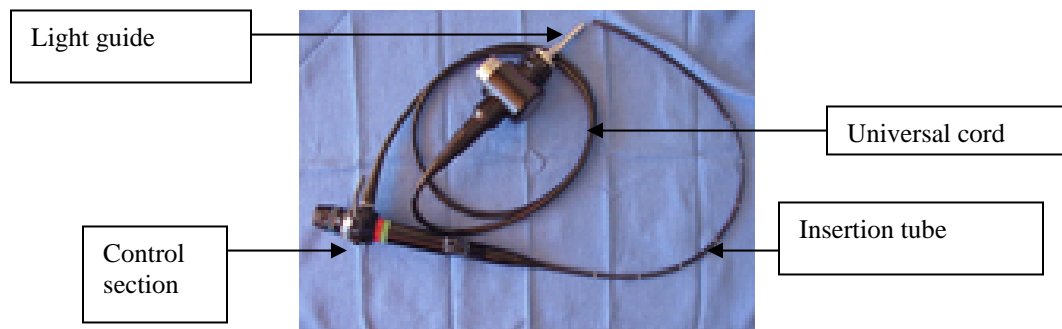


Question II.1: Electrical contact, the venting connector, and light guide are all considered part of which section of the flexible bronchoscope.

- A. Universal cord section
- B. Control section
- C. Light guide connector section
- D. Eyepiece (or video) section
- E. Insertion tube section

Answer II.1: C

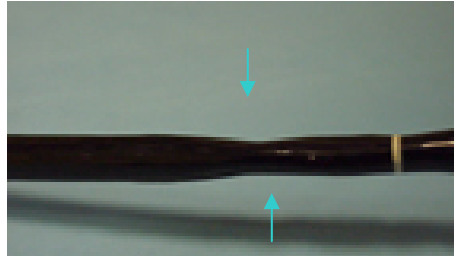
The light guide section plugs into the light source via the light guide. Light is transmitted through fiberoptic bundles to the distal end of the bronchoscope via the universal cord, the control section (which includes the eyepiece section) and the insertion tube section. Each optic fiber is clad with glass in order to isolate it. Fibers are arranged into a coherent bundle, and are thus easily broken when the scope is knocked, banged against hard surfaces, twisted, or bent excessively.



Question II.2

What happened to the flexible bronchoscope shown in the Figure.

- A. It was bitten
- B. It was caught in the drawer of a procedure cart
- C. It was squeezed by an angry bronchoscopist



Answer II.2

A

This scope was bitten, but the same appearance occurs when a scope is caught in a drawer. When bronchoscopy is performed through the mouth, a bite block should always be used. Drawers of procedure carts should never be left open during a procedure. This way, they cannot be inadvertently closed onto a bronchoscope. Bronchoscopists should treat their scopes gently. Scopes should not be bent excessively, bitten, slammed against bedrails or carts, caught in procedure cart drawers, or dropped onto the floor. Treat your bronchoscope... as you would like to be treated.



DANGER!



Question II.3: Most experts agree that which of the following is no longer routinely warranted before flexible bronchoscopy

- A. Informed consent
- B. Atropine
- C. Fasting state for at least 6 hours
- D. Electrocardiographic monitoring

Answer II.3: B

Several studies have now demonstrated that premedication with atropine or glycopyrolate is not beneficial in decreasing bronchoscopy-related cough or secretions. In addition, coagulation profiles, blood type and screen, serum electrolytes, platelet counts, blood count, and serum chemistry panels are not routinely warranted and should be individualized. Electrocardiograms are desirable in patients at risk for heart disease or when pertinent history or physical findings are discovered. During the procedure, pulse rate and oxygen saturation can be monitored by oximetry. Electrocardiographic monitoring is unnecessary.

Increasingly, a fasting state of 6 hours or greater appears to be unwarranted, and should be individualized. A number of institutions are studying this classic rule of anesthesia in the outpatient surgical arena. Informed consent is mandatory. Bronchoscopists should never begin a procedure without first reviewing the history and physical, speaking with the patient and family members about the procedure and its risks, and reviewing the radiology reports.



Question II.5: Which of the following should be considered to be unacceptable practice

- A. Performing bronchoscopy without routine administration of conscious sedation
- B. Performing bronchoscopy in a patient who appears uncooperative despite having signed informed consent
- C. Obtaining bronchoscopic biopsies from the healthy lung because chest radiographs were not reviewed prior to the procedure.
- D. Allowing the patient's family members to observe the bronchoscopy
- E. Using the words "bite", "blood", "dangerous", "cancer" or "bad" during the procedure when such words might startle the patient or promote greater anxiety and fear.

Answer II.5: C

It is definitely unacceptable to perform a procedure on the "wrong" side, whether it is an amputation, or a bronchoscopic lung biopsy. Measures to avoid such an event should be instituted in every bronchoscopy suite. Nurses should be instructed to review radiograph reports and to personally interview and examine patients. Trainees should have x-ray reports and original imaging studies available at the time of the procedure. Informed consent should be specific. The other answers are debatable. In some institutions there is a bias against using conscious sedation. Medications should, however, probably be offered to the patient before and certainly, during the procedure. It is well recognized that health care providers inaccurately judge degrees of procedure-related anxiety and fear. Some patients are originally uncooperative at the time of bronchoscopy even though they had previously signed an informed consent. Most of these patients can be gently convinced to proceed with the bronchoscopy when the nurses and physicians provide greater reassurance, a calm and safe environment, an opportunity for conscious sedation, compassion and caring. If patients are still combative or reluctant to proceed, the procedure should be postponed. Coercion and force should be avoided, even if the health care providers believe that it is in the patient's best interests to undergo the procedure.

In many institutions, it is believed to be unwise for patient's family members to observe bronchoscopic procedures. Others believe that family members have a right to be present, since they are the true support services for the patient, and, after all, the proficient bronchoscopist should have nothing to "hide". Observers should be told, however, that complications could occur. Each bronchoscopist and health care team should do what they feel most comfortable with, and of course, abide by their institution's policy. Using words that might shock or traumatize patients cannot always be avoided during a bronchoscopy. Still, many experts advocate using the words "mitosis" instead of cancer, "heme" instead of blood, "close" instead of bite, and "interesting" instead of bad or dangerous.

Question II.6: The lesion shown in the Figure below is

- A. A small contact nodule on the left vocal cord near the posterior commissure
- B. A small contact nodule on the right vocal cord near the anterior commissure
- C. A small contact nodule on the right vocal cord near the posterior commissure
- D. A small contact nodule on the left vocal cord near the anterior commissure

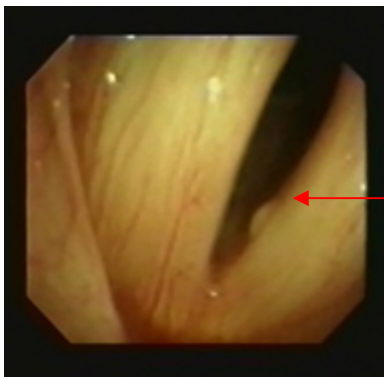


Answer II.6

D

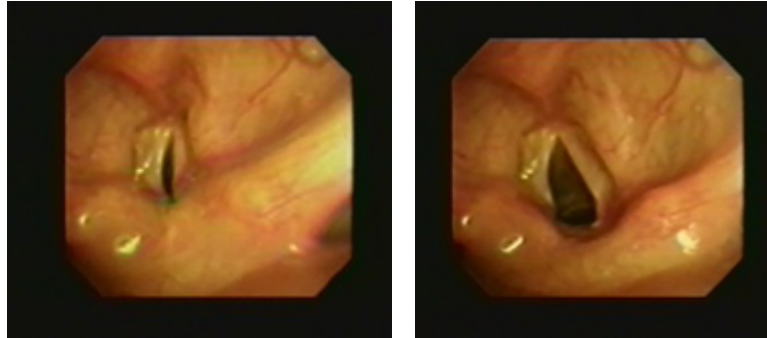
The abnormality is on the left vocal cord near the anterior commissure (located at the 6 o'clock position in the first figure below). It is probably of little or no consequence, but otolaryngology should be consulted for evaluation and possible removal. A hurried bronchoscopist easily overlooks laryngeal abnormalities. The larynx and hypopharynx (which extends from the tip of the epiglottis to the pyriform sinuses lateral to the aryepiglottic folds bilaterally) should be routinely examined during all flexible bronchoscopy.

Ahhhh, but look again!! Using the bronchoscope we were able to aspirate the small abnormality: it was just some mucus. Note the normal larynx in the second photograph. The view is different because the scope has been rotated such that the arytenoids cartilages are now seen in a 6 o'clock position and the V-shaped anterior commissure is at the 12 o'clock position.



Question II.7 A 58-year old man smoker has noted voice change and increased coughing during and after meals. Flexible laryngoscopic examination reveals the findings shown in the Figures below. Which of the following might be expected on chest radiograph.

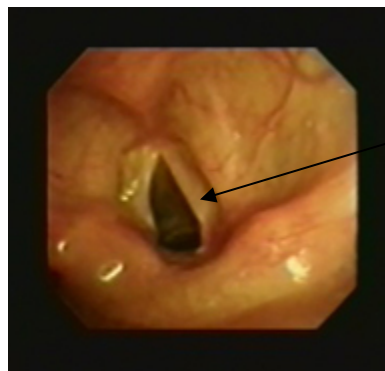
- A. Subglottic narrowing
- B. Left lower lobe atelectasis
- C. Left perihilar mass with obliteration of the aortopulmonary window
- D. Normal radiograph



Answer II.7 C

A mass filling the aortopulmonary could compress the left recurrent laryngeal nerve, causing the left vocal cord paralysis noted in the figures. Both the left and the right vocal cords are shown in adduction in the first figure, but only the right vocal cord abducts normally during phonation. The left vocal cord does not move. A careful inspection of laryngeal function is a routine part of any flexible bronchoscopic examination.

Patients should be asked to swallow, inhale, exhale, and speak. Vocal cord and arytenoids cartilage movements should be assessed and the aryepiglottic folds should be inspected. The left recurrent laryngeal nerve is a branch of the vagus nerve. It innervates the mucous membranes directly below the vocal cords, passing posterior within the superior mediastinum to hook around the aortic arch.



Right vocal cord
abducts normally

Question II.8: Mechanical and chemical irritation of laryngeal mucosa, such as that which occurs during flexible bronchoscopy, elicits cough and bronchoconstriction. Which of the other normal responses to upper airway stimuli could be considered most dangerous for patients undergoing flexible bronchoscopy.

- A. Hypertension from sympathetic stimuli
- B. Bronchodilatation from nasal and epipharyngeal irritation
- C. Cardiac arrhythmia and even cardiac arrest most likely resulting from irritation of the superior laryngeal nerve
- D. Increased mucous secretions that prompt cough and prevent penetration of extraneous materials.

Answer II.8: C

Laryngeal irritation has been shown to cause cardiac arrhythmias and even cardiac arrest in humans and in experimental studies. Repeated traumatic attempts at passing the flexible bronchoscope past the vocal cords should be avoided. During visualization of laryngeal function, vocal cord mobility, and during administration of topical anesthetic onto the larynx, the bronchoscope should be pulled back so that the larynx is clearly in view. Most experts agree that in a controlled setting, the tip of the bronchoscope should be kept above the epiglottis before intubating the trachea.

Question II.9: All of the following are potential indications for performing a “dynamic” bronchoscopy **except**.

- A. Spastic dysphonia due to adductor spasm
- B. Bronchoesophageal fistula
- C. Tracheal bronchomalacia
- D. Circumferential subglottic tracheal stricture
- E. Wide-based tumor obstructing the proximal aspect of a main bronchus

Answer II.9: E

Dynamic bronchoscopy consists of asking the patient to perform specific maneuvers while the airways are being visualized with the bronchoscope. These maneuvers include forced deep breathing, forced exhalation, and hyper flexion or hyperextension of the neck. Airways are examined after moving the patient into the supine, lateral decubitus, and seated postures. Dynamic bronchoscopy might be accompanied by a dynamic examination of the larynx during phonation in patients with hoarseness, dysphagia, or with symptoms suggestive of recurrent aspiration (cough, recurrent bronchitis, or pneumonia). Dynamic bronchoscopy might result in distending the folds or cartilaginous rings to identify a fistula. It might also identify dynamic collapse of the pars membranosa, an occasional cause for persistent cough and shortness of breath.

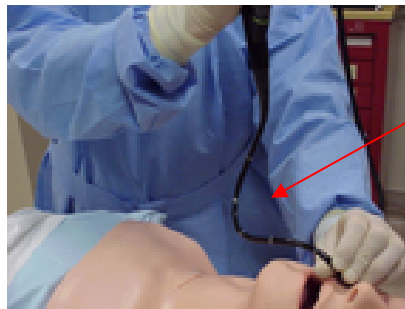
In patients with subglottic strictures, the patency of the airway should be assessed in multiple positions. Sometimes, there is a tendency for the stricture to become more severe during exhalation, or when the patient assumes certain positions. When the trachea or bronchi are obstructed by tumor, dynamic bronchoscopy is usually not necessary. “Ball-valving” is usually evident during a routine bronchoscopic examination, and rarely requires specific maneuvers. This occurs most frequently when tumors are on a small stalk, membranes protrude into the airway lumen, and when elastic tumors such as sarcomas extend out of a segmental bronchus into a main bronchus.

Question II.10 Which of the following positions is inelegant and risks damaging the flexible bronchoscope

- A. Pushing downwards on the bronchoscope so that a bend forms in the insertion tube.
- B. Standing up straight, shoulders back, weight equally distributed on both feet.
- C. Sitting on a stool, keeping the insertion tube straight at approximately patient height.

Answer II.10 A

Pushing downwards on the bronchoscope is inelegant, bad for the posture, and risks damaging the scope. Standing straight with weight equally distributed is much more comfortable, as is flexible bronchoscopy in the seated position.



BAD

Question II. 11 What is most inelegant about the bronchoscopist shown?

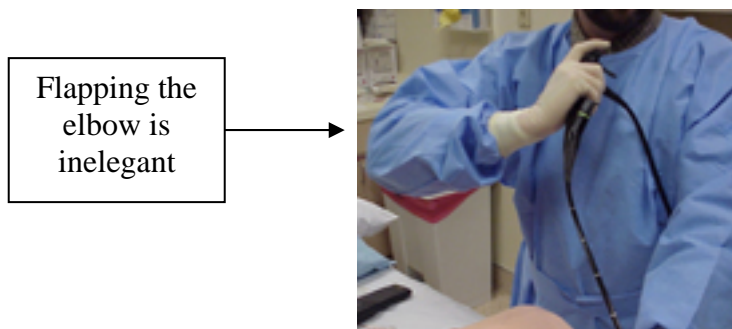
- A. He is scratching his beard
- B. He is “flapping” his right elbow
- C. He is holding the scope in the wrong hand
- D. He is wearing blue



Answer II. 11 B

Flapping the elbow is inelegant and appears clumsy. A more elegant posture is that shown in the Figures below. Here, the elbow can rest, if necessary, on the bronchoscopist’s hip. The arm is held close to the body and the control section of the videobronchoscope is held directly in front of the body. There is no awkward body language, dancing or swaying from one foot to the other. The insertion tube is relatively straight throughout the procedure.

In order to maintain an upright posture, the bronchoscopist can move closer to the patient. Scopes can be held in either the left or the right hand, depending on operator comfort, preference, and use of ancillary instruments.



Question II.12: Three months ago, you purchased two flexible bronchoscopes for your hospital. Today, your new bronchoscopy nurse informs you that the bronchoscopes had been stored in a haphazard way into small, padded procedure cart drawers. Visualization and light transmission is normal, yet she requests permission to install new full-length cabinets in which to hang the bronchoscopes. This is because she has noted which of the following in one of the scopes

- A. The outer sheath is ruptured
- B. The distal lens has turned yellow
- C. Multiple black dots are visible when looking through the eyepiece
- D. The steel components of the bronchoscope have corroded
- E. The bronchoscope has a new, fixed C-shaped curve along its entire length

Answer II.12: E

Fixed “memory” curves occur when flexible bronchoscopes are not stored in a full-length cabinet where bronchoscopes can hang. This can occur when scopes are rolled, folded, or placed into drawers for extended periods of time. Cabinets should be padded so that the distal extremity of the scope does not bang up against cabinet walls. Folding bronchoscopes into drawers for storage increases the risk of breaking fibers and sheaths by excessive bending, banging, or other mishandling such as closing the drawer onto the bronchoscope.

Rupture of an outer sheath easily occurs if the venting cap of the bronchoscope is not placed prior to ethylene oxide gas sterilization. The distal lens may turn yellow if repeated cleaning with povidone-iodine (Betadine) occurs or if the scope is exposed to radiation. Steel components can erode if scopes are immersed for excessively long periods in Glutaraldehyde.

Question II.13: The oral airway shown in the Figure below is the

- A. Ovassapian airway
- B. Williams airway intubator.
- C. Berman pharyngeal airway.



Answer II.13: B

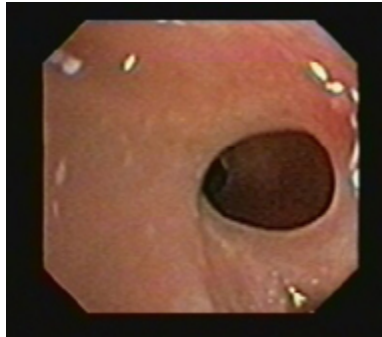
Oral intubating airways help the bronchoscopist keep the flexible bronchoscope in the midline, expose laryngeal structures, and maintain an open pharynx. The Williams airway intubator was designed for blind orotracheal intubation. However, in order to remove the Williams airway after intubation, the endotracheal tube adaptor must be removed prior to intubation. The Ovassapian airway, on the other hand, can be removed without disconnecting the endotracheal tube adaptor. The length and tubular shape of the Berman airway hinders maneuverability of the flexible bronchoscope.



Williams airway
intubator

Question II.14: The appearance of the airway stricture seen in the Figure should be described as

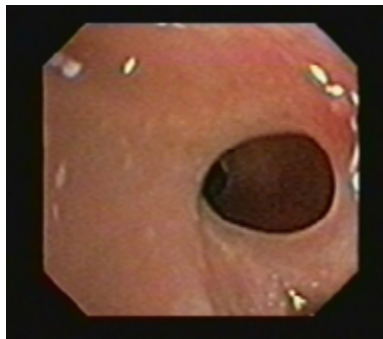
- A. Simple
- B. Hourglass
- C. Complex



Answer II.14: A

This is a simple circumferential membranous stricture. Tracheal stenosis can be congenital, acquired, or idiopathic. Histopathologically, there may be mucosal erosion, destroyed cartilage, granulation tissue formation, or full thickness dense fibrotic scar. It is important to understand the histopathologic process underlying the bronchoscopic abnormality when making management decisions regarding therapy.

A simple stenosis is defined as a partially or completely concentric, circumferential-type stricture in which a fibrous scar grows from the tracheal wall towards the center of the airway lumen. A bottleneck or hourglass stricture is characterized by localized collapse of tracheal cartilage. A complex stricture is one that includes a combination of other abnormalities, or extends for more than 5 cm or 6 cartilaginous rings.



Question II.15
seen in the Figure.

Which of the following best describes the airway device

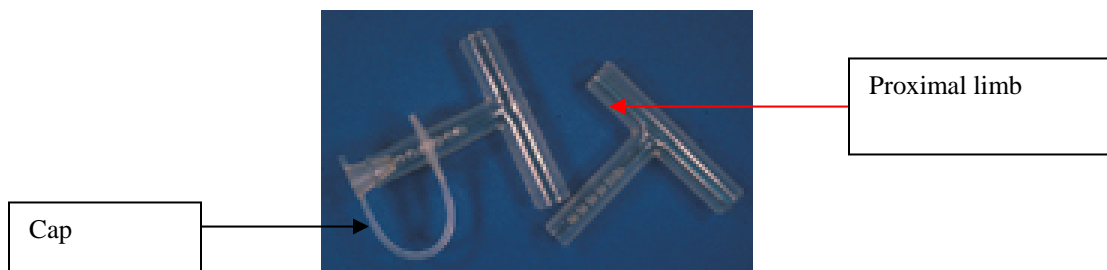
- A. Its popularity during the 1990s revolutionized interventional bronchoscopic practice
- B. Best used for patients with subglottic and upper-mid tracheal stenosis, this device requires a tracheostomy. A small cap on the device can be removed to allow suctioning and airway access if needed.
- C. Made of silicone, this device is usually inserted and removed using a rigid bronchoscope.



Answer II.15 B

The Montgomery T-tube was introduced in the 1960s. It is extremely useful for treating patients with subglottic stenosis or strictures involving the upper and mid trachea. It can be left in place indefinitely, or used temporarily as part of an endoscopic or open surgical management of tracheal stenosis. The vertical limb of the T-tube exits the patient through the tracheostomy stoma.

Patients can speak normally when this vertical limb is closed with a cap. Patients should keep the cap on at all times to avoid drying airway secretions. If the patient becomes short of breath because of recurrent tracheal stricture or accumulated secretions, the cap can be removed. The proximity of the horizontal (and shortest) limb of the T-tube to the vocal cords favors granulation tissue formation. The two other responses apply to studded silicone stents used to palliate central airways obstruction.



Question II.16: All of the following statements regarding bronchoscopy-induced hypoxemia are correct **except**

- A. Prebronchoscopy PaO₂ fails to predict the degree of fall in arterial PO₂ during flexible bronchoscopy
- B. Suctioning during bronchoscopy may contribute to a fall in alveolar PO₂, resulting in a decline in arterial PO₂.
- C. Hypoxemia may occur even in the absence of respiratory depression from sedatives.
- D. Hypoxemia has been associated with development of dysrhythmias.
- E. Arterial PO₂ falls by about 5 mm Hg on average during bronchoscopy.

Answer II.16: E

Bronchoscopy related fall in arterial PO₂ has been reported to be as high as 20 mm Hg on average. It has, for the most part, become standard of care to administer supplemental oxygenation to all patients undergoing flexible bronchoscopy and to monitor oxygen saturation, heart rate and blood pressure by pulse oximetry. One principle reason for this is to prevent hypoxemic events potentially related to respiratory depression when conscious sedation is administered..

Transient hypoxemia can occur during bronchoscopy because of excess sedation, respiratory insufficiency, diminished airway caliber and poor ventilation, or because of excessive washing or suctioning. Bronchoalveolar lavage can cause persistent hypoxemia lasting up to six hours after the procedure in rare instances.

The exact mechanisms of bronchoscopy-induced hypoxemia are not clear, but are likely to reflect altered ventilation-perfusion relationships. Note that some older studies and some guidelines, such as those of the British Thoracic Society or Argentinian Society for Bronchoscopy suggest that supplemental oxygen be administered only if oxygenation cannot be monitored or if oxygen saturation falls to below 90 percent.

Question II.17: Patients with which of the following disease are most likely to develop acute and airway obstruction after general anesthesia is initiated in the supine position.

- A. Posterior nerve sheath tumor
- B. Hodgkin's lymphoma
- C. Bronchogenic cyst

Answer II.17: B

Patients with a mediastinal mass, especially those with Hodgkin's lymphoma, are most likely to develop severe airway obstruction when anesthetized in the supine position. In addition to compression of the airway by the mass, airway obstruction is increased because of loss of bronchial smooth muscle tone, loss of spontaneous ventilation, and loss of negative intrathoracic pressure on inspiration. Loss of the airway on induction of anesthesia can be life threatening. Anesthesiologists may frequently call a bronchoscopist for assistance in such cases.

Question II.18: All of the following statements pertaining to ethylene oxide gas (ETO) sterilization of flexible bronchoscopes are correct except

- A. ETO sterilization penetrates all portions of the flexible bronchoscope
- B. ETO sterilization is highly effective against all types of microorganisms
- C. ETO sterilization without using an ETO venting cap will result in rupture of the outer polyurethane sheath of the flexible bronchoscope.
- D. ETO sterilization usually takes about 4 hours, and requires up to 24 hours of degassing time during which the scope cannot be used.
- E. ETO guarantees sterility and is therefore preferred over liquid chemical disinfection modalities.

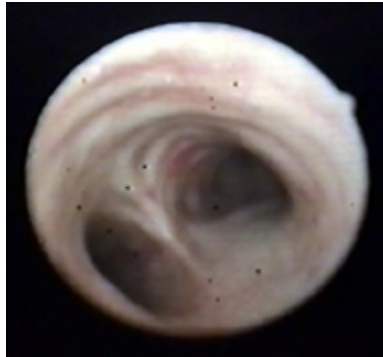
Answer II.18: E

Ethylene oxide (ETO) processing does not guarantee sterility. This and other disadvantages such as long degassing time and lengthy turnover make it impractical for busy bronchoscopy services. High-level disinfection, which inactivates all fungi, viruses, and vegetative organisms, but not all bacterial spores, is the modality used most frequently around the world. Disinfection for 45 minutes at 2.5 degrees Centigrade and using 2% Glutaraldehyde will also destroy all mycobacterial organisms.

After disinfection, scopes are rinsed with sterile water and dried using air suction. Any bronchoscope being cleaned must be “leak tested” first. If a leak is found coming from the working channel of the scope, or from a damaged exterior surface of the universal cord or extension tube, the scope should NOT be submersed in cleaning solution. Many services use older flexible fiberoptic bronchoscopes. An accessory “teaching head” is used to allow observation by a second person. The teaching head CANNOT be immersed or sterilized. It should, therefore, be kept as clean as possible, and wiped with alcohol after each use.

Question II.19: When looking through the eyepiece of a flexible bronchoscope you notice that multiple small black dots are visible. This means that

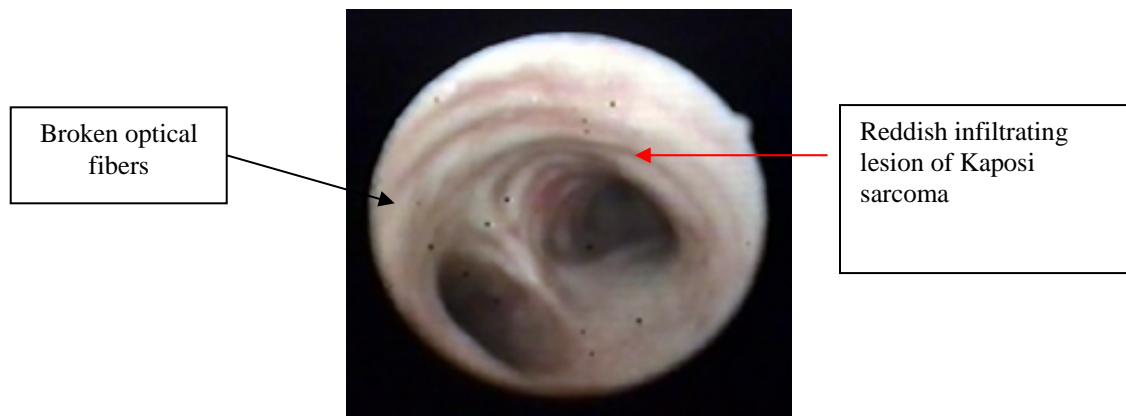
- A. Water has leaked into the bronchoscope
- B. The bronchoscope has been excessively exposed to radiation
- C. Multiple fiberoptic bundles are broken
- D. The bronchoscope needs to be replaced



Answer II.19: C

Multiple black dots are caused because light is no longer transmitted along individual or groups of glass optical fibers. As additional fibers are broken, dots multiply until they eventually fill a significant portion of the viewing field. Light transmission decreases and visualization eventually becomes unsatisfactory. Sooner or later, the bronchoscope will need to be replaced. A yellowish discoloration and darkening of the fiberoptic bundles occurs when a scope is exposed to excessive amounts of radiation.

When visualization is blurred, the lens should be wiped with saline or alcohol in order to remove a film caused by blood, secretions, or inadequate drying during the cleaning-disinfection process. If visualization does not improve, a leak-test should be performed because fluid may have entered the bronchoscope. No further washing and disinfection should be attempted. The bronchoscope needs to be sent out for repair.



Question II.20: Which of the following pulmonary function disturbances can be seen when performing bronchoscopy in a mechanically ventilated patient

- A. Increased airway resistance
- B. Reduced positive end-expiratory pressure
- C. Reduced functional residual capacity
- D. Increased arterial oxygen saturations
- E. Increased expiratory flow rate

Answer II.20: A

Airway resistance is increased because the cross sectional area of the trachea, usually about 3 cm², is reduced by the endotracheal tube and by the flexible bronchoscope within the endotracheal tube. Oxygen saturations and expiratory flow rates are reduced, although saturations might actually increase if abundant mucous plugs or secretions are removed. End-expiratory pressure and functional residual capacity are increased because of the increase in airway resistance.

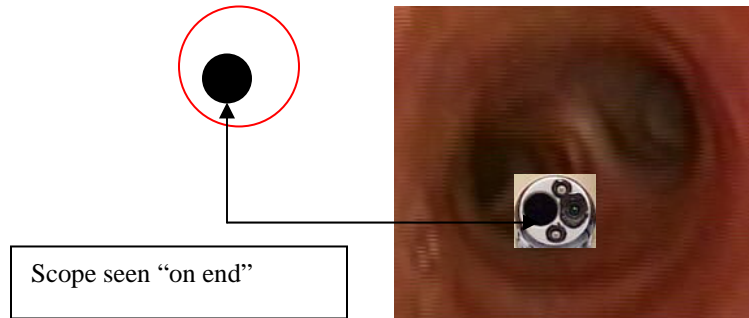
Most experts suggest increasing FiO₂ to 100 percent during bronchoscopy. Procedures should be stopped if peak airway pressures increase significantly, or if bronchoscopy is causing hypertension, significant tachycardia or dysrhythmias, or oxygen desaturation. However, in some cases, it is essential to remove mucous plugs or blood in order to restore adequate ventilatory function. In these cases, bronchoscopy should be judiciously performed while staying in the patient's airway as little time as possible.

Question II.21: In a tall adult male patient with normal airways, a standard flexible bronchoscope occupies approximately what percentage of cross-sectional area of the trachea.

- A. 5 percent
- B. 10-15 percent
- C. 20-25 percent
- D. more than 25 percent

Answer II.21: B

In an adult male with a normal trachea 12-24 mm in diameter, the flexible bronchoscope occupies approximately 10-15 percent of the cross-sectional area of the tracheal lumen. Obviously, the area occupied by the bronchoscope is increased in the presence of tracheal strictures caused by benign or malignant processes, when there is an indwelling endotracheal tube, and in smaller patients. In these cases, the size of the bronchoscope contributes to increased airway resistance, decreased expiratory flow rates, and increased functional residual capacity. Occasionally, increased positive end-expiratory pressure has also been noted.



Question II.22: Which of the following “expressions” is most appropriate for flexible bronchoscopic examination

- A. The middle way
- B. Gentleness is a virtue
- C. A bronchoscopist must have eyes on the tips of his fingers
- D. Never give up
- E. Feel the wall

Answer II.22: A

One of the secrets to performing a non traumatic and “gentle” examination is to always keep the flexible bronchoscope in the middle of the airway lumen (when using video, keep the image in the middle!). This improves overall visibility, decreases the likelihood to become lost, and avoids mucosal injury, cough and patient discomfort. This position within the airways also allows the bronchoscopist to maintain excellent posture and maneuverability no matter what hurdles may be encountered. Thus, harmony is maintained during the procedure.

Of course, the “middle way”, is that of Chinese Tao and Japanese Zen Buddhism: A way in which one is not distracted by the objective world nor disturbed in one’s own mind. The middle way is a way of inner peace, harmony, and transcendence of dualism. To quote Chuang Tzu, “when the shoe fits, the foot is forgotten”.

Another way to achieve bronchoscopic harmony is to perceive limitations, and to move beyond them. The expression “feel the wall” is attributed to Jean-Francois Dumon of Marseille, France. Dumon is perhaps the single most important personality in interventional bronchoscopy of recent years. Through his technical expertise, talent, and passion for endoscopy, this Frenchman from Marseille raised awareness about the usefulness of therapeutic bronchoscopy among extremely hesitant and skeptical pulmonary, oncology, and surgical communities. “Feel the wall” refers to the techniques of probing a tumor’s surface with forceps or suction catheter in order to best recognize consistence, state of necrosis, vascularity, risk of biopsy and potential for debulking by rigid bronchoscopy.

Undoubtedly, this expression also reflects a philosophy and a way of life. It represents a need to “feel” the boundaries of thought and the limitations of medical science. Those who question conventional wisdom in order to bathe in the realm of innovation and originality transcend these boundaries. There is, in fact, a way to “become One with the bronchoscope”, but that is another story....

Question II.23: The best reason to not administer conscious sedation before or during bronchoscopy is

- A. The patient is a military commando and his friends are watching
- B. The bronchoscopist is a macho
- C. The patient must drive immediately to work after the procedure
- D. The patient is allergic to Lidocaine
- E. The patient is critically ill and is a high risk intubation

Answer II.23: C

Patients should be warned that conscious sedation may be administered, and therefore, they should have someone accompany them after the procedure, and they should NOT drive their own automobile or motorcycle after receiving such medication, even if their vital signs (blood pressure, heart rate, oxygen saturation, and level of consciousness) reflexes in case of need for emergency responses (like driving) are delayed for several hours.

Do you think conscious sedation should be a “negotiation” between yourself and the patient? Many studies have shown that physicians are poor judges of the anxiety levels and comfort levels of patients undergoing invasive procedures. Remember that small amounts of a sedative given orally or intravenously can help alleviate procedure-related anxiety. Thus the benefits of conscious sedation (anxiety relief, amnesia, analgesia, improved cooperation) should be weighed against the disadvantages of conscious sedation (need for additional monitoring, risk of respiratory depression, risk for decreased patient cooperation because of inhibitions or restlessness).

Decisions should also include the type of procedure being performed (is this a very short inspection or a longer procedure with biopsies, needle aspiration, washings, brushings). What is the risk of a procedure-related complication? What is the risk of a drug-induced adverse event? Is the patient clinically stable, ambulatory, or critically ill? Whether to administer sedation, and which drug or drug to administer can and should be individualized based on the above scenarios.

Of course, some patients do not desire conscious sedation because of other disadvantages: perceived loss of self-control, need to be observed until return to baseline mental status after the procedure, danger of driving an automobile, and fear of allergic reactions or other medication-related adverse events.

In case of a true allergy to lidocaine, a medication belonging to the Ester group, such as Tetracaine could be administered.

Although bronchoscopy has been shown to be safe in unsedated patients, most bronchoscopists today believe that short-acting sedation should be offered to patients in order to help improve patient comfort during the procedure. In certain instances, however, procedures might be warranted in a fully awake, but cooperative individual. This might include cases where the patient has hemoptysis or a foreign body (where conscious cough or breathing can prove advantageous), cases where a dynamic examination is warranted, and cases where loss of the airway might be irreversible.

Question II.24 The image shown demonstrates

- A. Paralyzed vocal cords in abduction
- B. Normal vocal cords seen from below
- C. Subglottic tracheal stenosis
- D. The anal canal during sigmoidoscopy



Answer II.24 **B**

The image is that of the vocal cords seen from below. The flexible bronchoscope was introduced through the tracheostomy, after removing the tracheotomy tube. The scope is flexed caudally in order to examine the subglottis. The patient is asked to phonate. Here, normal vocal cords are seen in abduction. The subglottis is normal. Reason to perform this type of an examination are to exclude a subglottic or peristomal source of bleeding, to inspect the subglottis for cartilaginous abnormality, stricture, or to fully evaluate laryngeal function in patients with tracheostomies prior to permanent removal of the tracheostomy tube.



Question II.25: Which of the following is usually an early complication of tracheostomy tubes

- A. Tracheoinnominate artery fistula
- B. Granulomas
- C. Tracheomalacia
- D. Suprastomal tracheal flap
- E. Stenosis at the level of the stoma

Answer II.25: A

Tracheoinnominate fistulas have been reported in as many as 0.7 % of patients with a tracheostomy. Tracheoesophageal fistula can occur early or late and has been reported in as many as 0.5 % of patients with a tracheostomy. Cough, hemoptysis, or dyspnea in a patient with a history of tracheostomy should prompt bronchoscopic examination in order to identify airway abnormalities responsible for the symptoms.

Question II.26: Which of the following drugs used for conscious sedation, consistently suppresses airway reflexes and is therefore most beneficial for awake tracheal intubation

- A. Midazolam
- B. Diazepam
- C. Lorazepam
- D. Fentanyl
- E. Morphine

Answer II.26: D

Large doses of each of these drugs will produce general anesthesia and suppress all reflexes. Fentanyl is the preferred drug because of its faster action and shorter duration of action. From a pharmacological point of view, morphine is as good as Fentanyl for depressing airway reflexes. Propofol, a hypnotic agent that may also cause severe hypotension, especially in the elderly and in patients with known hypotension, also consistently suppresses airway reflexes. Propofol is an excellent choice for awake intubation, and certain bronchoscopic procedures. It is also useful for procedures in highly anxious patients and when a deeper level of anesthesia is desired.

Question II.27: You and your assistants are called to the emergency room because the anesthesiologist and emergency room physicians are unable to intubate a 33-year-old obese woman in status asthmaticus. She has known acute and chronic sinusitis and a deviated nasal septum. She is fully sedated. Oxygenation has been maintained by manual ventilation using an ambu-mask. The patient is tachycardic, hypotensive, and severely hypercarbic. Central venous access is being attempted. You have just finished a bronchoscopy and your 6 mm diameter flexible bronchoscope is in the automatic washer. You had a 4.8 mm videobronchoscope, but it was damaged yesterday when one of your patients accidentally bit it (you have since transferred the pulmonary trainee who was doing the procedure without the use of a bite block to a clinic in Siberia). The only scope you have available is a 3.2 mm pediatric flexible bronchoscope with a 1.2 mm working channel. The intensivist tells you that she wants this patient intubated with a # 7.5 mm endotracheal tube. The patient's husband, who is a famous medical malpractice attorney, refuses to leave the bedside. Which of the following will most likely facilitate a successful and safe oral intubation using bronchoscopic guidance in this patient.

- A. You remove the patient from the Trendelenburg position, and place her in the supine position before beginning bronchoscopically-guided intubation using a # 7.5 mm adult cuffed endotracheal tube via the oral route and through a bite block.
- B. You ignore the request of the intensivist and you begin bronchoscopically-guided intubation using a # 6 uncuffed endotracheal tube through the nares.
- C. You ignore the request of the intensivist and you begin bronchoscopically guided intubation using an # 8.0 cuffed, endotracheal tube via the oral route and through a bite block.
- D. You place a well-lubricated, uncuffed 5.0 mm internal diameter pediatric endotracheal tube inside a # 7.5 cuffed adult endotracheal tube and begin bronchoscopically-guided intubation via the oral route and through a bite block.
- E. You ignore the request of the intensivists and begin bronchoscopically guided intubation using a # 6.0 cuffed endotracheal tube via the oral route and through a bite block.

Answer II.27: E

This is one of those questions where the correct response is to do whatever you can to establish an airway quickly. Many experts would suggest using a small endotracheal tube that snugly fits over the 3.2 mm bronchoscope. Going through the mouth is often possible even as one ventilates and oxygenates the patient using the ambu mask. On the other hand, some would advocate first trying the nasal route anyway (if there are excessive secretions in the nares and oral pharynx one can always insert a nasal trumpet).

Placing a pediatric endotracheal tube inside a larger endotracheal tube can allow the bronchoscopist to “close the gap” between the tube and the bronchoscope. This facilitates maneuvering within the airway. The pediatric bronchoscope should protrude beyond the distal extremity of the smaller endotracheal tube, which itself, protrudes slightly beyond the distal extremity of the large endotracheal tube. This technique also helps avoid accidental passage of the small caliber bronchoscope through the Murphy eye of the large endotracheal tube. The problem is finding the right endotracheal tube size

“mix” to make this work, and having plenty of silicone lubricant available to make sure one tube can slide over the other. Beware...the pediatric endotracheal tube is frequently too short. If it has a cuff on it, it will not fit through the larger tube. Like all “emergency” techniques, this technique should be practiced in an inanimate model. It might be wiser to use other methods such as an intubating oral airway, a light wand or optical stylet, if you gain experience with these.

A variety of cuffed and uncuffed endotracheal tubes should always be available inside the airway procedure cart. Other intubation aids (tube changers, light wands, optical stylets, oral airways) should also be available. Bronchoscopic intubation without the use of an oral intubating airway increases the chance that the bronchoscope and endotracheal tube will deviate away from the midline. If the larynx is not seen before advancing the endotracheal tube, the endotracheal tube may get caught on the epiglottis, arytenoids, or in the hypopharynx.

One should attempt to make the first intubation attempt the last. Repeated attempts increase the risk for airway trauma, prolonged hypoxemia, and death.



Question II.28: Your newly hired and inexperienced technician has finished sterilizing a flexible bronchoscope using ethylene oxide gas sterilization. He calls to say that he forgot to place the ETO venting cap onto the venting connector before sterilization. You immediately say &#@&*!. Upon examining the bronchoscope you notice that

- A. The outer sheath is ruptured
- B. The distal lens has turned yellow
- C. Multiple black dots are visible when looking through the eyepiece
- D. The steel components of the bronchoscope have corroded
- E. The bronchoscope has a new, fixed S-shaped curve along its entire length

Answer I.28: A

Ethylene oxide gas is noncorrosive and able to penetrate otherwise inaccessible components of the flexible bronchoscope. If the ETO venting cap is not placed onto the venting connector, however, pressures inside and outside the bronchoscope will not equalize, and rupture of the outer sheath of the bronchoscope can occur. ETO provides extremely satisfactory sterilization for bronchoscopes used in patients with AIDS or hepatitis. The ETO venting cap must be removed prior to immersing the bronchoscope into cleaning solutions of any kind otherwise fluid will enter the bronchoscope.

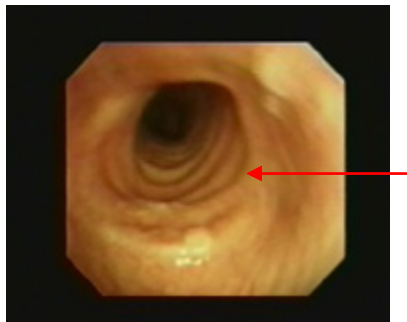
Question II.29: You are asked to come to the operating room because a patient with a massive goiter is about to undergo general anesthesia. The anesthesiologist performed flexible bronchoscopy and informs you that when the patient was completely supine, he was unable to pass the bronchoscope beyond the subglottis. When referring to the subglottic larynx, which distance is the anesthesiologist referring to.

- A. 1 cm beyond below the level of the vocal cords
- B. 2 cm below the level of the vocal cords
- C. 3 cm below the level of the vocal cords
- D. 4 cm below the level of the vocal cords

Answer I.29: B

The trachea is a cylindrical tube that projects onto the spine from C6 to the level of T5. As it passes downwards, it follows the curvature of the spine, and courses slightly backward. Near the tracheal bifurcation, it deviates slightly to the right. The subglottis ends 2 cm below the level of the vocal cords. This corresponds cranially to the inferior margin of the cricoid cartilage, which forms the only complete cartilage ring in the airway.

The thyroid gland surrounds the cervical trachea anterolaterally at the level of the second to fourth cartilaginous rings. Mediastinal masses, goiters, and thyroid or other head and neck cancers can cause significant extrinsic compression resulting in tracheal obstruction. Occasionally, an awake intubation with the patient in the seated position may be warranted prior to surgical resection.



Question II.30: A 25-year-old woman with a bilateral micronodular infiltrate, ten pound weight loss, morning headache, and persistent low-grade fever undergoes flexible bronchoscopy with bronchoscopic lung biopsy and bronchoalveolar lavage. Topical anesthesia is achieved using 2 puffs of 10% Lidocaine, and 4 cc of 2% Lidocaine instilled onto the main carina. In addition, 3 mg of Midazolam is administered for conscious sedation. The BAL is done within the right middle lobe bronchus. The bronchoscopic lung biopsy is obtained after wedging the flexible bronchoscope in the left lower lobe bronchus. The patient is asked to exhale, and at end expiration, the biopsy is taken. The patient has no pain. Shortly after the fourth biopsy, mild bleeding is noted. The patient begins to have a tonic-clonic seizure rapidly followed by respiratory arrest. Bleeding is stopped using a saline wash and suctioning. Cardiopulmonary resuscitation is successful. The patient is intubated and transferred to the intensive care unit. The biopsy sample showed miliary tuberculosis and small segment of pulmonary vein. What is the most likely cause of this patient's procedure-related complication?

- A. Lidocaine toxicity
- B. Midazolam toxicity
- C. Cardiac arrhythmia and myocardial injury
- D. Gas embolism
- E. Procedure-related elevation of intracranial pressure in a setting of tuberculous meningitis

Answer II.30: D

Wow...this patient had a cerebral gas embolism. It is likely that air entry occurred after laceration of a small pulmonary vein. Anecdotally, it has been taught that larger biopsy specimens are obtained when samples are taken at end-exhalation. This recommendation dates to the original descriptions of bronchoscopic lung biopsy by Dr. Donald Zavala from the University of Iowa back in the 1970s. On the other hand, because of a potential, although unproven increased risk for bleeding, pneumothorax, or air embolism, some experts do not advocate the end-exhalation biopsy technique.

Transbronchial lung biopsy (TBB or TBLB) is actually a misleading name for a procedure which is neither trans (across) nor bronchial (the goal is to obtain representative lung parenchyma containing bronchioles and alveoli, and an occasional blood vessel). Many experts today advocate the name bronchoscopic lung biopsy (BLB) instead. What do you think?

By the way, the only way to find out if you are obtaining representative samples of tissue (not necessarily diagnostic samples), is to review all specimens with the surgical pathologist, and to practice the various techniques described for obtaining bronchoscopic lung biopsies.

Regarding the other potential answers. Lidocaine does cause seizures. The appearance of serious adverse effects are not necessarily preceded by mild side effects especially if the patient has liver disease (lidocaine is metabolized in the liver).

Had the surgical pathology of the biopsy sample revealed Lupus erythematosus. And had you answered cardiac arrhythmia and myocardial injury, you could have been correct, because Lupus can cause a vasculitis and thus, coronary arteritis. Regarding

midazolam toxicity, respiratory depression and hypoxemia usually precedes any additional adverse events. The presence of the sudden neurologic event and the presence of the pulmonary vein in the biopsy sample are probably enough to suggest the diagnosis of gas embolism, making Tuberculous meningitis and elevated intracranial pressures an unlikely cause for her symptoms.