

Question IV.1: While intubating a patient over the flexible bronchoscope, the endotracheal tube is repeatedly caught on the right arytenoid cartilage. The distal tip of the bronchoscope is in the trachea. Which of the following maneuvers is most likely to help you pass the endotracheal tube between the vocal cords and into the trachea.

- A. Maintain constant downward pressure on the endotracheal tube until it “pops” off the arytenoids and enters the trachea
- B. Twist the endotracheal tube towards clockwise and counterclockwise until it “pops” off the arytenoids and enters the trachea
- C. Twist the endotracheal tube 90 degrees counterclockwise in order to reverse the locations of its beveled end and Murphy eye. Then gently advance the tube again.
- D. Withdraw the flexible bronchoscope from the trachea up into the endotracheal tube. Then reattempt intubation.
- E. Ask your assistant to withdraw the endotracheal tube while you maintain the bronchoscope in position directly below the vocal cords. This straightens the tube so that intubation can be reattempted.

Answer IV.1: C

Actually, each of the above techniques could be used. Asking an assistant to manipulate the endotracheal tube, however, is always a risk. Even while holding the bronchoscope firmly in position, it could be accidentally displaced and pulled out of the trachea. Removing the scope from the trachea into the oral or nasopharynx can also be dangerous since you might never visualize the cords again. Intubation might become impossible if blood, secretions, redundant tissues, or reflex laryngospasm impairs visualization.

As long as the bronchoscope is in the lower airways, even if intubation is delayed, oxygen can be delivered directly through the working channel of the bronchoscope into the trachea to prevent hypoxemia. The opportunity for this potentially life-saving gesture is lost if the scope is removed from the trachea.

Persistent pressure on the endotracheal tube might, on occasion, “pop” the tube off the arytenoids. However, it might land in the esophagus or aryepiglottic fold. There is also a risk of arytenoid fracture, arytenoid dislocation, and esophageal trauma. The same comment applies to twisting the endotracheal tube back and forth.

Therefore, a prudent alternative is to keep the flexible bronchoscope in position within the trachea. Gently rotate the endotracheal tube 90 degrees clockwise or counterclockwise, changing the place of the bevel tip and Murphy eye.

Bevel tip

Murphy eye



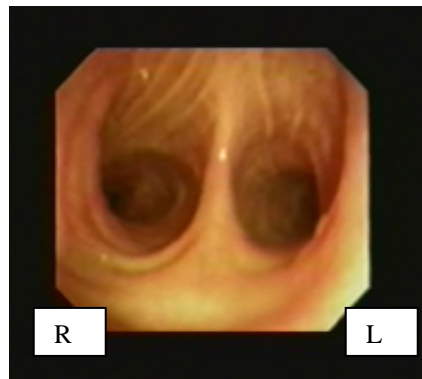
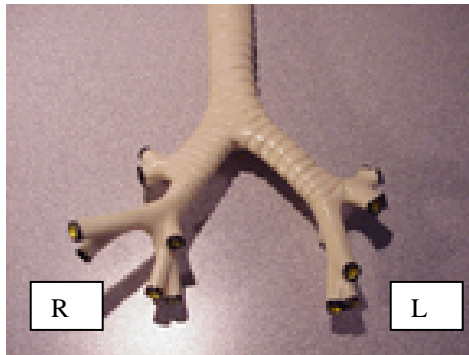
Question IV.2: All of the following approximate airway dimensions are correct except.

- A. The usual length of the left lower lobe bronchus beyond the origin of the superior segment is 1 cm.
- B. The usual length of the right upper lobe bronchus is 1.0 cm.
- C. The usual length of the left main bronchus is 4-5 cm. It bifurcates sharply from the midline of the trachea at an angle of 45 degrees.
- D. The usual length of the right main bronchus is 1.0 cm. It bifurcates at an angle of 25 degrees from the midline of the trachea.

Answer IV.2: D

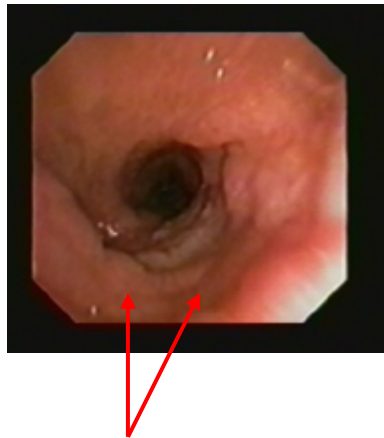
The right main bronchus is 2 cm long on average (not 1 cm as mentioned in response D), and has an internal diameter of 10-16 mm. This is slightly larger than the diameter of the left main bronchus. Because the right main bronchus is relatively straight and vertical, aspiration into this bronchus is more frequent than on the left.

The left main bronchus is much longer than the right main bronchus. It is usually 4-5 cm long. Because its lumen is narrow and relatively horizontal, rigid bronchoscopy, bronchoscopic laser resection, dilatation, and stenting of the left main bronchus is considered by many experts to be more dangerous than on the right side. The usual length of the left lower lobe bronchus beyond the origin of the superior segmental bronchus is 1 cm.



Question IV.3: The appearance of the bronchial mucosa along the anterior wall of the bronchus shown in the Figure below should be described as

- A. Pale, raised, and granular
- B. Thickened and erythematous
- C. Erythematous, shiny and edematous
- D. Thickened, erythematous and swollen

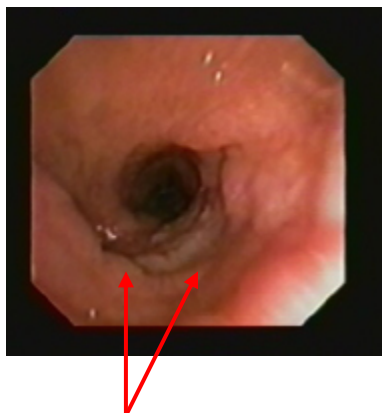


Answer IV.3: D

Thickened, erythematous, and swollen is one way to describe these abnormalities located along the anterior and lateral walls of this bronchus. Endobronchial biopsy revealed adenocarcinoma.

Assuring uniform descriptions of airway abnormalities is very difficult. Showing this photograph to five different bronchoscopists could result in five different descriptions! Wouldn't that be a fun exercise for a noon lecture?

Most important is to choose a simple vocabulary from which you select descriptive words. Always use the same words, so that your descriptions are concise and reproducible.



Thickened, erythematous, and swollen mucosa

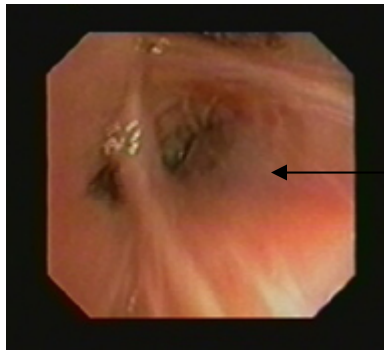
Question IV.4: Endobronchial metastases are more likely in each of the following malignancies except

- A. Colon cancer
- B. Breast cancer
- C. Hypernephroma
- D. Hodgkin's lymphoma
- E. Ovarian cancer

Answer IV.4: E

Colon, breast, renal cell carcinoma and melanoma are each malignancies that spread readily to the tracheobronchial tree. In addition, airway abnormalities are seen in patients with Hodgkin's lymphoma and in patients with esophageal cancer: One proposed mnemonic is Even Henri Colt's Bronchoscope Reveals Metastases (EHCBRM). If you have trouble remembering this one, don't hesitate to invent your own!

Cancer of the ovary rarely metastasizes to the airways, but does spread frequently to the pleura. Patients with malignant pleural effusions might have bronchoscopic signs of volume loss, lower lobe bronchial stricture, retraction, and localized erythema.



Lower lobe bronchi compressed by pleural effusion causing volume loss in a patient with ovarian



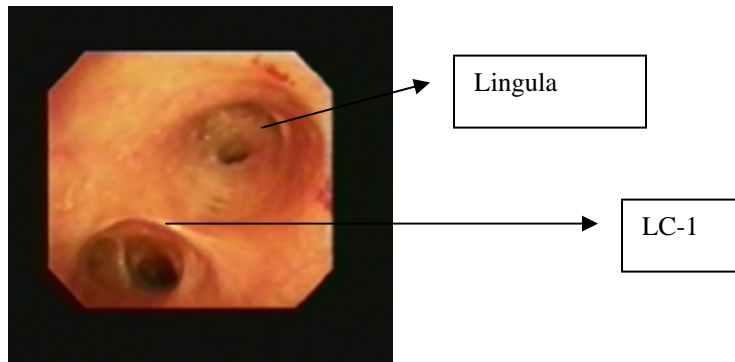
Other patient: Endobronchial metastases from Renal cell carcinoma.

Question IV.5: During bronchoscopy you note a redness and thickening on the carina between the anterior segment of the left upper lobe and the lingular bronchus. Suspecting carcinoma in-situ, but unsure whether other lesions might have been missed the patient is referred for fluorescence bronchoscopy. During your conversation with the interventional bronchoscopist, you state that the lesion is on

- A. LC-1
- B. LC-2
- C. LC-3

Answer IV.5: A

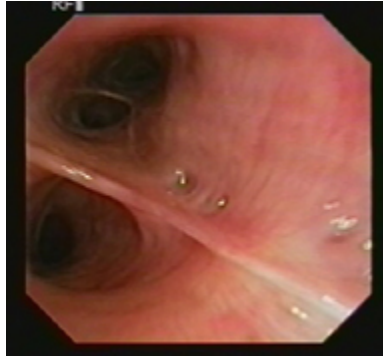
On the left, the carina separating the anterior segment of the left upper lobe bronchus from the lingual is termed LC-1, whereas the carina separating the lingular segment of the left upper lobe from the left lower lobe bronchus is called LC-2. Carina nomenclature is important because it helps describe potential need for pneumoplasty instead of pneumonectomy. With an abnormality only on LC-1, this patient could potentially undergo a lobectomy. On the other hand, had the lesion been located at the level of LC-2, a pneumonectomy or bronchoplasty would be warranted.



Question IV. 6

The findings shown in the Figure below are

- A. Mucous duct orifices
- B. Anthracotic pigment
- C. Bronchoesophageal fistula

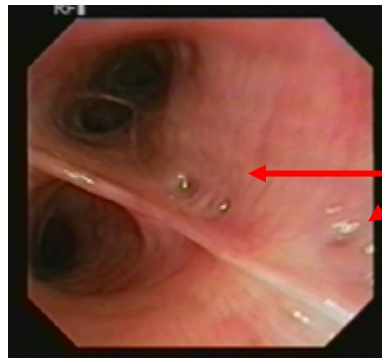


Answer IV. 6

A

Mucous duct orifices are usually seen on the medial and posterior aspects of the bronchial wall bilaterally. These pin-size “indentations” are found where the bronchial cartilage meets the posterior membrane of the left or right main bronchi. They are also frequently seen along the caudal (inferior) walls of the upper lobe bronchi. They may be dilated in patients with chronic bronchitis.

Anthracotic pigment is dark, blackish discoloration within bronchial mucosa, and is of no clinical or physiological consequence.



Mucous ducts
Also known as
bronchial pits

Question IV.7: Chronic cough and a single episode of hemoptysis prompt flexible bronchoscopy in a 65-year-old smoker with a normal chest radiograph. There is no evidence of purulent secretions or endobronchial obstruction. No cause for the hemoptysis is found. A small area of pale, thickened bronchial mucosa is noted at the spur of the superior segment of the right lower lobe bronchus. Washings, brushings, and endobronchial biopsies are taken. The next day, the pathologist calls you to say that there is evidence of nuclear enlargement, hyperchromatism, pleomorphism, and abundant mitoses at all levels of what appears to be a very disorganized epithelium. What is the most likely diagnosis?

- A. Squamous cell metaplasia
- B. Squamous cell dysplasia
- C. Squamous carcinoma in-situ
- D. Proliferation of bronchial neuroendocrine cells
- E. Squamous cell carcinoma

Answer IV.7: C

The presence of abundant mitoses on a background of hyperchromatism, pleomorphism and nuclear enlargement describes squamous dysplasia. There has been much debate regarding progression of dysplasia to carcinoma. Certainly specimens should be carefully examined, because carcinoma in-situ can be cured using a variety of bronchoscopic as well as open thoracic surgical resectional techniques.

Squamous metaplasia consists primarily of increased cellular atypia with increased proliferation of damaged bronchial epithelial cells and formation of intercellular bridges.

Frank squamous cell carcinoma is diagnosed when epithelial cell proliferation is accompanied by intercellular bridges and keratinization. Tumor thus invades longitudinally along the bronchial lumen, or transmurally through bronchial mucosa.

Bronchial neuroendocrine cells are normally present in the basal layer of normal bronchial epithelium. These cells can proliferate in response to irritants such as tobacco smoke, but are not malignant.

Question IV.8: Which of the following statements about bronchoscopic treatment of malignant central airway obstruction is correct

- A. Results are unsatisfactory most of the time
- B. Procedure-related mortality is about 10 percent
- C. Mean survival is about three months
- D. Indications are limited to those patients with good prognosis
- E. All procedures require general anesthesia



Answer IV.8: C

Bronchoscopic treatment of malignant central airway obstruction is frequently successful, has been shown to prolong life, improve ventilatory function, increase exercise tolerance, and improve quality of life. Even patients with an extremely poor prognosis should be referred for bronchoscopic treatment because airway obstruction can be palliated, which improves quality of life, and permits greater tolerance of other therapeutic modalities such as external beam radiation. Procedure-related mortality is less than 1 percent. Unfortunately, mean survival is low. This may be because patients are referred late in the course of their disease.

Palliative procedures are performed under general anesthesia or with conscious sedation. Procedures include Nd:YAG laser resection, dilatation, electrocautery, argon plasma coagulation, debulking, airway stent insertion using silicone, metal, or hybrid (silicone and metal) stents, photodynamic therapy, and brachytherapy.

Rigid bronchoscopy
being performed under
general anesthesia



Anterior
cartilaginous rings



Before and after laser resection of
tumor obstructing trachea and
extending along left lateral wall
of the trachea.

Question IV.9: All of the following statements about bronchoalveolar lavage are correct **except**.

- A. The typical lavage zone of an average size adult patient at total lung capacity represents 165 ml.
- B. The volume of fluid recovered is decreased in cigarette smokers and in the elderly.
- C. Specimens usually contain Lidocaine at concentrations great enough to inhibit bacterial and fungal growth.
- D. A 100 ml saline lavage results in the sampling of about 10^6 alveoli.
- E. In the absence of grossly purulent secretions, pooling all aspirated lavage fluid will provide a mostly alveolar sample.

Answer IV.9: C

Most studies do not demonstrate that lidocaine, used in normal doses for topical airway anesthesia, inhibits growth of bacterial and fungal pathogens. Bronchoalveolar lavage (BAL) allows recovery of cellular and noncellular components from the epithelial surfaces of the lower respiratory tract. BAL is different from bronchial washings that always contain far more than 3% bronchial squamous cells.

Experts believe that a 100 ml lavage of a single bronchial segment samples about 10×10^6 alveoli. In most instances about 50 % of fluid instilled should be recovered. BAL “return” (the fluid recovered by aspiration) is decreased in smokers, in the elderly, and when upper lobe segmental bronchi are sampled.

Experts advocate that at least 100 ml of fluid must be instilled into a single bronchial segment using proper technique in order to obtain an adequate alveolar sample. This includes careful and complete wedging of the bronchoscope within the segment to be lavaged.

Pooling lavage fluid by combining all the fluid obtained in one specimen container will still provide a mostly bronchioloalveolar sample so long as the lavage was performed using proper technique, and the sample is not grossly purulent from contaminated bronchial secretions.

Question IV.10: All of the following statements about bronchoalveolar lavage in stem cell transplants recipients are correct **except**

- A. BAL is safe even in thrombocytopenic patients
- B. Because of risk of bleeding, the oral route is always preferred to the nasal approach
- C. Negative BAL does not exclude the presence of fungal infection
- D. Negative BAL does not confirm the diagnosis of idiopathic pneumonia
- E. To diagnose lower respiratory tract infection, process BAL fluid for bacteria, fungal, virus stains and cultures, cytology for Cytomegalovirus inclusion bodies and Pneumocystis carinii, as well as for Immunofluorescence monoclonal antibody staining for respiratory syncytial virus, adenovirus, Para influenza virus, and influenza virus.

Answer IV.10: B

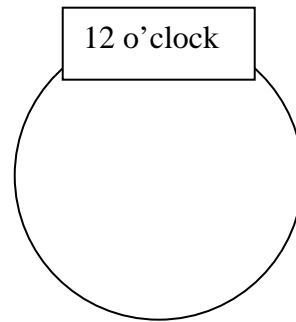
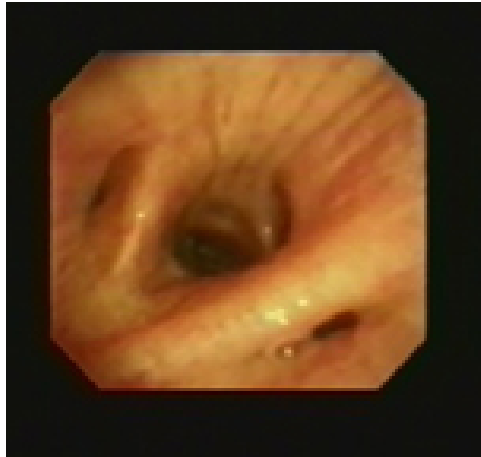
Bronchoscopy is safely performed even in patients with moderately severe (<50,000 platelets) and severe thrombocytopenia (<20,000 platelets) so long as careful and gentle technique is employed. If resistance is felt upon scope insertion, an attempt can be made in the contralateral nares. If resistance is again encountered, the oral route should be used (remember to always insert a bite block). Patients should be asked if they have had recent episodes of spontaneous or procedure-induced bleeding, and potential risks should be explained. Some operators prefer the oral route for bronchoscope insertion regardless.

Stem cell transplant patients may require multiple flexible bronchoscopies during the course of their illness. Therefore, special care should be taken so that each procedure is perceived as nonthreatening, gentle, and caring.

As always, patients should be asked if they desire conscious sedation. Generous amounts of topical anesthetic should be used to prevent cough so that a nontraumatic examination (avoid beating up the airway walls) is assured.

Question IV.11 Using the figure below, and imagining the interior of the airway as a clock face and using the carina as the central reference point. Where is RB 6?

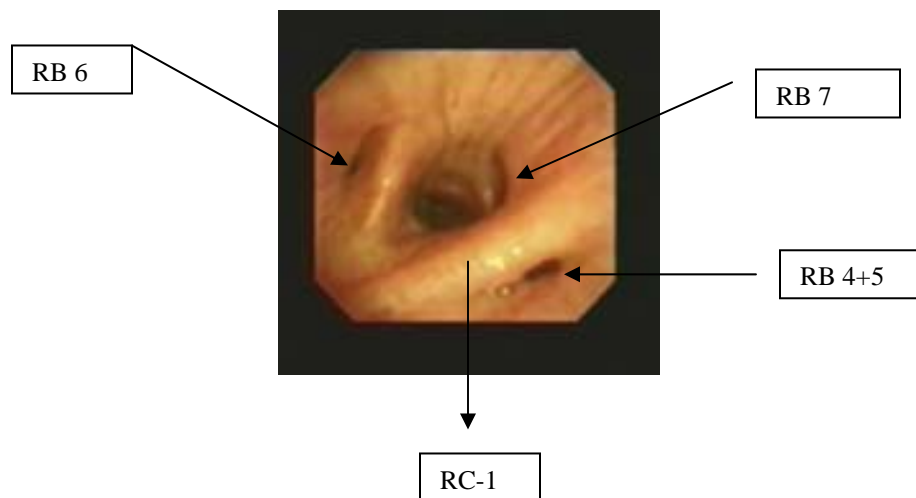
- A. At 3 o'clock
- B. At 9 o'clock
- C. At 5 o'clock



Answer IV.11

B

RB 6 is the superior segment of the right lower lobe. It is almost directly across from the right middle lobe bronchus (RB 4 and RB 5). The muscular posterior wall of the right main bronchus and bronchus intermedius is well recognized in this photograph because of the distinct elastic fibers. During bronchoscopy, one can always be aware of one's position within the airway, by identifying anterior lying cartilage, or the posterior lying membranous portion of the tracheobronchial tree.



Question IV.12: The right pulmonary artery is most adjacent to the anterior wall of the right main bronchus at

- A. The level of the carina
- B. The level of the right upper lobe bronchial orifice and origin of the bronchus intermedius
- C. The origin of the right lower lobe bronchus

Answer IV.12: B

At the level of the orifice of the right upper lobe bronchus, needle insertion through the anterior wall of the right main bronchus risks entering the right pulmonary artery, which lies immediately anterior to the bronchus at this level. Note that the right upper lobe bronchus in this cast is more vertical than usual.



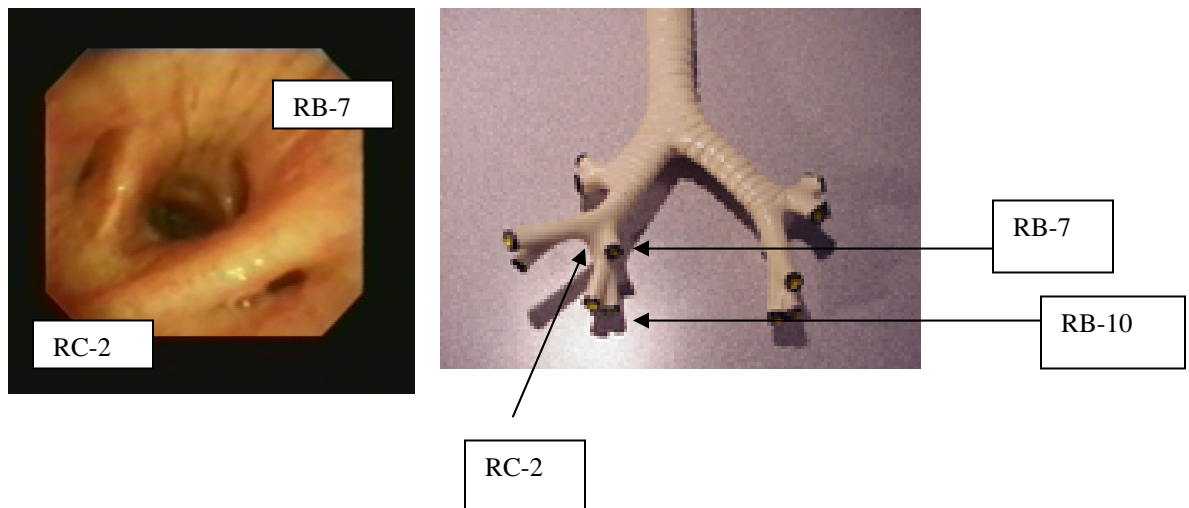
Question IV.13: During bronchoscopy a nodular abnormality is noted on the carina between the middle lobe bronchus and the right lower lobe bronchus, with erythema extending into the posterior basal lower lobe bronchus. During presentation of the case to your thoracic surgical and oncology colleagues you should describe these findings as which one of the following.

- A. Nodular abnormality involving RC-1 with erythema extending into RB 10.
- B. Nodular abnormality involving RC-2 with erythema extending into RB 10.
- C. Nodular abnormality involving RC-1 with erythema extending into RB 8.
- D. Nodular abnormality involving RC-1 with erythema extending into RB 7.

Answer IV.13: B

The posterior basal segment is always B 10. On the right, the carina between the right middle lobe bronchus and the bronchus to the right lower lobe is named the right carina 2 or RC-2, whereas the carina dividing the right upper lobe and the bronchus intermedius is termed the right carina 1 or RC-1.

Lower lobe bronchi are classified as bronchi B 6- B10. An airway nomenclature helps bronchoscopists describe extent of neoplastic involvement and sites of early lung cancer, and delineate limits for surgical resection.



Question IV.14: Bronchoalveolar lavage is most helpful for providing histologic confirmation of diagnosis in all of the following diseases **except**

- A. Chronic eosinophilic pneumonia
- B. Histiocytosis X
- C. Lymphangitic spread of carcinoma to the lungs
- D. Pulmonary alveolar proteinosis
- E. Invasive aspergillosis

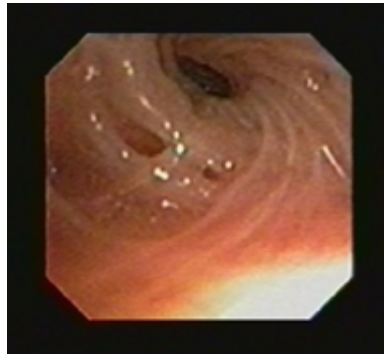
Answer IV.14: E

In patients with invasive aspergillosis, culture of BAL specimens is positive in less than 30 percent of cases; therefore negative results do not exclude this diagnosis in susceptible individuals.

In addition to those illnesses listed above, BAL is also helpful for making a diagnosis of occult pulmonary hemorrhage, fat embolism, and infectious lung diseases such as mycobacterial, pneumocystis carinii, and cytomegalovirus pneumonia.

Question IV.15 The abnormality shown in the figure below is consistent with which of the following

- A. Bronchogenic carcinoma
- B. Chronic bronchitis
- C. Endobronchial tuberculosis



Answer IV.15

B

Chronic bronchitis changes include erythema or pallor, scarring, and exaggerated bronchial pitting. Bronchitis changes are a frequent finding and are not necessarily of clinical significance. Endobronchial tuberculosis may cause fibrous strictures, redness, swelling, or scar formation. Features of bronchogenic carcinoma include intraluminal nodules, polypoid lesions, mucosal thickening, erythema, and extrinsic compression.



Question IV.16: Flexible bronchoscopy reveals small slightly swollen erythematous bronchial mucosa about 1 cm in surface area along the lateral wall of the bronchus intermedius directly below the right upper lobe bronchial orifice. Biopsy shows squamous cell carcinoma. The patient refuses thoracotomy. Which of the following bronchoscopic therapies should be recommended

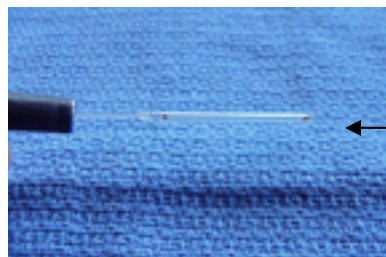
- A. Nd:YAG laser resection
- B. Photodynamic therapy
- C. Brachytherapy
- D. Electrocautery
- E. Argon plasma coagulation

Answer IV.16: B

Photodynamic therapy has been shown to achieve complete response in up to 80 percent of patients with superficial squamous cell carcinomas. Results are best when lesions are small, less than 3 cm in total surface area, and do not penetrate more than 4-5 mm into the bronchial wall. Recurrence is approximately 15 percent.

Photodynamic therapy requires injection through a peripheral vein of a hematoporphyrin derivative which is originally taken up by all organ systems, but rapidly and selectively accumulates in tumor cells, skin, liver and spleen. Photosensitization and cell death occurs after exposing the involved bronchial mucosa to nonthermal light energy, usually 630 nm wavelength. This light is absorbed to an average depth of 5 mm. The subsequent formation of oxygen free radicals results in cell death.

Procedures can be performed using a flexible bronchoscope and topical anesthesia. Follow-up bronchoscopy is usually required within 72 hours to remove necrotic tissues from the treated airways. The other techniques might also be effective, but firm clinical data are lacking to justify their use at this time.



Cylindrical diffuser fiber used to deliver nonthermal laser energy during PDT

Question IV.17 In a patient with an upper lobe infiltrate on chest radiograph and three AFB smear negative sputum samples, all of the following are reasons for proceeding with bronchoscopy **except**

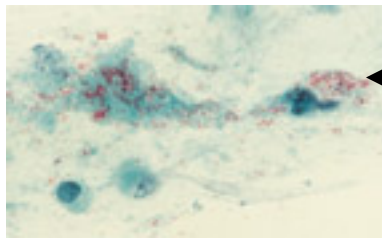
- A. The likelihood of identifying an organism for susceptibility testing is increased
- B. The likelihood of making another diagnosis is increased
- C. Early diagnosis of tuberculosis is made in up to 40% of smear negative cases
- D. Sputum collected after bronchoscopy may also be helpful for a diagnosis
- E. Routine bronchoscopic lung biopsy will increase the diagnostic yield

Answer IV.17 **E**

Bronchoscopy is extremely helpful in making a diagnosis of tuberculosis. Culture proof of disease is obtained in more than 70 percent of instances when disease is in fact present.

In patients with miliary tuberculosis, the value of bronchoscopy with bronchoalveolar lavage and bronchoscopic lung biopsy is well recognized, providing diagnostic material in more than 70 percent of cases when sputum smears are negative. If granulomas are seen on biopsy, diagnosis may be presumed, but should not be confirmed until mycobacteria organisms are noted.

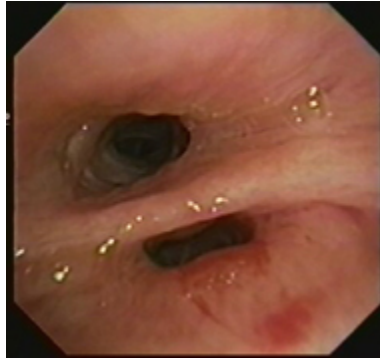
In some institutions it is common practice to send all bronchial washings for mycobacterium smear and culture, regardless of the indication for bronchoscopy. Studies have shown that the incidence of tuberculosis among such “routine” procedures ranges from 0.8% to 6%.



“ Acid-fast bacteria” in BAL

Question IV.18: The appearance of the airway abnormality seen in the Figure below should be described as

- A. Polypoid
- B. Nodular invasive
- C. Superficial invasive
- D. Intraepithelial neoplasia

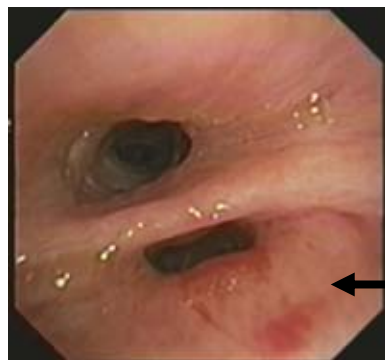


Answer IV.18: C

A generally accepted but infrequently referred to classification of bronchoscopic findings is that of the Japan Lung Cancer Society. In this classification, bronchoscopic findings are described as mucosal or submucosal.

Early stage cancer is a mucosal histopathologic change. Superficial invasive lesions have a loss of luster and disruption of mucosal folds. Lesions are often pale, red, or granular. Increased friability causes lesions to bleed easily when touched. Stenosis of the lumen is slight, but necrotic material may adhere to the lesion's surface.

Intraepithelial neoplasia is a term that encompasses histopathologic abnormalities including mild, moderate and severe dysplasia (which are considered to be premalignant lesions), and invasive (malignant) neoplasia or carcinoma *in situ*. Often these abnormalities are found at bronchial bifurcations. Carcinoma should be suspected whenever mucosal thickening, redness, or swelling are noted at these locations.



Superficial invasive carcinoma along posterior wall of middle lobe bronchus

Question IV.19: The esophagus is usually considered to be “adherent” to

- A. The carina
- B. The first two centimeters of the left main bronchus
- C. The right upper lobe bronchus
- D. The proximal right main bronchus

Answer IV.19: B

The esophagus is considered to be “adherent” to the first two centimeters of the left main bronchus. Bronchoesophageal fistulas can be found in this area in patients with malignancy or a history of interventional esophageal procedures, external beam radiation therapy, brachytherapy, and laser resection.

Question IV.20: You are about to describe an endobronchial abnormality to an interventional bronchoscopist. In which of the following might he be least interested

- A. Distance of the abnormality from the carina and other ipsilateral bronchial segments
- B. Whether the abnormality has a wide or narrow base
- C. Location of the abnormality in relation to the bronchial wall
- D. Size of the abnormality (length, diameter, degree of airway obstruction)
- E. Distance of the abnormality from the inferior margin of the vocal cords

Answer IV.20: E

If a lesion is noted in the bronchial tree, it is not necessary to report its distance from the vocal cords. Of course, this distance would be reported were the lesion in the trachea. Additional components of endobronchial disease that should be described are consistency (firm, rubbery, soft), appearance (glistening, vascular), friability (oozing, actively bleeding, pus-filled), color (white, red, dark, yellow), shape (regular, round, irregular, elongated, bulging), and dynamics (mobile with respiration or cough, ball-valving, immobile).

Question IV.21: You are asked to bronchoscope a patient who completed a three-week course of high-dose brachytherapy for a proximal right main and right upper lobe bronchial tumor ten days ago. The patient had previously undergone laser resection, which successfully restored central airway patency. The patient now complains of cough, dyspnea, and occasional hemoptysis. Which of following bronchoscopic findings is most likely.

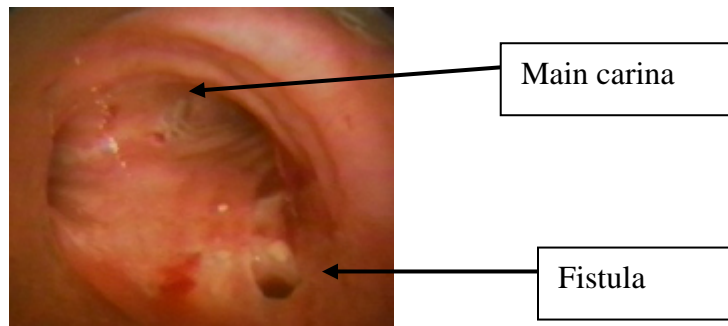
- A. Right main bronchial stenosis
- B. A fistulous tract beginning at the posterior wall of the right main or right upper lobe bronchus.
- C. Right lower lobe bronchial stricture
- D. Tumor extension from the right upper lobe bronchus to the proximal trachea

Answer IV.21: B

Brachytherapy is warranted in selected patients with intraluminal disease or extrinsic compression from tumor. Results are best when tumor does not extend more than a few millimeters beyond the bronchial wall. Success is most likely in patients who have had previous favorable responses to external beam radiation therapy. The radiation is applied using a radiation source delivered through a nylon catheter. The catheter is inserted bronchoscopically. Dosimetric analyses are performed by radiation oncology depending on the length and depth of tumor that must be treated.

Brachytherapy causes tissue necrosis, localized edema, hemorrhage, and fistulas. Complications are increased in patients undergoing concomitant Nd:YAG laser resection. Brachytherapy of a segmental bronchus may temporarily increase or even cause bronchial narrowing, but should not cause bronchial stenosis at a site that is distant from the treatment zone.

In the case described above, it is unlikely that the brachytherapist would have proceeded with lobar brachytherapy had significant residual tumor involving the right main bronchus and trachea been noted on bronchoscopy.



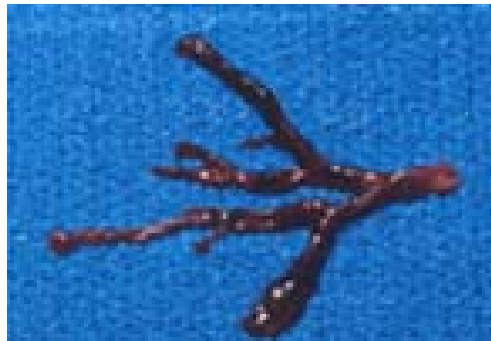
Question IV.22: While attempting to remove a large blood clot from the endotracheal tube and tracheobronchial tree in an intubated and mechanically ventilated patient of the intensive care unit, you should

- A. Use small cup forceps
- B. Request Nd:YAG laser assistance
- C. Move the endotracheal tube proximally
- D. Apply suction intermittently

Answer IV.22: C

Moving the endotracheal tube proximally will often help loosen the clot, which is frequently at least partially “caught” in the Murphy eye of the endotracheal tube. Most clots can be removed using a flexible bronchoscope, even when they form casts of the bronchial tree as seen in the Figure below.

In order to facilitate clot removal, one might (1) use the bronchoscope with the largest working channel possible, (2) use large alligator forceps to break up the clot, (3) use abundant saline washings and constant as well as intermittent suction, or (4) instill Streptokinase. (5) Cryotherapy can also be used to freeze and immediately extract the clot. (6) When the clot is pulled up within the trachea, one can remove the bronchoscope if necessary and insert a large-bore suction catheter to blindly aspirate the clot using high suction. If these efforts are unsuccessful, rigid bronchoscopy is warranted.



Question IV.23: Which of the following techniques is best used to facilitate wedging the flexible bronchoscope into a hard to reach segment of an upper lobe.

- A. Changing the V-shaped bend of the bending tip to a U-shaped bend by simultaneously flexing the tip and advancing the bronchoscope.
- B. Withdrawing the bronchoscope from the segmental bronchus in order to insert a cytology brush through the working channel into the apical segment. The scope is then advanced over the brush until wedged.
- C. Rotating the distally flexed tip of the bronchoscope by twisting the bronchoscope proximally between the index finger and the thumb at the nasal or oral insertion site.
- D. Using fluoroscopic guidance to monitor the position of the distal tip of the bronchoscope while rotating the patient's chin to the opposite side.

Answer IV.23: A

This is not a trick....Each of the described techniques can be used. Changing the shape of the bending tip of the bronchoscope by “bouncing” it off the bronchial wall, however, is probably the most elegant and time effective of the techniques proposed, and therefore choice A has been chosen as the “correct” response.

Insertion of a cytology brush takes time, does not always work, and risks inadvertent pneumothorax by advancing the brush too far. Many experts say that although they have heard of this technique, they have never seen it work when they have tried it themselves (personal communications).

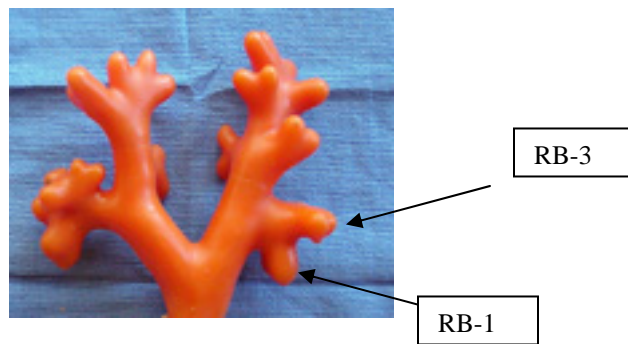
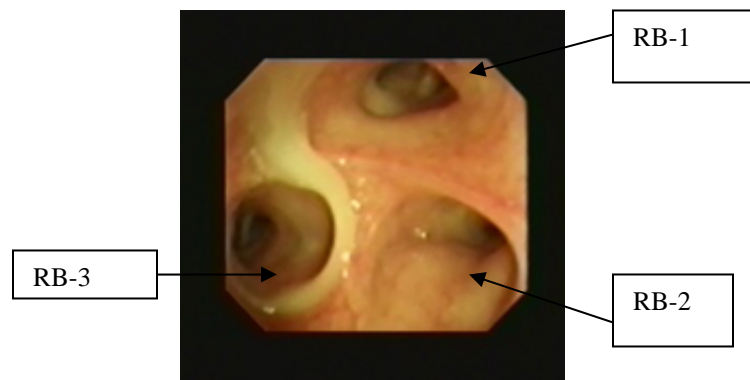
Fluoroscopic guidance, although often effective, may not be readily available. Rotating the distally flexed tip by twisting the bronchoscope at the oral or nasal insertion site can be effective, but is inelegant and can damage the scope. Remember, proper technique means driving the bronchoscope with only the hand holding the bronchoscope's control section. The other hand simply stabilizes the scope at the insertion location. Yes, it is indeed amazing...but it appears that all experts agree that flexible bronchoscopes should be “driven” by the hand holding the proximal portion of the scope known as the control section (many many personal communications).

Question IV.24: A thoracic surgery colleague has referred a patient for bronchoscopic removal of a foreign body located in RB2. On bronchoscopy, you will find the foreign body in

- A. The posterior basal segment of the right lower lobe.
- B. The medial basal segment of the right lower lobe.
- C. The anterior segment of the left upper lobe.
- D. The posterior segment of the right upper lobe.
- E. The anterior segment of the right upper lobe.

Answer IV.24: D

RB2 represents the posterior segment of the right upper lobe. RB1 and RB3 represent the apical and anterior segments of the right upper lobe respectively. Regardless of nomenclature employed, carinal, lobar, and proximal segmental nomenclature are relatively constant. Bronchi are thus named from 1-10 (1-3 upper lobe, 4-5 middle lobe or lingual, 6-10 lower lobe), while carinii are named C-1 or C-2. Nomenclature can be helpful for communicating with foreign as well as surgical colleagues.

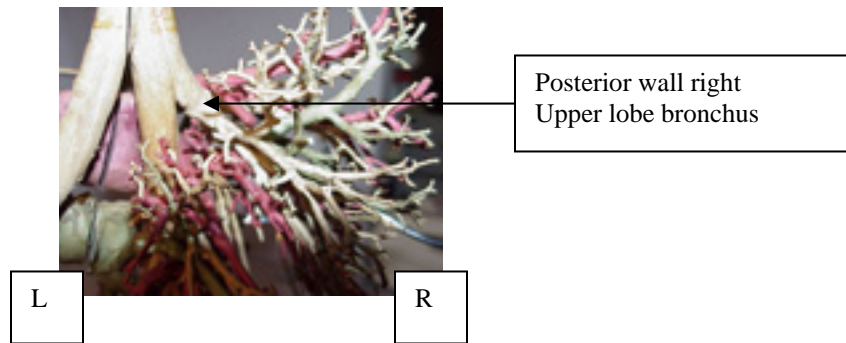


Question IV.25: Which of the following statements about the right upper lobe bronchus is correct

- A. The posterior portion of the right upper lobe bronchus is devoid of any vascular relationships
- B. The anterior portion of the right upper lobe bronchus is devoid of any vascular relationships
- C. The pulmonary vein is in direct contact with the right upper lobe bronchus

Answer IV.25: A

No vascular structure is directly adjacent to the posterior aspect of the right upper lobe bronchus. Anterior lies the pulmonary vein, but it is not in direct contact with the bronchus. The right pulmonary artery is adjacent to the anterior wall of the right upper lobe bronchus and origin of the bronchus intermedius. Needle aspiration at this site would be dangerous. Note that the direction of the right upper lobe bronchus in this cast is more vertical than usual.



Question IV.26: A previously healthy 40-year-old Brazilian physician living outside Manaus presents with acute onset of dyspnea, fever, myalgias, and dry cough. Ten days ago he cleaned out a chicken shack, which he rebuilt as a Japanese teahouse after removing soil and laying down a hardwood floor. Chest radiographs reveal lobar consolidation in the right mid and upper lung fields. Several small sub pleural nodular calcifications are present in the right and left upper lung zones. A skin test for tuberculosis is positive. Flexible bronchoscopy shows focal narrowing of the right middle lobe bronchus with surrounding erythema. The right main bronchus is also compressed. The patient notes dyspnea and dysphagia when placed in the supine position. Which of the following is the most likely diagnosis?

- A. Acute Histoplasmosis
- B. Influenza-like illness on a background of chronic Histoplasmosis
- C. Acute Cryptococcus infection
- D. Bronchogenic carcinoma

Answer IV.26: B

Sounds like this fellow has the flu as well as chronic findings of Histoplasmosis. Histoplasmosis capsulatum is a soil-inhabiting fungus most frequently found in chicken coops, cellars, and caves. Infection also occurs in city dwellers after exposure on excavation and construction sites, particularly in the Mississippi valley of the United States, although the disease has been noted among residents of fertile river valley basins in Malaysia, Vietnam, Paraguay, Brazil, and India. Acute infection in nonimmune individuals causes influenza-like illness after an incubation period of 10-16 days.

In other individuals, the incubation period may be as short as 3 days. Pulmonary infiltrates, often with an associated hilar and mediastinal adenopathy are noted on chest radiographs. Eventually, lymph nodes and pulmonary nodules calcify. Enlarged nodes may compress the right middle lobe bronchus, causing right middle lobe syndrome. Less frequently, calcifications may erode through the bronchial wall, forming an intraluminal broncholith. Compression of the superior vena cava, esophagus, and main bronchus (mediastinal fibrosis) occurs when mediastinal lymph nodes fuse into a single large mass surrounded by tissue necrosis and ultimately fibrosis.

Diagnosis is made by observation of free organisms in necrotic material, or when single round budding yeasts with bubbly cytoplasm are seen. In immunocompetent patients, necrotizing epithelioid and giant cell granulomas similar to those of tuberculosis may be found.

Question IV.27: An inhalation injury victim who has been in the intensive care unit for five weeks. Several episodes of gastric aspiration were witnessed during the last 7 days since extubation. During an acute aspiration event, you are asked to perform emergency flexible bronchoscopy. You note severe laryngeal edema, thickened vocal cords, and hemiparesis of the left arytenoids. These findings predispose to recurrent aspiration. You also note the abundant yellow secretions filling the lower lobe bronchi bilaterally. Surprisingly, there is no local bronchial inflammation, and bronchial mucosa looks normal except for a small raised erythematous plaque on the spur of the superior segmental bronchus of the right lower lobe bronchus. The abnormality is biopsied. The next day, the pathologist says that round black yeast forms are present on silver stained tissues. Which of the following infectious fungal diagnoses is most likely in this patient?

- A. Allergic bronchopulmonary aspergillosis
- B. Mucomycosis-zygomycosis
- C. Invasive Candidiasis
- D. *Torulopsis Candida Galbrata* infection

Answer IV.27: D

Torulopsis Candida Galbrata infection commonly follows aspiration of gastric contents. Yeast forms are best seen on silver stained tissue sections, where they appear as black round or oval spores in small clusters. Although *Torulopsis Candida Galbrata* can invade vascular structures, it is associated with minimal inflammatory or granulomatous airway mucosal reactions. In case you are curious, these are the major teaching points and purpose for this question.

Invasive candidiasis could have been suspected had oral thrush also been noted. *Aspergillus* may be a colonizer or a truly infectious organism, and can be found in greenish-yellow secretions, but may also be seen even when secretions do not appear purulent. The same comments regarding bronchoscopic appearance can be made about *Mucor*.

Question IV.28: In 1970, Shigeto Ikedo of Japan proposed a classification of bronchoscopic findings that is still extremely useful today. This classification includes all of the following except

- A. Abnormal organic changes of the bronchial wall
- B. Endobronchial abnormalities
- C. Abnormal substances in the bronchial lumen
- D. Dynamic disorders
- E. Consequences of previous surgical or bronchoscopic therapies.

Answer IV.28: E

Professor Ikeda built upon the classification proposed by Dr. Huzley and Dr. Stradling who had previously advocated a classification of bronchoscopic findings based on examination using the rigid bronchoscope. Today, many bronchoscopists inadvertently use this “Ikeda” classification to describe findings (although no one I know refers to this classification as belonging to Ikeda).

By using proper technique and keeping all the elements listed in this classification in mind the bronchoscopist can assuredly discover endobronchial abnormalities and describe them appropriately. As a reminder, the elements are as follows: (1) Abnormal organic changes of the bronchial wall (2) Endobronchial abnormalities (3) Abnormal substances in the bronchial lumen (4) Dynamic disorders

Today, one could add “Consequences of previous surgical or bronchoscopic therapies” to the list. This element pertains to surgical sutures, bronchial stump appearances, airway anastomoses, and mucosal changes from biopsy, laser resection, cryotherapy, electrocautery, photodynamic therapy, or brachytherapy.

Question IV.29: A 39-year-old man with a history of testicular cancer three years ago is now found to have a 3 cm right lower lobe opacity on chest radiograph. Computed tomography scan reveals that the mass contains calcifications. The mass is located in the right lower lobe, and is relatively central. Radiographically, there is no endobronchial disease or associated lymphadenopathy. The patient has no symptoms. The case is presented at a weekly chest conference. The medical oncologist fears that the mass is a metastasis. The radiologist is not as certain, but states that the lesion should be accessible by bronchoscopy. The interventional radiologist states the patient has a 30 percent chance for pneumothorax if the lesion is sampled percutaneously using fluoroscopic or computed-tomographic guidance. A thoracic surgeon recommends immediate thoracotomy and lung resection if frozen sections during thoracotomy are positive for malignancy. An inspection flexible bronchoscopy had been performed before the chest conference. No airway abnormalities were seen and only nondiagnostic bronchial washings had been obtained. You would now propose which of the following.

- A. Thoracotomy with lower lobectomy
- B. Video-assisted thoracoscopy with needle aspiration under thoracoscopic guidance
- C. Flexible bronchoscopy with computed tomography guidance for biopsy or needle sampling of the abnormality and on-site cytopathology.
- D. Flexible bronchoscopy with blind transbronchial needle aspiration.

Answer IV.29: C

Computed tomography-guided flexible bronchoscopy is a well-described procedure and should be considered in certain instances. This technique may be superior to fluoroscopically guided procedures if lesions are not well visualized fluoroscopically.

This patient should probably NOT have undergone the “exploratory” flexible bronchoscopy that provided no diagnostic material or useful information for subsequent decision-making, and did cause increased health care expenditures and patient discomfort. It would be unclear why bronchoscopic lung biopsy or needle aspiration would not have been attempted using fluoroscopic guidance.

A nonbronchoscopic option is to proceed with thoracoscopically guided needle aspiration. An open thoracotomy can probably be avoided. Remember, particularly if lesions are central, close to the esophagus, or left-sided (which was not the case in this instance)..that endoscopic ultrasound guided needle aspiration may help make a diagnosis...especially if there is evidence of mediastinal adenopathy. This diagnostic alternative should be considered even if it means referring the patient to a gastroenterologist specialist!

Question IV.30: A 67-year-old patient with lung cancer and central airways obstruction had photodynamic therapy (PDT) at another institution 5 days ago. He is now seeing you for follow-up and immediate referral to radiation therapy. You suggest that

- A. Radiation therapy be delayed for 4-6 weeks
- B. Radiation therapy be started immediately
- C. Radiation therapy be postponed until symptomatic relief is obtained from bronchoscopic therapies

Answer IV.30: A

Because both photodynamic therapy and external beam radiation therapy cause necrosis and tissue swelling, most experts suggest that radiation therapy be delayed for 4-6 weeks after PDT. This is different from Nd:YAG laser resection, a procedure during which post procedure necrosis and edema are minimal since most tissues are removed by debulking at the time of the bronchoscopy. The combination of PDT and radiation therapy can restore airway patency, even in patients with significant central airways obstruction.