Original Article

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COMPARISON OF HEMODYNAMIC RESPONSES TO USE OF LARYNGEAL MASK AIRWAY VERSUS ENDOTRACHEAL TUBE IN HYPERTENSIVE PATIENTS

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ABSTRACT

Objective: To compare hemodynamic responses to use of laryngeal mask airway (LMA) versus endotracheal tube (ETT) in hypertensive patients.

Study Design: A quasi-experimental study.

Place and Duration of study: Department of Anaesthesiology and Intensive Care, Combined Military Hospital Rawalpindi and Kharian from January 2008 to December 2008.

Patient and Methods: Seventy hypertensive patients selected by non-probability convenience sampling technique were equally distributed in two groups ETT and LMA using alternate patient technique (n=35 each). Patients in both groups were anaesthetised using common anaesthetic technique. Patients in ETT group underwent laryngoscopy and ETT intubation, whereas patients in LMA group received LMA without laryngoscopy for their airway maintenance. Hemodynamic variables, (pulse, systolic, diastolic and mean arterial pressures) were measured using non-invasive monitoring technique at various intervals before and after intubation or LMA placement, before and after extubation or LMA removal.

Results: In ETT group after intubation there was an increase both in, pulse from 69±9 to 75±8, and mean arterial pressure (MAP) from 89±10 to 104±4mm Hg, when compared to LMA group, in which pulse increased from 67±7 to 68±5 and MAP from 89±11 to 94±8 mm Hg. Before extubation pulse in LMA group patients was 73±10 and MAP was 93±9 whereas in ETT group mean pulse was 76±9 and MAP was 107±9 mm Hg. On ETT extubation pulse increased from 76±9 to 77±8 and MAP from 107±9 to 108±8 mm Hg, whereas in LMA group pulse changed from 73±10 to 69±7 and MAP from 93±9 to 95±9. All the hempdynamic responses were significantly lower in LMA group than in ETT group (p<0.05).

Conclusion: Use of LMA in hypertensive patients for control of ventilation showed significantly lower hemodynamic responses when compared to ETT at both intubation and extubation.

Keywords: Endotracheal tube, Hypertension, Laryngeal Mask Airway, Stress response.

INTRODUCTION

There is progressive rise in prevalence of hypertension in children and adolescents even in developing countries. Hypertensive patients have increased perioperative morbidity due to altered cardio vascular physiology. Anaesthetic techniques to minimize cardiovascular stressors should be investigated and practiced.

Endotracheal tube (ETT) intubation is indicated for airway management in patients undergoing general anaesthesia, particularly when there is risk of aspiration[1]. Laryngoscopy and ETT intubation after induction of anaesthesia offers maximum stress to the patient[2,3] and is frequently associated with transient hypertension, tachycardia and arrhythmias[4,5]. This transient response may, probably, be of little consequence in a healthy individual but it may be more severe and more hazardous in hypertensive patients[2,4]. Hypertensive patients due to vascular hyper reactivity show exaggerated response to stress, which can be avoided by avoiding laryngoscopy[2] in addition to physical and pharmacological interventions[6].

Laryngeal mask airway (LMA) is being increasingly used for maintenance of airway with an important role in rescue ventilation in difficult airway management in adult and in pediatric patients[7-12]. Insertion of LMA causes less hemodynamic changes than ETT intubation[13]. LMA is technically easier to insert, causes less coughing, straining and an attenuated pressor response[14]. Hemodynamic

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changes at ETT extubation are even higher than during intubation[2,15]. LMA removal is associated with less cardiovascular changes than ETT extubation[16]. Successful use of LMA in surgeries involving raised intra abdominal pressure such as during laparoscopic cholecystectomy and during elective cesarean section in healthy selected patients has been reported[17,18]. Studies have shown that use of LMA is safe and effective for both spontaneous and controlled ventilation[19,20]. This study was done to compare the hemodynamic responses to use of LMA vs. ETT in hypertensive patients with controlled ventilation.

PATIENTS AND METHODS

This quasi-experimental study was carried out at Combined Military Hospital Rawalpindi and Kharian in 2008 (January to December) after approval by ethics committee of the hospital. Informed consent was taken at the time of pre anaesthesia assessment. Seventy hypertensive patients 45-60 years of age, males and females of ASA class I or class II with history of essential hypertension on oral medication, undergoing orthopedic or limb surgical procedures under general anaesthesia were included in this study. Patients with history of angina, previous history or ECG evidence of myocardial infarction, patients on ß blockers, patients suffering from metabolic disorders as hyperthyroidism, diabetes mellitus, history of steroid use, history of COPD, gastro esophageal reflux, obesity and patients undergoing emergency procedures were not included in the study.

Thirty five patients each were placed in ETT or LMA group (n=35). Applying alternate patient sequence, non probability convenience sampling technique was used to distribute patients in the two groups, first patient and all odd numbered patients were placed in ETT group, while second patient and all even numbered patients were placed in LMA group.

Hemodynamic variables (pulse, systolic, diastolic and mean arterial pressure) were observed using non invasive method at various intervals and compared at ETT intubation or LMA placement and at ETT extubation or LMA removal among the ETT and LMA groups to assess if significant difference was present.

Routine dose of anti hypertensive medication was given with sip of water after midnight nil orally. No patient received any anti anxiety medication before surgery. After patient's arrival in operation theatre monitoring was commenced using 1500 K, Life scope N, Nihon Koden Corp, Japan. ECG electrodes were attached to continuously monitor standard limb lead II for heart rate monitoring. Non Invasive Blood Pressure (NIBP) cuff was applied to monitor blood pressure at desired intervals. Pulse oximeter probe on finger was used to monitor SPO2. Baseline hemodynamic variables were measured. All patients were anaesthetized using common anaesthetic technique. All patients were premedicated with injection Nalbuphine 0.08 mg / kg according to body weight. Anaesthesia was induced with Injection Thiopentone in a dose of 5 mg / kg body weight I/V. Patients lungs were ventilated with 40 % oxygen and 60% nitrous oxide mixture with 0.8–1.5% Isoflurane Once it was certain that patient can be ventilated with face mask, Injection Vecuronium 0.1 mg / kg was given to achieve muscle paralysis. Intermittent positive pressure ventilation with Bain circuit was done for three minutes to achieve adequate depth of anaesthesia and muscle paralysis. Before ETT intubation or LMA placement, pre intubation hemodynamic variable were recorded. Patients in ETT group underwent laryngoscopy with Macintosh laryngoscope and tracheal intubation with appropriate sized endotracheal tube (Kaisha Murphy tracheal tube, Kaisha trading Ltd, China), while patients in LMA group did not undergo laryngoscopy and their airway was secured using Laryngeal Mask Airway Device (Soft Seal Laryngeal Mask, Portex Inc. U.S.A) of appropriate size. The LMA was inserted according to the recommended guidelines. Bilateral air entry was confirmed. Patients were ventilated with a tidal volume of 8-10 ml/kg with ventilatory rate of 12-15 breaths per minute maintaining the end tidal CO_2 ($ETCO_2$) between 35–40 mm Hg as measured by capnometer (Capnomac Ultima, Datex, Finland). Hemodynamic variables (heart rate, systolic, diastolic and MAP) were recorded at 1, 2, 3, 5 and 10 minute after ETT intubation or LMA placement. At the end of surgical procedure, neuromuscular block was antagonized with Injection Neostigmine 0.03 mg/kg and Injection Glycopyrolate 0.01 mg/kg. Patients then breathed 100% oxygen. One minute pre extubation variables were recorded. Gentle pharyngeal suctioning was performed followed by ETT extubation or LMA removal. Hemodynamic variables were then recorded at 1, 2, 3 and 5 minute after ETT extubation or LMA removal. Airway was observed for any abnormality as trauma to teeth, airway soiling by regurgitated gastric fluid, any sign of aspiration or gastric insufflation. Data was recorded on a common proforma specially designed for the study.

Data Analysis:

Data was analysed using SPSS version 10. Descriptive statistics were used to describe the data. Chi-square test was applied for comparison of qualitative variables observations with in group. Independent sample t-test was applied for quantitative variables. *p*-value < 0.05 was considered significant.

RESULTS

Both the groups were compareable with respect to age (p>0.05) and gender (p>0.05) (Table-1).

After laryngoscopy and ETT intubation, mean pulse in ETT group increased from 69±9 to 75±8 per minute whereas in LMA group it increased from 67±7 to 68±5 per minute (p<0.05). After ETT intubation, MAP in ETT group increased from 89±10 to 104±4 mm Hg, whereas in LMA group MAP increased from 89±11 to 94±8 mm Hg (p<0.05). All hemodynamic variables in LMA group remained lower as compared to ETT group even 10 minutes after intubation or LMA placement (Table-2).

One minute before ETT extubation or LMA removal, all hemodynamic variables were lower (p<0.05) in LMA group when compared to patients in ETT group. Patients in ETT group on extubation, showed a increase in mean pulse from 76±9 to 77±8 per minute and an increase in MAP from 107±9 to 108±8 mm Hg. Patients in LMA group, on LMA removal showed a mean pulse decrease from 73±10 to 69±7 per minute and an increase in MAP from 93±9 mm Hg pre extubation to 95±9 mm Hg 1 minute after extubation. Two, three and five minutes after extubation or LMA removal, patients in ETT group displayed persistent increased mean pulse, systolic, diastolic and MAP (p<0.05) (Table-3).

No patient in either group had failed ETT intubation, failed LMA placement or failure to achieve IPPV. There was no incidence of hypoxia or evidence of aspiration in both groups.

Table-1: Demographic data of patients in study (n=70)

	LMA	ETT
Number of patients (n)	35	35
Age (mean ± SD)	50.6±4.1	52.3±4.2
Gender (Males, females)	17 (49%), 18 (51%)	19 (54%), 16 (46%)

DISCUSSION

Incidence of hypertension with clinical or occult coronary artery disease increases as the age increase. There is 10.7% risk of major perioperative cardiac morbidity in hypertensive patients, which can be minimized by maintenance of balance between myocardial oxygen supply and demand by avoiding periods of significant hypotension, hypertension and tachycardia.

Induction of general anaesthesia is associated with changes in cardiovascular variables due to specific effect of anaesthetic drugs administered and adrenergic state of the patient. In our study, after induction of anaesthesia all hemodynamic variables decreased significantly (p<0.05) compared to baseline value. This fall in blood pressure and pulse, was consistent with a study conducted by Fuji et al[21] in hypertensive patients.

Rookie et al[22] compared use of LMA and ETT in hypertensive patients undergoing

Table-2: Hemodynamic variables at induction and ETT Intubation or LMA Placement

	Pulse			Systolic Blood Pressure			Diastolic Blood Pressure			Mean Arterial Pressure		
	ETT	LMA	P-Value	ETT	LMA	P-Value	ETT	LMA	P-Value	ETT	LMA	P-Value
Base line	76±6	77±6	0.532	142±8	142±8	1.00	88±6	89±7	0.52	106±6	106±7	1.00
1 min before intubation/ placement	69±9	67±7	0.30	124±14	123±15	0.77	72±8	72±8	1.00	89±10	89±11	1.00
1 min after intubation/ placement	75±8	68±5	0.0001	142±5	127±11	0.0001	86±4	78±7	0.0001	104±4	94±8	0.0001
2 min after intubation/ placement	74±9	70±5	0.024	143±5	126±11	0.0001	88±6	77±8	0.0001	106±6	93±9	0.0001
3 min after intubation/ placement	74±8	69±6	0.0043	139±6	125±10	0.0001	87±7	77±6	0.0001	104±7	93±7	0.0001
5 min after intubation/ placement	73±6	68±6	0.0009	137±6	124±9	0.0001	82±10	76±7	0.0049	100±8	92±8	0.0001
10 min after intubation/ placement	72±5	67±6	0.0003	132±7	122±9	0.0001	82±6	75±7	0.0001	92±8	88±8	0.0025

Table-3: Hemodynamic variables at ETT extubation or LMA removal

	Pulse			Systolic Blood Pressure			Diastolic Blood Pressure			Mean Arterial Pressure		
	ETT	LMA	P-Value	ETT	LMA	P-Value	ETT	LMA	P-value	ETT	LMA	P-value
1min before extubation/ removal	76±9	73±10	0.19	143±15	125±12	0.0001	89±6	78±8	0.0001	107±9	93±9	0.0001
1 min after extubation/ removal	77±8	69±7	0.0001	142±13	127±12	0.0001	91±6	80±7	0.0001	108±8	95±9	0.0001
2 min after extubation/ removal	78±4	69±8	0.0001	134±19	123±18	0.015	86±6	78±6	0.0001	102±10	93±10	0.0003
3 min after extubation/ removal	78±7	70±6	0.0001	135±19	124±10	0.0034	81±5	78±6	0.026	99±6	93±7	0.0003
5 min after extubation/ removal	73±5	69±6	0.0035	132±9	123±10	0.0002	83±5	77±6	0.0001	99±6	92±7	0.0001

ophthalmic surgery. Both groups in his study received opioid, thiopentone and vecuronium before airway instrumentation. Hemodynamic variables increased on intubation in ETT group while they remained unchanged in LMA group. In our study after LMA placement or ETT intubation pulse, systolic, diastolic and MAP increased when compared to pre intubation values, however this increase was significantly more in patients in ETT group as compared to patients in LMA group.

Various studies[3,6] have demonstrated that laryngoscopy without or with ETT intubation causes stress response in form of transient hypertension, tachycardia, bradycardia or dysrhythmias. In our study, the hemodynamic changes after ETT intubation were significantly greater (p<0.05) and persistent than those after LMA insertion. This persistent increase in hemodynamic variables after laryngoscopy and ETT intubation was consistent with the findings of Fujii et al in hypertensive patients.

LMA is well tolerated causes less stress response during return of consciousness and awake removal is a safe technique[23]. In our study, before ETT or LMA removal, patients in LMA group showed, significant (p<0.005) lower pulse, systolic, diastolic and MAP as patients in LMA group were less irritable and well tolerated presence of LMA when compared to patients in ETT group.

On ETT extubation increase in heart rate, systolic, diastolic and MAP was larger (p<0.05) when compared to LMA removal. This increase persisted even 5 minutes after ETT removal. This finding was inconsistent to the study by Fuji[16], who evaluated cardiovascular responses to ETT extubation or LMA removal in normotensive and hypertensive patients and showed that in hypertensive patients increase in hemodynamic responses to ETT extubation or LMA removal were observed for up to 5 minutes and these responses were greater in ETT extubation as compared to LMA removal.

Shribman[4] found that plasma catecholamine levels and hemodynamic response to 10-second laryngoscopy were similar to laryngoscopy followed by ETT intubation while 3-second laryngoscopy has significantly less hemodynamic response than ETT intubation. An increase in blood pressure associated with laryngoscopy and ETT intubation in hypertensive patients is dangerous and may cause left ventricular failure, myocardial ischemia or cerebral hemorrhage. Airway management strategies to minimize cardiovascular changes should be investigated and practiced. The maintenance of hemodynamic stability during ETT intubation has clinical significance in elderly patients and patients with hypertension. Avoiding stimulation of laryngoscopy for ETT intubation prevents hemodynamic changes[24,25].

Use of the LMA avoids the need for laryngoscopy and ETT intubation, so that the marked hemodynamic response to these procedures may be circumvented. The LMA allows airway management without hypertension and tachycardia and should be considered when anaesthetizing patients with hypertension or coronary artery disease[26].

Our study in hypertensive patients demonstrated that the cardiovascular response to insertion of the LMA is less than that associated with ETT intubation of the trachea. This finding is consistent with the study conducted by Bannet et al and others[13,14]. Studies have found fewer hemodynamic changes with LMA compared to ETT In patients undergoing Coronary Artery Bypass Grafting surgery[27].

LMA has been used successfully for elective surgery where patient would traditionally be considered at increased risk of aspiration either because of type of surgery[2,4,28] or because of co existing upper gastro intestinal disease[3]. LMA has provided adequate ventilation in situations where intra abdominal pressure is raised such as pneumoperitoneum[2] and obesity[16]. LMA also offer potential advantage in terms of hemodynamic response[29], pulmonary physiology, emergence and postoperative airway morbidity[14,30]. LMA has proved to be effective even in children as it can easily be inserted and isolates glottis from esophagus when correctly positioned[31].

Our results in hypertensive patients confirmed that heart rate, systolic, diastolic and MAP after ETT intubation and extubation were greater than those after LMA insertion and removal.

Limitations of our study are that the study was conducted in hypertensive patients with controlled blood pressure with no end organ damage or associated metabolic abnormality and with normal airways therefore generalization of findings should not be extended to hypertensive patients with associated medical illnesses or hypertensive patients with difficult airway.

CONCLUSION

In our study use of LMA in hypertensive patients for control of ventilation showed lower hemodynamic responses at both intubation and extubation when compared with endotracheal tube.

REFERENCES

1. Miller RD. Miller's Anaesthesia. 6th ed. Elsevier Churchill Livingstone ; 2005, 164-7.
2. Nishikawa K, Kawamata M, Namiki A. Light wand intubation is associated with less hemodynamic changes than fiber optic intubation in normotensive but not in hypertensive patients over 60. Can J Anaesth 2001; 48:1148-54.
3. Prys RC, Greene LT, Meloche R, Fock P. Studies of anaesthesia in relation to hypertension II, hemodynamic consequences of induction and ET intubation. Br J Anaesth 1971; 43:531-47.
4. Shribman AJ, Smith G, Achola KJ. Cardiovascular and catecholamine response to laryngoscopy with and without tracheal intubation. Br J Anaesth 1987; 59: 295-9.
5. Singhal S, Neha A. Haemodynamic response to Laryngoscopy and Intubation: Comparison Of McCoy And Macintosh Laryngoscope . The Internet Journal of Anesthesiology. 2008 Volume 17 Number 1
6. Van den Berg AA, halliday EM, Soomro NA, Rasheed A, Baloch M: Reducing cardiovascular responses to laryngoscopy and tracheal intubation: a comparison of equipotent doses of tramadol, nalbuphine and pethidine, with placebo. Middle East J Anesthesiol; 2004 Oct., 17(6):1023-36.
7. Brain AIJ. The laryngeal mask – a new concept in airway management. Br J Anaesth 1983; 55:801-5
8. Paemet JL, Colona RP, Horrow JC, Miller F, Gonzales J, Rosenberg H. The laryngeal mask airway reliably provides rescue ventilation in case of un anticipated difficult tracheal intubation along with difficult mask ventilation. Anesth Analg 1998; 87:661-5.
9. Nolan JP, Deakin CD, Soar J, Bottiger BW, Smith G: European Resuscitation Council guidelines for resuscitation 2005. Section 4. Adult advanced life support. Resuscitation 2005; 67(Suppl 1):S39-86
10. Ogata J. The airway management using laryngeal mask airway and tracheal fiberoscopy in a pediatric patient with tracheal stenosis after tracheostomy. Masui. 2004;53:1282-5.
11. Somri M, Barna Teszler C, Tome R, Kugelman A, Vaida S, Gaitini L. Flexible fiberoptic bronchoscopy through the laryngeal mask airway in a small, premature neonate. Am J Otolaryngol. 2005;26:268-71.
12. Watts P, Lim K, Gandhewar R, Mukharjee A. the effect of laryngeal mask airway insertion on intraocular pressure measurement in children receiving general anesthesia. Am J Ophthalmol. 2007; 144(4):507-10.
13. Dahaba AA, Prax N, Gaube W, Gries M, Rehak PH, Metzler H: Haemodynamic and catecholamine stress responses to the Laryngeal Tube-Suction Airway and the Laryngeal Mask Airway. Anaesthesia 2006; 61:330-4
14. Khan FA, Afzal M, Kamal RS. Experience with LMA in Pakistani patients. J Pak Med Assoc 1996; 46:276-8.
15. Asai T, Koga K, Vaughen RS. Respiratory complications associated with tracheal intubation and extubation. Anesth Analg 1996; 82:129-33.
16. Fuji Y, Toyooka H. Cardiovascular response to tracheal extubation or LMA removal in normotensive and hypertensive patients. Can J Anaesth 1997; 44:1082-6.
17. Maltby JR, Berialt MT, Watson NC, Fick GH. Gastric distension and ventilation during laproscopic cholecystectomy. LMA classic vs. tracheal intubation. Can J Anaesth 2000; 47:622-6.
18. Han TH. Brimacombe JR, Lee EJ, Yang HS. The LMA is effective and probably safe in selected healthy parturient for elective cesarean section. A prospective study of 1067 cases. Can J Anaesth 2001; 48:1117-21.
19. Akhtar TM, McMurray P, Kew WJ. A comparison of LMA with tracheal tube for intra ocular ophthalmic surgery. Anaesthesia 1992; 47:668-71.
20. Verghese C, Brimacombe J. Survey of laryngeal mask airway usage in 1190 patients, safety and efficacy for conventional and non conventional usage. Anesth Analg 1996; 82:129-33.
21. Fujii Y, Tanaka H, Toyoka H. Circulatory responses to laryngeal mask airway insertion or tracheal intubation in normotensive and hypertensive patients. Can J Anaesth 1995; 42:32-6.
22. Rookie GO, Haridas RP, Rocke DA, Gouws E. Haemodynamic response to tracheal intubation or laryngeal mask insertion in hypertensive patients. S Afr J Surg. 1997; 35(1):24-6.
23. Amjad N. Use of laryngeal mask airway and ETT a comparison for ambulatory surgery. J Coll Physican Surg Pak. 2001;11:127-30.
24. Hung OR, Stewart RD. Lightwand intubation: I – a new lightwand device. Can J Anaesth 1995; 42:820-5.
25. Hung OR, Pytka S, Morris I, Murphy M, Stewart RD. Lightwand intubation: II – clinical trial of a new lightwand for tracheal intubation in patients with difficult airways. Can J Anaesth 1995; 42: 826-30.
26. Nishikawa K, Omote K, Kawana S, Namiki A. A comparison of hemodynamic changes after endotracheal intubation using the lightwand device and the laryngoscope in normotensive and hypertensive patients. Anesth Analg 2000; 90:1203-7.
27. Bennett SR, Grace D , S. C. Griffin. Cardiovascular changes with the laryngeal mask airway in cardiac anaesthesia Br J Anaesth 2004; 92: 885–7.
28. Aziz L, BashirK. Comparison of armoured laryngeal mask airway with endotracheal tube for adenotonsillectomy. J Coll Physician Surg Pak. 2006; 16:685-8.
29. Montazri K, Naghibi Kh, Hashemy SJ. Comparison of hemodynamic changes after insertion of laryngeal mask airway, face mask, and endotracheal tube. Acta Med Irani. 2004; 42:437-40.
30. Lopez-Gil M, Brimacombe J. The ProSeal laryngeal mask airway in children. Pediatr Anesth 2005; 15:229-34.
31. C Keller, Sparr HJ, Huger TJ, Brimacombe J. Patient outcomes with Positive pressure ventilation versus spontaneous ventilation in non paralysed adults with Laryngeal mask airway. Can J Anaesth.1998; 45,564-67.