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Original Article

Laryngeal Mask Airway Protector in Patients Undergoing Gynaecological Laparoscopy: A Comparative Study

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ABSTRACT

Background: Gynaecological laparoscopy under general anaesthesia presents distinct anaesthetic challenges, with haemodynamic fluctuations closely linked to the choice of airway device. Endotracheal intubation (ETT) provokes sympathoadrenal stimulation, whereas the laryngeal mask airway (LMA) protector, a second-generation supraglottic airway device, may offer superior haemodynamic stability. **Objective:** The objective of this study was to compare haemodynamic responses, intraoperative variables and the adequacy of respiration and ventilation between the LMA protector and the endotracheal tube in female patients undergoing gynaecological laparoscopy. **Methods & Materials:** A quasi-experimental study was conducted at the Gynaecological Operation Theatre, Department of Anaesthesia, Analgesia and Intensive Care Medicine, Bangladesh Medical University, from April 2024 to September 2025. Sixty female patients aged 18 to 40 years with ASA physical status I to II undergoing elective gynaecological laparoscopy were enrolled and alternatively allocated into Group E (ETT, n=30) and Group L (LMA protector, n=30). Mean arterial pressure (MAP), heart rate (HR) and SpO_2 were recorded in five perioperative time points while $ETCO_2$ were recorded at three perioperative time points. Data were analyzed using SPSS version 26. **Results:** Sociodemographic characteristics were comparable between both groups. After airway device insertion, MAP was significantly lower in Group L (84.4 mmHg vs. 94.7 mmHg; p=0.003), as was HR (85.0 vs. 93.5 bpm; p=0.038). Post-extubation MAP (90.7 vs. 103.2 mmHg; p=0.001) and HR (94.9 vs. 103.9 bpm; p=0.006) were also significantly lower in Group L. Duration of anaesthesia and surgery were comparable between groups. No significant differences in SpO2 or $ETCO_2$ were observed at any time point. Regarding postoperative complications, sore throat was significantly lower in group L, but no significant differences were observed in airway trauma, hoarseness of voice and dysphagia. **Conclusion:** The LMA protector provides superior intraoperative haemodynamic stability over endotracheal intubation without compromising respiratory parameters, supporting its suitability as an effective airway management alternative in gynaecological laparoscopy.

Keywords: *LMA protector, endotracheal intubation, haemodynamic parameters, gynaecological laparoscopy.*

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INTRODUCTION

Minimally invasive surgery has transformed the landscape of modern surgical practice gynaecological laparoscopy has emerged as one of the most widely performed day-case procedures worldwide [1,2]. Although laparoscopic techniques offer considerable advantages over open surgery—including reduced postoperative pain, shorter hospital stay earlier return to normal activity—these approaches introduce unique physiological and anaesthetic challenges. The creation of pneumoperitoneum through carbon dioxide insufflation raises intra-abdominal pressure when combined with the Trendelenburg position and peritoneal stimulation, this substantially increases the risk of gastric regurgitation and pulmonary aspiration [1]. In addition, the resulting increase in airway pressure reduces pulmonary compliance, promotes early small airway closure, elevates end-tidal carbon dioxide ($ETCO_2$) may lead to hypoxaemia, all of which carry implications for intraoperative ventilation management [3]. These physiological consequences underscore the importance of selecting an airway management strategy that provides adequate ventilation while maintaining haemodynamic stability throughout the procedure [1,4].

Endotracheal intubation (ETT) remains the conventional approach for airway management during gynaecological laparoscopy and is widely regarded as the gold standard for securing a patent airway [8]. However, direct laryngoscopy and tracheal intubation are well recognized to provoke a sympathoadrenal response [6,7]. The stimulation of supraglottic structures during laryngoscopy, the passage of the endotracheal tube through the vocal cords inflation of the tracheal cuff in the infraglottic region collectively activate laryngeal and tracheal receptors, producing clinically significant rises in mean arterial pressure and heart rate [7]. These haemodynamic fluctuations may be particularly concerning in patients with underlying cardiovascular conditions or in settings where haemodynamic stability is critical [5,6].

Beyond intraoperative haemodynamic disturbance, endotracheal intubation is associated with postoperative airway morbidity. Tracheal cuff inflation contributes to mucosal irritation, whilst forceful passage of the tube through the glottis frequently results in sore throat, hoarseness of voice dysphagia following surgery [1,5]. Laryngospasm, coughing increased incidence of postoperative nausea have also been documented with endotracheal intubation relative to supraglottic airway alternatives [6,8].

Over the past decade, supraglottic airway devices (SADs) have gained increasing acceptance for airway management in laparoscopic surgical procedures [9]. Among these, the LMA protector represents a notable advancement in second-generation SAD design. Constructed from medical-grade silicone, it features a preformed, curved structure that allows insertion without laryngoscopy or specialized guiding tools, thereby reducing stimulation of the glottic and supraglottic regions and minimizing the sympathoadrenal response [10,11]. An integrated cuff pressure indicator—the cuff pilot—enables consistent maintenance of intracuff pressure and reduces the risk of device displacement or air leak [10]. The LMA protector incorporates dual gastric drainage channels, permitting passage of a gastric or suction tube to the stomach, thus isolating the respiratory from the digestive tract and providing a degree of protection against aspiration [11]. These structural and functional features make the LMA protector particularly relevant in gynaecological laparoscopy, where heightened intra-abdominal pressure and patient positioning increase aspiration risk.

Several studies have reported that LMA insertion in laparoscopic procedures results in fewer intraoperative haemodynamic fluctuations compared with endotracheal intubation, along with advantages in terms of faster recovery and reduced postoperative airway morbidity [6,10]. However, comparative evidence specifically evaluating the LMA protector—a newer second-generation device—against ETT in the context of gynaecological laparoscopy remains limited. Despite its documented advantages and structural superiority over classical LMAs, its routine adoption in gynaecological surgical settings has not yet been established [8,11]. This study was therefore conducted to compare intraoperative haemodynamic responses and perioperative variables between the LMA protector and endotracheal tube in patients undergoing elective gynaecological laparoscopy under general anaesthesia.

OBJECTIVES

The objective of this study was to compare haemodynamic responses, intraoperative variables and the adequacy of respiration and ventilation between the LMA protector and the endotracheal tube in female patients undergoing gynaecological laparoscopy.

METHODS & MATERIALS

This quasi-experimental study was conducted at the Gynaecological Operation Theatre, Department of Anaesthesia, Analgesia and Intensive Care Medicine, Bangladesh Medical University, Dhaka, between April 2024 and September 2025, following approval from the Institutional Review Board (IRB). A total of 60 female patients aged 18 to 40 years, with American Society of Anesthesiologists (ASA) physical status I or II, body mass index (BMI) not exceeding 30 kg/m^2, Mallampati classification I or II scheduled for elective gynaecological laparoscopy under general anaesthesia, were enrolled after obtaining informed written consent. Patients were excluded if they had respiratory comorbidities, risk factors for aspiration (hiatus hernia or gastro-oesophageal reflux), coagulation disorders, pathology of the oropharynx or cervical spine, valvular heart disease, history of surgery on the oral cavity, conversion to open surgery, or if adequate airway placement was not achieved within two attempts and surgical duration more than 120 minutes. Participants were alternatively allocated into Group E (endotracheal tube, ETT; n=30) and Group L (LMA protector; n=30). All patients were fasted for eight hours for solids and six hours for liquids. After establishing routine monitoring and intravenous access, patients were pre-oxygenated for five minutes with 100% oxygen. Anaesthesia was induced with intravenous fentanyl (2 mcg/kg) and propofol (2 mg/kg) in both groups, followed by suxamethonium (1.5 mg/kg). In Group E, tracheal intubation was performed using a Macintosh laryngoscope with a size 7 or 7.5 cuffed endotracheal tube, with the cuff inflated to 20 cmH_2O. In Group L, the LMA protector (size based on weight: <50 kg for size 3; 51–70 kg for size 4) was inserted with the cuff inflated to 60 cmH_2O as guided by the integrated cuff pilot. Correct placement was confirmed by bilateral chest movement and capnography. Anaesthesia was maintained with 60% nitrous oxide in oxygen and isoflurane with vecuronium for muscle relaxation. Volume-controlled ventilation was applied with a tidal volume of 8 ml/kg and a respiratory rate of 12 breaths/min. Haemodynamic parameters, including mean arterial pressure (MAP), heart rate (HR) and peripheral oxygen saturation (SpO_2) were recorded preoperatively, after airway device insertion, after pneumoperitoneum, and before and after extubation. End-tidal carbon dioxide ($ETCO_2$) was recorded after airway device insertion, after pneumoperitoneum and before extubation. The duration of anaesthesia and surgery was also recorded. Postoperative complications (sore throat, hoarseness of voice, dysphagia) were also recorded after 24 hours. All data were compiled and analyzed using the Statistical Package for the Social Sciences (SPSS) version 26.0. Continuous variables were expressed as mean ± standard deviation and median (interquartile range). Normality was assessed with the Shapiro-Wilk test. Group comparisons for continuous variables were performed using the Mann-Whitney U test categorical variables were analyzed using the chi-square or Fisher's exact test as appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 60 female patients were enrolled and allocated equally into Group E (endotracheal tube) and Group L (LMA protector), with 30 patients in each group. All patients completed the study without exclusion or dropout. The results are presented below in tables and figures (*Table I*).

Table I
Distribution of the participants according to sociodemographic and clinical characteristics (*n*=60).

Variables	Group E (n=30)	Group L (n=30)	p value
Age (years), mean±SD	28.6±6.8	28.7±5.8	0.796
BMI (kg/m²), mean±SD	24.05±2.3	22.9±2.8	0.106
ASA physical status			
Class I	21 (70%)	26 (86.7%)	0.209
Class II	9 (30%)	4 (13.3%)	
Mallampati classification			
Class I	15 (50%)	20 (66.7%)	0.19
Class II	15 (50%)	10 (33.3%)	

Group E: Endotracheal tube; Group L: LMA protector. Values expressed as mean±SD, frequency and percentage (%). Mann-Whitney U test for continuous data; chi-square test for categorical data. p<0.05 statistically significant.

The two groups were well matched with respect to baseline demographic and clinical characteristics. Mean age was 28.6 ± 6.8 years in Group E and 28.7 ± 5.8 years in Group L, with no statistically significant difference (p=0.796). BMI was slightly higher in Group E (24.05 ± 2.3 kg/m²) than in Group L (22.9 ± 2.8 kg/m²), though this difference was not significant (p=0.106). The majority of participants in both groups were ASA class I: 70% in Group E and 86.7% in Group L (p=0.209). Similarly, Mallampati class I was more prevalent in Group L (66.7%) than in Group E (50%), with no statistically significant difference (p=0.190). These findings confirm adequate baseline comparability between the two groups (*Table II*).

Table II

Distribution of the participants according to haemodynamic parameters (*n*=60).

Variables		Group E (n=30)	Group L (n=30)	p value
MAP (mmHg)	Preoperative	100.5±26.6	96.3±19.5	0.485
	After airway device insertion	94.7±10.6	84.4±8.0	0.003*
	After pneumoperitoneum	97.1±28.1	101.0±26.4	0.610
	Before extubation	100.3±33.9	87.2±10.5	0.151
	After extubation	103.2±25.6	90.7±7.0	0.001*
HR (bpm)	Preoperative	96.5±21.0	95.0±11.2	0.185
	After airway device insertion	93.5±13.1	85.0±11.9	0.038*
	After pneumoperitoneum	78.9±13.5	82.0±15.1	0.450
	Before extubation	77.9±14.2	82.7±16.1	0.234
	After extubation	103.9±12.8	94.9±8.6	0.006*
SpO_2 (%)	Preoperative	99.4±0.8	99.4±0.5	0.921
	After airway device insertion	99.7±1.1	99.7±1.2	0.615
	After pneumoperitoneum	99.1±1.2	99.3±1.2	0.470
	Before extubation	98.9±1.5	98.4±1.2	0.607
	After extubation	99.4±1.2	99.8±0.3	0.115
$ETCO_2$ (mmHg)	After airway device insertion	35.9±5.2	36.4±3.9	0.124
	After pneumoperitoneum	34.2±4.7	35.4±3.7	0.262
	Before extubation	34.6±5.3	35.2±5.0	0.674

*Group E: Endotracheal tube; Group L: LMA protector. Values expressed as mean±SD. Mann-Whitney U test applied. *p<0.05 statistically significant. MAP: mean arterial pressure; HR: heart rate; SpO_2: peripheral oxygen saturation; $ETCO_2$: end-tidal carbon dioxide.*

After airway device insertion, MAP was significantly lower in Group L (84.4 ± 8.0 mmHg) than in Group E (94.7 ± 10.6 mmHg; p=0.003). Following extubation, MAP remained significantly lower in Group L (90.7 ± 7.0 mmHg vs. 103.2 ± 25.6 mmHg; p=0.001). Heart rate showed a similar pattern: it was significantly lower in Group L after airway device insertion (85.0 ± 11.9 bpm vs. 93.5 ± 13.1 bpm; p=0.038) and after extubation (94.9 ± 8.6 bpm vs. 103.9 ± 12.8 bpm; p=0.006). No significant differences in MAP or HR were observed between the two groups at the preoperative, post-pneumoperitoneum, or pre-extubation time points. SpO_2 values were comparable between groups at all measured points, with no statistically significant differences. $ETCO_2$ levels also did not differ significantly between Group E and Group L at any recorded time point, confirming that both airway devices maintained equivalent respiratory gas exchange throughout the procedure (*Figure 1*).

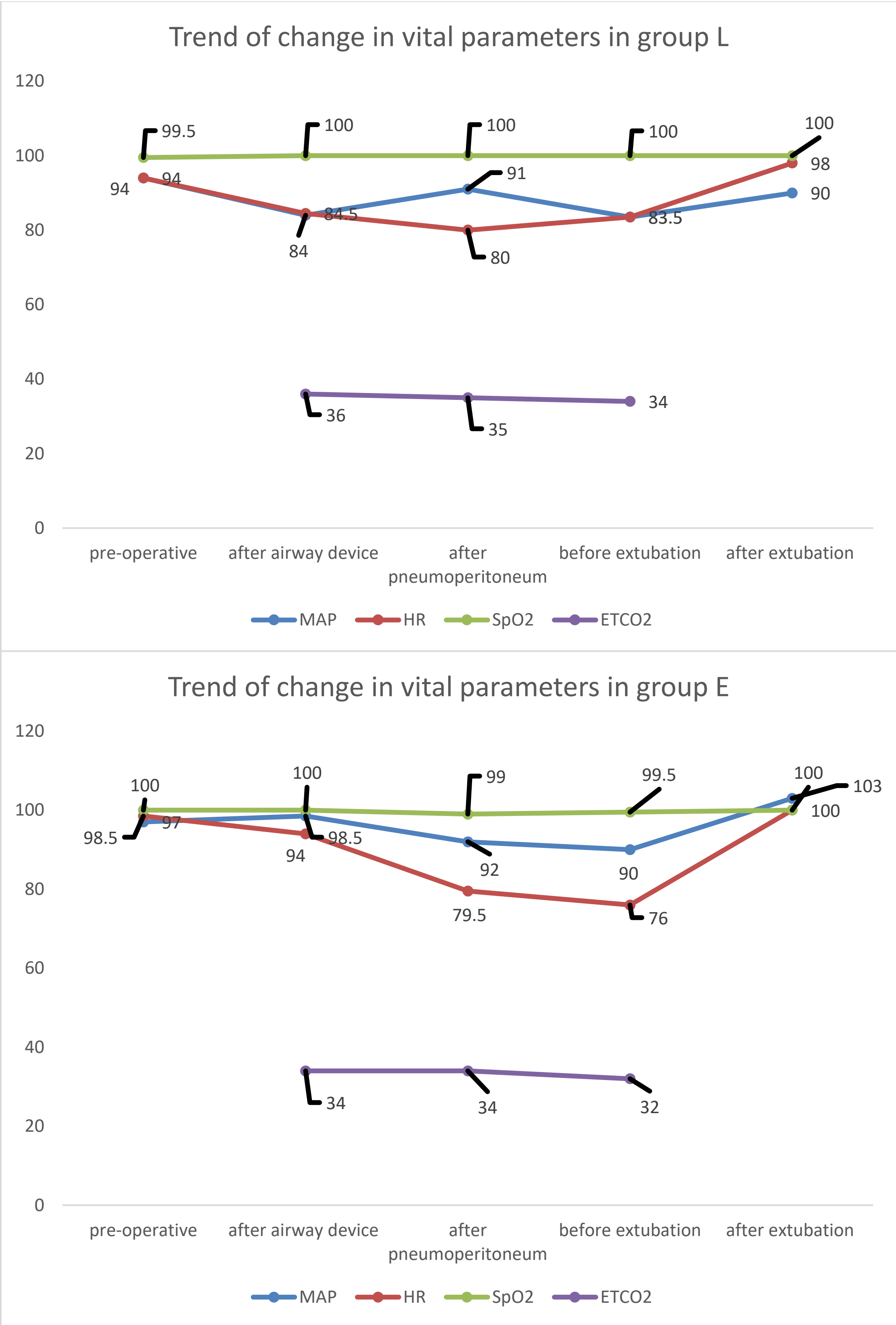

Figure 1 Trend of changes in vital parameters (Group L and Group E).

The figures depict the median trends in haemodynamic parameters across five perioperative time points for Group L (LMA protector) and Group E (endotracheal tube). In Group L, median MAP remained relatively stable, starting at 94 mmHg preoperatively, declining slightly after airway insertion (84 mmHg), with a modest rise after extubation (90 mmHg). Median HR began at 94 beats/min, fell to 84 after airway device placement and reached its nadir following pneumoperitoneum (80 beats/min), before rising to 98 beats/min after extubation. SpO_2 was consistently maintained near 100% at all time points $ETCO_2$ remained between 34 and 36 mmHg throughout. In Group E, median MAP exhibited greater variability, starting at 98.5 mmHg preoperatively, falling to 94 mmHg after airway insertion, declining further through the intraoperative period rising sharply to 103 mmHg after extubation. Median HR followed a downward trend from 97 beats/min preoperatively to a nadir of 76 beats/min before extubation, followed by a sharp rise to 100 beats/min post-extubation. SpO_2 remained near 99 to 100% and $ETCO_2$ showed a mild decline from 35 to 32 mmHg toward the end of the procedure. These graphical representations illustrate the consistently lower and more stable haemodynamic profile in the LMA protector group relative to the endotracheal tube group, particularly at device insertion and extubation (*Table III*).

Table III
Distribution of the participants according to intra-operative variables (*n*=60).

Variables	Group E (n=30)	Group L (n=30)	p value
Duration of anaesthesia (min), mean±SD	78.8±22.7	75.2±22.5	0.344
Duration of surgery (min), mean±SD	57.5±19.9	56.2±20.3	0.704

Group E: Endotracheal tube; Group L: LMA protector. Values expressed as mean±SD. Mann-Whitney U test applied. p<0.05 statistically significant.

The total duration of anaesthesia was comparable between groups, with Group E recording a mean of 78.8 ± 22.7 minutes compared to 75.2 ± 22.5 minutes in Group L (p=0.344). The duration of surgery was similarly equivalent, with Group E averaging 57.5 ± 19.9 minutes and Group L 56.2 ± 20.3 minutes (p=0.704). The absence of significant differences in procedural duration between the two groups confirms that operative time cannot account for any observed differences in haemodynamic parameters between groups.

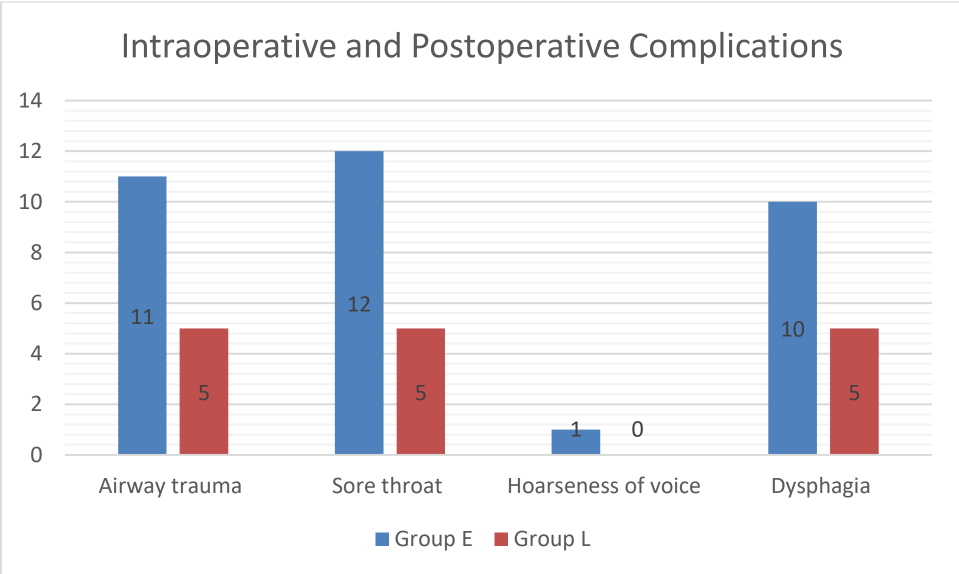

Figure 2 Distribution of the participants according to intra-operative and post-operative complications (*n*=60).

Figure 2 shows the intraoperative and postoperative complications. A significantly higher incidence of sore throat was observed in Group E (40%) compared to Group L (16.7%), with the difference being statistically significant (p = 0.045). Although airway trauma occurred more frequently in Group E (36.7%) than in Group L (16.7%), the difference did not reach statistical significance (p = 0.080). Similarly, dysphagia was more commonly reported in Group E (33.3%) than in Group L (16.7%), but this difference was also not statistically significant (p = 0.136). Hoarseness of voice was reported in 3.3% of group E, showing no significant difference.

DISCUSSION

This quasi-experimental study compared the haemodynamic effects of the LMA protector with those of endotracheal intubation in patients undergoing gynaecological laparoscopy under general anaesthesia. A total of 60 female patients were enrolled and equally allocated into two groups data were analysed across demographic, haemodynamic intraoperative domains to assess clinical outcomes.

The two groups were well matched at baseline with respect to age, BMI, ASA physical status Mallampati classification, all of which showed no statistically significant differences. The mean age was 28.7 ± 5.8 years in Group L and 28.6 ± 6.8 years in Group E (p=0.796), confirming that age did not function as a confounding variable for haemodynamic or recovery outcomes. Mean BMI was slightly higher in Group E (24.05 ± 2.3 kg/m²) than in Group L (22.9 ± 2.8 kg/m²), though this difference was not significant (p=0.106). The majority of participants in both groups were ASA class I and Mallampati class I, indicating a low-risk anaesthetic profile and straightforward airway anatomy, thereby validating the use of both airway devices in the study population. Comparable baseline characteristics were also reported in other studies evaluating LMA-type devices [10,12].

The most clinically relevant findings of this study relate to the haemodynamic response following airway device insertion and at extubation. After airway device placement, MAP was significantly lower in Group L (84.4 mmHg) than in Group E (94.7 mmHg; p=0.003). This difference was similarly significant after extubation, with Group L recording 90.7 mmHg compared to 103.2 mmHg in Group E (p=0.001). Heart rate followed the same pattern: significantly lower in Group L after device insertion (85.0 bpm vs. 93.5 bpm; p=0.038) and after extubation (94.9 bpm vs. 103.9 bpm; p=0.006). These findings are consistent with the known mechanism by which LMA insertion, requiring no laryngoscopy or passage through the vocal cords, causes far less stimulation of airway reflexes and therefore a reduced sympathoadrenal response compared with endotracheal intubation.

Yilmaz et al. observed a significantly lower heart rate in the LMA protector group compared to the endotracheal intubation group after airway device insertion (p=0.002) significantly lower MAP after extubation (p=0.018), findings that are broadly consistent with those of the present study [8]. Lim et al. similarly found that systolic blood pressure and heart rate were significantly lower in the LMA group at 2.5 minutes and 5 minutes following device insertion compared with the endotracheal tube group [13]. Kang and Park noted that the incidence of haemodynamically significant events, including high systolic blood pressure, was greater in the ETT group [6]. Several other investigators have reported statistically significant reductions in MAP, HR, systolic blood pressure diastolic blood pressure at selected time points in favour of LMA over ETT [14,15].

No significant differences were observed in SpO_2 or $ETCO_2$ between the two groups at any recorded time point. SpO_2 values remained near 100% in both groups throughout the procedure, reflecting adequate oxygenation with both airway devices. $ETCO_2$ was similarly maintained within the target range of 34 to 36 mmHg across all stages of anaesthesia. These findings confirm that the haemodynamic advantage of the LMA protector was not achieved at the cost of respiratory safety. Yilmaz et al. [8] also reported no significant differences in $ETCO_2$ at any time point following insertion, pneumoperitoneum, or before extubation Ozdamar et al. [3] similarly observed no significant changes in SpO_2 or $ETCO_2$ between LMA and ETT groups during laparoscopic procedures. Equivalent $ETCO_2$ values between the two groups across multiple comparable studies reinforce the conclusion that LMA protector ventilation in this setting is equally effective as endotracheal intubation in terms of carbon dioxide clearance and respiratory management [1,15].

The duration of anaesthesia and surgery was comparable between the two groups (p=0.344 and p=0.704, respectively), with Group E recording a mean anaesthetic time of 78.8 ± 22.7 minutes versus 75.2 ± 22.5 minutes in Group L mean surgical durations of 57.5 ± 19.9 and 56.2 ± 20.3 minutes, respectively. This equivalence eliminates procedural length as a source of bias when comparing intraoperative haemodynamic data. Comparable operative and anaesthetic durations between LMA and ETT groups have similarly been reported by Yilmaz et al. Mahaseth et al., further supporting the methodological rigour of these comparisons [8,15].

Sore throat, the most common anaesthesia-related complaint after general anaesthesia, was 2.4 times more frequent in the ETT group (40% vs. 16.7%, p= 0.045). This is consistent with the broader literature; in a large propensity-matched study of 6,739 patients who underwent laparoscopic hysterectomy, Jia et al. [14] reported a significantly higher incidence of sore throat with ETT (20% vs. 14.4%, P<0.001), and multiple smaller trials have demonstrated the same patterns [6]. The difference is attributable to direct mucosal trauma from laryngoscopy and tracheal cuff pressure, while airway trauma and dysphagia showed trends favouring the LMA, but did not reach significance.

Collectively, the data from this study consistently demonstrate haemodynamic superiority of the LMA protector over endotracheal intubation at the two time points of greatest cardiovascular risk: airway device insertion and extubation. This benefit can be attributed to the anatomical placement of the LMA protector above the glottis, which avoids direct tracheal manipulation and stimulates fewer airway reflexes. The integrated cuff pressure monitoring and dual drainage channels of the device further enhance safety by reducing the risk of displacement and aspiration. The consistency between numerical findings and graphical trend data confirms the robustness of these conclusions. Accordingly, the LMA protector may be considered a safe, effective haemodynamically favourable alternative to endotracheal intubation in appropriately selected patients undergoing elective gynaecological laparoscopy.

CONCLUSION

The LMA protector provides superior haemodynamic stability over endotracheal intubation during gynaecological laparoscopy, with significantly lower mean arterial pressure and heart rate at airway device insertion and extubation. Both devices maintained equivalent oxygenation and ventilation throughout the procedure operative durations were comparable between groups. These findings support the LMA protector as a safe, less invasive haemodynamically favourable alternative to endotracheal intubation in appropriately selected female patients undergoing elective gynaecological laparoscopy under general anaesthesia.

CONFLICTS OF INTEREST

None.

ETHICAL APPROVAL

This study approved by the institutional ethical review board of Bangladesh Medical University (BMU).

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