ORIGINAL ARTICLE

Comparison of hemodynamic changes with the insertion of laryngeal mask airway insertion and endotracheal intubation in laproscopic cholecystectomy

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Abstract

Objective: Comparison of Hemodynamic changes with the insertion of Laryngeal Mask Airway (LMA)and Endotracheal (ETT)Intubation in laparoscopic cholecystectomy.

Material and Methods: A prospective randomized control trial was conducted at anesthesia department Khyber teaching Hospital Peshawar form February 2019 to September 2019. 144-patients from age 18-60 years, having ASA grade I/II, with BP of 110/70 to 120/80 mmHg on admission undergoing laparoscopic cholecystectomy were included in this study and were randomized via lottery methods into two groups. Group-A patients will have LMA insertion while group-B patients will have ETT insertion. Informed consent was taken before surgery from each patient. Patient having GERD and compromised pulmonary function were excluded from study. Changes in blood pressure and heart rate were recorded in both groups. Group-A, insertion of LMA and Group-B. Endotracheal intubation, data were compiled and analyzed with SPSS 20. Chi-square test was applied to compare changes in both groups, taken $P \leq 0.05$ as significant.

Results: The ETT group consisted of 29 males and 43 females while the LMA group had 32-males and 40-females. The maximum and minimum ages in the ETT and LMA groups ranged from 22 to 60 years and 21 to 60 years respectively. The mean weight of subjects was 67.3 kg in LMA group and 65.3 in ETT group. In terms of demographic data such as age, sex, weight and ASA classification, no substantial difference between the two groups was observed. Good hemodynamic response was calculated at 10-minutes and LMA group showed good hemodynamic response in 79% (57) of patients while in ETT good hemodynamic response was shown in 68%(49) of patients. This difference was statistically significant.

Conclusion: Good hemodynamic response was calculated at 10 minutes and LMA group showed good hemodynamic response in 79% (57) of patients while in ETT good hemodynamic response was shown in 68% (49) of patients. This difference was statistically significant. The use of LMA should be encouraged in routine cases, especially in cases with cardiac issues.

Keywords: Endotracheal tube (ETT), laryngeal mask airway (LMA), hemodynamic response, laparoscopic cholecystectomy.

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Introduction:

Managing airway is of extreme significance during delivery of general anesthesia. Anaesthetized patients are not able to maintain adequate airway and artificial devices are used to maintain airway.[1] Conventionally, endotracheal intubation and laryngoscopy has been collectively used for keeping airway and anesthesia delivery. It also has a role in prevention of aspiration. Although intubation has many benefits including establishment of an adequate airway, preventing of aspiration pneumonia and delivering anesthetic gases for safe operation, it has its own complications. These complications can occur during both insertion and removal of endotracheal tube. These complication include trauma

to the airway that leads to hypoxia, stimulation of physiological reflexes that causes increased heart rate, spasm of larynx, misplaced ETT and fluid in the lungs.[1, 2]

A less invasive way of establishing a secure airway is with a laryngeal mask airway. This device is a kind of supra glottic device that means it does not cut across glottis and is rather sitting on top of glottis. Insertion of LMA needs no specific instrumentation i.e. no laryngoscope is needed. LMA is an intermediary between geudel airway and an ETT. It offers some benefits of an ETT while at the same time it avoids complications usually encountered with ETT like pharyngeal reflexes.[2]

The process of securing an airway be it ETT or LMA, act as an adverse stimulus that causes a temporary but distinct response via the sympathetic system activation leading to pronounced hypertension and increased heart rate. In vulnerable patients principally those with CHD, CVD, HTN, and intracranial aneurysm, these transitory changes can cause left ventricular failure, arrhythmias, myocardial ischemia, cerebral hemorrhage.[3-5] There are different ways to reduce these harmful effects. Reducing the time for ETT insertion, use of intravenous narcotics and vasodilators can reduce these harmful effects, but the results are not promising .[6]

The process of inserting Laryngeal mask airway involves reduced handling of airway as compared to endotracheal intubation, but it has particular restrictions. LMA is not advisable in patients with the possibility of aspiration, those with pharyngeal obstruction and those with low pulmonary compliance.[7]

ETT insertion can induce a cardiovascular reflex comprising of increased heart rate, and disturbances in rhythm. Brain originally described airway management via laryngeal mask airway without the risk of this reflex. It has been extensively used since then.[8] Laryngoscopy with endotracheal intubation in a patient with normal blood pressure has been acknowledged to cause tachycardia and hypertension under a variety of anesthetic techniques.[9-11] Laryngoscopy and Tracheal intubation cause reflex circulatory responses. In this, there is tachycardia despite the increase in systemic arterial pressure.

In patients with normal blood pressure laryngoscopy and ETT insertion is instantly followed by 25 mm hg rise in mean arterial pressure. However it is evident form studies that this effect does not cause a lasting effect on patient with normal blood pressure.[12] Further studies have shown that any foreign body when inserted into trachea can cause disturbances in cardiovascular system such as increase arterial pressure and premature ventricular beats.[13]

As previously stated LMA insertion doesn't need laryngoscope. LMA is useful during management of failed or problematic intubation. LMA is particularly important in patients with aberrant anatomy such as in patients with oropharynx tumor, patients with congenital problems, patients having poor cervical spine mobility. Sore throat often caused by endotracheal intubation can be avoided by LMA.

Laryngeal mask airway can be inserted without the need of proper neck positioning and in experienced hands can be inserted while standing in any direction i.e. from front of patient. It can be re used up to 40 times. in comparison with single use ETT, LMA is cost effective and eco-friendly. This study was conducted to ascertain the advantages of LMA more specifically the good hemodynamic response elicited by either LMA or ETT in surgeries of intermediate duration.

Material and Methods:

A prospective randomized control trial was conducted at anesthesia department Khyber teaching Hospital Peshawar form February 2019 to September 2019. 144-patients from age 18-60 years, having ASA grade I/II, with BP of 110/70 to 120/80 mm of Hg on admission undergoing laparoscopic cholecystectomy were included in this study and were randomized via lottery methods into two groups. Group-A patients will have LMA insertion while group-B patients will

Table 1: *Demographic data*

Parameter	Group-A (LMA)	Group-B (ETT)	P Value
Age	39.5	38.3	0.568
Weight (kg)	67.3	65.3	0.278
ASA grade			
I	44	48	0.137
II	28	24	

Table 2: *Mean heart rate per min*

Parameter mean systolic pressure	ETT group (mmHg)	LMA group (mmHg)	P value of difference between two groups
Pre-insertion	121.2±12.5	117.2±11.6	0.067
Insertion	146.4±12.3	127.211.3	<0.0001

Table:

Parameter Heart rate	ETT group (beats per/min)	LMA group (beats per/min)	P value of difference between two groups
Pre-Insertion	96.0±12.5	87.8±11.6	0.383
Insertion	115±12.3	106.9±11.3	0.047
1 minute	103.5±12.4	98±8.3	0.0001
3 minutes	96.5±13.1	89±5.3	0.0001
5 minutes	92.2±11.4	84±5.2	0.066

At baseline there was no difference in systolic blood pressure. Just after insertion of ETT there was an increase in systolic blood pressure in both LMA group and ETT group. However, this increase was more significant statistically (p<0.001) in ETT group and it also stayed longer as compared to that moved stimulated by LMA insertion

Table 3: *Mean systolic pressure in mmHg*

Parameter	ETT group	LMA group	P value of difference between two groups
1 minute	135.4±12.4	121.5±8.3	<0.0001
3 minutes	128.5±13.1	117.6±5.3	<0.0001
5 minutes	122.0±11.4	115.4±5.2	0.002

Table 4: *Mean diastolic pressure in mmHg*

Parameter Mean diastolic pressure	ETT group (mmHg)	LMA group (mmHg)	P value of difference between two groups
Pre-Insertion	76.4±7.2	75.7±7.1	0.618
Insertion	90.1±11.7	83.5±8.6	<0.001
1 minute	85.2±10.4	78.0±7.4	<0.0001
3 minutes	80.7±13.1	75.5±8.0	0.005
5 minutes	76.1±11.4	74.7±7.3	0.447

The diastolic blood pressure at start was similar in both ETT and LMA groups. After insertion, there was a rise in DBP in both groups that was substantially greater as compared to other group. The values returned to reference value by three minutes in the LMA group and by five minutes in the ETT group. After five minutes the values were same in both groups.

have ETT insertion. Informed consent was taken before surgery from each patient. Patient having GERD and compromised pulmonary function were excluded from study.

At study entry baseline demographics (age, gender and weight on weighing scale in supine position) were recorded. The basal HR and blood pressure were recorded before surgery. All the patients were allowed food and drink up till 8-hours before surgery. All patients were premedicated which included ranitidine 150 mg on the night preceding surgery and also 2-hours prior to surgery and Alprazolam at a dose of 0.25 mg on the night preceding surgery with sips of water. Patients were pre-oxygenated with 100% O_2 for at least 3-minutes. Anesthesia was induced with intravenous propofol at dose of 2 mg/kg, fentanyl at dose of 2 µg/kg, and atracurium at dose of 0.6 mg/kg was used for mechanical ventilation. Patients were then ventilated for 3-minutes before intubation and insertion. In the ETT group, tracheal intubation was attempted with a cuffed tracheal tube. ETT of 7.5 mm for women and 8.5 mm for men was used. LMA of the size of 3/4 was used for women and size 4/5 for men. Patients' lungs were mechanically ventilated and an end tidal CO2 at 30-35mmhg was maintained by adjusting minute volume accordingly.

Anesthesia was maintained using isoflurane with N2O/oxygen mixture in 50%; 50% volume ratio. The values of heart rate, systolic BP, diastolic BP were logged after induction, immediately after intubation or insertion and at minute 1,3,5 and 10. Outcome variable i.e. good hemodynamic response were after 10-minutes of intubation or insertion by the researcher himself and recorded on especially designed proforma. All the procedures were done under the supervision of consultant anesthesiologist of 3-years post fellow ship experience. Good hemodynamic response taken as diastolic blood pressure between 110/70 to 120/80 mmHg after 10-minutes of endotracheal intubation and laryngeal mask airway.

Results:

The ETT group consisted of 29 males and 43 females while the LMA group had 32-males and 40-females. The maximum and minimum ages in the ETT and LMA groups ranged from 22 to 60 years and 21 to 60 years respectively. The

Table 5: *Good hemodynamic response recorded at 10 minutes*

	ETT group (mmHg)	LMA group (mmHg)	P value of difference between two groups
Good hemodynamic response	49(68%)	57(79%)	<0.05

mean weight of subjects was 67.3 kg in LMA group and 65.3 in ETT group. In terms of demographic data such as age sex weight and ASA classification, no substantial difference between the two groups was observed.

The mean heart rates of the both groups were statistically similar at induction. At intubation, there was a significant tachycardia in both groups, but this increase was statistically higher in ETT group as compared to patients with LMA insertion. This elevated heart rate stayed for a longer time period in ETT group as compared to LMA group. IN ETT group heart rate returned to reference value in five minutes while it took only three minutes in LMA group for heart rate to return to normal baseline value.

At baseline there was no difference in systolic blood pressure. Just after insertion of ETT there was an increase in systolic blood pressure in both LMA group and ETT group. However, this increase was more significant statistically ($p<0.001$) in ETT group and it also stayed longer as compared to that moved stimulated by LMA insertion

The diastolic blood pressure (DBP) at start was similar in both ETT and LMA groups. After insertion, there was a rise in DBP in both groups that was substantially greater as compared to other group. The values returned to reference value by three minutes in the LMA group and by five minutes in the ETT group. After five minutes the values were same in both groups.

Good hemodynamic response was calculated at 10 minutes and LMA group showed good hemodynamic response in 79% (57) of patients while in ETT good hemodynamic response was shown in 68%(49) of patients. This difference was statistically significant.

Discussion:

Our study population consisted of 144 patients undergoing laparoscopic cholecystectomy. The primary aim of this study was to assess the changes in hemodynamics that occurred by insertion of laryngoscopy along with ETT to those that occurred due to insertion of LMA. Each group consisted of 72-patients each. They were analogous in regards to age, sex, ASA classification. The results of this study have confirmed that there is hemodynamic response after ETT with laryngoscopy and with LMA insertion. This response comprised of tachycardia, increased Systolic blood pressure, a rise in diastolic blood pressure and mean arterial pressure. However, ETT placement following laryngoscopy caused greater changes as compared to LMA insertion.

There was a decrease in the systolic blood pressure, diastolic blood pressure and mean arterial pressure in both patient groups in this study, after the induction of anesthesia and a similar decrease before insertion of any device. Heart rate in both groups increased from pre induction values. These results were in agreement with the research conducted in Scotland,[14] this study showed that after induction of anesthesia there was a significant increase in heart rate accompanied by a decrease in arterial pressure. This effect can be attributed to the anesthesia induction drugs that are known to show a hypotensive effect.

In ETT group, compared to pre-intubation value, heart rate, Systolic blood pressure and diastolic blood pressure were considerably higher following insertion. These changes persisted for a period of 5-minutes and after that they returned to the pre-intubation value.

Millar and coworkers found similar results in their study[15] they found that in patients having normal blood pressure, ETT and laryngoscopy caused a sudden increase of mean arterial pressure with a mean value of 25mmHg. These

changes can be attributed to stimulation of supra-glottic region and trachea which causes a sympatho-adrenal response.

Lignocane, fentanyl, esmolol and magnesium,[16] are some of the medicines that can be used to alleviate the hemodynamic response resulting from intubation using laryngoscopy and endotracheal tube. But these effects caused by these drugs are not their true pharmacological effects but rather they are side effects of the drugs.

In a study conducted by Kihara et al. they demonstrated that there were no significant blood pressure changes, in comparison to baseline, in patients with LMA used for securing airway. They also showed removing LMA too did not significantly alter any hemodynamic parameter.[16] Our study showed that as compared to LMA insertion, endotracheal intubation caused significant hemodynamic effect in patients.

Idress et al.[17] in additional research validated that in comparison between LMA and ETT intubation, LMA caused significantly less derangement ($P<0.05$) in blood pressure response as compared to endotracheal intubation. They also found that on extubation there was a similar cardiovascular response in both ETT and LMA group. Kihara et al. found in their study that LMA when used in hypertensive patients, showed no substantial changes in pulse, systolic blood pressure, diastolic blood pressure when compared to Endotracheal tube insertion.[18] In our study we used the sample consisted of normotensive patients but we found the same result.

In another study authors found no significant change in hemodynamic response in ETT group with normo-tensive patient population. This may be due to usage of Propofol as an induction agent that has better hemodynamic response as compared to induction using thiopentone.[19] We have also used Propofol in our study. Yamallchl et al.[20] used Propofol 2mg/kg on induction. They used Laryngeal mask airway in patients with normal and elevated blood pressures and compared both groups. They found similar hemodynamic response so they inferred that propofol is effective induction method as it prevents any harmful cardiovascular response to laryngeal mask airway. They didn't compare results with endotracheal intubation.

Braude N et al.[21] conducted a study using laryngeal mask airway and oropharyngeal airway and compared hemodynamic response in both groups . Their results showed a mild tachycardia and increase in blood pressure with insertion of LMA as compared with geudel airway. This is in contraindication to results of our study where we observed lessincrease in heart rate, systolic and diastolic blood pressures in LMA group as compared to ETT group. In this study we studied normotensive patients, with ASA grade I and II undergoing laparoscopic cholecystectomy and compared usage of LMA and ETT and found that good hemodynamic response was observed more significantly in patients with LMA insertion as compared with patients who had ETT insertion.

There are several limitations to our study. This study was conducted on patients with normal blood pressures and normal airways. In this study intermittent recordings were used due to limited resources; it could mean missed readings during the study. Although randomization was done but it was not a double-blind study. there could be an element of observational bias in this study. In this study it was found out that pressor response produced by LMA is less as compared to ETT, for a normo-tensive patient this is subtle finding but for a patient with cardiac or vascular pathology it can be of vital importance.

Conclusion:
We conclude that LMA should be used to avoid marked pressor response by ETT. In our setting, the use of LMA is limited, it is therefore recommended to develop strategies and guidelines to encourage the use of LMA instead of ETT.

Limitation:
Our study was performed on patients with ASA class I and II. This warrants further research on LMA in other populations. Lastly, due to easier insertion, using of LMA in emergency settings

should also be assessed as it can prove to be tool of great benefit in emergency and disaster management.

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Role and contribution of authors:

Dr. Neelam Noreen Halimi, main idea, collection of data and literature review.

Dr. Ijaz Hussain, helped in acquisition of data and in result analysis.

Dr. Muhammad Ilyas, supervision, critical review and making final changes for approval of the version to be published.

Dr. Shahana, helped in introduction and discussion writing.

Dr. Syed Israr Muaziz: helped in data computing, discussion writing and references.

Dr. Syeda Sadia: Helped in data collection and references.

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