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Original Article

Insertion Characteristics of Laryngeal Tube Suction-disposable and Laryngeal Mask Airway Supreme in General Surgeries

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Abstract

Background: Laryngeal tube suction disposable and laryngeal mask airway supreme are newly introduced supraglottic airway devices which have an inbuilt drainage channel through which a gastric tube can be passed to allow efflux of gastric fluid and gas. This study was carried out to compare the insertion characteristics, leak pressure, hemodynamic, and ventilatory parameters and post-operative airway morbidity with the use of either of the two devices.

Materials and Methods: Eighty adult patients aged 18–60 years, American Society of Anesthesiology Grades I and II and Mallampati Grades I and II scheduled for surgeries under general anesthesia of <2 h duration, were allocated to Group LTS-D (n = 40) receiving general anesthesia with laryngeal tube suction disposable and Group LMAS (n = 40) receiving general anesthesia with laryngeal mask airway supreme. They were then compared with respect to their insertion characteristics, leak pressure, hemodynamic and ventilatory parameters, and pharyngolaryngeal complications.

Results: Statistically significant difference was seen between the insertion time (P = 0.01), first time success rate (P = 0.002), ease of insertion (P = 0.021), and overall success rate (P = 0.023) between the two groups. Leak pressure, peak pressure, hemodynamic, and ventilatory variables were comparable between the two groups. Patients ventilated with LTS-D had higher incidence of blood staining (P = 0.019), trauma to lip and tongue (P = 0.043), and sore throat at 1 h postoperatively (P = 0.025).

Conclusion: This study concluded that LMAS has better insertion characteristics than LTS-D with low incidence of postoperative pharyngolaryngeal complications.

Keywords: Insertion time, Laryngeal mask airway supreme, Laryngeal tube suction disposable, Pharyngolaryngeal complications, Supraglottic airway device

INTRODUCTION

Supraglottic airway devices (SADs) have been in use in elective surgery and emergency medicine since the introduction of classical laryngeal mask airway (cLMA) into clinical medicine by Archie Brain in early 1980 at Royal London Hospital.[1] The cLMA has undergone various modifications aimed at improving the ease of insertion and patient comfort and safety.[2] Compared to tracheal intubation and extubation, the use of SADs is associated with more stability in hemodynamics,[3] intracranial pressure,[4] and intraocular pressure.[5] Similar results were seen in studies by Dhanda *et al.*,[6] Akhondzade *et al.*[7] who compared use of SADs with endotracheal tube for ventilation and found that hemodynamic parameters were found to be better with use of SADs.

Newer SGAs have an inbuilt drainage channel to facilitate the efflux of gastric fluid and gas and allow the insertion of a gastric tube.

The newly introduced laryngeal tube suction is a further development of the laryngeal tube which allows better

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separation of the respiratory and alimentary tracts. The LTS is a dual-lumen silicone tube without latex, in which one lumen is used to ventilate and the other is used to decompress, suction, and position a gastric tube. It consists of a proximal cuff which seals the oropharynx and a distal cuff which blocks the esophagus and reduces gastric insufflation. It is color coded for immediate identification of the size.

The laryngeal mask airway supreme (LMAS) is a new disposable airway device that combines features of the LMA Proseal (PLMA and gastric access) and LMA Fastrach (curved shaft to ease insertion) and has been available since April 2007.[8] It allows rapid passage of higher volume of gas through the airway and can be inserted rapidly and in a safe manner due to its advanced cuff and airway tube design.

Both are second generation, single use, and supraglottic airway devices provided with a gastric access which can be used for both spontaneous and mechanically ventilated patients.

In our study, we compared LTS-D and LMAS with respect to insertion characteristics, leak pressure, hemodynamic and ventilatory parameters, gastric tube placement, and airway morbidities.

MATERIALS AND METHODS

After approval from the Institutional Ethics Committee, Government Medical College Amritsar, a prospective randomized, and comparative study was conducted on 80 patients of ASA Grade I or II in aged 18–60 years posted for elective general surgeries. Sample size was calculated in consultation with the statistician taking mainly the parameters of insertion characteristics and leak pressure and based on previous study to get the power of study more than 85%.

The surgeries included were cholecystectomy, fibroadenoma, lumpectomy, incision and drainage, dilation and curettage, gynecomastia, axillary swelling, skin grafting, and submandibular swelling. Inclusion criteria were as follows: Age 18–60 years, ASA Grade I or II, Mallampati Grade I or II, and elective surgical procedures of <2 h duration. Exclusion criteria were as follows: ASA Grade III or IV, Mallampati Grade III or IV, BMI > 30 kg/m^2, known risk of pulmonary aspiration, and known or predicted difficult airway.

The demographic data collected for each patient was as follows: Age, gender, height, weight, type, and duration of surgery.

Pre-anesthetic check-up, including detailed history and thorough general physical examination of patient, was carried out a day before surgery and was recorded.

The patients were divided into two groups (each group containing 40 patients) who were posted for surgery under general anesthesia using laryngeal tube suction disposable (LTS-D) and laryngeal mask airway supreme (LMAS). After selection of the patients, a written informed consent from every selected patient was taken in their vernacular language.

The patients were kept NPO after 12 midnight and tablet alprazolam 0.5 mg was given at 6 am in the morning before surgery with a sip of water.

A standard anesthesia sequence was followed. On arrival in theater, the patient was connected to standard monitoring devices, including electrocardiogram, non-invasive blood pressure (NIBP), heart rate (HR), end tidal carbon dioxide ($EtCO_2$), and oxygen saturation (SpO_2) and the baseline values, were recorded. All emergency airway equipment's and emergency drugs were kept ready. After removal from its sterile packet, the integrity and function of the LTSD and LMAS were checked.

Anesthesia was induced in supine position after preoxygenating the patient for 3–5 min. Premedication i.v midazolam (1 to 2 mg), i.v butorphanol (1 to 2 mg), was given on the OT table before induction. Preservative free lignocaine 2 % (2 mL) was given to attenuate the pain from propofol injection. Induction was done with i.v propofol (1.5 to 2 mg/kg body weight), i.v vecuronium (0.08 mg/kg body weight), and anesthesia, which was maintained with oxygen: Nitrous oxide (50:50) with isoflurane (MAC value of 1.15). All patients were ventilated manually for 3–4 min before insertion of either of the two supraglottic airways.

A senior anesthetist who was experienced in placement of SGA was the one placing either of the two devices. A size 3/4/5 LTS–D and size 3/4/5 LMAS were used according to manufacturer's recommendations. The devices were lubricated with a water-soluble jelly before their insertion.

After insertion, the cuff was inflated with the minimum amount of air required to achieve an effective seal. The recommended intracuff pressure was not allowed to exceed 60 cmH_2O measured using cuff pressure gauge. The time taken to insertion of the device from the time of picking up of the device to the appearance of first capnograph trace was recorded. In case, a difficulty was encountered during insertion of either of the two devices, manoeuvers such as jaw thrust manoeuver or hyperextension of the neck were done to ease insertion. Ease of insertion was

graded as very easy, easy, difficult (additional manoeuvers such as jaw thrust and hyperextension of neck) and very difficult (failure). Additional propofol increments were given if coughing, gagging or body movements occurred during device insertion to increase the depth of anesthesia.

Correct position with proper ventilation was confirmed by: (a) End tidal carbon dioxide between 35 and 45 mmHg, (b) a square wave capnograph, (c) good chest expansion on manual ventilation, (d) auscultation over both lungs, and (e) no audible leak from the drain tube on positive pressure ventilation when peak airway pressure was kept at 20 cmH_2O.

The initial ventilation was started using TV (tidal volume) of 8 ml/kg, RR of 12–14 /min, and I:E ratio of 1:2.

Failed insertion of SGA was considered if: (a) Inability to position the device within 60 s, (b) any air leak observed through the drainage channel during positive pressure ventilation despite corrective manoeuvers (deeper insertion or up and down manoeuver), and (c) inability to maintain an end tidal carbon dioxide between 35 and 45 mmHg.

In case of failure of insertion of one of the two devices following two attempts, endotracheal intubation was done for proper ventilation of the patient.

After proper taping of the airway device when it was secured in position, an appropriate sized gastric tube was passed through the suction channel of either of the device after proper lubrication. Correct placement of gastric tube was confirmed by epigastric auscultation of air injected by a 10 ml syringe. Gastric tube placement was graded as easy, difficult, or unable to pass.

Following insertion, the ventilatory variables (leak pressure and peak pressure), hemodynamic parameters (NIBP and HR), and ventilatory parameters (SpO_2, $EtCO_2$, ITV, and ETV) were recorded at regular intervals.

The leak pressure was determined after confirmation of correct placement of the device in supine position. Under the manual control ventilation mode, the APL valve (adjustable pressure limiting valve) in the breathing circuit of the anesthesia machine was closed, and the fresh gas flow was adjusted to 3 L/min to elevate the pressure in the breathing circuit until the airway pressure was stabilized, that is, the leak airway pressure (OLP/airway sealing pressure).[9] Leakage was defined as air escape audible with a stethoscope placed on the larynx and leak pressure was defined as the airway pressure at which leakage was first detected. Expiratory valve was released completely once the pressure exceeded 40 cmH_2O. In patients in whom the airway pressure reached 40 cmH_2O, the leak was interrupted and a value of 40 cm H_2O was recorded.

On completion of surgery, all anesthetic gases were stopped and patient ventilated with 100% oxygen. The patient was brought to spontaneous respiration and muscle paralysis reversed with neostigmine (0.05 mg/kg) and glycopyrrolate (0.5 mg). After oral suctioning, the SGA was removed on return of protective airway reflexes. The shape and blood staining of the device were checked thoroughly after removal. Tolerance during removal was graded as good (comfortable patients), moderate (coughing, retching, and biting of device), and poor (vomiting or vagal rection).

Patients were asked for any sign of airway morbidity such as swelling of tongue, sore throat, dysphagia, or dysphonia at first hour postoperatively and then again at 24 h.

OBSERVATIONS AND RESULTS

Patients were divided into two groups LTS-D and LMAS of 40 each in a random and unbiased manner.

Group LTS-D (n = 40): Forty patients received general anesthesia using laryngeal tube suction disposable.

Group LMAS (n = 40): Forty patients received general anesthesia using laryngeal mask airway supreme.

There were no fallouts from the study.

In Table 1, there was no statistical difference between the demographic and surgical data between the two groups with $P > 0.05$

The difference in the duration of insertion between both the groups was found to be statistically significant with $P = 0.01$ [Table 2 and Figure 1].

Table 1: Comparison of demographic and surgical data

	Group LTS-D	Group LMAS	*P* value
Age (years)	37.73±9.63	36.03±9.23	0.211 (NS)
Sex (F/M)	24/16	26/14	0.644 (NS)
Weight (Kg)	62.90±7.26	60.57±8.29	0.090 (NS)
Height (cm)	160.25±8.23	160.20±8.28	0.170 (NS)
ASA (I/II)	23/17	28/12	0.245 (NS)
Duration of surgery (min)	61.12±23.83	68.25±24.24	0.185 (NS)

Table 2: Comparing insertion time

	Group LTS-D		Group LMAS		*P*-value
	Mean	SD	Mean	SD	
Insertion time (Seconds)	14.35	3.34	10.08	3.16	0.01 (S)

The first-time success rate, number of attempts, and ease of insertion were found to be better with use of LMAS than LTS-D such that the difference came out to be statistically significant with $P < 0.05$ [Table 3].

The overall success rate was 100% with use of LMAS as opposed to 87.5% seen with use of LTS-D which was found to be statistically significant with $P = 0.023$ (S).

The difference between leak pressure and peak pressure between the two groups came out to be statistically non-significant ($P > 0.05$) [Table 4].

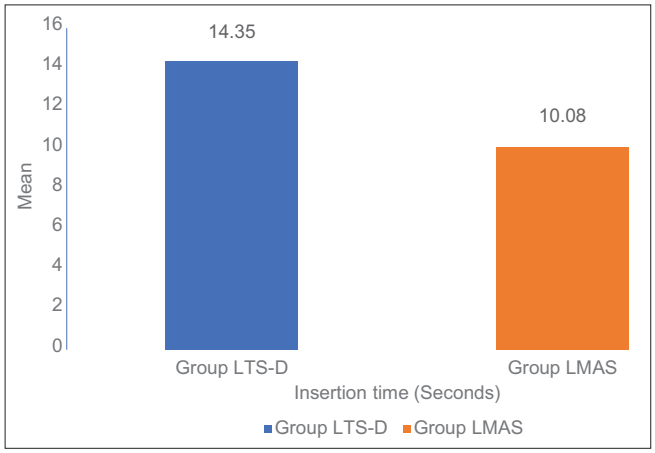

Figure 1: Comparing insertion time

Table 3: Comparing first time success rate, number of attempts, ease of insertion and overall success rate

Variables	Group LTS-D		Group LMAS		*P* value
	No.	%	No.	%	
First time success rate	27	67.50	38	95.00	0.002 (S)
No. of attempts					
1	27	67.50	38	95.00	0.023 (S)
2	8	20.00	2	5.00	
Ease of insertion					
Very easy	4	10.00	8	20.00	0.021 (S)
Easy	18	45.00	29	72.50	
Difficult	13	32.50	3	7.50	
Very difficult (Failure)	5	12.50	0	0.00	
Overall success rate	87.5%		100%		0.023 (S)

Table 4: Comparison of leak and peak pressure

Variables	Group LTS-D		Group LMAS		*P*-value
	Mean	SD	Mean	SD	
Leak pressure (cmH_2O)	20.88	2.77	20.38	2.15	0.098 (NS)
Peak pressure (cmH_2O)	22.63	2.22	21.95	1.95	0.080 (NS)

There was seen statistically significant difference between the two devices with more incidence of blood staining, trauma to lip, and tongue and sore throat seen with use of LTS-D [Figures 2 and 3].

DISCUSSION

The demographic and surgical data were found to be comparable between the two groups in our study.

In our study, we found that the insertion characteristics of LMAS are better than LTS-D. The mean duration of insertion of laryngeal tube suction disposable in Group LTS-D was 14.35 ± 3.34 s and of laryngeal mask airway supreme in Group LMAS was 10.08 ± 3.16 s with $P = 0.01$. First time, success rate ($P = 0.002$) and ease of insertion ($P = 0.021$) were better with use of LMAS than LTS-D. Our findings are comparable with the study by Russo *et al.*,[10] in which the insertion time was found to be 11 ± 9 s for LMA supreme and 14 ± 10 s for LTS-D ($P = 0.173$) and the insertion success rate of LMAS was 95% as compared to LTS-D of 70%.

The mean insertion time was found to be more for LTS-D as compared to LMA supreme since more manoeuvers such as jaw thrust manoeuver and hyperextension of neck were required to be done during the insertion of LTS-D as compared to LMA supreme. This is supported by study by Somri *et al.*[11] who found that jaw thrust manoeuvers were required in 11 patients in LTS-D and three patients in LMAS to achieve an effective airway during spontaneous ventilation in 80 patients.

The unique elliptical airway tube of laryngeal mask airway supreme allows for the easy and fast insertion of the device with less resistance and no kinking. It also keeps the device stable *in situ*.

Similarly, in a study by Schalk *et al.*,[12] the time required for successful insertion of LTS-D was shortest in the FIT/JT group (23 ± 6s), and significantly longer in the SIT/JT (42 ± 29s, $P < 0.001$) and SIT groups (51 ± 29s, $P < 0.001$) (FIT = Frontal Insertion Technique, SIT = Standard Insertion Technique, and JT = Jaw Thrust). Performing jaw thrust enhances the retropharyngeal space and increases the insertion success rate of the LTS-D from 49 to 100%.

In our study, we found that the mean leak pressure for LTS-D was 20.88 ± 2.77 cmH_2O and for LMAS was 20.38 ± 2.15 cmH_2O such that the difference was statistically non-significant with $P = 0.098$.

The oropharyngeal leak pressure quantifies the efficacy of airway sealing in supraglottic airway devices. A higher

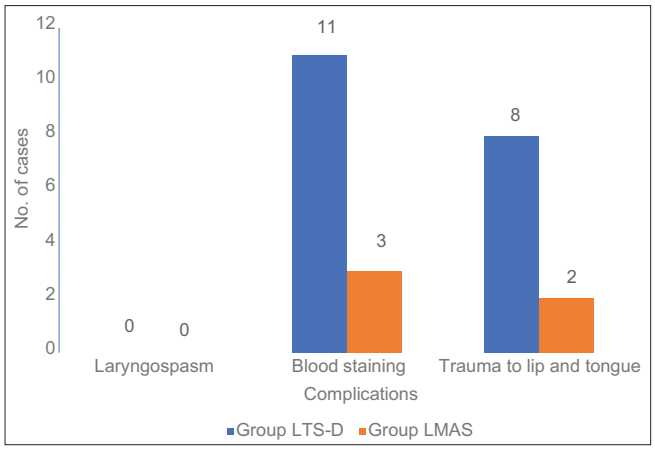

Figure 2: Comparing peroperative complications

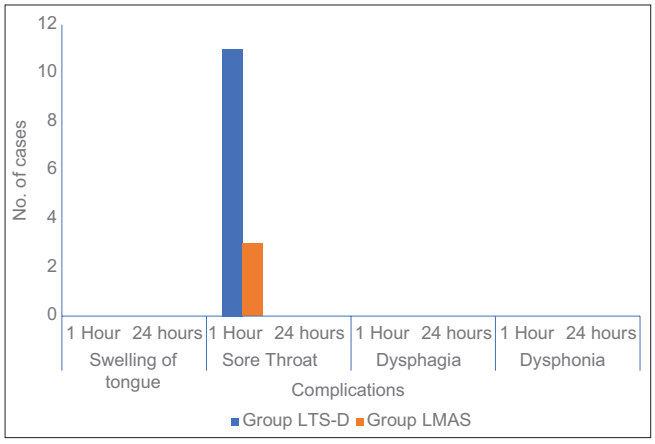

Figure 3: Comparing postoperative complications

oropharyngeal leak pressure indicates that safe controlled ventilation can be carried out at higher airway pressure if required.[13] The large pre-curved cuff of LMAS contributes in providing an effective seal.

In a study by Zhang *et al.*[14] conducted on 40 patients to determine, the oropharyngeal leak pressure of LMAS at different intracuff pressures, the mean OLP obtained at cuff pressure of 60 cmH_2O was 20.7 cmH_2O (18.9 to 22.5 cmH_2O) which is comparable with our study.

Damodaran *et al.*[15] conducted a study comparing the oropharyngeal leak pressure of Air-Q, I gel, and LMAS in 75 patients of ASA Grade I/II between the age group of 18–60 years and found that the OLP for LMAS was 24.80 ± 4.78 cm H_2O. Our findings are comparable with this study.

In the study by Russo *et al.*,[10] no difference in the leak pressure between LTS-D and LMAS was seen with the $P = 0.184$ which is non-significant and, thus, supports the result of our study.

The difference between hemodynamic and ventilatory parameters between the two groups was found to be statistically non-significant.

The incidence of airway morbidity during insertion as well as after removal of the device has been found to be more with the use of LTS-D as compared to LMAS in our study.

There were seen 11 (27.50%) cases of blood staining of the device and 8 (20%) cases of trauma to lips and tongue with use of LTS-D as opposed to 3 (7.50%) cases of blood staining and 2 (5%) case of trauma to lips and tongue with the use of LMAS such that the difference was found to be significant ($P > 0.05$).

Post-operative pharyngolaryngeal complications such as laryngospasm, swelling of tongue, dysphagia, and dysphonia were not seen in either of the two groups in our study.

There was no incidence of aspiration or regurgitation with use of either of the two devices.

Both the devices were tolerated well during their removal.

The incidence of sore throat was higher in group LTS-D at 1 hour with 11 (27.50%) patients showing the same as compared to 3 (7.50%) cases in group LMAS and the difference came out to be significant with $P = 0.025$.

Higher incidence of airway morbidity with use of LTS-D may be due to more of additional manoeuvers and increased number of attempts required during its insertion.

Similar results were seen in a study by Russo *et al.*[10] and Henlin *et al.*,[16] in which rate of complications was found to be more with use of LTS-D than LMAS.

A gastric tube of appropriate size was successfully passed through the gastric channel of both the devices after proper lubrication. In our study, we found that 16Fr and even 18Fr sized gastric tubes could be easily passed through the gastric channels of LTS-D as opposed to mostly 16Fr or a size smaller could be passed through the drainage channel of LMAS. Thus LTS-D presents an advantage over LMAS when evacuation of large gastric contents needs to be carried out.

The results are supported by the study done by Somri and Vaida *et al.*[17] Correct placement of the gastric tube ensures correct placement of the device.

CONCLUSION

In conclusion, during elective general surgical procedures of less than two hours duration, both laryngeal tube suction

disposable and laryngeal mask airway supreme can be used since they provide an effective airway with minimal alterations in hemodynamic variables. LMAS is better than LTS-D since it can be inserted with ease with less time taken for insertion, less requirement of additional manoeuvers and has less rate of failure. Furthermore, the incidence of post-operative airway morbidities is less with use of LMAS, thus making it a more suitable device than LTS-D.

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