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Original Article

Comparison of the effects of supreme laryngeal mask airway and endotracheal tube on airway reflexes in patients who underwent nasal surgery: A randomized, controlled clinical trial

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Abstract

Aim: The primary purpose of this study was to compare the effects of supreme laryngeal mask airway (SLMA) and endotracheal tube (ETT) on (laryngospasm, bronchospasm, cough, desaturation) airway reflexes in patients who undergo nasal surgery. The secondary purpose was to evaluate the hemodynamic responses in this respect.

Material and Methods: The study was conducted as a prospective, randomized, single blind and controlled clinical trial in 92 patients between the ages of 18 and 65 for whom elective nasal surgery was planned, who volunteered for the study and who were American Society of Anaesthesiologists (ASA) I-II group. The patients were divided randomly into two groups as the supreme laryngeal mask (SLMA Group, n = 46), and the endotracheal tube (ETT Group, n = 46). The laryngospasm, bronchospasm, cough, desaturation (S^PO^2 ≤90) and hemodynamic parameters were evaluated after the extubation (T1) ^{5th} and (T2) 60^{th} minutes.

Results: The demographic data were similar in both groups. In the SLMA Group, laryngospasm was detected at T1: (5^{th} minute after the extubation) in 2 (4.3%) patients, Bronchospasm was detected at T1 (2.2%) in 1 patient, cough was detected at T1 in 4 (8.7%) patients, desaturation was detected at 3 (6.5%) patients. In the ETT Group, laryngospasm was detected at T1 (13%) in 6 patients (13%), bronchospasm was detected at T1 in 2 patients (4.3%), cough was detected at T1 (10.9%) in 5 patients, desaturation was detected in 5 patients (10.9%). There were no statistically significant differences between the groups in terms of the perioperative respiratory complications.

Conclusion: It was determined in our study that the incidence of the respiratory adverse events (laryngospasm, bronchospasm, and cough) in the patients applied SLMA was less than ETT in nasal surgery patients undergoing general anesthesia.

Keywords: Supreme laryngeal mask airway; endotracheal tube; respiratory adverse event.

INTRODUCTION

Perioperative respiratory events are important morbidity and mortality causes that are related with anaesthesia. There are many predisposing factors, which are increased airway sensitivity, upper respiratory tract infection, smoking, and endotracheal intubation (1,2).

Mechanical stimulation of the larynx and trachea during laryngoscopy and endotracheal intubation causes an increase in the sympathoadrenal activity. Together with hemodynamic response, this causes undesirable pharyngolaringeal adverse events (3).

The fact that laryngeal mask airway (LMA) is anatomically placed in the supraglottic region, it does not come into direct contact with the tracheal mucosa, and does not require direct laryngoscopy for insertion are advantages over endotracheal tubes (ETT) (4). One of the new-generation supraglottic airway devices is LMA-Supreme™ (SLMA, INTAvent Orthofix, Maidenhead, UK) (5). Its important advantages include having gastric drainage tube, high oropharyngeal leakage pressure and semi-hard elliptical structure. Unwanted airway reflexes increase in nasal surgery because of blood contamination in the vocal cord and tracheal area compared to other surgery types.

The primary purpose of the present study was to compare the effects of SLMA and ETT on airway reflexes

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(laryngospasm, bronchospasm, cough, and desaturation) in patients who underwent nasal surgery. The secondary purpose was to evaluate the hemodynamic responses in this respect.

MATERIAL and METHODS

This study was conducted in prospective, randomized, single-blind and controlled clinical design with 92 volunteering patients between the ages of 18-65, who had American Society of Anaesthesiologists (ASA) I-II, and who were scheduled for elective nasal surgery after the permission from the local ethics committee (2019/176) and the written consent of the patients were received. The patients were divided into two groups randomly as the laryngeal mask airway supreme (SLMA Group, n = 46), and the endotracheal tube (ETT Group, n = 46). To ensure randomization, the MedCalc, version-16 Statistical Software for Windows (medcalc.com.tr.) was used.

In the evaluation of the preoperative anaesthesia, obese patients who had a body mass ındex (BMI) above 30, those with potentially difficult airway findings, those who were above ASA II, those who had active upper respiratory tract infections, pregnant women, and the patients at risk of high regurgitation or aspiration were excluded from the study.

For premedication purposes, the patients were administered midazolam as 0.05 - 0.1 mg.kg-1 IV 30 minutes before the surgery. The patients who were admitted to the surgery room were preoxygenated routinely for 3 minutes (80% O^2). Mean artery pressure (MAP), pulse oximetry (S_pO2), electrocardiogram (ECG), and heart rate (HR) monitoring were carried out. Anaesthesia machine leakage test was performed before induction. The amount of leakage was similar in both groups and was within acceptable limits.

Anaesthesia induction was performed in both groups with Fentanyl 1 µg.kg-1 IV, rocuronium 0.5 mg.kg-1, propofol 2.5 mg.kg-1 IV. In ETT; number 8 endotracheal tube was used in male patients, and number 7 endotracheal tubes was used in female patients. The SLMA size was determined in line with the recommendations of the manufacturer. The cuff pressure was adjusted to 60 H_2O in SLMA cases and to 25 H_2O in ETT cases by using a manometer (Portex Cufator Endotracheal Tube Inflator and Manometer, Portex® Limited, Hythe, Kent, UK). The accurate position of the airway devices, the absence of leakage sound from the mouth, and the chest enlargement during ventilation were confirmed with capnography and auscultation. Anaesthesia maintenance was carried out with 50% O2/ air mixture at 1 MAC value and with remifentanil infusion (0.1 µg / kg / min I.V.).

The intraoperative mechanical ventilation was adjusted in IPPV mode as 4 L/min fresh gas flow, 8 mL / kg tidal volume, 5 cm H_2O positive expiratory pressure and respiratory rate at 35-45 mm Hg EtCO2 value.

The mean artery pressure (MAP) and HR were recorded just before the anaesthesia induction (basal, T1), after the intubation, and at 5th min (T2), 15th min (T3), 30th min (T4), and 60th min (T5). The demographic and surgical data were recorded as age, gender, weight, anaesthesia and surgery duration.

The patients who opened their eyes with stimuli, who had regular spontaneous respiration, whose respiratory count was 14-20/minute, and whose oxygen saturation was >95% after the surgery were extubated and taken to the recovery room.

The patients whose Modified Aldrete's score was 9 were transferred to the relevant service (6).

The laryngospasm, bronchospasm, cough and desaturation (S^pO2 ≤90) were evaluated by a blinded observer after the extubation, at the 5th (T1) and at the 60th (T2) minutes. The patients with VAS value>4 were given paracetamol (20 mg/kg, IV) as a saviour analgesic.

The pain assessment was made by using the Numeric Rating Scala (NRS) between 0-10. According to the NRS, the pain score is "0-1: No Pain; 2-4 Mild Pain, 5-7 Moderate Pain, and 8-10 Severe Pain".

Laryngospasm is the sustained closure of the vocal cords resulting in the partial or complete loss of the patient's airway (2); and desaturation was defined as S_pO2 ≤90. Bronchospasm was evaluated as increased respiratory effort and wheezing especially during expiration.

Cough was evaluated in the postoperative period (less than 5 coughs were ignored in the first minute after SLMA or ETT was removed; more than 5 coughs were considered to exist).

Power Analysis

The amount of Type 1 error (alpha) must be 0.05, the power of the test (1-beta) 0.9, the difference between rates 0.59, the discordant ratio 0.67, and when the alternative hypothesis (H1) is two-way, the minimum sampling size required to find a statistically significant difference must be 13. The calculations were made by using the R Software (7).

Statistical Analysis

The data were expressed as median (min-max) values or frequency (percentage) for overall variables. Normality was assessed using Shapiro Wilk test. The non-normally distributed data were compared by Mann Whitney U test between the groups. Qualitative data were analysed with Pearson chi-square test and Yates corrected chi-square test as appropriate. P<0.05 values were considered as significant. IBM SPSS statistics version 25.0 for Windows was used for statistical analysis.

RESULTS

A total of 92 patients who underwent nasal surgery were included in the present study. In the SLMA Group, 24 (52.1%) of the cases were female; and 22 (47.8%) were male. In the ETT Group, 23 (50%) of the cases were female, and 23 (50%) were male. The SLMA Group, age (median)

was 32 (23-45), and 37 (24-46) in the ETT Group. In the SLMA Group, the surgery time was 50 min (44-60 min), and the anaesthesia time was 70 min (62-80 min). In the ETT Group, the surgery time was 50 min (40-60 min), and the anaesthesia time was 68 min (61-77 min). No statistically significant differences were detected between the groups. The ratio of successful airway device insertion was similar in both groups. The weight, height, Mallampati score, BMI, ASA, and smoking values of the cases were similar; and there were no significant differences between the groups. The demographic characteristics of the patients are given in Table 1.

In the SLMA Group, laryngospasm was detected at T1 (5th min after the extubation) in 2 patients (4.3%), bronchospasm was detected at T1 in 1 patient (2.2%), Cough was detected at T1 in 4 patients (8.7%), and desaturation was detected in 3 patients (6.5%). In the ETT Group, Laryngospasm was detected at T1 in 6 patients (13%), Bronchospasm was detected at T1 in 2 patients (4.3%), Cough was detected at T1 in 5 patients (10.9%), and Desaturation was detected in 5 patients (10.9%). There were no statistically significant differences between the groups in terms of perioperative respiratory complications. The perioperative respiratory adverse events are presented in Table 2.

Table 1. Characteristics of the study groups

Variable	SLMA (n=46)		ETT (n=46)		P value
	Median	25%-75% or n (%)	Median	25%-75% or n (%)	
Age, years	32	23-45	37	24-46	0.728[a]
Gender,(male/female)		23 (50%)/23 (50%)		24 (52.1%)/22 (47.8%)	0.677[b]
Height, cm	170	163-174	165	160-173	0.387[a]
Weight, kg	70	61-73	66	57-75	0.628[a]
BMI, (kg/m2)	23	22-26	25	22-26	0.396[a]
ASA, n					
1		26 (56.5%)		24 (52.1%)	0.399[b]
2		20 (43.5%)		22 (47.8%)	
Mallampati Score					
1		28 (60.8%)		27 (58.6%)	0.991[b]
2		18 (39.2%)		19 (41.4%)	
Airway device inserted successfully					
At the first attempt		41 (89.1%)		40 (87%)	0.999[b]
At second attempt		5 (10.8%)		6 (13%)	0.915[b]
Smoking		18 (39.1%)		16 (34.7%)	0.793[b]
Duration of Anesthesia, min	70	62-80	68	61-77	0.514[a]
Duration of Surgery, min	50	44-60	50	40-60	0.461[a]

Values are expressed median with 25%-75% or numbers n (%), ASA: American Society of Anesthesiology; BMI: Body Mass Index; cm: centimeter; kg: kilogram; min: minutes; n: number, a: Mann Whitney-U test; b: Chi-square test; SLMA: Supreme laryngeal mask airway; ETT: Endotracheal tube

Table 2. Incidence of Respiratory Adverse Events

Variable	SLMA (n=46)		ETT (n=46)		P value	
	T1	T2	T1	T2	P^{T1}	P^{T2}
Laryngospasm, n (%)	2 (4.3%)	0 (0%)	6 (13%)	0 (0%)	**0.267**	NA
Bronchospasm, n (%)	1 (2.2%)	0 (0%)	2 (4.3%)	1 (2.2%)	**0.999**	NA
Cough, n (%)	4 (8.7%)	0 (0%)	5 (10.9%)	0 (0%)	**0.999**	NA
Desaturation <90%, n (%)	3 (6.5%)	0 (0%)	5 (10.9%)	0 (0%)	**0.714**	NA

T1: 5th min post-extubation, T2: 60th min post-extubation, SLMA: Supreme laryngeal mask airway, ETT: Endotracheal tube; NA: not available; Values are numbers (percentage); P values are calculated based on chi-square test.

In the SLMA Group, the HR was statistically and significantly lower than the ETT group at perioperative 5th, 15th, 30th and 60th minutes (p<0,001, p< 0,001, p=0,009, p<0,001, respectively) (Table 3). In the SLMA Group, MAP was significantly lower than the ETT Group at the 15th min after the intubation (p=0.008). There were no significant differences between the groups at other time points (shown in Table 4)

Table 3. Heart rate of the patients at various timepoints in two groups

Variable	S LMA (n=46)		ETT (n=46)		p[a] value
	Median	25%-75%	Median	25%-75%	
Baseline	80	72-92	79	73-92	0.821
Perioperative					
5th min	73	65-83	87	73-98	**<0.001**
15th min	70	65-79	80	71-89	**<0.001**
30th min	74	67-80	80	71-87	**0.009**
60th min	76	70-80	81	77-88	**<0.001**

Values are presented as median with 25%-75%; a: Mann Whitney-U test; SLMA: Supreme laryngeal mask airway, ETT: Endotracheal tube

Table 4. Mean arterial pressure of patients

Variable	S LMA (n=46)		ETT (n=46)		p[a] value
	Median	25%-75%	Median	25%-75%	
Baseline	84	76-101	79	69-94	0.229
Perioperative					
5th min	70	65-77	75	64-87	0.154
15th min	70	65-79	79	68-90	**0.008**
30th min	72	65-82	77	69-86	0.127
60th min	72	68-79	76	70-86	0.102

Values are presented as median with 25%-75%; a: Mann Whitney-U test; SLMA: Supreme laryngeal mask airway, ETT: Endotracheal tube

DISCUSSION

In the present study, the perioperative respiratory adverse event effects of SLMA and ETT were compared in patients undergoing nasal surgery. The incidence of clinical incidence of laryngospasm, bronchospasm, desaturation and cough, which are among respiratory adverse effects, was less in SLMA although not statistically. Hemodynamically, MAP values were similar in both groups, and HR values were lower in SLMA. These values were also statistically significant.

General anaesthesia application causes that the protective reflexes in the airline are lost. Although ETT is considered as the gold standard in maintaining airway clearance, LMAs have come to the agenda as an alternative to ETT. The effects of both devices on airway protective reflexes (i.e. laryngospasm, bronchospasm, cough, and desaturation) are still being discussed (8,9).

Clinically, laryngospasm can cause hypoxemia and bradycardia. This is an important mortality and morbidity causes (10).

Although there are many factors in the aetiology of perioperative laryngospasm, SLMA allows less blood and mucus leakage to the glottic area and to the trachea compared to ETT under its umbrella effect. Also, since it does not have direct contact with vocal cord and trachea, it causes less stimulation of airway reflexes (8, 11).

Maltby et al. compared the ETT and LMA in laparoscopic gynaecologic operations and reported the incidence of laryngospasm as 8.2% in ETT and 1.6% in LMA (12).

There are other studies in the literature supporting these results, for example Zimmert et al. in a study comparing a laryngeal mask airway and the endotracheal tube reported a lower incidence of laryngospasm in the LMA group (13, 14).

In our study, on the other hand, the incidence of laryngospasm was 4.3% in SLMA and 13% in ETT, which is in line with the literature. Considering the results of Maltby et al. (12), we believe that the type of operation (nasal surgery) was effective in the high incidence of laryngospasm in our study.

Bronchospasm is a condition causing increases in mortality and morbidity. It emerges during the application of anaesthesia in the form of expiratory wheeze, prolonged expiration or increased inflation pressures during Intermittent Pressure Ventilation (IPPV).

Although there are many causes of bronchospasm developing in the perioperative period, Westhorpe et al. (15) reported that 80% of cases were related with nonallergy/anaphylaxis, and the primary cause of bronchospasm was airway irritation in 35% of the cases, and endotracheal tube in 23%. It was also reported in the same study that the incidence of bronchospasm was 3%. Bronchospasm; in our study, 2.2% was found in SLMA, and 4.3% in the ETT Group, which is in line with the literature.

Postoperative cough may cause serious complications in some types of surgeries because it causes an increase in intracranial and intraocular pressure (16, 17). The most common reason of cough is the local irritation of the respiratory mucosa and the tracheobronchial mucosal irritation during the aspirations of the secretions that leak from the upper respiratory tract during surgery. In a study in which otolaryngology surgery was carried out (18), cough was detected in 1.2% patients in the LMA Group, and in 12.8% patients in the ETT group. In our study, cough incidence was 8.7% in SLMA and 10.9% in the ETT Group. There are other studies in the literature showing that cough incidence in patients undergoing general anaesthesia is less in SLMA than in ETT (19).

In the present study of ours, HR, which is among hemodynamic data in SLMA, was statistically significantly lower compared to ETT. It was seen that SLMA provided better hemodynamic stability in nasal surgery cases, which is in line with the literature (20).

CONCLUSION

The present study showed that the incidence of the respiratory adverse events (laryngospasm, bronchospasm, and cough) due to the use of SLMA in nasal surgery cases under general anaesthesia is lower than that of ETT. In addition, the SLMA provided better hemodynamic stability in the patients. We believe that the SLMA may be an alternative airway device to ETT in nasal surgery.

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