

Original Research Article

Comparison of ProSeal laryngeal mask airway, classical laryngeal mask airway with endotracheal tube in gynecological laparoscopy under controlled ventilation

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ABSTRACT

Background: PLMA is a recent, complex, and ingenious development with some added feature of classic LMA like modified dual cuff, drain tube, positive pressure ventilation at higher peak inspiratory pressure. Study was to evaluate and compare the use of classical laryngeal mask airway, ProSeal laryngeal mask airway, and endotracheal tube with controlled ventilation in patients undergoing gynecological laparoscopic procedure.

Methods: About 150 patients, ASA risk I and II, posted for elective gynecological laparoscopy were recruited in the study. All the patients between 18 to 45 years of age were randomly divided in three groups, group PLMA, group CLMA, group ETT (50 patients each). Attempt of insertion of airway device, leaks pressure, pulmonary ventilation, hemodynamic; heart and MAP, gastric distention was recorded. All patients were of middle age group, comparable in weight. Mean duration of laparoscopy was comparable in all the groups.

Results: Significant rise in heart rate and mean arterial pressure seen in group ETT after induction of anesthesia. Changes in the end tidal CO₂ and peak airway pressure after induction of anesthesia, before and after pneumoperitoneum were comparable in all three groups. After head low position peak airway pressure is slightly raised in group PLMA, group CLMA. Gastric distension was noted higher in group 10% as compare to group PLMA (8%) and group (2%). Incidence of sore throat (22%), nausea vomiting (14%) and airway trauma (14%) was higher in group ETT.

Conclusions: Hemodynamic stability was better in and CLMA group at time of induction and comparable in all three groups at time of pneumoperitoneum and trendelenburg position along with pulmonary ventilation. Post-operative sore throat, nausea vomiting was higher with endotracheal tube.

Keywords: CLMA, Classical laryngeal mask airway, PLMA, ProSeal laryngeal mask airway

INTRODUCTION

The airway management of the patients undergoing laparoscopic procedures has progressed from Endotracheal Intubation (ETT) to lesser invasive devices like ProSeal Laryngeal Mask Airway (PLMA).¹ The important concern during this procedure is peritoneal

insufflations and raised intra-abdominal pressure which mandates the requirement of proper glottic seal to prevent pulmonary aspiration and adequate ventilation to eliminate absorbed CO₂. The general anesthesia with endotracheal tube has been made the gold standard for this.² Although the tracheal tube is considered ideal for laparoscopic procedures, there is consistent inflow of

reports highlighting the safety of LMA in laparoscopic surgery.³ Over a period, new airway devices have been added to the anesthesiologist's armamentarium. The LMA is an innovative device for upper airway management, of which, the PLMA is a recent, complex, and ingenious development with some added feature of classic LMA like:

- Modified dual cuff to increase the seal,
- Drain tube which provides a channel for regurgitation fluid and easy insertion of gastric tube,
- It enables positive pressure ventilation at higher peak inspiratory pressure.⁴

The aim of this study was to evaluate and compare the use of classical laryngeal mask airway, ProSeal laryngeal mask airway, and endotracheal tube with controlled ventilation in patients undergoing gynecological laparoscopic procedure.

METHODS

Total 150 patients, ASA risk I and II, posted for elective gynecological laparoscopy were recruited in the study. All the patients between 18 to 45 years of age were randomly divided in three groups, group PLMA, group CLMA, group ETT (50 patients each).

Group PLMA: ProSeal laryngeal mask airway.
Group CLMA: Classical laryngeal mask airway.
Group ETT: Endotracheal tube.

Exclusion criteria

- Patients at risk of aspiration,
- Reduced pulmonary compliance,
- Respiratory tract pathology,
- Mouth opening less than 2 fingers,
- More than 3 attempts.

Patient's demographic data like age, weight, history and findings of examination of cardiovascular and other systemic examination were recorded. Routine investigations like hemoglobin, renal functional test, urine sugar, albumin, chest X-ray was done in all patients. Specific investigations were also carried out as a when required. All patients kept nil per orally overnight.

On arrival in the operation theatre vital parameter i.e. pulse, blood pressure, ECG, SPO2 were recorded. All patients were premedicated with IV injection ranitidine (50mg), injection metoclopramide (10mg) injection glycopyrolate (0.004mg/kg) and injection fentanyl (2µ/kg). Patients were pre-oxygenated with 100% oxygen for 3min. General anesthesia was induced with injection propofol (2-2.5mg/kg) and injection succinyl choline. injection lignocaine (40-50mg) given to prevent pain on injection with propofol. IPPV is avoided to prevent gastric inflation. Correct size of CLMA or PLMA inserted, position judged by chest inflation, auscultation of breath sounds, capnography. Anesthesia was

maintained with injection veuronium, nitrous oxide, O₂ and isoflurane plus intermittent positive pressure ventilation. After that patient put on ventilator on MODE: CMV, CMV frequency 12/min, tidal volume 10ml/kg, all procedure was also done with endotracheal intubation except conventional laryngoscopy was done with group ETT. Surgeon was blinded for device.

Following observations were done

- Attempt of insertion of laryngeal mask airway whether 1st, 2nd or failed,
- Position of LMA,
- Leaks pressure was judged,
- Pulmonary ventilation judged by,
- Hemodynamic; heart and MAP recorded,
- Gastric distension: by surgeon:
 - At time of the insertion of laparoscope and
 - Upon decompression of pneumoperitoneum,
 - Scored stomach size at ordinarily scale (0-10).
0-No distended,
10-Distended.

After end of surgery all patients were reversed with injection neostigmine plus injection glycopyrolate and patient is extubated with adequate muscle tone and reflexes. In case of PLMA or CLMA air was aspirated from cuff and LMA removed with patient cooperation.

Following observation were done in post-operative management:

- Blood stain on device (airway trauma),
- Nausea vomiting,
- Sore throat up to 24hrs,
- Dysphagia.

RESULTS

All patients were of middle age group, comparable in weight (Table 1). Diagnostic laparoscopy constituted the major of surgeries all the three groups. Other procedures performed were operative laparoscopy, cyst aspiration, myomectomy and Laparoscopic Assisted Vaginal Hysterectomy (LAVH). Mean duration of laparoscopy was comparable in all the groups. In PLMA group insertion occurred at 1st attempt in 92% while ETT Group, it was 100% at 1st attempt (Table 2). Heart rate was comparable in group CLMA and group PLMA after induction of anesthesia, however significant rise in heart rate seen in group ETT after induction of anesthesia (Table 3). Mean arterial pressure is significantly rising after induction of anesthesia in group ETT, comparable in group CLMA and group PLMA (Table 4). After pneumoperitoneum MAP were significantly increased in all three groups. Then after it remained stable in all three groups. Changes in the end tidal CO₂ after induction of anesthesia, before and after pneumoperitoneum and after head low position were comparable in all three groups (Table 5).

Table 1: Demographics.

FACTOR	CLMA	PLMA	ETT
Number of patients	N=50	N=50	N=50
Age in years (Mean±SD)	32.16±6.0	32.58±5.69	33.28±5.7
Weight (kg)	58.68±7.35	60.24±6.03	59.52±7.77
ASA (I and II)	48/2	46/4	45/5

Table 2: Number of attempts for securing airway.

	CLMA	PLMA	ETT
1 st attempt	48 (96%)	46 (92%)	50 (100%)
2 nd attempt	2 (4%)	4 (8%)	0 (0)

Table 3: Heart rate: (/min, (Mean±SD)) (*p<0.05).

Group	Basal parameter	After induction (placement of device)	Before pneumoperitoneum	After pneumoperitoneum	After head low position	After decompression
CLMA	81.2±5.97	87.9±6.6	86.32±4.45	87.6±5.16	92.2±4.81	81.2±5.9
PLMA	81.64±7.5	85.62±7.6609	81.22±6.105501	82.66±12.4	91.16±9.5	86.4±7.436
ETT	79.2±13.70	97.22±7.42*	84.68±6.145979	88.3±7*	93.3±6.5	86.36±8.16

Table 4: Mean arterial pressure (mm of Hg (Mean±SD)).

Group	Basal parameter	After induction (Placement of device)	Before pneumo peritonium	After pneumo peritonium	After head low position	After desufflation
CLMA	89.5±4.175976	89.41±5.95	84.51±5.27	97.06±15.74	96.84±5.1	93.24±6.45
PLMA	92.98±6.4422	95.1± 8.583919	100.7867±7.004942	97.53333±5.815376	102.75±4.65	94.30±4.49
ETT	92.94±7.9607	103.82±6.878014*	91.44±7.454606	105.16±4.375898*	98.413333±10.3908996	97.85333±7.853581

(*: p<0.05)

Table 5: ETCO2 (mm of Hg (Mean±SD)).

Group	After induction (Placement of device)	Before pneumoperitoneum	After pneumoperitoneum	After head low position	After desufflation
CLMA	28.16±1.251285	30.8±1.293626	31.38±1.0669	32.54±0.8381	21.12±1.40900
PLMA	29.26±2.078166	29.3±2.07266	30.26±2.058432	31.36±1.351643	29.44±2.042008
ETT	25.6±2.498979	24.78±1.329262	27.78±2.10238	29.7346939±1.86	24.46± 1.940019

Table 6: Gastric distension.

Gastric distention	CLMA	PLMA	ETT
After insertion of laparoscope	5 (10%)	4 (8%)	1 (2%)
After decompression of pneumoperitoneum	5 (10%)	0	0

Changes in peak airway pressure were comparable in all three groups after induction of anesthesia, before and after pneumoperitoneum.

Changes in peak airway pressure after head low position is comparable in group ETT, but slightly increased in group CLMA and Group PLMA (Figure 1). But oxygen saturation on SPO2 probe was maintained in both groups. Oxygen saturation was maintained in all three groups throughout the duration of surgery. Gastric distension was noted higher in group CLMA 10 % as compare to group PLMA (8%) and group ETT (2%) after insertion of laparoscope (Table 6). Gastric distension has remained similar in group CLMA after decompression of pneumoperitoneum as we could not able to pass Ryle’s tube in CLMA as in case of PLMA and ET.

Table 7: Post-operative side effects.

Post-operative side effects	CLMA	PLMA	ETT
Sore throat	3 (6%)	5 (10%)	11 (22%)
Nausea	5 (10%)	4 (8%)	7 (14%)
Vomiting	5 (10%)	4 (8%)	7 (14%)
Dysphagia	0 (0%)	0 (0%)	0 (0%)
Blood stain on device	3 (6%)	5 (10%)	11 (22%)

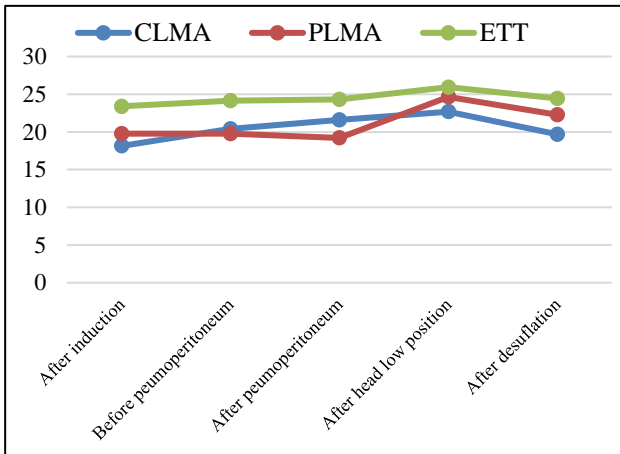


Figure 1: Peak airway pressure.

Incidence of sore throat was higher in group ETT (22%) as compared to group PLMA (10%) and group CLMA (6%). Incidence of nausea vomiting was also higher in group ETT (14) as compared to group PLMA (8%) and CLMA (10%) (Table 7). Incidence of airway trauma (Blood stain on device) were higher in group ETT (14%) as compared to group PLMA (8%) and group CLMA (8%). There was no incidence of dysphagia noted in all three groups.

DISCUSSION

Laparoscopic surgeries are day care surgery because it is minimally invasive surgery. So, in our study 150 adult female patients belonging to ASA I and II undergoing elective gynecological surgery of short duration around 60-90min were selected. Anesthetic technique was standardized. All patients were given general balanced anaesthesia with controlled ventilation. We have divided patients in three groups into PLMA, CLMA and ETT. Similar study also noted by Malt J et al in 2002 in laparoscopic cholecystectomy, similar study also conducted by same author in 2003 in gynecologic laparoscopy.^{5,6}

Similar comparative study was carried out by Lim Y in 2007, Piper SN et al series of case studies documenting the efficacy of the PLMA in laparoscopy surgeries have been carried out by Evans NR et al in 2002 and Sharma B, Sood J et al.⁷⁻¹⁰ In this study basal parameter like heart

rate and mean arterial blood pressure were noted in all the three groups and were found to be comparable.

After induction of anaesthesia i.e. placement of device significant rise in heart rate and MAP noted in group ETT in our study compared to other groups. However, in PLMA group and CLMA group heart rate and MAP was found to be comparable. These are due to the direct stimulation of trachea by ETT and added stress response to laryngoscopy causes reflex sympathetic stimulation causing tachycardia and hypertension. ProSeal™ LMA is supraglottic device so there is no direct stimulation of trachea and less stress response.

Lim Y et al, reported an attenuation of hemodynamic response to PLMA insertion compared with endotracheal tube intubation. Sood J, Shroff P et al, carried out similar series of case studies in laparoscopic surgeries using PLMA as airway device observed that there was minimal hemodynamic response to insertion of PLMA thus our observation was in agreements with their studies. After pneumoperitoneum there was rise in heart rate and MAP in ETT group. In PLMA and CLMA groups rise in heart rate was comparable in our study. These changes were due to cardiovascular changes i.e. sympathetic stimulation secondary to hypercarbia (pneumoperitoneum). Finding was like previous study done by Shroff P et al.

In our study heart rate and MAP increased after trendelenburg position in all the three groups, related to the redistribution of body fluids and blood volume with head low position which causes increase in venous return leading to increase in central venous pressure and increase in stroke volume.

In our study changes in End Tidal CO₂ (ETCO₂) were comparable in all the three groups throughout the surgery specifically before and after pneumoperitonium and oxygen saturation SPO₂ was also maintained. Both the parameter suggests that ProSeal LMA and classical LMA permitted effective ventilation during gynecological laparoscopies as evidenced. This is due to ProSeal LMA and classical LMA adapting its shape to various contour of pharynx.

Kamat S et al, in their study observed that changes in ETCO₂ were comparable in both PLMA and ETT groups before and after pneumoperitonium. Similar study was showed by Malt JR et al in 2003 and Sharma B et el. Our results were comparable with their study.^{3,10}

In our study changes in peak airway pressure was comparable in all the groups before and after pneumoperitonium. After head low position peak airway pressure was increased in all groups. Slightly increase in CLMA group and PLMA group but lower than ETT group. Its principle could be related to gas flow along with device or within lungs or both. However internal diameter of LMA airway tube was similar to ETT so it

likely to be related to reduced pulmonary airway resistance. Brimacombe J et al, also found lower peak airway pressure in PLMA group as compared to ETT group.¹¹⁻¹³

In our study, in CLMA group gastric distension was found in 5 cases as compared to 4 cases in PLMA group and 1 case in ETT group after insertion of laparoscope. We have passed Ryle's tube in those cases of PLMA and ETT group. We have avoided bag and mask ventilation during induction to prevent gastric distension as we want to compare gastric distension with each device. The incidence of gastric distension was higher in CLMA and PLMA in our study. Roger J concluded that incidence of gastric distension was associated with airway pressure in excess of 20cm of H₂O with clinically unrecognized LMA malposition in the hypo pharynx.¹⁴ In our study, incidences of sore throat and blood stain on device was higher (22%) in ETT group than that of PLMA 10% and CLMA (6%) groups. This was explained by the presence of a cuff in the pharynx is much less stimulating than cuff in the trachea and mucosal pressure is lower in PLMA and CLMA. Shroff P et al, reported incidences of sore throat and blood stain on device in ETT group (10%) and PLMA (5%), Brimacombe J et al ETT (10%) and PLMA (2%). In our study, incidences of nausea vomiting were 8% in PLMA group and 10% in CLMA and 14% in ETT group. Similar to study by Brimacombe J et al, PLMA (2%) and ETT 23%.

CONCLUSION

Ease of insertion of airway device is better in ETT group but hemodynamic stability is better in PLMA and CLMA group as compared to ETT group at time of induction of anesthesia (placement of device), and comparable in all three groups at time of pneumoperitoneum and trendelenberg position. PLMA and CLMA have provided good pulmonary ventilation in gynecological laparoscopy under controlled ventilation. Post-operative sore throat, nausea vomiting was higher with endotracheal tube.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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