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Original Research Article

Comparative Study of Pressor Responses after Tracheal Extubation and LMA (Laryngeal Mask Airway) Removal in Controlled Hypertensive Patients: A Randomised Clinical Trial

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ABSTRACT

Background and objectives: Airway management using endotracheal intubation and laryngeal mask airway (LMA) are known to induce hemodynamic changes. The predominant response is tachycardia and systemic hypertension. The present study was undertaken to compare the hemodynamic responses after tracheal extubation and LMA removal in controlled hypertensive patients.
Methodology: The study was conducted on 70 patients in age group of 35-65 yrs, ASA Grade II scheduled for elective surgical procedures. Patients were allocated in randomized manner in two groups, one undergoing endotracheal tube intubation (Group T) and other undergoing laryngeal mask airway insertion (Group L). Each group had 35 patients. The hemodynamic data included pulse rate and blood pressure that were recorded at time intervals: baseline before intubation, at 1, 2, 3, 5 and 10 min after extubation or LMA removal. Rate pressure product was calculated.
Results: Extubation caused significant increase in mean pulse rate in Group T, which failed to reach baseline level after 10 minutes. LMA removal in Group L was associated with significant increase in mean pulse rate however it returned back to baseline at 5minutes after removal. Significant rise in MAP after extubation and LMA removal was observed in Group T and L, it did return to baseline values after 5 min in Group L and no such effect observed even after 10 min in Group T. Rise in mean pulse rate and mean arterial pressure was significantly higher when compared between group T and group L. Similar observations were made for rate pressure product in Group L and T respectively.
Interpretation and conclusion: Both endotracheal extubation and laryngeal mask airway removal were associated with a statistically significant rise in pulse rate, rate pressure product and MAP. The rise was significantly higher in Group T as compared to Group L. LMA removal was found to be accompanied with lesser pressor response as compared to endotracheal tube extubation in controlled hypertensive patients. Use of Laryngeal mask airway is quite advantageous and hence is desirable in hypertensive patients.

Keywords: Controlled Hypertension, Laryngeal Mask Airway, Pressor Response, Tracheal Extubation.

INTRODUCTION

Airway management using endotracheal intubation and laryngeal mask airway (LMA) are known to induce hemodynamic changes. [1] The stress response to laryngoscopy is well known to be centrally mediated sympathetic reflex, presumed that stretching of the laryngeal and pharyngeal tissue during laryngoscopy was the major cause of the hemodynamic response. [2] The predominant response is tachycardia and systemic hypertension. These reflex responses are mediated by increased sympathetic nervous system

activity. Sympatho-adrenergic responses that occur at intubation as well as during extubation may lead to complications like myocardial infarction, left ventricular failure, cerebrovascular accidents, intracranial hypertension and a rise in intraocular pressure. The aim of anesthesiologist is to provide an incident-free extubation process devoid of adverse cardiovascular events. [3]

Previous studies on circulatory effects of anesthesia in treated and untreated hypertensive patients observed that most of the patients experienced three periods of circulatory instability: during intubation, after tracheal intubation, and during the immediate period surrounding awakening [4] as the release of endogenous catecholamines increases myocardial oxygen demand. [5]

The present study was undertaken to compare the hemodynamic responses after tracheal extubation and LMA (laryngeal mask airway) removal in controlled hypertensive patients subjected to operative procedures under general anesthesia.

MATERIALS AND METHODS

The present study was conducted in Department of Anesthesiology, Deccan College of Medical Sciences, Hyderabad. After obtaining clearance from Ethical Committee, total of 70 patients visiting Princess Esra Hospital, Hyderabad were selected for the study. The study design is that of a prospective randomized trial.

Seventy-controlled hypertensive patients in the age group of 35-65 years belonging to ASA Grade II scheduled for elective surgical procedures were enrolled for the study. A controlled hypertensive patient is a known hypertensive patient on anti hypertensives with systolic blood pressure less than 140mmHg & diastolic blood pressure less than 90mmHg or a recently diagnosed case, diagnosed at least 2 weeks before surgery on antihypertensives with systolic blood pressure <140 and diastolic blood pressure less than 90mmHg. [6]

Patients were then allocated in a randomized manner into two groups, one undergoing
endotracheal tube intubation (Group T) and other group undergoing laryngeal mask airway insertion (Group L). Each group had 35 patients.

Pre anesthetic check-up was carried out one day prior to surgery. Informed consent was obtained from all the patients. All patients underwent history taking and a thorough clinical examination which included pulse rate, blood pressure, respiratory rate, weight, airway assessment and systemic examination viz. cardiovascular system, respiratory system and per abdomen. All patients with history of chronic obstructive pulmonary diseases, emergency surgical procedures, pregnant women, morbid obese patient and patients with pharyngeal mass, gastroesophageal reflux, renal or hepatic failure, and patients with Mallampati grade III or IV were excluded from the study.

Pre operative investigations carried on all patients included haemoglobin estimation, urine examination; albumin, sugar, microscopic examination, random blood sugar, blood urea and serum creatinine, chest X-ray, ECG and Echo.

All the patients received 5mg alprazolam orally night before surgery. Inj Ondansetron 4mg IV, inj glycopyrrolate 0.005mg/kg and inj ranitidine 50mg I.V were administered 1 hour before surgery.

Once the patient was shifted to the operation theatre, pulse rate and blood pressure were noted. Pre-oxygenation was done with 100% oxygen for 5 minutes. Inj. Fentanyl 1µg/kg IV was given. Intravenous induction was carried out with injection thiopentone sodium 5mg/kg and Inj. Lignocaine 1.5mg/kg IV After the loss of eyelash reflex, injection succinylcholine 1.5mg/kg was administered and positive pressure ventilation was carried through a face mask using 100% oxygen. After one minute either laryngoscopy and endotracheal intubation or blind laryngeal mask insertion size 3 or size 4 was carried

out as per the groups allocated to them. Air was injected into the cuff of endotracheal tube or laryngeal mask cuff until a tactile seal was achieved. Anesthesia was maintained with oxygen (50%) + nitrous oxide (50%) + Sevoflurane (0.5%) and vecuronium bromide 0.1mg/kg. [7]

At the end of procedures, reversal was obtained with Inj glycopyrrolate 0.01mg/kg and neostigmine 0.05mg/kg IV Endotracheal extubation and laryngeal mask airway removal was carried out when patient was completely conscious and responded to verbal commands. The hemodynamic data which included pulse rate and blood pressure were recorded at the following time intervals: baseline before intubation, at 1, 2, 3, 5 and 10 min after extubation or removal of LMA.

Statistical analysis: All variables were presented as mean±SD. Patient characteristics and hemodynamic variables were compared using the χ^2 - test, Student's *t*-test or analysis of variance test as appropriate. P values less than 0.05 were considered statistically significant.

RESULTS

70 patients of ASA physical status II, with controlled hypertension undergoing elective surgical procedures under general anesthesia were studied. The patients in group T (Endotracheal extubation) were compared with group L (Laryngeal mask airway removal). Each group comprised of 35 patients. Following are the results of the study.

There was no statistically significant difference between the two groups for parameters viz. age, gender, body weight and height. Table 1 shows the same.

TABLE.NO.1: Shows patients demographic data.

PARAMETER	Group T (N=35)	Group L (N=35)	't' value	'p' value
Age (yrs)	47.08 ± 4.5	46.48 ± 5.2	0.51	0.60
Gender (Male/female)	19/16	20/15	0.49	0.54
Body weight (kg)	56.3 ± 8.2	54.08 ± 6.3	1.27	0.21
Height (cm)	170.5 ± 3.5	169.9 ± 4.8	0.59	0.55

Pulse rate: The mean pulse rate at the baseline (immediately before extubation) was 87 ± 10.2 beats/minutes in patients of Group T. It raised to 112.52 ± 12.6 beats/minutes at one minute after extubation. The values of pulse rate at 2, 3, 5 and 10 minutes after extubation were 107.21 ± 11.98, 106.12 ± 15.038, 100.78 ± 10.63 and 95.68 ± 14.8 respectively. The mean pulse rate, in patients of group L, at baseline (just before LMA removal) and 1, 2, 3, 5 and 10 minutes after LMA removal are 87.4 ± 8.1, 94.8 ± 9.80, 93.021 ± 10.22, 90.38 ± 10.79, 87.9 ± 10.62 and 86.91 ± 10.37 respectively.

Extubation caused instantaneous and significant increase in mean pulse rate which did not return back to baseline level even after 10 minutes. Laryngeal mask removal was also associated with significant increase in mean pulse rate compared to baseline and it returned to baseline level at 5minutes after the removal as shown in table 5.1and 5.2. This shows that the sympathetic responses were lesser in patients of group L as compared to patients of group T. Graph 1 also depicts the same.

Mean Arterial Pressure: Table 3 shows the mean ± SD of mean arterial pressure in both groups at different intervals. This shows that there was a significant rise in mean arterial pressure after extubation which did not reached baseline values even after 10 minutes post extubation as shown in table 5.1.

There was also significant rise in mean arterial pressure after LMA removal; however it reached baseline values at 5 minutes after LMA removal as shown in table 5.2. The rise in mean arterial pressure was significantly higher when compared between group T and group L. Graph 2 represents the same.

All haemodynamic values are expressed as mean±SD. (*Significant; **Highly significant)

TABLE.NO.2: Shows the Mean Pulse rate of the 2 groups.

MEAN PULSE RATE (beats/min)	Group T	Group L	't' value	'p' value
Baseline	87 ± 10.2	87.4 ± 8.1	0.18	0.85
1 min after extubation	112.52 ± 12.6	94.8 ± 9.80	6.56	< 0.0001**
2 min after extubation	107.21 ± 11.98	93.021 ± 10.22	5.33	< 0.0001**
3 min after extubation	106.12 ± 15.038	90.38 ± 10.79	5.031	< 0.0001**
5 min after extubation	100.78 ± 10.63	87.9 ± 10.62	5.071	< 0.0001**
10 min after extubation	95.68 ± 14.8	86.91 ± 10.37	2.87	< 0.005**

TABLE.NO.3: Shows the Mean Arterial Pressure of the 2 groups.

MEAN OF MEAN ARTERIAL PRESSURE (mmHg)	Group T	Group L	't' value	'p' value
Baseline	101.3 ± 6.64	99.5 ± 5.8	1.8	0.23
1 min after extubation	118.956 ± 8.80	106.022 ± 10.91	5.47	< 0.0001**
2 min after extubation	114.89 ± 5.579	103.09 ± 6.891	7.87	< 0.0001**
3 min after extubation	112.79 ± 5.458	99.76 ± 10.91	6.319	< 0.0001**
5 min after extubation	110.67 ± 5.35	98.95 ± 5.45	9.07	< 0.0001**
10 min after extubation	104.66 ± 5.52	99.6 ± 5.61	3.8	< 0.0003**

TABLE.NO.4: Shows the Mean Rate Pressure Product of the 2 groups.

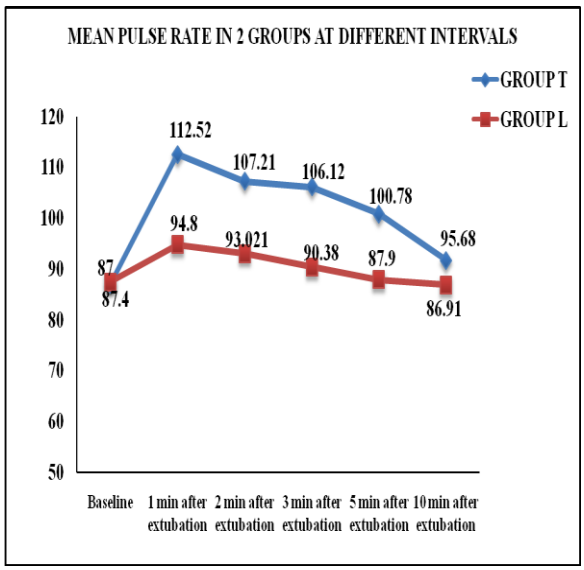
MEAN RATE PRESSURE PRODUCT	Group T	Group L	't' value	'p' value
Baseline	12438.7 ± 1901.2	12108.6 ± 1181.4	0.87	0.38
1 min after extubation	17681.3 ± 2190.52	13501.3 ± 1645.86	9.02	< 0.0001**
2 min after extubation	16735.23 ± 2198.37	12989.31 ± 1698.05	7.97	< 0.0001**
3 min after extubation	17013.8 ± 2245.3	12495.1 ± 1721.85	9.44	< 0.0001**
5 min after extubation	15121.4 ± 1625.82	12101.2 ± 1589.35	7.85	< 0.0001**
10 min after extubation	14598 ± 2345.3	12150.6 ± 1567.4	5.22	< 0.0001**

TABLE.NO: 5.1 Intra group comparison after 5min and 10 min in Group T

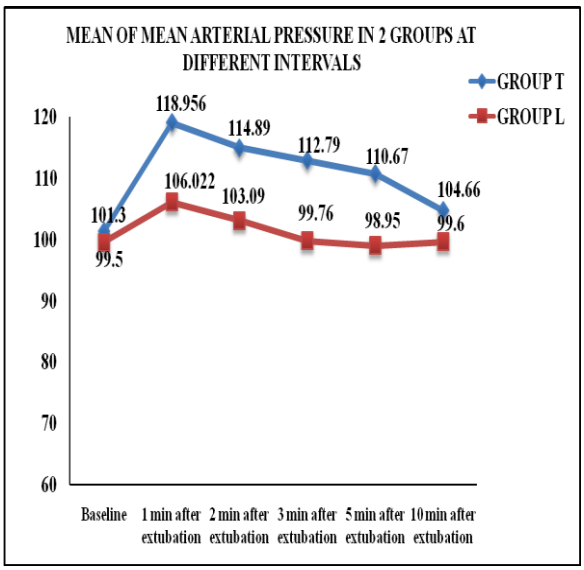
PARAMETER	GROUP T				
	Baseline	After 5 min	P value	After 10 min	P value
Mean pulse rate	87 ± 10.2	100.78 ± 10.63	< 0.0001**	95.68 ± 14.8	0.005*
Mean of mean arterial pressure	101.3 ± 6.64	110.67 ± 5.35	< 0.0001**	104.66 ± 5.52	0.02*
Mean rate pressure product	12438.7 ± 1901.2	15121.4 ± 1625.82	< 0.0001**	14598 ± 2345.3	0.001*

TABLE.NO: 5.2 Intra group comparison after 5min and 10 min in Group L

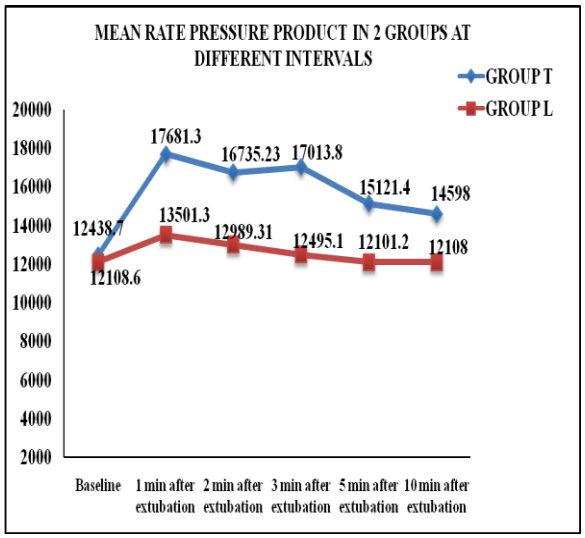
PARAMETER	GROUP L				
	Baseline	After 5 min	P value	After 10 min	P value
Mean pulse rate	87.4 ± 8.1	87.9 ± 10.62	0.82	86.91 ± 10.37	0.83
Mean of mean arterial pressure	99.5 ± 5.8	98.95 ± 5.45	0.68	99.6 ± 5.61	0.94
Mean rate pressure product	12108.6 ± 1181.4	12101.2 ± 1589.35	0.98	12150.6 ± 1567.4	0.89



Graph: 1



Graph: 2



Graph: 3

Rate Pressure Product: Table 4 shows the rate pressure product in both groups at different intervals. This shows that extubation caused a significant rise in mean rate pressure product in group T from baseline value. These values failed to reach baseline even after 10 minutes of extubation as represented in table 5.1. In group L, LMA removal caused a significant rise in the rate pressure product when compared to baseline, however the values reached near baseline at 5 minutes post removal as shown in table 5.2.

This rise in rate pressure product was significantly higher in group T than in group L. Graph 3 depicts the same.

DISCUSSION

After induction of general anesthesia, the anesthetist becomes guardian of the patient's airway because protective reflexes have been obtunded. The tracheal tube and laryngeal mask airway are two devices that can be used. Laryngoscopy with intubation violates the patient's protective airway reflexes, stimulate the pharyngeal tissues and lead to a hypertensive 'pressor' response. This maneuver gives rise to a marked increase in arterial pressure and heart rate. [8] Although these alterations are short lived and are probably of no consequence in healthy individuals but these responses are undesirable in patients with cardiovascular diseases like hypertension or coronary artery disease. Hypertensive patients have been shown to exhibit exaggerated cardiovascular response at extubation than normotensive patients. Sympathoadrenergic responses that occur at intubation as well as during extubation may lead to complications like myocardial infarction, left ventricular failure, cerebrovascular accidents, intracranial hypertension and rise in intraocular pressure. [9]

We studied 70 ASA Grade II controlled hypertensive patients, who were randomly allocated into 2 groups of 35 each. Endotracheal extubation was performed in patients of group T, where as size 3 or size 4 laryngeal mask airway removals was carried in group L.

There was no difference in the demographic data of age, gender, height and weight in patients of both the groups. Our findings are similar to that found in other studies. [9,10]

In the present study, extubation caused instantaneous and significant increase in mean pulse rate which failed to reach baseline level even after 10 minutes. Laryngeal mask removal was associated with significant increase in mean pulse rate compared to baseline however it returned back to baseline at 5minutes after the removal. There was a significant rise in mean arterial pressure after extubation which did not return to baseline values even after 10 minutes post extubation, however the rise in mean arterial pressure after LMA removal, reached baseline values at 5 minutes of removal. We also found that extubation caused a significant rise in mean rate pressure product in group T from baseline value. These values failed to reach baseline after 10 minutes of extubation. The rise in mean pulse rate and mean arterial pressure was significantly higher when compared between group T and group L.

In group L, LMA removal caused a significant rise in the rate pressure product when compared to baseline, however the values reached near baseline at 5 minutes post removal. And this rise in rate pressure

product was significantly higher in group T than in group L.

Thus the main observations of our study are, both endotracheal extubation and laryngeal mask airway removal were associated with a statistically significant rise in pulse rate, rate pressure product and mean arterial pressure when compared with baseline values. The rise was significantly higher in the extubation group as compared to laryngeal mask airway removal group. The values did not returned to baseline values even after 10minutes of extubation, whereas in laryngeal mask group the haemodynamic values returned to baseline levels, 5 minutes after LMA removal.

Endotracheal extubation causes rise in haemodynamic responses because of mechanical stimulation of respiratory tract including vocal cords causing increased sympathetic nervous system activity in the cervical sympathetic fibres, whereas the lesser cardiovascular response associated with laryngeal mask removal may be due to the fact that the laryngoscopy was avoided and vocal cords were not stimulated. [10]

Mushtaq R et al conducted a study entitled "Pressor Responses after tracheal extubation or lma removal in controlled hypertensive patients". It was found that that haemodynamic data in laryngeal mask group at baseline increased to statistically significant levels post removal, but came back to baseline values 3 minutes post removal, whereas these values were significantly higher even after 5minutes of extubation. [11] The findings of our study are similar to that found in the above study.

Our findings are also similar to that found by Bukhari S A et al. The two devices for airway control were compared for pressor responses and intraocular pressure changes following insertion of laryngeal mask airway and endotracheal intubation. They observed a significant increase in heart rate in both the groups after insertion. [12]

In a study conducted by Yoshitaka Fuji MD et al, pressor response to tracheal extubation was compared with the response to laryngeal mask airway removal in normotensive and hypertensive patients. They found that MAP increased immediately following extubation and remained elevated for three minutes. MAP increased immediately following LMA removal and remained elevated for two minutes. The increases in these variables were less in LMA group than in endotracheal group. The study concluded that cardiovascular responses to extubation were greater than those related to removal of LMA in both normotensive and hypertensive patients. The changes in hemodynamic variables immediately following extubation or LMA removal from baseline levels were greater in hypertensive patients than in normotensive patients. [13]

In another study conducted by Brande N et al, it was observed that there was a significant increase in systolic blood pressure immediately after tracheal extubation and for the subsequent 2 minutes. Mask removal in the laryngeal mask group was associated with a systolic increase that achieved significance at one minute after insertion. The increase in mean blood pressure was both lesser and of shorter duration in LMA group. [14]

The findings of our study are consistent with those found in above mentioned studies.

Mohamed M. Abdel Fattah conducted a study over Comparison of hemodynamic response to tracheal intubation with laryngoscope versus intubating laryngeal mask airway in elderly hypertensive patients. It was found that rate pressure product after endotracheal intubation with laryngoscope showed significant increase compared with LMA. [15]

We conclude that LMA removal has less hemodynamic consequences that last for a shorter period compared to entotracheal intubation in controlled hypertensive patients.

CONCLUSIONS

LMA removal was found to be accompanied with lesser pressor responses

as compared to endotracheal tube extubation in controlled hypertensive patients. Use of Laryngeal mask airway is quite advantageous and hence is desirable in hypertensive patients where in there is a concern about the pressor responses due to airway instrumentations.

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Conflicts of interest: There are no conflicts of interest.

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