hemithorax

LL is a 43 woman with a history of breast cancer metastatic to the lungs who presents with shortness of breath and right sided pleuritic chest pain. She underwent a right sided mastectomy and chemotherapy 3 years earlier. She lives abroad, but is visiting her son in the United States. In her country of origin, several thoracenteses were performed, but results of the pleural fluid analysis are not available. The family reports a rapidly declining functional status and increasing dyspnea. On Physical examination her vital signs are normal. She is Spanish-speaking and, appears older than her stated age. She has mild bi-temporal wasting, decreased right-sided breath sounds, with dullness to percussion over entire right lung field, and a normal cardiac exam. Her chest wall demonstrates evidence of right breast mastectomy, the abdomen is benign, and there is no extremity edema. The chest radiograph shows near complete opacification of the right hemi-thorax. A chest CT shows a massive right pleural effusion filling the right hemi-thorax, with leftward mediastinal shift and a rim of soft tissue thickening in the pleura. A diagnostic and therapeutic thoracentesis reveals an exudative effusion. Cytology demonstrates malignant cells consistent with primary breast cancer. The patient wants her dyspnea treated and wishes to return to her home country as soon as possible.

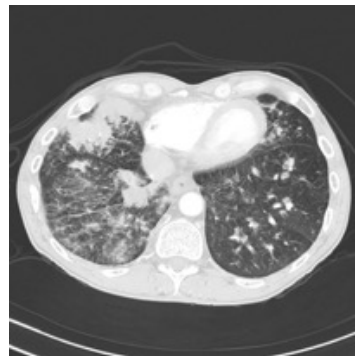


After addressing items of the four boxes, please consider the following:

1. Describe the clinical relevance of malignant pleural effusion
2. Describe the role of bronchoscopy in patients with malignant pleural effusions.
3. Describe an appropriate choice of palliative treatments available for a patient with malignant pleural effusion.

Flexible Bronchoscopy with BAL in Suspected Pulmonary Lymphangitic Carcinomatosis and Informed Consent in a Deaf Patient

MM is a 72 year old man with stage IV adenocarcinoma of the lung admitted for progressive dyspnea. He had chemotherapy and recently received tyrosine kinase inhibitors. He has increasing shortness of breath, fatigue, dry cough, and weight loss. He also has COPD with FEV1 35% predicted and is deaf. He lives with his 33 year old son. Karnofsky status is 50. Chest radiograph shows diffuse bilateral interstitial infiltrates and an ill-defined opacity at the right lung base. Computed tomography scan reveals intralobular septal thickening and consolidation in the right middle lobe which was the site of the primary tumor. Temperature is 37.6, blood pressure 112/74, pulse 92, respiratory rate 22, and SaO2 91% on room Air. He is in no acute distress but is ill-appearing and cachectic. There are diffuse bilateral crackles with decreased breath sounds at the right base. He has digital clubbing. Sodium is 136, BUN 33, Creatinine 1.7, Glucose 124, complete blood count WBC 12.3 Neutrophil 78% no bands, Hemoglobin is 13.3 and platelets 163,000. Blood cultures are negative, urinalysis is negative, and sputum gram stain is negative (cultures are pending). The oncology team formulated a differential diagnosis that includes lymphangitic carcinomatosis, pulmonary infection, and drug-related pneumonitis. Pulmonary consultation is requested for bronchoscopy.



After addressing items of the four boxes, please consider the following:

1. Identify radiographic characteristics of pulmonary lymphangitic carcinomatosis.
2. Define the role of BAL and TBLB to diagnose lymphangitic spread.
3. Describe at least two ways for obtaining informed consent from a person with a hearing disorder.

Computed Tomography and Bronchoscopy in Bronchiectasis

NN is a 70 year old male with a one year history of barking cough, especially after lying down or sleeping. His cough improves in the upright position. He also complains of shortness of breath (WHO Dyspnea scale II). During the past several years he has been hospitalized several times for recurrent bronchitis, and has had at least two episodes of pneumonia requiring antibiotics. He has a history of adult onset asthma, and eczema. He has been taking inhaled bronchodilators, nasal sprays, Singulair, corticosteroids, and since more than two months has been on oral corticosteroids (Prednisone, currently tapered to 10 mg/day). He has bilateral bronchi and wheezing on auscultation of the trachea. Forced Expiratory Volume is 1.93 L (51% predicted) with 17% improvement after bronchodilators. Forced Vital Capacity is 2.62L (52% predicted), with 22% improvement after bronchodilators. Total Lung Capacity is 98% predicted, Residual Volume is 171% predicted, and Diffusion Capacity 89%. Computed tomography reveals bronchial thickening and lower lobe bronchiolitis.



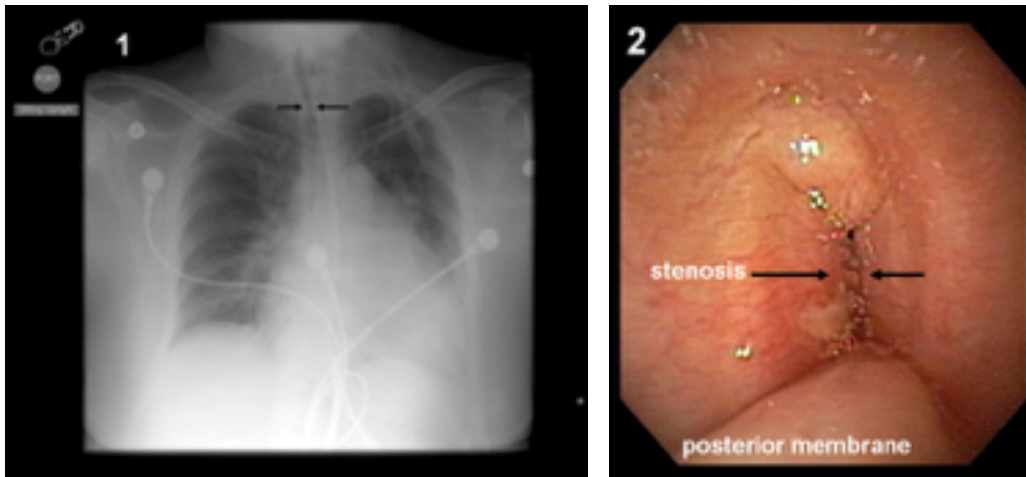
After addressing items of the four boxes, briefly respond to the following questions:

1. List FIVE common bacterial infections associated with bronchiectasis and discuss their impact on prognosis and frequency depending on etiology of bronchiectasis.
2. Identify the role of chest computed tomography scanning in exploring the etiologies of bronchiectasis.
3. Explain at least THREE indications for bronchoscopy in patients with bronchiectasis.

H.Colt

Evaluation and Treatment of Post-Intubation Tracheal Stenosis

OO, an 86 year old woman with a history of stroke required prolonged endotracheal intubation and percutaneous dilatational tracheostomy. Later, she was decanulated and sent to a nursing home where her stoma healed satisfactorily. She now presents with respiratory failure requiring intubation. Congestive heart failure is diagnosed and treated. Minutes after extubation has stridor requiring reintubation. Three days later she is again extubated but increasing work of breathing and stridor are noted. History includes congestive heart failure, hypertension, moderate dementia and residual hemiplegia from her stroke. She follows commands when spoken to. SaO₂ is 95%. Karnofsky is 50, ASA score is 3, and all laboratory data are normal. She has one daughter who rarely visits, but says she enjoys watching television and eating. The radiograph reveals hour glass configuration of the upper tracheal, cardiomegaly and pulmonary vascular congestion. Bronchoscopy reveals a severe triangular stomal stricture 3 cm below the vocal cords. During expiration the tracheal lumen is narrowed by 100%.



After addressing items of the four boxes, briefly respond to the following questions:

1. Describe THREE qualitative features of post-intubation tracheal stenosis.
2. Describe THREE diagnostic modalities other than bronchoscopy to assess severity, extent, and morphology of this patient's tracheal stricture.
3. Describe FOUR therapeutic alternatives for patients with tracheal stenosis.
4. Describe THREE stricture characteristics that determine need and type of treatment.

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