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Evaluation of the effects of LMA supreme, baska mask LMA and endotracheal intubation on intracranial pressure in laparoscopic operations by measuring the diameter of the sonographic optic nerve sheath

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ABSTRACT

Aim: The laryngeal mask (LMA) has been used for years to provide a safe and effective airway. Nowadays, it is also preferred in gynecological laparoscopic operations. In our study, we aimed to evaluate the effects of Baska Mask LMA (LMA-B), LMA Supreme (LMA-S) and ETT (endotracheal tube) applications on intracranial pressure in laparoscopic gynecological operations by measuring optic nerve sheath diameter (ONSD).

Methods: Patients between the ages of 18-65 in ASA I-II-III physical status who were going to undergo laparoscopic gynecological operation were included in the study. The patients were divided into three groups by randomisation prospective as ETT, LMA-B and LMA-S. ONCD measurements were measured before general anesthesia (T0), 1 minute after induction (T1), 1 minute after intubation (T2), 3 minutes after intubation (T3), 10 minutes after the pneumoperitoneum and trendelenburg position (T4), and 30 minutes after the pneumoperitoneum and trendelenburg position (T5) and before extubation (T6).

Results: 60 patients were included in the study. No statistical difference was found between the groups in terms of demographic characteristics and clinical data (all $p>0.05$). The change in ONSD within three different groups showed an increase in the measurements at the 10th and 30th minutes after the pneumoperitoneum and trendelenburg position; ETT (4.84±0.23 mm), LMA-S (4.83±0.28mm), and this increase was found to be the lowest in LMA-B (4.64±0.26 mm) application ($p=0.61$).

Conclusion: we think that Baska Mask LMA can be preferred more than ETT and other LMA applications according to the indication and IBP follow-up can be done reliably with ONSD measurements.

Key words: General anesthesia, intracranial pressure, optic nerve sheath diameter, ultrasonography, laparoscopic surgery.

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Introduction

Supraglottic airway devices (SGAD) have been widely used in anesthesia applications for years. Although it was initially used as an alternative to the face mask, it is also preferred in the indications where ETT is used, with its additional new modifications. The important

advantage of SGAD is that it allows the airway to be secured in cases where both tracheal intubation and ventilation with a mask are difficult. The new SGAD includes modifications to separate the respiratory and gastrointestinal tract and reduce leakage. These include Laryngeal Mask Proseal, I-gel LMA, LMA-S, LMA-B, Fasttrach LMA and Ambu Aura Gain [1] .

Measurement of ICP is limited to cranial imaging methods or interventional methods. However, it has been shown that the ONSD measurement is valid especially when ICP ≧ 20mm Hg [2]. Although the gold standard for ICP measurement is intraventricular devices, these invasive techniques increase the risk of infection and bleeding [3] . Measurement and evaluation of ONSD with ultrasonography (USG) are guiding in determining the increased ICP due to the reflection of pressure in the subarachnoid space and CSF changes on the optic nerve sheath [4,5] .

In our study, we aimed to evaluate the effect of the application of Baska Mask LMA, LMA-S and ETT on intracranial pressure in laparoscopic gynecological operations by measuring the ONSD and to show its change over time.

Materials and methods

The study was carried out with the approval of Bolu AIBU Faculty of Medicine Clinical Studies Ethics Committee (approval number: 2019/240).

Patients between the ages of 18-65 and at risk of ASA I-II-III who will undergo gynecological laparoscopic surgery with general anesthesia were included in the study. Patients with hypersensitivity to drugs to be used, patients with cerebrovascular disease, pregnant women, patients with eye disease, patients who underwent eye surgery and cranial tumor surgery were excluded from the study. Informed consent of the patients was obtained. Age, weight, height, body mass index and ASA score were recorded. The type of surgery, duration of surgery, duration of anesthesia, trendelenburg time, pneumoperitoneum time, and amount of fluid administered during the surgery and amount of opioids were recorded.

Patients were randomized into three groups as those undergoing ETT, LMA-S, and LMA-B. Optic nerve imaging was performed with Sonosite brand Plus 180 model ultrasound used in our clinic and with a high frequency (>7.5 MHz) linear transducer. ONSD measurement was performed with the patient in the supine position and the eyelids closed, by placing the transducer on the eyelid without applying high pressure with the help of a gel. ONSD was measured 3 mm behind the optic disc. Measurements were made for both eyes in the transverse and sagittal planes, and the arithmetic mean of the four measured values was taken as a basis. Intubation and LMA application were performed 2 minutes after induction. Anesthesia was maintained with 1 MAC sevoflurane. Fresh gas flow was applied at 2 lt/min. During the operation, the patient's ETCO2 value was kept between 35-45 mmHg.

Statistical analysis

Analyzes were performed with SPSS 25.0 program (SPSS Inc., Chicago, Illinois, USA). Measurement values were calculated as frequency, percentage, mean and standard deviation. Kruskall-Wallis test was used to examine the differences in ONSD measurements according to the groups, and the chi-square test was used for proportional comparisons. Kruskall Wallis and Mann Whitney U tests were used to research the differences in ONSD measurement times according to patient groups. Friedman and Wilcoxon sign test was used to research the

difference in ONSD measurement times. Wilcoxon sign pairwise comparison test was used to determine the different measurements (post hoc test). P values less than 0.05 were considered statistically significant in the study.

Results

60 patients were included in the study. Case numbers of the groups were 20 ETT, 20 LMA-S, 20 LMA-B. The pneumoperitoneum times (min) of the groups was measured as 74 ETT, 56 LMA-S, 70 LMA-B. Trendelenburg times (min) of the groups were measured as 65 ETT, 47 LMA-S, 65 LMA-B. No statistically significant difference was found in terms of demographic data of the groups including age, weight, height, BMI; surgery time, anesthesia time, pneumoperitoneum time, trendelenburg time, total fentanyl dose, total fluid amount, LMA insertion or intubation time, ASA classification score (Table 1) .

No statistically significant difference was found in terms of demographic data of the groups (age, weight, height, BMI), surgery time, anesthesia time, pneumoperitoneum time, trendelenburg time, total fentanyl dose, total fluid amount, LMA insertion or intubation time and ASA classification score (Table 1) .

Pre-induction 1st minute ONSD values were measured as 4.17 ETT, 4.17 LMA-S, 4.04 LMA-B, and no statistically significant difference was found (p= 0.82). The 1st minute Post-induction ONSD values were measured as 4.02 ETT, 3.98 LMA-S, and 3.91 LMA-B, and no statistically significant difference was found (p= 0.44). PIT, 1st minute ONSD values were measured as 4.28 ETT, 4.21 LMA-S, 4.18 LMA-B, and no statistically significant difference was found (p= 0.37). Post-intubation, the 3rd minute ONSD values were measured as 4.38 ETT, 4.36 LMA-S, 4.26 LMA-B, and no statistically significant

Table 1. Demographic and clinical data of the groups.

Parameters	ETT	LMA-S	LMA-B	*p* value
Number of Patients (n)	20	20	20	
Age (years)	44.95±11.26	42.5±13.77	44.25±9.72	0.45
Weight (kg)	70.7±7.64	72.65±9.76	70.8±4.93	0.39
Height (meter)	1.63±0.05	1.63±0.05	1.59±0.04	0.74
BMI (kg/m^2)	26.62±2.36	27.09±3.06	28.11±1.41	0.71
Operation Time (min)	90.05±45,7	83.5±37.35	81.75±30.68	0.13
Pneumoperitoneum Time (min)	74.55±45.5	56.8±31.44	70.85±28.81	0.09
Trendelenburg Time (min)	65.25±43.63	47±29.55	65.85±27.86	0.06
Duration of Anesthesia (min)	106.8±47.65	101.75±39,35	92.55±33.6	0.11
Total Fentanyl Doses (mcg)	107.5±24.47	100.0±0.01	100.01±0.01	0.07
Total Fluid (cc)	1367.5±575.89	1150±384.91	1215±360.96	0.22
LMA Application or Intubation Time (sec)	15.0±5.01	13.05±3.32	12.3±1.56	0.49
ASA I/II/III (n)	6/11/3	5/14/1	12/8/0	0.48

Table 2. Comparison of ONSD values by time and groups.

Measuring Time	ETT (n:20)	LMA-S (n:20)	LMA-B (n:20)	*p* value
Preinduction (mm)	4.17±0.20	4.17±0.31	4.04±0.21	0.82
Postinduction 1. Min (mm)	4.02±0.2	3.98±0.27	3.91±0.21	0.44
Postintubation 1.min (mm)	4.28±0.24	4.21±0.36	4.18±0.21	0.37
Postintubation 3.min (mm)	4.38±0.23	4.36±0.28	4.26±0.25	0,.12
PP+TRD 10.min (mm)	4.67±0.24*	4.70±0.24*	4.52±0.26*	0.64
PP+TRD 30.min (mm)	4.84±0.23*	4.83±0.28*	4.64±0.26*	0.61
Pre-extubation (mm)	4.39±0.19	4.35±0.26	4.18±0.17	0.12

difference was found (p= 0.12). PP+TRD 10th minute ONSD values were measured as 4.67 ETT, 4.70 LMA-S, 4.52 LMA-B, and no statistically significant difference was found (p= 0.64). PP+TRD 30.min ONSD values were measured as 4.84 ETT, 4.83 LMA-S, 4.64 LMA-B and no statistically significant difference was found (p= 0.61). ONSD values at the time pre extubation; It was measured as 4.39 ETT, 4.35 LMA-S, 4.18 LMA-B and no statistically significant difference was found (p = 0.12). (Table 2), (Figure 1).

Discussion

In our study, we found that the increased ICP can be followed by measuring ONSD in laparoscopic operations, especially in cases that continue in the trendelenburg position, and intubation techniques do not affect this situation in general, but LMA-B is more advantageous. There are studies reporting that intraocular pressure, ONSD, and ICP are correlated with each other [6-9] . Salah et al. stated that the application of i-Gel LMA increased the intraocular pressure less

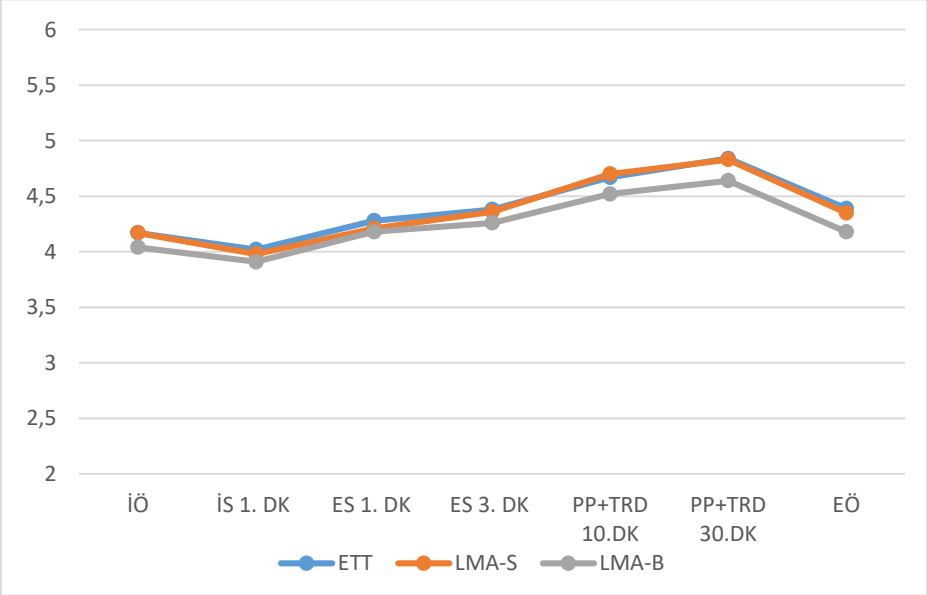

Figure1. Optic nerve sheath diameter measurements.

IO: Before Induction, IS: After Induction, ES: After Intubation, PP+TRD: After Pneumoperitoneum and Trendelenburg Position, EO: Before Extubation, ETT: Endotracheal Tube Applied Group, LMA-S: Supreme LMA Applied Group, LMA-B: Another Mask LMA Applied Group.

than ETT in 1, 2, 3, 5 minute intraocular pressure measurements [10] . Mehernoor et al. also observed that the application of LMA increased the intraocular pressure statistically less than ETT [11]. In our study, the mean of ONSD measurements 1 and 3 minutes after the application, 10 and 30 minutes after the pneumoperitoneum and trendelenburg position, and before extubation in the LMA-B group were found to be lower than the ETT group and LMA-S group.

Studies have shown that ultrasound measurement of ONSD is a useful and noninvasive method for the evaluation of ICP (96). It has also been reported that ultrasound-measured ONSD is strongly correlated with ICP measured by invasive methods, and is an accurate, simple and fast measurement method to detect changes in ICP increase [12-14]. In our study, no complications were encountered in the ultrasound-guided ONSD measurement.
In previous studies, the upper limit of ONSD was taken as 5 mm [15] . In the study conducted by Kimberly et al it was found that an ONSD higher than 5 mm indicated a ICP of more than 20 mmHg [16]. In other studies the ONSD cut-off value indicating raised ICP was between 5,7-5,8 mm [17,18]. In our study highest ONSD measure of 4,84 was in the ETT group.
In the study conducted by Kim DH et al they did not find a correlation between ONSD and sex and BMI [19]. There is an increase of ICP in laparoscopic surgeries. The ICP increase during surgery can be explained by two mechanisms. First; an increase of IAP caused by position will push the diaphragm upwards and compression of the inferior vena cava will cause an increase of CVP. This in turn will create a resistance against the venous drainage of blood from the central nervous system to the right atrium. Venous and cerebrospinal fluid pressure will rise in sagittal sinus causing an increase of ICP [20]. Second; rising PaCO2 can cause an increase of ICP. Position, especially trendelenburg, and a diaphragm compressed by an increased IAP can cause a rise in PaCO2 by deepening the ventilation/perfusion mismatch. Rising PaCO2 causes arterial vasodilation, accentuating the increase in ICP. Although an increase in ICP is inevitable, there are mechanisms in the central nervous system that compensate the increased ICP [21]. Studies indicate that the trendelenburg position coupled with CO2 pneumoperitoneum will increase ICP by 10 mmHg compared to the basal value [22-24]. In our study, it was determined that there was an increase of ONSD among all the groups in the pneumoperitoneum and trendelenburg position during laparoscopic surgery, but it was within safe limits and did not reach a level that would have a negative effect on ICP.

In conclusion, in the trendelenburg stage of laparoscopy, the ONSD also increased in all three applications, and this increase was found to be the least in LMA-B application. Therefore, we think that Baska Mask LMA can be preferred more than ETT and other LMA applications according to the indication and IBP follow-up can be done reliably with ONSD measurements.

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