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Clinical Experiences of Fiberoptic Bronchoscopy in Patients with Respiratory Failure in the Intensive Care Unit

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Seventy-nine fiberoptic bronchoscopies were performed in 46 Patients during 2 years in the Intensive Care Unit of Severance Hospital, Yonsei Medical Center. Bronchoscopies were done more than twice in 13 patients. Forty-three bronchoscopies were done through the orotracheal tube in 27 patients, and narcotics and sedatives such as morphine sulfate, diazepam and lorazepam were added with pancuronium bromide during 52 bronchoscopy procedures in 21 patients. Ventilatory support was accomplished by control mode ventilation for 63 bronchoscopies in 37 patients. Twenty-four patients were from the surgical department, and 37 bronchoscopies were performed in 18 patients in a post-thoracotomy state. Twenty-two patients were nonsurgical patients. We performed 48 bronchoscopies in 26 patients to treat lung haziness, 14 bronchoscopies in 3 patients to confirm the operative anastomosis after pneumonectomy or tracheoplasty, and 11 bronchoscopies to confirm the airway patency and vocal cord movement. We obtained good results from 41 bronchoscopies performed for therapeutic purposes and 28 bronchoscopies done for diagnostic purposes. But in 4 patients with pleural effusion and pneumonia, we could not get any improvement in chest X-ray taken after bronchoscopy. We suggested other procedures in 6 patients for diagnosis or treatment, such as suspension laryngoscopy, thoracentesis, ultrasonogram and laser surgery.

Key Words: Fiberoptic bronchoscopy, respiratory failure, intensive care unit

The development of the fiberoptic bronchoscope (FOB) over the past decade represents an important advance in the care of patients with pulmonary disease. Lindholm and co-workers reviewed the diagnostic and therapeutic utility and complications of FOB in critical care medicine in 1974. Feldman and Huber (1976) reported their experience with bronchoscopy in the ICU and recommended the technique for difficult tracheal intubation, selected tracheobronchial tree drainage in atelectasis and diagnosis of hemoptysis in the intubated patient. Steven and co-workers (1981) reported 297 ICU bronchoscopies, which represented 31% of the total number of hospital bronchoscopies accomplished during the 23 month-study period.

Since July 1987, we have used a fiberoptic bronchoscope (Olimpus BF type 4B2 slim 4.9mm outer diameter) in 46 patients who were admitted for treatment of acute respiratory failure to the Intensive Care Unit of Severance Hospital of Yonsei Medical Center.

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PATIENTS and METHODS

We analyzed the age, sex distribution and route of insertion of bronchoscopy, drugs used for fiberoptic bronchoscopy, ventilator mode and disease distribution, indications for bronchoscopy and the results.

RESULTS

Among the patients who have been admitted to the Intensive Care Unit during the last 2 years, 79 bronchoscopies were done in 46 patients. The ratio of male to female patients was 35 to 11, and 25 bronchoscopies were done on patients in their sixties (Table 1). Bronchoscopies were done more than twice in 13

Table 1. Age and sex distribution

Age (years)	Male No. (F)		Female No. (F)		Subtotal No. (F)	
	single	multiple	single	multiple	single	multiple
1 - 10						
11 - 20	2 (2)		1 (1)		3 (3)	
21 - 30	1 (1)	6 (12)	0		1 (1)	6 (12)
31 - 40	1 (1)	2 (7, 4)	1 (1)		2 (2)	2 (7, 4)
41 - 50	6 (6)	1 (2)	1 (1)		7 (7)	1 (2)
51 - 60	6 (6)		4 (4)	1 (4)	10 (10)	1 (4)
61 - 70	5 (5)	3 (7, 6, 4)	3 (3)		8 (8)	3 (7, 6, 4)
71 - 80	1 (1)		0		1 (1)	
81<	1 (1)		0		1 (1)	
Subtotal	23 (23)	12 (42)	10 (10)	1 (4)	33 (33)	13 (46)
Total					46 (79)	

No.: Number of patients
(F): Frequency of bronchoscopy

Table 2. Route distribution

Route	No. of patients (F)
Orotracheal route	27 (43)
Nasotracheal route	5 (6)
Transtracheal route	8 (18)
Transnasal route	6 (12)
Total	46 (79)

F: Frequency of bronchoscopy

patients.

Forty-three bronchoscopies in 27 patients were done through the orotracheal tube, and 12 bronchoscopies were done through the transnasal route (Table 2). To prevent cough reflex, pancuronium bromide was given 59 times in 28 patients. Narcotics and sedatives such as morphine sulfate, diazepam and lorazepam were administered 52 times in 21 patients. N-acetylcystine, as a mucolytic was instilled into the bronchoscope in 62 bronchoscopies of 31 patients (Table 3).

Ventilation was supported with the CMV mode for 63 bronchoscopies in 37 patients with or without PEEP and the bronchoscopies were performed during spontaneous breathing in 6 patients (Table 4). Twenty-four of 46 patients were from the surgical department. Thirty-seven bronchoscopies in 18 patients were done after thoracotomy for esophagogastrocolonostomy, pneumonectomy or bronchopleural fistula repair. Twenty bronchoscopies were performed in 11 patients with cerebral contusion whose consciousness was suppressed and 11 bronchoscopies were done in 6 chest

Table 3. Durgs used for fiberoptic bronchoscopy

Drugs			No. of Patients (F)
Pancuronium bromide	–	–	1 (1)
	–	+ Mucomyst	6 (6)
	+ Morphine sulfate	+ Mucomyst	12 (40)
	+ Diazepam	– Mucomyst	6 (9)
	+ Lorazepam	+ Mucomyst	3 (3)
Lidocaine	–	–	10 (10)
	–	+ Mucomyst	4 (4)
None			4 (6)
Total			46 (79)

Table 4. Ventilator mode

	No. (F)
Mechanical ventilatory support	
CMV with PEEP	26 (42)
CMV without PEEP	11 (21)
IMV with PEEP	1 (3)
CPAP	2 (3)
Spontaneous breathing	6 (10)
Total	46 (79)

No.: Number of patients
F: Frequency of bronchoscopy
CMV: Control mode ventilation
IMV: Intermittent mandatory ventilation
PEEP: Positive end expiratory pressure
CPAP: Continuous positive airway pressure.

trauma patients with rib fracture (Table 5.)

We used FOB 51 times as a therapeutic procedure and 28 times as a diagnostic procedure. Atelectasis was the most common indication for bronchoscopy in the postoperative state, especially after thoracotomy or laparotomy and following chest trauma with or without rib fractures. We performed 48 bronchoscopies in 26 patients to treat lung haziness shown in the chest X-ray. As a diagnostic procedure, 14 bronchoscopies in 3 patients were performed to confirm the anastomosis site after pneumonectomy or tracheoplasty and 11 bronchoscopies in 11 patients to confirm airway patency and vocal cord movement (Table 6).

Twenty-eight bronchoscopies in 17 patients for diagnostic purposes were performed with good results, and 41 bronchoscopies in 19 patients for

Table 5. Disease Distribution

Disease Distribution	No. of patients	Frequency of bronchoscopy
Surgical patients, operation name		
Total laryngectomy	1	1
Thyroidectomy	1	1
Esophagocolonogastrostomy	6	11
Aortic valve replacement, MVR	3	3
Tracheoplasty	2	8
Bronchopleural fistula repair	2	2
Pneumonectomy, lobectomy	5	13
Explo-laparotomy	4	4
Nonsurgical patients		
Cerebral contusion		
Cerebral hemorrhage	11	20
Chest trauma, rib fracture	6	11
Snake bite, ITP, collagen dis.	5	5
Total	46	79

Table 6. Indications for bronchoscopy

Indications	No. of patients	Frequency of bronchoscopy
Diagnostic purposes		
Anastomosis site confirm after op.	3	14
Airway patency or granuloma	7	7
Vocal cord function confirm	4	4
Bleeding point	2	2
Bronchogram	1	1
Therapeutic purposes		
Lung haziness or atelectasis	26	48
Intubation through nose	2	2
Foreign body removal	1	1
Total	46	79

Table 7. Results

Result	No. of patients	Frequency of bronchoscopy
Diagnostic purposes		
Success	17	28
Therapeutic purposes		
Successful improvement in the follow-up Chest X-ray	19	41
No change	4	4
Recommend other procedure	6	6

therapeutic purposes to treat lung haziness showed successful improvement of atelectasis in the follow-up chest X-ray. But in 4 patients with pleural effusion and pneumonia, we could not get any improvement in results. We recommended other procedures, such as suspension laryngoscopy, thoracentesis, ultrasonogram and laser surgery for removal of granuloma in 6 patients instead of fiberoptic bronchoscopy (Table 7).

DISCUSSION

Fiberoptic bronchoscopy is widely used to investigate abnormalities of the tracheobroncheal tree. The number of indications for this procedure has grown considerably since its introducion. The aim of fiberoptic bronchoscopy in ICU patients is often the therapeutic removal of secretions from medium-sized bronchi to resolve atelectasis and improve respiration (Lindholm *et al.* 1974; Stevens *et al.* 1981; Venecko 1982; Khandelwal 1987; Dellinger 1986).

Feldman and Huber (1976) reported their experiences with FOB in the ICU and recommended the technique for difficult tracheal intubation, selected tracheobronchial tree drainage in atelectasis and diagnosis of hemoptysis.

We have experienced 79 bronchoscopies in 46 patients over a 2 year period. Intubation facilitates delivery of a high fraction of inspired oxygen (FiO_2) and ensures adequate ventilation during the procedure. Sixty-seven out of 79 bronchoscopies were performed through the orotracheal, transtracheal or nasotracheal intubation tube.

Once the endotracheal tube is in place, trauma to the upper airways during bronchoscopy could be eliminated. An endotracheal tube is essential if removal of the bronchoscope is anticipated during the procedure for specimen collection, or if large amounts of blood or thick secretions which necessitate cleaning are expected. We used T-adaptors for inserting the bronchoscope into the endotracheal or tracheostomy tube to maintain an adequate seal and allow continuation of ventilatory support with a mechanical ventilator or an Ambu-bag (Shinnick 1974; Macintyre 1987).

Use of medication with sedatives or analgesics and muscle relaxants is an important consideration when undergoing bronchoscopy. Morphine sulfate, diazepam and lorazepam with pancuronium bromide intravenously were administered 52 times and Mucomyst was instilled into the endotracheal tube through the side channel of the bronchoscope. Lidocaine, 1-2mg/kg, was given intravenously to prevent cough reflex in 10 procedures of 8 patients.

Since hypoxemia may occur during bronchoscopy, a supplemental oxygen supply should be provided. Intermittent sampling of the arterial blood for gas analysis is a less desirable alternative because of the delayed report. We used a pulse oximeter during the procedure and if oxygen saturation dropped below 90%, we stopped the procedure temporarily until saturation returned to 90%.

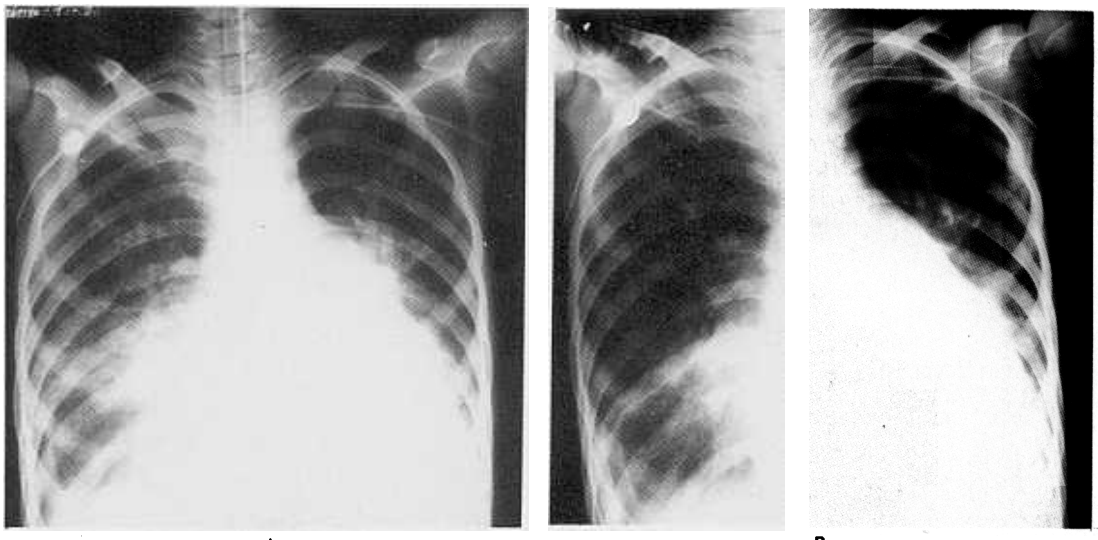
To help correct hypoxemia during suctioning, the following steps would be beneficial:low vacuum settings on the suctioning device should be used, use only intermittent suctioning for a short interval, and use high flow oxygen enrichment 6-9LPM (Miller 1979).

Nussbaum (1982) reported 34 FOB with a 1.2mm suction channel in children younger than 2 years. We could not perform bronchoscopy in children because of the lack of a suitable size of fiberoptic bronchoscope.

Fiberoptic bronchoscopy offers a convenient and direct way of obtaining bronchial secretions. However, it has been shown that the cultures of material so obtained may not accurately reflect upper respiratory tract microorganisms because of contamination by them (Flatauer *et al.* 1980).

The fiberoptic bronchoscope is an excellent tool for airway inspection, and after prolonged or difficult intubation, there is a risk of complications such as mucosal erosions, edema, hematoma, tracheomalacia and tracheoesophageal fistula. We performed 11 bronchoscopies for inspection of airway patency and vocal cord movement in 11 patients, and 14 bronchoscopies in 3 patients to confirm the anastomosis site of tracheoplasty and pneumonectomy.

We also took bronchograms in chest trauma patients with rib fracture and the bronchus rupture was confirmed successfully followed by pneumonectomy (Koh 1987).



A B

Fig. 1. X-rays of chest A-P taken in patients with hemoptysis (A) and after fiberoptic bronchoscopy resolved haziness in the right lower lung field (B).

Atelectasis is particularly common in the postoperative setting and follows in patients with or without rib fracture. Pneumonia and hypotension are predisposing factors in this patient group. We performed 48 bronchoscopies in 26 patients with atelectasis and lung haziness on the chest X-ray caused by inspissated secretions, and we noted radiographic evidence of lung re-expansion following 87% of the procedures (Fig. 1). The fiberoptic bronchoscope is most effective in treating atelectasis caused by central plugging or retained secretions. Because bronchoscopy does not treat the factors predisposing to atelectasis, the procedure must be followed by other respiratory therapies. Although controversial, FOB is employed in specimen collection for diagnosis of pneumonia (Flatauer *et al.* 1980; Bartlett *et al.* 1976). In our cases, we could not get good results in 4 patients with lung haziness on the chest X-ray. We later confirmed pleural effusion with chest CT and recommended thoracentesis in those cases (Feinsilver *et al.* 1986).

We recommended other diagnostic and therapeutic procedures such as ultrasonogram, thoracentesis and suspension laryngoscopy with laser surgery for granuloma removal in patients whom we could not obtain good results.

Potential complications associated with FOB have been reported (Lindholm *et al.* 1978; Miller 1979). Hypoxemia, hypercapnia and cardiac dysrhythmia during the procedure can develop but such complications did not develop in our cases. The fiberoptic bronchoscope is a valuable and lifesaving tool for the diagnosis and management of upper respiratory tract obstruction and atelectasis in the intensive care unit setting.

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