One Health Journal of Nepal

Original Article Open Access

Hemodynamic Changes to Insertion of Various Airway Devices: A Comparative Study

Chhanda Bahadur Budhathoki,[1*] Ram Prasad Sharma,[1] Pawan Kumar Raya,[1] Sundar Prasad Hyoju[1]

[1]Department of Anesthesiology, Nepal Police Hospital, Maharajgunj, Kathmandu

ABSTRACT

Introduction: Cuffed endotracheal tubes (ETTs) are the gold standard for airway management during laparoscopic surgeries but are associated with hemodynamic stress and postoperative throat complications. Supraglottic devices like Proseal LMA (PLMA) and Laryngeal Tube Suction II (LTS II) offer better glottic sealing with fewer complications. This study compares the hemodynamic effects and postoperative outcomes of PLMA, LTS II, and ETT in patients under general anesthesia.

Methods: In this comparative cross-sectional study, 90 ASA I–II patients aged 18–65 years undergoing elective laparoscopic cholecystectomy were assigned to PLMA, LTS II, or ETT groups. Following standard anesthesia induction, airway devices were inserted, and hemodynamic parameters (HR, SBP, DBP, MAP) were recorded at defined intervals.

Results: A total of ninety patients with similar demographic characteristics were assessed. The time taken for insertion was the shortest with endotracheal tube (ETT) at 14.4 ± 2.4 seconds, compared to the laryngeal mask airway (PLMA) at 19.4 ± 4.1 seconds and the LTS II at 21.8 ± 3.1 seconds ($p < 0.001$). After insertion, ETT resulted in a significantly higher increase in heart rate and blood pressure compared to PLMA and LTS II ($p < 0.001$), which displayed similar and lower levels of response. The incidence of postoperative sore throat was highest with ETT at 60%, as opposed to PLMA at 26.7% and LTS II at 33.3% ($p = 0.02$). Statistically non-significant dysphagia occurred more often with ETT (16.7%).

Conclusions: PLMA and LTS II are effective alternatives to ETT for elective surgeries, offering greater hemodynamic stability and reduced postoperative throat morbidity.

OPEN ACCESS

*Correspondence:
Dr. Chhanda Bahadur Budhathoki
Department of Anesthesiology,
Nepal Police Hospital, Maharajgunj,
Kathmandu.

Email:
chhanda06@hotmail.com

Submitted Date: 2025-06-08
Accepted Date: 2025-08-13

ORCID of corresponding author:
0009-0008-1418-4425

Keywords : *Endotracheal tube, laryngeal tube suction II, Proseal laryngeal mask airway.*

INTRODUCTION

Anesthesia allows for procedures that would be intolerable for patients who are conscious or only sedated, but it can also depress vital systems—such as the cardiovascular, respiratory, and central nervous systems—leading to immediate life-threatening risks which renders airway management essential.[1] In patients under anesthesia, decreased muscle tone in the upper airway, particularly in the genioglossus muscle, can lead to obstructions.[2] Techniques such as head tilt, jaw thrust, and the use of adjuncts like oral or nasal airways help maintain an open airway.[2] Face masks are useful for assisting ventilation, while endotracheal tubes (ETTs), which are considered the gold standard, provide secure ventilation, protect against aspiration, and enable high-pressure ventilation.[3] Nonetheless, the insertion of ETTs requires skill and may induce sympathetic responses (such as hypertension and tachycardia), which can be dangerous for patients with cardiovascular or cerebrovascular issues.[5] There is also a continued concern about misplacement, particularly in prehospital settings. Supraglottic airway devices (SGADs) like the Proseal Laryngeal Mask Airway (PLMA) and Laryngeal Tube Suction II (LTS II) are characterized by easier and less invasive insertion, resulting in fewer hemodynamic effects.[3-8] The PLMA and the LTS II allow for gastric drainage, thereby lowering the risk of aspiration. This study assessed their hemodynamic responses, insertion times, and postoperative complications in comparison to ETTs.

METHODS

This comparative cross-sectional study aimed at assessing and comparing the hemodynamic responses, insertion durations, and postoperative complications related to three airway management tools: Proseal Laryngeal Mask Airway (PLMA), Laryngeal Tube Suction II (LTS II), and Endotracheal Tube (ETT). The research was conducted at Bir Hospital, Mahaboudha, and Shree Birendra Hospital, Chhauni, located in Kathmandu, between March 2015 and July 2015.

The participants comprised patients aged between 18 and 65 years, classified as ASA physical status I or II, weighing from 30 to 100 kg, and undergoing elective surgeries that required advanced airway management. Individuals, who declined participation, were on medications impacting cardiovascular function, faced high aspiration risk, had airway or esophageal issues, fell outside the specified weight range, or experienced unsuccessful device insertion after three attempts were excluded.

The sample size was determined based on previous studies that compared the average heart rates following device placement (PLMA: 109.50±12.41 bpm; ETT: 122.83±8.30 bpm). Utilizing a pooled standard deviation of 111.44 and a mean difference of 13.33, with a 95% confidence interval ($\alpha = 1.96$) and 80% power ($\beta = 1.63$), the minimum sample required was 16 per group. To facilitate the analysis of additional variables, the total sample size was increased to 90, dividing into 30 participants per group.

Participants were allocated into three groups (Group P - PLMA, Group L - LTS II, Group E - ETT) using a lottery method. Only the patients were unaware of their assigned group.

Following ethical approval and obtaining informed consent, eligible patients scheduled for elective surgeries were enrolled. After standard preoperative evaluation and preparation, airway management was carried out using one of three devices—Proseal Laryngeal Mask Airway (PLMA), Laryngeal Tube Suction II (LTS II), or Endotracheal Tube (ETT)—according to routine clinical procedures and the anesthetist's judgment.

Standard anesthesia induction methods were adhered to, including premedication with midazolam and pethidine, induction with propofol, and muscle relaxation achieved with vecuronium. Device insertion occurred once adequate paralysis was confirmed, with insertion time noted from the moment the device was handled until the first capnographic waveform was observed. Correct placement was verified through clinical assessment.

Hemodynamic variables were documented at baseline, during induction, immediately following device placement, and post-device removal. Anesthesia maintenance and postoperative care followed established protocols. Postoperative complications related to the airway were evaluated on the first postoperative day. Data collection was facilitated through standardized forms for subsequent analysis.

Demographic information, device insertion times, hemodynamic data, and postoperative complications were documented using standardized data collection forms. The airway devices were inserted following standard protocols. Insertion time was tracked from the moment the device was picked up to the appearance of the first capnographic waveform. Hemodynamic variables were measured at specified intervals, and postoperative complications were evaluated on the first day following surgery.

Data analysis was performed using SPSS 16.0 software. Descriptive statistics provided summaries of demographic and clinical data. The Chi-square test was employed for categorical variables, ANOVA for continuous variables, and Z-tests for pair wise comparisons. A p-value of less than 0.05 was deemed statistically significant.

Ethical clearance was granted by the Institutional Review Board of Bir Hospital (Reference No: 2). Informed written consent was obtained from all participants. Confidentiality was maintained, and participants were assured of their right to withdraw at any time. Any complications were addressed according to institutional protocols, ensuring no financial burden fell on patients or their families.

RESULTS

Demographic profile

The age and gender distribution among the three groups were comparable. The mean age was 40.1 ± 12.28 years in group E, 40 ± 10.2 years in group P, and 40.8 ± 11.3 years in group L, with no significant difference ($p = 0.953$). Of the 90 patients, 22 (24%) were male and 68 (75.6%) female. Group E had 4 (13.3%) males and 26 (86.7%) females; group P had 8 (26.7%) males and 22 (73.3%) females; and group L had 10 (33.3%) males and 20 (66.7%) females. Gender distribution across groups was not statistically different ($p = 0.186$).

The mean weight and height of patients were comparable across the three groups, with no statistically significant differences ($p = 0.163$ and $p = 0.367$, respectively). Group E had a mean weight of 52 ± 7 kg and height of 155.6 ± 13.8 cm; group P had 53.9 ± 3.8 kg and 152.8 ± 2.9 cm; and group L had 53.3 ± 8.5 kg and 153.1 ± 3.2 cm. ASA physical status distribution was also similar, with most patients in ASA I across all groups and no significant difference ($p = 0.925$). Overall, demographic variables including age, sex, weight, height, and ASA status were comparable among the groups with

no statistically significant differences (Table 1)

Table 1: Patient characteristics

Variables	Group E	Group P	Group L	p value
Age (year)	40.1±12.28	40±10.2	40.8±11.3	0.953
Sex(M/F)	4/26	8/22	10/20	0.186
Weight(kg)	52.0±7.0	53.9±3.8	55.3±8.5	0.163
Height(cm)	155.6±13.8	152.8±2.9	153.1±3.2	0.367
ASA Status(I&II)	26/4	25/5	27/3	0.925

Device insertion time

The mean insertion times for airway devices in groups E, P, and L were 14.4 ± 2.4 sec, 19.4 ± 4.1 sec, and 21.8 ± 3.1 sec, respectively, showing a statistically significant difference ($p < 0.001$; Table 2). Group E had significantly shorter insertion times compared to both group P ($p < 0.001$; Table 3) and group L ($p < 0.001$; Table 5), while the difference between groups P and L was not statistically significant (Table 2)

Table 2: Time of Insertion between three groups

Time (sec)	Group E	Group P	Group L	p- value
Mean time (sec)	14.4±2.4	19.4±4.1	21.8±3.1	<0.001
Time(sec) between Group E and P		8/22	10/20	0.186
Time(sec) between Group P and L	14.4±2.4	19.4±4.1	-	< 0.001
Time(sec) between Group E and L	-	19.4±4.1	21.8±3.1	0.14
ASA Status(I&II)	14.4±2.4	-	21.8±3.1	<0.001

Heart Rate at various time intervals

The baseline and post-induction heart rates were comparable across the three groups. Mean pre-induction HR was 78.4 ± 13.5 bpm in group E, 82.9 ± 15.1 bpm in group P, and 80.8 ± 12.9 bpm in group L ($p = 0.456$). Post-induction HRs were 80 ± 17.3 bpm (E), 82.4 ± 13.8 bpm (P), and 79.8 ± 7.6 bpm (L), with no statistically significant difference ($p = 0.719$). (Table:3)

Table 3: Mean heart rate between the three groups at different time intervals

*ANOVA **Z- Test

Time period	Mean Heart Rate (bpm)			p-value *	E vs P p-value **	P vs L p-value **	E vs L P-value **
	Group E	Group P	Group L				
Preinduction	78.4±13.5	82.9±15.1	80.8±12.9	0.456	0.228	0.565	0.484
Post induction	80±17.3	82.4±13.8	79.8±7.6	0.719	0.566	0.376	0.946
Before insertion	8017.3	82.413.5	81.3±9.4	0.918	0.727	0.716	0.928
After insertion	95.6±11.1	82.1±14.0	91.2±10.2	<0.001	<0.001	<0.005	0.119
Before removal	90.5±14.5	81±7.1	85.9±9.9	0.005	0.002	0.030	0.162
After removal	76.2±8.9	79.3±9.3	77.4±10.3	0.456	0.198	0.456	0.640

Mean heart rate between group P and group L at different time intervals

Time Period	Mean Heart Rate (bpm)		p -value
	Group P	Group L	
Preinduction	82.9±15.1	80.8±12.9	0.565
Post induction	82.4±13.8	79.8±7.6	0.376
Before insertion	82.413.5	81.3±9.4	0.716
After insertion	82.1±14.0	91.2±10.2	<0.005
Before removal	81±7.1	85.9±9.9	0.030
After removal	79.3±9.3	77.4±10.3	0.456

Mean heart rate between group P and group E at different time intervals

Time Period	Mean Heart Rate (bpm)		p -value
	Group P	Group E	
Preinduction	82.9±15.1	78.4±13.5	0.228
Post induction	82.4±13.8	80±17.3	0.566
Before insertion	82.413.5	8017.3	0.727
After insertion	82.1±14.0	95.6±11.1	<0.001
Before removal	81±7.1	90.5±14.5	0.002
After removal	79.3±9.3	76.2±8.9	0.198

Mean heart rate between group E and group L at different time intervals

Time Period	Mean Heart Rate (bpm)		p -value
	Group P	Group E	
Preinduction	80.8±12.9	78.4±13.5	0.484
Post induction	79.8±7.6	80±17.3	0.946
Before insertion	81.3±9.4	8017.3	0.928
After insertion	91.2±10.2	95.6±11.1	0.119
Before removal	85.9±9.9	90.5±14.5	0.162
After removal	77.4±10.3	76.2±8.9	0.640

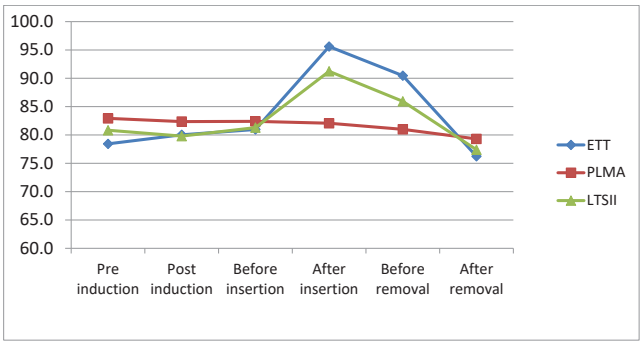

Figure 1: *Average HR*

Heart rate (HR) at post-induction and before device insertion was comparable among all three groups (E, P, and L), with no statistically significant differences ($p > 0.05$). After device insertion, HR increased in all groups, with group E showing the highest rise (95.6 ± 11.1 beats/min), followed by group L (91.2 ± 10.2) and group P (82.1 ± 14.0), showing a statistically significant difference ($p < 0.001$). Pairwise comparisons revealed significantly higher HR in group L vs. P ($p < 0.005$) and group E vs. P ($p < 0.001$), while E vs. L was comparable ($p = 0.119$). Before device removal, HR remained significantly higher in groups E and L compared to P ($p = 0.002$ and $p = 0.003$, respectively), with no significant difference between E and L ($p = 0.162$). After removal, HR returned to comparable levels across all groups ($p = 0.456$)

Systolic Blood Pressure at various time intervals.

The baseline systolic blood pressure (SBP) among the study groups was comparable. The mean pre-induction systolic blood pressure in group E was 124.2 + 10.4 mm of Hg. In group P, it was 125.3 + 5 mm of Hg, and it was 123.3 + 7.8 mm of Hg in group L, which was comparable (p-value 0.608) (Table 4).

Table 4: Systolic blood pressure between three different groups at different time intervals

Time Period	Systolic blood pressure (mm of Hg)			p -value
	Group E	Group P	Group L	
Preinduction	124.2±10.4	125.3±5	123.3±7.8	0.608
Post induction	122.2±8.3	112.9±7.1	109.5±8.3	0.243
Before insertion	106.8±7.7	110.3±6.8	107.6±8.3	0.178
After insertion	152.9±12.8	118.9±8.2	124.5±9.1	<0.001
Before removal	141.9±13.1	115.1±6.3	117.4±6.7	<0.001
After removal	123.3±8.6	114.9±6.3	118.6±9.8	0.001

Systolic blood pressure between group P and group L at different time intervals

Time Period	Systolic blood pressure (mm of Hg)		p- value
	Group P	Group L	
Preinduction	125.3±5	123.3±7.8	0.225
Post induction	112.9±7.1	109.5±8.3	0.088
Before insertion	110.3±6.8	107.6±8.3	0.167
After insertion	118.9±8.2	124.5±9.1	0.016
Before removal	115.1±6.3	117.4±6.7	0.177
After removal	114.9±6.3	118.6±9.8	0.082

Systolic blood pressure between group P and group E at different time intervals

Time Period	Systolic blood pressure (mm of Hg)		p- value
	Group P	Group E	
Preinduction	125.3±5	124.2±10.4	0.591
Post induction	112.9±7.1	122.2±8.3	0.378
Before insertion	110.3±6.8	106.8±7.7	0.066
After insertion	118.9±8.2	152.9±12.8	<0.001
Before removal	115.1±6.3	141.9±13.1	<0.001
After removal	114.9±6.3	123.3±8.6	<0.001

Systolic blood pressure between group L and group E at different time intervals

Time Period	Systolic blood pressure (mm of Hg)		p- value
	Group L	Group E	
Preinduction	123.3±7.8	124.2±10.4	0.695
Post induction	109.5±8.3	122.2±8.3	0.432
Before insertion	107.6±8.3	106.8±7.7	0.711
After insertion	124.5±9.1	152.9±12.8	<0.001
Before removal	117.4±6.7	141.9±13.1	0.001
After removal	118.6±9.8	123.3±8.6	0.055

Mean SBP among three groups and between two groups at various time intervals

*ANOVA **Z- Test

Time period	Mean SBP (mm of Hg)			p-value *	E vs P p-value **	P vs L p-value **	E vs L P-value **
	Group E	Group P	Group L				
Preinduction	122.2±8.3	112.9±7.1	109.5±8.3	0.243	0.378	0.088	0.432
Post induction	106.8±7.7	110.3±6.8	107.6±8.3	0.178	0.066	0.167	0.711
Before insertion	152.9±12.8	118.9±8.2	124.5±9.1	<0.001	<0.001	0.016	<0.001
After insertion	141.9±13.1	115.1±6.3	117.4±6.7	<0.001	<0.001	0.177	0.001
Before removal	123.3±8.6	114.9±6.3	118.6±9.8	0.001	<0.001	0.082	0.055
After removal	122.2±8.3	112.9±7.1	109.5±8.3	0.243	0.378	0.088	0.432

Systolic blood pressure (SBP) was comparable among groups at pre-induction, with p-values of 0.225 (P vs L), 0.591 (P vs E), and 0.695 (L vs E). After induction, SBP decreased in all groups (E: 122.2 ± 8.3, P: 112.9 ± 7.1, L: 109.5 ± 8.3 mmHg) with no significant difference (p = 0.243). Before device insertion, SBP slightly decreased but remained comparable (p = 0.178). After insertion, SBP rose significantly, with group E showing the highest values (E: 152.9 ± 12.8, P: 118.9 ± 8.2, L: 124.5 ± 9.1 mmHg; p < 0.001). Comparisons showed significantly higher SBP in group L vs P (p = 0.016), group E vs P (p < 0.001), and group E vs L (p < 0.001). Before device removal, SBP remained significantly higher in group E compared to P and L (p < 0.001), while P vs L was comparable (p = 0.117). (Table:4)

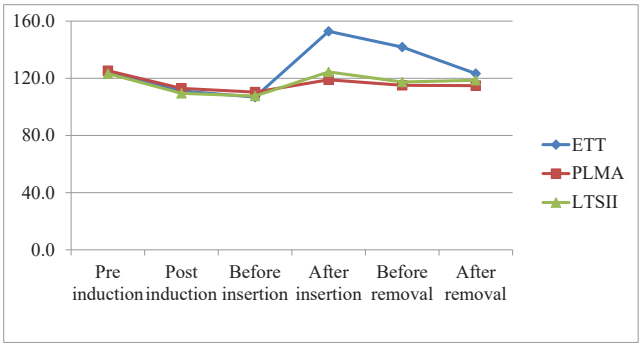

Figure 2: *Average SBP at various time intervals*

After removal of the endotracheal tube, Proseal LMA, and laryngeal tube suction II, mean systolic blood pressures were 123.3 ± 8.6, 114.9 ± 6.3, and 118.6 ± 9.8 mm Hg, respectively (p = 0.001). SBP was comparable between groups P and L (p = 0.082), significantly higher in group E than P (p < 0.001), and comparable between groups E and L (p = 0.055). (Table:4)

Diastolic Blood Pressure at various time interval

The baseline diastolic blood pressure (DBP) among the three groups was comparable (p = 0.636). Pre-induction DBP was 76.1 ± 9.2 mmHg in group E, 74.5 ± 6.9 mmHg in group P, and 74.2 ± 8.4 mmHg in group L. Post-induction, DBP decreased across all groups but remained statistically comparable (p = 0.231). Before insertion, mean DBP was 65.7 ± 7.3 mmHg (E), 62.4 ± 5.5 mmHg (P), and 64.2 ± 6.0 mmHg (L) with no significant difference (p = 0.125), though comparison between E and P showed a significant difference (p = 0.045). After device insertion, DBP increased significantly, with group E showing the highest value (91.6 ± 8.1 mmHg) compared to P (70.7 ± 4.9 mmHg) and L (73.1 ± 8.3 mmHg), p < 0.001. Post-insertion comparisons showed no significant difference between P and L (p = 0.261), but group E had significantly higher DBP than both P and L (p < 0.001). Before removal, DBP remained significantly higher in group E (81.4 ± 8.2 mmHg) compared to P (70.2 ± 5.9 mmHg) and L (70.9 ± 5.2 mmHg), p < 0.001. After device removal, DBP decreased toward baseline but remained significantly higher in group E (78.4 ± 7.4 mmHg) than in P (71.7 ± 5.5 mmHg) and L (71.0 ± 6.2 mmHg), p < 0.001; P and L were comparable (p = 0.678). (Table: 5)

Table 5: Diastolic blood pressure between three different groups at different time intervals

Time Period	Diastolic blood pressure (mm of Hg)			p -value
	Group E	Group P	Group L	
Preinduction	76.1±9.2	74.5±6.9	74.2±8.2	0.636
Post induction	67.3±7.9	64.6±5.0	66.5±5.4	0.231
Before insertion	65.7±7.3	62.4±5.5	64.2±6.0	0.125
After insertion	91.6±8.1	70.7±7.9	73.1±8.3	<0.001
Before removal	81.4±8.2	70.2±5.9	70.9±5.2	<0.001
After removal	78.4±7.4	71.7±5.5	71.0±6.2	<0.001

Diastolic blood pressure between group P and group L at different time intervals

Time Period	Diastolic blood pressure (mm of Hg)		p- value
	Group P	Group L	
Preinduction	74.5±6.9	74.2±8.2	0.879
Post induction	64.6±5.0	66.5±5.4	0.161
Before insertion	62.4±5.5	64.2±6.0	0.226
After insertion	70.7±7.9	73.1±8.3	0.261
Before removal	70.2±5.9	70.9±5.2	0.645
After removal	71.7±5.5	71.0±6.2	0.678

Diastolic blood pressure between group P and group E at different time intervals

Time Period	Diastolic blood pressure (mm of Hg)		p- value
	Group P	Group E	
Preinduction	74.5±6.9	76.1±9.2	0.458
Post induction	64.6±5.0	67.3±7.9	0.119
Before insertion	62.4±5.5	65.7±7.3	0.049
After insertion	70.7±7.9	91.6±8.1	<0.001
Before removal	70.2±5.9	81.4±8.2	<0.001
After removal	71.7±5.5	78.4±7.4	<0.001

Diastolic blood pressure between group L and group E at different time intervals

Time Period	Diastolic blood pressure (mm of Hg)		p- value
	Group L	Group E	
Preinduction	74.2±8.2	76.1±9.2	0.408
Post induction	66.5±5.4	67.3±7.9	0.648
Before insertion	64.2±6.0	65.7±7.3	0.378
After insertion	73.1±8.3	91.6±8.1	<0.001
Before removal	70.9±5.2	81.4±8.2	<0.001
After removal	71.0±6.2	78.4±7.4	<0.001

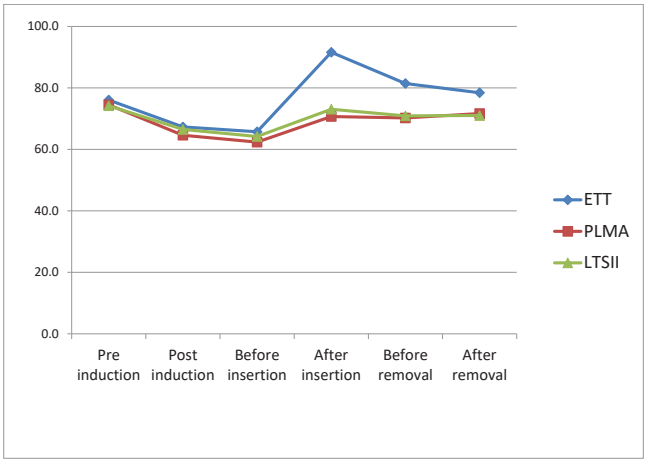

Figure:3 *Average DBP*

Mean Arterial Pressure at various time interval

Baseline mean arterial pressure (MAP) was comparable among groups E, P, and L (p = 0.729). Although MAP decreased post-induction and before device insertion, the differences were not statistically significant (p = 0.861 and 0.555). After device insertion, MAP increased significantly in group E (111.7 ± 8.8 mmHg) compared to group P (86.5 ± 6.6 mmHg) and group L (89.1 ± 7.5 mmHg), with a significant overall difference (p < 0.001). MAP was significantly higher in group E than in P and L (p < 0.001), while P and L were comparable (p = 0.065). Before device removal, MAP remained significantly higher in group E (101.3 ± 8.6 mmHg) than in P (84.8 ± 5.3 mmHg) and L (86.1 ± 4.9 mmHg), with p < 0.001. After removal, MAP was again significantly different among the groups (p < 0.001), being highest in group P (93.0 ± 5.5 mmHg), while groups E and L had similar MAP (both 86.6 ± 5.8 mmHg). Comparisons showed MAP was significantly higher in group P than E (p = 0.001) and in E than L (p < 0.001); P and L were comparable (p = 0.55). (Table:6)

Table 6: Mean Arterial pressure between three different groups at different time intervals

Time Period	Mean arterial pressure (mm of Hg)			p -value
	Group E	Group P	Group L	
Preinduction	91.7±7.3	91.3±5.3	90.4±7.1	0.729
Post induction	81.1±7.3	80.4±4.3	80.4±4.3	0.861
Before insertion	79.0±8.8	77.3±5.6	78.3±5.9	0.555
After insertion	111.7±8.8	86.5±6.6	89.9±7.5	<0.001
Before removal	101.3±8.6	84.8±5.3	86.1±4.9	<0.001
After removal	93.0±5.5	85.7±5.0	86.6±.5.8	<0.001

Mean Arterial pressure between group P and group L at different time intervals

Time Period	Mean arterial pressure (mm of Hg)		p- value
	Group P	Group L	
Preinduction	91.3±5.3	90.4±7.1	0.567
Post induction	80.4±4.3	80.4±4.3	0.979
Before insertion	77.3±5.6	78.3±5.9	0.501
After insertion	86.5±6.6	89.9±7.5	0.065
Before removal	84.8±5.3	86.1±4.9	0.317
After removal	85.7±5.0	86.6±.5.8	0.551

Mean Arterial pressure between group P and group E at different time intervals

Time Period	Mean arterial pressure (mm of Hg)		p- value
	Group P	Group E	
Preinduction	91.3±5.3	91.7±7.3	0.806
Post induction	80.4±4.3	81.1±7.3	0.650
Before insertion	77.3±5.6	79.0±8.8	0.292
After insertion	86.5±6.6	111.7±8.8	<0.001
Before removal	84.8±5.3	101.3±8.6	0.001
After removal	85.7±5.0	93.0±5.5	0.001

Mean Arterial pressure between group L and group E at different time intervals

Time Period	Mean arterial pressure (mm of Hg)		p- value
	Group L	Group E	
Preinduction	90.4±7.1	91.7±7.3	0.479
Post induction	80.4±4.3	81.1±7.3	0.664
Before insertion	78.3±5.9	79.0±8.8	0.669
After insertion	89.9±7.5	111.7±8.8	<0.001
Before removal	86.1±4.9	101.3±8.6	<0.001
After removal	86.6±.5.8	93.0±5.5	<0.001

Post-operative Airway complication

Postoperative airway complications—sore throat, dysphagia, and hoarseness—were compared among groups E, P, and L. Sore throat occurred in 60% of group E, 26.7% of group P, and 33.3% of group L, showing a statistically significant difference ($p = 0.02$). It was significantly higher in group E compared to P ($p = 0.009$) and L ($p = 0.038$), while P and L were comparable ($p = 0.573$).

Dysphagia was observed in 16.7% of group E, none in group P, and 6.7% in group L. Although not statistically significant overall ($p = 0.053$), comparisons between all groups (E vs. P, E vs. L, P vs. L) were individually non-significant. (Figure: 4)

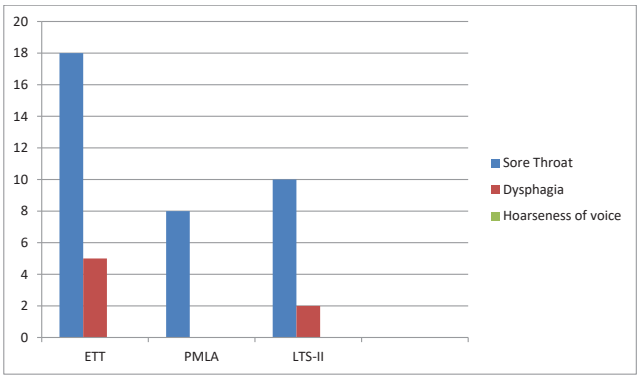

Figure: 4 *Postoperative complications between the groups*

DISCUSSION

Achieving a safe and effective airway is the principal aim of anesthesiologists. During laparoscopic surgeries, safe airway management is crucial because intrathoracic pressure increases due to raised intra-abdominal pressure, gastroesophageal, and biliary reflux, which may result from obesity and chronic systemic illnesses of the patients.

Although new airway devices have emerged in anesthesia, laryngoscopy and intubation remain the gold standard for airway management. However, this sequence of induction, laryngoscopy, and intubation causes marked hemodynamic changes that are of great concern. These circulatory disturbances are reflexly provoked by sympathetic stimulation during laryngoscopy and tracheal intubation, associated with a rise in plasma norepinephrine.[4,9] The hemodynamic changes usually comprise tachycardia, increased blood pressure, raised intracranial pressure, and occasionally cardiac arrhythmia. Although this reflex response is usually short and transient, these effects cannot be underestimated in high-risk individuals. Potentially fatal complications such as myocardial ischemia, heart failure, pulmonary edema, and intracerebral hemorrhage can occur in patients with coronary artery disease, systemic arterial hypertension, and decreased intracranial vascular compliance. Similarly, tracheal intubation is associated with some intraoperative and postoperative disadvantages like laryngospasm, sore throat, dysphagia, and hoarseness of voice.

Over time, new airway devices have been developed that are less invasive than endotracheal tubes. In this study, a comparison was made among endotracheal tube (ETT), Proseal laryngeal mask airway (PLMA), and laryngeal tube suction II (LTS II) for airway management in laparoscopic surgeries, focusing primarily on hemodynamic changes, insertion time, and postoperative sore throat, dysphagia, and hoarseness.[10-13]

Patients aged 18-65 years of either sex and ASA physical status I and II, scheduled for laparoscopic cholecystectomy, were enrolled. After induction, ETT, PLMA, and LTS II were inserted in three different groups. The time taken for insertion was noted. Hemodynamic changes in heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) were observed at intervals: pre-induction, post-induction, before insertion, after insertion, before removal, and after removal of the respective airway devices. Postoperative airway-related complications—sore throat, dysphagia, and hoarseness—were also observed among the groups.

Demographic characteristics among the groups regarding age, gender, body weight, height, and ASA physical status were not statistically significant. The mean insertion times for groups E, P, and L were 14.4±2.4 seconds, 19.4±4.1 seconds, and 21.8±3.1 seconds, respectively. The time for successful insertion was from picking up the laryngoscope to visualization of the first capnographic wave in group E, and from picking up the device to the capnographic wave in groups P and L. Time differences among groups were statistically significant ($p < 0.001$), with group E showing significantly shorter insertion times than groups P and L ($p < 0.001$). Between groups P and L, insertion time was shorter in group P ($p = 0.014$).

Shriyan DR et al. observed similar findings with PLMA and LTS insertion times (19.37 ± 6.23 s vs. 23.97 ± 5.95 s, $p < 0.01$).[14] Klaver et al. reported longer insertion times (around 53-55 s), likely due to less experienced operators.[6] Roth H. et al. found comparable times between PLMA and LTS (~23 seconds), consistent with our results.[11] In our study, the use of an introducer for PLMA facilitated shorter insertion time compared to LTS, aligning with findings by Genzuwuerker HV et al. and Cook TM et al.[5,15]

Baseline HR was comparable among groups. Post-induction and pre-insertion HR increased but were statistically insignificant. After insertion, HR rose significantly in all groups ($p < 0.001$), with significant differences between groups E vs. P and P vs. L, but

not between E vs. L. The increased HR in group E is due to stress from laryngoscopy and intubation. Before removal, HR was elevated at lighter anesthesia planes and showed statistical significance ($p = 0.005$). After removal, HR nearly returned to baseline with no significant difference.

Shriyan DR et al. found greater hemodynamic response with LTS than PLMA, consistent with this study.[14] Dahaba AA et al. observed similar results with increased HR in LTS compared to PLMA due to greater pharyngeal stimulation from the larger LTS cuff.[7] Saraswat N et al. reported lower HR with PLMA than ETT, also consistent with our findings.[12] Conversely, Sharkasy MH et al. found higher HR with ETT than LTS, differing from our study, possibly due to longer LTS insertion times in our protocol.[16] Other studies by Esa K et al., Bain B et al., Lalwami J et al., and Genzwuerker HV et al. support our findings of increased HR with ETT and LTS compared to PLMA.[3,5,8,10]

Baseline SBP was comparable among groups. SBP increased significantly after device insertion ($p < 0.001$), with group E showing higher SBP than groups P and L ($p < 0.001$). Before removal, SBP remained significantly higher in group E compared to others. After removal, SBP decreased but remained significantly higher in group E than in group P ($p < 0.001$), while groups P and L were comparable. Sharkasy MH et al. and Esa K et al. reported similar findings with elevated SBP in ETT groups compared to supraglottic devices.[3,16]

DBP was comparable at baseline but increased significantly after insertion, with group E showing higher DBP than groups P and L ($p < 0.001$). DBP differences were significant before and after removal between groups E vs. P and E vs. L, but not between P vs. L. Sharkasy MH et al. and Esa K et al. also reported elevated DBP in ETT compared to LTS and PLMA.[3,16] MAP was comparable at baseline but significantly increased after insertion, before removal, and after removal in all groups ($p < 0.001$). Group E had significantly higher MAP than groups P and L during these periods, while groups P and L were comparable.

Sharkasy MH et al. and Saraswat N et al. found similar trends with MAP elevation in ETT groups.[16,17] Dahaba AA et al.noted higher MAP with LTS compared to PLMA, but our study did not find this, possibly due to appropriate LTS sizing.[7] Genzwuerker HV et al. and Misra MN et al. similarly reported greater hemodynamic responses with ETT than PLMA.[7,13]

Postoperative sore throat, dysphagia, and hoarseness were recorded on the first postoperative day. Sore throat was defined as throat irritation or discomfort; dysphagia as difficulty swallowing; hoarseness as the change in voice. The incidence of these complications was higher in the ETT group compared to the PLMA and LTS groups, consistent with the less invasive nature of supraglottic airway devices and reduced trauma during insertion and removal.

CONCLUSIONS

In summary, while endotracheal intubation remains the gold standard for airway management, supraglottic devices like PLMA and LTS II offer viable alternatives during laparoscopic surgeries. Both SGADs demonstrated significantly less hemodynamic stress response and fewer postoperative airway complications compared to ETT. Among SGADs, PLMA showed advantages over LTS II in terms of insertion time and reduced sympathetic stimulation. These findings support the consideration of PLMA and LTS II as effective airway devices in selected laparoscopic procedures, especially in patients at risk of cardiovascular complications.

ACKNOWLEDGEMENT

None

CONFLICT OF INTEREST

None

FUNDING

This study was funded with the authors' own contributions.

REFERENCES

1. Miller RD, Eriksson LI, Fleisher LA,Wiener KJP YW. Airway management in Adults. 7th ed. USA: churchill living stone; 2010. 1573 p.
2. Butterworth Johan F, Mcakey David C WJD. Airway management. 5th ed. USA: The Mc Graw-Hill companies; 2013. 314 p.
3. Esa K, Azarinah I, Muhammad M, Helmi MA, Jaafar MZ. A Comparison between Laryngeal Tube Suction II airway TM and Proseal TM Laryngeal Mask Airway in Laparascopic Surgery. Med J Malaysia. 2011;66(3):182–6.
4. Cavus E, Deitmer W, Francksen H, Serocki G, Bein B, Scholz J, et al. Laryngeal tube S II, ProSeal laryngeal mask, and EasyTube during elective surgery: a randomized controlled comparison with the endotracheal tube in nontrained professionals. Eur J Anaesthesiol. 2009;26(9):730–5.
5. Genzwuerker H V., Altmayer S, Hinkelbein J, Gernoth C, Viergutz T, Ocker H. Prospective randomized comparison of the new Laryngeal Tube Suction LTS II and the LMA-ProSeal for elective surgical interventions. Acta Anaesthesiol Scand. 2007;51(10):1373–7.
6. Klaver NS, Kuizenga K, Ballast A, Fidler V. A comparison of the clinical use of the Laryngeal Tube S and the ProSeal Laryngeal Mask Airway by first-month anaesthesia residents in anaesthetised patients. Anaesthesia [Internet]. 2007 Jul [cited 2016 Mar 19];62(7):723–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17567350
7. Dahaba AA, Prax N, Gaube W, Gries M, Rehak PH, Metzler H. Haemodynamic and catecholamine stress responses to the Laryngeal Tube-Suction Airway and the Proseal Laryngeal Mask Airway. Anaesthesia. 2006;61(4):330–4.

8. Bein B, Carstensen S, Gleim M, Claus L, Tonner PH, Steinfath M, et al. A comparison of the proseal laryngeal mask airway, the laryngeal tube S and the oesophageal-tracheal combitube during routine surgical procedures. Eur J Anaesthesiol [Internet]. 2005 May ;22(5):341–6.

9. Güleç H, Cakan T, Yaman H, Kilinç AŞ, Başar H. Comparison of hemodynamic and metabolic stress responses caused by endotracheal tube and Proseal laryngeal mask airway in laparoscopic cholecystectomy. J Res Med Sci. 2012;17(2):148–53.

10. Lalwani J, Dubey KP, Sahu BS, Shah PJ. ProSeal laryngeal mask airway: An alternative to endotracheal intubation in paediatric patients for short duration surgical procedures. Indian J Anaesth. 2010;54(6):541–5.

11. Roth H, Genzwuerker H V, Rothhaas A, Finteis T, Schmeck J. The ProSeal laryngeal mask airway and the laryngeal tube Suction for ventilation in gynaecological patients undergoing laparoscopic surgery. Eur J Anaesthesiol. 2005;22(2):117–22.

12. Namita Saraswat, Aditya Kumar, 1 Abhijeet Mishra, 2 Amrita Gupta, 1 Gyan Saurabh 3 and Uma Srivastava1. The comparison of Proseal laryngeal mask airway and endotracheal tube in patients undergoing laparoscopic surgeries under general anaesthesia. Indian J Anaesth. 2011;55(2):129–34.

13. M Misra BR. The Pro-Seal LMAtm And The Tracheal Tube: A Comparison Of Events At Insertion Of The Airway Devicele. Internet J Anesthesiol. 2007;16(2).

14. Deepa Ravindra Shriyan, Bhaskar Murlidhar Patil, Pinakin Gujja3 NK. A Prospective Randomized Study to Compare ProSeal LMA and Laryngeal Tube with Suction in Patients Posted for Short Duration Surgeries Under General Anaesthesia with Controlled Ventilation. Int J Contemp Med Res. 2016;3(5):1235–8.

15. Cook TM, Cranshaw J. Randomized crossover comparison of ProSeal?? Laryngeal Mask Airway with Laryngeal Tube Sonda?? during anaesthesia with controlled ventilation. Br J Anaesth. 2005;95(2 PAPER):261–6.

16. MOHAMAD HAMED EL-SHARKASY, M.D.*; MAGDY ALY OMERA, M.D.*; AMR HELMY, M.D.* and IBRAHIM SHABAAN IBRAHIM MS*. Comparative Study of the Laryngeal Tube Versus Endotracheal Tube in Mechanically Ventilated Anesthetized Patients. Med J Cairo Univ. 2009;77(1):173–80.

17. Bhattacharya3 DBSDCSDA, Sood5 DVPKDJ. No TitPROSEAL LARYNGEAL MASK AIRWAY: A study of 100 consecutive cases of laparoscopic surgeryle. Indian J Anesth. 2003;47(6):467–72.