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Section 7 – TRACHEA AND MEDIASTINUM

Chapter 67 – Bronchoscopy and Tracheoscopy

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Examination of the subglottic, tracheal, and bronchial airways is a fundamental skill required of all otolaryngologists. The surgeon must be familiar with available endoscopic instruments that are used in this examination. The surgeon must also be able to use the techniques required for examination, surgical biopsy, and other interventions on the infraglottic respiratory tract. Thorough knowledge of the various techniques will help the practitioner best manage each patient.

BRONCHOSCOPIC ANATOMY

Examination of the lower airway requires knowledge of the endoscopic anatomy of the tracheobronchial tree. The trachea begins immediately inferior to the cricoid cartilage. The distance from the cricoid to the tracheal bifurcation is approximately 10 cm in most adults. In this short distance the trachea moves posteriorly from a nearly subcutaneous location in the neck at the level of the cricoid cartilage to deep within the chest, behind the aorta and pulmonary artery, at the level of the carina. This deep and complex location of the distal airway and its relative inaccessibility increase the necessity for endoscopic evaluation and therapy when feasible.

The lung is divided into three lobes on the right and two on the left. There are a total of 18 segments, each of which is associated with a named bronchus (Fig. 67-1). The bronchoscopist should memorize this anatomy.

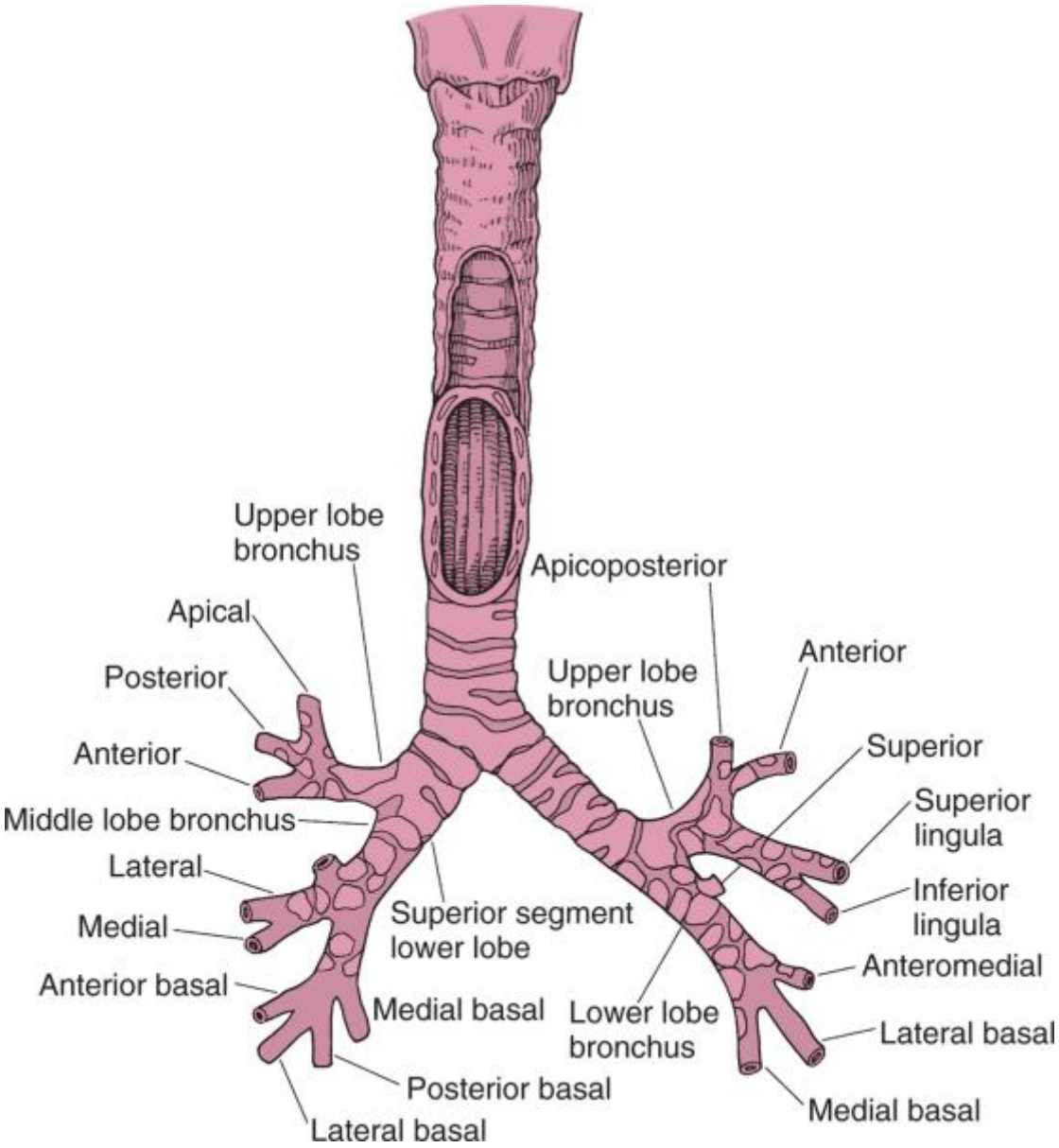

Figure 67-1 Tracheobronchial anatomy.
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DEVELOPMENT

Gustave Killian is credited with performing the first translaryngeal examination of the trachea in 1897 with a hollow gastroscope.[1–3] This particular episode had little clinical significance because it was performed on a paid volunteer; however, later that same year Killian reported the removal of a foreign body from the bronchus.[4]

The art of bronchoscopy was fully developed by Jackson in the early part of the past century. This pioneer spent his career in the design of instruments, development of anesthetic techniques, and perfection of the skills required for management of diseases of the tracheobronchial tree. His clinical activities in Pittsburgh and Philadelphia achieved international recognition, and his clear and precise written descriptions of operative techniques are still essential reading for endoscopists.[5]

The technology improved dramatically in 1968 when Ikeda and associates introduced a flexible bronchofiberscope.[6] The use of flexible endoscopes for evaluating and treating disorders of the larynx and tracheobronchial tree has since become routine. Flexible endoscopic procedures generally require less anesthetic and sedation than do similar endeavors with rigid instruments. Moreover, flexible endoscopes will often provide more direct vision over a greater field of view; hence, their use is standard in the diagnosis of endobronchial abnormalities. Despite these potential advantages, the airway control and versatility of rigid endoscopic instrumentation are frequently essential. Thus, the endoscopist must have a working knowledge of both types of

instruments.

ENDOSCOPIC EQUIPMENT

Flexible Fiberoptic and "Chip-Tip" Bronchoscopes

The flexible bronchoscope is a flexible tube containing one to three bundles of tiny glass fibers that are flexible and can be angulated mechanically when a knob or lever is moved. In the traditional fiberoptic bronchoscope, one bundle transmits images from the distal objective to the eyepiece or camera. More recently, "chip-tip" bronchoscopes have been developed in which a charged-coupled device (CCD) chip camera is placed at the tip of the scope, thereby eliminating this fiberoptic bundle. Working light is transmitted to the distal end of the instrument by adjacent bundles of fibers in both the traditional and "chip-tip" versions. The image created by the fiberoptic systems is a composite of those formed by the optical bundle wherein each fiber carries one pixel. The smaller the fibers, the more fibers that can be placed in the scope and the greater the definition of the image. In actuality, there is a finite limit, both technical and financial, in the number of fibers that can be placed in a scope small enough to pass into the tracheobronchial tree. The newer "chip-tip" bronchoscopes provide higher resolution because the image is captured directly, with elimination of the intermediate bundle of optic. However, they must be used with dedicated light sources and integrated camera control systems and are considerably more costly. A suction channel that doubles for insertion of instruments is also contained in the working tube.

Flexible bronchoscopes are produced in a variety of lengths and diameters (Fig. 67-2). The standard, commercially available bronchoscopes currently produced by a popular manufacturer (Olympus Corp., Strongsville, OH) range in diameter from 2.2 to 6.4 mm. Although a smaller diameter will often provide greater flexibility and ease of passage into narrow airways, this advantage is achieved at the cost of decreased lighting and image resolution, as well as smaller or absent suction and working channels. The length of flexible fiberscopes also varies, with shorter and less costly instruments being used for examination of the nasopharynx and the larynx.

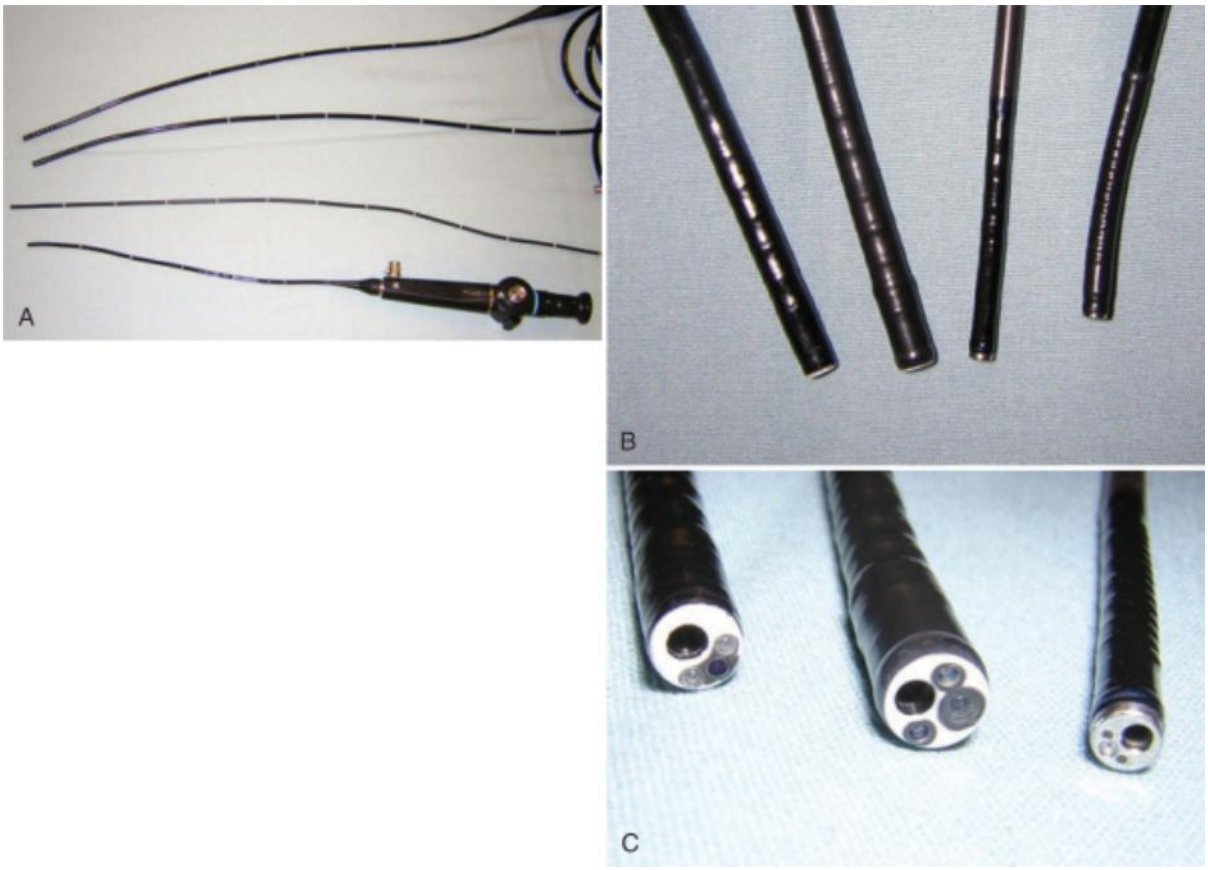

Figure 67-2 **A,** Two fiberoptic bronchoscopes *(top)*, a "chip-tip" bronchoscope *(middle)*, and a nasopharyngoscope *(bottom)* for comparison. The smallest of the bronchoscopes is a pediatric bronchoscope; the other two are for adults. Note that the "chip-tip" bronchoscope is no larger than the adult one. **B,** Comparison of the tips of the endoscopes. Note that the pediatric bronchoscope *(second from the left)* is approximately the same diameter as the nasopharyngoscope *(left)*. **C,** Note the differences in size of the working channels.

The image that is transmitted through a flexible bronchoscope may be viewed in several ways. The easiest and most direct method is for the operator to observe the image directly in the eyepiece. This is the best way to maintain anatomic orientation, but it limits the viewing to a single individual, and it is not an option with the newer

bronchoscopes that have a distally located camera chip. As a result, most training programs now routinely use video monitors, whether required (for the “chip-tip” bronchoscope) or optional (with fiberoptic systems), to familiarize trainees and staff with working off the video monitor (Fig. 67-3).

Figure 67-3 For the surgeon, flexible bronchoscopy is easiest to perform while standing at the head of the table and viewing the anatomy either directly through the endoscope or on the video monitor. This position permits the procedure to be performed in the same orientation as that used for rigid bronchoscopy.

Rigid Bronchoscopes

Rigid bronchoscopes are hollow tubes through which the patient can be ventilated during visual inspection and therapeutic manipulation. The distal end is beveled to facilitate insertion through the vocal cords and to enhance manipulation of the distal bronchi. The distal end of the bronchoscope tube also contains side perforations that allow ventilation of the trachea and contralateral bronchus when the bronchoscope is advanced into a distal lobar bronchus (Fig. 67-4). Illumination is usually provided by a distally placed light fiber, but proximal illumination is also possible with a light beam diverted by a small prism that projects a small distance into the lumen.

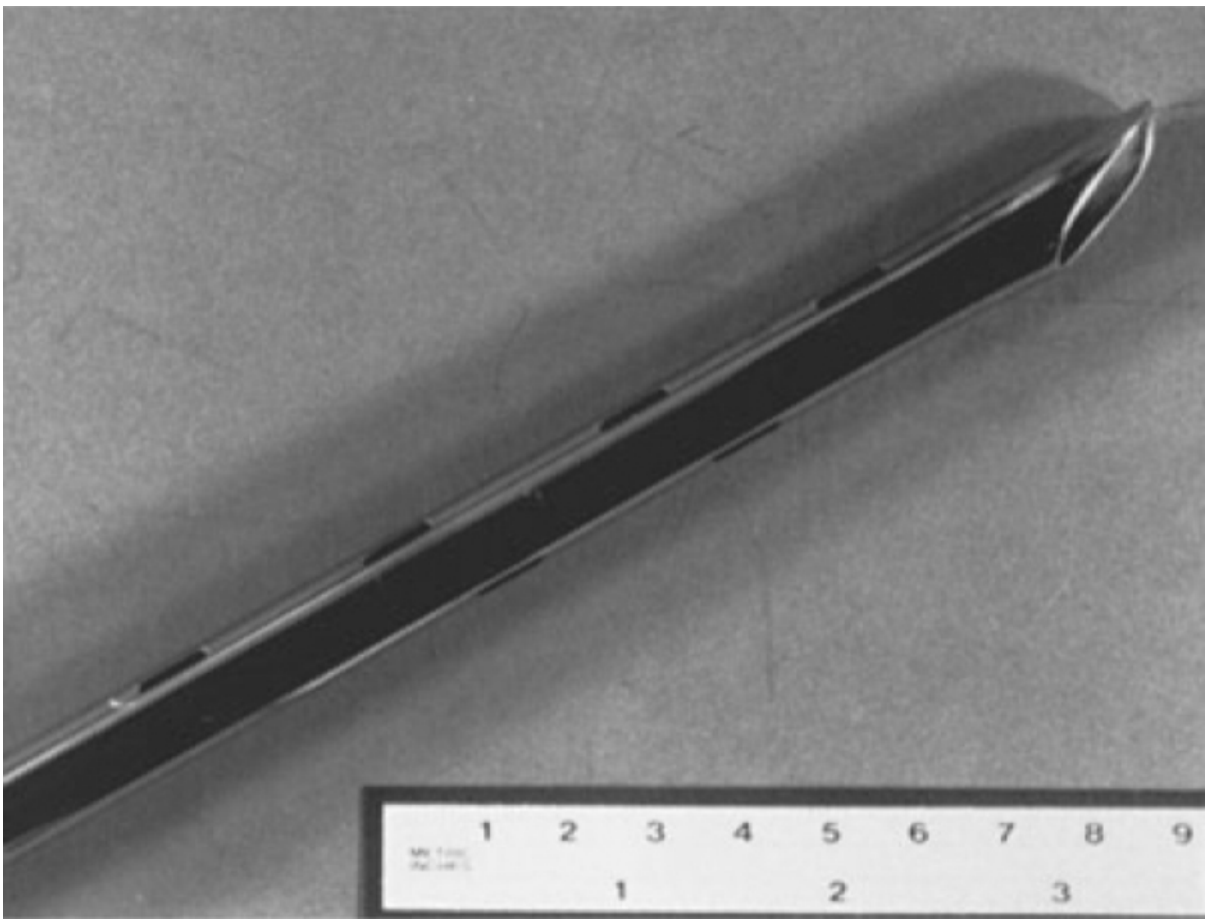

Figure 67-4 Tip of a bronchoscope. The ventilation side ports permit aeration of the contralateral bronchus when the tip of the scope is impacted in the bronchus being examined. The beveled end of the bronchoscope facilitates passage through the larynx, past the carina, and into the distal main stem bronchi.

Rigid bronchoscopes can be obtained in several diameters and lengths (Fig. 67-5). A variety should be immediately available for any planned bronchoscopic procedure to match the size of the bronchoscope to the airway of the patient. This is particularly critical in hospitals in which management of airways in children may occur. Working instruments, such as biopsy forceps, foreign body forceps, and rigid suction tubes, should be matched to the respective bronchoscope for size and length.

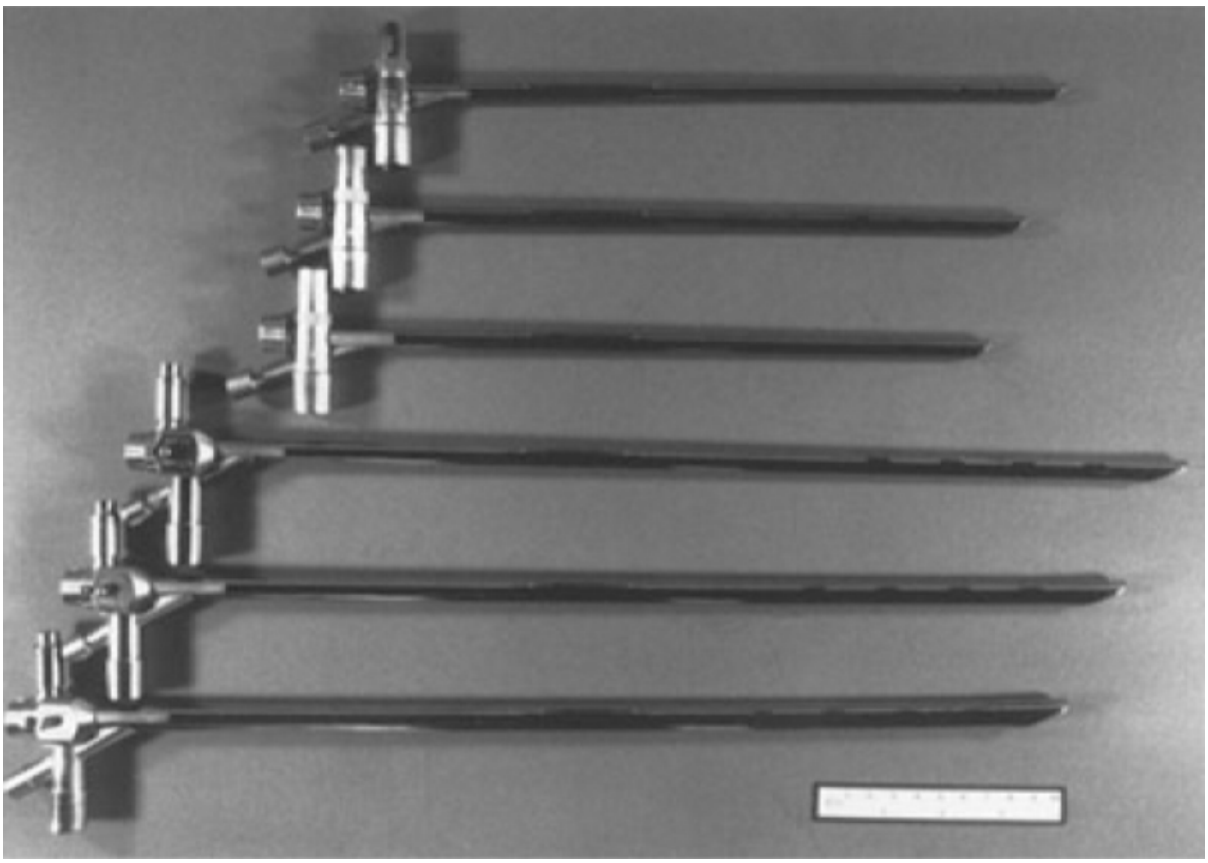

Figure 67-5 Bronchoscopes are available in various diameters and lengths. Inner diameters range from 3 mm (not shown) to 8.5 mm. Maintenance of a complete set of sizes is vitally important in a facility in which procedures are performed on both children and adults.

As with the flexible bronchoscope, there are several alternatives for image display. Viewing down the open tube or through a window plug is the most direct method, but the distance and small visual angle are limiting. Most endoscopists routinely use rigid telescopes, either straight or angled view, that are inserted through the bronchoscope. These instruments provide magnified images, a wider field of view, and lateral viewing of areas not in the direct line of vision through the bronchoscope. As in flexible bronchoscopy, video cameras are attached to the telescopes to permit group viewing and documentation.

When positive pressure ventilation is used through the rigid bronchoscope, the proximal end must be occluded with a tightly fitting window plug. If a telescope is inserted and positive pressure ventilation is desired, the open end can be occluded with a perforated rubber diaphragm through which the telescope is introduced. Most manufacturers provide a proximally located port to attach a jet ventilator as an alternative to conventional positive pressure ventilation (Fig. 67-6).

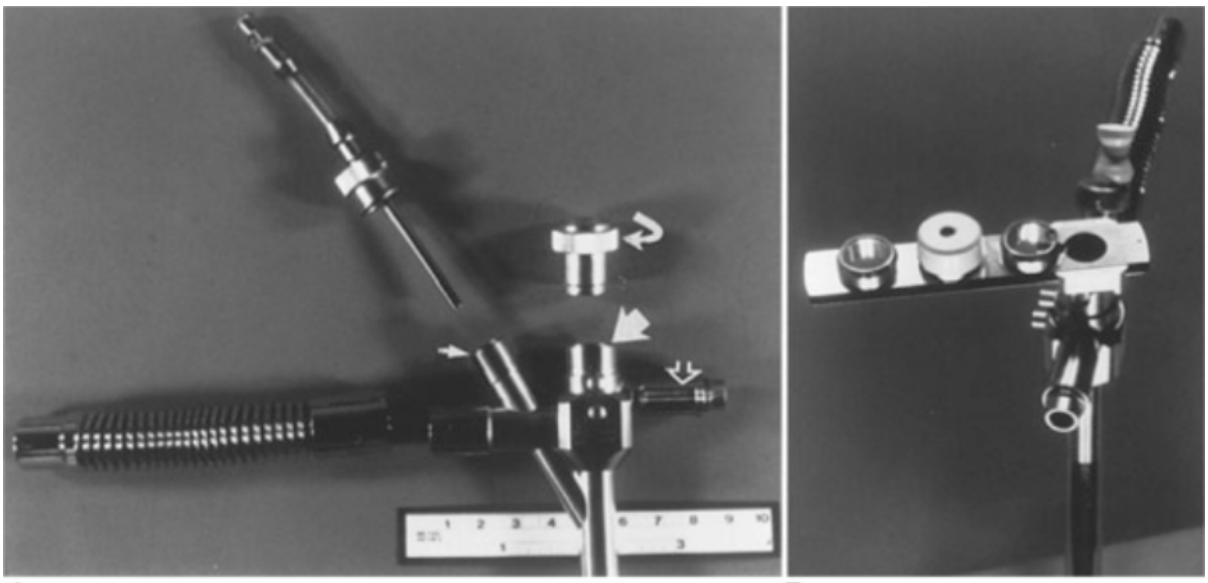

Figure 67-6 **A,** Proximal end of a bronchoscope with a 15-mm anesthesia adapter *(large arrow)* for control of ventilation, an adapter for jet ventilation *(small arrow)* through the angled port, a clear glass eyepiece *(curved arrow)* to permit simultaneous ventilation while observation is ongoing, and a light connector *(open arrow)* for distal fiberoptic illumination. Pediatric bronchoscopes have an adapter for proximal illumination that uses a prism in the proximal airway (see Fig. 67.5). **B,** A sliding eyepiece holder permits the use of various eyepieces (magnifying or plain glass), an open tube, or rubber grommet through which a Hopkins rod telescope can be passed.

PATIENT SELECTION

The indications for bronchoscopy include a variety of conditions as noted in Table 67-1. Such conditions include evaluation of pulmonary masses, infiltrates, hemoptysis, and strictures of the airway. Routine bronchoscopy is often included in the evaluation for second primary tumors in patients with head and neck malignancies. Bronchoscopy is most commonly used by the otolaryngologist or head and neck surgeon for either removal of foreign bodies or diagnosis and management of airway masses or strictures. These procedures are technically difficult and usually require a rigid scope. For this reason, rigid endoscopy remains a vital component of the training program in otolaryngology and head and neck surgery.

Table 67-1 -- INDICATIONS FOR BRONCHOSCOPY AND TRACHEOSCOPY

Diagnosis
Hemoptysis
Mass lesion noted on a chest radiograph
Transbronchial biopsy
Infectious process
Search for a second primary malignancy
Evaluate tracheal/bronchial stenosis
Therapeutic
Removal of a foreign body
Suction of inspissated mucus
Bronchoalveolar lavage
Transbronchial drainage of an abscess
Removal of an obstructing lesion
Dilatation/resection of a cicatricial scar

BRONCHOSCOPY TECHNIQUE

The decision to perform either flexible or rigid bronchoscopy must be made before the procedure and is based on the relative risks and advantages of each technique for the specific patient. A rigid bronchoscope provides more secure control of the airway and permits ventilatory support. The rigid method also allows the insertion of larger

working instruments and suction tubes. A flexible bronchoscope, however, provides visibility further peripherally in the distal bronchi and enhanced viewing angles to observe around angles in the main stem and segmental bronchi. The two techniques can be combined if preoperative planning has considered this eventuality. A rigid bronchoscope may be inserted initially and then a flexible bronchoscope advanced through the rigid bronchoscope. This technique takes advantage of the particular strengths of each method and is particularly useful for complex procedures involving strictures, tumors, or foreign bodies.

Flexible Bronchoscopy

Although examination of the pharynx and visualization of the larynx can readily be accomplished at the bedside, formal bronchoscopic examination requires more extensive anesthesia and monitoring than is generally available outside the operating room or endoscopy suite. Flexible bronchoscopy is routinely performed under topical anesthesia with sedation. Preoperative sedation with intravenous diazepam or midazolam is usually sufficient for patient relaxation. The posterior pharynx is anesthetized with 10% lidocaine spray, and if transnasal passage of the bronchoscope is intended, the nasopharynx is treated with 2% lidocaine jelly or 4% lidocaine solution slowly dripped into the nose. A small piece of cotton soaked in 4% lidocaine is held in a spring-loaded right-angled forceps and applied to each piriform sinus.

When the gag and cough reflexes are suppressed, a flexible bronchoscope may be inserted either nasally or orally with a bite block in place. When the larynx is visualized, 2 to 4 mL of 4% lidocaine is injected into the trachea through the bronchoscope, and then the bronchoscope is advanced through the vocal cords. Additional lidocaine can be delivered as a bolus as needed into the distal airway to suppress cough, but the total dose administered must always be considered.

Monitoring by continuous pulse oximetry, electrocardiography, and noninvasive blood pressure recording is standard. The patient should be observed afterward until the gag reflex and alertness have returned.

General anesthesia is required for patients who cannot tolerate local anesthesia, either because of severe anxiety or when an excessive gag reflex cannot be suppressed. General anesthesia for flexible bronchoscopy may also be required for situations in which the planned bronchoscopic procedure will require total immobility.

With general anesthesia, a flexible bronchoscope can be passed either adjacent to or through the endotracheal tube. Passage adjacent to the tube is usually performed during suspension laryngoscopy. The endotracheal tube cuff must be deflated for a moment to pass the endoscope by the cuff, after which it can be reinflated. Insertion of a flexible bronchoscope through a large-diameter endotracheal tube is often used for examination of the distal trachea and bronchi. This is facilitated by a right-angled adapter with a perforated rubber diaphragm (Portex Corp., Wilmington, MA). If the surgeon elects to pass the bronchoscope through the endotracheal tube, care must be taken to select a bronchoscope and endotracheal tube that ensure sufficient residual airway to ventilate the patient. If the bronchoscope is too large for the respective endotracheal tube or if it is insufficiently lubricated, the bronchoscope may become stuck in the endotracheal tube and impede ventilation. In such a case, common sense must prevail because the anesthesiologist will be anxious about the inability to ventilate and the surgeon will pull harder on the bronchoscope and thereby cause the anesthesiologist to squeeze the endotracheal tube. Irrigating saline solution into the endotracheal tube along the bronchoscope will usually loosen the scope and allow it to be withdrawn. If irrigation fails, it is best to extubate the patient with the bronchoscope in the endotracheal tube and insert a new endotracheal tube. Persisting in efforts to force the bronchoscope when it seems to be stuck in the endotracheal tube will frequently damage the bronchoscope.

It is of critical importance to maintain anteroposterior and lateral orientation during flexible bronchoscopy. Without correct orientation it is impossible to reliably locate and correctly identify the primary and segmental bronchi. Anatomic and spatial orientation is best preserved when the patient is supine and the operator stands directly behind the patient's head. Frequently, this is impractical, but it is the easiest way to establish orientation when the anatomy becomes confusing. Working off a video monitor can also lead to disorientation for an inexperienced observer. When using a fiberoptic bronchoscope, it is best to remove the camera and observe directly through the eyepiece while standing behind the patient. If a “chip-tip” bronchoscope is used, this is not feasible. In these situations, one can withdraw into the trachea and note the position of the tracheal rings to determine anterior and posterior orientation.

Rigid Bronchoscopy

Rigid bronchoscopy can be performed safely and efficiently if proper care is taken with anesthetic management, patient positioning, and atraumatic exposure of the larynx. General anesthesia is preferable for rigid bronchoscopy unless a compelling reason exists to avoid it. Rigid bronchoscopic examination under local anesthesia can be performed, but such a procedure is stressful to both the patient and operator.

General anesthesia is initiated via a face mask until the patient is sufficiently anesthetized and relaxed to permit

intubation of the airway. Alternatively, spontaneous ventilation can be sustained until the trachea is intubated with the bronchoscope. Spontaneous ventilation is typically used when anatomically deforming abnormalities are present in the pharynx or larynx. Initial positioning with the head slightly elevated in a “sniffing” position should enhance exposure of the larynx. A movable headrest or assistant “head holder” permits repositioning of the head as the bronchoscope is later manipulated within the trachea and bronchi. Insertion of the bronchoscope through the larynx and into the trachea requires careful visualization of the larynx and is the most challenging part of the entire procedure. The uvula, tonsillar fossa, epiglottis, arytenoids, and vocal cords can be located and identified by viewing directly through the tube of the rigid bronchoscope (Figs. 67-7 through 67-10). Although this is the most direct method, many inexperienced observers will often become disoriented because of the long distance and small field of view. Even experienced observers can find it difficult to clearly view the larynx through a rigid bronchoscope with unfavorable anatomy. An alternative method uses a laryngoscope, either an anesthesia laryngoscope or a Jackson slide laryngoscope, to visualize the larynx. The bronchoscope can then be advanced to the vocal cords under direct vision with the laryngoscope and the line of sight switched to view down the bronchoscope as it is advanced through the cords (Fig. 67-11 through Fig. 67-15). This method has been well outlined by Jackson and Jackson.[5] Care should be taken to insert the bronchoscope with the longer edge of the bevel in the center of the larynx and the shorter edge against the left vocal cord (see Figs. 67-6 and 67-14). This avoids catching and traumatizing the right vocal cord with the leading edge of the bronchoscope.

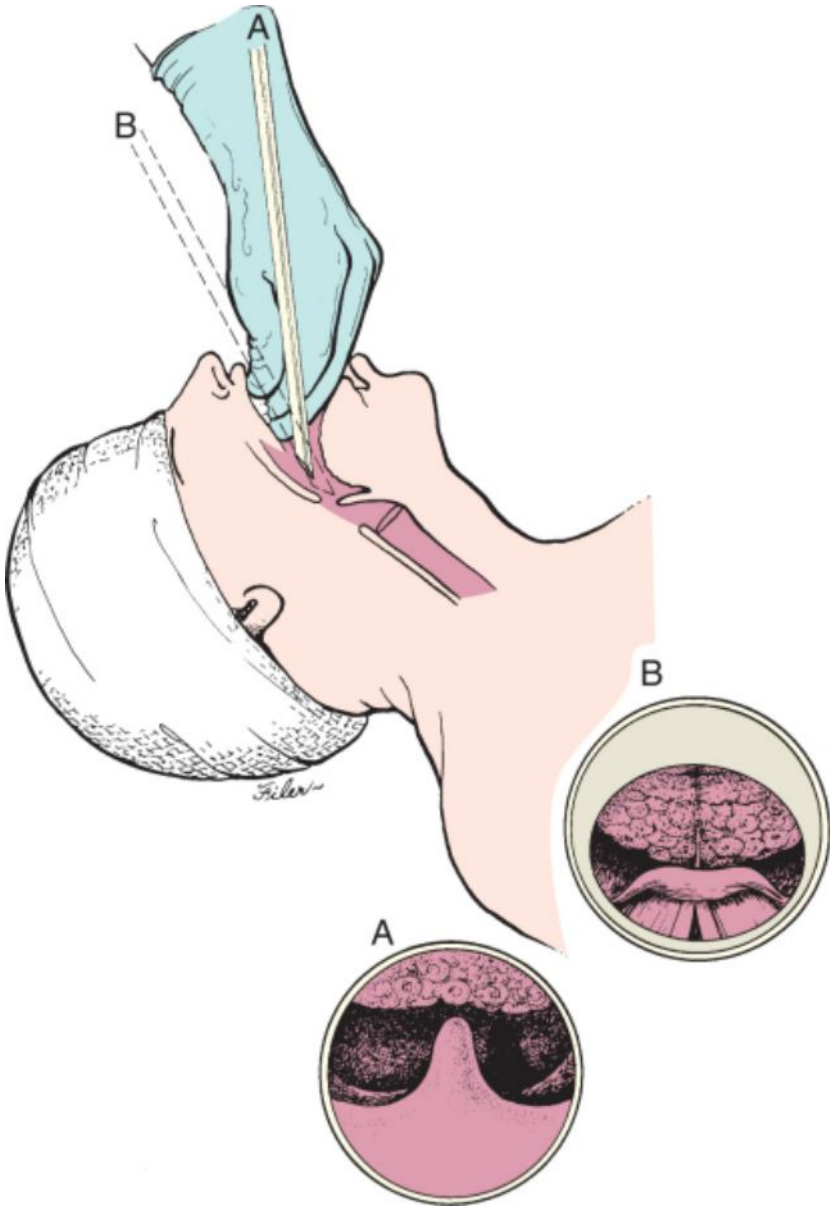

Figure 67-7 Technique of intubation. The bronchoscope is aligned in the midline of the tongue while the mouth is held open with the thumb and fingers. The bronchoscope is supported with the thumb, and the uvula (**A**) and epiglottis (**B**) are visualized to maintain midline orientation.

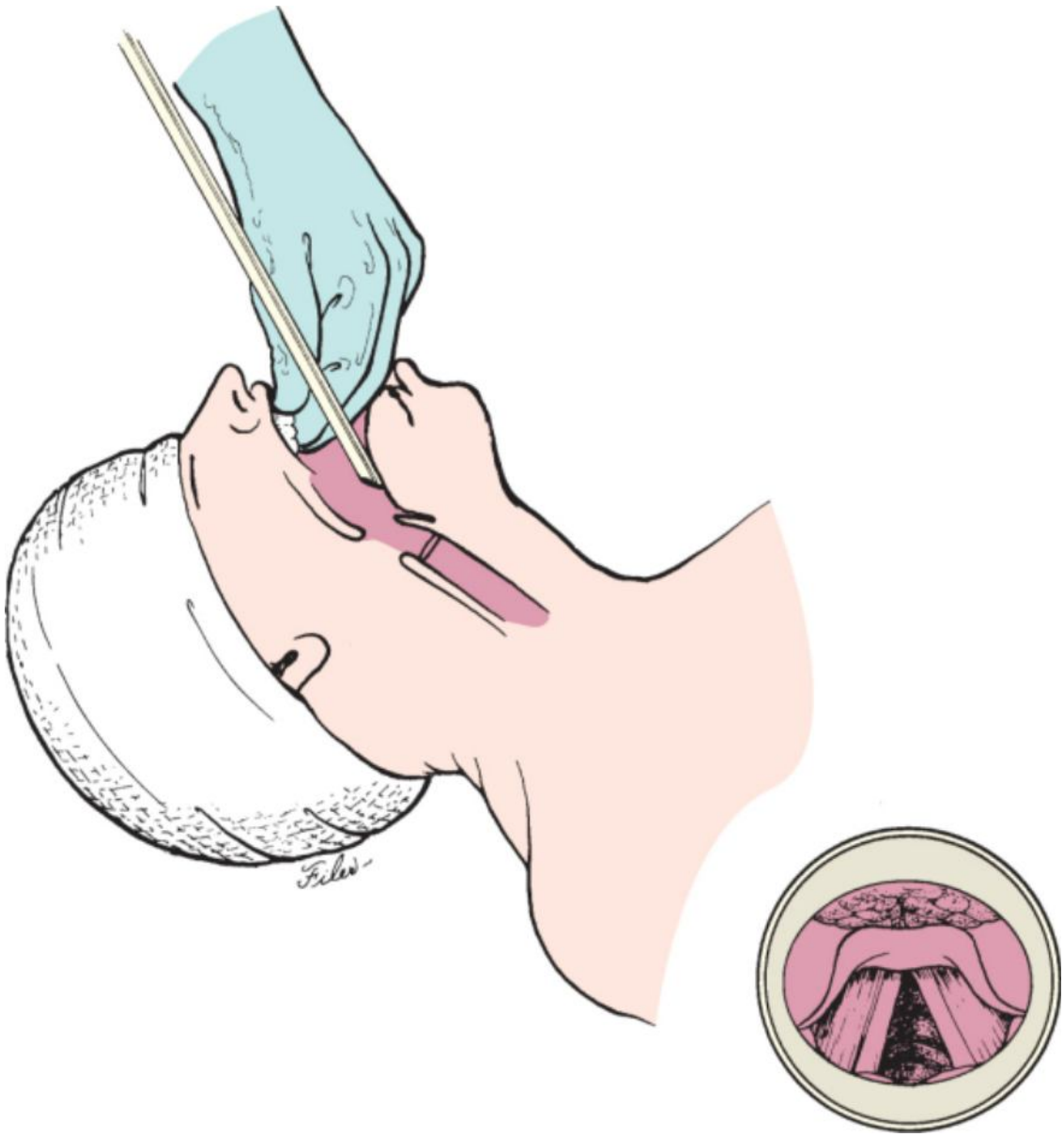

Figure 67-8 The bronchoscope is advanced while aiming behind the epiglottis, and the larynx is visualized.

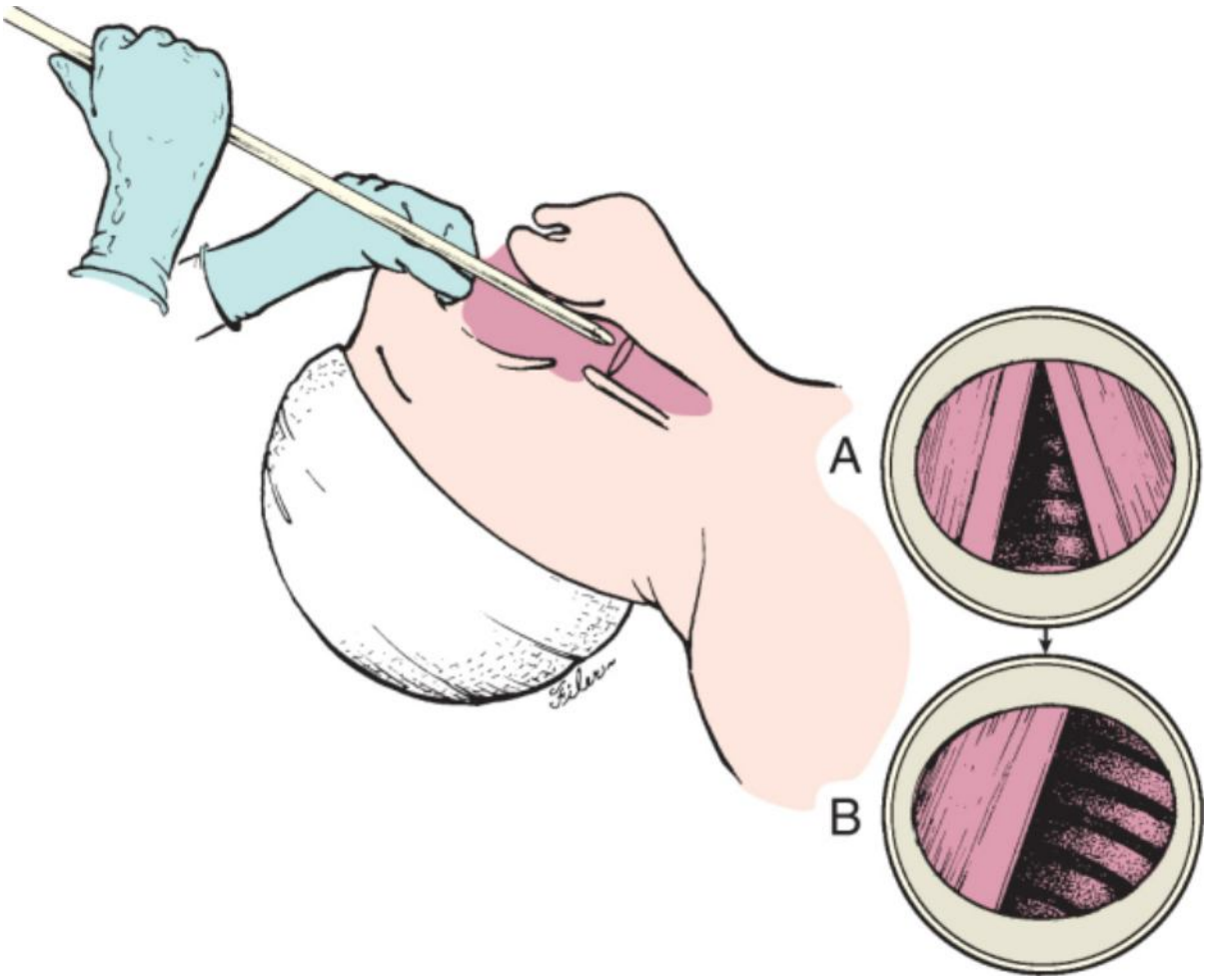

Figure 67-9 With the tip of the bronchoscope behind the epiglottis, the initial view (**A**) will show both the right and the left vocal cords. This is not the correct position to advance the bronchoscope into the trachea. The bronchoscope is rotated 90 degrees clockwise so that the leading tip of the beveled end is to the right lateral side. The entire bronchoscope is shifted laterally to expose the left vocal cord (**B**). With this exposure and this orientation, the bronchoscope may be advanced safely into the trachea without causing trauma to the right vocal cord. The left vocal cord will slide along the bevel and be pushed laterally as the bronchoscope enters the trachea.

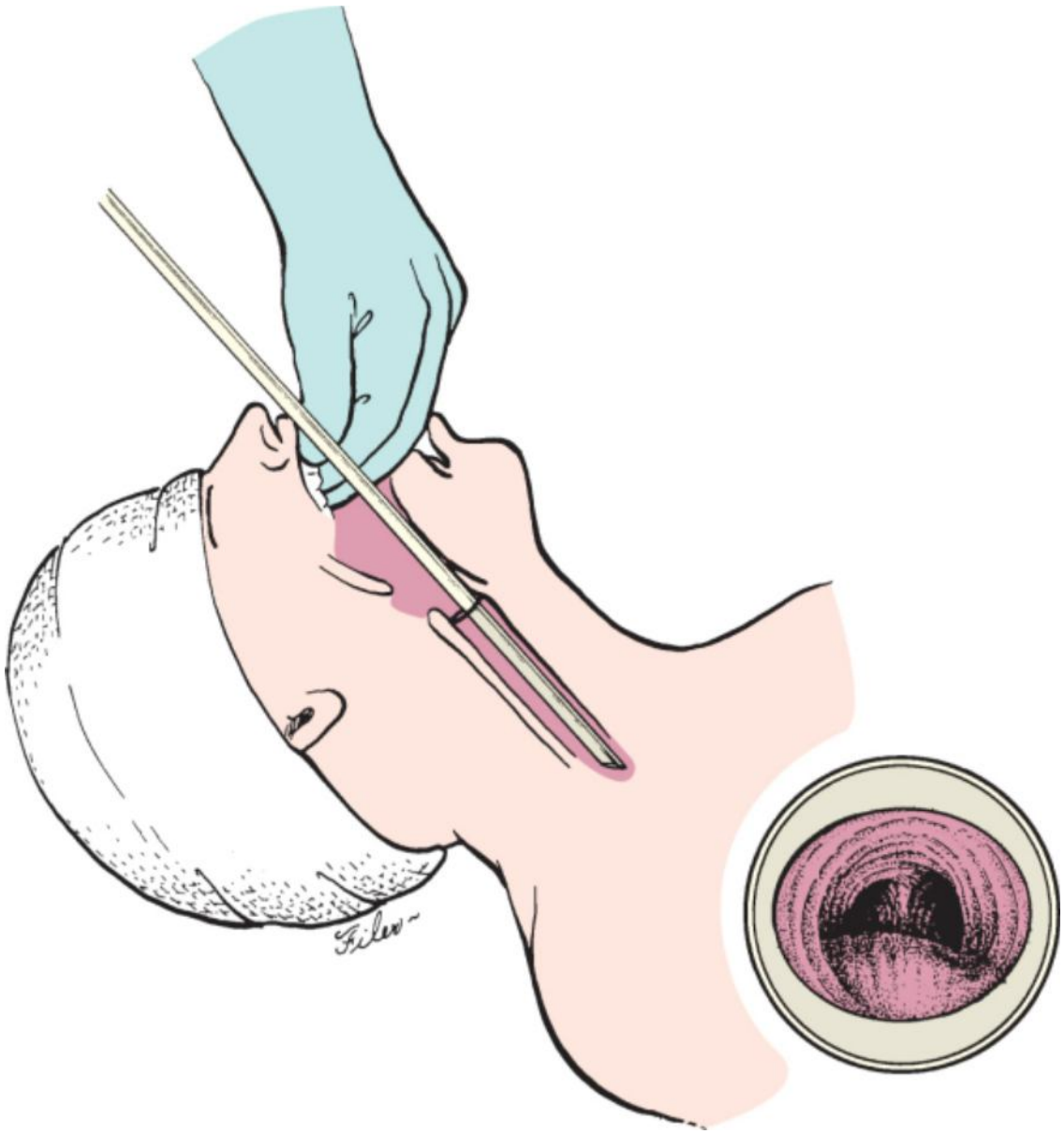

Figure 67-10 The bronchoscope has been advanced past the larynx into the trachea for distal tracheal examination. It is of great importance at this point that the upper hand be placed in a firm position to protect the teeth and upper jaw from pressure from the bronchoscope. The bronchoscope should rest on the left thumb and not against the teeth; this is a position similar to an open bridge, as used with a cue stick for shooting billiards.

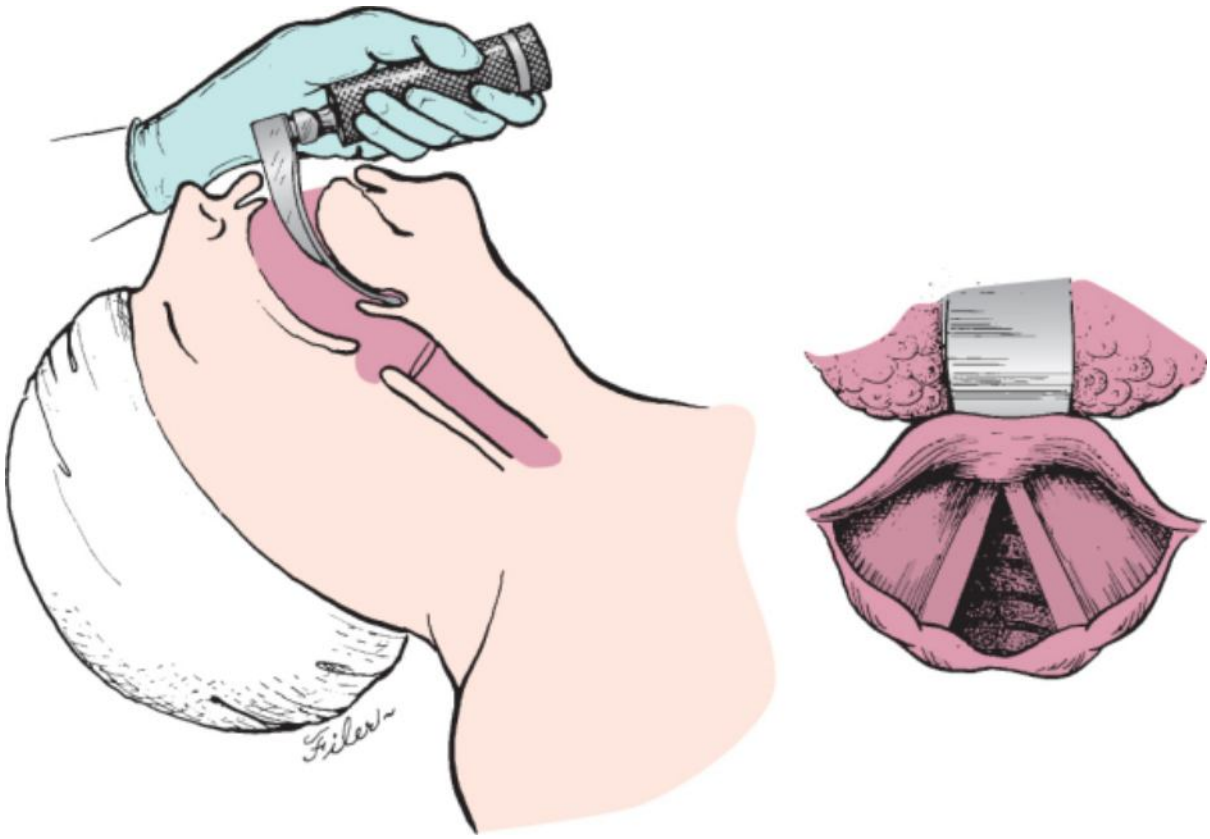

Figure 67-11 The larynx is exposed directly with an anesthesia laryngoscope that has a curved blade. The tongue base and epiglottis are elevated.

Figure 67-12 While the larynx is visualized with the laryngoscope held in the left hand, the bronchoscope is inserted behind the epiglottis to the level of the vocal cords with the right hand.

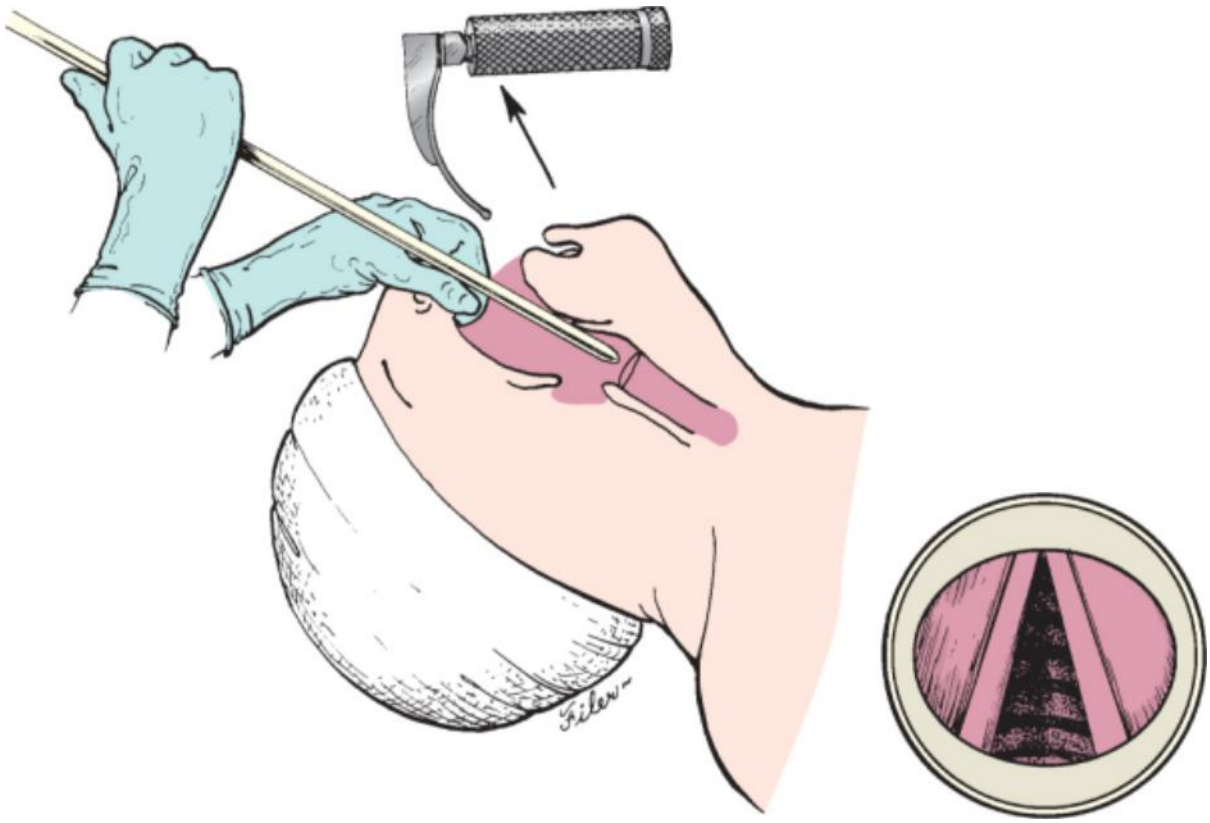

Figure 67-13 The operator's view is now directed down the shaft of the bronchoscope. The laryngoscope is removed, and the left hand is placed on the upper teeth to support the bronchoscope.

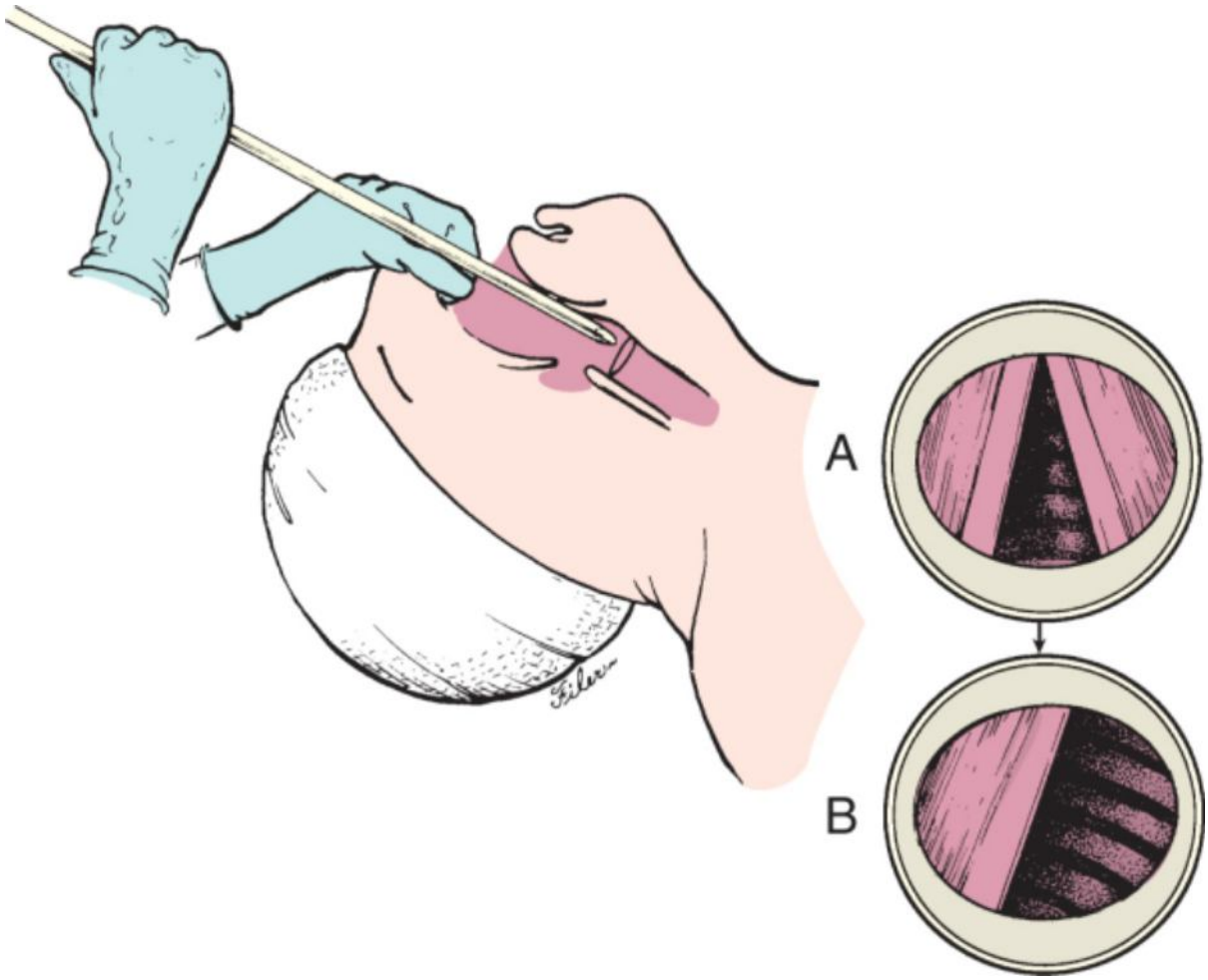

Figure 67-14 With the tip of the bronchoscope behind the epiglottis, the initial view (**A**) will show both the right and the left vocal cords. This is not the correct position to advance the bronchoscope into the trachea. The bronchoscope is rotated 90 degrees clockwise so that the leading tip of the beveled end is to the right lateral side. The entire bronchoscope is shifted laterally to expose the left vocal cord (**B**). With this exposure and this orientation, the bronchoscope may be advanced safely into the trachea without causing trauma to the right vocal cord. The left vocal cord will slide along the bevel and be pushed laterally as the bronchoscope enters the trachea.

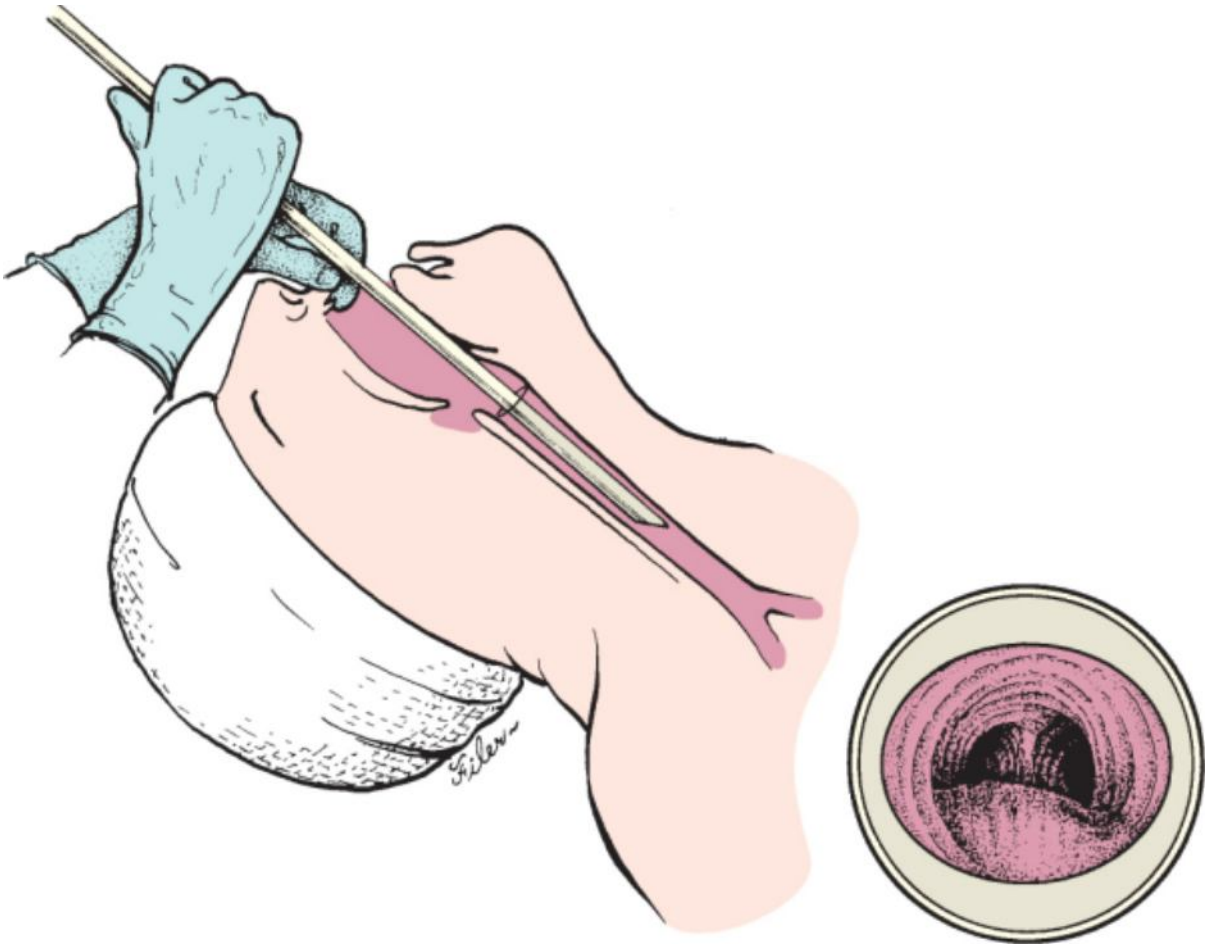

Figure 67-15 The bronchoscope has been advanced past the larynx into the trachea for distal tracheal examination. It is of great importance at this point that the upper hand be placed in firm position to protect the teeth and upper jaw from pressure from the bronchoscope. The bronchoscope should rest on the left thumb and not against the teeth; this is a position similar to an open bridge, as used with a cue stick for shooting billiards.

As the bronchoscope is advanced through the trachea and into each main stem bronchus, the upper teeth must be protected with the fingers of the left hand while the bronchoscope is supported on the left thumb to avoid injury to the teeth. The distal end of the bronchoscope must remain free within the lumen of the airway. To accomplish this, the head can be repositioned by a change in elevation or lateral rotation.

Viewing directly through the bronchoscope tube is efficient, but visibility is limited. Visibility is enhanced by inserting telescopes that provide either straight or laterally angled fields of view. The telescopes may be attached to a video camera for group display and to allow the operator to work with the head away from the bronchoscope. Care must be taken to avoid advancing the telescopes beyond the end of the bronchoscope and injuring the airway.

Working instruments should be matched to the diameter and length of the bronchoscope. An array of suction tubes, biopsy forceps, and different styles of foreign body forceps should be readily available.

Communication and cooperation between the anesthesiologist and surgeon are essential for safe ventilation during a rigid bronchoscopic procedure. Standard positive pressure ventilation is the easiest method and requires no additional equipment. This method, however, is limiting to the surgeon and requires maintenance of a closed system, thus minimizing time for the insertion of instruments and working in the distal airway. With positive pressure ventilation, there will always be a significant air leak around the bronchoscope such that high gas flow is required in the ventilation circuit. This is particularly troublesome when examining the proximal trachea because the side holes of the bronchoscope may be above the larynx. High-frequency jet ventilation is greatly preferable for

rigid bronchoscopic procedures but requires that the anesthesiologist be familiar with the technique. This technique does not require a closed system, and any air leak is inconsequential. Jet ventilation can be directed through a port on the proximal end of the bronchoscope. If it is anticipated that the bronchoscope will need to be repeatedly inserted and removed during the procedure, a flexible catheter can be inserted through the larynx and into the trachea beside the bronchoscope (Fig. 67-16).

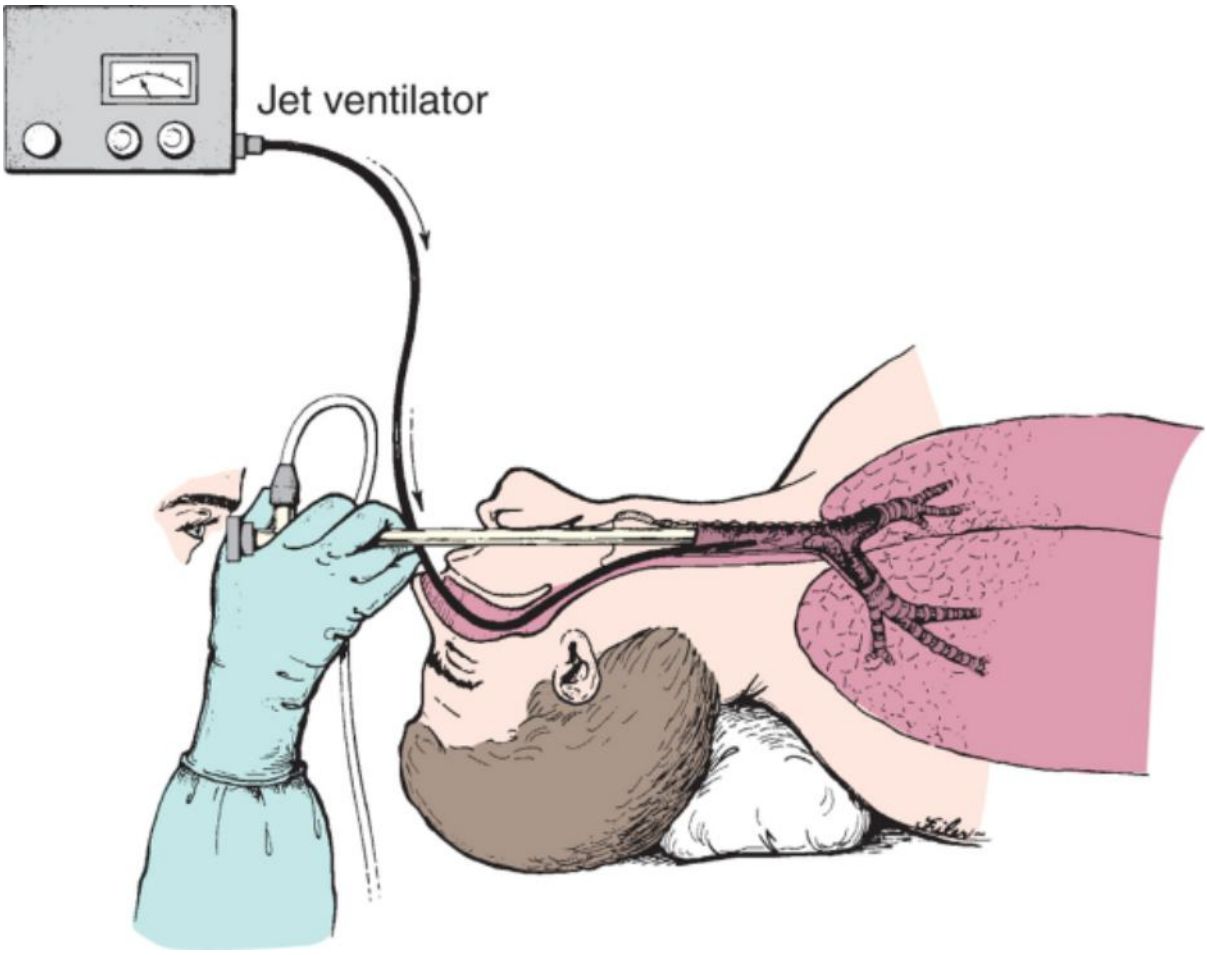

Figure 67-16 A flexible nasotracheal suction catheter placed in the trachea alongside the bronchoscope can be used for jet ventilation. When a complex bronchoscope procedure requires removal and reinsertion of the bronchoscope, this method allows continued ventilation when the bronchoscope has been removed.

Foreign Bodies

Management of foreign bodies is a discipline unto itself. Advances in instrumentation have dramatically enhanced the safety and efficacy of these difficult and often risky procedures. As a result, current standards of care suggest that foreign body removal should be referred to centers with specifically trained staff and appropriate instrumentation. The use of forceps with an attached telescope (so-called optical forceps) increases the ability to visualize and retrieve foreign bodies. Various sizes of bronchoscopes, forceps, and other related paraphernalia should be available in any center performing foreign body removal (Fig. 67-17). Because foreign bodies are most commonly encountered in children, the centers most likely to have this type of equipment are children's hospitals or larger hospitals with active pediatric departments. A few caveats useful in the management of foreign bodies are included in Table 67-2.

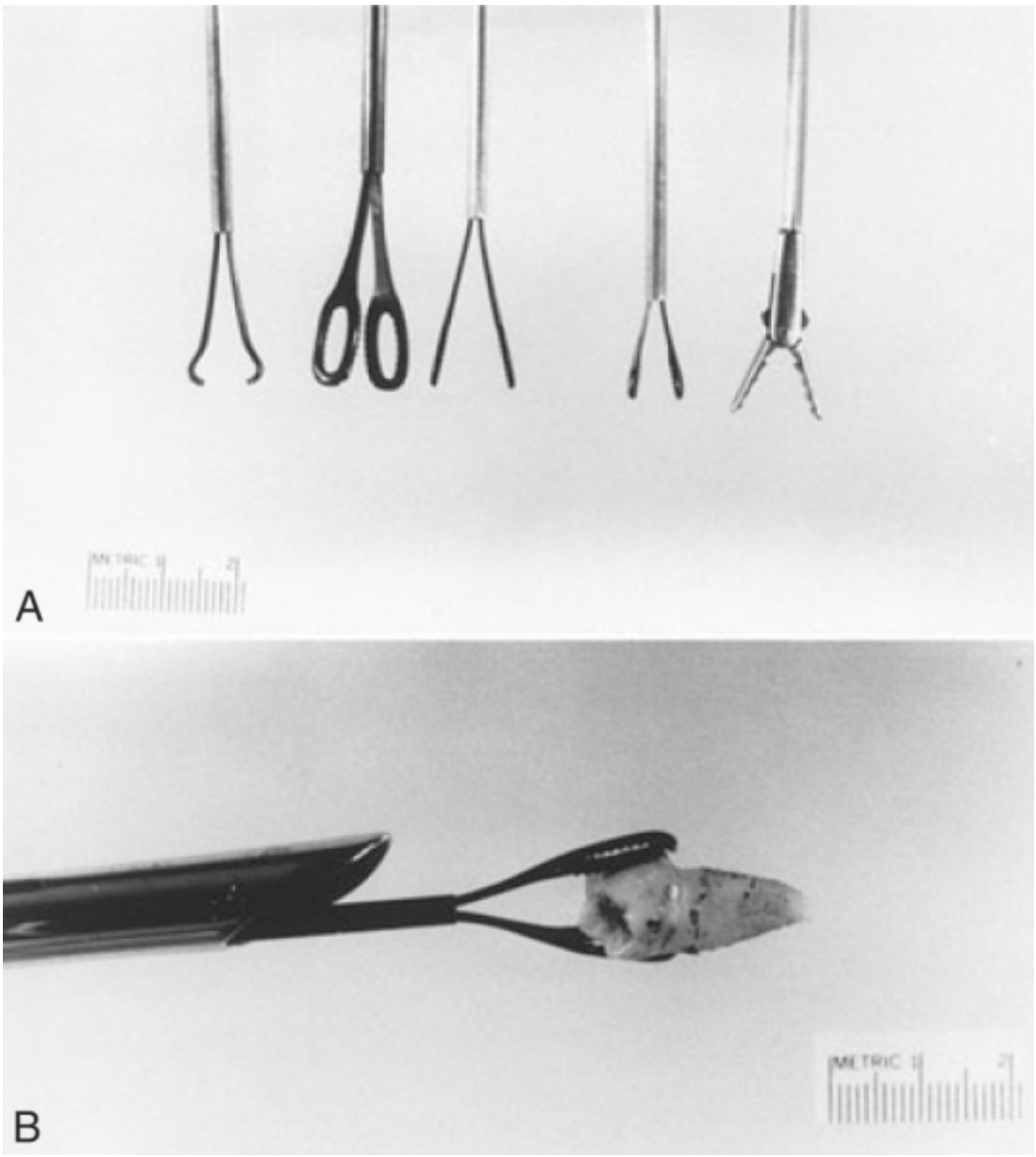

Figure 67-17 **A,** Foreign body forceps for use with a rigid bronchoscope. The jaws are individually designed for grasping different-shaped objects. **B,** Many foreign bodies, such as teeth, are too large to remove through a rigid bronchoscope. They should be secured against the opening of the bronchoscope and the bronchoscope and tooth removed in unison. The bronchoscope will help protect the larynx from injury by the tooth on removal.

Table 67-2 -- CAVEATS IN THE MANAGEMENT OF TRACHEOBRONCHIAL FOREIGN BODIES

1. Ensure that all instrumentation is available and functioning *before* inducing anesthesia.
2. Correct instruments are mandatory. Biopsy forceps are *not* adequate substitutes for foreign body forceps. A variety of sizes, shapes, and grasping surfaces should be available.
3. Perform a “dry run” with a similar foreign body to test the various methods of grasping, twisting, and retrieving the object. A box of variously sized nuts, dried carrot pieces, pins, and tacks should be kept with the endoscopy instrumentation.
4. Ensure that the anesthesiologist is adequately skilled in the management of children undergoing bronchoscopy. This factor alone may require transfer of patients to a facility better equipped to handle the procedure safely.
5. Foreign body retrieval is inherently more difficult from the left side. When a left-sided foreign body has been grasped, rotating the child so that the right side is down may help drop the foreign body into the right lower lobe should it be lost during retrieval.
6. During foreign body retrieval, the foreign body should be pulled back to the bronchoscope and both the bronchoscope and forceps removed en bloc. This helps prevent loss of the foreign body during removal by being sheared off at the end of the scope.
7. After foreign body removal, careful and systematic inspection of all visible segmental and subsegmental bronchi is necessary to ensure that the foreign body or bodies have all been removed.

8. If during extraction the foreign body is lost and airway obstruction occurs, it may be easiest to push the foreign body into a distal bronchus to permit ventilation of the patient before again attempting retrieval.

Although rigid bronchoscopy is the standard for removal of foreign bodies, there is increasing experience in retrieving foreign bodies from the airways with flexible bronchoscopic instrumentation. Foreign body extraction with a flexible bronchoscope requires specifically designed instrument such as wire basket catheters, multiple-pronged grasping catheters, and balloon catheters (Fig. 67-18). General anesthesia should be used for removal of an object with flexible bronchoscopy. This avoids chasing a moving object as the patient coughs and breathes spontaneously. The bronchoscope is passed through an appropriately sized endotracheal tube. Once the object has been secured, it is withdrawn against the end of the endotracheal tube, and both the bronchoscope and the endotracheal tube are withdrawn together (Fig. 67-19). Rigid bronchoscopic instruments should be immediately available should flexible bronchoscopic extraction be unsuccessful.

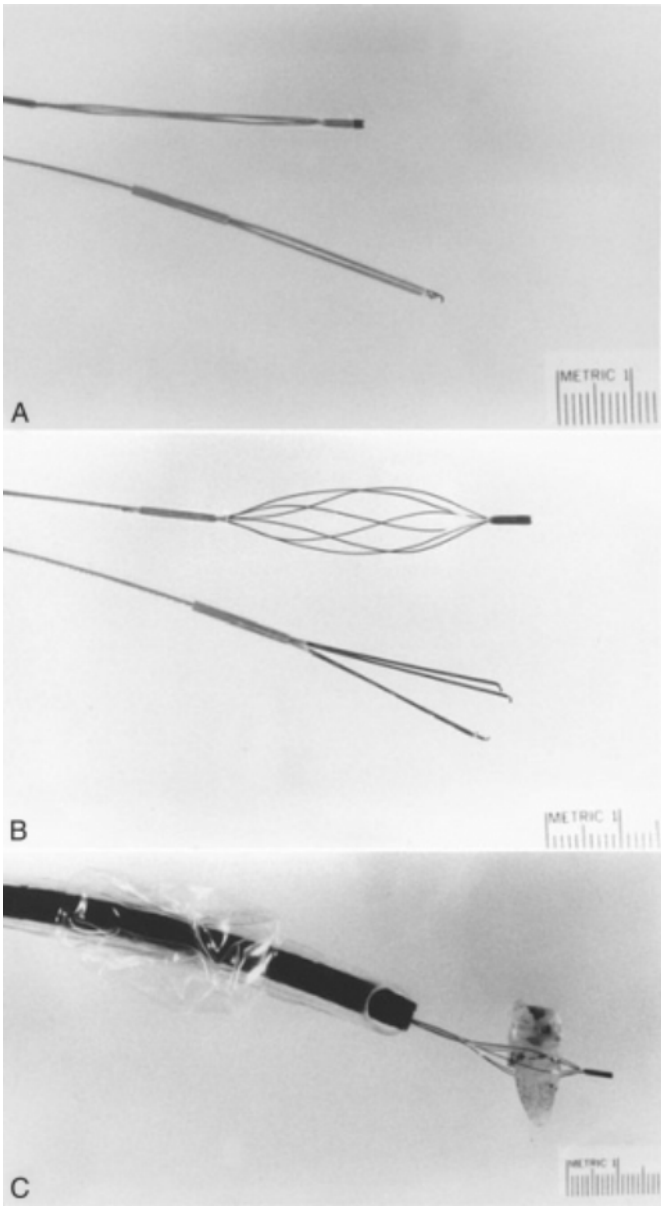

Figure 67-18 Multipronged grasping forceps and basket devices can be used for removal of a foreign body with a flexible bronchoscope. **A,** The instruments are passed inside a sheath through the bronchoscope channel. **B,** When extended from the insertion sheath, they can engage the foreign body. **C,** Tooth engaged by the basket retrieval instrument.

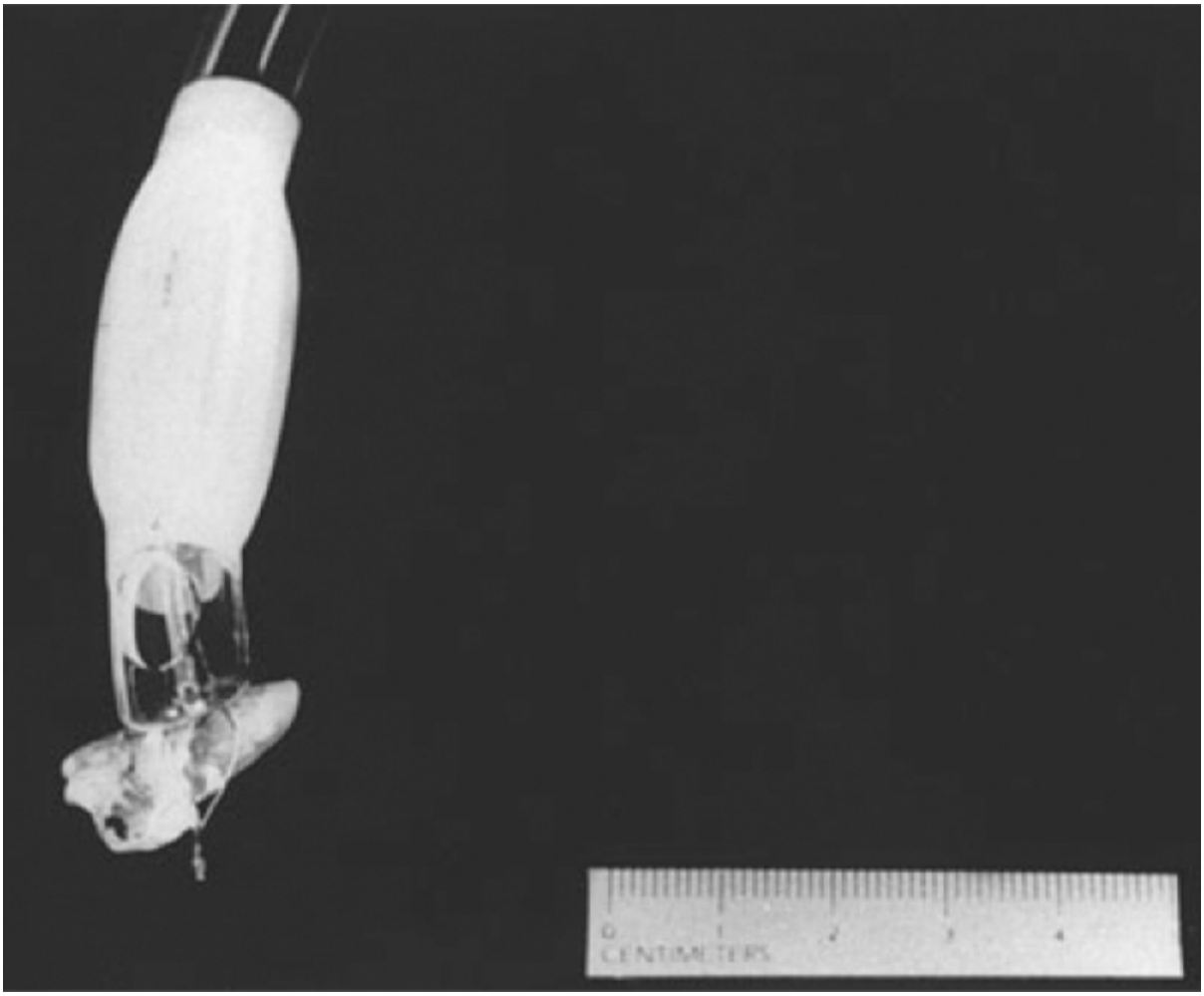

Figure 67-19 Many foreign bodies, once grasped, cannot be removed through the endotracheal tube. They should be withdrawn tightly against the end of the endotracheal tube. The tube, bronchoscope, and foreign body are then removed as one unit.

POSTOPERATIVE MANAGEMENT

Postoperative care of a patient who has undergone tracheobronchoscopy is minimal unless significant in-strumentation has been required. A standard chest radiograph obtained in the recovery room is standard in most centers. If there is concern for a potential pneumothorax, the patient should be monitored closely for several hours after the procedure. Delayed complications are rare because in most instances, any difficulties, if they are to occur, will arise in the immediate postoperative period.

PEARLS

Flexible Bronchoscopy

- Flexible bronchoscopy is preferred in most instances because general anesthesia is typically not needed. Sedation is required, as well as appropriate monitoring.
- Flexible bronchoscopy can be performed through an appropriately sized endotracheal tube in an anesthetized patient.
- Right-left and anterior-posterior orientation during flexible bronchoscopy is enhanced if the surgeon stands above the head of the patient.
- Reorientation can often be enhanced by removal of the camera head (if possible).
- Some foreign bodies can be removed with flexible instrumentation; however, such removal should be performed in the operating suite under general anesthesia.
- Familiarity with bronchoscopic anatomy and instrumentation is a prerequisite.

Rigid Bronchoscopy

- Rigid bronchoscopy should be performed only by those with skill and experience.

- Children, in particular, should be referred to a specialized center for rigid bronchoscopy and removal of foreign bodies.
- A selection of appropriately sized bronchoscopes, telescopes, and instruments must be available before initiating the procedure.
- Communication between the surgeon and anesthesiologist is required for safe performance of bronchoscopy.

PITFALLS

- There is a significant “learning curve” for bronchoscopy.
- Communication with the anesthesiologist is necessary to prevent disaster in procedures performed under general anesthesia.
- Close monitoring is essential during and after all bronchoscopic procedures.
- Difficulty ventilating the patient should immediately result in reappraisal of the equipment and airflow system. If ventilatory problems persist, the patient should be intubated with a cuffed endotracheal tube and then examined for the possibility of a pneumothorax.
- Procedures performed in the airway of children are inherently more risky and more difficult. Consequently, endoscopic procedures on the airway of children should be performed only by persons who are trained in their performance and have access to the appropriate equipment.
- Manipulation of obstructing lesions of the trachea and bronchi can result in perforation of the airway or unmanageable bleeding requiring thoracotomy.

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