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Original Article

# Predictors of Outcomes Following KTP Laser Supraglottoplasty for Severe Laryngomalacia

John Drew Prosser, James Arthur Norton, Jack Calvin Borders, Anjum Naveed

ABSTRACT: INTRODUCTION: Laryngomalacia is the most common cause of infant stridor. The majority of cases are self-limited but up to 20% of patients require surgical intervention secondary to severe airway obstruction or poor weight-gain. PATIENTS AND METHODS: IRB approved, retrospective study in a tertiary care children's hospital was planned . to determine what factors predict short-term (in-hospital) and long-term (out patient follow-up) success following laser supraglottoplasty for severe laryngomalacia. RESULTS: 31 children underwent laser supraglottoplasty from Feb 2009-Sept 2010. Co-morbidities included gastro-oesophageal reflux disease GERD (58%), prematurity (32%), neurologic (13%), cardiac (13%), and synchronous airway lesions SALs (23%). Age <2 months was associated with lower cure rates (71% vs 100%, p=0.0285), but not longer hospital stays or more non-invasive ventilatory support (NIV). Children with neurologic comorbidities required a longer duration (57 vs 5 hours, p<0.0001) of NIV and longer stays (3.5 vs 1.19 days, p<0.0001). GERD was not associated with more NIV or worse cure rates. Children with cardiac comorbidities tended to have longer inpatient stays but this did not reach statistical significance (p=0.076). Children with SALs had longer inpatient stays (2.57 vs 1.16 days, p<0.0001) and required more NIV (33.1 vs 5.5 hours, p=0.002). They were also more likely to receive Heliox (p=0.05). Prematurity trended patients toward longer hospital stays, more NIV and lower cure rates (p=0.08, 0.11, and 0.19 respectively). Complication rates were 12.9 percent. CONCULSION: This study confirms that primary laser supraglottoplasty has a high success rate (90.3%). Patients with neurologic comorbidities and SALs have longer hospital stays and require more inpatient support. Age < 2 months is associated with lower cure rates.

Key Words: Laryngomalacia,KTP laser, Supraglottoplasty.

INTRODUCTION: Laryngomalacia (LM) is a condition characterized by dynamic collapse of supraglottic structures during inspiration causing airway obstruction. An omega shaped epiglottis is often associated with laryngomalacia(Fig1). It is the most common cause of stridor in infants[1]. The condition typically presents between 2-6 weeks of age, progresses until 6-9 months and resolves after the age of 2 years. In up to 20% of cases surgical intervention is required secondary to severe airway obstruction, acute life-threatening events, documented obstructive sleep apnea, poor weight-gain or failure to thrive[2]. Supraglottoplasty with or without epiglottopexy is generally considered the primary initial intervention in severe LM requiring surgical intervention. If primary intervention fails to be curative patients typically undergo a secondary supraglottoplasty or are considered for tracheostomy. Synchronous airway lesions (SALs) in children with LM are well documented with an incidence approaching 58%[3]. LM patients with certain medical co-morbidities have poorer outcomes following supraglottoplasty compared to those without. Specifically, neurologic co-morbidities are associated with a higher rate of revision supraglottoplasty and eventual tracheotomy[4]. We aim in this study to identify the factors which predict short-term (in-hospital) and long-term (out patient follow-up) success or failure following primary laser supraglottoplasty for the treatment of severe laryngomalacia.

PATIENTS AND METHODS: A retrospective study was performed at a tertiary care academic children's medical center. Children who were diagnosed with severe laryngomalacia and who underwent KTP laser supraglottoplasty between February 2009 and September 2010 were included in the study. The diagnosis of laryngomalacia was made based on clinical presentation and confirmed by awake flexible fiberoptic laryngoscopy. Supraglottoplasty was performed for poor weight gain, witnessed apneas, confirmed obstructive sleep apnea(OSA), or severe life-threatening respiratory events. Surgery was performed utilizing the KTP laser by removing the redundant tissue over the arytenoids as

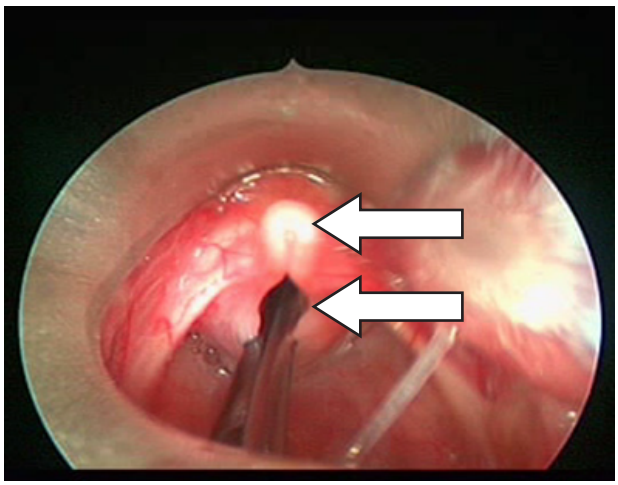

Figure-1: Endoscopic view of patient with laryngomalacia.Upper arrow indicate Omega shaped epiglottis, Lower arrow indicate prominent aryepiglottic fold

*Department of Otolaryngology, Medical College of Georgia, Division of Pediatric Otolaryngology
**Department of Otolaryngology, Tawm Hospital, Al Ain, United Arab Emirates.

Figure-2: 4 point use of KTP laser to reduce the bulk of epiglottis and aryepiglottic fold.

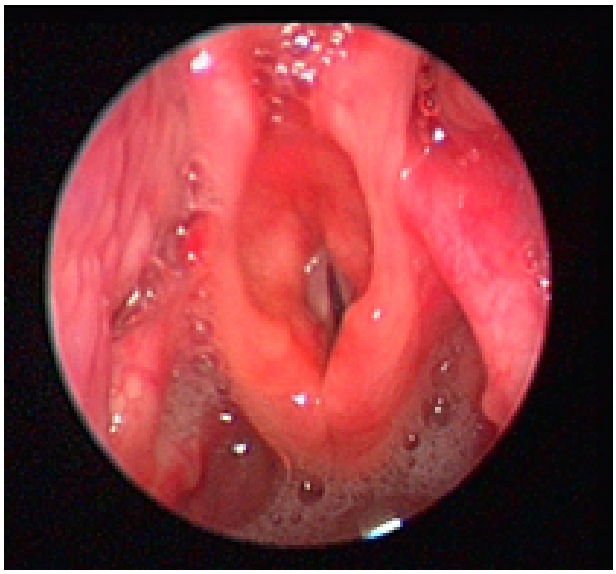

Figure-3: Late post operative view larynx after KTP laser supraglottoplasty.

well as the lateral aspects of the epiglottis (Fig-2). A comprehensive airway evaluation was performed at the time of surgery, and any Synchronous Airway Lesions were documented. Patients having supraglottoplasty by any other technique or inadequate documentation of hospital course were excluded. Charts were reviewed for age, co-morbidities, SALs, length of in-hospital invasive (intubation/ ventilation/ SIPAP) and non-invasive (Heliox/ supplemental oxygen/ racemic epinephrine/ CPAP) respiratory support. Length of hospital stay, outpatient resolution of symptoms, and any associated complications were reviewed. Patients were divided into age groups based on age at the time of surgery: <2 months, 2-10 months, and >10months of age. Co-morbidities were classified as GERD, cardiac, neurologic, prematurity or SALs.

STATISTICAL ANALYSIS.

Means and standard deviations were calculated with Microsoft Excel program. Comparisons between groups were made using a paired t-test. Statistical significance was determined by using a p-value less than or equal to 0.05.

RESULTS: Thirty-one children were identified for inclusion in this study. The average age at primary supraglottoplasty was 8 months of age (range 1-60 months). Co-morbidities included GERD (58%), prematurity (32%), neurologic co-morbidities (13%), cardiac co-morbidities (13%), and synchronous airway lesions (23%). When stratified by age at primary surgery (<2 months, 2-10 months, and >10 month of age), age <2 months was associated with persistence of symptoms on outpatient follow-up (71% vs 100% resolution rate, p=0.0285). Age was not associated with longer inpatient stay or the requirement for more non-invasive ventilatory support. In regards to co-morbidities as inpatients, those children with neurologic co-morbidities required a longer duration of non-invasive ventilatory support (57 vs 5 hours, p<0.0001) following surgery and subsequently had longer inpatient stays (3.5 vs 1.19 days, p<0.0001). Gastro oesophageal reflux disease as a co-morbidity was not associated with increased in-hospital support, prolonged stay or outpatient failures. Children with cardiac co-morbidities tended to have longer inpatient stays (2.25 vs 1.37 days) but this did not reach statistical significance (p=0.076). Children with synchronous airway lesions had significantly longer inpatient stays (2.57 vs 1.16 days, p<0.0001) and required more inpatient support (33.1 vs 5.5 hours, p=0.002). Patients with SAL were significantly more likely to receive Heliox therapy (29% vs 4%, p=0.05) than those without other airway lesions. Children with a history of prematurity trended toward longer hospital stays, more in-patient support and lower cure rates but none of these reached statistical significance (p=0.08, 0.11, and 0.19 respectively). No patients required re-intubation or tracheotomy (Table-1).

| Comorbids | Percentages | Average post-operative Inpatient Stay | Statistical Significance for longer Hospital stay (P-Value) |
|---|---|---|---|
| GERD | 58% | 1.16 days | - |
| Prematurity | 32% | 2.75 days | 0.08 |
| Neurological Comorbid | 13% | 3.5 days | <0.0001 |
| Cardiac | 13% | 2.25 days | 0.076 |
| SAL | 23% | 2.57 days | <0.0001 |

Table-1 : Frequencies and post operative stay with comorbids.

| Complication | Percentages |
|---|---|
| Aspiration | 6.45% |
| Persistent Stride | 3.22% |
| Inarequed Reflux | 3.22% |

Table-2 : Complications of procedure (n=31).

Resolution of symptoms on follow-up was 90.3 %. Postoperative view of supraglottoplasty after healing can be seen in (Fig-3). Complication rates were 12.9 percent and included 2 cases of aspiration which resolved with conservative treatment, 1 case of persistent stridor, and 1 case of increased emesis/reflux symptoms following surgery. No particular group was associated with increased rate of complications (Table-2).

DISCUSSION: This study confirms the high rate of success with primary laser supraglottoplasty in the treatment of severe laryngomalacia (90.3%). In our cohort the most common comorbidities were gastro oesophageal reflux disease , prematurity, SALs. Of the co-morbidities both neurologic and SALs were associated with a longer need for inpatient non-invasive ventilatory support and subsequently longer inpatient hospitalizations. While cardiac co-morbidities trended toward longer in-patient stays this did not reach statistical significance. Gastro oesophageal reflux disease was very common in our cohort as published in previous studies[5], and its presence did not significantly affect outcomes however all patients with documented reflux were aggressively treated. The finding that children with synchronous airway lesion were more likely to require Heliox is not surprising given that our group commonly uses this medication in the immediate post-operative period in children with airway stenosis. Younger age (< 2 months) at primary surgery was associated with decreased cure rates on long-term follow-up when compared with those > 2 months presumably because of the severity of disease. No patient's required intubation or tracheotomy. Identifying these factors pre-operatively can both direct pre-operative parent counseling and guide post-operative therapy. Also this data suggests that children should undergo a complete airway evaluation at the time of primary surgery to assess for synchronous airway lesions as this will significantly affect post-operative management.

CONCLUSION: This study confirms that laser supraglottoplasty is associated with high success rates.Patient's with neurologic co-morbidities and synchronous airway lesion have longer hospital stays and require more inpatient support. Age < 2 months is associated with lower cure rates. This data should guide management and informed consent.

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