

Original Articles

Review of Bronchoscopy Results of Paediatric Patients with Persistent Stridor and Refractory Wheezing

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Abstract

Objective: To review the results of bronchoscopy of patients presenting with persistent stridor and refractory wheezing and to find out the diagnostic yield and complication rate of this procedure. **Methods:** It is a retrospective review. Information of the individual patients, findings, complications and laboratory results of the bronchoscopies were retrieved from the log book and hospital records for analysis. **Results:** Forty-four patient records were analysed. All patients presented with persistent stridor (n=32) had pathologies identified and 6 out of 12 patients (50%) with persistent or recurrent wheezing had lesions detected in their airways by bronchoscopy. Patients with underlying diseases were more likely to have abnormalities found (p<0.05). There was no fatalities in our series. Transient desaturation was the most common complication and was encountered in 19 patients. Patients less than 1 year had a significantly higher risk of desaturation (p=0.006, OR=5.95). **Conclusions:** Our study results showed that bronchoscopy is a safe and useful clinical tool for investigation of patients with persistent stridor or refractory wheezing. We recommend routine administration of supplementary oxygen to young patients during bronchoscopy to prevent transient desaturation.

Key words

Flexible bronchoscopy; Stridor; Underlying disease; Wheezing

Introduction

Flexible bronchoscopy (FB) has been widely used for the investigation of paediatric respiratory disease since it first became available for paediatric use in 1978.¹ There are a lot of clinical indications for FB in paediatric patients. Stridor and wheezing are among the two commonest causes for performing FB.²⁻⁴ FB has been well recognised for its diagnostic effectiveness when carried out under appropriate indications.⁵ The service of FB has been introduced in our department since 1998. We are interested to find out the

diagnostic yield of FB under our hand when compared with other series. Therefore, we decided to review the bronchoscopy results of our patients who presented with persistent stridor and refractory wheezing. We would also like to know from our results the safety of this clinical procedure and its contribution to the clinical management of this group of patients.

Methods and Statistics

All information of bronchoscopies including demography, indications, drugs used for sedation, endoscopic findings, bronchoalveolar lavage results and complications were recorded in a log book. We included in our study all patients of whom the indications for bronchoscopy undertaken between 1st July of 1998 to 31st December of 2002 were either 1) persistent stridor or 2) persistent or recurrent wheezing for greater than 1 month with poor response to inhaled or systemic corticosteroid. Data of these patients were retrieved from the log book and hospital records for further analysis.

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Parents or legal guardians were asked for their informed consent before performing the bronchoscopy. All bronchoscopies were performed in the paediatric intensive care unit. During the procedure, the heart rate and oxygen saturation were continuously monitored by pulse oximeter and cardiac monitor. An experienced assistant was also present to administer medications, monitor the clinical status of the patients and assist in doing bronchoalveolar lavage (BAL). Various medications were used for sedating the children including midazolam (0.1-0.2 mg/kg), chloral hydrate (50 mg/kg), ketamine (1-2 mg/kg), pethidine (1 mg/kg) or combination of the above. Lignocaine solution was dripped into the nose to achieve topical anaesthesia.

Bronchoscopy was performed with Olympus model LF-P, LF-T, BF3C20. The airway was carefully inspected to search for any anatomical lesions, abnormal mobility of the airway wall and inflammatory change of the mucosa. The findings of the process were videorecorded for review after the procedures.

BAL was performed if there were clinical indications by gently wedging the tip of the bronchoscope in a segmental or subsegmental bronchus of the right lower lobe. 2 to 3 ml/kg aliquots of warm normal saline solution was then instilled followed by immediate aspirating the BAL fluid (BALF) into a sterile specimen container with wall suction at ~100-150 mmHg. The BALF obtained after each instillation was pooled and sent to laboratory for analysis. BALF were cultured for bacteria and virus. Bacterial pathogens identified was considered significant only if a single organism was isolated at >10⁴ CFU/ml. A semiquantitative lipid laden macrophage index (LLMI) was calculated if clinically indicated by examining 100 alveolar macrophages of the Oil-Red-O stained specimen for the amount of intracellular lipid. An LLMI >85 was regarded as elevated which is suggestive of aspiration.

The patients were divided according to their age into two groups (0-1 year and >1 year). Association between age and possibility of airway pathology, site of the lesions, complications during the procedure was examined with chi square test and Fisher exact test. Further analysis was performed to define the correlation between desaturation during bronchoscopy and underlying diseases, clinical symptoms, drugs used of sedations. P value was considered statistically significant if it was less than 0.05.

Results

A total of 143 patients had bronchoscopies during the

study period and 44 children fulfilled the inclusion criteria of our study. There were 25 boys and 19 girls. The mean age of the study population was 2.4 years old with their range from 4 days to 18 years old. Twenty-two bronchoscopies were performed on patients less than 1 year old. Thirty-two patients had bronchoscopies because of persistent stridor whereas persistent or recurrent wheezing was the indication for the clinical procedure in the other 12 patients. Thirty patients had underlying diagnoses apart from the suspected airway disease (Table 1).

Bronchoscopic Findings

Airway pathologies were identified in 38 out of 44 patients. Six in the group of patients with wheezing (50%) had abnormalities detected on bronchoscopy. All patients with persistent stridor as their indication for bronchoscopy had airway lesions found during the procedure. Bronchoscopic diagnoses of both groups were listed in Table 2 and Table 3 respectively. Laryngomalacia and pharyngeal collapse represented the most common upper airway abnormalities. Normal anatomy is the main bronchoscopic finding (50%) of the lower airway. The patients with underlying diseases were more likely to have airway lesions identified if they presented with either persistent stridor or refractory wheezing and this association was found to be statistically significant (p<0.05). Equal numbers of patients with airway pathologies were found in both groups with age less than and older than 1 year (p=1.0).

BAL Findings

BAL was performed on 7 patients. LLMI was elevated in 2 patients (LLMI=160 and 100). One of them had stridor

Table 1 Underlying diseases of the patients

Underlying diseases	No. of patients (%)
Cerebral palsy	16 (36.4)
Multiple congenital abnormalities	4 (9)
VATER syndrome	2 (4.5)
Congenital heart disease	1 (2.2)
Arthrogyriposis	1 (2.2)
Pierre Robin syndrome	1 (2.2)
Congenital nephrotic syndrome	1 (2.2)
Penashoken syndrome	1 (2.2)
β thalassaemia major	1 (2.2)
IgA dermatosis	1 (2.2)
Dextrocardia	1 (2.2)

Table 2 Bronchoscopic findings of patients with persistent stridor

Bronchoscopic diagnoses of patients with stridor	No. of patients (%)
Laryngomalacia	17 (38.6)
Pharyngeal collapse	7 (16)
Laryngitis	1 (2.2)
Tracheomalacia	1 (2.2)
Bronchomalacia	1 (2.2)
Bilateral vocal cord palsy	1 (2.2)
Bronchitis	1 (2.2)
Vallecular cyst	1 (2.2)
Swollen arytheniod epiglottic fold	1 (2.2)
Blisters	1 (2.2)

Table 3 Bronchoscopic findings of patients with refractory wheezing

Bronchoscopic diagnoses of patients with persistent or recurrent wheezing	No. of patients (%)
Normal anatomy	6 (13.6)
Tracheomalacia	2 (4.5)
Bronchomalacia	2 (4.5)
Vascular compression of bronchus	1 (2.2)
Laryngomalacia	1 (2.2)

clinically and was found to have his aryepiglottic fold swollen on bronchoscopy. He was subsequently confirmed to have gastroesophageal reflux with 24-hour lower oesophageal pH-monitor. None of the patients had virus isolated in their BAL samples. *Pseudomonas aeruginosa* was recovered from 1 patient who had airway abnormalities found as well.

Sedation

Twenty-seven patients were sedated with midazolam alone during the bronchoscopy. Chloral hydrate was used as the sole sedative agent for the procedure in 6 patients. Ketamine was given to 2 patients. Nine patients required combination of either midazolam, ketamine, chloral hydrate or pethidine because of difficult sedation during the procedure.

Complications

There was no fatalities in our series. Transient oxygen

desaturation occurred in 19 patients. Five of them had more severe desaturation with oxygen saturation dropping below 90 percent. Most patients responded to supplementary oxygen. However 2 patients suffered from more prolonged desaturation requiring ambubagging in one and administration of flumazenil in the other. Apnoea was experienced by 2 patients during the procedure. Three patients developed fever after bronchoscopy of which 1 of them had BAL performed. All 3 patients had their fever subsided within one day. There was no correlation found between the types of sedation and isolated oxygen desaturation ($p=0.902$). No difference on the rate of desaturation was noticed between the patients with underlying diseases and those without underlying diseases ($p=0.533$). Patients with stridor had more desaturation comparing to the group with wheezing (15 of 32 *versus* 4 of 12) but this was not statistically significant ($p=0.419$). There were significantly more occurrence of oxygen desaturation in patients aged less than 1 year old comparing to the older patients (14 of 22 *versus* 5 of 22, $p=0.006$, odds ratio=5.95, 95% confidence intervals 1.95-22.33).

Therapeutic Changes

Diagnostic findings of the bronchoscopies has led to therapeutic changes in 15 patients (34%). These changes included surgical intervention ($n=7$), adjusting the dosage or initiation of corticosteroid therapy ($n=6$), antimicrobial therapy ($n=1$), commencement of noninvasive mechanical ventilation ($n=1$).

Discussion

Our study results indicated that we have achieved a high diagnostic yield with the use of FB in our patients with persistent stridor and wheezing. We have been able to identify bronchoscopic diagnoses in all patients presenting with stridor. Laryngomalacia constitutes the most common diagnosis in this group and this result is consistent with other published series.^{2-4,6} Surprisingly, pharyngeal collapse was found to be the next commonest lesion of the upper airway pathology. This can be related to the significant numbers of patients with cerebral palsy included in the present study and neurasthenic laryngomalacia is known to be a complication of cerebral palsy.⁷ In contrast to other large clinical series, adenoid hypertrophy had not been found in our patients. This may be due to the fact that patients with obstructive sleep apnoea do not usually present

with persistent stridor or wheezing and therefore were not being included in our study. Acute stridor is definitely not an indication for bronchoscopy. However, one of our patient was examined for delayed resolution of stridor after 3 weeks. She was diagnosed to have laryngitis on FB and her symptom subsided subsequently after completing a short course of oral steroid. Another patient worth mentioning was a neonate presenting with skin bullae and stridor on the first few days of life. Bronchoscopy revealed swollen larynx and a vesicle on the left aryepiglottic fold. The diagnosis of IgA dermatosis was later confirmed by skin biopsy.

In the group with persistent or recurrent wheeze, diagnostic findings were obtained in 6 patients (50%). The diagnostic rate of this group is relatively low when compared with other published series. This can be explained by the few numbers of BAL being performed during the bronchoscopy. Schellbase et al and his colleagues described in their study the high yield of clinically useful information by using bronchoscopy together with BAL.⁸ In retrospect, BAL should have been more frequently done to improve the diagnostic yield. Only one patient with persistent wheezing was found to have vascular compression of the airway despite this diagnosis was reported to be relatively common in other series.⁸ But that may be due to the small number of patients in the present study. Though upper airway abnormality is not usual cause of wheezing, one patient with persistent wheeze had laryngomalacia as the only bronchoscopic finding. His BAL findings showed elevated LLMI. He was subsequently diagnosed to have gastroesophageal reflux by 24-hour lower oesophageal pH study. His clinical symptom could have been explained by the gastrointestinal disease.

The incidence of concurrent upper and lower airway lesions on bronchoscopy was reported to be 14% and 17.5% in two series.^{4,9} Only one patient in our series had synchronous upper and lower airway pathology, namely laryngotracheobronchomalacia. But the low incidence may be attributed again to the small number of cases. So despite being an uncommon finding in our results, we still recommend examination of the lower airway even when the plausible cause of stridor has been demonstrated to be of upper airway origin in order not to miss any important lower airway pathology.

From our results, we observed that all patients with underlying diseases and persistent stridor or refractory wheezing had airway lesions detected by bronchoscopy. Bronchoscopy should be seriously considered as a choice

of investigation in this group of patients.

Desaturation was the most frequent complication arising from the procedure. Five patients had oxygen saturation dropped below 90%. Most of these events were transient and these patients usually responded to administration of supplementary oxygen. However, one patient required ambubagging while flumazenil was given in another patient during the desaturation episode. In contrast to de Blic et al's study,¹⁰ oxygen and bronchodilator were not given systemically to our patients before bronchoscopy, this could perhaps partly account for the slightly higher rate of minor desaturation seen in our series. Another possible reason was the large number of young patient included in the present study. The size of their airway might be smaller and thus more prone to partial or total obstruction leading to oxygen desaturation. Also higher dosage of sedative drugs was sometimes required in this group of patients as they were the ones who struggled the most during the procedure. This might in turn result in respiratory depression causing desaturation. In fact, patients aged less than one year were noticed to have significantly higher risk of desaturation in our study. This observation is in consistent with the results of other published series describing more frequent oxygen desaturation in very young children.^{10,11} In view of this, we recommend routine administration of supplementary oxygen to young patients both prior to and during bronchoscopy. Patients with laryngotracheal abnormality were reported to have more frequent desaturation.¹⁰ However, we have not been able to identify such association from our results.

No patient died nor required prolonged intensive care secondary to respiratory deterioration after the procedure. There was no correlation observed between complication and types of sedation used. This is in agreement with the findings of other series.¹⁰ Interestingly, epistaxis which was widely reported in other studies had not been encountered in our patients.^{3-6,10}

Seven patients subsequently required surgical intervention for their airway lesions. The bronchoscopic findings contributed significantly to the change of medical treatment in another 8 patients. Even for those with mild airway lesions not requiring intervention or negative findings, FB still enabled us to give reassurance and relieved the concern of the parents.

In conclusion, we found from the results of our study that bronchoscopy was a safe clinical procedure and it provided useful information for the management of patients presenting with persistent stridor and refractory wheeze.

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