General Anesthesia for Bronchofiberscopy

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Recently, a new flexible fiberoptic bronchoscope, the "bronchofiberscope" has become available and has added new dimensions to the usefulness of bronchoscopy.[1, 2] The Olympus BF Type 5B is a flexible tube 5 mm in diameter with a working length of 56 cm. The tip is manipulated by remote control from the proximal portion of the bronchoscope and can be directed into airways as small as subsegmental bronchi, including those in the upper lobes. Direct visualization, photography, brush biopsy, sampling bronchial secretions, and aspiration of mucus in areas inaccessible to the conventional rigid bronchoscope are possible. Ordinarily, the instrument is introduced through a rigid "trachea tube," a rigid bronchoscope or a nasopharyngeal airway.[3-5] These methods are satisfactory for patients breathing spontaneously, but controlled ventilation is difficult or impossible. A simple technique that allows ventilatory control and administration of general anesthesia is presented.

METHODS

A right-angle anesthetic elbow connector with a suction channel is needed for this technique. A suction channel can be built onto an ordinary adapter mask elbow, or the commercially-available Rovenstine-Woods curved connector with suction nipple, Magill suction T-piece connector, or Bird tracheostomy adapter with suction arm, etc., can be used. A rubber diaphragm cut from a piece of glove or Penrose drain is taped over the suction channel and a 3–5-mm slit is made at its center. The connector is attached to the Y-piece inhaler assembly of the anesthesia machine.

While almost any general anesthesia technique can be used, the author uses thiopental, Innovar, or diazepam for induction and a 60 per cent N_2O–O_2 mixture and succinylcholine for maintenance of anesthesia and relaxation. In patients with marginal pulmonary function more than 50 per cent oxygen is used. The oropharynx, larynx, and upper trachea are thoroughly sprayed with a topical anesthetic and the patient is intubated with as large an endotracheal tube as possible without causing trauma. The bronchofiberscope is introduced into the endotracheal tube through the suction piece of the connector while ventilation is maintained (fig. 1). To facilitate introduction of the instrument, the rubber diaphragm is initially retracted and then allowed to contract to maintain a reasonably tight seal. Small air leaks occurring around the shaft of the bronchofiberscope are easily compensated for by increasing the flow rate and closing the pop-off valve of the anesthesia machine. Pulse, blood pressure, and electrocardiogram are monitored. At the end of the procedure, when spontaneous breathing and reflex activity return, the trachea is extubated.

From July 1970 to March 1972, this technique of general anesthesia for bronchofiberscopy was used for 115 patients. From 36 of these patients, whose ages ranged from 22 to 65 years (mean 42 years), arterial blood samples were taken through a teflon cannula placed in the radial artery. Samples were obtained prior to induction of anesthesia, immediately before introduction of the bronchoscope, several times during bronchoscopy, immediately afterwards, and 30 minutes after termination of the procedure. Blood-gas and acid-base values were measured using appropriate *p*H, carbon dioxide, and oxygen electrodes. When both the rigid bronchoscope and the bronchofiberscope were needed, the Sanders technique of ventilation[6] was employed; the rigid bronchoscope was inserted first and, while ventilation was maintained with Sanders' Venturi injector, the bronchofiberscope was introduced through it.

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FIG. 1. Bronchofiberscope introduced into the endotracheal tube via the suction channel of the elbow connector while controlled ventilation is possible through connecting tubings.

In 30 additional patients on mechanical ventilators in the Recovery Room or Intensive Care Units, bronchofiberscopy for therapeutic purposes was performed, using topical anesthesia. Some of these patients were in respiratory failure. The connector with suction channel was interposed between the mechanical ventilator and endotracheal or tracheostomy tube, and bronchofiberscopy carried out while mechanical ventilation was maintained.

RESULTS

Excellent conditions for endoscopy were provided in all patients. Recovery from anesthesia occurred promptly after the procedure was completed, and the patients were able to cough vigorously. Results of the arterial blood–gas studies are summarized in figure 2. Carbon dioxide tension and *p*H remained within normal limits throughout bronchoscopy, and oxygen tension remained well above 130 torr at an inspired oxygen concentration of 40 per cent. In patients on mechanical ventilators, arterial blood–gas and acid–base measurements taken on numerous occasions also demonstrated the adequacy of ventilation during bronchofiberscopy with this technique.

An increase in airway resistance occurred after insertion of the bronchofiberscope into the endotracheal tube. However, this was minimal and of no major consequence when ventilation was assisted or controlled and a tube larger than 34 French gauge or 8.5 mm internal diameter was used. The technique could not be used with tubes smaller than 32 French or 8 mm internal diameter because resistance to airflow was excessive and ventilation became impaired. Olympus BF Types 4B and 3A are 4 mm and 3.2 mm in diameter, respectively, and can be passed through smaller endotracheal tubes.

DISCUSSION

Comparable techniques have been suggested by Berkwitz and Sechzer [7] and by Renz *et al.*[8] With solution of the major problem of inadequate ventilation, uninterrupted examination for as long as needed and as often as necessary can be accomplished without risk of hypoxia or hypoventilation. General anesthesia be-

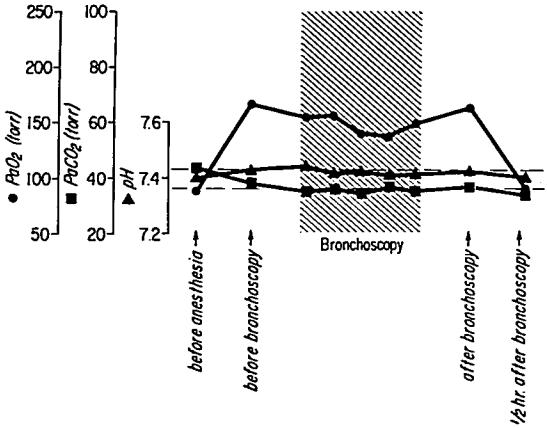

FIG. 2. Mean arterial blood gas and pH values in 36 patients anesthetized with thiopental/Innovar, 60 per cent nitrous oxide and 40 per cent oxygen, before and after bronchoscopy with the Olympus bronchofiberscope (Type 5B).

comes safe, and may indeed be a method of choice for many patients. Utilization of the bronchofiberscope permits unhurried careful catheterization of segmental and subsegmental bronchi, fluoroscopy-guided catheterization, and precise positioning of the catheter for selective cultures, biopsy and bronchography. The method has been very valuable in teaching situations when residents were learning bronchofiberscopy and familiarizing themselves with tracheobronchial anatomy.

Bedside bronchofiberscopy was found to be an extremely helpful therapeutic adjunct for patients in postsurgical and respiratory care units who needed aspiration of secretions or mucous plugs. In patients whose tracheas were not intubated, a soft rubber nasopharyngeal airway was used to facilitate introduction of the bronchofiberscope into the trachea. Oxygen was administered through a nasopharyngeal airway or catheter placed in the other nostril. Even thick secretions could be removed through the bronchofiberscope by repeated lavage with saline and acetylcystine solution and frequent suctioning.

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