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MISCELLANEOUS

Can supreme™ laryngeal mask airway be an alternative to endotracheal intubation in laparoscopic surgery?

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Abstract

Background and objectives: In laparoscopic surgical procedures, experts recommend tracheal intubation for airway management. Laryngeal mask airway (LMA) can be a good alternative to intubation. In this case series, we aimed to examine the use of the Supreme™ LMA (SLMA) in laparoscopic surgical practice.

Methods: We planned the study for sixty patients between the ages of 18 and 60, who would undergo laparoscopic surgery. We recorded one, 15, 30, 45, and 60-minute peripheral O_2 saturation (SpO_2) and end-tidal carbon dioxide ($EtCO_2$) values, heart rate and mean arterial blood pressure (MAP). We observed the duration of SLMA insertion, the rate of gastric tube applicability, whether nausea, vomiting, and coughing developed, and whether there was postoperative 1-hour sore throat.

Results: The initial $EtCO_2$ mean was lower than the $EtCO_2$ means of 15, 30, 45, and 60 minutes ($p < 0.0001$) and the 15-minute $EtCO_2$ mean was lower than other measured EtCO2 means. We observed the initial heart rate mean to be higher than the ones following the SLMA insertion, prior to the SLMA removal, and after the SLMA removal. The heart rate mean after the SLMA insertion was remarkably lower than the heart rate mean prior to the SLMA removal ($p = 0.013$). The MAP after the SLMA insertion was lower than the initial MAP means, as well as the MAP averages prior to after the removal of SLMA ($p = 0.0001$).

Conclusion: SLMA can be a suitable alternative to intubation in laparoscopic surgical procedures in a group of selected patients.

Introduction

For patients at risk of aspiration, endotracheal intubation is still accepted as the gold standard. In recent years, however, alternative airway devices like laryngeal mask airway (LMA) have been used in this patient group, both in routine proce-

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dures and in the presence of airway problems.[1] Endotracheal intubation is also suggested to open up the airway in laparoscopic surgical procedures. In addition, in some prospective and retrospective studies, it is recommended that classic LMA can be used as an alternative.[2]

LMA has been used successfully in anticipated and unanticipated difficult airway management since 1981.[3,4] Following the first classic LMA model, researchers have developed sub-models.[5] The ProSeal laryngeal mask (PLMA), unlike the classic LMA model, has a drainage tube which provides a gastric tube passage. Supreme™ LMA (SLMA) has been desig- ned to combine the desired features of fast-track (ILMA) and PLMA. The fact that SLMA is elliptical and has an anatomi- cally shaped semi-hard airway tube enables it to be inserted quickly. Moreover, it has got a gastric channel for the gastric tube passage. When placed accurately, it provides protection against regurgitation and prevents gastric distension.[2,6,7] In this study, we aimed to share our experiences related to the use of SLMA in laparoscopic surgery.

Methods

After approval from the local ethics committee and written informed consent of the patients, we completed this study in a 6-month period. We selected sixty patients of the ASA I group who were 18 to 40 years old and were scheduled to undergo laparoscopic surgery. Patients who had abnormal airway, a history of reactive airway, severe heart and res- piratory tract diseases, gastro-esophageal reflux, a history of hiatal hernia, and who had recovered from respiratory tract infections in the last 6 weeks were excluded from the study. Patients had to fast for an 8-hour period prior to the study. For premedication, standard intravenous 0.05 mg.kg^{-1} of midazolam was applied. In the operation room, non-invasive systemic arterial pressure, cardioscope on DII derivation, and pulse oximeter monitorization (SpO_2) were performed. We gave patients a standard induction with 2 mg.kg^{-1} of propofol, 1 μg.kg^{-1} of fentanyl, and 0.5 mg.kg^{-1} of rocuronium. A lubricated SLMA (Laryngeal Mask Company Limited, Le Rocher, Victoria, Mahe, Seychelles) with a size of either 3 or 4 was inserted by an anesthesiologist with more than five years of experience. No digital manipulation or other apparatus was used while the SLMA was being inserted. The SLMA cuff was inflated to the maximum volume and it was confirmed that there was no gas leakage. We determined the size of the SLMA to be inserted depending on the gender and weight of the patient. After the SLMA was inserted, we assessed ventilation by observing the patient's chest expansion and listening to both lungs bilaterally with a stethoscope. We recorded the SpO_2 value one, 15, 30, 45 and 60-minutes after SLMA insertion. We monitored the end tidal carbon dioxide (EtCO2) value throughout the operation period recorded at one, 15, 30, 45, 60-minutes after SLMA application. A gastric tube was inserted in all patients. We carried on the anesthesia with the mixture of 2% sevoflurane and 40% air/O_2. We gave additional boluses of rocuronium (0.1 mg.kg^{-1}) when required. We did not use nitrous oxide. We performed controlled ventilation on the patients to ob- tain 8 mL.kg^{-1} tidal volume, 12.min^{-1} respiration rate, and 1:2 inspiratory:expiratory rate. We kept SLMA cuff pressure below 60 cmH_2O using a digital manometer. We recorded the heart rate and mean arterial blood pressure (MAP) of the patients upon entry, following the SLMA insertion, prior to the SLMA removal, and after the SLMA removal. For analgesia, we gave the patients preoperative 30 mg.kg^{-1} intravenous paracetamol. After the patients' spontaneous breathing re- sumed, they have reversal of neuromuscular block with 0.01 mg.kg^{-1} of atropine and 0.03 mg.kg^{-1} of neostigmine. When breathing normalized, we removed SLMA. We recorded the duration of SLMA insertion. We recorded the rate of gastric tube applicability, whether nausea, vomiting, aspiration, coughing developed, and whether patients had a sore throat 1-hour postoperatively.

Table 1 Patients age, weight, operation duration and Laryngeal Mask Airway insertion duration.

	Min	Max	Mean±SD
Age (yr)	18	37	25.9 ± 5.8
Weight (kg)	45	77	60 ± 8.73
Operation duration (min.)	35	90	53.17 ± 12.11
Insertion duration (min.)	8	16	11.93 ± 1.67

SD, standard deviation.

Table 2 Operational procedure.

	n	%
Laparoscopic cholecystectomy	20	33.3
Laparoscopic appendectomy	18	30
Laparoscopic inguinal herniorrhaphy	22	36.7

Statistical evaluation

We used the descriptive statistical methods (mean, standard deviation, frequency distribution) in the evaluation of the data. In the repetitive measurements of multiple groups we used one-way variant analysis and in the comparison of subgroups we used the Newman-Keuls multiple comparison test. We considered $p < 0.05$ value as statistically significant.

Results

The average age of the patients enrolled in the study was 25.9 ± 5.8 years, the average weight was 60 ± 8 kg, the average operation period was 53.17 ± 12 minutes, the duration of SLMA insertion was 11.93 ± 1.67 seconds (Table 1). We list operational procedures in Table 2. Table 3 displays the dis-

Table 3 The range of patients according to the gender and the size of Laryngeal Mask Airway size.

	n	%
Sex		
Male	29	48.3
Female	31	51.7
Laryngeal Mask Ai rway size		
3	28	46.7
4	32	53.3

Table 4 Rate of nausea, vomiting, gastric tube insertability, sore throat and coughing.

		N	%
	No	53	88.3
Nausea	Yes	7	11.7
	No	53	88.3
Vomiting	Yes	7	11.7
	No	4	6.7
Gastric tube	Yes	56	93.3
	No	55	91.7
Sore throat	Yes	5	8.3
	No	55	91.7
Coughing	Yes	5	8.3

Table 5 The SpO_2 and $EtCO_2$ values.

Time	SpO_2	$EtCO_2$
1 minute	98.47 ± 1.35	33.4 ± 4.05
15 minutes	98.82 ± 0.98	35.02 ± 4.55
30 minutes	98.83 ± 1.06	36.58 ± 5.03
45 minutes	98.62 ± 0.97	36.48 ± 4.59
60 minutes	98.7 ± 0.87	36.62 ± 4.41
p	0.396	0.0001[a]

SpO_2, peripheral O_2 saturation; $EtCO_2$, end-tidal carbon dioxide.
[a] $p < 0.05$ (mean ± SD).

tribution of the patients according to gender and SLMA size. We observed nausea and vomiting in 11.7% of the patients. We could not place the gastric tube in 6.7% of patients. We observed coughing and sore throats in 8.3% of the patients (Table 4).

Statistically, no remarkable variation was observed in one, 15, 30, 45, and 60-minute SpO_2 value averages of the patients (Table 5).

Statistically, we observed a considerable variation in $EtCO_2$ means at minutes one, 15, 30, 45, and 60 ($p < 0.05$, Newman-Keuls). The 1-minute $EtCO_2$ means were remarkably lower than the means of 15, 30, 45, and 60-minute $EtCO_2$ ($p < 0.0001$, Newman-Keuls). While the 15-minute $EtCO_2$ means were statistically much lower than the 30, 45, and 60-minute $EtCO_2$ means ($p < 0.0001$, Newman-Keuls), there was no statistically considerable difference between the other times (Tables 5 and 6).

There was a significant variation in the initial average heart rate after we inserted the SLMA, before we removed the SLMA, and after we removed the SLMA. The initial heart rate mean was higher than the pulse rate mean following the SLMA insertion, prior to the SLMA removal, and after the SLMA removal. While the average heart rate following the insertion of the SLMA was statistically much lower than the average heart rate prior to the removal of the SLMA, there was no statistically significant statistically difference between the other times (p values in Tables 7 and 8).

A remarkable variation was observed in the initial average MAP, after we inserted the SLMA, before and after we remo- ved the SLMA ($p = 0.0001$, Newman-Keuls). The average MAP after the SLMA insertion was statistically much lower than the initial average MAP prior to the SLMA removal and after the removal ($p = 0.0001$). There was no statistically significant difference between the other times (Tables 7 and 8).

We could not provide efficient ventilation in only one patient; therefore, we applied endotracheal intubation.

Table 6 Statistical differences between $EtCO_2$ values according to measurement times.

Newman-Keuls multiple comparison test	p value
Initial/15 minutes	0.001[a]
Initial/30 minutes	0.0001[a]
Initial/45 minutes	0.0001[a]
Initial/60 minutes	0.0001[a]
15 minutes/30 minutes	0.003[a]
15 minutes/45 minutes	0.001[a]
15 minutes/60 minutes	0.0001[a]
30 minutes/45 minutes	0.751
30 minutes/60 minutes	0.919
45 minutes/60 minutes	0.481

[a] $p < 0.05$.

Table 7 Patients average heart rate and Mean Arterial Blood Pressure.

	Heart rate	MAP
Initial	98.38 ± 17	84.43 ± 14.31
After the insertion of LMA	91.4 ± 15.36	68.35 ± 13.03
Prior to LMA removal	95.53 ± 12.55	85.13 ± 12.35
After the removal of LMA	93.02 ± 14.91	83.9 ± 13.09
p	0.001[a]	0.0001[a]

MAP, mean arterial blood pressure; LMA, laryngeal mask airway.
[a] $p < 0.05$ (mean ± standard deviation).

Table 8 Statistical differences between heart rate and MAP values according to measurement times.

Newman-Keuls multiple comparison test	Heart rate p value	MAP p value
Initial/after the insertion of LMA	0.0001[a]	0.0001[a]
Initial/prior to LMA removal	0.199	0.719
Initial/after the removal of LMA	0.019a	0.776
After the insertion of LMA/prior to LMA removal	0.013a	0.0001[a]
After the insertion of LMA/after the removal of LMA	0.383	0.0001[a]
Prior to LMA removal/after the removal of LMA	0.120	0.424

MAP, mean arterial blood pressure; LMA, Laryngeal Mask Airway.
[a] $p < 0.05$.

Discussion

Hypoventilation, gastric distension, and aspiration associated with the use of LMA were not more frequent in laparoscopic surgery than with the use of endotracheal tubes.[8] In their literature review, Viira et al.[9] found the reported aspiration incidence and serious morbidity frequency together with LMA to be very low. In laparoscopic surgery, the risk of aspiration may increase depending on the Trendelenburg position, peritoneal stimulation that occurred during the surgery, and increased intra-abdominal pressure as a result of the pressure on abdominal wall.[8] Some authors reported that, along with the increase in intra-abdominal pressure, the possibility of gastro-esophageal refl ux was also increasing in laparoscopic surgery.[8] However, in gynecological laparoscopies, the studies investigating the risk of gastro-esophageal refl ux when applying positive pressure ventilation with a tracheal tube and LMA found no evidence that showed that the risk of gastro-esophageal refl ux increased with LMA.[10,11]

The use of LMA in cases in which an emergency appendectomy is performed is controversial. Because it includes a gastric channel, PLMA may be superior to other supraglottic airway devices. The gastric distension in laparoscopic surgery procedures in which PLMA is used is not greater than tracheal tube. The most important point to consider when using PLMA in appendectomies is the experience of the user and the careful selection of the cases. The aspiration risk in appendectomies with no additional risk factors is quite low. Relying on the fact that PLMA is less invasive than intubation and provides better protection than classic LMA, we used PLMA in appendectomies and safely carried out airway management.[7] Our study was planned considering the fact that SLMA is more suitable to the anatomic structure than PLMA and it causes less oropharynageal leakage pressure.[7] We meticulously selected patients; we particularly did not involve patients with doubtful diagnoses in the study. After we inserted the SLMA, we confi rmed that patients received effi cient ventilation

In laparoscopic cholecystectomies, studies have suggested endotracheal intubation - one of the most commonly applied general surgery procedures - as airway management. However, one retrospective and three prospective studies claim that classic LMA is a suitable alternative. As for PLMA, it is more effective than classic LMA since it includes a gastric channel.[12] One study found that no gastric distention was caused by a laparoscopic cholecystectomy with properly placed PLMA, which ventilates in equal affectivity to the endotracheal tube.[13] Carron et al.[14] described one patient with severe pulmonary fi brosis who had an elective laparoscopic cholecystectomy; they ensured airway control with SLMA and stated that there was less airway resistance.

In several studies with patients undergoing gynecological laparoscopic surgery, studies found PLMA to be superior to classic LMA and endotracheal intubation.[15,16] In addition, Lee et al.[17] compared SLMA with PLMA in gynecological laparoscopic surgery and showed that, although their complication rates are similar, in SLMA there was less oropharyngeal leak pressure than in PLMA. In a study comparing SLMA with endotracheal intubation, researchers found that airway control was provided in equal affectivity in gynecological laparoscopic surgeries and SLMA developed less laryngopharyngeal morbidity.[18] In another study, Yao et al.[19] reported that in gynecological laparoscopy, SLMA ensures ventilation that is equally safe and effective as endotracheal intubation. They also stated that SLMA causes fewer stress responses and side effects. Furthermore, besides preventing the soft tissue damage associated with laryngoscopies, avoiding endotracheal intubation has advantages such as reducing airway resistance as well as the risks of bronchial and esophageal intubation.[7] In our study, MAP and heart rates after the SLMA insertion were considerably lower than the initial value. We did not detect an increase in MAP and pulse rates following the extubation.

We related this to the lack of hemodynamic stress responses associated with SLMA

In laparoscopic surgery, as a result of the increase in intraabdominal pressure, early closure in small airways and an increase in peak airway can be seen. In this case, an increase in $EtCO_2$ can develop with no variation in SpO_2.[8] Our fi ndings confi rmed this. Although there was no considerable variation in the SpO2 values of our patients, the 15, 30, 45, and 60 minute EtCO2 values were remarkably higher than the initial $EtCO_2$ values. In addition, 30, 45, and 60-minute $EtCO_2$ values were meaningfully higher than 15-minute $EtCO_2$ values. For this reason, we suggest that $EtCO_2$ values of patients should be followed carefully

In their first study, Eschertzhuber et al.[20] found a gastric tube insertion success rate of 92% in SLMA. Natalini et al.[16] showed that gastric tube insertion does not guarantee the full drainage of stomach contents, and in 10% of the patients in PLMA, the gastric tube is folded with no symptoms of oropharyngeal leakage. We aimed to insert a nasogastric tube into all of the patients. However, we were unable to do so in four (6.7%) patients.

Laparoscopic surgery is a high risk factor related to postoperative nausea and vomiting.[21] Patients undergoing general anesthesia for laparoscopic cholecystectomy have a high risk of postoperative nausea and vomiting with incidences up to 75%.[22] In our study, the rates of postoperative nausea and vomiting are considerably less. For this reason, LMA Supreme™ may be preferable for this group of patients.

Sore throat after tracheal intubation is common, with an incidence of 30-70%.[23] In our study, the rates of sore throat are signifi cantly less. We stress that this situation is important for patient comfort.

In conclusion, although our study was limited to a small sample size of heterogeneous patients, we suggest that SLMA can be a good alternative to intubation in selected groups of patients in laparoscopic surgical procedures by experienced users when it is placed properly and their position is stabilized.

Conflicts of interest

The authors declare no conflicts of interest.

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