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Haemodynamic Changes in Laryngoscopy with Endotracheal Intubation and Laryngeal Mask Airway Insertion: A Comparative Study in General Surgery Patients

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Abstract

Introduction: Airway management is must during delivery of general anaesthesia. Previously, laryngoscopy and endotracheal tube (ETT) insertion has been the mainstay in providing adequate airway management and delivering anaesthesia. The laryngeal mask airway (LMA) offers a much less invasive way of maintaining the airway as it does not pass through the glottis but is placed over the glottis. It does not require the use of the laryngoscope. *Objective:* To determine the haemodynamic response elicited by laryngoscopy and endotracheal intubation and compare it with that elicited by laryngeal mask insertion in ASA I and ASA II patients, undergoing elective general surgeries. *Methods:* A hospital based prospective randomized comparative study was conducted to determine the haemodynamic response, elicited by laryngoscopy and endotracheal intubation and compare it with that elicited by laryngeal mask airway insertion in ASA I and ASA II patients, undergoing elective general surgeries. After induction of anaesthesia either an ETT or LMA was inserted. Evaluations included measurement of blood pressure and heart rates before insertion, and 1 minute, 3 minutes and 5 minutes after insertion. *Results:* There was an increase in HR, SBP and DBP seen after laryngoscopy and ETT insertion as well as after laryngeal mask airway insertion. The change in haemodynamic parameters after laryngoscopy and ETT insertion were significantly greater than those elicited by LMA insertion. *Conclusion:* A significant haemodynamic response consisting of an increase in HR, SBP and DBP was seen after the insertion of both the LMA and ETT in this study. It was also concluded that the haemodynamic response to laryngoscopy and ETT insertion is significantly greater than that to LMA insertion.

Keywords: Endotracheal Intubation; Laryngeal Mask Airway; Haemodynamic Response.

Introduction

Airway management is of most important during delivery of general anaesthesia. Patients who have been anaesthetized are unable to maintain an adequate airway on their own and artificial airway maintenance devices are employed [1]. Previously laryngoscopy and endotracheal intubation has been the mainstay in providing adequate airway management, delivering anaesthesia and avoidance of aspiration in anaesthetized patients. Though intubation has many advantages including provision of a reliable airway, prevention of aspiration and delivery of anaesthetic gases, it is not without complications. These can be seen during insertion, after insertion and during extubation. These complications are airway trauma, physiological reflexes like hypoxia, tachycardia and hypertension, malposition, laryngospasm, narrowing and increased airway resistance as well as negative pressure pulmonary edema [2]. The laryngeal mask airway offers a much less invasive way of maintaining the airway as it does not pass through the glottis but is placed over the glottis. It does not require instrumentation like use of the laryngoscope. It acts as an intermediate between the endotracheal tube and the oropharyngeal airway and offers some of the advantages of the endotracheal tube while surpassing the

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disadvantages like stimulation of the laryngopharyngeal reflex [2].

Laryngoscopy and tracheal intubation or laryngeal mask airway insertion are noxious stimuli which provoke a transient but marked sympathetic response manifesting as hypertension and tachycardia. In susceptible patients particularly those with systemic hypertension, coronary heart disease, cerebrovascular disease and intracranial aneurysm, even these transient changes can result in potentially deleterious effects like left ventricular failure, arrhythmias, myocardial ischaemia, cerebral haemorrhage and rupture of cerebral aneurysm [3,4,5]. There are a number of ways to blunt these haemodynamic changes. They include minimizing the duration of laryngoscopy, the use of intravenous narcotics, lidocaine, vasodilators and beta - blocking agents, but most of these have produce variable results [6]. Laryngeal mask airway insertion involves lesser mechanical manipulation of upper airway than endotracheal intubation does, but it has its own limitations as it is contraindicated in patients who are at risk for aspiration, those with low pulmonary compliance and those with pharyngeal obstruction.

Objectives

To determine the haemodynamic response elicited by laryngoscopy and endotracheal intubation and compare it with that elicited by laryngeal mask airway insertion, in ASA I and ASA II patients undergoing elective general surgery cases

Materials and Methods

Study Design

A prospective randomized comparative study was conducted during the period of July 2014 to July 2015.

Study Population

This study done in adult patients who fulfils the inclusion and exclusion criteria and between the age of 18 to 55 years who were ASA I and ASA II patients of both sexes presenting for elective general surgeries.

Sampling Procedure

Patients those not meeting the inclusion criteria or those refusing to participate were excluded. The patients were then randomly allocated to one of the two groups: ETT group and LMA group. They were then randomly assigned to anesthetists experienced in handling both devices. A total of 50 patients in the LMA group and 50 patients in the ETT group were completed in a span of 12 months.

Inclusion Criteria

1. Patients undergoing elective surgeries
2. Aged between 18- 55 years
3. Mallampatti I and II
4. ASAI and ASAII
5. Willing to participate in the study by giving written informed consent

Exclusion Criteria

1. History of respiratory problems
2. History of angina, palpitations, syncopal attacks
3. Baseline heart rate< 60 per minute
4. Baseline systolic pressure >140 mm of Hg

Study Tools

Laryngeal mask airways for airway management in the LMA group and endotracheal tubes with laryngoscopes for the ETT group. I.V. cannulae, drugs including propofol, pentazocin, suxamethonium, midazolam, oxygen and isoflurane for the induction and maintenance of anaesthesia. Monitoring of HR, SBP and DBP of the patients was done using multipara monitors. The data sheets used to collect information contained demographic data, proposed surgery, type of airway management tool, ease of insertion, haemodynamic variables including heart rate, non invasive systolic and diastolic pressure before induction, preinsertion/intubation, immediately after laryngoscopy with intubation or insertion of laryngeal mask, 1, 3 and 5 minutes after intubation or insertion of laryngeal mask.

The patients were then premedicated with injection midazolam 0.05mg/kg and pentazocine 0.5 mg/kg, 3 minutes prior to induction. Pre-oxygenation was done during these three minutes after which, induction of anaesthesia using I.V. propofol 2 mg/kg was done. For the ETT group muscle relaxation for intubation was facilitated by the use of injection succinylcholine 1.5-2 mg/kg. Patients were then ventilated with 100 percent oxygen for a period of 1 minute prior to intubation with the aid of Macintosh laryngoscope or insertion of laryngeal mask airway. Duration of intubation/

insertion was defined as the time from the start of laryngoscopy/LMA insertion, until cuff inflation. Monitoring Heart rate, non invasive blood pressure which included systolic, and diastolic blood pressure were monitored throughout the study and recorded at the following time points a) Pre insertion/intubation. b) Immediately after laryngoscopy and intubation or insertion of laryngeal mask. c) One minute after intubation or insertion of laryngeal mask. d) Three minutes after intubation or insertion of laryngeal mask e) Five minutes after intubation or insertion of laryngeal mask.

Results

All the patients that met the inclusion criteria were included in the study. In the ETT group, 2 patients were excluded as they needed more than 2 attempts for intubation. Each group had a total of 50 participants. The ETT group had 30 males and 20 females and the LMA group had 30 males and 20 females. The ages ranged from 18 to 55 years and 22 to 54 years in the ETT and LMA groups respectively. The range for weight was 44 to 82 kg and 52 to 80 kg in the ETT and LMA groups respectively. 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, weight and ASA classification (As shown in Table 1).

It was seen from Table 2 that heart rates of the 2 groups were comparable at induction. 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.

It was seen from Table 3 that 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.

It was observed from Table 4 that 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

Table 1: Demographic and clinical characteristics of study participants

	LMA (n=50)	ETT (n=50)	P- value
Mean Age (years)	37.5	38.8	0.568
Mean Weight (kg)	65.7	63.8	0.278
Sex - Male	20	20	1.000
Female	10	10	
ASA - I	23	20	0.137
II	07	10	

Table 2: Mean heart rate at different times among ETT and LMA study participants

	ETT Mean±SD	P value for difference within ETT group	LMA Mean±SD	P value for difference within LMA group	P value for difference between ETT and LMA groups
Pre-insertion	93.0±13.5	-	90.8±11.8	-	0.383
Insertion	111.9±13.6	<0.0001	106.9±11.1	<0.0001	0.047
1 minute	106.5±13.4	<0.0001	97.8±9.2	<0.0001	0.0001
3 minute	99.5±13.1	<0.0001	88.5±6.8	0.592	0.0001
5 minute	92.2±11.4	0.664	85.4±6.5	0.059	0.066

Table 3: Mean systolic blood pressure at different time points among the study participants

	ETT Mean±SD	P value for difference within ETT group	LMA Mean±SD	P value for difference within LMA group	P value for difference between ETT and LMA groups
Preinsertion	121.2±10.8	-	117.0±11.9	-	0.067
Insertion	146.4±16.4	<0.0001	127.7±12.9	<0.0001	<0.0001
1 minute	135.4±12.8	<0.0001	121.5±11.4	<0.0001	<0.0001
3 minute	128.5±11.5	<0.0001	117.6±10.5	0.487	<0.0001
5 minute	122.0±11.8	0.665	115.4±9.1	0.147	0.002

Table 4: Mean Diastolic blood pressure at different times among ETT and LMA study participants

	ETT Mean±SD	P value for difference within ETT group	LMA Mean±SD	P value for difference within LMA group	P value for difference between ETT and LMA groups
Preinsertion	76.4±7.2	-	75.7±7.1	-	0.618
Insertion	90.1±11.7	<0.0001	83.5±8.6	<0.0001	<0.001
1 minute	85.2±10.4	<0.0001	78.0±7.4	0.012	<0.0001
3 minute	80.7±10.0	0.007	75.5±8.0	0.793	0.005
5 minute	76.1±9.8	0.813	74.7±7.3	0.310	0.447

to baseline by 3 minutes in the LMA group and by 5 minutes in the ETT group. The difference between the groups was lost by 5 minutes.

Discussion

This study conducted on a total of 100 patients, aimed at comparing the haemodynamic changes elicited by laryngoscopy with endotracheal intubation, to those elicited by laryngeal mask airway insertion. This study demonstrated that there is a haemodynamic response consisting of an increase in heart rate, SBP, and DBP that comes with laryngoscopy with ETT insertion as well as with LMA insertion [7]. However, the response caused by laryngoscopy with ETT insertion is significantly greater than that caused by LMA insertion. It was also observed that insertion of an LMA is easier and takes a shorter time compared to laryngoscopy with ETT insertion.

The heart rates in both groups showed an increase from the pre induction values. These results were similar to those observed in a study done in Scotland, where it was shown that arterial pressure decreased significantly and heart rate increased significantly after induction of anaesthesia. The same effects were also observed in several other studies done previously [8-12]. This effect could be attributed to the hypotensive effect of the induction drugs used [9]. The HR, SBP, and DBP 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 Miller 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 [10]. The study done by Russell and colleagues also demonstrated a significant increase in arterial blood pressure after intubation [11].

The observed changes are probably due to the sympathoadrenal response caused by stimulation of the supraglottic region and that of the trachea. The LMA group in this study also showed a significant increase in HR, SBP, and DBP after insertion of the LMA. These results are similar to those of a study done to investigate the cardiovascular effects related to insertion of the Brain laryngeal mask airway compared to those after insertion of a Guedel oral airway, a significant increase in arterial pressure and in heart rate followed insertion of the laryngeal mask and the Guedel airway [12]. 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. Several other studies have shown results similar to those of this study [13,14,15].

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 [16]. SBP and DBP were almost twice as high in the ETT study group compared to the LMA study group after instrumentation. These findings are similar to those of Wilson and colleagues [17]. However, the difference in HR 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 difference might have been picked by our study due to the larger sample size compared to that of their study. 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 [15]. 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. The longer time needed in the ETT group could translate to a longer stimulation period, leading to a greater haemodynamic response. This was shown by the study done by Stoelting who stated that time required to perform endotracheal intubation, directly correlates with an increase in MAP [17].

Conclusions

A significant haemodynamic response consisting of an increase in HR, SBP, and DBP was seen after the insertion of both the LMA and ETT in this study. It was also observed that the haemodynamic response to laryngoscopy and ETT insertion is significantly greater than that to LMA insertion. The response is also short lived in the LMA group compared to ETT group. This response might be of no clinical importance in the healthy, normotensive patients, but might be harmful in patients with hypertension, aortic or cerebral aneurysm, raised intracranial pressure or other cardiovascular diseases. In such cases, the attenuated response of the LMA might be desirable. Time taken to insert an LMA was significantly shorter and insertion was easier as compared to laryngoscopy and ETT insertion. These factors might be contributory to the higher haemodynamic changes seen with laryngoscopy and ETT insertion.

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