

# Local Experience in Paediatric Flexible Bronchoscopy

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## Summary

All children who underwent flexible bronchoscopy in the respiratory unit at Paediatric Institute, Hospital Kuala Lumpur from June 1997 to June 2002 were reviewed.

A hundred and ten children underwent the procedure under sedation or general anaesthesia. The median age of these children was eight months. (Q1 3, Q3 30) The commonest indication for performing flexible bronchoscopy was for chronic stridor (50 cases) followed by persistent or recurrent changes such as lung infiltrates, atelectasis and consolidation on the chest radiographs (22). Laryngomalacia was found to be the commonest cause of stridor in 29 children. Two patients were diagnosed with pulmonary tuberculosis. With regard to safety, three procedures were abandoned due to recurrent desaturation below 85%. One of these patients had severe laryngospasm that required ventilation for 48 hours but recovered fully. Two neonates developed pneumonia requiring antibiotics following bronchoscopy. No patients developed pneumothorax or bleeding following the procedure. Bronchoscopy is a safe procedure when performed by well-trained personnel. Since it is an invasive procedure the benefits must outweigh the risks before it is performed.

**Key Words:** Flexible bronchoscope, Stridor, Laryngomalacia, Atelectasis

## Introduction

Wood<sup>1</sup> initially reported the clinical importance of flexible bronchoscopy in the evaluation of paediatric airway disorders in 1978. It has gained increasing acceptance and importance in the last 15 years in the field of Respiratory Paediatrics. Due to the small airway size of children and the demanding technology in producing the bronchoscopes, the use of flexible bronchoscopy was developed later than adult bronchoscopy. Although history and physical examination can

assist in localizing signs and symptoms to either upper and lower airway abnormalities, diagnostic studies are required to localise and define the lesions. Investigative tools such as radiographs and pulmonary function tests are helpful. However flexible bronchoscope allows direct evaluation of the anatomy and function of the airways. During fiberoptic bronchoscopy, bronchoalveolar lavage fluid and biopsy specimens for cytology and histopathology can be obtained. It can be life saving as in assisting intubations in difficult airways.

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It does not replace the role of rigid bronchoscopy but complements it. The principal advantage of the rigid bronchoscope is that it allows complete control of the airways as it is able to function as a rigid endotracheal tube. It remains an important tool for the removal of foreign body, assessing the degree of stenosis for dilatation and / or laser therapy.

In Malaysia, very few centres perform flexible bronchoscopy in children. Initially the rigid bronchoscope was used to assess the paediatric airway by otorhinolaryngologists. However, these bronchoscopes were limited in their use particularly in assessing the smaller airways in neonates.

The paediatric flexible bronchoscopy service was started in 1996 in the paediatric respiratory unit in Universiti Kebangsaan Malaysia. From mid 1997, the paediatric respiratory unit at the Paediatric Institute, Hospital Kuala Lumpur continued to provide the service. We would like to share our experience with this procedure over the last five years.

### **Materials and Methods**

This is a retrospective review of all patients who underwent fiberoptic bronchoscopy at the paediatric respiratory unit from June 1997 to June 2002. The procedures were performed by NMZ or NAW. NMZ was always present during the bronchoscopy sessions. Both bronchoscopists are paediatric chest physicians and were trained in performing paediatric bronchoscopy. The procedure was performed using the Olympus BF3C30 fiberoptic bronchoscope with an outer diameter of 3.5 mm and the N20 with an outer diameter of 2.2 mm. Both bronchoscopes are produced in Japan. The N20 had no suction channel. Therefore, it can only be used as a diagnostic tool in neonates with no therapeutic ability. All the procedures were performed under general anaesthesia except in neonates where bronchoscopy was performed under sedation.

### **Sedation in Neonates**

The sedation/analgesia protocol was as recommended by the consensus statement of the American Thoracic Society<sup>2</sup>. The children were fasted for six hours prior to the procedure. The premedication was chloral hydrate at 50-100 mg/kg/dose. A good intravenous line was established before the procedure. Intravenous midazolam at 0.1 mg/kg /dose up to a total maximum dose of 0.2-0.3 mg/kg/ was given. A repeat dose was given after five minutes. Intravenous pethidine 0.5 mg-2 mg/kg was also given. Local anaesthesia was applied to the nasal cavity, vocal cords, trachea, carina and the bronchi. Two percent lignocaine solution was used to anaesthetise the upper airway and 1% for the lower airway. The child's vital sign which included the heart rate, respiratory rate and oxygen saturation (SpO<sub>2</sub>) were monitored continuously using a Nellcor pulse oximeter. Intranasal oxygen was delivered via nasal prong at 2 L/min to maintain saturation above 95%.

### **General anaesthesia in children**

General anaesthesia was administered by the paediatric anaesthetist. Intravenous propofol 2mg was given. Thiopentone 4 mg/kg was given in children less than one year, for older children the dose was 2mg/kg. Intravenous fentanyl was given at 1 microgram/kg to reduce the sympathetic effects. The children were oxygenated with 100% oxygen and volatile halothane/isoflurane were delivered to maintain sleep.

The bronchoscope was introduced via the laryngeal mask to assess the upper and lower airways. Bronchial secretions were obtain via bronchoalveolar lavage using 3-5 mls/kg of normal saline aliquots. The specimens were sent for microscopy, culture for bacterial, tuberculosis and fungus. Specimens for polymerase chain reaction (PCR) were sent when tuberculosis was suspected. All the sessions were videotaped and stored in a computer for documentation and review.

Following bronchoscopy, the heart rate, blood pressure and oxygen saturation were continuously monitored until the child was fully conscious in the ward. The child was allowed orally once he/she was fully awake.

## Results

One hundred and ten patients underwent the period of review. The indications for bronchoscopy were mainly diagnostic. There were 35 females and 75 males. The ethnic distribution was Malay (71), Chinese (24), Indian (9), Orang Asli (2) and Iban (4). The median age of the patients at the time of bronchoscopy was 8 months (Q1 3, Q3 30).

The commonest indication for performing bronchoscopy was the investigation of persistent or recurrent stridor. The stridor was moderate to severe associated with failure to thrive, feeding difficulties such as choking or desaturation during feeding and the need for oxygen supplementation. The other indications for bronchoscopy are shown in Table I. Table II shows the underlying aetiology for recurrent or persistent stridor in these children.

Of the three children with haemoptysis, one had negative findings, one had bronchial adenoma and one had generalised inflammation. In six children with bronchiectasis, one was diagnosed with tuberculosis, one had right bronchial stenosis and another had infection. The remaining three patients had no other abnormalities.

In children who were assessed for either lung collapse or consolidation, the findings were as follows: one child had endobronchial tuberculosis and two children had negative findings. Airway oedema due to inflammation and pus/secretions were found obstructing the airways in the remaining cases.

In children with tuberculosis, the indications for bronchoscopy were persistent collapse of the lung, endobronchial involvement, external compression due to lymph nodes.

Two children had negative findings; seven patients had intraluminal narrowing due to oedema and caseous material obstructing the lumen. Only one patient was positive for tuberculosis by polymerase chain (PCR) technique.

With regard to complications, the procedures were abandoned in three children due to persistent oxygen desaturation below 85%. One of them who had severe laryngomalacia developed laryngospasm during the procedure. He was ventilated for 48 hours and recovered fully. Five children had transient desaturation to 90% but it normalised immediately when the bronchoscope was withdrawn from the airway. Two neonates became more tachypnoeic following the bronchoscopy and were treated for pneumonia. There were no spontaneous pneumothorax or haemoptysis following the procedure.

**Table I: Indications for performing flexible bronchoscopy**

Indications	Number of patients* (%)
Chronic stridor	50 (45)
Collapse/consolidation of the lung	22 (20)
Tuberculosis	9 (8)
Bronchiectasis	6 (5)
Recurrent haemoptysis	3 (3)
Suspected foreign body	2 (2)
Pulmonary hypoplasia with recurrent left lung infection	2 (2)
Assessment of tracheostomy	3 (3)
Localized emphysema	1 (1)
Non specific causes	12 (11)

\*n = 110

**Table II: Bronchoscopic findings in children with chronic stridor**

Diagnosis	Number of patients* (%)
Laryngomalacia-moderate to severe	29 (58)
Subglottic stenosis	6 (20)
Primary tracheomalacia	4 (8)
Vascular Ring	1 (2)
Laryngeal cyst	1 (2)
Laryngeal web	1 (2)
Vocal cord palsy	3 (6)
Tracheal stenosis	1 (2)
Bilateral choanal atresia	1 (2)
Inflammation of the vocal cords	2 (4)
Normal	1 (2)

\*n = 50

## Discussion

Flexible bronchoscopy is an invasive procedure. However, it is fairly safe when performed under controlled situations. Since 1997, we performed all the procedures under general anaesthesia except in neonates. There are advantages and disadvantages of this. Very young children will often need deep sedation or general anaesthesia for the examination to be done with a similar degree of comfort and painlessness. It is unacceptable to bronchoscope a toddler under light sedation and restraints and only obtaining suboptimal endoscopic information due to movement, cough and obstructed view.

Bronchoscopy performed under sedation with topical anaesthesia of the airway mucosa, enables inspection of the dynamic anatomy of the airway particularly the upper airway during spontaneous respiration. The airway can be examined without much distortion or damage to the mucosa surface.

With general anaesthesia, the bronchoscope can be passed down via a laryngeal mask. It permits the inspection of the vocal cords, larynx, upper trachea and the lower airways. It may allow the inspection of movement of the vocal cords and epiglottis depending on the placement of the laryngeal mask in the upper airway.

When performing bronchoscopy under local sedation, qualified personnel must be present to assist in the monitoring and resuscitation. We found that performing bronchoscopy under sedation is more manageable in neonates. It is easier to sedate the neonates and manages the airways. A ventilator is always present on standby to ventilate if the need arises. In our experience none of the neonates required assisted ventilation following the procedure. In some centres as well as in ours it is preferred to perform flexible bronchoscopy in children under general anaesthesia<sup>3,4</sup>.

## Diagnostic Evaluation

There is lack of data and consensus on the indication for bronchoscopy. It is indicated whenever the information desired is best obtained by flexible bronchoscopy. The major clinical indications are for i) investigations<sup>5</sup> of recurrent or persistent stridor, expiratory wheeze or rhonchi when asthma has been excluded, ii) recurrent, persistent pulmonary infiltrates, iii) chronic cough when common conditions such as asthma and cystic fibrosis are excluded iv) hemoptysis, v) equivocal tracheobronchial foreign body, vi) assessing position, patency, or airway damage related to endotracheal and tracheostomy tubes and viii) to obtain samples of airway secretions and or cells by bronchoalveolar lavage.

Our data shows that the commonest indication is to investigate the underlying causes of stridor. There were cases of stridor that had been referred directly to the otorhinolaryngologist that were not included in the data because it was unsafe to perform flexible bronchoscopy due to the need of continuous ventilation and the need for immediate surgical intervention. A clinically meaningful result was found in 96% of cases with stridor; moderate to severe laryngomalacia being the commonest.

In the series by Wood et al<sup>6</sup>, the commonest indication for bronchoscopy was stridor. Forty percent of the stridor was due to laryngomalacia followed by subglottic oedema and stenosis. Stridor needs to be investigated when it is severe and progressive, causes apnoeic episodes, feeding difficulties, growth retardation or when symptoms point to a diagnosis other than infantile laryngomalacia. Vocal cord paralysis has been implicated as the second commonest cause of neonatal stridor<sup>7</sup>.

Expiratory wheeze or rhonchi is an indication for bronchoscopy, if it is localised and when other underlying causes such as asthma and cystic fibrosis have been ruled out. In a retrospective series<sup>8</sup> in 30 young children with recurrent wheeze that did not respond to bronchodilators, tracheomalacia was diagnosed in 12 children. Other causes that need to be excluded are vascular ring or tracheal stenosis.

In evaluating children with chronic cough<sup>9</sup>, bronchoscopy may play a role if conditions such as asthma, immunodeficiency, gastro-oesophageal reflux and chronic aspiration are excluded and therapeutic trials fail. Children with abnormal airway dynamics such as tracheomalacia may often have persistent cough usually precipitated by respiratory tract infection.

Rigid bronchoscopy remains the procedure of choice in removing foreign body. Flexible bronchoscopy is used to explore the airways of children who are less likely to have foreign body

aspiration with an option to switch to rigid bronchoscopy when a foreign body is found. In the author's experience, flexible bronchoscopy was used twice to localise a foreign body that had migrated into the smaller airways. Since the foreign body was not accessible by the rigid bronchoscope, open thoracotomy was performed. The flexible bronchoscope was used to localize the foreign body. Thus enabling the surgeon to access the site through the incision.

In tuberculosis, bronchoscopy is important in deciding on the use of steroid therapy especially in children with a chest radiograph that does not suggest bronchial involvement. Approximately 60% of children with pulmonary tuberculosis had bronchial abnormalities detected on bronchoscopy<sup>10</sup>. In diagnosing tuberculosis, gastric lavage gives a better yield than bronchoalveolar lavage for isolation of *Mycobacterium tuberculosis*<sup>11</sup>.

Bronchoscopy is an essential investigation in bronchiectasis particularly when it is localised. Structural abnormalities and foreign bodies can be excluded as seen in one of our patients as well as obtaining secretions for culture.

In tracheostomised patients the American Thoracic Society (ATS) and the European Respiratory Society<sup>12</sup> (ERS) recommend regular surveillance bronchoscopy with either the rigid or flexible bronchoscope every six to 12 months. If decannulation is not planned only the trachea around and below the tracheostomy needs to be inspected.

There are limitations to flexible bronchoscopy. The patient must be able to breathe spontaneously around the instrument. The examination must be brief in children under two years of age and the bronchoscope removed when oxygen desaturation occurs. Careful attention to the patient's physiological status is vital.

As illustrated, the paediatric flexible bronchoscopy has become an important diagnostic tool.

Although there are very few doctors who are trained in paediatric flexible bronchoscopy, we hope that we are able to expand the expertise with

proper and adequate training in the paediatric respiratory subspeciality.

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