PAEDIATRIC FLEXIBLE BRONCHOSCOPY: EXPERIENCE FROM PESHAWAR

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ABSTRACT

Background and Objective: Flexible bronchoscopy is an important procedure in respiratory medicine. There is no local data available summarizing the experience of flexible bronchoscopy in pediatric population. We, therefore, decided to documents and record all bronchoscopies performed on children in our unit. The aim was to find different indications for flexible bronchoscopy, explore the diagnostic yield for these indications and highlight the potential complications.

Methodology: Seventy one (71) diagnostic and therapeutic bronchoscopies, performed in children during a 14 years period, were analyzed.

Results: There were 46 male and 25 female. Age ranged from 40 days to 13 years, with a mean age of 6.47 years ± 3.719 SD.Suspected foreign body inhalation (19 cases), persistent lower zone opacity (11 cases) and opaque hemithorax (9 cases) were the most common indications. Fifty (70) % of bronchoscopies had a meaningful outcome. Diagnostic yield for individual indications ranged from 25 % to 100 %. Recurrent infections, as a group, were the most rewarding indications (100% diagnostic yield); followed by radiographic abnormalities as a group (71 % diagnostic yield). Complications were recorded only in 9.8 % of the children. Oxygen de-saturation was the most common (4.2 %) but easily reversible complication; rest of the complications was small in numbers and also easily reversible.

Conclusions: Flexible bronchoscopy in children is a safe procedure and the overall meaningful outcome for most indications is high.

Key Words: Bronchoscopy; Pediatric Bronchoscopy; Diagnostic/Therapeutic Bronchoscopy.

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INTRODUCTION

Flexible bronchoscopy (FB) is one of the most important and commonly performed procedures in adult pulmonary medicine.[1,2] FB was initially performed in pediatric population in 1978 and since then its use in this population is constantly increasing. This is because of the availability of high quality optics in appropriately sized flexible instruments.[3-5]

Pediatric bronchoscopy has come into fashion mainly through the efforts of respiratory physicians originally trained in adult flexible bronchoscopy. In the recent decades, flexible bronchoscope has become an integral part of pulmonary practice. Its use has progressively increased to help cover the visual diagnosis of the upper and lower airways lesions. It is also use for interventional, therapeutic and supportive work such as obtaining bronchoalveolar lavage (BAL) for cytological, virological, bacteriological and immunological investigations.[6] Other potential indications include bronchoscopic intubation for anesthetists, catheterization of fistulae, intra-operative assistance for cardiac and airway surgery, removal of distal foreign bodies not reached by rigid instruments and limited selective segmental or lobar

bronchographic procedures.

The pediatric airway has many differences in anatomy and pathology as compared to adult airways. The small size of the children airways, differences in the anatomy of the larynx as well as the differences in pathologies according to age group, are characteristics that make the endoscopic examination of the pediatric population quite unique and different from adults.[7]

Common indications for pediatric flexible bronchoscopy are stridor, voice disturbance, persistent productive cough, unusual cough, hemoptysis, persisting chest signs such as wheeze or crackles in a localized area, persistent radiographic infiltrates or atelectasis, recurrent infiltrates, recurrent pneumonia or interstitial disorders.[6]

The aim of the present study was to share personal experiences of performing bronchoscopy, as a diagnostic and therapeutic tool, in pediatric population referred to our department with certain indications.

MATERIAL & METHODS

This was a prospective, diagnostic/therapeutic and descriptive study, conducted at Pulmonology department, Post Graduate Medical institute, Lady Reading Hospital Peshawar, from 2000 to 2013. The study was conducted on a diverse group of patients received for bronchoscopy from all over Khyber Pakhtunkhwa, adjacent areas of Punjab and Afghanistan. The referring doctors also belonged to different specialties, including pediatricians, pulmonologists, thoracic and E.N.T surgeons, general physicians and general practitioners. Database recordings included demographic characteristics, indications, bronchoscopic findings, bronocho-alveolar wash analysis and complications. The patients were booked for the procedure on the basis of preliminary examination, clinical symptoms and X-ray examination. All patients' clinical record was reviewed to determine and reconfirm the indication for bronchoscopy. Informed written consent was taken from the guardians of patients before performing the procedure.

Flexible bronchoscopy was performed in a designated bronchoscopy suite. Patients were advised to come for the procedure nil by mouth for at least 4 hours before bronchoscopy. A combination of premedication's including sedative agents (midazolam, 1 to 2 mg i/v), local anesthesia (2%lignocain) and supplemental oxygen (minimum 2 L/min) were administered. Midazolam was not used in children below two years of age. Lignocain jelly (02 %) was applied to the bronchoscope and lignocain solution (02 %) sprayed into the nostrils via a syringe and then applied to the larynx and trachea via the bronchoscope. Bronchial wash was obtained for microbiological examination when needed as per indication. When foreign body inhalation was confirmed and localized but its removal was not feasible, the patient was referred for rigid bronchoscopy.

Children with stridor were bronchoscoped when there was a suspicion for diagnosis other than laryngomalacia or when there was failure to thrive. Children with recurrent infection were bronchoscoped when they failed to respond to appropriate antimicrobial agent for an appropriate period of time. We looked into diagnostic yield for each indication as well as analyzed the positive bronchscopic findings.

At least one consultant pulmonologist, independent from the operator, and two bronchoscopy technicians would monitor the respiration, cyanosis, pulse rate and oxygen saturation during the procedure. Children becoming hypoxic or distressed during the procedure were observed in the recovery room or ward for atleast1-3 hours. Supplemental Oxygen inhalation and sulbutamol $\pm$ steroid nebulization carried out, as per need, till complete stability of the child.

In early infants small bronchoscope, without suction channel, was used mainly for diagnostic purpose. The infant would be held by the mother sitting, on the couch, cross legged/Indian style. The whole procedure was performed very quickly. The bronchoscope was removed from trachea within 30 seconds as only diagnostic inspection of the airways was done. That was how the procedure would be performed without making the baby much fretful i.e. without expressing distress or irritation.

Continuous supplemental oxygen inhalation was carried out via a nasal cannula through the free nostril. Continuous pulse and oxygen saturation monitoring done via pulse oximetry. Two flexible bronchoscopes were used, Olympus BF type PE2 (outer diameter 4.9 to 5.0 mm) and Olympus BF type N 20 (outer diameter 1.8 to 2.2 mm). Flexible bronchoscopy was performed via the nasal route in most cases. However oral route was used if nasal route was too narrow for the scope to pass and when foreign body removal was a possibility, as determined by pre procedure assessment.

Data were analyzed by using SPSS version 15.0.Frequencies / Percentages were calculated for qualitative variables, while Mean$\pm$ standard deviation was calculated for quantitative variables. We looked into diagnostic yield for each indication as well as analyzed the positive bronchoscopic findings.

RESULTS

Out of total 71 children, 46 were male and 25 were female. Male to female ratio was 1.84:1. The age of patients ranged from 40 days to 13 years, with a mean age of 6.47 years and standard deviation of ± 3.719 SD.

Different indications for bronchoscopy and their positive bronchoscopic findings/diagnostic yields are summarized in (table 1). Persistent radiological opacity was the commonest indication, 25 (35.21 %) cases. This was followed by bronchoscopy for suspected foreign body inhalation, 19 (26.76 %) cases.

The overall diagnostic yield (success rate for finding a cause for the indicated pathology i.e. meaningful outcome) was 70 %. Most indications had a high diagnostic yield (between 66 and 100 %).The highest diagnostic yield (100%) was found, when bronchoscopy was performed for infection as an indication; a positive diagnostic yield for infection was defined as the presence of purulent secretions and bronchial inflammation. Suspected foreign body inhalation and opaque hemithorax had a relatively lower diagnostic yield, 10 out of 19 cases (52 %) and 5 out of 9 cases (55%), respectively, while children referred with hemoptysis had the lowest diagnostic yield (25 %).

Table 2 summarizes the site of pathology in different indications. Left lung was the most common site of pathology, 30 cases (42.3%). Right lung was involved in 21 patients (29.6 %). In four cases the pathology was central (5.6%) and in one child both sides were involved. Fifteen (21.1%) patients had normal bronchoscopy study. Right lung was the most common site of involment in children with recurrent chest infections (85.7%), persistent mid-zone opacity (66.7 %) and foreign body inhalation (63.2%); while left lung was mostly involved in children with opaque hemithorax (88.9%) and persistent lower-zone opacity (90.9%).

Abnormal findings on bronchoscopy are summarized in table 3. The table shows that most patients, 21 (29.6%), had a normal study. Increased secretions, 12 (16.9%) and inflammation with or without increased secretions, 10 (14.0%), were the most common abnormal bronchoscopic findings. Foreign body localization, 10 (14.0%) cases, was also a common findings. Bronchial tumour was noted in two patients. One patient had aberrant upper division and stenosed lower division of left main bronchus. Another had agenesis of left lung.

Therapeutic bronchoscopy was limited to foreign body removal mainly. Among patients with a confirmed foreign body aspiration 60% (06 cases) were male, whereas girls accounted for 40% (04 cases). The mean age of the patients with a confirmed aspiration was 6.52 years. In 60% (06 cases) children, foreign body was identified on right side. While 40% (4 cases) the aspiration was on left side. In 2 children foreign body was successfully removed without any compli-

Table 1: Different indications for bronchoscopy and their diagnostic yield (n=71)

Indications	Total Patients	Pathology Identified	Undiagnosed / Pathology not Identified	Diagnostic Yield (%)
Suspected FB inhalation	19	10	9	52
Persistent lower zone opacity	11	8	3	72
Opaque hemithorax	9	5	4	55
To look for endobronchial pathology	9	8	1	88
Recurrent infection	7	7	0	100
Hemoptysis	4	1	3	25
Persistent midzone opacity	3	2	1	66
Tracheobronchial injury	3	3	0	100
Persistent upper zone opacity	2	2	0	100
Collapse lung	2	2	0	100
Stridor	1	1	0	100
Evaluation of tracheostomy tube	1	1	0	100
Total	71	50	21	70

Table 2: Site of pathology in different indications (n=71)

Indications	Site					Total
	Normal	Right Lung	Left Lung	Central	Bilateral	
Suspected FB identified	9	6	4	0	0	19
	47.4 %	31.6%	21.0%			
Persistent lower zone opacity	0	1	10	0	0	11
		9.1%	90.9%			
Opaque hemithorax	0	1	8	0	0	9
		11.1%	88.9%			
To look for endobronchial pathology	2	1	4	2	0	9
	22.2 %	11.1%	44.4%	22.2%		
Recurrent infection	0	6	0	0	1	7
		85.7%			14.3%	
Hemoptysis	3	0	1	0	0	4
	75%		25.0%			
Persistent midzone opacity	0	2	1	0	0	3
		66.7%	33.3%			
Tracheobronchial injury	1	2	0	0	0	3
	33.3 %	66.7%				
Persistent upper zone opacity	0	1	1	0	0	2
		50.0%	50.0%			
Collapse lung	0	1	1	0	0	2
		50.0%	50.0%			
Stridor	0	0	0	1	0	1
Evaluation of tracheostomy tube	0	0	0	1	0	1
Total	15	21	30	4	1	71
	21.1 %	29.6%	42.3%	5.6%	1.4%	100.0%

cations during the course of the procedure. Other cases were referred for rigid bronchoscopy. Therapeutic option of bronchoscopy, done primarily for some other indication, was also used to suck out copious bronchial secretions in 22 (30.9 %) cases.

Complications during and after bronchoscopy were minor and recorded only in 9.8% of the children. Oxygen de-saturation was the commonest (4.2%), though easily reversible by increasing the flow of oxygen inhalation without interrupting the procedure. Three children experienced oxygen de-saturation during the procedure that required removal of the bronchoscope. Two patients had minor bleeding that stopped spontaneously. Only one patient had severe bronchospasm immediately after the procedure which subsided with nebulized steroid and bronchodilator therapy. One child with suspected foreign body inhalation was too restless, despite conscious sedations with 2 mg medazolam, to undergo bronchoscopy. He would pull the bronchoscope out, when an attempt would be made to get into his nose. He was excluded from the study.

DISCUSSION

The pediatric airway has many differences in anatomy and pathology as compared to adults and therefore diagnostic and therapeutic skills have to be

Table 3: Bronchoscopic findings (n=71)

Bronchoscopic Findings	Number of Patients	%
Normal findings	21	29.65
Increased Secretions	12	16.95
Foreign Body localized	10	14.00
Increased secretions and / or inflammation	10	14.00
Narrowing / stenosis	6	8.50
Narrowing due to external compression	4	5.65
Inflammation with granulation tissue	3	4.25
Bronchial tumour	2	2.80
Tracheoesophageal fistula	1	1.40
Agenesis of left lung	1	1.40
Aberrant upper division and stenosed lower divison of left main bronchus	1	1.40
TOTAL	71	100

very different and unique.[7] We therefore undertook this prospective study in order to share personal experiences regarding different indications for bronchoscopy in our pediatric population, explore diagnostic yield for these indications and highlight potential complications. Similar study reports come from different centers across the globe with variable numbers of procedures performed on diverse populations.[5,8] These differences in local practice and expertise, as well as the difference in patient populations and ages, makes comparisons between different centers problematic.[9]

Regarding indications for bronchoscopy, radiological abnormalities such as persistent opacity or atelectasis were the commonest ones (38 %). Moreover in our study these radiological abnormalities also had a high diagnostic yield of 71 %. Our team, originally trained in adult bronchoscopy, had to develop pediatric bronchoscopy skills because of lack of specialist pediatric bronchoscopists. Despite of this, overall 70 % of pediatric bronchoscopies had a meaningful outcome. This outcome is similar to the figures published by Maffey et al recently and Wood et al reported 30 years ago.[10, 11] Moreover Pérez- Godfrey et al and Ruiz et al reported an overall abnormality in 67% and 69 % of the children, respectively, that underwent bronchoscopy over a ten years period.[12, 13] Kabra et at form India reported a lower diagnostic yield of 54 %.[14]

In our study foreign bodies were identified in 10 out of 19 patients who were bronchoscoped for suspected foreign body inhalation. Out of the 10 children, with confirmed foreign body inhalation, foreign bodies were extracted in two children only and the rest were referred for rigid bronchoscopy. Although there are studies that reported successful extraction of aspirated foreign bodies by using fiexible bronchoscope, others strongly believe that Flexible Bronchoscope should not be used for foreign body removal.[15, 16] It is important to note that in our study 9 out of 19 children did not have a foreign body and thus flexible bronchoscopy obviated the need for rigid bronchoscopy. We therefore suggest that in cases where a diagnosis of foreign body aspiration is not certain, flexible bronchoscopy should be the diagnostic modality of choice to avoid the risk of general anesthesia for rigid bronchoscopy.[17, 18] Moreover, there is a need for high index of suspicion for FB aspiration because this entity can mimic various pathologies.[19]

We bronchoscopied 7 children with recurrent infections to look for the cause of repeated infections. Children with recurrent infection were bronchoscoped only when they failed to respond to an appropriate antibiotic for an appropriate period of time. The most common findings included abundant secretions with or without infiammed mucosa. This finding of otherwise normal bronchoscopy is similar to other study reports. Moreover, normal bronchoscopy can be very reassuring for parents of the children who suffer cough and fever for a long time.[20] In these cases therapeutic suctioning was done and bronchial washings sent for microbiological examinations routinely. This has been reported to be of great help in patients with persistent or recurrent infection.[21]

In our study complications were in small numbers

and easily reversible. The proportion of complications were in accordance with other studies.[20,22] Literature review shows that in proper designated sittings and in experienced hands flexible bronchoscopy is a safe procedure. However, fatalities have been reported with the procedure. Therefore adherence to standard protocols, by carrying out the procedure in a designated bronchoscopy suite in a hospital sitting and careful monitoring, is recommended to avoid morbidities and mortalities during the procedure.[1, 23, 24]

CONCLUSION

Flexible bronchoscopy in children has a high diagnostic yield, overall 70%. Suspected foreign inhalation and persistent radiological opacity are the most common indications for flexible bronchoscopy. The therapeutic indications are practically limited to foreign body. Therapeutic suction of copious bronchial secretions constitutes a secondary therapeutic indication. The procedure is safe and complications are rare and easily manageable.

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