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Characteristics of patients undergoing supraglottoplasty for laryngomalacia

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ABSTRACT

Objective: To examine the characteristics of patients undergoing supraglottoplasty for the treatment of laryngomalacia and to better understand the features of laryngomalacia that may predispose patients to the need for supraglottoplasty.
Methods: Review of patients who underwent supraglottoplasty for laryngomalacia at our academic tertiary care children's hospital between 2005 and 2012 examining demographic information, medical comorbidities, symptoms, indications for surgery, operative findings and procedure, site of laryngeal obstruction, operative techniques, and surgical success rates.
Results: Seventeen patients with laryngomalacia underwent nineteen procedures. The most common indications for supraglottoplasty were persistent stridor beyond 18 months of age (64.7%), difficulty feeding (47%), and failure to thrive (29.4%). The most common comorbidities were gastroesophageal reflux (88.2%) and cardiopulmonary disease (35.3%). Operative findings included shortened aryepiglottic folds in sixteen patients (94.1%), retropositioned epiglottis in sixteen (94.1%), and prolapsed arytenoid mucosa in five (29.4%). Fifteen patients (88.2%) underwent division of the aryepiglottic folds and four underwent ablation of arytenoid mucosa (23.5%). Of the seventeen patients who had followed up at the time of study conclusion, sixteen (94.1%) had symptom improvement and twelve (70.6%) had complete resolution of their symptoms.
Conclusions: Supraglottoplasty is an effective treatment for laryngomalacia. Outcomes in our patients are similar to those reported in prior literature. The findings of shortened aryepiglottic folds and a retropositioned epiglottis appear to be disproportionately represented in our cohort of patients undergoing supraglottoplasty.

1. Introduction

Laryngomalacia is the most common congenital anomaly of the larynx and the most common cause of neonatal and infantile stridor [1,2]. In patients affected by laryngomalacia, there is dynamic [3] collapse of the supraglottic airway structures during inspiration which results in supraglottic airway obstruction and inspiratory stridor. Although the exact pathophysiology is unknown, several theories have been advanced to explain the etiology of the supraglottic airway collapse. These hypotheses include inadequate rigidity of the laryngeal cartilages, excessive laryngeal inflammation due to gastroesophageal reflux, and defective neuromuscular control of the larynx [4]. The association between gastroesophageal reflux and laryngomalacia has been well documented, but the causal relationship is unclear [5,6]. One school of thought holds that gastric reflux incites an inflammatory response in the laryngeal mucosa, causing tissue edema which leads to airway obstruction. Another possibility is that patients with laryngomalacia generate abnormally large negative intrathoracic pressure gradients during inspiration as an attempt to overcome supraglottic airway obstruction, and this abnormal pressure gradient then promotes gastric reflux [2].

The disorder involves collapse of the involved tissues of the supraglottic larynx resulting in supraglottic airway obstruction and inspiratory stridor. Several classification systems of laryngomalacia have been developed depending on the subsite of laryngeal involvement but none have been widely adopted [3,7]. In basic terms, clinicians recognize that obstruction can occur anteriorly in the larynx, with medial collapse of a tubular

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epiglottis, or posterior collapse of a retropositioned epiglottis, posteriorly in the larynx, with anterior collapse of arytenoids, or in the mid-larynx, with medial collapse of aryepiglottic folds. These areas of collapse may occur in isolation or in combination.

The vast majority of cases of laryngomalacia will resolve during the second year of life, but up to 10–20% of patients may have symptoms severe enough to warrant surgical intervention in the form of supraglottoplasty or tracheotomy [8]. Persistent stridor, failure to thrive, and difficulty feeding are some of the more common indications for surgical intervention. The purpose of our study was to examine the characteristics of patients undergoing supraglottoplasty for laryngomalacia at our institution. This would allow us to identify aspects of patients who undergo supraglottoplasty, and hopefully allow us to better predict which patients with laryngomalacia will ultimately require supraglottoplasty.

Prior studies have examined patients who have undergone supraglottoplasty for laryngomalacia in order to determine what risk factors might be predictive of the need for operative intervention. Patients with a history of prematurity, of severe symptoms, or of emergent presentation to the hospital have been demonstrated to be at greater risk for needing future operative intervention [9,10]. To our knowledge, the varying subtypes of laryngomalacia have not been examined as a possible predictive risk factor for the need for operative intervention. In a prior study of patients with laryngomalacia, all eight patients who underwent supraglottoplasty were noted to have short aryepiglottic folds and all of those patients underwent division of the aryepiglottic folds as part of the surgical treatment [11]. We hypothesized that patients with short aryepiglottic folds and a retropositioned epiglottis would be more likely to undergo supraglottoplasty than patients with redundant arytenoid mucosa.

2. Materials and methods

After approval was received from our Institutional Review Board, we performed a retrospective case series of a single surgeon looking at all patients who underwent supraglottoplasty at our academic tertiary care children's hospital from 2005 to 2012. All patients were identified based on the surgeon's operative records. Nineteen total patients were identified. Only patients who underwent supraglottoplasty for laryngomalacia were included in the analysis, which excluded two patients who underwent supraglottoplasty to attempt tracheostomy decannulation. Patients underwent surgery for one of several indications, including persistent stridor, difficulty feeding, failure to thrive, obstructive sleep apnea, cyanosis, aspiration, or prolonged intubation. We examined patient demographic information, medical comorbidities, symptoms, indications for surgery, operative findings and procedure, site of laryngeal obstruction, operative techniques, and surgical success rates for each patient.

Findings at the time of flexible laryngoscopy and at the time of supraglottoplasty were recorded for each patient and classified according to the site of supraglottic obstruction (e.g., prolapse of the arytenoid mucosa, shortened aryepiglottic folds, or retropositioned epiglottis). Several patients had more than one site of supraglottic collapse, and this was also noted. All of our patients in this study initially underwent flexible fiberoptic laryngoscopy in the outpatient clinic. At the time of surgical intervention, a direct laryngoscopy was performed with the patient spontaneously ventilating without the presence of an endotracheal tube in order to accurately determine confirm the diagnosis and the subsite of laryngeal collapse. Once this has been confirmed, the patient is endotracheally intubated by the surgeon for the remainder of the procedure. The primary surgeon in this study utilizes a Parsons laryngoscope and inspects the larynx under spontaneous ventilation to determine the sub-site of obstruction. If the anterior commissure is not easily visible with this method and there is dynamic collapse of the epiglottis or aryepiglottic folds the patient is considered to have short aryepiglottic folds. If there is prolapse of arytenoid mucosa with inspiration the patient is considered to have redundant arytenoid mucosa.

The operative procedures that were performed in these patients were reviewed, and the type of technique that was utilized was recorded (e.g., division of the aryepiglottic folds or ablation of redundant arytenoid mucosa).

Outcomes were assessed at followup in the outpatient clinic. Patients were classified depending on the persistence of symptoms, such as stridor, feeding intolerance, or failure to thrive. Patients with no remaining symptoms were classified as having complete resolution, patients with some decrease in symptoms were classified as having improvement, and patients with persistent, unchanged symptoms were classified as surgical failures.

3. Results

Seventeen patients with laryngomalacia underwent a total of nineteen procedures. Age at the time of operation ranged from 1 month to 91 months, with a mean age of 33.7 months. Males made up 64.7% of our study population and females the other 35.3%. The vast majority of our patients were Caucasian (94.1%) which roughly mirrors the makeup of the population that we service. Stridor was present in 18 of the 19 patients (94.7%).

The most common presenting symptoms and indications for supraglottoplasty (Fig. 1) were persistent stridor beyond 18 months of age (64.7%), difficulty feeding (47%), and failure to thrive (29.4%). Other indications for surgery included cyanotic episodes (17.6%), aspiration symptoms (17.6%), and obstructive sleep apnea symptoms (29.4%). The most common comorbidities were gastroesophageal reflux (88.2%) and cardiopulmonary disease (35.3%). Of the 15 patients with gastroesophageal reflux, 9 (60%) had undergone an esophagram to confirm the diagnosis while 6 patients were diagnosed based on the presence of clinical symptoms, such as frequent spitting up or vomiting. Other common comorbidities included synchronous airway anomalies (35.3%), a history of a genetic syndrome (11.8%), a history of neurologic impairment or developmental delay (11.8%), and a history of prematurity (5.9%). The breakdown of surgical indications, comorbidities, and procedures performed can be seen in Table 1.

Operative findings included shortened aryepiglottic folds in sixteen patients (94.1%), retropositioned epiglottis in sixteen patients (94.1%), and prolapsed arytenoid mucosa in five (29.4%) (Fig. 2). The vast majority of our patients also had some vocal fold pathology; 82.4% were noted to have true vocal fold edema and 11.8% also had a vocal fold lesion, such as a nodule. All patients were noted to have normal vocal fold mobility.

In terms of the surgical procedure performed, fifteen patients (88.2%) underwent division of the aryepiglottic folds and four underwent ablation of arytenoid mucosa (23.5%) (Fig. 3). The laser was used in eight cases (47.1%) and cold steel in nine (52.9%). Two patients required a second procedure both of which involved ablation of redundant arytenoid mucosa. The laser was used in both of the patients who underwent a second procedure. Successful extubation occurred in the OR or in the PACU in sixteen patients (94.1%). The remaining patient remained intubated for a prolonged period of time.

Of the eleven patients with persistent stridor, eight initially underwent only division of the aryepiglottic folds while three underwent division of the aryepiglottic folds and ablation of redundant arytenoid mucosal tissue. Of the five patients with obstructive sleep apnea symptoms, all five initially underwent