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**Original Research Article**

# "Hemodynamic Changes Between Endotracheal Intubation And Laryngeal Mask Airway Insertion"

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**Abstract:** ***Introduction:*** Haemodynamic stability is an important aspect to the anaesthesiologist for the benefit of the patients especially during intubations, laryngeal mask insertion. Laryngoscopy and endotracheal intubation can cause striking changes in Haemodynamics as result of intense stimulation of sympathetic nervous system. Airway management is a crucial skill for the clinical anesthesiologist. ***Objective:*** To evaluate the hemodynamic changes between endotracheal intubation and laryngeal mask airway insertion. ***Material and Methods:*** This was prospective observational study conducted in Dept. Of Anesthesiology, 250 Bedded Shaheed Shaikh Abu Naser Specialized Hospital, Khulna, Bangladesh from July to December 2020. This was a prospective observational study on 52 patients of ASA I-II status divided into 2 groups of 26 each. In the ETT (Endotracheal tube) group endotracheal intubation was done using Macintosh laryngoscope by using portex cuffed endotracheal while in LMA (Laryngeal mask airway) group laryngeal mask airway was inserted according to the standard recommendation. Heart rate, Systolic, Diastolic and Mean arterial pressure and dysrhythmias were monitored. ***Results:*** The two groups were comparable in terms of demographic data as there were no significant differences between the 2 groups in terms of age, sex, duration of surgery, ASA grades and MPC classification. Heart rate (HR), Systolic blood pressure (SBP), Diastolic blood pressure (DBP), Mean arterial pressure (MAP) remains on higher side in ETT group than LMA group which was statistically significant. $P<0.05$. Dysrhythmias were noted in 2 patients of ETT group while LMA group did not notice any dysrhythmias. ***Conclusion:*** In conclusion the demonstrated that there is a haemodynamic response consisting of an increase in Heart rate, SBP, DBP and MAP that comes with ETT insertion as well as with LMA insertion. However, the response caused by ETT insertion is significantly greater than that caused by LMA insertion.

**Keywords:** Endotracheal Tube; Laryngeal Mask Airway, Hemodynamic Changes.



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## INTRODUCTION

Haemodynamic stability is an important aspect to the anaesthesiologist for the benefit of the patients especially during intubations, laryngeal mask insertion. Laryngoscopy and endotracheal intubation can cause striking changes in Haemodynamics as result of intense stimulation of sympathetic nervous system. Airway management is a crucial skill for the clinical anesthesiologist. Airway management following general anesthesia, allows ventilation and oxygenation as well as delivery of the anesthetic gases [1]. Complications following airway management in the operating room are very rare but may be life threatening. Due to rapid achievements in airway management technology, many of the newer airways are unfamiliar to most of the anaesthesiologists. Supraglottic airway devices are developed with increasing frequency following the overwhelming success of the laryngeal mask airway (LMA) [2,3]. The laryngeal mask airways (LMA) have become popular in airway management as a missing link between facemask and tracheal tube in terms of both anatomical position and degree of invasiveness. The laryngeal mask airway avoids tracheal intubation and provides hands free means of achieving gastight airway [4]. Laryngeal mask airway (LMA) devices are those that ventilate the patient by delivering gases above the level of vocal cords. The laryngeal mask airway (LMA) devices are also indispensable and often the first to be used to secure airway in emergency situation and in those difficult to ventilate and intubate patients. Use of supraglottic airway devices when intubation problems occurs in a patient with previously unrecognized difficult airway, especially in a "Cannot ventilate cannot intubate" situation was suggested by The 'American Society of Anesthesiologist' task force on management of difficult airway. Though endotracheal intubation has many advantages over laryngeal mask airway including provision of a definitive airway, prevention of aspiration and delivery of anaesthetic gases, it is not without complications. So complications can occur during endotracheal intubation, after endotracheal intubation and during extubation [5].

**Disadvantages of endotracheal intubation**

i) Damage to soft tissue, vocal cords, teeth, laryngeal and tracheal mucosa while laryngoscopy
ii) Risk of Aspiration
iii) Exaggerated haemodynamic response
iv) Barotrauma

Most laryngeal mask airway (LMA) devices are designed to overcome the above disadvantage of endotracheal intubation.

**Advantages of laryngeal mask airway (LMA) devices**

i) Avoidance of laryngoscopy
ii) Less invasive
iii) Increased ease of placement in inexperienced and experienced hands
iv) Improved haemodynamic stability.
v) Better tolerance by patients [2].

Control of heart rate and blood pressure are the important aspect to the anaesthesiologist for the benefit of the patients especially during intubations, laryngeal mask insertion. During laryngoscopy and endotracheal intubation significant changes in hemodynamics can result in intense stimulation of sympathetic nervous system [3]. These changes are potentially dangerous in patients with cardiovascular or cerebrovascular disease as they may lead to intra & post- operative life-threatening ischemia, infarction or cerebral hemorrhage. To prevent these complications laryngeal mask airway can be used as alternative to endotracheal intubation for airway management for short case procedure during anaesthesia [4]. To establish the benefits of LMA in the form of hemodynamic stability we compared the hemodynamic response to laryngeal mask airway insertion and endotracheal tube intubations [5].

## MATERIAL AND METHODS

This was prospective observational study conducted in Dept. Of Anesthesiology, 250 Bedded Shaheed Shaikh Abu Naser Specialized Hospital, Khulna, Bangladesh from July to December 2020. The study enrolled adult patients aged 18 to 60 years who presented American Society of Anaesthesiology (ASA) physical status I and II. Patient fulfilling the following inclusion criteria were enrolled.

**Inclusion criteria**

1. Age group 18-60 years males and females.
2. American Society of Anaesthesiologist (ASA) class I and II.
3. Mallampatti Class (MPC) I and II.
4. Cormack and Lehane (CL) Grade I and II.
5. Scheduled for short elective surgical procedures less than 90 minutes.

**Exclusion criteria**

1. Pregnant and Lactating women.
2. History of difficult intubation.
3. Patient with predetermined difficult airway.

 

4. History of angina, Myocardial Infarction, syncopal attacks.
5. Hypertensive patient.

Patients were randomized according to computer-generated tables.
Group I: Airway was secured using LMA.
Group II: Airway was secured using endotracheal tube.

A total of 52 patients were included in the study. The identity and consent of the patient were confirmed prior to induction of anaesthesia. A standard protocol has been followed for all the patients. A detailed history and examination was taken and the procedure to be done had been explained to the patient and a written informed consent was obtained for the general anaesthesia to be given. Monitoring in the form of Electrocardiogram, Pulse- oximeter, Non-invasive Blood pressure (SBP, DBP, MAP) were instituted. All the patients were premedicated with I.V. inj. glycopyrollate 0.004mg/kg I.V. inj. ondansetron 0.08mg/kg I.V, inj. midazolam 0.03 mg/kg I.V, inj. Fentanyl 2 micrograms/kg. Patient was pre-oxygenated for 3 mins with 100% oxygen. Patients were induced with. Inj. thiopentone 5mg/kg body weight and after confirmation of loss of eye lash reflex inj. Atracurium 0.5 mg/kg I.V. to facilitate endotracheal intubation 0r LMA insertion. Size of the device was decided by the qualified anaesthesiologist conducting the case based on the age, weight and manufacturers recommendation. Endotracheal intubation or Laryngeal mask airway (LMA) device was inserted by anaesthesiologist having at least 2 years' experience or at least 50 device insertions. Endotracheal tubes of size 7 for female and 8 for male patients or laryngeal mask size 3 for female and size 4 for male patients were used. Anaesthesia was maintained using oxygen/ nitrous and sevoflurane. At the end of the surgical procedure, the neuromuscular block (NMB) was reversed with neostigmine and glycopyrrolate.

Heart rate, non-invasive blood pressure which included systolic, diastolic, mean arterial pressure and any dysrhythmias were monitored throughout the study and recorded at the following time points:

a) Pre-operative
b) At intubation/insertion
c) One minute after intubation or insertion of laryngeal mask.
d) Three minutes after intubation or insertion of laryngeal mask
e) Five minutes after endotracheal intubation or insertion of laryngeal mask
f) Post extubation

## STATISTICAL ANALYSIS

All data collection, data entry was done in Excel. SPSS Version 21 was used for most analysis. Outcomes for haemodynamic parameters like heart rate, SBP, DBP, MAP, dysrhythmias for both laryngeal mask airway inserted and endotracheal tube inserted groups were noted and analyzed statistically. Qualitative data was represented in form of frequency and percentage. Association between qualitative variables like any type of dysrhythmias was assessed by chi-Square test with continuity correction for all 2x2 tables. Quantitative data was represented using Mean ± SD and Median & Interquartile range. Analysis of Quantitative data between quantitative variables such as haemodynamic parameters like heart rate, non-invasive blood pressures with two Subgroups was done using unpaired t-test while within the group analysis was done using the paired t test. Continuous variables were described using mean ± standard deviation. P value of less than 0.05 was considered statistically significant.

## RESULTS

The present study was conducted on 52 patients aged between 18 & 60 years. In the ETT group endotracheal intubation was done using Macintosh laryngoscope while in LMA group laryngeal mask airway was inserted according to the manufacture's recommendation. The LMA group had 14 males and 12 females and the ETT group had 14 males and 12 females. The ages ranged from 18 to 49 years and 26 to 48 years in the LMA and ETT groups respectively. The range for duration of surgery was 45 to 90 minutes for both LMA and ETT groups. The two groups were comparable in terms of demographic data as there were no significant differences between the 2 groups in terms of age, sex, duration of surgery, ASA grades and MPC classification ($P>0.01$). The heart rates of the 2 groups were comparable at preoperative stage. At insertion, the heart rate increased significantly in both groups, but the increase was substantially higher in the ETT group as compared to the LMA group. The elevation in heart rate significantly persisted for a longer period of time in the ETT group, where it returned to the baseline value by 5 minutes as compared to the LMA group where it returned by 3 minutes. Increase in mean heart rate after extubation was more pronounced with ETT Group than LMA Group. Difference was statistically significant. ($P<0.01$) (Table 1). The systolic blood pressure in the two groups was comparable at baseline. An increase in SBP was noted just after insertion of either the LMA or ETT, but the increase elicited by the ETT was significantly higher(p<0.001) and persisted for a longer period of time as compared to that elicited by the insertion of an LMA. It took 5 minutes for the ETT values to return to baseline and 3 minutes for the LMA values to do so. Increase in SBP after extubation was more pronounced with ETT Group than LMA Group. Difference was statistically significant. (P<0.01) (Table 2). The diastolic blood pressure was comparable between the 2 groups at baseline. After insertion, both groups showed an increase in DBP that was statistically significant within and between the groups. The values returned to baseline by 3 minutes in the LMA group and by 5 minutes in the ETT group. Increase in DBP after extubation was more pronounced with ETT Group than LMA Group. Difference was statistically significant. (P<0.01) (Table 3). In terms of MAP, the two groups were not statistically different at baseline. After insertion, the ETT group had an increase in MAP that was significantly higher and more persistent as compared to the LMA group. These changes subsided to baseline values by 3 minutes and 5 minutes in the LMA and ETT groups respectively. Increase in MAP after Extubation was more pronounced with ETT Group than LMA Group. Difference was statistically significant. (P<0.01) (Table 4). Two patients in ETT group suffered from dysrhythmia at insertion. Dysrhythmia appeared in 8.69% cases in ETT group & 0% cases in LMA group. There was no statistically significant difference between the groups in respect of dysrhythmias. Although the statistical value did not show any difference (P Value 0.24), higher incidence of dysrhythmia in ETT group seems to be significant, which may become evident in large scale.

**Table-1: Mean heart rate at different times among LMA and ETT study participants.**

| Time of recording of Heart Rate | Heart Rate | | | | P value |
|---|---|---|---|---|---|
| | LMA | | ETT | | |
| | Mean | SD | Mean | SD | |
| Preoperative* | 91.56 | 5.83 | 94.04 | 7.19 | 0.206 |
| At Insertion | 99.87 | 6.09 | 115.30 | 8.29 | <0.01 |
| 1 minute after insertion | 95.78 | 5.88 | 109.69 | 7.87 | <0.01 |
| 3 minute after insertion | 92.08 | 6.08 | 102.82 | 7.85 | <0.01 |
| 5 minute after insertion | 90.08 | 5.93 | 95.21 | 7.39 | <0.01 |
| After Extubation | 91.13 | 5.68 | 102.21 | 7.89 | <0.01 |

*Preoperative values are taken as Baseline values.

**Table-2: SBP at different times among LMA and ETT study participants.**

| Time of recording of SBP | SBP | | | | P Value |
|---|---|---|---|---|---|
| | LMA | | ETT | | |
| | Mean | SD | Mean | SD | |
| Preoperative* | 116.30 | 5.78 | 120.34 | 4.25 | 0.1 |
| At Insertion | 126.95 | 5.92 | 147.30 | 5.25 | <0.01 |
| 1 minute after insertion | 121.26 | 6.26 | 136.30 | 6.73 | <0.01 |
| 3 minute after insertion | 117.17 | 5.48 | 128.43 | 5.91 | <0.01 |
| 5 minute after insertion | 115.21 | 5.32 | 121.56 | 4.11 | <0.01 |
| After Extubation | 117.73 | 5.38 | 134.60 | 5.53 | <0.01 |

*Preoperative values are taken as Baseline values

**Table-3: DBP at different times among LMA and ETT study participants.**

| Time of recording of DBP | DBP | | | | P Value |
|---|---|---|---|---|---|
| | LMA | | ETT | | |
| | Mean | SD | Mean | SD | |
| Preoperative* | 72.87 | 4.48 | 75.30 | 4.13 | 0.61 |
| At Insertion | 81.43 | 4.39 | 91.08 | 4.14 | <0.01 |
| 1 minute after insertion | 76.60 | 4.14 | 86.26 | 4.84 | <0.01 |
| 3 minute after insertion | 73.56 | 4.19 | 81.34 | 5.27 | <0.01 |
| 5 minute after insertion | 72.04 | 4.23 | 76.39 | 4.91 | <0.01 |
| After Extubation | 74.04 | 3.95 | 85.43 | 4.02 | <0.01 |

*Preoperative values are taken as Baseline values.

**Table-4: MAP at different times among LMA and ETT study participants**

| Time of recording of MAP | MAP | | | | P Value |
|---|---|---|---|---|---|
| | LMA | | ETT | | |
| | Mean | SD | Mean | SD | |
| Preoperative* | 87.30 | 4.66 | 90.30 | 4.05 | 0.23 |
| At Insertion | 96.47 | 4.56 | 109.65 | 4.34 | <0.01 |
| 1 minute after insertion | 91.21 | 4.45 | 102.60 | 5.30 | <0.01 |
| 3 minute after insertion | 88.04 | 4.36 | 97.00 | 5.30 | <0.01 |
| 5 minute after insertion | 86.43 | 4.39 | 91.43 | 4.54 | <0.01 |
| After Extubation | 88.56 | 4.18 | 101.78 | 3.98 | <0.01 |

*Preoperative values are taken as Baseline values.

## DISCUSSION

This study was conducted on a total of 52 patients, aimed to evaluate and comparing the haemodynamic responses elicited by endotracheal intubation, to those elicited by laryngeal mask airway insertion. The two groups consisting of 26 participants each were comparable in terms of Age, Sex, ASA class, MPC grade, duration of surgery and baseline haemodynamic parameters. This study demonstrated that there is a haemodynamic response consisting of an increase in Heart rate, SBP, DBP and MAP with ETT insertion as well as with LMA insertion. However, the response caused by ETT insertion is significantly greater than that caused by LMA insertion. The HR, SBP, DBP as well as the MAP were significantly elevated after the insertion of the endotracheal tube in the ETT group of the study compared to the pre-intubation values. The elevation persisted for a period of 5 minutes by which the parameters returned to the pre-intubation values. These results are similar to those found by Millar and co-workers who found that in normotensive patients, laryngoscopy and insertion of a tracheal tube is immediately followed by an average increase in mean arterial pressure of 25 mmHg [6]. The changes in haemodynamics in the LMA group were significantly lower compared to those seen with the ETT group. Similar findings were reported by the study done by Anita and colleagues who demonstrated that endotracheal intubation was associated with a significant increase in heart rate and arterial pressure compared to LMA insertion [7]. In our study these changes subsided to baseline values by 3 minutes and 5 minutes in the LMA and ETT groups respectively. Increase in MAP after Extubation was more pronounced with ETT Group than LMA Group. Difference was statistically significant. (P<0.01). Two patients in ETT group suffered from dysrhythmia at insertion. Dysrhythmia appeared in 8.69% cases in ETT group & 0% cases in LMA group. There was no statistically significant difference between the groups in respect of dysrhythmias. Although the statistical value did not show any difference (P Value 0.24), higher incidence of dysrhythmia in ETT group seems to be significant, which may become evident in large scale. Several other studies have shown results similar to those of this study [8-10]. The attenuated response shown by LMA could be due to the fact that the LMA avoids the sympathoadrenal response caused by insertion of the endotracheal tube through the trachea. This explanation is supported by the study done in Japan, which showed that direct stimulation by a tracheal tube induces greater cardiovascular responses than stimulation of the glottis by laryngoscopy alone [11]. SBP and DBP were almost twice as high in the ETT study group compared to the LMA study group after insertion. However, the difference in heart rate in our study was significantly higher in the ETT group compared to the LMA group unlike in their study where there was an increase in heart rate in both groups with no significant difference between the groups. The HR increase in the ETT group lasted longer in our study similarly to the findings of their study [12]. The haemodynamic changes in the LMA group took about 3 minutes to return to pre insertion values while it took about 5 minutes for the changes to return to pre intubation values in the ETT group. Several other studies have demonstrated that the haemodynamic response to LMA is short lived compared to that to ETT [12, 13, 10]. The greater and more persistent changes in cardiovascular parameters seen with ETT as compared to LMA insertion probably reflect higher catecholamine levels in the ETT group as seen in previous studies [14-16]. Based on the literature, we anticipated that the insertion of a LMA would elicit a much smaller hemodynamic response than tracheal intubation [9]. Hemodynamic responses to insertion of the LMA were minimal, which supports the findings of Oczenski *et al.*, [9] Wilson *et al.*, [12] and Marietta *et al.* [17], who reported that the cardiovascular responses induced by laryngoscopy and intubation were more than twice as high as those produced by the insertion of a LMA. Kihara *et al.* had demonstrated that LMA insertion has no significant haemodynamic effect compared to base line. In Md. Harun-Or-Rashid, *et al*. study [5] hemodynamic parameter i.e. pulse rate, systolic blood pressure, diastolic blood pressure and presence of any dysrhythmias were monitored after 1,3,5 & 10 minutes after LMA insertion or ETT intubations. There was statistically significant changes (P<0.05) in pulse rate, systolic blood pressure, diastolic blood pressure and (appearance of dysrhythmia in some patients) in group B(ETT) patients whereas there was less changes in pulse rate, systolic blood pressure, diastolic blood pressure whose airway was maintained by LMA insertion (Group-A). They also have shown that LMA removal too did not change haemodynamic parameter significantly [18]. In our study LMA insertion compared to ETT intubation demonstrated statistically significant haemodynamic effect in ETT group. In our Study we observed similar results. This study limitation was conducted on healthy, normotensive patients with normal airways. Patients with predetermined difficult airway and those having history of difficult intubation were not included in our study; otherwise haemodynamic parameters would show a different picture in patients with difficult intubation. In this study, intermittent recording of the haemodynamics was used, due to the available resources. This could mean that the maximal change could have been missed especially within the first minute of intubation. Randomization was done but double blinding was not possible.

## CONCLUSION

In conclusion, the demonstrated that there is a haemodynamic response consisting of an increase in Heart rate, SBP, DBP and MAP with ETT insertion as well as with LMA insertion. However, the response caused by ETT insertion is significantly greater than that caused by LMA insertion.

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