TITLE

OUT PATIENT FIBRE-OPTIC LARYNGOSCOPY FOR STRIDOR IN CHILDREN AND INFANTS

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Abstract

Many neonates are referred for a diagnosis with stridor. The gold standard investigation has traditionally been a rigid or direct microlaryngoscopy. This impacts on existing theatre schedules, demands a high level of skills from the paediatric anaesthetist along with the risk of exposing a neonate to a general anaesthetic. A bed in paediatric intensive care is often required and must be reserved. As laryngomalacia is the most common diagnosis and less serious than the investigations for infants with stridor themselves, clinicians have been looking to use the flexible fibre-optic laryngoscope to view the upper airway in awake neonatal patients. We present our experience in 66 neonatal patients initially managed by awake per-oral flexible fibre-optic laryngoscopy for stridor. We conclude that the technique is safe, straightforward and allows a diagnosis to be achieved in a significant number of cases. We recommend it as a first line investigation, reserving microlaryngoscopy for the group of patients in whom a diagnosis cannot be made in the out patients clinic.

Key Word

Stridor, Laryngeal diseases, Laryngoscopy, Paediatric, Respiratory sounds

Introduction

Rigid laryngoscopy under general anaesthesia is established as the gold standard for the investigation of upper airway problems in the infant and neonate. However there are inherent problems with this technique particularly related to the complexity of administering a general anaesthetic to children and also the uncertainty of gaining a functional assessment of the larynx whilst the child is anaesthetised. Sub-specialization means that anaesthetists without paediatric training and the support of a Paediatric Intensive care unit will be understandably reluctant to take even the most straightforward cases.

The risks of administering an anaesthetic to a neonate (20 paediatric perioperative deaths in the UK - ASA grade I or II per year) [1] must also be balanced against the recognition that repeated studies have shown the likely diagnosis for stridor, in this patient group, is laryngomalacia (in up to 80%) [2,3] and that this condition is known to be self limiting with expected resolution within 18 months of diagnosis [4,5].

Because of these concerns, investigators [6] have proposed the use of flexible laryngoscopy in the assessment of children with upper airway disease. The oral technique has the advantages of being a relatively simple procedure that can be appropriately performed in the awake patient either as an outpatient or in the ward with little risk to the patient and a high likelihood of establishing a useful diagnosis. The additional benefits include the possibility of a functional assessment of the larynx.

The introduction of fibre-optic flexible laryngoscopy in awake children has been accredited to Silberman *et al* in 1976 [6], however the technique has still not become routine. To date proponents of the technique have tended to complicate the issue using general or topical anaesthesia [2], sedation and laryngeal masks [7]. This probably represents clinician fears over the efficacy and practical ease of the technique. We present a series of awake, per-oral, fibre-optic laryngoscopies both in the outpatient department and on the ward. This series represents the personal experience of one paediatric laryngologist and those in the department who have been introduced to the technique.

Materials and method

A prospectively planned, retrospective study of case notes was made for 66 infants who underwent awake, per-oral flexible fibre-optic laryngoscopy over a 5-year period between 1995 and 2001 at Addenbrooke's hospital, Cambridge, UK. Data collection was via a proforma that included information on the age and sex of the patient, also on the symptoms and time course of signs leading to the referral. We were interested in the provisional diagnosis, the diagnosis post laryngoscopy and the subsequent management particularly with reference to whether the patient had a subsequent microlaryngoscopy under general anaesthetic. The patients represented all neonatal referrals with stridor or related history to the senior author (one of two paediatric laryngologists' within a tertiary referral centre). Children with uncompensated respiratory distress were excluded from the study. The patients were either seen in the Ear Nose and Throat (ENT) outpatient department or on the paediatric wards. The patients were seen with their parents, a history taken along with a full medical examination then, if appropriate, an awake, per-oral fibre-optic laryngoscopy was performed without the need for any sedation or anaesthesia. The parents were fully informed about the procedure and allowed to watch. The endoscope used was a 3mm flexible Olympus endoscope kept in the outpatient department. Neither biopsy nor suction channels were found necessary. The laryngoscopies were all performed or supervised by a single surgeon (RFG).

Procedure

The children were examined in the supine position with their heads in the midline. The operator stood or sat at the head end of the examination couch whilst an assistant or parent helped to calm the infant (Fig 1). The tip of the endoscope was then guided into the oral cavity using the index finger and thumb of the non dominant (commonly left) hand. The little finger of the same hand is placed between the gums/teeth to keep the child's mouth open, whilst the dominant hand was used to hold and manipulate the eyepiece. It was found that the child tended to suck the tip of the endoscope making it easy to guide back through the oral cavity under direct vision to the level of the oropharynx. At this point the tip was flexed 90^0 to visualise the larynx. The tip remained above the epiglottis allowing a good view of the supraglottis and glottis. Functional assessment of the larynx is possible with quiet breathing and is often made easier by the child crying as movements of the glottis are exaggerated.

Results

During the study period 66 patients underwent awake, per-oral, fibre-optic flexible laryngoscopy at Addenbrooke's hospital. The majority of cases were male (59%). The age range varied from 2 days to 3 years old. The majority of patients were under 6 months old (Figure 2). The vast majority (94%) were referred with a history of stridor, usually from birth that conformed to the textbook description of laryngomalacia by becoming more pronounced when the child was excited. The other indications for referral were an abnormality in voice or a weak cry. The referring paediatricians or general practitioners had usually made a provisional diagnosis of laryngomalacia or a vocal cord lesion.

The glottis was adequately visualised in 59 (89%) of endoscopies allowing a working diagnosis to be reached (Table 1). Seven (11%) patients were unable to tolerate the procedure and subsequently underwent a microlaryngoscopy under general anaesthetic. A further 14 cases from the initial 59 patients that tolerated the procedure were listed for microlaryngoscopy, as the findings at flexible endoscopy were inconclusive. On review, the results at microlaryngoscopy concurred with the initial results of awake flexible laryngoscopy in all 14 patients (Table 2).

The commonest diagnosis was laryngomalacia (52%), absence of functional or anatomical abnormality was the next commonest (14%). Vocal cord paralysis accounted for 11% - 1 case of bilateral and 6 cases of unilateral palsy. Subglottic stenosis a further 8% - 1 case of subglottic haemangioma and 4 cases of inflammatory strictures. The remaining cases included 2 laryngeal papillomas, a laryngeal cleft,

external compression from a bifid aorta and a case of laryngeal mucosal oedema. None of our patients were found to have an additional endoscopic diagnosis. All patients were followed up till their stridor ceased or became irrelevant (3 patients have died – 2 patients from a complication of the original condition that predisposed them to stridor).

There were no significant complications from any of the procedures.

Discussion

Stridor is used to describe the noise made by non-laminar (turbulent) airflow in the respiratory tract. It will arise when the calibre of an airway falls beneath a threshold diameter for a given flow of air (textbooks often refer to a diameter less than 50% of normal - indicating a natural reserve) or if the speed of air movement increases beyond a threshold velocity for a given airway diameter (we can all simulate stridor by forced exhalation).

Stridor is either inspiratory or expiratory or biphasic. Inspiratory stridor is generated at or above larynx, biphasic is tracheal and expiratory stridor is below the carina and equates with wheeze.

There are many ways pathology can cause stridor. Stenotic lesions reduce airway calibre by a mass effect. Laryngomalacia reduces airway calibre by loss of its circular cross section as the pressure inside the airway is reduced by fast moving air (Bernoulli's law) and the airway collapses. Indeed this phenomenon is made worse by the patient hyperventilating in situations of excitement.

Stridor in neonates is a common symptom (94% in our series) resulting in referral to an ENT clinic (particularly if the clinic has a declared interest in paediatric airway management). Because of the multiple ways pathology can cause stridor it can be difficult to distinguish between pathologies on history and symptoms alone. There is also an argument that the patient may have two co-existing pathologies causing the same symptom of stridor [8]. Because of these concerns, the established gold standard

investigation of these patients has been a direct (rigid) microlaryngoscopy, tracheoscopy and bronchoscopy [9]. However there is increasing support for the use of less invasive techniques in the investigation of uncomplicated neonatal stridor as many investigators have shown that the most common diagnosis is laryngomalacia and that the natural history of the disease allows a watch and wait policy to be safely pursued. Non-invasive techniques that have been described include pneumotachography (flow volume loops) [10], flexible laryngoscopy and video assisted flexible laryngoscopy [11].

There are definite benefits to using the per oral route over the transnasal route. Firstly, infants better tolerate the former route as the scope elicits a suckling reflex once on the tongue. Secondly, it avoids possible nasal trauma as well as upsetting the infant either through use of the scope or through use of topical anaesthetic sprays. Thirdly, 3mm nasal endoscopes are widely available and can be easily used per orally. The main drawback of this technique is the inability to inspect the nasal airway, the nasopharynx and the soft palate before reaching the pharyngo-larynx.

Our study shows that the technique of awake per-oral flexible fibre-optic laryngoscopy is a straightforward and safe technique that allows an assessment of the paediatric upper airway in a similar way to adults. In our group of 66 patients only 7 cases had a new diagnosis as a result of a subsequent microlaryngoscopy. These new diagnoses came from the 21 cases that were listed for microlaryngoscopy because we were unable to arrive at a diagnosis following awake per-oral flexible fibre-optic laryngoscopy. Therefore 45 (68%) cases out of the 66, avoided a microlaryngoscopy

as a result of our approach to this problem. This result confirms similar findings in other studies.

The commonest diagnosis in our group of patients was laryngomalacia 52%. This fits the expected pattern [12], but does not agree with *Berkowitz* [13] who found that laryngomalacia accounted for 22% in his series and the commonest diagnosis was vocal cord palsy 44%, he felt that this reflected a particular referral pattern to his unit.

There is concern that the procedure, whilst allowing and excellent view of the supraglottis and glottis, does not allow an adequate subglottic view. This is not supported by *Berkowitz* [13] or *Hawkins and Clark* [12] who claim in their studies that they had an adequate view of the subglottis in up to 75%. We are happy to concede that the subglottis may not be reliably ruled out as an area of missed pathology and always arranged a subsequent microlaryngoscopy, particularly to examine the subglottis, in those patients who had a normal examination on flexible laryngoscopy. We are also reassured by the repeated observation that subglottic pathology is rare in these patients (8% in our study 5% in *Berkowitz*).

In our group we were unable to identify a coexisting second pathology causing stridor in any of our patients. This is at odds with many investigators who report synchronous lesions in up to 19% of infants. However it appears that these synchronous lesions are rarely significant or life threatening. *Manusco et al* found that only 4% of synchronous lesions required intervention [8].

Conclusion

We have shown that awake per-oral flexible fibre-optic laryngoscopy is a quick, safe, simple technique that, with experience, allows a diagnosis in 89% of neonatal patients referred to the ENT surgeons with simple stridor. It avoids the complications of admitting a child and submitting them to an anaesthetic. It avoids up to 68% of direct microlaryngoscopy and bronchoscopies, reducing the pressure on operating theatre lists and the already busy paediatric anaesthetic staff whilst removing the risk and trauma of a general anaesthetic in such a young patient group. It also avoids the necessity to have a Paediatric Intensive Care Unit (PICU) bed available for each microlaryngoscopy case – PICU beds are already a limited resource (223 PICU beds in the UK) [14]. It has therefore become the investigation of choice in our unit with 4 exceptions[15]:

1. If the larynx cannot be visualised by flexible laryngoscopy.
2. If a child had a clinical history suspicious for a subglottic or tracheal pathology.
3. If the child has significant respiratory distress.
4. If child is failing to thrive.

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Legends

Figure 1:

Photograph to show position of patient, operator and assistant. (Monitor system in background for illustration purpose only; operator should face the screen in actual settings).

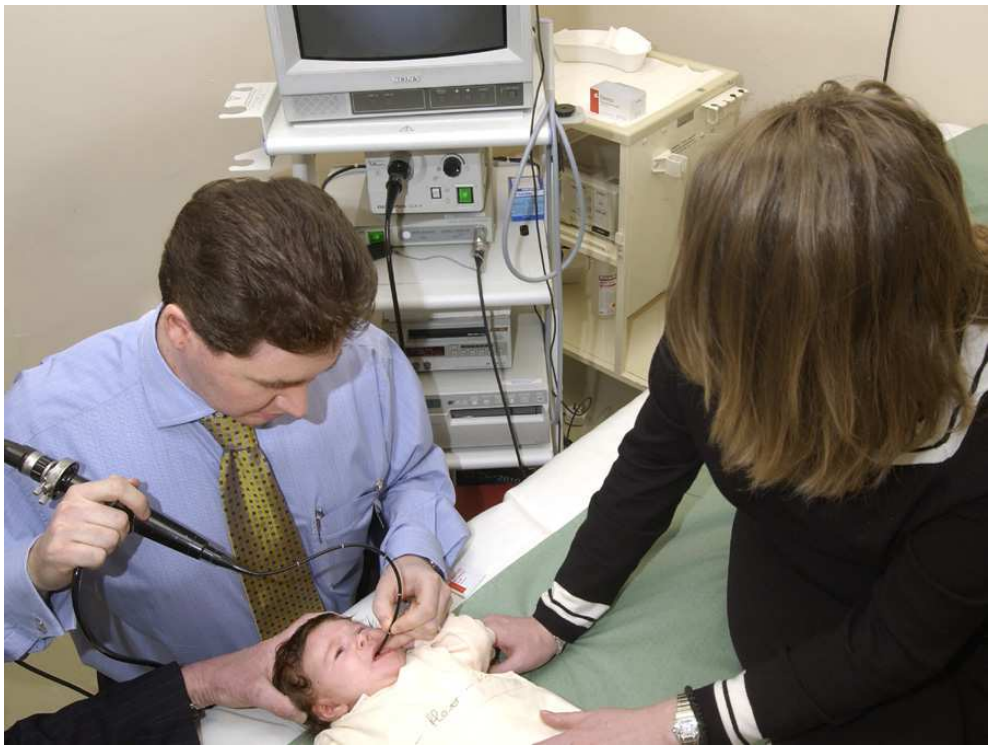

Figure 2:

Patient's ages at presentation.

Table 1

Diagnoses reached following flexible laryngoscopy

Table 2

Diagnoses reached following microlaryngoscopy

Figure 2: Patient's ages at presentation

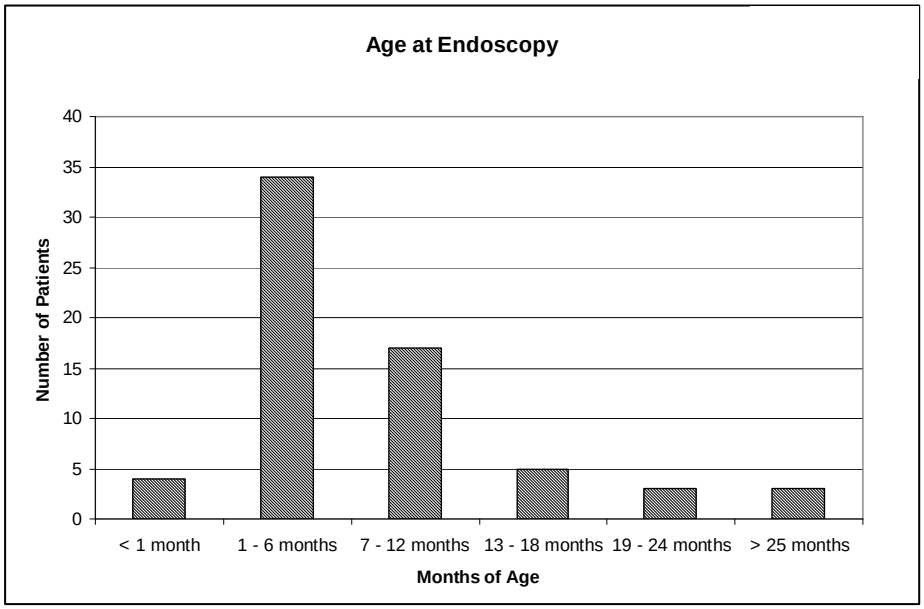

Table 1: Diagnoses reached following flexible laryngoscopy.

Laryngoscopic Diagnosis	*Number*	*Percentage*
No Endoscopic Abnormality	*9*	*14*
Laryngomalacia	*34*	*52*
Subglottic stenosis	*4*	*6*
Subglottic haemangioma	*3*	*5*
Vocal cord paralysis	*4*	*6*
(unilateral)	*(3)*	
(bilateral)	*(1)*	
Laryngeal papilloma	*2*	*3*
Other:	*3*	*4*
Laryngeal oedema (2^o to steroids)	*(1)*	
Nasal discharge	*(1)*	
Choanal atresia	*(1)*	
Unable to complete examination	*7*	*11*
Total	***66***	***100***

Table 2: Diagnoses reached following microlaryngoscopy.

Diagnosis confirming flexible laryngoscopic diagnosis.	*Laryngomalacia*	*6*
	Subglottic haemangioma	*3*
	Subglottic stenosis	*2*
	No abnormalities	*3*
	Total	***14***
New Diagnosis	*Laryngeal cleft*	*1*
	Bifid aorta	*1*
	Vocal cord paralysis	*3*
	No abnormalities	*2*
	Total	***7***