

Etiological evaluation of stridor in children

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ABSTRACT

Background: Stridor is a harsh, vibratory sound produced when airway becomes partially obstructed, resulting in turbulent flow of air through large airways. **Objectives:** The objectives of the study were to find out the most common causes of stridor, according to the age group for the better management and outcome. **Materials and Methods:** The present study was a hospital-based observational study where in children between the age group of 0 and 5 years with stridor were studied over 1-year period at a tertiary hospital of south India from January 2017 to 2018. A total of 71 cases were included in the study. Children were subjected to chest X-ray, computed tomography scan, blood tests, laryngoscopy, and bronchoscopy according to requirement and findings compiled and analyzed statistically. **Results:** Majority of the stridor cases were in the age group of <1 year, male outnumbered females. The etiologies of stridor in present study were croup (47.9%), laryngomalacia (19.7%), laryngeal diphtheria (12.7%), subglottic stenosis (7.04%), laryngotracheomalacia (2.8%), glottic web (1.41%), left vocal cord paresis with subglottic stenosis with tracheomalacia (1.41%), subglottic stenosis with tracheomalacia (1.41%), foreign body (1.41%), tracheomalacia (1.41%), and laryngeal papillomatosis (1.41%). **Conclusion:** Every child with stridor should be approached in specified protocol and causes should be evaluated.

Key words: Croup, Diphtheria, Laryngomalacia, Laryngotracheomalacia, Stridor, Subglottic stenosis

Stridor is the noise from a narrowed airway. It is a sign from which the underlying cause must be sought and is not a diagnosis or a disease [1]. The role of pediatrician in a child with noisy breathing is to determine the etiology, level of obstruction and its severity causing respiratory compromise. The word stridor is derived from the Latin word Stridulus which means creaking, whistling, or grating. Stridor is an abnormal, harsh, and high-pitched inspiratory sound produced by turbulent airflow through a partially obstructed airway of the laryngeal area or the extra-thoracic trachea [2]. Stridor is a predominant inspiratory monophonic noise [2]. It should be differentiated from wheeze later which occurs in forced expiration whereas stridor occurs mostly in inspiration [2]. Wheeze originates from the intrathoracic trachea and alveoli whereas stridor originates from extra thoracic trachea [2].

Upper airway obstruction is a common and serious problem and also a common cause of respiratory failure in infants and children. Stridor is the fairly common symptom of the upper airway obstruction in neonates and children. Medical history and physical examination are the main stay in patients with stridor presenting to the emergency department [3]. The red flag signs of stridor

are presence of drooling of saliva and agitation, tripod position, cyanosis, decreased conscious level, respiratory distress, silent chest, bradycardia, and episodes of apnea [2]. The presence of these warning signs should alert pediatricians of the probability of severe respiratory compromise in the child. This warrants immediate management to secure airway to prevent further deterioration of the child. The presence or absence of fever is used to identify infectious and non-infectious causes of stridor. The present study was conducted to determine the most common causes of stridor, according to the age group for better management and outcome.


MATERIALS AND METHODS

The study was conducted in the department of medicine at a tertiary hospital of south India. Children between 0 and 5 years of age with stridor who presented to pediatric department requiring admission between January 2017 and 2018 were included in study. The study was observational and prospective study. Post-extubating stridor patients, children with external trauma to neck, and children with alleged history of acid consumption were excluded from the study.

Sample size was estimated based on published literature, 76% cases presented with acute symptoms among 50 cases

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Access this article online	
Received - 17 May 2020 Initial Review - 27 May 2020 Accepted - 14 July 2020	Quick Response code 
DOI: 10.32677/IJCH.2020.v07.i07.007	

studied in 0–12 years. Assuming 5% level of significance, 10% absolute precision, sample size calculated by the formula mentioned below: P =proportion of cases (Acute symptoms 0.76), $d=0$.

$$\text{Sample size} = \frac{Z_{1-\alpha/2}^2 P(1-P)}{d^2}$$

Here

$Z_{1-\alpha/2}$ = Is standard normal variate (at 5% type 1 error ($P<0.05$) it is 1.96 and at 1% type 1 error ($P<0.01$) it is 2.58). As in majority of studies P values are considered significant below 0.05 hence 1.96 is used in formula.

p = Expected proportion in population based on previous studies or pilot studies.

d = Absolute error or precision – Has to be decided by researcher.

Using the above values at 95% confidence level, a sample size of 71 subjects with stridor was included in the study. Written informed consent from each patient and ethical clearance for study was obtained. Complete clinical examination, relevant investigations such as complete blood count, C-reactive protein, and X-ray were carried out. Findings were tabulated in pre-structured, pre-tested pro forma according to objectives of study, and submitted for analysis. Data were entered into Microsoft excel sheet and were analyzed using SPSS 22 version software. Categorical data were represented in the form of frequencies and proportions. $p<0.05$ was considered statistically significant.

Table 1: Age at onset of stridor

Age (year)	Birth (%)	Later (%)	Total
<1	20 (40.8)	29 (59.2)	49
1–3	1 (7.7)	12 (92.3)	13
3–5	0	9 (100)	9
Total	21 (29.6)	50 (70.4)	71

Table 2: Age-wise distribution of cause of stridor

Etiology	Age			Total n (%)
	<1 year	1–3 year	3–5 year	
	n (%)	n (%)	n (%)	
Croup	22 (64.7)	12 (35.3)	0 (0)	34 (47.9)
Laryngomalacia	14 (100)	0 (0)	0 (0)	14 (19.7)
Laryngeal diphtheria	0 (0)	0 (0)	9 (100)	9 (12.7)
subglottic stenosis	5 (100)	0 (0)	0 (0)	5 (7.04)
Laryngotracheomalacia	2 (100)	0 (0)	0 (0)	2 (2.82)
Laryngomalacia with subglottic stenosis	1 (100)	0 (0)	0 (0)	1 (1.41)
Glottic web	0 (0)	1 (100)	0 (0)	1 (1.41)
Vocal cord paresis with subglottic stenosis with tracheomalacia	1 (100)	0 (0)	0 (0)	1 (1.41)
Subglottic stenosis with tracheomalacia	1 (100)	0 (0)	0 (0)	1 (1.41)
Foreign body	1 (100)	0 (0)	0 (0)	1 (1.41)
Tracheomalacia	1 (100)	0 (0)	0 (0)	1 (1.41)
Laryngeal papillomatosis	1 (100)	0 (0)	0 (0)	1 (1.41)
Total	49 (69)	13 (18.3)	9 (12.7)	71 (100)

RESULTS

Of 71 cases, 50 (70.4%) were male and 20 (29.6%) were female. Almost 2/3rd of the patients 49 (69%) showed acute symptoms. Most of the patients (69%) were infants followed by 18.3% in 1–3 year age group and 12.7% in 3–5 year age group. Almost 1/3rd of the cases of stridor presented later in life (Table 1). Most cases of stridor were seen in less than 1 year with croup being the most common cause. In age group of 3 to 5yrs laryngeal diphtheria was the commonest cause (Table 2).

Most common precipitating factor for stridor was cry/agitation (80%) followed by preceding upper respiratory tract infection (73.4%), feeding (11.2%), supine position (9.8%), and choking (1.4%). In the current study, retraction was present in 98.6% of cases, followed by tachypnea (94.4%), cough (87.3%), weak cry (70.4%), voice change (63.4%), and difficulty in swallowing in 12.7%.

Out of 71 cases, X Ray was abnormal in 11.3% cases and CT neck abnormal in 22.2% cases (Table 3). A total of 52% of enrolled stridor cases underwent invasive procedure. Bronchoscopy was done in 28 cases and in 9 cases direct laryngoscopy was done. Of 71 cases, 7 cases (9.8%) were managed conservatively, 43 cases (60.6%) with medical treatment, and in 21 cases (29.6%) corrective surgeries for structural abnormalities of airway done.

DISCUSSION

By Holdinger's laws of airway obstruction, severity of noisy breathing in relation to the sleep wake cycle is important. When the noise is worse during sleep, obstruction is nasal or pharyngeal where the noise is aggravated during awake; the obstruction is laryngeal or tracheal. About 1 mm of narrowing in a 4 mm diameter infantile airway results in a 75% change in airflow by Poiseuille's law [4]. Bernoulli's principle [5] states that as the velocity increases through a constant area, pressure on the wall

of lumen decreases. Characterization of the voice is another important part of examination in children with stridor. Lesions in the area of larynx may impede normal vocal fold function and cause hoarseness of voice along with stridor. Respiratory papillomas due to human papilloma virus or patent ductus arteriosus repair may cause hoarse voice. Demonstration of cough by child should be elicited when there is concern about laryngeal innervations. In this study, most of the children presented with stridor were stable; hence, complete history recording and physical examination were done.

In this study, the most common age group was <1 year which is similar in above mentioned studies. In the current study, boys were more than girls. The other studies also similarly showed male predominance (Table 4).

Most of the cases of stridor presented later in life, 50 of 71 cases of stridor presented later in life indicating acquired causes more than congenital causes. Stridor was present since birth in 21 cases. In the present study, most common precipitating factor for stridor was cry and agitation which was seen in 80%. In the current study, acute symptoms were present in 69% of cases and chronic symptoms present in 31% of cases. Acute onset of stridor is more in all above mentioned studies (Table 5).

Regarding etiology, in the present study, acquired causes outnumbered congenital cases. Of acquired causes, acute laryngotracheobronchitis was the most common cause for stridor. The most common congenital etiology was laryngomalacia. Above-mentioned studies showed similar results except Dandala *et al.* who observed a greater number of congenital causes which

Table 3: Correlation of X-ray and CT scan findings in various etiologies

Etiology	X-ray		CT scan		Total
	Abnormal	Normal	Abnormal	Normal	
	n (%)	n (%)	n (%)	n (%)	
Croup	3 (8.8)	31 (91.2)	-	-	34
Laryngomalacia	2 (14.3)	12 (85.7)	2 (14.3)	12	14
Laryngeal diphtheria	0 (0)	9 (100)	-	-	9
Subglottic stenosis	2 (40)	3 (60)	2 (40)	3 (60)	5
Laryngotracheomalacia	0 (0)	2 (100)	0 (0)	2 (100)	2
Laryngomalacia with subglottic stenosis	1 (100)	0 (0)	1 (100)	0 (0)	1
Glottic web	0 (0)	1 (100)	0 (0)	1 (100)	1
Vocal cord paresis with subglottic stenosis with tracheomalacia	0 (0)	1 (100)	0 (0)	1 (100)	1
Subglottic stenosis with tracheomalacia	0 (0)	1 (100)	0 (0)	1 (100)	1
Foreign body	0 (0)	1 (100)	-	-	1
Tracheomalacia	0 (0)	1 (100)	1 (100)	0 (0)	1
Laryngeal papillomatosis	0 (0)	1 (100)	0 (0)	1 (100)	1
Total	8 (11.3)	63 (88.7)	6 (22.2)	21 (77.8)	71

CT: Computed tomography

Table 4: Comparative evaluation

Parameters studied	Present study (n=71)	Suganya <i>et al.</i> (n=50) [7]	Zoumalan <i>et al.</i> (n=202) [8]	Rao <i>et al.</i> (n=80) [9]	Dandala <i>et al.</i> (n=50) [10]	Arnel <i>et al.</i> (n=75) [11]
Age distribution (<1 year)	69%	62%	74%	55%	82%	
Sex distribution						
Males	50	35		46	28	47
Females	21	15		34	22	28
Signs and symptoms						
Retractions	98.6%	98%				52%
Tachypnea	98.4%	72%				85.3%
Etiology of stridor						
Congenital	21	15		28	37	
Acquired	50	35		58	13	

Table 5: Distribution of chronicity of symptoms

Onset	Present study n=71 (%)	Suganya <i>et al.</i> n=50 (%) [7]	Rupa and Raman n=180 (%) [12]	Alberta <i>et al.</i> 2011 (%) [13]	Elango <i>et al.</i> n=85 (%) [14]
Acute	69	76	67.8	78.6	57.6
Chronic	31	24	32.2	21.4	42.6

was contradictory to the present study. Among infectious etiology croup cases outnumbered followed by laryngeal diphtheria which was unique in this study. The study had a few limitations. The study had a small sample size studied over only 1-year.

CONCLUSION

Stridor is a symptom of underlying pathology and proper evaluation of its causes is important to prevent life threatening condition. Every child with stridor should be approached in specified protocol and causes should be evaluated.

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Funding: Departmental; Conflicts of Interest: None Stated.

How to cite this article: Supriya N, Murthy GRR, Kumar PP, Sanjay KS. Etiological evaluation of stridor in children. Indian J Child Health. 2020; 7(7):309-312.