Asian Journal of Pharmaceutical and Clinical Research

Innovare Academic Sciences
Knowledge to Innovation

Vol 16, Issue 2, 2023

Online - 2455-3891
Print - 0974-2441

Research Article

# HAEMODYNAMIC RESPONSES TO TRACHEAL EXTUBATION OR LARYNGEAL MASK AIRWAY REMOVAL IN PATIENTS UNDERGOING SHORT SURGICAL PROCEDURES: A COMPARATIVE AND CLINICAL STUDY

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*Received: 10 December 2022, Revised and Accepted: 20 January 2023*

## ABSTRACT

**Aims and Objectives:** The aim of the study was to evaluate and compare the hemodynamic responses after endotracheal tube (ET) extubation and laryngeal mask airway (LMA) removal in American Society of Anaesthesiologists (ASA) I and ASA II patients undergoing short surgical procedures.

**Methods:** This was a randomized, comparative, observational, and clinical study conducted in a tertiary care medical college. The duration of study was 1 year. Hundred patients of ASA Grade I and II with age between 18 and 60 years, including both males and females posted for short surgeries under general anesthesia were selected for the study. Patients were divided into two groups (Depending on whether endotracheal intubation was done or LMA was used) of 50 patients each. Hemodynamic parameters (systolic blood pressure [SBP], diastolic blood pressure [DBP], mean arterial pressure [MAP], and heart rate [HR]) were recorded and compared before induction, during surgery and postoperatively at 1, 2, 5, and 10 min between both the groups.

**Results:** There was no significant difference between these two groups regarding the demographic aspect of the patients such as age and gender. Furthermore, the parameters such as ASA grade and duration of surgery were comparable. The baseline hemodynamic parameters between the two groups were also similar and no significant difference was observed. The changes in hemodynamics (mean HR, SBP, DBP, and MAP) were more in Group E as compared to Group L and the difference was found to be statistically significant ($p<0.05$). Similarly respiratory events were more profound in Group E as compared to Group L and the difference was found to be statistically significant ($p<0.05$).

**Conclusion:** LMA is a better choice for short surgical procedures as it provides more hemodynamic stability during removal as compared to ET extubation. LMA is also associated with less complications as compared to ET.

**Keywords:** Endotracheal intubation, Laryngeal mask airway, Extubation, Hemodynamic stability.

 DOI: http://dx.doi.org/10.22159/ajpcr.2023v16i2.47231. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

## INTRODUCTION

Airway management is one of the most crucial parts of clinical anesthesiology. Endotracheal intubation as well as laryngeal mask airway (LMA) is commonly used to provide assisted ventilation in patients undergoing various short surgical procedures [1]. Endotracheal intubation has the distinct advantage of being a definitive airway and is associated with significantly reduced risk of complications such as aspiration. However, it is an invasive procedure and, though uncommon, complications such as vocal cord ulceration and laryngotracheal stenosis can occur. LMA has gained popularity because of its non-invasive nature [2]. LMA is not only effective but also can be used in emergency situations and in patients in whom difficult intubation is anticipated. However, use of LMA is associated with complications such as aspiration, trauma, and rarely nerve injuries. Less serious complications associated with LMA include sore throat, hoarseness, and difficulty in swallowing. Extubation or removal of LMA is the crucial time when many of these complications occur in patients who had been intubated or patients who received ventilation by LMA [3].

Tracheal extubation is associated with various cardiovascular and airway responses leading to tachycardia, hypertension, arrhythmias, myocardial ischemia, coughing, agitation, bronchospasm, increased bleeding, raised intracranial, and intraocular pressure [4]. These transitory changes are of little consequences in American Society of Anaesthesiologists (ASA) Grade I and II patients going for general surgical procedures, but could be of major concern for the anesthesiologists in patients especially with intracerebral space occupying lesions, where a sudden hypertension during or in immediate post-extubation phase could lead to raised cerebral blood flow, intracranial pressure, and decreased cerebral perfusion pressure resulting into increased intracranial bleeding, high morbidity, and mortality. Attenuation of pressor response in these situations is one of the most keenly researched subjects in the field of anesthesiology [5].

Airway instrumentation is invariably linked with certain cardiovascular changes such as tachycardia or bradycardia, rise in blood pressure, and a plethora of cardiac arrhythmias [6]. Airway instrumentation leads to sympathoadrenal discharge culminating in undesirable hemodynamic disturbances [7]. The pressor response can lead to various adverse events such as myocardial ischemia, pulmonary edema, acute heart failure, and cerebrovascular accidents in susceptible individuals. The anesthesiologist aims to provide an incident-free extubation process devoid of adverse cardiovascular events. This holds, especially true for patients having prior coronary artery disease and long-standing hypertension [8].

Smooth extubation as well as removal of LMA becomes more important when the patient has cardiovascular disease or in patients who have undergone neurosurgery, ENT surgery, or ophthalmological surgeries [9]. Anesthesiologist when pressed on for a smooth extubation tends to go for a deep extubation of the ET (ETT), which has the theoretical risk of losing the airway, before the patient is fully conscious and requires airway manipulations which, in turn, may result into significant hemodynamic changes secondary to sympathetic nervous system stimulation [10]. Many researchers have found LMA to be useful in effective airway management of patients undergoing short surgical procedures with fewer sides effects as compared to patients in whom endotracheal intubation was done [2].

We undertook this study to compare hemodynamic responses to tracheal extubation or LMA removal in ASA Grade I and Grade II patients undergoing short surgical procedures.

### Aims and objectives

The aim of the study was to evaluate and compare the hemodynamic responses after ET extubation and LMA removal in ASA I and ASA II patients undergoing short surgical procedures.

## METHODS

This was a randomized, comparative, observational, and clinical study conducted in a tertiary care medical college after due approval from the Institutional Ethics Committee for academic research projects. Hundred patients of ASA Grade I and II with age between 18 and 60 years, including both males and females posted for short surgeries under general anesthesia were selected for the study after thorough history taking and clinical examination. Fifty patients in each group were selected on the basis of computer-based randomization by systematic random sampling using computer generated code. Sample size calculation was done on the basis of pilot study on hemodynamic changes during endotracheal extubation and LMA extubation. Keeping power (1-Beta error) at 80% and confidence interval (1-alpha error) at 95%, the minimum sample size required in each group was 35 patients; therefore, we included 50 patients (more than minimum required number of cases). The patients were divided into two groups.

Group E: Group of 50 patients in whom endotracheal intubation was done.

Group L: Group of 50 patients in whom LMA was used.

Demographic details were recorded in all cases. Pre-anesthetic evaluation was done. Basic laboratory investigations (complete blood count, hepatic, and renal function tests as well as ECG) necessary for general anesthesia were done. Patients were kept nil per oral for 8 h before the surgery. Information about the study was given to the patients. An informed valid written consent was taken after the patient and relatives were explained about the whole procedure in their own language.

On the day of surgery, decision of either to intubate with ET or LMA insertion was taken before surgery. All of the patients were randomly allocated to one of the two groups in a double-blind manner using a computer-generated randomized number table. Once the patient was wheeled in for surgery, the consent and fasting status were checked. Following standard ASA monitoring protocol, a multichannel monitor consisting of pulse oximetry, non-invasive blood pressure, electrocardiography, and capnometer was attached for continuous monitoring and baseline readings were noted. After securing wide bore IV cannula, patient was premedicated with intravenous Injection Ondansetron (0.08 mg/kg), Injection Glycopyrrolate (0.04 mg/kg), Injection Midazolam (0.03 mg/kg), and Injection Fentanyl (2 mcg/kg). Following the pre-oxygenation for 3 min, patient was induced with Injection Propofol (2 mg/kg) and Injection Atracurium (0.5 mg/kg) was administered to induce neuromuscular blockade and facilitate endotracheal intubation or LMA insertion. Both endotracheal intubation and LMA insertion were performed as per standard anesthesia protocol. Anesthesia was maintained by 50% $N_2O$ in $O_2$ and Sevoflurane. Atracurium Besylate was used for muscle relaxation with a top up of 25% of the loading dose when the participant came out of relaxation, with the help of peripheral nerve stimulator. Mechanical ventilation was provided using closed circuit and normocarbia was maintained throughout the surgery. At the end of the surgery, Sevoflurane and nitrous oxide were discontinued, neuromuscular status was assessed using peripheral nerve stimulator, pharyngeal suction was done under direct vision, 100% oxygen was provided for 3 min and residual neuromuscular block was reversed by Neostigmine (0.05 mg/kg) with Glycopyrrolate (0.08 mg/kg). Once the patient attended normal tone, power, and reflexes and was responding to verbal command, ETT extubation or LMA removal was performed. Hemodynamic parameters systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate [HR]) were recorded before induction, during surgery and postoperatively at 1, 2, 5, and 10 min.

Quantitative data were represented as mean and standard deviation. Association between qualitative variables was assessed by Chi-square test and Fisher's exact test. Comparison of quantitative data between endotracheal extubation and LMA extubation cases was done using "Unpaired t-test" or by "Mann–Whitney test". SSPS 21.0 was used for statistical analysis and $p<0.05$ was taken as statistically significant.

### Inclusion criteria

The following criteria were included in the study:

1. Age group 18–60 years males and females
2. ASA I and II
3. MPC I and II
4. Scheduled for elective surgeries
5. Duration of surgery lasting 1–2 h.

### Exclusion criteria

The following criteria were excluded from the study:

1. Pregnant patients
2. Anticipated case of difficult extubation
3. Upper or lower respiratory infection
4. History of cardiac disease, angina, MI, syncope episodes
5. ASA III and above
6. Patients with uncontrolled systemic illnesses likely to affect the outcome.

## RESULTS

Total number of males in Group E and Group L were 30 and 27, respectively, whereas number of females in Group E and Group L were 20 and 23, respectively. Although there was a male preponderance in both the groups, the gender distribution among the study groups was comparable with no statistically significant difference ($p>0.05$). The mean age of the patients in Group E (Endotracheal extubation) was 38.28 years and in Group L (LMA removal) was 37.78 years. No statistical difference was found ($p>0.05$). The mean duration of surgery for Group E and Group L was 56.7±10.98 min and 56.4±12.16 min, respectively. The duration of surgery among the two groups was found to be comparable with no statistically significant difference ($p>0.05$) (Table 1).

Mean pre-induction HR of Group E was 85.34±5.39/min and that of Group L (LMA Removal Group) was 83.24±6.24/min. Following just after extubation, there was greater increase in the mean HR in Group E as compared to Group L. Thereafter, Group E showed greater increase in the mean HR as compared to Group L from 1 min to 10 min after extubation with a statistically significant difference ($p<0.0001$) (Table 2).

The mean pre-induction SBP of Group E was 124.96±7.61 mm of Hg and that of Group L was 125.5±17.90 mm of Hg. Just after extubation, there was greater increase in the mean SBP in Group E as compared to Group L. There after similar trend was observed which revealed Group E having greater increase in the SBP as compared to Group L from 1 min to 10 min after extubation with a statistically significant difference($p<0.0001$) (Table 3).

The mean pre-induction DBP of Group E was 81.4±5.46 mm of Hg and that of Group L was 79.9±4.88 mm of Hg. The table demonstrated that, just after extubation, Group L was associated with lesser increase in the

**Table 1: Gender distribution, age group, and ASA grades of the studied cases**

| Demographics and duration of surgery in studied groups | Endotracheal extubation (group E) | LMA removal (Group L) | p-value |
|---|---|---|---|
| Gender distribution | | | |
| Male | 30 | 27 | 0.67 (Not significant) *Fisher test |
| Female | 20 | 23 | |
| Total | 50 | 50 | |
| Age distribution | | | |
| <20 years | 3 | 1 | 0.78 (Not significant) *Mann Whitney test |
| 21–30 years | 17 | 16 | |
| 31–40 years | 5 | 10 | |
| 41–50 years | 15 | 14 | |
| >50 years | 10 | 9 | |
| Total | 50 | 50 | |
| Mean age | 38.28±12.69 | 37.78±12.26 | |
| ASA grades | | | |
| ASA I | 38 | 36 | 0.82 (Not significant) *Fisher test |
| ASA II | 12 | 14 | |
| Total | 50 | 50 | |
| Mean duration of surgery (minutes) | 56.7±10.98 | 56.4±12.16 | 0.80 (Not significant) *Mann Whitney test |

ASA: American Society of Anaesthesiologists, LMA: Laryngeal mask airway

**Table 2: Comparison of heart rate between the two groups at various time intervals**

| Time period | Group E | Group L | p-value* (Mann-Whitney test) |
|---|---|---|---|
| Pre-operative | 81.74±5.49 | 79.44±6.30 | 0.05 |
| Pre-induction | 85.34±5.39 | 83.24±6.24 | 0.11 |
| Just after extubation | 112.34±8.74 | 96.36±5.46 | <0.0001 |
| 1 min after extubation | 107.24±8.91 | 92.18±4.33 | <0.0001 |
| 2 min after extubation | 103.64±6.98 | 87.22±11.81 | <0.0001 |
| 5 min after extubation | 94.86±5.32 | 85.58±3.97 | <0.0001 |
| 10 min after extubation | 88.74±4.36 | 82±3.76 | <0.0001 |

**Table 3: Comparison of systolic blood pressure at various time intervals**

| Time period | Group E | Group L | p-value* (MannWhitney Test) |
|---|---|---|---|
| Pre-operative | 126.9±7.86 | 124.72±6.99 | 0.08 |
| Pre-induction | 124.96±7.61 | 125.5±17.90 | 0.09 |
| Just after extubation | 149.86±6.70 | 134.06±5.32 | <0.0001 |
| 1 min after extubation | 144.06±6.92 | 126.34±16.48 | <0.0001 |
| 2 min after extubation | 135.5±6.33 | 124.48±5.12 | <0.0001 |
| 5 min after extubation | 128±5.19 | 120.54±5.47 | <0.0001 |
| 10 min after extubation | 122.6±5.19 | 116.12±5.40 | <0.0001 |

DBP as compared to Group E. Thereafter similar results were obtained till 10 min after extubation with a statistically significant difference (p<0.0001) (Table 4).

The pre-induction mean value of MAP of Group E was 91.58±3.68 mm of Hg and that of Group L was 92.18±1.21 mm of Hg. Just after extubation, there was comparatively lesser increase in MAP in Group L as compared to Group E. The similar results were obtained in successive records with Group L having lesser increase in MAP as compared to Group E up to 10 min after extubation. This difference in MAP over serial readings was statistically significant (p<0.001) (Table 5).

**Table 4: Comparison of diastolic blood pressure at various time intervals**

| Time period | Group E | Group L | p-value* (MannWhitney Test) |
|---|---|---|---|
| Pre-operative | 83.54±4.71 | 83.16±4.08 | 0.34 |
| Pre-induction | 81.4±5.46 | 79.9±4.88 | 0.13 |
| Just after extubation | 95.28±3.38 | 90.88±2.61 | <0.0001 |
| 1 min after extubation | 91.02±2.90 | 86.86±3.38 | <0.0001 |
| 2 min after extubation | 85.04±3.72 | 82.88±3.36 | 0.008 |
| 5 min after extubation | 83±3.75 | 78.74±3.28 | <0.0001 |
| 10 min after extubation | 80.2±4.03 | 76.82±3.85 | 0.0001 |

The analysis of respiratory complication in both the groups showed that in cases of patients in. In patients of Group E, cough was seen in 12 (24%) patients whereas bucking was seen in 9 (18%) patients. One (2%) patient had brief period of desaturation. Airway manipulation by means of readjustment of ET, chin lift, or jaw thrust was required in 4 (8%) patients. In patients of LMA group, cough was seen in 9 (18%) whereas bucking was seen in 3 (6%) patients. Episode of desaturation was seen in 1 (2%) patient. LMA repositioning was required in 9 (18%) patients. The respiratory events during or immediately after extubation were higher in Group E as compared to Group L (p=0.024) (Fig. 1).

## DISCUSSION

The LMA gained wide acceptance as an alternative to traditional ET intubation due to ease of insertion and a possible lower risk of trauma to the trachea [11]. The LMA provides more hands-free anesthesia than a facemask does, avoids many morbidities associated with tracheal intubation because there is no stress from the laryngoscope, and allows a faster recovery that does not require muscle relaxation [12]. Its insertion does not require penetration of larynx, thereby making the placement less stimulating than tracheal tube insertion or extubation. As a result, there is less likelihood of pressor response with LMA. Since

**Table 5: Comparison of mean arterial pressure at various time intervals**

| Time period | Group E | Group L | p-value* (MannWhitney Test) |
|---|---|---|---|
| Pre-operative | 92.26±6.61 | 92.56±5.38 | 0.98 |
| Pre-induction | 91.58±3.68 | 92.18±1.21 | 0.36 |
| Just after extubation | 113.04±4.06 | 92.16±3.80 | <0.0001 |
| 1 min after extubation | 105.3±4.81 | 89.54±4.01 | <0.0001 |
| 2 min after extubation | 96.8±3.20 | 87.2±3.21 | <0.0001 |
| 5 min after extubation | 92.14±3.76 | 84.54±3.42 | <0.0001 |
| 10 min after extubation | 90.14±2.97 | 82.84±3.97 | <0.0001 |

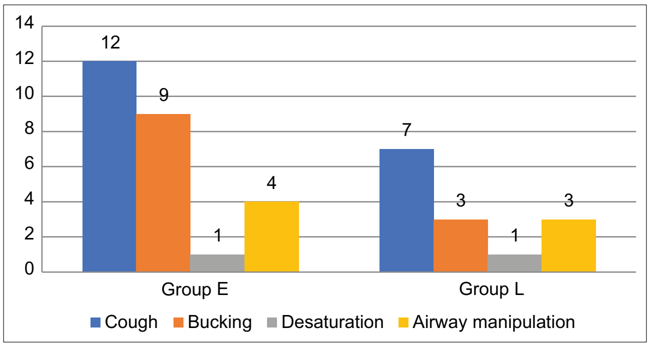


**Fig. 1: Respiratory events during or immediately after extubation**

LMA is less invasive, it is expected to have less effects on hemodynamics of patients and comparison of hemodynamics in patients who had been either intubated or ventilated through LMA, particularly at the time of extubation or LMA removal, has been a topic of intense research [13].

In our study, there was no significant difference between these two groups regarding the demographic aspect of the patients such as age and gender. Furthermore, the parameters such as ASA grade and duration of surgery were comparable. The baseline hemodynamic parameters between the two groups were also similar and no significant difference was observed.

The analysis of hemodynamic responses at the time of extubation or LMA removal showed that overall, there was a rise in all the hemodynamic responses, namely, HR, SBP, DBP, and MAP. However, the mean increase in the values was significantly lower in the LMA group as compared to endotracheal group. The differences were statistically significant (p<0.05). This was expected as in patients in whom LMA was used generally, there is no sympathoadrenal response which is provoked by insertion of the ET through the trachea seen in patients who had undergone endotracheal intubation. In a similar study, Ubale and Jadhav enrolled 46 patients of ASA I and II status and divided them into two groups of 23 each [14]. In the ETT group, endotracheal intubation was done using Macintosh laryngoscope using portex cuffed endotracheal while in LMA group LMA was inserted according to the standard recommendation. HR, systolic, diastolic, and MAP, and dysrhythmias were monitored. The authors found that the two groups were comparable in terms of demographic data as there were no significant differences between the two groups in terms of age, sex, duration of surgery, ASA grades, and MPC classification. HR, SBP, DBP, and MAP remains on higher side in ETT group than LMA group which was statistically significant. The study concluded that hemodynamic instability caused by ETT insertion was significantly greater than that caused by LMA insertion. These findings were similar to our study. Similar findings were also reported by the authors such as Obsa *et al.* [15] and Shribman *et al.* [16]

The analysis of respiratory events in our study showed that in cases of patients of Group E, there was high incidence of respiratory events such as coughing, bucking, or requirement of airway manipulation as compared to those in Group L. Episode of desaturation was seen in one patient in each group. In a similar study Suppiah *et al.* compared respiratory complications in patients who were intubated and those who were ventilated using LMA [17]. The authors found that 93.3% of patients in Group intubation group had at least one respiratory complication, while it was only 36.7% of patients in patients ventilated using LMA. The difference was statistically significant (p<0.001). The incidence of coughing and bucking was also lower in LMA Group and the difference was statistically significant (p<0.001). Similar lower incidence of respiratory events in patients ventilated using LMA was also reported by the authors such as Peirovifar *et al.* [18] and Van Esch *et al.* [19].

### Limitation of the study

We only studied cases undergoing short surgical procedures and belonging to ASA Grade I and II. Inclusion of ASA Grade III would certainly help in determining outcome in patients who have significant hemodynamic instability.

## CONCLUSION

LMA is a better choice in patients undergoing short surgical procedures as it is associated with more hemodynamic stability during removal as compared to endotracheal intubation. The incidence of adverse respiratory events is also significantly less in LMA as compared to endotracheal intubation.

### Study attributed to

Department of Anaesthesiology TNMC and B.Y.L. Nair Hospital Mumbai (India).

## ACKNOWLEDGMENT

The authors would like to acknowledge the support extended by the staff of Department of Anaesthesiology TNMC and B.Y.L. Nair Hospital Mumbai (India) for their valuable support in undertaking this study.

## AUTHORS CONTRIBUTION

NP – Concept and design of the study, interpreted the results, prepared first draft of manuscript, and critical revision of the manuscript; PU – Statistically analyzed and interpreted, reviewed the literature, and manuscript preparation; and AS – Concept and coordination of the overall study.

## CONFLICTS OF INTEREST

None.

## AUTHORS' FUNDING

None.

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