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ORIGINAL ARTICLE

# Flexible Laryngoscopy in Management of Congenital Stridor

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**Abstract** The incidence of congenital stridor is on rise due to improved neonate and infant survival rate. The gold standard investigation for evaluation of stridor is rigid laryngotracheobronchoscopy, but this is invasive and requires general anesthesia. Flexible fibreoptic laryngoscopy, a relatively simple and less invasive procedure can be done under topical anaesthesia for evaluation of stridor. In this study, we have presented our experience of flexible laryngoscopy in children with congenital stridor, their results and management. Laryngomalacia was the commonest cause of stridor accounting for 80% of cases. 15% (6) patients required tracheostomy for relieving airway obstruction and 22.5% (9) patients required a definitive surgical procedure for correcting the cause. Flexible laryngoscopy is safe and gives a comprehensive analysis of airway including its dynamic functions. We also recommend flexible laryngoscopy as a frontline investigation for evaluation of stridor.

**Keywords** Stridor · Flexible laryngoscopy · Congenital lesions

## Introduction

Stridor is an abnormal noisy breathing that occurs due to the turbulent flow of air through a partially obstructed airway [1]. Congenital laryngeal anomalies usually present with chronic stridor and the common aetiologies include laryngomalacia, bilateral vocal cord palsy and subglottic stenosis [2, 3]. Most of these anomalies seldom require active surgical intervention.

Increase in neonatal and infant survival rates attributed to efficient diagnosis and management of airway disorders in a neonate and children has also resulted in the increased incidence of congenital stridor being diagnosed. Most of these airway lesions are associated with synchronous lesions elsewhere in the airway and identification of such co existing lesions is a very important factor in the management. Rigid laryngotracheobronchoscopy has been the gold standard investigation for evaluation of such cases. However the invasive nature and requirement of general anaesthesia are considered as its limitations. Flexible fibreoptic laryngoscopy, a relatively less invasive, outpatient procedure can be used as an alternate without compromising the outcome. In this study, we have reviewed and analysed our experience in children who presented with chronic stridor, their etiologies and management with flexible fibreoptic laryngoscopy.

## Materials and Methods

A retrospective review of clinical data of children (< 5 years) from 2006 to 2016 who visited our hospital with chronic stridor was done. Children who had a previous history of intubation, acute onset, those with diseases/anomalies of nose, nasopharynx and oropharynx, and the patients with a known cause of stridor diagnosed elsewhere were excluded from the study. 40 patients who met the criteria were further evaluated and their data were analysed further for gender, age, indication and results of endoscopy, co-morbidity and whether trachoestomy required, and also outcomes following intervention.

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All the patients underwent flexible fibreoptic endoscopy either in office setup or operation theatre depending upon the severity of stridor. Also wherever required, patients had been investigated for any associated systemic illnesses like congenital heart disease, hydrocephalus and organomegaly.

### Procedure

Fibreoptic laryngoscope of 3 mm width was used in all the children. All the patients were assessed under topical anaesthesia without sedation. The child was placed in supine position. Transnasally the nasopharynx, laryngeal inlet, glottis, subglottis and upper trachea were assessed (Fig. 1). The functional assessment of the upper airway was possible as the patients were breathing normally.

## Results

During the period of 10 years, a total of 45 children presented with stridor. Only 40 patients who met the criteria were included in the study. The mean age of the study population was 23 months (0–58 months). Out of 40 children, 26 were male and 14 were female. The cause of stridor in the study group was as follows (Fig. 2).

In this study, the most frequent cause of stridor was laryngomalacia, seen in 32 (80%) of the patients, followed by laryngeal web seen in 7.5% (3), laryngeal haemangioma and subglottic stenosis in 5% (2) each and bilateral vocal cord palsy in 2.5% (1) patients.

Laryngomalacia was further classified based on modified Hollinger classification into three types. In our study, type 1 was found in 22 patients, type 2 in 6 patients and type 3 in 4 patients.

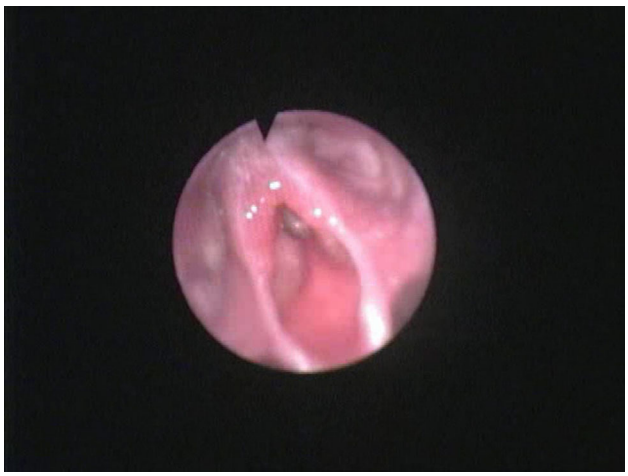

**Fig. 1** View through a flexible laryngoscope

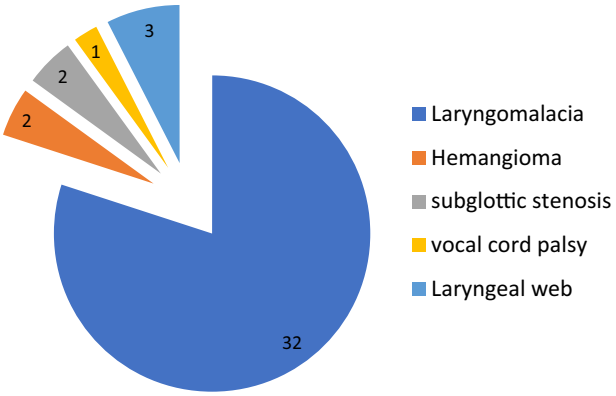


**Fig. 2** Etiology of chronic congenital stridor

### Type of Intervention

Among these 40 patients, 9 patients required active surgical intervention to relieve their airway obstruction. Rest of the patients were managed conservatively. The number of patients and the type of intervention done in each category are shown in Table 1.

### Tracheostomy

Six patients required tracheostomy, either to relieve stridor or as a preliminary intervention prior to definitive treatment (Table 2). All these patients were successfully decannulated later at varying intervals. The time taken for decannulation, from tracheostomy was 1½ months to 2 years.

### Associated Co-morbidities

None of patients in this study had synchronous airway lesions. In case of bilateral abductor cord palsy, MRI brain was taken to rule out Arnold–Chiari malformation.

## Discussion

The management of chronic congenital stridor is usually conservative. However some cases may detiorate rapidly and show signs of failure to thrive. Such cases may require an active surgical management either as a definitive procedure or to secure airway. So, it is important to identify the etiology early to avoid the morbidity and mortality.

In this series, laryngomalacia was the most common cause of stridor accounting up to 80% of cases. Stridor in laryngomalacia is usually mild, presents by 6 weeks of life, exacerbated by exertion like feeding, crying, and lying in a supine position and usually the stridor stabilises or resolves by 1 year of age [4]. Type 1 where there is an inward

**Table 1** Number of patients in each category who required surgical intervention and the type of intervention

| S. no. | Diagnosis | Number of cases required surgical intervention (percentage) | Name of surgical procedure |
|---|---|---|---|
| 1 | Laryngomalacia | 3 (9.3) | Laser assisted aryepiglottoplasty |
| 2 | Bilateral vocal cord palsy | 1 (100) | Laser cordectomy |
| 3 | Congenital subglottic stenosis | 2 (100) | Laser assisted endoscopic excision of stenotic segment |
| 4 | Laryngeal web | 3 (100) | Endoscopic release in two patients and open release via laryngofissure in one patient |
| 5. | Subglottic haemangioma | 0 (0) | Conservative management and periodic assessment |

**Table 2** Number of tracheostomised patients

| Diagnosis | Number of patients required tracheostomy |
|---|---|
| Laryngomalacia | 0 |
| Laryngeal web | 3 |
| Subglottic stenosis | 2 |
| Subglottic haemangioma | 0 |
| Bilateral vocal cord palsy | 1 |
| Total | 6 |

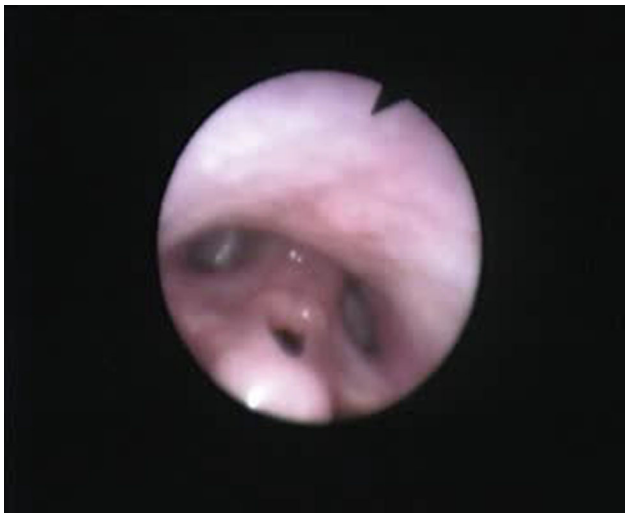

**Fig. 3** Type 1 laryngomalacia

collapse of aryepiglottic folds (Fig. 3) is the most common type. In this study, 90.7% of patients with laryngomalacia were managed conservatively. However, 9.3% of patients required surgical intervention in the form of LASER assisted aryepiglottoplasty. All these patients, who required surgical intervention had Type 3 laryngomalacia, where there is medial collapse of corniculate and cuneiform cartilages. Post operatively these patients where monitored in the paediatric ICU. The mean follow up of these patients were 2 years and none had stridor in the post operative period. According to Friedman et al. [5] 22% of patients with laryngomalacia require active airway management. Altman et al. [6] have reported that tracheotomy and endotracheal intubation were required in 13 and 39%, respectively. These results were consistent with results of this study.

Subglottic hemangioma (SGH) is relatively a rare cause of stridor and self limiting. It accounted to 5% of cases in this series and none required definitive surgical intervention. The treatment for subglottic haemangioma is rapidly evolving over the past few decades. Starting from mere observation, systemic/intralesional corticosteroids, treatment phase has gone through tracheostomy, laser and open excision to oral propranolol [7–9]. However for rapidly expanding haemangiomas, still the surgical options remain to be gold standard. According to Bitar et al. [10], LASER excision had 89% success rate although with the risk of subglottic stenosis.

Laryngeal webs represent failure of recanalisation of larynx in the early weeks of embryogenesis and its association with velocardiofacial syndrome has been reported. The webs can be thin (Fig. 4) or thick and the management differs for each [11]. Partial laryngeal webs usually present in late infant period like a child in this series which presented in 2nd year of life. Thin anterior glottic webs can be managed by endoscopic release. However thick glottic webs require laryngofissure and keel placement which is usually performed after 5 years of age. Laser is avoided generally in glottic webs due to reformation of webs and risk of subglottic stenosis. In this study, endoscopic release using cold knife instruments was performed in two patients and one patient required laryngofissure, followed by release and keel placement (Fig. 5). All patients were successfully relieved from respiratory distress later.

Congenital bilateral vocal cord palsy is more common than congenital unilateral vocal cord palsy. Like laryngomalacia, this condition is a problem in dynamic function of airway and can be easily missed out when airway assessment was carried out in general anesthesia. Though most of the times its idiopathic, hydrocephalus and Chiari malformations of brainstem have to be ruled out [12]. The aim of intervention is to decannulate without affecting voice and swallowing [13]. Arytenoidectomy, cordectomy, vocal cord lateralisation and posterior costal cartilage grafting are the main surgical options. In this study, there was a child

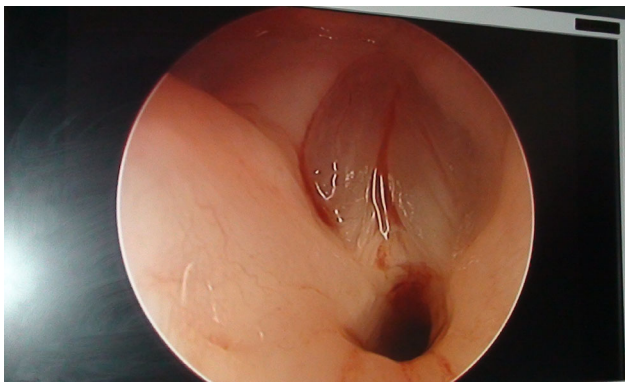

**Fig. 4** Thin glottic web

whose diagnosis was missed with direct laryngotracheobronchoscopy performed elsewhere and the child had persistent respiratory distress along with failure to thrive. Later flexible laryngoscopy was carried out in our institute and diagnosed to have bilateral abductor cord palsy. He was managed by emergency tracheostomy followed by laser posterior cordectomy at a later stage. Patient was successfully decannulated later at 2 year of age.

Congenital Subglottic stenosis is a part of a continuum of embryologic failures including laryngeal atresia, stenosis, and webs. Membranous congenital SGS is more common than cartilaginous stenosis [14, 15]. Treatment options available are endoscopic release, and open surgical procedure like cricotracheal resection and anastomosis and laryngotracheoplasty [16, 17]. In this study, both the patients had grade 3 membranous stenosis and both were managed endoscopically using laser.

This study shows that flexible fibreoptic laryngoscopy is a valuable tool for assessing the airway. Its ability to assess the dynamic functions of larynx and trachea without general anaesthesia makes it an ideal tool for initial assessment of patients with stridor especially in cases like laryngomalacia and cord palsy. Transnasal assessment also helps in assessing presence of synchronous nasopharyngeal lesions. In this study we were able to diagnose the cause of stridor in all patients, thus avoiding rigid microlaryngobronchoscopy and its associated morbidities under general anesthesia. The concern of subglottis being not adequately visualised with flexible laryngoscopy was not bothering, as we were able to diagnose laryngeal webs and subglottic stenosis. Berkowitz et al. [18] also had same opinion, as they were able to see subglottis adequately in 75% of cases.

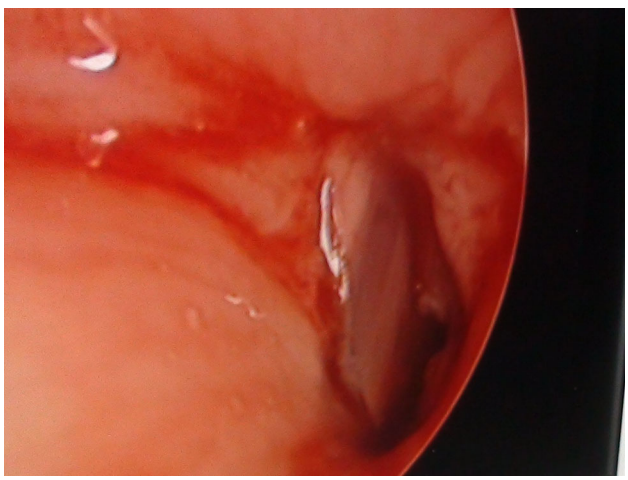

**Fig. 5** Keel in the glottis

The availability of 2 mm scopes and high definition video cameras has eased the procedure of endoscopy and improved the image quality even in neonates without anaesthesia [19–21]. However its use in cases of acute stridor and failure to thrive are questionable.

In this study we did not observe any synchronous airway lesions in these children, which is at odds to other investigators [5, 11].

## Conclusion

Flexible fibreoptic laryngoscopy is a valuable tool for the dynamic evaluation of chronic airway obstruction. This can be done under topical anesthesia and gives a comprehensive analysis of the airway thus avoiding a microlaryngobronchoscopy and morbidity of general anaesthesia in paediatric age group. Though laryngomalacia is the commonest cause of stridor, other rare causes have to be excluded. Prompt and early surgical intervention wherever necessary reduces the mortality and morbidity.

#### Compliance with Ethical Standards

**Conflict of interest** There were no conflict of interests between authors or anyone who participated in the study.

**Informed Consent** Informed consent was obtained from the guardians/parents before performing the procedure.

**Ethical Standards** The procedures performed in the study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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