นิพนธ์ต้นฉบับ

A 10 - year - review of pediatric laryngoscopy and bronchoscopy at King Chulalongkorn Memorial Hospital

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Objective : *To review the authors' experience with children who underwent flexible laryngoscopy and bronchoscopy over a 10 - year period.*

Setting : *Department of Pediatric, Faculty of Medicine , Chulalongkorn University*

Research design : *Retrospective descriptive study*

Patients/Methods : *Two hundred and two children who underwent flexible laryngoscopy and bronchoscopy at the Pediatric Department between December 1988 and December 1998 were reviewed.*

Results : *A total of 233 flexible endoscopic procedures (148 laryngoscopy only, 85 bronchoscopy) were performed in children ranging in age from 9 day to 14 years. Eighty - two percent of the children were examined for signs and symptoms of upper airway disease. The indications among this group were stridor (62.0 %), problems related to intubation (13.8%) and hoarseness (10.8%). The most common finding in this group was laryngomalacia (69 cases,41.6%), followed by subglottic lesions (14 cases, 8.4%) and glottic lesions (12 cases, 7.2%). Lower airway obstruction (tracheomalacia, external compression of the trachea) was also found in 3.6% of the cases. Pulmonary lesions were the indication for bronchoscopy in 36 children (17.8%). Atelectasis and lower airway obstruction were*

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presenting signs in 16 cases of this group and their causes were found in 14 cases. In 20 children with pneumonia, bronchoscopy was performed for bronchoalveolar lavage and brush biopsy. Twenty-five children were referred to the ENT department for endoscopy under general anaesthesia and15 children had surgical correction performed.

Conclusion : *Flexible laryngoscopy and bronchoscopy is a safe and useful diagnostic technique in children with various respiratory problems, especially in children with signs of upper and lower airway obstruction.*

Key words : *Flexible fiberoptic bronchoscopy, Laryngoscopy, Children.*

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จิตลัดดา ตีโรจนวงศ์, นวลจันทร์ ปราบพาล, สุชาดา ศรีทิพยวรรณ. การส่องกล้องตรวจทางเดินหายใจในเด็กที่โรงพยาบาลจุฬาลงกรณ์ในช่วงระยะเวลา 10 ปี . จุฬาลงกรณ์เวชสาร 2542 มิ.ย; 43(6): 361-71

วัตถุประสงค์ : *เพื่อรวบรวมและรายงานประสบการณ์การส่องกล้องตรวจทางเดินหายใจในเด็ก โดย Flexible fiberoptic bronchoscopy ในช่วงระยะเวลา 10 ปี*

สถานที่ที่ทำการศึกษา : *ภาควิชากุมารเวชศาสตร์ คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย*

รูปแบบการวิจัย : *Retrospective descriptive study*

ผู้ป่วยและวิธีการศึกษา : *รวบรวมข้อมูลต่าง ๆ ของผู้ป่วยเด็กจำนวน 202 รายที่เข้ารับการส่องกล้องตรวจทางเดินหายใจที่ภาควิชากุมารเวชศาสตร์ระหว่างเดือนธันวาคม 2531 ถึง ธันวาคม 2541*

ผลการศึกษา : *ทำการส่องกล้องตรวจทางเดินหายใจในเด็กอายุตั้งแต่ 9 วัน ถึง 14 ปี มีการส่องกล้องตรวจรวมทั้งสิ้น 233 ครั้ง เป็นการตรวจเฉพาะกล่องเสียงและส่วนที่อยู่เหนือกล่องเสียง (Laryngoscopy)148 ครั้ง และส่องตรวจในหลอดลมด้วย 85 ครั้ง 82% ของเด็กเข้ารับการตรวจด้วยอาการอุดกั้นของทางเดินหายใจส่วนบน โดยมีข้อบ่งชี้ที่สำคัญดังนี้ stridor 62.0% อาการที่เกี่ยวเนื่องกับการใส่ท่อช่วยหายใจ 13.8% และเสียงแหบ 10.8% ความผิดปกติที่พบบ่อยในเด็กกลุ่มนี้คือ laryngomalacia 41.6% ความผิดปกติบริเวณ subglottic 8.4% และบริเวณกล่องเสียง 7.2% ในเด็กกลุ่มนี้พบว่ามีความผิดปกติของหลอดลมร่วมด้วยถึง 3.6% เด็ก 36 ราย(17.8%) เข้ารับการส่องตรวจในหลอดลมเนื่องจากความผิดปกติในปอด 16 ราย ในกลุ่มนี้มีภาวะปอดแฟบหรือลักษณะของหลอดลมอุดกั้นและตรวจพบสาเหตุได้ถึง 14 ราย ผู้ป่วยเด็ก 20 ราย เป็นปอดอักเสบและได้รับการส่องกล้องตรวจเพื่อหาเชื้อที่เป็นสาเหตุโดยการทำ Bronchoalveolar lavage และ brush biopsy ผู้ป่วยเด็ก 25 รายถูกส่งต่อยังแผนกโสต นาสิก ลาริงซ์วิทยา เพื่อทำการส่องกล้องตรวจทางเดินหายใจซ้ำโดยการดมยาสลบ และ 15 รายได้รับการผ่าตัดแก้ไขร่วมด้วย*

สรุป : *Flexible laryngoscopy และ bronchoscopy เป็นการตรวจวินิจฉัยที่ปลอดภัย และมีประโยชน์อย่างยิ่งในเด็กที่มีปัญหาทางระบบหายใจ โดยเฉพาะเด็กที่มีปัญหาทางเดินหายใจอุดกั้นทั้งส่วนบนและส่วนล่าง*

Since the introduction of the first pediatric flexible fiberoptic bronchoscope (FFB) in 1978. [1] The use of FFB in children has steadily risen and it became widely available and well accepted during the last decade. [1-12] It has been reported to be an excellent first-line method of examining the pediatric airway.[6] The advantages of FFB include avoidance of general anesthesia, the low incidence of complications, the great peripheral range of the instrument in the airways, and allowance of examining the airways in their dynamic natural state without distortion.[1-10] Furthermore, it can be introduced easily through the endotracheal tube in critically ill children for evaluating the position of the endotracheal tube and assessing airway patency during mechanical ventilation. [2,3,13]

In the Pediatric Department of King Chulalongkorn Memorial Hospital, pediatric fiberoptic bronchoscopy was first performed in 1988. Two different sizes of FFB were used. The first one was a standard pediatric size of 3.5 mm. outer diameter and1.2 mm. working channel (Olympus BF). This working channel is not large enough to admit a biopsy forceps, but it is adequate for injection of topical anesthetics for bronchoalveolar lavage and for bronchial brushing.[14] This size FFB cannot pass through the endotracheal tube when the internal diameter is smaller than 5 mm.[14] Another FFB recently used during the last 5 years is an ultrathin bronchoscope of 2.2 mm. external diameter without a working channel (Olympus BF). It is valuable when examinations are carried out through a small artificial airway.[14]

Most flexible laryngoscopy and bronchoscopy examinations were performed in a treatment room, or at bedside in the pediatric intensive care unit without general anesthesia. The cases in severe respiratory distress and at high risk of hypoxia during bronchoscopy were examined under general anesthesia in the operating room via the laryngeal mask.

The aim of this review was to evaluate the indications, the informations obtained from the endoscopy and its therapeutic use.

Subjects and Methods

The cases of all children who underwent fiberoptic laryngoscopy and bronchoscopy at the Pediatric Department of King Chulalongkorn Memorial Hospital between December 1988 and December 1998 were reviewed. Data collection included age, sex, presenting symptoms and signs as indications for endoscopy, type of the procedure, diagnosis and concurrent procedures performed during the bronchoscopy and complications. Repeated endoscopy under general anesthesia to establish the diagnosis and treatment were also reviewed.

Results

A total of 202 children underwent flexible laryngoscopy and bronchoscopy. Boys constituted 122(60.4%)and 80 (39.6%) were girls. The ages ranged from 9 days to 14 years. Fifty five percent of them were under 6 months of age at the time their first procedures and 27.7% were under two months. (Table1)

A total of 233 endoscopic examinations were performed. Repeated examinations were done in 17 individuals with a maximum of 9 procedures in one child. In 148 (63.5%) examinations only laryngoscopy were performed.

Table 1. Age distribution in children underwent flexible laryngoscopy and bronchoscopy.

Age	Laryngoscopy		Bronchoscopy		Total	
(years)	No of children	No of procedures	No of children	No of procedures	No of children	No of rocedures
0-1	109	118	30	41	139	159
1-2	19	20	5	5	24	25
2-3	4	4	3	3	7	7
3-4	2	2	3	4	5	6
4-5	2	2	1	1	3	3
> 5	2	2	22	31	24	33
Total	138	148	64	85	202	233

Of the 202 children who underwent laryngoscopy and bronchoscopy, 166(82.2%) children were evaluated for signs and symptoms of upper airway abnormalities including stridor (103 cases, 62.0%), problems related to endotracheal intubation (23 cases, 11.4%), noisy breathing (18 cases, 10.8%), hoarseness with or without stridor (16 cases, 9.6%) and nasal obstruction (6 cases, 3.6%). The most common finding was laryngomalacia (69 cases, 41.6%). Normal airway was diagnosed in 23 children (13.8%). The indications and findings are summarized in Table 2. Seventy one percent (73 cases) of children who presented with stridor had preendoscopic diagnosis as laryngomalacia; the flexible endoscopy confirmed the diagnosis in 55 children (75.3%). Thirteen children (17.8%) had no abnormal findings. Four children had unexpected anatomical abnormalities (laryngeal web 1, vocal cord paralysis 1, adenoid hypertrophy 1 and choanal stenosis 1).

Table 2. Indications and flexible endoscopy diagnosis in children with signs of upper airway diseases.

Indication	No	Flexible endoscopic diagnosis	No
1 Stridor	103		
1.1 Suspected laryngomalacia	73	Laryngomalacia	55
		Normal	13
		Inflammation	4
		Laryngeal web	1
		Vocal cord paralysis	1
		Adenoid hypertrophy	1
		Choanal stenosis	1
1.2 With abnormal X-ray or other abnormalities	30	Laryngomalacia	6
		Normal	3
		Inflammation	6

Table 2. (Continous)

Indication	No	Flexible endoscopic diagnosis	No
		Subglottic stenosis or suspected mass	9
		Supraglottic cyst	2
		Hemangioma	2
		Laryngeal web	1
		Tracheal stenosis	1
2. Problems related to intubation	23	Laryngomalacia	2
		Normal	1
		Inflammation	14
		Subglottic stenosis	5
		Tracheomalacia	3
		Extraluminal mass compressed airway	1
		Unilat. vocal cord paralysis	1
		Vocal nodule	1
3. Noisy breathing	18	Laryngomalacia	6
		Normal	3
		Inflammation	1
		Adenoid hypertrophy	6
		Extraluminal mass compressed airway	1
		Abnormal epiglottis	1
		Lymphoid hyperplasia	1
		Relaxing tongue	1
4. Hoarseness	16	Normal	3
		Inflammation	6
		Vocal cord paralysis	3
		Granulation tissue at vocal cord	1
		Vocal nodule	1
		Laryngeal papilloma	1
5. Nasal obstruction	6	Choanal stenosis	5
		Inflammation	3
		Adenoid hypertrophy	1
Total	166		174*

*Some children had more than one diagnosis.

Thirty children presented with stridor and other clinical clues suggesting anatomical airway abnormalities including past history of intubation, feeding difficulties, respiratory distress, pectus excavatum, skin hemangioma and abnormal x-ray findings. The flexible endoscopy showed significant airway pathology in 15 children (50.0%).The airway pathology included subglottic lesions (stenosis 7cases,mass 2 cases), supraglottic cyst 2 cases, hemangioma 2 cases, laryngeal web 1 case and tracheal stenosis 1 case.

In children who had problems related to endotracheal intubation (extubation failure, preextubation evaluation, and persistent stridor post extubation), the findings were swelling and hyper-secretion with mucosal inflammation in 14 children. Of these, 2 children had associated laryngomalacia and 3 had tracheomalacia. Subglottic stenosis was found in 5 children. Other findings were vocal cord paralysis (1 case), vocal nodule (1 case) and evidence of extraluminal compression (1 case).

Vocal cord lesions (vocal cord paralysis, granulation tissue at the vocal cords, vocal nodule and laryngeal papilloma) were the significant findings in children with hoarseness. For noisy breathing, laryngomalacia and adenoid hypertrophy were diagnosed in 6 children, two of them had both. Choanal stenosis, inflammation of the nasal passage and adenoid hypertrophy were the findings in children with nasal obstruction.

Pulmonary lesions were the indications for bronchoscopy in 36 children (17.8%) in this review. The indications and findings of bronchoscopy in this group are shown in Table 3. Ten children presented with signs and symptoms suggested lower airway obstruction (wheezing, hyperinflation on chest x-ray). The diagnosis was established in 8 children (tracheal stenosis 3 cases, external compression 2 cases, inflammation 2 cases, and tracheomalacia 1 case). Gastroesophageal reflux was diagnosed in 2 children after the investigations for other causes of wheezing were negative. In 4 children with atelectasis, bronchoscopic findings were mucous plug (2 cases) and external compression (2 cases).

In children with pneumonia, the bronchoscope could rule out the airway abnormalities and BAL with or without brush biopsy could be performed directly at the area of radiological abnormalities. These procedures could provide material for microbiologic and cytological studies which was important for guiding therapy. Hemoptysis was the indication in 3 children; the flexible bronchoscopy was performed under general anesthesia in 2 children. Though the bleeding point could not be identified, the BAL for hemosiderin-laden macrophages was positive. The bronchoscope was done in another child via the endotracheal tube in pediatric intensive care and mucosal bleeding was detected.

In this review, 25 children were referred to the ENT Department for repeated endoscopy under general anesthesia with or without surgical intervention. In 22 children (88.0%) the diagnosis was confirmed and surgical intervention was done in 15 children (60.0%). The details of these children are shown in Table 4. The diagnosis was changed to normal in 2 children who were initially diagnosed with a subglottic mass. A new diagnosis was found in 1 child whose airway inflammation was the only finding in FFB, but abnormal vocal cords were found under direct laryngoscopy.

Table 3. The indications and finding of bronchoscopy in children with pulmonary lesions.

Indication	No	Finding (concomittent procedure)	No
1. Wheezing and other signs suggested lower airway obstruction	10	Tracheal stenosis	3
		External compression	2
		Tracheomalacia	1
		Inflammation only	2
		Normal	2
2. Atelectasis	6	Mucous plug	3
		Extraluminal mass	3
3. Pneumonia in immunocompromised host	8	Inflamed bronchus	7
		Normal airway	1
		(BAL 8 , brush biopsy 2)	
4. Persistent pneumonia, interstitial pneumonitis	5	Inflamed bronchus	3
		Normal airway	2
		(BAL 5)	
5. Hemoptysis	3	Normal mucosa	2
		Bleeding from bronchial mucosa	1
		(BAL 2)	
6. Miscellaneous	4	Inflamed mucosa	4
Total	36		36

Table 4. Findings of endoscopy and surgical treatment by ENT compared with the diagnosis by FFB.

Diagnosis by FFB	Confirmed	New diagnosis	Surgical intervention
Subglottic lesion (stenosis , mass)	5	2	2
Choanal stenosis	3	-	2
Tracheal stenosis	3	-	2
Tracheomalacia	2	-	2
Hemangioma	2	-	-
Supraglottic cyst	2	-	2
Laryngeal web	2	-	2
Laryngeal papilloma	1	-	1
Nasopharyngeal mass	1	-	1
Inflammation only	-	1	-
Adenoid hypertrophy	1	-	1
Total	22	3	15

No major complication occurred during the fiberoptic laryngoscopy and bronchoscopy examinations. Some children developed transient hypoxemia during bronchoscopy especially in those with BAL, but hypoxia was rapidly resolved after removing the FFB and administration of 100% oxygen. A few children had nasopharyngeal bleeding which stopped quickly and did not require further treatment.

Discussion

Flexible fiberoptic bronchoscopy is being used much more frequently for the evaluation of potential problems of the airways in children. In most children, this procedure can be done safely at bedside without general anesthesia, which may reduce the need for anesthetic expertise and equipment, and the expense and time delays involving in transferring patients to the operating room. The two sizes of FFB we used in this study both had their specific advantages. The standard pediatric size (3.5-mm external diameter) was used for diagnostic laryngoscopy and bronchoscopy in nonintubated children and was also used for BAL and brush biopsy. The ultrathin FFB was used for examination of the tracheobronchial tree of small children via the endotracheal tube. This was particularly valuable in critically ill children because it caused minimal disturbance to mechanically ventilated children.

The age and sex distributions in our studies were similar to previous studies. The procedures were performed more commonly in boys [4,5] and the children who underwent only laryngoscopy were younger than those who underwent bronchoscopy.[3,8,10]

Stridor was the most common presenting symptom for upper airway examination. Laryngomalacia was the most common finding in this study. This finding was the same as in previous studies.[6,15] In this review, 5.5% of children who had signs and symptoms compatible with laryngomalacia were diagnosed to have other causes of airway obstruction. Therefore, the documentation of laryngomalacia and the exclusion of other causes of stridor usually provide a great comfort to the family (and the pediatrician)and may prevent further and costly diagnostic evaluation.

Our review confirmed that the chance of missing significant airway pathology was high if stridor was severe, or associated with other signs including skin hemangioma, failure to thrive, pectus excavatum, past history of intubation and abnormal x-ray findings. We found significant airway anomalies in 50% of children with the above mentioned abnormalities as compared with only 5% in children without these diagnostic clues. Tostevin PM et al[16] had studied the value of radiological investigations in pre-endoscopic assessment of children with stridor. They found that lateral neck and antero-posterior high kilovoltage X-ray could identify many of the more gross pathologies of the larynx and trachea eg. the space occupying lesions which occurred infrequently. However, the more common diseases e.g. laryngoma-lacia or subglottic stenosis were rarely identified radiologically. They suggested that radiology had a limited screening role in children with stridor.

In intubated small children, the ultrathin FFB provided useful information in preextubation evaluation and therapeutic planning for children who had extubation failure.

Most of the bronchoscopy examinations in this review were performed in various groups of children with pneumonia in order to get the BAL fluid

for microbiological and cytological diagnosis. This indication was previously reported to be least helpful in children with recurrent or persistent pneumonia.[10] However, this was reported to be a valuable test for investigation of the causes of pneumonia in three particular groups of children: the immunocompromised, those who fail to respond to broad spectrum antibiotics, and those with symptoms suggestive of atypical pneumonia.[17,18] Since it was not possible to use a protected brush through the pediatric flexible bronchoscope for obtaining uncontaminated specimens from the lower airway, the results of any culture had to be interpreted with some caution.[10]

The diagnostic yields in children with persistent atelectasis and those with suspected lower airway obstruction in this review were very high. This could be explained by the careful selection of the children. The bronchoscopy was only done on children with high suspicion of airway abnormalities.

In 2 of 3 children with hemoptysis, we performed the bronchoscopy under general anesthesia because these children were at greatest risk of severe hypoxia. Rigid bronchoscopy was also performed in the same setting with no additive information.

Comparing the findings of endoscopy under general anesthesia in 25 children, 2 children who were suspected to have subglottic masses from FFB were diagnosed to have normal airways. This subglottic area was reported to be the most difficult portion of the larynx to be seen by the FFB,[4,6] especially in children with glossoptosis, severe laryngomalacia, vocal cord paralysis and in infants with excessive pooling of secretion.[6]

Flexible bronchoscopy was found to be a relatively safe procedure in pediatrics. The complications in this study were only minor complications which were the same as reported in previous studies.[3-6,8,11]

Conclusions

Flexible fiberoptic laryngoscopy and bronchoscopy in the pediatric age group is safe, well tolerated and can provide a high diagnostic yield and therapeutic guide. The situations in which the flexible bronchoscopy has been proven to be most useful are stridor, and potential airway problems for patients in the pediatric intensive care unit.

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