COMPARISON OF HEMODYNAMIC CHANGES AFTER INSERTION OF LARYNGEAL MASK AIRWAY, FACEMASK AND ENDOTRACHEAL INTUBATION

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Abstract- Hemodynamic changes are major hazards of general anesthesia and are probably generated by direct laryngoscopy and endotracheal intubation. We designed this prospective randomised study to assess the cardiovascular changes after either laryngeal mask airway (LMA), face mask (FM) or endotracheal tube (ETT) insertion in the airway management of adult patients anesthetised with nitrous oxide and halothane. A total of 195 healthy normotensive adult patients with normal airways were randomly assigned to one of the three groups according to their airway management (n= 65 each) for transurethral lithotripsy procedures. Heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial blood pressure (MAP) values were recorded before the induction of anesthesia, and then every three minutes until 30 min thereafter. The mean maximum HR and MAP values obtained during 15 and 30 minutes after insertion of LMA were 81±13, 73±8 bpm and 82±14, 79 ±11 mmHg, respectively which were significantly smaller compared to those with FM (84±12, 80±6 bpm and 86±10, 83±13 mmHg) and ETT (96±8, 88±7 bpm and 91±11, 82±9 mmHg) ($P < 0.05$). Direct stimulation of the trachea appears to be a major cause of the hemodynamic changes associated with tracheal intubation during general anesthesia, but why hemodynamic changes in LMA were smaller than facemask needs further study. In healthy normotensive patients the use of LMA for the airway management during general anesthesia results in a smaller cardiovascular change than FM and ETT.

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Key words: Laryngeal mask airway, Facemask, Endotracheal tube, Hemodynamic changes

INTRODUCTION

Induction of general anesthesia is known to induce clinically relevant changes in hemodynamic variables probably generated by direct laryngoscopy and endotracheal intubation which appear to be attenuated by alternative airway managements.

Tracheal intubation causes a reflex increase in sympathetic activity that may result in hypertension, tachycardia, and arrhythmia (1). A change in plasma catecholamine concentrations also has been demonstrated to be a part of the stress response to tracheal intubation. The extent of the reaction is affected by many factors: the technique of laryngoscopy and intubation, and the use of various airway instruments, like tracheal tube and the laryngeal mask airway (LMA) (1).

Although in the majority of patients undergoing anesthesia, these responses are transient and probably of little consequence, they may be harmful to some patients, mainly those with myocardial or cerebrovascular diseases (1-3). We therefore conducted a prospective, randomised study to examine the hemodynamic changes produced by inserting a LMA, face mask (FM) or endotracheal tube (ETT) in healthy normotensive anesthetized patients.

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MATERIALS AND METHODS

Our institutional ethics committee approved the study and patients provided written informed consent before inclusion. Exclusion criteria were a history of difficult airway management, respiratory problems or cardiac disease.

A total of 195 ASA physical status I patients, aged 20-65 years receiving general anesthesia for transurethral lithotripsy procedures (duration 30-60 min) were randomly allocated to one of the three groups: LMA group, FM group and ETT group. Each group contained 65 patients.

Patients were premedicated with intravenous midazolam (0.05 mg/kg) 10 minutes before induction of general anesthesia and were fasted for at least 8 hours. After 5 to 10 min rest in the operating room, systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), heart rate (HR) and SPO_2 monitoring was commenced using the HXD-1 series block–type multifunctional monitor.

Anesthesia was induced with fentanyl 2 µg/kg and thiopental Na 4-6 mg/kg IV until loss of eyelash reflex and maintained with halothane in a mixture of nitrous oxide and oxygen (FiO_2 50%). Atracurium 0.4 mg/kg was administered for endotracheal intubation and/or mechanical ventilation via the LMA or the FM.

Intubation, LMA or FM insertion was attempted 180 seconds after the beginning of injection of atracurium. LMA, FM or ETT were inserted according the recommended instructions. All device insertions were performed by a single experienced investigator. The patients' lungs were ventilated with 1% halothane and 50% N_2O in oxygen via a Bain circuit and LMA, FM or ETT, with a fresh gas flow of 100 ml/kg/min and a ventilatory frequency of 12-15 bpm.

Measurements of SBP, DBP, MAP, HR and oxygen saturation were recorded immediately before induction of general anesthesia and every three minutes thereafter. A second investigator that was not aware of the patients group (LMA, FM or ETT) recorded these measurements. Patients were excluded if any abnormal cardiac rhythm developed, if difficult airway management occurred or if haemoglobin oxygen saturation decreased below 90% after induction.

Patients' characteristics were compared using the Student *t* test, and measurements of HR, SBP, DBP and MAP were analysed using repeated measures analysis of variance. Statistical significance was defined as $P<0.05$. Data are presented as mean ± standard deviation (SD).

RESULTS

There were no significant differences among the three groups in term of age and gender (Table 1). Although the LMA group had a lower mean age than the other two groups, the difference between the three study groups was not no statistically significant.

One patient who required three trials for insertion of LMA, two patients with difficult mask ventilation required intubation and one patient with difficult intubation were excluded from the study according to the exclusion criteria mentioned previously.

HR and MAP values immediately before the insertion of the device (LMA, FM or ETT) were

Table 1. Demographic characteristic, preinduction and preinsertion (baseline) hemodynamic values*

Variable	LMA group	FM group	ETT group
Age(yr)	39 ± 9	42 ± 10	41 ± 12
Sex(F/M)	23/42†	19/46†	21/44†
Preinduction Values ‡			
HR (bpm)	73 ± 12	68 ± 9	69 ± 16
MAP(mmHg)	78 ± 9	73 ± 12	75 ± 11
Preinsertion Values§			
HR (bpm)	75 ± 16¶	79 ± 8¶	76 ± 12¶
MAP (mmHg)	81 ± 12¶	82 ± 17¶	83 ± 8¶

Abbreviations: LMA, laryngeal mask airway; FM, face mask; ETT, endotracheal tube; F/M, female/male; HR, heart rate; MAP, mean atrial pressure.

* Data are given as mean ± SD unless otherwise specified.

† Number.

‡ Obtained immediately before the induction of general anesthesia.

§ obtained immediately before the insertion of LMA, FM or ETT.

¶ $P < 0.05$ versus preinduction values.

significantly higher than the preinduction values ($P<0.01$) but no significant differences were seen among the three groups ($P>0.05$).

Compared with preinduction and preinsertion values, changes in HR and MAP values observed during 15 minutes after induction of general anesthesia were statistically significant in all groups and the LMA group had a significantly lower HR and MAP than the other two groups (repeated measures ANOVA: $P<0.005$), meanwhile the maximum mean changes in SBP, DBP and HR were more marked after ETT (SBP 15% ± 11%, DBP 10% ± 13%, HR 17% ± 19%) and FM (SBP 12% ± 8%, DBP 6% ± 11%, HR 13% ± 7%) than insertion of LMA (SBP –3% ± 13%, DBP –5% ± 16%, HR 4% ± 13%) ($P<0.005$, $P<0.005$ and $P<0.01$ for SBP and DBP and HR, respectively).

At the 30 minutes after induction of anesthesia, MAP and HR slightly decreased in three groups compared with 15 min post induction but compared with preinduction values these changes were not statistically significant ($P>0.05$) but the LMA group had a significant lower values ($P<0.05$) than FM and ETT groups (Table 2).

The observed increases in MAP and HR were transient in all groups and did not require any treatment for any subject.

Table 2. Hemodynamic changes after the insertion of laryngeal mask airway, facemask and endotracheal intubation*

Variable	LMA group	FM group	ETT group
Number	64	63	64
Values 15 min after device insertion			
HR (bpm)	81±13†	84±12	96±8
MAP(mmHg)	82 ±14†	86 ± 10	91 ± 11
Values 30 min after device insertion			
HR (bpm)	73 ± 8†	80±6	88±7
MAP (mmHg)	79 ±11†	83 ± 13	82 ±9

Abbreviations: LMA, laryngeal mask airway; FM, face mask; ETT, endotracheal tube; HR , heart rate; MAP, mean atrial pressure.

*Data are given as mean ± SD.

† $P < 0.05$ versus ETT and FM group.

DISCUSSION

Induction of general anesthesia and tracheal intubation may be associated with marked changes in cardiovascular variables due to both the specific effect of the anesthetic drugs administered perioperatively and the adrenergic state of the patient. Alternative airway management strategies have been suggested to minimise cardiovascular changes.

The results of this prospective, randomized, double blind investigation demonstrated that in healthy, normotensive patients the insertion of the LMA caused a smaller increase in MAP and HR than did FM or ETT.

Based on the literature, we anticipated that the insertion of a LMA would elicit a much smaller hemodynamic response than tracheal intubation (4). Hemodynamic responses to insertion of the LMA were minimal, which supports the findings of Oczenski *et al.* (4), Wilson *et al.* (5) and Marietta *et al.* (6), 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. Our data contradict the results of Braude *et al.* (7), who found no significant difference in pressure response after insertion of LMA and ETT. However, it was not clear that using a LMA was less stressful than FM or not.

Possible limitations of this study deserve mentioning. First, we conducted our study on patients with normal airways and no cardiac disease. A longer duration of difficult airway management may produce different responses between the LMA, FM and ETT. Perhaps hemodynamic responses to those devices may be different in hypertensive patients. Second, we used the patients whose airways were successfully managed on the first attempt to clarify the effects of devices. Therefore, we could not observe the differences in hemodynamic changes in cases of repeated trials.

We conclude that hemodynamic responses to LMA are significantly lower than ETT and FM under halothane/N_2O anesthesia. It is likely that direct stimulation of the trachea by a tracheal tube has a major role in causing the cardiovascular responses to tracheal intubation in halothane/N_2O anesthesia but why LMA has lower cardiovascular responses than FM as well, needs further study.

REFERENCES

1. Barak M, Ziser A, Greenberg A, Lischinsky S, Rosenberg B. Hemodynamic and catecholamine response to tracheal intubation: direct laryngoscopy compared with fiberoptic intubation. J Clin Anesth. 2003 Mar; 15(2):132-136.

2. Casati A, Cappelleri G, Fanelli G, Magistris L, Beccaria P, Albertin A, Torri G. The pressor response after laryngeal mask or cuffed oropharyngeal airway insertion. Acta Anaesthesiol Scand. 1999 Nov; 43(10):1053-1056.

3. Laxton CH, Milner Q, Murphy PJ. Haemodynamic changes after tracheal intubation in cigarette smokers compared with non-smokers. Br J Anaesth. 1999 Mar; 82(3):442-443.

4. Oczenski W, Krenn H, Dahaba AA, Binder M, El-Schahawi-Kienzl I, Jellinek H, Schwarz S, Fitzgerald RD. Hemodynamic and catecholamine stress responses to insertion of the Combitube, laryngeal mask airway or tracheal intubation. Anesth Analg. 1999 Jun; 88(6):1389-1394.

5. Wilson IG, Fell D, Robinson SL, Smith G. Cardiovascular responses to insertion of the laryngeal mask. Anaesthesia. 1992 Apr; 47(4):300-302.

6. Marietta DR, Lunn JK, Ruby EI, Hill GE. Cardiovascular stability during carotid endarterectomy: endotracheal intubation versus laryngeal mask airway. J Clin Anesth. 1998 Feb; 10(1): 54-57.

7. Braude N, Clements EA, Hodges UM, Andrews BP. The pressor response and laryngeal mask insertion. A comparison with tracheal intubation. Anaesthesia. 1989 Jul; 44(7):551-554.