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COMPARISON BETWEEN PROSEAL LARYNGEAL MASK AIRWAY AND LARYNGEAL TUBE SUCTION II IN LAPAROSCOPIC SURGERY

Anesthesiology

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ABSTRACT

Aim: To compare the use of Proseal LMA and LTS II in anaesthetized patients undergoing laparoscopic procedures. **Material and Methods:** 100 adult patients, scheduled for laparoscopic surgery were randomly allocated into two groups. In Group A, Proseal LMA and in Group B, LTS II was inserted, respectively, to secure the airway. Both the devices were compared with regards to insertion characteristics, oxygenation and ventilation parameters and quality of airway seal. **Results:** Insertion time was comparable for PLMA and LTS II, with value of 28.72secs and 30.48secs respectively. Group A and Group B had comparable high success rate of insertion in first attempt (92% vs 90%). Both the groups were comparable in terms of ease of insertion score. The difference in Oropharyngeal seal pressure was highly significant statistically (PLMA 30.06cmH2O vs LTS II 27.84cmH2O). The difference in SpO2 values was not found to be significant. The results for Inspiratory and Expiratory tidal volumes and mean values for airway pressures were comparable. End Tidal CO2 values were not different statistically for both the groups. **Conclusion:** PLMA and LTS II show similar efficacy in maintaining ventilation and oxygenation, during laparoscopic surgery. However, LTS II provides a less efficient oropharyngeal seal, making it a less obvious choice for airway management in procedures with raised intragastric pressure.

KEYWORDS

Proseal Laryngeal Mask Airway (PLMA), Laryngeal Tube Suction II (LTS II), Oropharyngeal seal

INTRODUCTION

Till recently cuffed endotracheal tube has been considered an ideal device for providing safe glottic seal in laparoscopic procedures. Now, a number of supraglottic airway devices are being used and have extended an anaesthesiologist's armamentarium for airway management.

Because of its several advantages, Proseal Laryngeal Mask Airway (PLMA) is being increasingly used for securing airway for a wide range of laparoscopic procedures [1].

Laryngeal Tube (VBM, Medizintechnik, GmbH, Germany) is a newly developed Supraglottic airway device [2]. A double lumen Laryngeal Tube, the Laryngeal Tube Suction (LTS) has been recently developed [3] with modifications making it suitable for use in laparoscopic procedures as well. In 2005, the LTS was replaced by the LTS mark II (LTS II) [4].

Studies have shown encouraging results with use of PLMA and LTS II in laparoscopic procedures [5]. We compared the use of both the devices, Proseal Laryngeal Mask Airway and Laryngeal Tube Suction II in anaesthetized patients undergoing laparoscopic procedures, with regards to insertion characteristics, oxygenation and ventilation parameters and quality of airway seal.

MATERIAL AND METHODS

After obtaining approval of the Institutional Ethics Committee and written informed consent from patients, 100 patients of either sex, ranging from 18-60 years of age, ASA grade I and II, scheduled for laparoscopic surgery were randomly allocated to two groups as:

Group A- Use of Proseal Laryngeal Mask Airway
Group B- Use of Laryngeal Tube Suction II

Patients with BMI>35 kg/m2, known or predicted difficult airway, upper respiratory tract infection in previous 10 days, preoperative increased risk of aspiration and pathological conditions of upper respiratory tract or upper gastrointestinal tract were excluded from the study.

After preanaesthetic evaluation, written informed consent was obtained from the patients. All patients were kept fasting overnight and received Tablet Alprazolam 0.25mg and Tablet Ranitidine 150mg, the night before surgery. On the morning of surgery, intravenous line was secured. Patients received IV Metoclopramide 10mg and IV Ranitidine 50mg, 45minutes before surgery.

In the operation theatre, standard anaesthesia monitors, including electrocardiograph, pulse oximeter and noninvasive blood pressure, were attached and baseline vital signs were recorded. Patients received IV Ondansetron 0.1mg/kg and IV Tramadol 1mg/kg. After preoxygenation for 3mins, anaesthesia was induced intravenously with Propofol 2-2.5mg/kg. Neuromuscular blockade was achieved with Succinylcholine 1.5mg/kg. Manual facemask ventilation was performed until conditions were suitable for insertion of the airway.

In Group A, size of Proseal LMA was selected according to the patient's weight. Proseal LMA was inspected for any tear, cuts or kinking and any blockage in the tube. The cuff was inflated and examined for any leaks. Once checked, the cuff was deflated using cuff deflating tool and water soluble lubricant was applied on the dorsal surface of the cuff. The device was inserted using an introducer tool, with the patient's head in the 'sniffing position'. The cuff was inflated with air and the cuff pressure was adjusted to 60cmH2O using a cuff pressure manometer (Rusch Endotest, Cuff Pressure Gauge).

In Group B, size of Laryngeal Tube Suction II was selected according to the patient's height. LTS II underwent inspection for any apparent damage or blockage in the tube. The cuffs were inflated and checked for any leaks. Once checked, the cuffs were deflated. After applying a water soluble lubricant, the LTS II was inserted with the subject's head in the 'sniffing position'. The device was introduced in the oropharynx against the hard palate and slid down until a resistance was felt or the second bold black line on the tube passed between the upper and lower incisors. Both the cuffs were inflated with air using a pre-prepared syringe through the single inflation line. The cuff pressure was adjusted to 60cmH2O using a cuff pressure manometer (Rusch Endotest, Cuff Pressure Gauge).

Correct placement for both devices was confirmed using:

- Bilateral chest excursion on manual ventilation and auscultation over both lungs
- A square-wave capnography and normal value of partial pressure of end tidal CO2

- No audible leak from the drain tube with peak airway pressure at 20cmH2O.

Once confirmed the device was then connected to the anaesthesia machine (Datex Ohmeda, Aestiva 5) and fixed by taping it over the chin.

In case of an ineffective airway, intervention such as jaw lift, adjusting the head and neck position and changing the depth of device insertion were performed.

The number of insertion attempts were recorded and the ease of insertion for both airway devices was assessed.

Ease of insertion was graded using four point scoring system
3 = insertion at first attempt without tactile resistance
2 = insertion at first attempt with tactile resistance
1 = insertion successful at second/ third attempt
0 = insertion failed at three attempts

In the event of failure to establish an effective airway after three attempts, intubation with endotracheal tube was performed. An effective airway was defined as SpO2≥95%, ETCO2≤45mmHg and minimal air leak (the difference between inspiratory and expiratory tidal volume less than 15%).

After successful insertion of the device, effectiveness of the airway seal was compared. With the cuffs inflated and the fresh gas inflow at 3L/min, the adjustable pressure limiting valve was closed and airway pressure allowed to increase but not permitted to exceed 40cmH2O; pressure at which gas leakage occurred was determined. Gas leakage was judged to be present when any of the following criteria was present:
- Audible leak from the mouth
- Expired volume less than 85% of the inspired volume

The insertion time was noted from removal of the face mask to attachment of the breathing system to the PLMA or LTS II (after inflation of the cuffs) and delivery of the first tidal volume. A lubricated 16F or 14F Gauge gastric tube was inserted.

Anaesthesia was maintained with N2O:O2 in a ratio of 66:33% with Isoflurane and Atracurium 0.5mg/kg bolus and 0.1mg/kg maintenance doses were used to maintain neuromuscular blockade.

The initial mode of ventilation was started using volume control with a starting tidal volume (VT) of 9ml/kg, RR of 12/min, I:E ratio of 1:2 and PEEP of 5.

Ventilatory parameters were recorded after insertion, at 1, 2, 5, 10 minutes and at 10 minute intervals till the removal of the airway device including

- Inspired and expired tidal volumes
- Peak airway pressure and Plateau pressure
- ET Co_2
- SpO_2

During capnoperitoneum, insufflation pressure of abdomen was kept between 12-14mmHg and SpO2>95% and $ETCO_2$≤45mmHg was maintained by adjusting the FiO2, Respiratory rate and Tidal volume.

If airway obstruction occured during maintenance of anaesthesia, manipulation of the device and one reinsertion was permitted.

At the end of the surgery, anaesthesia was discontinued. Muscle paralysis was reversed using Neostigmine 50µg/kg and Glycopyrrolate 10µg/kg. Patient were given 100% Oxygen during emergence. Before removal of the device, stomach was emptied again and nasogastric tube removed. Airway device was removed when the patient was awake and able to respond to verbal commands.

At the end of the study, all the data collected was compiled and analysed using appropriate statistical tests.

RESULTS

A total of 100 patients were included in the study.

Table 1 shows the demographic profile. Both the groups were comparable and there was no statistically significant difference with respect to age, weight, height, BMI and sex distribution.

Table 1: Demographic Profile

Parameter	Group A	Group B	p-value
Age (years)	40.48 ± 12.38	39.28 ± 11.24	0.61
Weight (Kg)	60.6 ± 7.76	63.08 ± 7.83	0.11
Height (cms)	155.58 ± 4.34	156.46 ± 5.02	0.06
BMI (Kg/m2)	25.008 ± 2.79	24.75 ± 2.39	0.63
Sex (Male/Female)	7/43	14/36	0.085
Values are expressed as either Mean ± Standard deviation or by absolute numbers.			

Table 2 shows the comparison of insertion characteristics. Both the groups were comparable in terms of device insertion time (PLMA 28.72secs vs LTS II 30.48secs). Group A and Group B had comparable high success rate of insertion in the first attempt (92% vs 90%) and equal second attempt insertion rate (8%). No patient in Group A required a third attempt for insertion. A third attempt was necessary for one patient in Group B. The overall insertion success rate was 100% for both the groups. Both the groups were comparable in terms of ease of insertion scores.

Table 2: Insertion Characteristics

Parameter	Group A	Group B	p-value
Insertion Time (secs)	28.72 ± 4.91	30.48 ± 4.51	0.06
Insertion Attempts			
1	46 (92)	45 (90)	1.00
2	4 (8)	4 (8)	
3	0	1 (2)	X2 0.71
Failure	0	0	
Ease of Insertion Score			
3	41(82)	37 (74)	0.33
2	5 (10)	8 (16)	0.37
1	4 (8)	5 (10)	1
0	0	0	-
Values are expressed as either Mean ± Standard deviation or by absolute numbers with percentage in brackets.			

Table 3 shows the values for oropharyngeal seal pressure and ventilatory parameters. The difference in the oropharyngeal seal pressure was highly significant statistically, with higher value for Group A (PLMA 30.06 cmH_2O vs LTS II 27.84 cmH_2O).

Ventilatory parameters were recorded at different time intervals after device insertion, at 1minute, 2mins, 5mins, 10mins and then at 10min intervals till the removal of the device. Mean values were calculated for all the parameters. On statistical analysis, difference in SpO2 values was found to be statistically not significant. The results for Inspiratory and Expiratory tidal volumes, delivered by both the devices, were comparable. Difference in Peak airway pressures and Plateau airway pressures was found to be statistically significant at various time intervals. However, the mean values for airway pressures were comparable. End tidal CO_2 values were not different statistically for both the groups.

Table 3: Oropharyngeal Seal Pressure and Ventilatory parameters

Parameter	Group A	Group B	p-value
Oropharyngeal Seal pressure (cmH2O)	30.06 ± 2.97	27.84 ± 3.41	0.0007**
Mean SpO2 (%)	99.307 ± 0.166	99.37 ± 0.124	0.08
Mean Inspiratory Tidal Volume (ml)	443.1 ± 7.0196	445.41 ± 4.72	0.88
Mean Expiratory Tidal Volume (ml)	427.37 ± 6.853	430.34 ± 2.257	0.68
Mean Peak Airway Pressure (cmH2O)	16.039 ± 1.484	15.49 ± 1.78	0.22
Mean Plateau Airway pressure (cmH2O)	14.68 ± 1.339	14.12 ± 1.549	0.32
Mean End tidal CO2 (mmHg)	35.97 ± 1.96	35.98 ± 2.084	0.47
Values are expressed as Mean ± Standard deviation **=highly significant (p<0.005)			

DISCUSSION

Many anaesthesiologists consider tracheal intubation to be the gold standard for airway management. But the use of endotracheal tubes is associated with certain inherent disadvantages [6,7]. The advent of supraglottic airway devices, especially those with a second lumen i.e. drain tube, may circumvent some of these problems even in patients who require high airway pressures for adequate ventilation, as in laparoscopic surgery. The use of supraglottic airway devices under conditions of elevated intraabdominal pressure requires an excellent airway seal, due to the potential risk of regurgitation.

Esa et al [5] conducted a study to compare LTS II and PLMA during laparoscopic surgery. Both the devices had comparable high success rate of insertion in first attempt (96% PLMA vs 89% LTS II) and proportion of easy and difficult insertion cases was comparable. In their study there was significant increase in the peak and plateau pressure after the induction of capnoperitoneum. Otherwise both devices showed comparable peak and plateau pressure before and after capnoperitoneum. Oxygenation and ventilation was optimum in both groups. The quality of airway seal as indicated by the airway sealing pressure was excellent for both the devices (PLMA 35.7cm H2O vs LTS II 33.6cm H2O).

In our study, both PLMA and LTS II were comparable with respect to attempts of insertion. First attempt insertion success rate was comparable for both the devices (PLMA 92% vs LTS II 90%). The overall insertion success rate was 100% for both the devices. The difference in mean insertion time was not significant statistically (PLMA 28.72secs vs LTS II 30.48secs). Also, no statistically significant difference was found in terms of ease of insertion score. Comparable results for both the devices were obtained in the studies conducted by Roth et al [8] and Zand et al [9], with respect to insertion characteristics.

On comparison of oxygenation and ventilatory parameters, the differences in SpO2 values and inspiratory and expiratory tidal volumes, did not show any statistically significant difference. Difference in peak airway pressure and plateau airway pressure was found to be statistically significant at various time interval readings, with higher airway pressure values for PLMA group. But the mean values for airway pressures for the use of either device were comparable. However, Cook et al [10] and Gaitini et al [11] in their studies found results where peak airway pressures with the PLMA were lower than with LTS II. Comparison between LTS II and PLMA during pressure controlled ventilation by Kikuchi et al [12] found that tidal volume produced was significantly lower with LTS II than with PLMA.

In our study the difference in the oropharyngeal seal pressure for the devices was highly significant statistically (PLMA 30.06cm H2O vs LTS II 27.84m H2O). Our results were consistent with various other studies. In a comparison of LTS II with PLMA by Kikuchi et al [12], the median leak pressure was significantly lower with LTS II than with PLMA. In addition, a slight decrease in the intracuff pressure produced a leak around the cuff when the LTS II was used, whereas the PLMA continued to seal the airway adequately until the cuff pressure was reduced to relatively low levels. Further, the airway seal with LTS II was less stable than with the PLMA because the leak was easily produced by inclining the shaft. Cook et al [10] and Zand et al [9] found higher airway seal pressures in the PLMA group than the LTS II group.

Limitation of this study

- There was no blinding in the data collection, which is possible source of bias.
- All the users had less experience with the LTS II than with the PLMA.
- We used patients with normal airways during controlled positive pressure ventilation, therefore, we cannot comment on results that could be obtained in spontaneously breathing patients and during difficult airway management.

CONCLUSION

Both PLMA and LTS II show similar efficacy in maintaining ventilation and oxygenation, during laparoscopic surgery. However, the LTS II provides a less efficient oropharyngeal seal. A lower oropharyngeal seal pressure makes LTS II a less obvious choice for airway management in procedures with raised intra-gastric

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