Flexible Fiberoptic Bronchoscopy

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The flexible fiberoptic bronchoscope was introduced in Japan by Dr. Shigeto Ikeda in the mid-1960s and became available for clinical use in the United States around 1970. The application of this technique represents one of the most significant advances for the diagnosis and management of chest diseases as it enables the physician to directly visualize the tracheobronchial tree and obtain diagnostic specimens from regions of the lung previously inaccessible to the rigid bronchoscope. Except for subpleural lesions, fiberoptic bronchoscopy is the surgical procedure of choice in the evaluation of many pulmonary lesions.[1] In addition, fiberoptic bronchoscopy plays a major therapeutic role in the evaluation of airway patency and elimination of retained secretions.

The new Olympus® (BF-IT), Machida® (FBS-6TL; FBS-6TL II), and Pentax® (FB-19A) fiberoptic bronchoscopes have larger channels measuring 2.6 mm in diameter as compared with older models whose channels measure 1.8 to 2.2 mm. These larger channels provide more effective suctioning and larger biopsy specimens.[2]

Indications for Fiberoptic Bronchoscopy

The following are accepted indications for fiberoptic bronchoscopy:

1. Any pulmonary lesion of uncertain nature. Subpleural lesions are exceptions.
2. Retained bronchial secretions
3. Evaluation of airway patency
4. Miscellaneous:
   a. hemoptysis in a patient with a normal chest radiograph
   b. positive sputum cytology (that is, cancer) in a patient with normal chest radiograph
   c. small, peripheral foreign bodies in adults
   d. patients with trauma or disease affecting the cervical spine or jaw
   e. patients on mechanical ventilators

Rigid bronchoscopy is preferred in the following situations:

1. Severe pulmonary hemorrhage
2. Centrally located foreign bodies
3. Children requiring bronchoscopy
4. Tracheal stenosis, secondary to intrinsic or extrinsic lesions

Risks and Contraindications

The following conditions are associated with increased risks during or following fiberoptic bronchoscopy:[3]

1. Hemoptysis (increased incidence of post-bronchoscopy bleeding)
2. Bronchial asthma (danger of severe bronchospasm)
3. Uremia (danger of severe hemorrhage after biopsy)
4. Immunosuppression (hazard of post-bronchoscopy infection)
5. Superior vena cava obstruction (danger of inducing laryngeal edema)

Poor patient cooperation, hypoxemia with an arterial Po_2 that cannot be increased to 60 to 65 torr with supplemental oxygen, uncorrected bleeding diathesis, acute respiratory acidosis of any degree, dangerous cardiac arrhythmias, recent (within six weeks) acute myocardial infarction, and untreated active pulmonary tuberculosis are contraindications for fiberoptic bronchoscopy. Terminally ill and aged patients with unstable vital signs should not have fiber-

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optic bronchoscopy performed. Severe pulmonary hypertension and poor cardiopulmonary reserve are relative contraindications.

Physician and Patient Preparations for Fiberoptic Bronchoscopy

Prior to bronchoscopy, the endoscopist should perform a history and physical examination, review the chest radiographs, electrocardiograms, and blood and urine tests. Arterial blood gas and spirometric studies should be performed, if possible, prior to the procedure. Coagulation studies (prothrombin time, partial thromboplastin time, platelet count) should be obtained. Three sputum smears for acid-fast organisms should be obtained in patients whose chest radiographs are consistent with a diagnosis of tuberculosis. Finally, a signed operative permit should be obtained from the patient.

Oxygen prophylaxis. All patients should receive supplemental oxygen administered by nasal catheter or cannula 5 L/min. The Pao_2 may decrease as much as 20 torr during and for several hours after bronchoscopy.[4] This drop in oxygen tension appears to be the result of multiple factors, including partial or complete obstruction of the airways, filling of alveolar spaces with lavage or anesthetic solutions, and suctioning. Therefore, all patients who have a reduced Pao_2 prior to the procedure should be given supplemental oxygen for six to ten hours following bronchoscopy.

Cardiac monitor. It is desirable that all patients should have cardiac monitoring during bronchoscopy. The sudden development of an arrhythmia or change in cardiac rate may suggest hypoxemia. Recent studies suggest that fiberoptic bronchoscopy does not consistently enhance preexisting ectopic beats in patients with ischemic heart disease, therefore, the procedure is not contraindicated in patients with stable angina. However, patients with coronary heart disease should be monitored closely during the procedure, since sinus tachycardia can develop, which may cause ischemic events thus precipitating arrhythmias.[5] The most important factor in the development of arrhythmias is not bronchoscopy itself, but rather the underlying cardiopulmonary status of the patient.

Preoperative orders. For a morning procedure, NPO after midnight is required; for an afternoon procedure, only a light liquid breakfast may be given. Atropine 0.8 to 1.0 mg is given intramuscularly 30 minutes before bronchoscopy since this drug blocks vasovagal reflexes and also reduces the amount of bronchial secretions. Depending upon the age, size and clinical condition of the patient, morphine 7.5 to 15 mg or meperidine 50 to 100 mg may be given intramuscularly with the atropine. In our institution we commonly use codeine 60 mg and atropine 0.8 to 1.0 mg 30 minutes prior to bronchoscopy. Patients with severely reduced pulmonary function are given only atropine.

Topical anesthesia is an extremely important factor in securing patient acceptance and performing a successful bronchoscopic examination. Lidocaine is the most commonly used agent as it is effective and safe provided a maximum dosage of 600 mg is not exceeded during the procedure. This dose, which is larger than that usually recommended, has been found safe in a large series. In patients with severe liver disease or congestive heart failure no more than 300 mg should be given.

The patient is first instructed to gargle with approximately 4 ml of 4% lidocaine for one to two minutes, followed by spraying of the oropharynx and the most widely patent nostril with 5 ml of 4% lidocaine via a #15 DeVilbus atomizer. Cotton balls soaked in 4% lidocaine are applied to each piriform sinus for one minute; then, via a curved cannula, 2.0 ml of 1% lidocaine is administered over the vocal cords.

With the patient either seated or supine the flexible fiberoptic bronchoscope can be passed (with or without an endotracheal tube) either transnasally or transorally. The most commonly used technique for diagnostic study in the United States is the direct transnasal passage. (If fiberoptic bronchoscopy is carried out through an endotracheal tube, the internal diameter of the tube should be 8.5 mm). The distal six inches of the fiberoptic bronchoscope is lubricated with lidocaine jelly. The bronchoscope is then passed through the nostril and when in the oropharynx, the tip angulated anteriorly to view the larynx. If the patient begins coughing, 2 ml of 1% lidocaine is administered over the vocal cords. The patient is instructed to take a deep breath, and the bronchoscope is passed into the trachea during this inspiration. Additional small amounts of 1% lidocaine are given as necessary to suppress coughing. Once the bronchoscope is in the tracheobronchial tree, examination of all five lobes can be performed in approximately 10 to 15 minutes.

Biopsy Technique

A variety of biopsy instruments, primarily brushes and forceps, are available for diagnosis of

pulmonary lesions. In general, both brushes and forceps are used for all lesions. The brush biopsy is obtained by moving the brush briskly back and forth over the suspicious area. If the bronchoscope has been introduced through the endotracheal tube, after each biopsy, the brush is pulled back just inside the bronchoscope and the bronchoscope removed from the tracheobronchial tree. The brush is then advanced forward and smears are made on glass slides which are placed in 95% alcohol.

Forceps biopsy can be used in the diagnosis of local or diffuse pulmonary lesions. In diffuse lung disease, the forceps is introduced into a small peripheral airway, usually in a lower lobe segment. The forceps is opened in inspiration, the patient is instructed to exhale completely, the forceps is advanced slowly about 1 cm, and at the end of an exhalation the biopsy obtained. Following the removal of the forceps, the distal end of the bronchoscope should be wedged into the bronchial segment for one minute to prevent possible bleeding. The biopsy specimen is placed in a sterile tube filled with Ringer solution. In general, three to four specimens, sometimes as many as six to eight, are taken. Bronchial washings with 10 to 20 ml saline solution should also be obtained. The specimens should be sent for cytology, smears, and cultures for acid-fast organisms, fungi, and pathogenic organisms.

It is desirable to perform transbronchial biopsy under fluoroscopic control if available. Because of the possibility of bilateral pneumothorax, biopsies are taken from one lung only.

In localized disease the forceps is introduced to the lung lesion, then withdrawn 1 cm, opened, then advanced until it touches the lesion; the forceps is closed and the biopsy obtained. Prior to brush or forceps biopsy, administration of 5 ml boluses of 1:20,000 epinephrine over visible tumors or into distal airways (in cases of diffuse lesions) before biopsy, reduces the incidence of pulmonary hemorrhage. A total of 20 ml of 1:20,000 epinephrine solution can be given over a period of 20 minutes, except in patients with severe hypertension and serious arrhythmias. In patients with uremia, brush or forceps biopsies should not be done because of the possibility of severe hemorrhage; in those with a platelet count of less than 50,000/mm,[3] six to ten platelet packs should be infused just prior to bronchoscopy. Finally, patients with bronchial asthma are prone to develop severe bronchospasm. They should be given bronchodilators and probably steroids prior to bronchoscopy.

Where centrally located visible carcinoma of the lung is present, the incidence of positive forceps biopsy is about 97%. The overall yield in peripheral carcinoma of the lung is about 60% to 70%, in metastatic carcinoma of the lung, about 30% to 40%, and in diffuse lung diseases, the diagnostic yield ranges from 62% to 79%. In stage I sarcoidosis, transbronchial biopsy will confirm the diagnosis in 50% to 60% of cases while in stage II and stage III sarcoidosis, diagnostic success is about 90%.

Complications of Fiberoptic Bronchoscopy

The overall complication rate is approximately 8%. The mortality rate is 0.1%. The following are potential complications:

1. Hypoxemia
2. Laryngospasm
3. Hemorrhage
4. Pneumothorax
5. Bronchospasm
6. Cardiac arrhythmias and acute myocardial infarction
7. Post-bronchoscopy infection
8. Trauma due to endotracheal tube insertion
9. Hypoventilation

In summary, fiberoptic bronchoscopy is an extremely useful technique in the diagnosis and management of pulmonary diseases. It is quite safe and comfortable for the patient and it permits examination of airways previously inaccessible to the endoscopist. However, physicians must evaluate each patient carefully. The procedure should be performed by an experienced endoscopist who is familiar with risk factors and proper indications for fiberoptic bronchoscopy.

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