

Fiberoptic Bronchoscopy as a Diagnostic Tool in Neonatal Intensive Care Unit: A Single Center Experience

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ABSTRACT

Background: Respiratory disorders are recognized as a leading cause of morbidity and mortality in neonates. Fiberoptic Bronchoscopy (FOB) is used by pediatricians both for diagnostic and therapeutic indications in children. Nonetheless, there is a paucity of data regarding the diagnostic utility and safety of FOB in neonates, and it has remained relatively under-used in the care of neonates. The present study provided a practical overview of the wide diagnostic aspects of the FOB in newborns hospitalized in the Neonatal Intensive Care Unit (NICU). Frequencies of common indications, their findings, and highlights contribute to the quick management of neonates with respiratory disorders.

Methods: This descriptive study was conducted in the NICU of Namazi hospital and included 150 neonates with various respiratory problems admitted over 5 years within 2013-2018. All subjects underwent FOB and bronchoalveolar Lavage (BAL) using a bronchoscope of 2.8 (EVIS EXERA III Olympus bronchoscope).

Results: The greatest indications for performing FOB entailed hypersecretion in 138 (92%) cases, prolonged mechanical ventilation in 108 (72%) neonates, and persistent radiological finding in 97 (64.6%) subjects. Bronchoscopy detected various airways anomalies, such as Laryngomalacia (72%), Tracheobronchomalacia (64%), subglottic stenosis (26%), vocal cord paresis (18%), tracheoesophageal fistula (6.7%), laryngeal cleft (6%), and laryngeal web (4%). BAL results demonstrated that the cultures were positive in 20 (13.33%) neonates. *Acinetobacter* was the most commonly reported bacterial infection observed in 8% of neonates.

Conclusion: As evidenced by the obtained results, when performed by an experienced and well-trained person and in an environment with appropriate facilities, FOB can be a safe and efficient tool for the early diagnosis of numerous airway disorders among neonates admitted to NICUs.

Keywords: Bronchoscopy, Diagnostic, Neonates, NICU, Respiration disorder

Introduction

The recent increase in the number of live births, as well as great progress in the management and care for neonates, especially premature ones, has resulted in overcrowding, a low nurse-to-patient ratio, limited distance between incubators which promote the spread of multidrug-resistant organisms in NICUs. Therefore, the early diagnosis of the diseases can lead to quick treatments, as well as the discharge of patients from the ward. On the other hand, respiratory disorders are the most common causes of admission to NICU and mortality in both term and preterm neonates (1, 2).

Neonatal respiratory disorders can be caused

by various factors, including congenital lung malformations and lung abnormalities in preterm and full-term neonates (3). Bronchopulmonary dysplasia (BPD) is responsible for prolonged hospitalization and readmissions after discharge (4). Respiratory distress is often due to non-pulmonary causes, such as sepsis or a congenital heart disease (5), although some other factors are also associated with neonatal mortality in NICU (6).

It is sometimes difficult to differentiate between respiratory and non-respiratory etiology based on clinical symptoms. The accurate diagnosis of respiratory disorders is of paramount

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importance in the management of neonates (7). FOB is a diagnostic and therapeutic tool which has decreased the mortality from respiratory diseases(8).BAL is a procedure facilitated by FOB, and has proved a valuable diagnostic and therapeutic tool for neonates with respiratory diseases (9).

There are several therapeutic methods for the use of FOB in the treatment of neonates with respiratory diseases, including stenting, therapeutic suction, balloon dilation, cryotherapy, and curosurf injection (10-14). Today, FOB is increasingly being used by pediatricians to diagnose and treat neonatal respiratory disorders (15-17). Nonetheless, there is a paucity of information regarding the diagnostic and therapeutic value, utility, and safety of FOB in neonates (18).

The assessment of the diagnostic role of FOB in neonates can be of great help in the planning and management of respiratory disorders in neonates. To date, no study has been conducted on the indications of FOB utilities among the neonatal age group in our region. Moreover, a limited number of studies have been performed merely on sample sizes in Asia. With this background in mind, it was decided to publish the information obtained in the present study.

Methods

The study population consisted of 150 neonates with various respiratory disorders. These neonates had undergone FOB in the NICU of Namazi hospital for 5 years within 2013-2018. All of the evaluated neonates were visited in the NICU for their initial consultation. The inclusion criteria were as follows: 1) long-term coughing, 2) stridor, 3) airway bleeding, 4) endotracheal intubation, 5) emphysema, 6) unexplained respiratory distress, 7) difficulty feeding, 8) cyanosis, 9) abnormal crying sound, 10) persistent radiological abnormalities, and 11) prolonged mechanical ventilation.

After a face-to-face interview with the parents and obtaining informed consents, patients were scheduled for FOB. During the procedure, all of the neonates underwent a complete cardiopulmonary and pulse oximetry monitoring. Before and after the procedure, a chest X-ray was performed to evaluate indications, as well as complications. In the current study, a small size bronchoscope with an outer diameter (OD) of 2.8 mm (EVIS EXERA III Olympus bronchoscope) was used to investigate the airway anatomy.

FOB is usually performed trans-nasally; nonetheless, we performed it both trans-nasally and trans-orally in order to direct investigation of the oral and oropharyngeal airways or via an artificial airway in those with mandatory ventilator supports. Nasal prongs were used for the maintenance of oxygenation. All bronchoscopies were conducted after a well preoxygenation, and BAL was performed to diagnose infections in neonates.

Results

A total of 150 neonates were included in the current study. The procedure was well tolerated and completed almost in less than 2 min. The characteristics of neonates are summarized in Table 1. The youngest neonate was a 2-day-old neonate who was suspected of tracheoesophageal fistula (TEF). The youngest gestational age was a neonate born at 29 weeks. He had bronchopulmonary dysplasia and was subjected to bronchoscopy at the age of 60 days due to long mechanical ventilation and persistent radiological abnormality.

The indications for FOB included hypersecretion in 138 (92%) cases, prolonged mechanical ventilation in 108 (72%) neonates, persistent radiological finding in 97 (64.6%) subjects, stridor in 24 (16%) newborns, and miscellaneous causes (cough, respiratory distress, difficulty feeding, abnormal crying sound, cyanosis during feeding). In neonates with

Table 1. The characteristics of neonates

		Percent (%)	Frequency
Gender	Male	48	72
	Female	52	78
Gestational age	Preterm	34.7	52
	Term	65.3	98
	Post term	00.0	0
Birth Weight	VLBW<1500gr	13.3	20
	LBW<2500gr	26	39
	NBW>2500gr	60.7	91
	Total	100.0	150

Table 2. Frequency of fiberoptic bronchoscopy findings in neonates

		Percent (%)	Frequency	Total (%)
Laryngomalacia	Severe	25	27	108 (72)
	Moderate	35.2	38	
	Mild	39.8	43	
Tracheobronchomalacia	Severe	23.96	23	96 (64)
	Moderate	29.17	28	
	Mild	46.87	45	
Subglottic stenosis	Severe	20.52	8	39 (26)
	Moderate	35.89	14	
	Mild	43.59	17	
Vocal cord paralysis		18	27	27 (18)
Unilateral		51.85	14	
Bilateral		48.15	13	
Generalize inflammation		20	30	30 (20)
Granulation tissue		46	69	69 (46)
Vocal cord		23.18	16	23 (15.33)
supraglottic		10.14	7	
Trachea nodules		4	6	6 (4)
Mucosalplugging		92	138	138 (92)
TEF		6.67	10	10 (6.67)
Laryngeal Web		4	6	6 (4)
Laryngeal cleft		6	9	9 (6)

unexplained stridor, FOB demonstrated various anomalies, including tracheobronchomalacia in 9(37.5%) cases, laryngomalacia in 6 (25%) neonates, subglottic hemangioma in 4 (16.67%) subjects, laryngeal web in 2 (8.33%) subjects, subglottic stenosis in 2 (8.33%) cases, and vocal cord palsy in 1 (4.17%) subject. Anomalies observed in cases with persistent radiological findings (e.g., unresolved atelectasis, pneumonia, and persistent pulmonary infiltrates) were tracheobronchomalacia (72.16%), granulation tissues (71.13%), laryngomalacia (55.67%), and subglottic stenosis (8.25%). Mucus plug was observed in all cases with persistent radiological findings, and complications were not detected during FOB. Moreover, after FOB, no complication was clinically and radiologically detected. The frequency of FOB findings in neonates is summarized in Table 2.

BAL was performed for all neonates who underwent FOB. The result of this procedure showed that neonatal culture was positive in 20 (13.33%) neonates. *Acinetobacter* which was observed in 8% of neonates was the most commonly reported bacterial infection in neonates. The frequency of *non-albicans Candida*, *Methicillin-resistant coagulase-negative staphylococci (MRCoNS)*, *Klebsiella*, and *Methicillin-sensitive staphylococcus aureus (MSSA)* was obtained at 3, 2, 1, 1, and 1, respectively.

Discussion

Respiratory disorders are a leading cause of

morbidity and mortality in neonates. FOB is currently used for diagnostic and therapeutic indications in neonates. Nonetheless, there is a paucity of information regarding the diagnostic and therapeutic utility, as well as safety of FOB in neonates (18). The most common FOB indications in the present study entailed hypersecretion, prolonged mechanical ventilation, and persistent radiological abnormality, respectively.

In accordance with the results reported in a study conducted by Tang, et al., hypersecretion was the most common cause of referral from NICU to bronchoscopy in the current study (19). Prolonged mechanical ventilation was recognized as the second cause of referral in the present study. Nonetheless, it was the major cause of concern in the neonatal units as observed in the findings obtained by Vijayasekaran, et al. The current study demonstrated that the persistent radiological abnormality is the third most common cause of patient referral. Bronchoscopy investigation showed that tracheobronchomalacia and granulation tissues were the two common causes of this problem; however, it was not mentioned in previous studies on newborn and premature neonates.

In the present study, neonates with unexplained respiratory distress and normal chest x-ray had tracheobronchomalacia, laryngomalacia, and tracheomalacia in their FOB investigation. Midulla F et al. and Vijayasekaran et al. also found laryngomalacia and tracheomalacia in their bronchoscopy findings in cases with unexplained

respiratory distress (7). They considered unexplained respiratory distress as an accepted indication for bronchoscopy (7, 20). In the present study, although tracheobronchomalacia was one of the main issues in the neonates with an unexplained respiratory distress, it was not indicated in previous studies.

This can be attributed to the absence of careful examination of the right and left bronchi, mucus plugs, copious amount of bronchial secretion, and rapid respiratory rate during bronchoscopy making vision so blurred. BAL was performed in all neonates and microbiological yield had direct influence in the antimicrobial management of the cases. In a similar vein, a study performed by Fogliae E et al. confirmed the influence of BAL in the antimicrobial management (21). Moreover, Liu J et al. suggested that BAL is effective in the treatment of neonatal pulmonary atelectasis (9).

The majority of previous studies have pointed to the safety of FOB procedure (8, 22). However, since these studies were performed on a few patients, we re-examined the rate of complications and concluded that complications were not detected during and after FOB procedures in the present study. The decrease of Sao₂ was mild to moderate, remained more than 85% during the procedure, and resolved rapidly after the withdrawal of the bronchoscope. It is noteworthy that no bradycardia was observed.

Conclusion

The results of the present study confirmed the high diagnostic ability of bronchoscopy in both neonates who were mechanically ventilated and those who breathed spontaneously. Furthermore, it was found that FOB can serve not only as an important diagnostic tool in the management of respiratory diseases but also as a safe procedure in the premature and term neonates.

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Conflicts of interest

None declared.

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