



The laryngeal mask airway for pediatric adenotonsillectomy: Predictors of failure and complications

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ABSTRACT

Objectives: We hypothesize that the laryngeal mask airway (LMA) is a safe technique for airway management in pediatric adenotonsillectomy (T&A).

Methods: After institutional review board (I.R.B.) approval, we conducted a retrospective review of 1199 medical records of children who underwent T&A from 2002 to 2006 at Doernbecher Children's Hospital, a teaching institution in Portland, OR. There were no significant demographic differences between the LMA ($n = 451$), endotracheal tube (ETT) ($n = 715$), and failed LMA groups ($n = 33$). Outcome variables were LMA failure (LMA replaced with endotracheal tube), and any complication. We collected demographic and medical data to determine the incidence and predictors of LMA failure, and to characterize the failed LMA group.

Results: The incidence of LMA failure was 6.8%. Patients who underwent adenoideotomy had significantly lower odds of LMA failure compared to patients who had a tonsillectomy or adenotonsillectomy (OR 0.28, 95% CI 0.15–0.52, $P < 0.0001$). One of the surgeons (OR 0.46, 95% CI 0.45–0.48, $P < 0.0001$) was also associated with decreased odds of LMA failure. Controlled ventilation (OR 7.17, 95% CI 4.99–10.32, $P < 0.0001$), and younger patients (OR 1.05 for each year decrease in age, 95% CI 1.03–1.07, $P \leq 0.0001$) were associated with increased odds of LMA failure.

The complication rate was 14.2% in the LMA group and 7.7% in the ETT group. Increased odds of developing any complication were seen in male patients (OR 1.4, 95% CI 1.01–1.7, $P = 0.04$), and in patients with co-morbidities other than obstructive sleep apnea syndrome or upper respiratory tract infection (OR 4.2, 95% CI 1.03–17.2, $P = 0.04$). The odds of developing a complication were lower in the ETT group compared to the LMA group (0.63, 0.46, 0.8, $P = 0.005$).

Conclusions: LMA use for pediatric T&A is associated with a higher incidence of complications, mainly as a result of airway obstruction following insertion of the LMA or McIvor gag placement. Complications were more likely if tonsillectomy was performed when compared to adenoideotomy alone. Appropriate patient selection, careful insertion, and avoidance of controlled ventilation may decrease the incidence of LMA failure, especially if tonsillectomy is performed. The ability of surgeons to work around the LMA can modify the failure rate significantly.

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1. Introduction

Approximately a quarter of a million tonsillectomies with or without adenoideotomy are performed in the USA annually, making it the second most common surgical procedure in children [1]. The endotracheal tube (ETT) is considered the standard for

airway control and protection during general anesthesia, especially when the airway is 'shared' between the anesthesia provider and the surgeon. However, within the last 15 years there has been increasing use and acceptance of the flexible reinforced laryngeal mask airway (LMA) for pediatric adenotonsillectomy (T&A), particularly in Europe [2–6]. In the U.S., the use of the LMA for pediatric T&A has been studied in children with upper respiratory tract infections [7].

Previous studies have demonstrated some advantages of the LMA over the ETT for pediatric T&A, though most of them have been small studies [3,4,8], with one notable exception [2]. We hypothesized that the LMA is a safe alternative to the ETT for pediatric T&A. This study identifies predictors of LMA failure

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Table 1
Demographics and procedure times for LMA, FLMA and ETT groups.

Variable	LMA	LMA failure	ETT	P-Value
Number of patients (n)	451	33	715	
Age (S.D.) in years	6.1 (3.5)	6 (4.1)	6.7 (4.6)	0.011
Weight (S.D.) in kg	26.8 (15.6)	31.6 (22)	29.8 (20.5)	0.008
Male	55%	60%	54%	0.722
Procedure time in minutes (S.D.)	52 (20)	68 (20)	61 (29)	<0.0001

ETT, endotracheal tube; LMA, laryngeal mask airway.

(FLMA) based on our experience with the device over a 5-year period.

2. Materials and methods

Following our institutional review board (I.R.B.) approval, we examined the medical records for all pediatric patients between January 2002 and December 2006 that underwent adenoidectomy, tonsillectomy, or T&A with or without bilateral myringotomy and ventilation tubes by three pediatric otolaryngology surgeons and fifteen pediatric anesthesiologists at Doernbecher Children's Hospital (DCH), an academic teaching hospital in Portland, Oregon. Investigators reviewed all identified patients' electronic health records (lifetime clinical record, LCR) who underwent surgery during the study period. LCR was an electronic repository for images of scanned paper surgical and anesthetic records, and was therefore very reliable as a data source, as it was identical to reviewing original paper charts. Patients' demographic, medical, anesthetic, and surgical data was transcribed into a secure database. All patients who met the inclusion criteria were included in the analysis. The quality of data collection was monitored by randomly auditing 5% of patient records in the study database. Patients were analyzed by group according to the method of airway control (LMA, FLMA, and ETT). The choice of ETT versus LMA was at the discretion of the attending anesthesiologist in order to examine usual clinical practice rather than by a defined protocol. The LMA (LMA Flexible™, LMA North America, San Diego, USA) size was determined by the anesthesiologist according to manufacturer's recommendations. Adenoidectomy was performed with curettage, and tonsillectomy by dissection and/or cautery techniques. Variables collected and evaluated in the model included age, gender, weight, indication for surgery, type of surgery, comorbidities, premedication, intraoperative medications, airway group (LMA vs. ETT), controlled versus spontaneous ventilation, deep versus awake extubation, timing of LMA failure, place of discharge, identities of the anesthesiologists and surgeons, procedure completion, length of procedure, and complications. The primary outcome was the incidence of failed LMA (FLMA), which was defined as the need to replace the LMA with an ETT. Secondary outcomes identified a priori were the incidence of any complication, and anesthesia time in the LMA versus ETT group. Patients were monitored for complications in the recovery room and until discharge home or to the inpatient ward.

Table 2
Indications for surgery by group: number of patients = N (%).

Group	OSAS	CAT	COM	Chronic sinusitis	OSAS+COM	Other	Total
LMA	214 (18.4)	57 (4.9)	75 (6.4)	9 (0.7)	21 (1.8)	61 (5.2)	437 (37.6)
FLMA	19 (1.6)	4 (0.3)	2 (0.17)	0	2 (0.17)	5 (0.4)	32 (2.7)
ETT	309 (26.5)	124 (10.6)	62 (5.3)	18 (1.5)	47 (4)	133 (11.4)	693 (59.6)
Total	542 (46.6)	185 (15.9)	139 (11.9)	27 (2.3)	70 (6)	199 (18)	1162 (100)

ETT, endotracheal tube; LMA, laryngeal mask airway; LMAF, laryngeal mask airway failure; OSAS, obstructive sleep apnea syndrome; CAT, chronic adenotonsillitis; COM, chronic otitis media; 37 pts had missing data.

Demographic and medical characteristics of patients in each of the airway groups were summarized using descriptive statistics. A logistic generalized estimating equation (GEE) regression model was used to identify predictors for LMA failure and assess the association between airway groups and occurrence of any complication after adjusting for any confounding variables. Statistical significance was set at $P < 0.05$. Data were analyzed using SAS 9.1 (SAS Institute, Inc., Cary, NC, USA).

3. Results

3.1. Demographics

Overall, 54.8% of patients were male, mean age was 6.4 (S.D. 4.2) years, mean weight was 28.7 (S.D. 18.9) kg, and the mean procedure time was 58 (S.D. 26.7) min. There was no significant difference in demographic characteristics between groups (Table 1).

3.2. Indications for surgery and co-morbidities

The indications for surgery are listed in Table 2. Most frequent indications were for obstructive sleep apnea (OSA) (46.6%), and chronic adenotonsillitis (15.9%).

Reported co-morbidities included 542 (46.6%) patients with OSA, 139 (11.8%) with upper respiratory tract infections (URI), and 312 (26.5%) with other conditions such as cleft lip and/or cleft palate, developmental delay, seizures, and a variety of congenital syndromes; the remaining 183 (15.5%) patients reported no comorbidity apart from chronic or recurrent tonsillitis.

3.3. Anesthetic techniques

1003 (84.4%) patients received premedication with midazolam, acetaminophen, ketamine, or other drugs. 1024 (85.4%) patients had an inhalational induction, and sevoflurane was used for 95% of these patients for induction. 175 (14.6%) patients had an intravenous induction, with propofol used in 168 (99.4%). Ventilation was controlled in 437 (36.6%) patients, and was spontaneous in 754 (63.3%).

3.4. Procedure time and completion

The mean procedure time was 58 (S.D. 26.7) min, and it was shorter in the LMA group by 7 min compared to the ETT group ($P < 0.001$). Most patients (1189, 99.5%) were discharged home

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