Original Article

Comparison of laryngeal tube suction II and proseal LMA™ in pediatric patients, undergoing elective surgery

ABSTRACT

Background: Supraglottic airway devices now have an established place in pediatric anesthesia practice. The laryngeal tube suction (LTS) II, a recent revision of the LTS, has very few studies evaluating its use in pediatric patients. The aim of this study was to compare insertion and ventilation profiles of the LTS-II size 2 and the ProSeal™ Laryngeal Mask Airway (PLMA) size 2 in pediatric patients undergoing elective surgeries.

Materials and Methods: A randomized prospective study was conducted in 100 children aged 2–5 years between 12 and 25 kg weight, of the American Society of Anesthesiologists physical status I and II scheduled for routine elective surgeries of <90 min duration. They were randomly divided into two groups of 50 each, depending on the device inserted, and a standard protocol for anesthesia was followed. Outcome measures were studied in terms of ease and time of insertion, oxygen saturation (SpO_2), oropharyngeal seal pressure (OSP), and ventilation failures.

Results: Both groups were well matched in terms of age, weight, and type of surgery. The success rate for the first attempt was 90% for both the LTS-II group and PLMA group. Insertion was found to be easy in the majority of cases in both groups, and there was no statistical difference in blood pressure, heart rate, or SpO_2 on insertion. However, the OSP was significantly more in LTS-II and PLMA ($P < 0.001$). There were no clinically important complications in the postoperative period.

Conclusions: Pediatric size 2 LTS-II is easy to insert and provides higher OSP compared with same size PLMA in anesthetized and paralyzed children undergoing elective surgery. It is a safe alternative to PLMA in short duration elective surgeries and may be a better device as it provides for higher OSPs.

Key words: Laryngeal tube suction II; pediatric patients; pediatric surgery; ProSeal LMA

Introduction

Supraglottic airway devices now have an established place in pediatric anesthesia following the overwhelming success of the laryngeal mask airway (LMA). The laryngeal tube suction (LTS) II (VBM, Medizintechnik, Sulz, Germany) is a relatively new and unique supraglottic airway device having a translucent double lumen silicone tube with two inflatable balloons and a modified smaller tip. It has been used in adult patients and found comparable to LMA. Pediatric version of LTS II is available in four different sizes 0, 1, 2, and 2.5; on the basis of bodyweight. However, there are no studies evaluating the use of LTS II in pediatric patients during anesthesia; even though, ProSeal™ LMA (PLMA, Laryngeal Mask Company, Henley-on-Thames, United Kingdom) has been studied in isolation as well as in comparison with other supraglottic devices.[1-3]

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In view of dearth of literature on status of LTS II in pediatric population, this study was undertaken, which aimed at comparing LTS II and PLMA in age group of 2–5 years with weight 12–25 kg (corresponding to size 2 of LTS II) for ease and time taken for insertion along with oropharyngeal sealing pressures (OSPs) in both devices. Hemodynamic parameters and any complications due to insertion of the device were also analyzed.

Materials and Methods

After obtaining approval from the hospital Ethics Committee, a prospective randomized study was conducted in 100 patients over 1 year, comparing LTS II size 2 with PLMA of the same size.

Inclusion criteria were pediatric patients aged 2–5 years with weight 12–25 kg, American Society of Anesthesiologists physical status I and II posted for elective surgeries of <90 min duration. Surgeries were in the supine position and included lower abdominal, inguinal, and orthopedic procedures. Exclusion criteria were patients with upper respiratory tract symptoms, patients at risk of gastric regurgitation; and other contra-indications of supraglottic devices such as limited mouth opening, pharyngeal/laryngeal abscess, or any other obstructive lesions.

Hundred patients were equally randomized to any of the two groups (LTS II and PLMA) of 50 each, for airway management by opening a sealed envelope. Consent was obtained from the parents before the intervention. All the children were kept fasting. As per hospital protocol, an intravenous line placed in the ward on the morning of surgery. The child, on arrival in the preoperative area, was premedicated with intravenous 0.1 mg/kg of midazolam for calm parental separation. Inside the operation theater, monitoring such as electrocardiography, noninvasive blood pressure, and oxygen saturation (SpO_2) was commenced. After premedication (fentanyl, 1–2 μg/kg) and preoxygenation for 3 min, anesthesia was induced with propofol (2.5 mg/kg). The child was then administered Atracurium and after a lapse of 3 min, the device, as chosen according to the group the child may belong, was inserted using the routine technique used for supraglottic devices. Subsequently, anesthesia was maintained with Sevoflurane (1%–2%) in nitrous oxide (60%) and oxygen (40%).

Like other supraglottic devices, the devices were inserted in the "sniffing" position. The ease of insertion was graded as very easy, easy, or difficult. Maneuvers used for troubleshooting were chin lift, jaw thrust, head extension, neck flexion and gentle pushing, or pulling of the device.[1,2] Insertion without any manipulation was labeled "very easy." Use of any one maneuver was "easy" and more than that was labeled "difficult." Three unsuccessful attempts were considered a failed attempt which was then managed with alternate airway options. These cases were excluded from the study. Insertion time was recorded from the time of removal of facemask to delivery of the first breath through the assigned airway device.

The device was secured properly, and the cuff was inflated using a cuff pressure monitor to achieve a pressure of 60 cm H_2O which was maintained throughout by continuous cuff pressure monitoring. A catheter through the gastric channel of the respective device was passed to decompress the stomach. The device was connected to the breathing system, and effectiveness of established airway was analyzed by capnography and visual inspection of chest lift.

Baseline systolic BP (SBP), heart rate (HR) and SpO_2 were recorded before insertion and then 1 and 5 min after insertion. The anesthesiologist assessed the ease of insertion, and other observations were noted by a blinded neutral observer, usually a resident or a theater staff. The OSP was measured by closing the expiratory valve of the circle system at a fixed gas flow of 3 L/min till an audible leakage was heard at the mouth or the opening of the drainage tube. Adverse events such as coughing, breath holding, and laryngospasm were noted at the end of surgery, during removal of the device. Blood staining of the cuff, sore throat, or hoarseness in the recovery area were also noted.

Statistical analysis was performed using the SPSS software version 17.0; (SPSS Inc., Chicago, USA). Sample size of fifty patients each was decided based on a pilot study of 10 patients. Taking alpha error of probability as 0.05 and power required 95%, to detect a projected difference of 30% between the groups for the OSP. The demographic data and complications were analyzed using the Chi-square test. The OSP and hemodynamic data were compared using the unpaired *t*-test. Insertion characteristics and insertion attempts of the gastric tube were analyzed using Fisher's exact test. Data were presented as number percentages or mean ± standard deviation as appropriate. The value of "$P < 0.05$" was considered as statistically significant.

Results

Demographic data in the two groups was comparable [Table 1]. No failures of insertion were noted in either group. The

number of attempts of insertion was also similar. Ease of insertion was more in the LTS II group with only 4% cases of difficult insertion compared to the PLMA group having 8% cases of difficult insertion. The OSP for the LTS II and PLMA groups, respectively. This difference was statistically significant [Table 2].

Gastric channel catheter could be easily passed in both the groups. Blood staining was observed in four cases in the PLMA groups and in two cases in the LTS II group, the difference was statistically insignificant.

No cases of a sore throat or hoarseness were seen in both groups [Table 2]. Hemodynamic parameters such as SBP, HR, and Sp02 were comparable before and after insertion of the airway in both groups [Table 3]. No other complications were observed in any of the patients.

Table 1: Demographic data

Parameters	LTS II (*n*=50)	PLMA (*n*=50)	*P*
Age (years)	2.97±0.71	3.09±0.81	0.432
Weight (kg)	14.14±1.68	14.66±1.85	0.144
Gender (male:female)	29/21	31/19	0.683
Type of surgery			
Inguinal surgery	18	22	
Lower abdominal surgery	19	18	
Orthopedic surgery	13	11	

LTS: Laryngeal tube suction; PLMA: ProSeal™ laryngeal mask airway

Table 2: Insertion parameters and complications

Parameters	LTS II (*n*=50)	PLMA (*n*=50)	*P*
Insertion attempts: 1/2/3	45/4/1	45/5/0	0.574
Ease of insertion: Very easy/easy/difficult	44/4/2	40/6/4	0.533
Insertion time (s)	13.84±2.38	14.02±1.70	0.664
Gastric tube insertion attempts: 1/2/3	47/3/0	49/1/0	0.307
OSP (cm H_2O)	25.18±1.59	22.10±1.36	<0.001
Complications after removal of device			
Blood staining	2	4	0.40
Sore throat	0	0	
Hoarseness	0	0	

OSP: Oropharyngeal seal pressure; LTS: Laryngeal tube suction; PLMA: ProSeal™ laryngeal mask airway

Table 3: Comparison of hemodynamic parameters

Parameters	LTS II (*n*=50)	PLMA (*n*=50)	*P*
SpO2	100	100	-
HR (before insertion of device)	106.2	109.48	0.092
HR (1 min after insertion of device)	107.42	111.04	0.065
SBP (before insertion of device)	94.42	94.56	0.887
SBP rate (1 min after insertion of device)	96.02	96.20	0.847

SBP: Systolic blood pressure; HR: Heart rate; LTS: Laryngeal tube suction; PLMA: ProSeal™ laryngeal mask airway; SpO2: Oxygen saturation

Discussion

The LTS II is the most recent version of the laryngeal tube (LT) family of supraglottic airway devices. At the time of commencement of the present study, there were very few studies available in the literature which described the successful use of the LTS-II in adults to secure the airway during short duration surgeries[1-4].The PLMA, which was designed to improve controlled ventilation and airway protection compared to classic laryngeal mask airway, has found wide spread use[5]. Although, a recent report described the use of LTS-II as a rescue device in difficult airway situation in children aged 2 months to 6 years[6], an extensive search of literature did not yield any study evaluating use of LTS II in pediatric patients during anaesthesia.. However, PLMA has been studied in comparison with other supraglottic airway devices.[7-9]

In this study, it was found that insertion of the LTS-II was successful on the first attempt in 90% of patients and was equal to the PLMA group with no failures in either group. These rates can be taken as acceptable; however, no comparison can be drawn in view of the lack of literature on LTS II in children. The success rates for LTS-II were found to be variable in studies done in adult patients. On the one hand, Mihai *et al*. reported that insertion of LTS-II was successful for 98.5% (66/67) of size 4 and 100% (33/33) of size 5 devices, respectively.[1] While Kikuchi *et al*. reported that the success rate for inserting the LTS-II was 81% on the first attempt and 97.29% after two attempts compared to 60.41% on the first attempt and 85.41% after two attempts while using PLMA in 100 adult patients.[10] However, success rates with respect to PLMA insertion in our study were well-matched with other studies in children. Goyal *et al*. reported that insertion of the PLMA was successful on the first attempt in 90% of cases and 97.5% after two attempts in 120 children of age group 2–5 years.[11]

In the present study, the LTS-II was easy to insert and required minimal mouth opening. Higher instances of difficult insertion were recorded in the PLMA group. The PLMA has a comparatively larger bowl, which is more difficult to insert and has a tendency to fold over itself. A large tongue, a floppy epiglottis, an anterior larynx and tonsillar hypertrophy in pediatric patients may also contribute to the difficult insertion of PLMA.[12] Even though, the result obtained in this study was neither clinically nor statistically significant, PLMA does seem to be prone for malposition. Several malpositions for ProSeal LMA have been described by Brimacombe *et al*., including insufficient depth, the tip inserted into the glottis, the tip folded backward, and severe epiglottic downfolding.[13,14] Securing a final, effective airway

took <30 seconds in both the groups with mean duration of 13.84 seconds in LTS II and 14.02 seconds in PLMA group. This was noted to be similar to the findings as obtained in studies by Kikuchi *et al*. and Mihai *et al*.[1,10]

In the present study, it was found that passage of the gastric tube through LTS-II was 94% in the first attempt and 100% after two attempts compared to 98% on the first attempt and 100% after two attempts while passing through PLMA. Mihai *et al*. were successfully able to pass a gastric tube through LTS-II in all patients with 98% at first attempt.[1] However, it should be noted that the size 2 LTS-II allows a larger gastric tube (maximal 12 Fr) compared with PLMA (10 Fr) of similar size. This has an obvious advantage for suctioning contents and venting gas from the stomach.

In the present study, the OSP of the LTS-II was significantly higher than that of PLMA. Unfortunately, at present, we do not have any studies in children to draw comparisons. A review of studies in adult showed a mixed observation. In general, OSP of PLMA has been found to be higher which could be explained by the presence of a dorsal cuff in PLMA size 3 and above.[1] Asai *et al*. found that the OSP of PLMA was higher than that of LTS-II (35.7 vs. 33.6 cm H_2O).[15] Zand *et al*. also found that the OSP of PLMA was higher than that of LTS-II.[16] However, Brimacombe *et al*. found no difference in OSP between LTS-II and PLMA, in adult patients.[17]

In pediatric patients too, PLMA offers higher OSP when compared to standard LMA and classic LMA.[18,19] However, with the arrival of a newer version of supraglottic devices in pediatric age group like I-gel and their comparison with PLMA, it was found that OSP was better in I-gel than PLMA.[11,20] As mentioned above, no study is available in the literature regarding OSP in pediatric patients using LTS-II. A plausible explanation for lower OSP when compared to LTS II as recorded in our study would be the absence of dorsal cuff in smaller sizes of PLMA. Thus, our study underlines that LTS II is capable of establishing higher and better OSP than PLMA.

Although blood staining was observed on the cuff in 4% of children in the LTS-II group as against 8% in PLMA group, it was not statistically significant. This is in keeping with complication rates in other similar studies.[19] It is pertinent to mention that these results were obtained when the cuff pressure was consistently maintained at 60 cm H_2O in both devices to prevent gas leakage. Indeed, Wong *et al*. have shown a minimal sore throat when cuff pressure of LMAs was <60 cm H_2O.[21]

The hemodynamic parameters were comparable for both devices during the perioperative period. Changes noted were comparable with previous studies.[15] When ventilation-related parameters were analyzed, both the devices were equally effective in achieving normal oxygenation and ventilation in all patients.

When the results of various study parameters obtained in our investigation, are compared with historical observations for LT in pediatric patients, it is clear that LTS II is better device indeed. For example, in the present study, it was found that insertion of LTS-II was 90% in the first attempt and 98% after two attempts compared to 78.6% on the first attempt and 95.7% after two attempts while inserting LT including the inability to insert the LT in 12% of cases.[22]

Limitations

The sample population included only 2–5 years of age and only one size of both the devices was taken in this study. Second, only low-risk patients with normal airways were included. Use and analysis in full stomach patients were also not within the scope of this study.

Conclusions

Pediatric size 2 LTS-II is easy to insert and provides higher OSP compared with same sized PLMA in anesthetized and paralyzed children undergoing elective surgery. It is a safe alternative to PLMA in short duration elective surgeries and may be a better device as it provides for higher OSPs.

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Conflicts of interest

There are no conflicts of interest.

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