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Risk factors for failure of supraglottoplasty

C.M. Douglas [a,*], A. Shafi [b], G. Higgins [a], K. Blackmore [c], D.M. Wynne [a], H. Kubba [a], W.A. Clement [a]

[a] Department of Paediatric Otolaryngology, Royal Hospital for Sick Children, Dalnair St, Yorkhill, Glasgow G3 8SJ, Scotland. United Kingdom
[b] School of Medicine, Level 6, Ninewells Hospital and Medical School, Dundee, DD1 9SY, Scotland, United Kingdom
[c] Department of Otolaryngology, The James Cook University Hospital, Marton Road, Middlesbrough, Cleveland, TS4 3BW, United States

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ABSTRACT

Objectives: To assess for identifiable risk factors for failed surgical intervention in children with laryngomalacia.
Methods: Retrospective case note review between September 2007 and March 2012. Case notes were reviewed for demographic data, symptoms, co-morbidities, operative technique, postoperative recovery, complications, length of hospital stay including intensive care unit (ICU) care, and resolution of symptoms.
Results: 148 children underwent supraglottoplasty. Case notes were available for 115 (78%) patients. 35% (41/115) of cases were females and 65% (74/115) were male. A bimodal age distribution was observed with peaks at 3 months and 3.5 years. Those over one year of age were more likely to have complications ($p = 0.035$). There was no significant difference in outcomes for age ($p > 0.05$). In patients less than one year, reflux symptoms were significantly associated with a higher likelihood of failure of the operation ($p = 0.013$). Patients under one year with pre-operatively identified comorbid conditions were less likely to have an improvement in breathing ($p = 0.002$). Cold steel was used in 55% (63/115) of cases, laser only in 17% (20/115) cases and a combination of the two techniques in 28%, (32/115). There was no association between the surgical technique used and complications ($p = 0.558$). There was no association between improvement in symptoms and surgical technique used ($p = 0.560$). There was a significant association between delayed post-operative neurological diagnosis and failure of the operation ($p < 0.001$). 21 (18%) patients required a second procedure.
Conclusions: Pre-operative predictors of failure were patients with reflux symptoms ($p = 0.013$). Patients that required a second procedure were 37 times more likely to have a delayed diagnosis of an underlying neurological condition. Failure of symptoms to improve after supraglottoplasty should alert the clinician to the possibility of an underlying neurological disorder.

1. Introduction

Laryngomalacia is responsible for the majority of cases of neonatal and infant stridor. The cardinal symptom is inspiratory stridor that worsens with feeding, excitement, crying, and agitation in the supine position. The natural history of laryngomalacia is that it worsens at around 4–8 months, improves between 8 and 12 months and usually resolves spontaneously by two years of age [1]. There is a spectrum of disease, with severe laryngomalacia resulting in feeding difficulties, failure to thrive, apnoea, cyanosis or and/pectus excavatum. Surgery, in the form of supraglottoplasty, is the recommended treatment for severe laryngomalacia, to prevent worsening growth problems, cor pulmonale and heart failure. Around 5–20% of patients with laryngomalacia will require surgery [2]. The aim of the procedure is to open up the collapsing supraglottis by releasing the shortened aryepiglottic folds and removing redundant supraglottic tissue. The procedure can be done using cold steel, laser or a combination of both techniques [3]. The aim of this study was to assess for identifiable risk factors for failed surgical intervention in children with laryngomalacia.

2. Methods

This retrospective case note review was conducted for all children undergoing surgery for laryngomalacia for the period September 2007–March 2012, in the Department of Paediatric Otolaryngology, Royal Hospital for Sick Children, Glasgow. The

* Corresponding author. Tel.: +44 141 201 6940; fax: +44 141 201 0865.
E-mail address: catriona.douglas2@nhs.net (C.M. Douglas).

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hospital is the tertiary referral centre for airway pathology in Scotland. Patients were identified using the Departmental airway database. A total of 148 patients underwent supraglottoplasty during this time period. For each patient, the initial diagnosis of laryngomalacia was made based on the clinical presentation that included a combination of the following symptoms: stridor, apnoea, apparent cyanotic episodes (blue spells), and feeding difficulties leading to failure to thrive. The diagnosis was then confirmed by awake fibreoptic laryngoscopy. All patients were diagnosed with severe laryngomalacia defined as causing severe airway obstruction and/or failure to thrive that required surgical intervention. All children underwent a full microlaryngoscopy and bronchoscopy examination of the airway under general anaesthetic to confirm the diagnosis and check for secondary lesions prior to supraglottoplasty being performed. Supraglottoplasties were performed using micro-laryngeal instruments, CO_2 laser and/or a combination of the two techniques. Surgical technique used was each individual surgeon's personal preference. Case notes were reviewed for the following: age at first symptoms, age at diagnosis with flexible laryngoscopy, presenting symptoms (presence of stridor, apnoeas, cyanosis, sleep disturbance, feeding difficulties, failure to thrive), reflux, medical comorbidities, age at surgery, type of surgery, postoperative symptoms, need for nasogastric (NG) tube, need for revision supraglottoplasty. The diagnosis of reflux was made purely on clinical symptoms with associated frequent vomiting. Patients did not routinely undergo pH monitoring. Where reflux was diagnosed, patients were treated with ranitidine and/or omeprazole and gaviscon with doses calculated according to patients weight and BNF recommendations. Patients remained on anti-reflux medications until they had improved clinically; the medication was then gradually reduced, then stopped. All patients had a minimum of six months follow up. The primary outcome measure was the presence of postoperative upper airway obstruction, either requiring revision surgery or causing persistent upper airway obstruction and/or failure to thrive. Continued stridor after surgery was not considered a failure if the child was improving clinically. Statistical analysis was performed using minitab software (Minitab version 16, State College, P.A.). Chi square analysis was used unless the numbers were below 5, in which case fishers exact test was used. The significance level was set at 0.05.

3. Results

One hundred and forty-eight patients underwent supraglottoplasty of which case notes were available for 115 (78%). Casenotes for the remaining 22% were not available, due to being stored offsite. 35% (41/115) of cases were females and 65% (74/115). 80% (92/115) significantly improved after one procedure and 18% (21/115) required revision surgery.

3.1. Age

A bimodal age distribution was observed with peaks at 3 months and 3.5 years. Patients developed stridor from birth up to 5 years. 20% of the patients were born prematurely. 102 patients [89%] presented under age one and 13 (11%) of patients presented over the age of one year. In patients that presented at less than one year of age, the average age of onset of stridor was 18 days (0–365), with average age at presentation to ENT of 88 days (1–365), 70 days from onset to review. In patients that presented at over one year of age, the average age of onset of stridor was 1146 days (670–1825), with the average age of presentation to ENT 1621 days (730–2190), 475 days from onset to review. Table 1 shows the break down of patients, according to age and symptoms/signs. Patients that were older than one were significantly more likely to present with snoring ($p = 0.0006$). Patients that were older than one year were significantly less likely to present with feeding difficulty ($p = 0.001$). In the under one age group, reflux was significantly associated with poorer outcomes ($p = 0.013$) as were comorbidities ($p = 0.002$). Those who were older than one year of age at presentation were more likely to have post-operative complications ($p = 0.035$). There was no significant difference in outcome for age ($p > 0.05$).

3.2. Comorbid conditions

Fifteen patients had a known co-morbidity at the time of their operation (Table 2). Those with known comorbid condition, under one year, were less likely to have resolution of symptoms ($p = 0.002$). There was some evidence that those with comorbidities were less likely to have an unplanned ICU admission but this did not reach statistical ($p = 0.094$). There was no association between post-op complications and comorbid conditions. Previously undiagnosed neurological conditions were identified in the post-operative period in six patients (Table 3). There was a significant association between a post-operative diagnosis of a

Table 1
Signs and symptoms and association with outcome.

Sign/ symptom	>1 year			<1 year		
	No patients with symptoms failed surgery	No patients without symptoms failed surgery	Predispose to failure[a]	No patients with symptoms failed surgery	No patients without symptoms failed surgery	Predispose to failure
Snoring	1/10	0/3	$p = 1$	2/27	17/75	$p = 0.06$
Feeding difficulty	0/1	1/12	$p = 1$	14/57	5/45	$p = 0.08$
Apnoeas/ cyanosis	0/2	1/11	$p = 1$	6/39	13/63	$p = 0.5$
Reflux	01/3	0/10	$p = 0.23$	16/60	3/42	$p = 0.013$
Co-morbidity	1/7	0/6	$p = 1$	7/13	12/89	$p = 0.002$
Failure to thrive	0/1	1/12	$p = 1$	12/59	7/43	$p = 0.6$
Pectus/ recession	0/3	1/10	$p = 1$	13/71	6/31	$p = 0.9$

[a] Due to small numbers Fishers exact test used.