Clinical review of laryngomalacia in a tertiary hospital

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ABSTRACT

Introduction: Laryngomalacia is the most common cause of stridor in infants, with severity ranging from mild to severe forms. Accurate classifications of severity is essential for guiding management and improving outcomes.

Material and methods: We conducted a retrospective study of paediatric patients under two years of age diagnosed with laryngomalacia at a tertiary referral centre between January 2010 and December 2020. Data collected included demographic details, clinical presentation, comorbidities, endoscopic findings, treatment, and follow-up duration. Severity was classified using a symptoms-based scoring system by Shah et al, while laryngomalacia types were determined according to Olney et al's endoscopic classification. Association between severity, endoscopic findings, comorbidities and treatment choice were analysed using logistic regression.

Results: A total of 148 patients were included (59.49% male). Mild, moderate, and severe laryngomalacia were observed in 45.27%, 35.14%, and 19.59% of patients, respectively. Type 3 laryngomalacia, identified via endoscopy, was significantly associated with severe disease (p<0.001). Comorbidities, particularly gastroesophageal reflux disease, cardiac, pulmonary, syndromic, neurological conditions and synchronous airway lesions, were significantly linked to higher severity (p<0.05). A strong association was found between severity and treatment: moderate cases had 89.6 times, and severe cases 133.3 times, the odds of receiving surgical intervention compared to mild cases (p<0.001).

Conclusion: Mild laryngomalacia was most prevalent, but severity increased with specific comorbidities and endoscopic findings. Objective symptom scoring and endoscopic classification are valuable for assessing severity and guiding appropriate management in laryngomalacia.

KEYWORDS:
Laryngomalacia; Congenital stridor; Comorbidities; Conservative; Supraglottoplasty

INTRODUCTION

Laryngomalacia is the leading cause of stridor in infants, accounting for 35-75% of cases.[1] It results from dynamic upper airway obstruction due to inward collapse of supraglottic structures during inspiration. Proposed aetiologies include immature laryngeal cartilage, anatomical variations, gastroesophageal reflux, poor neuromuscular control, and hypotonia, though none are definitively proven.[2]

Clinically, laryngomalacia presents with high-pitched, musical inspiratory stridor, typically appearing in the first weeks of life, peaking at 6 to 9 months and resolving spontaneously by 12 to 24 months.[3] Severe cases may present with respiratory distress, apnoea, cyanosis, and feeding difficulties, including poor coordination of sucking and swallowing, choking, regurgitation, and micro-aspiration. Severity of laryngomalacia is categorised as mild, moderate, or severe, with severe cases marked by stridor, dyspnoea, feeding problems, cyanosis, and failure to thrive.[1]

Landry and thompson in 2012 classify laryngomalacia severity based on clinical presentation and oxygen saturation levels: mild laryngomalacia is defined by the presence of inspiratory stridor alone with resting oxygen saturation (SpO2) greater than 98%; moderate laryngomalacia is characterised by inspiratory stridor accompanied by frequent feeding difficulties and choking, with SpO2 between 95-96%; and severe laryngomalacia includes apnoea, cyanosis, failure to thrive and a resting SpO2 of 85-86%.[3]

In contrast, Shah et al[4] propose an objective symptom-based scoring system, where milder symptoms are assigned a score of 1, and more severe manifestations such as apnoea, cyanosis, or failure to thrive, are given higher scores. The cumulative score categorised severity as mild (1-3), moderate (4-5), or severe (6 or more). The presence of comorbidities also significantly impacts the severity and clinical progression of laryngomalacia. The most frequently encountered comorbidities are gastroesophageal reflux disease (GERD) and neurological disorders.[2] Additional factors such as synchronous airway lesions, congenital heart disease, and the presence of syndrome or genetic disorder may also influence disease outcomes.[2]

Flexible nasopharyngolaryngoscopy (FNPLS) is the gold standard for diagnosis, allowing direct visualization of supraglottic collapse.[2] Olney et al, classified laryngomalacia into three types based on FNLPS: Type 1 (arytenoid mucosa prolapse), Type 2 (foreshortened aryepiglottic folds) and Type 3 (posterior epiglottic displacement).[5] Most infants (80%) have mild to moderate symptoms managed conservatively and resolved spontaneously at the age of 12 to 24 months, while up to 20% with severe symptoms may require surgical intervention.[1]

This study aimed to determine the severity distribution of laryngomalacia using symptoms score and to explore the

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associations between severity, endoscopic findings, comorbidities, and treatment in a tertiary centre cohort. Despite the existence of several classification systems, there is limited research that systematically correlates objective symptoms severity scoring with anatomical findings, comorbidities and management outcomes in laryngomalacia. This gap can lead to inconsistent severity assessment and suboptimal treatment selection, potentially affecting patient outcomes. By applying an objective scoring system and correlating it with clinical and endoscopic data, this study seeks to enhance the precision of severity assessment and guide evidence-based management.

MATERIALS AND METHODS

This retrospective study was conducted at Hospital Pakar Universiti Sains Malaysia (HPUSM), Kelantan, following approval from the Human Research Ethics Committee (USM/JEPeM/21030205). We included peadiatric patients under two years of age who were diagnosed with laryngomalacia between January 2010 and December 2020. Inclusion criteria were diagnosis of laryngomalacia established by 24 months of age and availability of complete clinical and endoscopic records. Patients with a history of prior airway surgery were excluded. Data collected included demographic and perinatal details (gender, gestational age, APGAR score, birth weight, age at presentation and diagnosis, antenatal history), presenting symptoms, disease severity, comorbidities (including syndromic and non-syndromic conditions) endoscopic findings, presence of synchronous airway lesions, treatment modalities, and duration of follow-up. All surgical operations were performed under the Paediatric Otorhinolaryngology service, by one of three designated Pediatric ORL surgeons in HPUSM.

Severity was classified using Shah et al.'s scoring system: mild (score 1-3), moderate (4-5), severe (6 or more)4. Laryngomalacia types were assigned per Olney et al. based on FNLPS5. Statistical analysis was performed using IBM Statistical Package for Social Sciences (SPSS version 27.0) and STATA 16. Ordinal logistic regression assessed associations between clinical features and severity. Simple logistic regression analysed the link between severity and treatment. Significant was set at p-value less than 0.05.

RESULTS

A total of 148 patients met inclusion criteria (59.46% male). Table I shows the details of the descriptive analysis of variables involved in the study. The most common symptoms was stridor. Followed by retraction/ chest recession, feeding difficulties, dyspnoea, failure to thrive, cyanosis and apnoea.

From Table II below, the severity distribution were mild (45.27%), moderate (35.14%) and severe (19.54%).

Detailed endoscopy revealed the following types of laryngomalacia: Type 1 in 12 patients (8.1%), Type 2 in 72 patients (48.6%), and combined types in 64 patients (43.2%). The combined types were accounted for Type 1+2 in 50 patients, Type 2+3 in 8 patients, Type 1+3 in 1 patient and Type 1+2+3 in 5 patients. Isolated Type 3 was not observed; however, Type 3 in combination was significantly associated with severe form of laryngomalacia ($p < 0.001$).

Table III shows an association between the type and severity of laryngomalacia. Comorbidity was found in 84 patients (56.76%). The most commonly found comorbidity was GERD followed by syndromic, cardiac comorbidity, neurological disease, SAL, lung comorbidity, renal disease, and GIT disease as shown in Table I. Other comorbidities such as prematurity, hypothyroidism, asymmetrical small for gestational age with microcephaly, cleft lip and palate were found in 20 patients (13.52%). Patients who had cardiac, lung, neurological disease, GERD, syndromic, and SAL were found to have a significant association with the severity of laryngomalacia. However, renal disease and GIT disease showed no association with the severity of laryngomalacia.

Table IV shows the association between comorbidities and the severity of laryngomalacia. Comorbidities were present in 56.76%, most commonly GERD, followed by syndromic, cardiac, neurological, synchronous airway lesions, pulmonary, renal and gastrointestinal diseases. Cardiac, pulmonary, neurological, GERD, syndromic conditions and synchronous airway lesions were significantly associated with increased severity ($p < 0.05$).

Table V demonstrates the association between the severity of laryngomalacia and the treatment of choice among patients. Treatment of choice was significantly associated with severity. Moderate cases had 89.60 times, and severe cases 133.33 times, the odds of surgical intervention compared to mild cases ($p < 0.001$). Surgical interventions included aryepiglottoplasty (n=53), aryepiglottoplasty with tracheostomy (n=12), and aryepiglottoplasty with epiglottopexy (n=4).

DISCUSSION

Laryngomalacia was more prevalent in males (male:female ratio of about 1.5:1), consistent with other studies.[6,7,8] Inspiratory stridor was universal[4,5,7] and nearly half of patients (45.89%) had feeding problems, a known risk for poor weight gain due to increased respiratory effort, gastro-esophageal or laryngopharyngeal reflux disorders, and uncoordinated suck-swallow-breathing.

From our study, Type 3 in endoscopic findings correlated with severe disease and surgical intervention, aligning with prior reports.[9-10] All Type 3 cases were combined with other types and managed surgically, often with supraglottoplasty and epiglottopexy. This involves surgical division of the short aryepiglottic folds to release the epiglottis and the removal of excess aryepiglottic fold mucosa to prevent it from prolapsing over the glottis as well as fixation of the epiglottis to the base of the tongue.

Over half of patients had comorbidities, most commonly GERD, which was significantly associated with severe symptoms, as reported in other studies.[1,3,11,12,13] Reflux disease had been reported in 65%-100% of infants with laryngomalacia.[5,14] Infants with laryngomalacia experience increased airway resistance, which leads to higher negative

Table I: Descriptive analysis of demographics, symptoms, and co-morbidities

Variable	n (%)
Demographic	
Gender	
Male	88 (59.46)
Female	60 (40.54)
Gestational age (Weeks)	38.00 (2.00)a
Age of presentation (Days)	14.00 (23.00)[a]
Age of diagnosis (Days)	30.00 (46.00)[a]
Birth weight (g)	2900.00 (800.00)[b]
APGAR score at 1 minute	9.00 (0.50)[a]
APGAR score at 5 minutes	10.00 (0.00)[a]
Variable	**n (%)**
Symptoms	
Stridor	148 (100.00)
Retraction/Chest recession	134 (90.54)
Feeding difficulties	67 (45.27)
Failure to thrive	35 (23.65)
Dyspnea	62 (41.89)
Apnea	7 (4.73)
Cyanosis	15 (10.14)
Co-morbidities	
Cardiac disease	30 (20.27)
Lung disease	11 (7.43)
Neurological disease	30 (20.27)
Syndromic	32 (21.62)
GERD	46 (31.08)
Gastro intestinal disease (GIT)	2 (1.35)
Renal disease	4 (2.70)
Synchronous airway lesion (SAL)	25 (16.89)
Others	20 (13.51)
None	64 (43.24)

[a] Median (IQR)
[b] Mean (SD)

Table II: Proportion of severity of laryngomalacia among study population

Severity	n (%)
Mild	67 (45.27%)
Moderate	52 (35.14%)
Severe	29 (19.54%)

Table III: Association between type and severity of laryngomalacia

Variable	Regression coefficient (b)	Wald z test	Crude OR (95% CI)	p-value
Type 1	-0.06	-0.13	0.95 (0.42,2.14)	0.893
Type 2	0.36	0.65	1.44 (0.48,4.30)	0.515
Type 3	2.84	4.53	17.08 (5.00,58.38)	<0.001

intrathoracic pressures during inspiration. This pressure gradient can compromise the protective function of the oesophageal sphincters, increasing the risk of gastroesophageal reflux. The resulting reflux may irritate the laryngeal mucosa, causing oedema and further exacerbating airway collapse.[15]

Additionally, symptoms such as coughing, choking, and aspiration observed in infants with moderate to severe laryngomalacia are often attributed to GERD, which impairs laryngeal sensation and disrupts airway protection and swallowing mechanism.[16-18] Therefore, it is recommended that all laryngomalacia patients with feeding difficulties be treated for GERD. Acid suppression therapy has been shown to improve laryngeal sensation, enhance swallowing function, and potentially shorten the disease course5. However, if severe symptoms persist despite optimal medical management, surgical intervention should be considered.[15] Persistent partial airway obstruction can generate significant pressure differences between the thoracic and abdominal cavities, further weakening the lower oesophageal sphincter and perpetuating GERD. In our cohort, 36 out of 46 patients

Table IV: Association between comorbidities and severity of laryngomalacia

Variable	Regression coefficient (b)	Wald z test	Crude OR (95% CI)	p-value
Cardiac disease	0.88	2.28	2.41 (1.13, 5.13)	0.023
Lung disease	2.03	3.08	7.63 (2.09, 27.82)	0.002
Neurological disease	1.09	2.75	2.98 (1.37, 6.47)	0.006
Syndromic	1.61	4.07	4.99 (2.30, 10.80)	<0.001
GERD	2.41	6.09	11.14 (5.13, 24.21)	<0.001
Synchronous airway lesion	2.19	5.03	8.96 (3.81, 21.04)	<0.001
Renal disease	1.29	1.30	3.64 (0.52, 25.41)	0.192
GIT disease	0.62	0.40	1.85 (0.09, 37.76)	0.688

Table V: Association between severity of laryngomalacia and treatment of choice among patients

Variable	Treatment n (%)		b	Wald test	OR (95% CI)	p
	Conservative	Surgical				
Severity						
Mild	64 (82.1)	3 (4.3)	0		1	
Moderate	10 (12.8)	42 (60.0)	4.49	6.54	89.60 (23.28, 344.81)	<0.001
Severe	4 (5.1)	25 (35.7)	4.89	6.12	133.33 (27.83, 638.77)	<0.001

with GERD symptoms had moderate to severe laryngomalacia and all underwent supraglottoplasty. This consistent with finding by Hadfield et al., who reported that supraglottoplasty can reduce grastroesophageal reflux in patients with laryngomalacia.[15]

The prevalence of syndromic and genetic disorders among laryngomalacia patients has been reported to range from 8% to 20%.[5,15] The most frequently observed syndromes in the literature include Down Syndrome, CHARGE syndrome, and Pierre Robin sequences.[19] Similarly, in our study, Down syndrome was the most common, present in 10 patients, followed by unclassified syndromes in 7 patients and Pierre Robin sequence in 4 patients. Notably, syndromes associated with retrognathia, such as Pierre Robin sequence, were more likely to require tracheostomy; in our study, 2 oit of 4 patients with Pierre Robin sequence underwent tracheostomy. These findings indicate that syndromic and genetic abnormalities are significantly associated with increased severity of laryngomalacia.

Synchronous airway lesion (SAL) are reported in 12 to 45% of laryngomalacia cases, with tracheomalacia being the most common, followed by subglottic stenosis and vocal cord paralysis.[20] Studies has shown that the presence of SAL is associated with greater disease severity and an increased likelihood of requiring surgery.[21,22] In our series, all patients with SAL had severe laryngomalacia and required surgical intervention. However, some reports suggest that SAL may not always correlate with clinical severity.[23]

The management of laryngomalacia is guided by disease severity. Mild cases typically require only observation, while moderate cases with feeding issues may benefit from anti-reflux therapy and, in some instances, surgical intervention. Surgery is reserved for severe cases presenting with failure to thrive or respiratory distress.[9] Our findings align with previous studies, demonstrating a significant association between laryngomalacia severity and treatment modality.[5,9,24] Nearly all patients with mild laryngomalacia were managed conservatively, whereas 67 patients with moderate or severe disease underwent supraglottoplasty, with or without epiglottopexy.

This study supports the utility of an objective scoring system for classifying disease severity and guiding appropriate treatment selection, ultimately improving patient outcomes and addressing a critical gap in standardized assessment. Our findings align with global prevalence rates (mild: 45.3%, moderate: 35.1%, severe: 19.6%) but uniquely highlight the predictive value of endoscopic typing (Type 3) and comorbidities (GERD, SAL. Syndromic conditions) in severe progression. The strong association between severity and surgical likelihood (moderate: OR 89.6; severe OR 133.3) underscores the scoring system's clinical relevance, supporting its adoption for risk stratification.[4]

CONCLUSION

In summary, mild laryngomalacia was the most prevalent form observed in our study, followed by moderate and severe cases. Disease severity was significantly influenced by the presence of comorbidities, particularly GERD, syndromic and genetic disorders and synchronous airway lesions. The anatomical type of laryngomalacia, as determined by endoscopic evaluation, was also associated with clinical severity. Our findings demonstrate that an objective symptom-based scoring system is effective for classifying laryngomalacia severity and guiding management, ensuring that treatment is appropriately matched to disease severity.

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