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Comparison between selective and routine intensive care unit admission post-supraglottoplasty



Timothy Cooper, MD ^a, Bree Harris, MD ^a, Ahmed Mourad, BSc ^b, Daniel Garros, MD ^{c,d}, Hamdy El-Hakim, FRCS(ORL-HNS) ^{d,e,f,*}

^a Division of Otolaryngology-Head and Neck Surgery, Canada

^b Faculty of Medicine and Dentistry, Canada

^c Division of Pediatric Critical Care, Canada

^d Department of Pediatrics, Canada

^e Divisions of Otolaryngology-Head and Neck Surgery and Pediatric Surgery, Canada

^f Department of Surgery, The Stollery Children's Hospital, University of Alberta, Edmonton, Alberta T6G 2B7, Canada

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ABSTRACT

Objective: To compare major post-operative respiratory complications, post-operative disposition and duration of hospital admission before and after adopting a selective intensive care unit (ICU) admission care plan following supraglottoplasty (SGP).

Methods: Retrospective case series set in a tertiary pediatric referral center. Eligible patients undergoing SGP between October 2003 and July 2015 were identified through a prospectively kept surgical database. Historical cohorts with routine admission to ICU and selective admission to ICU were identified based on a shift in surgeon practice. The cohorts were compared with respect to demographics, presenting features, endoscopic findings, baseline sleep and swallowing study results, major respiratory complications (including repeat or unplanned ICU admission or intubation) and length of post-operative hospital admission.

Results: 141 eligible patients were identified with 35 children in the routine ICU admission cohort and 106 in the selective ICU admission cohort. There were no significant differences between cohorts regarding major respiratory complications with only one patient in the selective ICU admission cohort requiring an unplanned admission to ICU ($P = 1.00$, Fisher's exact test). This gives a number needed to harm of 78 step-down unit admissions for 1 unplanned ICU admission. The rate of ICU admission was reduced from 71% to 26% with adoption of a selective ICU admission care plan ($p < 0.01$, χ^2). Mean duration of post-operative hospitalization was reduced from 5.1 ± 3.5 days to 1.9 ± 2.3 days ($P < 0.01$, Student's t-test).

Conclusions: Selective post-operative ICU admission following SGP significantly reduces ICU utilization and may reduce length of hospital stay without compromising safety and care. This has significant cost benefit implications.

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1. Introduction

Laryngomalacia (LM) is the most common congenital laryngeal anomaly, classically presenting with stridor early in life [1]. Relatively recently, numerous atypical primary presentations have been described including swallowing dysfunction (SD) [2] and sleep

disordered breathing (SDB) [3–5], with authors coining terms like state-dependent LM [6] and late-onset LM [5,7,8]. Traditionally most cases of LM are managed conservatively with only the most severe cases necessitating surgical intervention [1,9,10]. Supraglottoplasty (SGP) is the standard surgical intervention for LM. This procedure involves division of the aryepiglottic folds, trimming of redundant supra-arytenoid tissue, and epiglottopexy [11] in varying permutations. There has been increased utilization of SGP as indications have expanded to treat SDB or SD presumably secondary to the anomaly [12–15].

* Corresponding author. 2C3.57 Walter MacKenzie Centre, Edmonton, AB, T6G 2R7, Canada.

E-mail address: hamdy.elhakim@albertahealthservices.ca (H. El-Hakim).

Post-operative care following SGP is surgeon and centre dependent [16]. Recommended post-operative care environments range from close monitoring on a step-down unit to remaining intubated and admission to an intensive care unit (ICU) routinely [16,17]. As such, there is limited evidence supporting post-SGP care pathways. While Shroeder et al. (2009) [18] suggest a need for airway and respiratory support in a significant number of post-operative patients, the series by Fordham et al. (2013) [19] and Albergotti et al. (2015) [17] suggest that children can be safely managed outside of an ICU environment. No studies to date have examined how a transition from routine to selective ICU admission has affected patient outcomes.

It was therefore our goal to compare ICU admission rates, major post-operative respiratory complications, and duration of hospital admission before and after adopting a selective ICU admission care plan following SGP.

2. Material and methods

This is a retrospective case series and chart review of a consecutive series of children undergoing SGP by a single pediatric otolaryngologist (HE). All children underwent surgery in the same tertiary pediatric referral center, the Stollery Children's Hospital. Institutional ethics review board approval was obtained through the Human Ethics Research Online system prior to commencing the study. Patients were identified through an electronic search of a prospectively kept comprehensive surgical database kept by the senior author (HE).

This study included all children under the age of 18 undergoing a cold steel technique SGP from October 2003 to July 2015. All patients had an endoscopically confirmed diagnosis of LM and type classification based on Olney's classification [9].

Patients were excluded if they had undergone a revision SGP or if a laser technique was utilized. Children with known syndromic diagnoses were also excluded, in addition to those with a pre-existing history of neurologic impairment, including hypotonia. Lastly, we did not include those patients who were direct transfers from an outside ICU for surgery with planned transfer back post-operatively.

The retrospective series was divided into two cohorts based on a change in post-operative care plan philosophy by the senior author (HE) starting in 2009. The routine ICU admission cohort consisted of consecutive patients undergoing SGP between October 2003 and December of 2008. During this time period, children were routinely admitted to ICU post-operatively irrespective of any variables and only under exceptional circumstances were they admitted to a step-down unit (older age, smooth procedure and recovery stimulating a change to pre-operative plan). The selective ICU admission cohort consisted of consecutive patients undergoing SGP from January 2009 to July 2015. During this time, patients were routinely admitted to a step-down unit post-operatively, with only a select group of patients being admitted to ICU. The reasons for lower threshold of admission to ICU post-operatively in this cohort included young infants (<3 months), McGill sleep oximetry score of ≥ 3 [20], history of cyanotic spells or apparent life threatening episodes (ALTE's), or anticipated difficult intubation.

The preoperative variables collected included age at time of surgery, gender, primary presenting features, type of LM, comorbid conditions, sleep study results, and swallowing assessments. Data collected regarding the post-operative course included post-operative disposition, failure of extubation or requirement for reintubation, admission to the ICU from the ward, and post-operative length of stay. The data was collected from both hospital and clinic charts as well as an institutional pediatric ICU database (PICUES[®]).

The primary presentation was defined as the most concerning feature or main focus of the referring physician or parent in the child going on to have a SGP which had been routinely documented by the surgeon. These definitions were kept consistent with prior publications by the senior author (HE) [2,13]. Stridor was defined as noisy breathing while awake, not primarily related to feeding. SD included difficulty feeding, choking, or coughing and was evaluated with either a clinical swallowing assessment or video fluoroscopic swallowing study (VFSS). S-SDB was defined as consistent snoring, arousals, apneas, or nocturnal or diurnal symptoms.

Comorbidities were defined as follows in accordance with prior publications by the senior author (HE). Gastroesophageal reflux disease (GERD) was diagnosed based on a combination of past medical history, history of response to proton pump inhibitors, esophagoscopy/gastroscopy with biopsy, or pH probe study results. Prematurity was defined as children born at ≤ 36 weeks gestational age. Obese children were those with a documented BMI of ≥ 97 th percentile. Neurologic conditions were determined based on past medical history. Cyanotic episodes were defined as a reported history of blue spells. ALTE's were defined as a history of brief episodes of two or more of apnea, change in color or complexion, change in muscle tone, or altered level of consciousness. These comorbid conditions were recorded as either present or absent.

McGill pulse-oximetry scores were assigned to overnight pulse oximetry (PO) results [20]. Swallowing evaluation (clinical assessments, with functional endoscopic evaluation of swallowing and/or videofluoroscopic swallowing studies) were considered abnormal in the presence of either aspiration or penetration.

Post-operative disposition was designated as either ICU or a step-down unit. The ICU consisted of a fully operational ICU admitting both medical and surgical pediatric patients at the Stollery Children's Hospital. The step-down unit consisted of a nursing unit with cardiorespiratory monitoring and two-to-one nursing care and was distinct in both staffing and physical location from the ICU. Reintubation or failure of extubation included the need to reintubate patients who developed respiratory distress following extubation in ICU, or after being transferred un-intubated from the recovery area post-operatively. Re-admission to ICU included any re-admission to the unit of a SGP patient, within 30 days of surgery. Length of ICU admission and length of post-operative hospital admission was recorded in days from the date of surgery.

The primary outcome measure was a comparison between the two cohorts regarding major respiratory complications including need for reintubation and need for readmission to ICU. Secondly, we compared the routine and selective ICU admission cohorts regarding post-operative disposition and length of hospitalization.

3. Statistical analysis

Descriptive statistics of each cohort were calculated including mean ages, mean pulse oximetry scores, and frequencies. Measures of central tendency were compared using Student's t-test or the Mann-Whitney *U* test as appropriate based on sample size. Frequencies and proportions were compared between the two cohorts using Fisher's exact test or χ^2 . Statistical significance was accepted as $P < 0.05$ in all cases. Number needed to harm was calculated using the reciprocal of the difference in absolute event rates of major respiratory complications (reintubation and ICU readmission) in the routine and selective ICU admission cohorts. Statistical analysis was performed using SPSS Statistics Version 23 (IBM, Armonk, NY).

4. Results

One hundred seventy SGP patients were identified in the

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