LARYNGEAL MASK INSERTION

- Effect of Age on Hemodynamic Responses -

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Introduction

For the past few decades laryngeal mask airway (LMA) was being widely used to provide spontaneous as well as controlled ventilation for surgical patients. Since it does not cross the glottic opening, the hazard of laryngoscopy especially sudden elevation of blood pressure and tachycardia are thus avoided. Various studies have shown that airway management with LMA may be used to avoid the hemodynamic response to tracheal intubation, when such a response is undesirable[1,2,3].

Induction of anesthesia, direct laryngoscopy and tracheal intubation induces marked cardiovascular changes as well as autonomic reflex activity[4]. Various factors can alter the hemodynamic response, and age is one of them. The pressor response was not seen in term neonates who were intubated awake but was present in infants who showed a significant rise in blood pressure[5]. Elderly patient on the other hand showed an attenuated chronotropic response but had a significant blood pressure rise[6,7].

The aim of our study was to find the effect of age on hemodynamic response after LMA insertion.

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Methods and Materials

Approval of the University Ethical Committee and the informed written consent were was obtained from all patients. Ninety adult patients, (ASA I-II) of both sexes, to undergo elective surgical procedures in which the laryngeal mask airway (LMA) for airway maintenance as part of technique, were recruited in the study. Exclusion criteria consisted of: patients with ASA III, history of hypertension, hypovolemic patients or those with persistent preinduction blood pressure of more than 160 mmHg systolic and 90 mmHg diastolic. Patients receiving any preoperative cardiovascular medication, which was likely to affect the heart rate or blood pressure response (e.g. beta-adrenergic blockers or calcium channel blockers), were excluded. A patient with previous cardiovascular pathology, in whom the use of laryngeal mask airway was contraindicated (e.g. obese, full stomach etc) or requiring more than one attempt at LMA insertion, was also excluded.

Selection of patients was based on the eligibility criteria.

After recruitment patients were equally divided (30 each) into three groups: Group Y (young) 18-25 years, Group M (middle) 40-45 years and Group E (elderly) 65-80 years.

All patients received oral tablet of midazolam 7.5 mg one hour preoperatively. On arrival to the operating room, monitors were attached and a peripheral vein was cannulated using an 18g intravenous cannula after giving perivenous local anesthetic.

Baseline readings of systolic, diastolic and mean arterial pressure and heart rate were recorded after a stabilization period of five minutes. Blood pressure was measured non-invasively by an automatic oscillometer. The CM5 ECG lead, oxygen saturation and end-tidal carbondioxide were monitored continuously (Datex Cardiocap Monitor).

Patients were instructed to count from time zero at which induction was done using propofol 2 mg/kg of the body weight given over 30 seconds. On loss of verbal contact, laryngeal mask was introduced by one of two investigators. We standardized the technique that was used in all ninety patients.

A midline approach for LMA insertion was used. The neck of the patient was flexed on the chest and head was extended on the neck using the non-dominant hand cupped behind the occiput. The LMA was held at the tube-mask junction between the index finger anteriorly and thumb posteriorly. The mouth of patient was opened by using fingers of the dominant hand that are not holding the tube. The lubricated cuff was positioned on the hard palate in the midline and completely flattened against it by inserting straight into the mouth and then manipulated into the position. Once flattened against the hard palate, the thumb was no longer needed to hold the tube, as the position was maintained by upward pressure from the index finger in contact with tube. The LMA was then slowly advanced along the palatopharyngeal curve by extending the index finger and internally rotating the wrist. When the cuff could not be advanced further, the finger was withdrawn from the mouth lateral to the tube. The cuff was inflated and the end of tube was held until the index finger was withdrawn. Immediately after insertion of the LMA, N_2O 66% and isoflurane, were introduced into the circuit 0.5% increase with every breath.

The heart rate and blood pressure were measured immediately after propofol injection and at 1, 2, 3, 4 & 5 minutes after insertion of LMA. The response variable was taken as both an absolute and a percentage change, in heart rate, systolic, diastolic and mean blood pressures at any time with that at the baseline.

Sample Size and Statistical Analysis

A total of 90 subjects equally divided into three groups (30 each) with the expectation of a maximum 15% change from the baseline in hemodynamic measures, with different readings on a subject at different time were taken, least 80% and a 5% level of significance. The response variable was taken both as absolute change and as the percentage change, in the measurement of heart rate and blood pressure at any time compared with that of the baseline.

The statistical design was the repeated measure design with ‘Age

group' as the between-subject factor and 'Time' as the within-subject factor. Repeated measures (ANOVA) were used to see the effect of age group separately at each time interval and the effect of time separately at each age group. The analysis was done on SAS (Statistical Analysis System) version 6.12-computer package (SAS Institute inc., Carry, NC, and U.S.A) A *p* value of less than 0.05 was taken as significant.

Results

The three groups were comparable with respect to weight, height, BMI, gender distribution and ASA grading (Table 1).

Table 1
Demographic and base line data

Group	Weight (kg)	Height (cm)	BMI	ASA (I: II)	Gender (Male: Female)
Young (Y)	65.6 (7.2)	163.0 (8.0)	24.7 (2.3)	22:08	19:11
Middle aged (M)	65.6 (6.5)	159.5 (8.0)	25.8 (2.5)	17:13	14:16
Elderly (E)	67.7 (7.7)	164.0 (7.5)	25.2 (2.6)	01:29	15:15

The **baseline hemodynamic** values are shown in Table 2. The baseline data showed the increase in blood pressure and decline in the heart rate in elderly age group that was significantly different from young and middle age group.

Table 2
Base Line Hemodynamics

Group	Blood Pressure (mmHg)			Heart Rate
	SAP[2]	DAP[3]	MAP[4]	Beats/minute[1]
Young (Y)	119.4 (8.2)	75.0 (5.9)	89.7 (6.1)	83.9 (12.5)
Middle aged (M)	125.7 (8.2)	77.7 (6.1)	92.9 (6.2)	78.7 (06.8)
Elderly (E)	140.0 (4.6)	81.1 (6.4)	100.3 (4.5)	73.9 (07.7)

[1] Old is significantly different from Young.

[1] Young is significantly different from Middle & Old.

[1] Young is significantly different from Old.

Heart Rate

After induction with propofol, the change in **heart rate (HR)** in all three groups was not significantly different from the baseline. No significant change from baseline was observed in any group after LMA insertion. A maximum change of 14% was observed in the middle-aged group. On intergroup comparison, response in the middle-aged group was significantly different from elderly and young group at 2, 3, 4 and 5 minutes. In all three groups, maximum response was seen at one minute after LMA insertion that returned to baseline at 3 minutes in young and elderly, but at 4 minutes in the middle age group. The response was higher in the middle aged compared to both young and elderly patients and took longer to return to baseline (Table 3).

Table 3
The percentage change in heart rate (SD) at different times in relation age group

Percent change from Baseline &	**Age Group**		
	Young Mean (SD)	Middle Mean (SD)	Elder Mean (SD)
After induction	1.49 (14.97)	-2.46 (03.92)	2.64 (4.86)
One minute after LMA insertion	12.03 (15.53)	14.63 (05.79)	11.60 (5.65)
Two minutes after LMA insertion	4.26 (09.25)	9.12 (08.02)*	6.22 (5.12)**
Three minutes after LMA insertion	-0.65 (07.69)	5.36 (09.62)*	0.51 (5.32)**
Four minutes after LMA insertion	-6.68 (08.70)	-0.09 (09.14)*	-4.75 (4.74)**
Five minutes after LMA insertion	-10.56 (07.79)	-4.94 (10.01)*	-8.70 (4.24)**
N	30	30	30

* Young is significantly different from middle age group.

** Middle age group is significantly different elderly age group.

Systolic Blood Pressure

After induction, the greatest decrease in **systolic blood pressure**

(SBP) was seen in the young age group (8%) which was significantly different from the old age group but not from the middle age group (Table 4). After LMA insertion, the greatest increase in systolic blood pressure (7%) was seen in the middle age group, which was not statistically different from either group. SBP came back to baseline later in the middle-aged group by 3 minutes, young and elderly it came back to baseline at 2 minutes. The difference in post insertion reading was not significant in any of the groups compared to baseline values.

Table 4
The percentage change in systolic blood pressure (SD) at different times in relation to the age group.

Percent change from Baseline &	**Age Group**		
	Young Mean (SD)	Middle Mean (SD)	Elder Mean (SD)
After induction	-7.55 (5.04)*	-3.81 (3.80)	-3.25 (1.75)
One minute after LMA insertion	4.01 (7.69)	6.66 (4.17)	3.39 (4.86)
Two minutes after LMA insertion	-0.76 (7.15)	1.72 (5.47)	-0.14 (4.47)
Three minutes after LMA insertion	-4.48 (7.21)	-1.52 (5.63)*	-4.38 (3.55)**
Four minutes after LMA insertion	-8.32 (6.89)	-5.00 (5.67)	-7.64 (3.40)
Five minutes after LMA insertion	-12.44 (7.34)	-8.06 (5.16)	-10.10 (3.32)
N	30	30	30

* Young age group is significantly different from elderly age group.
** Young age group is significantly different from middle age group.

Diastolic Blood Pressure

Diastolic blood pressure (DBP). None of the values in any group showed a significant change from the baseline. The maximum change observed was in the middle aged group (11%) after insertion of LMA.

Following induction, however, a greater decrease in the young age group which was statistically significant different from the other two groups (Table 5).

Table 5
The percentage change in diastolic blood pressure (SD) at different times in relation to the age group.

Percent change from Baseline &	**Age Group**		
	Young Mean (SD)	Middle Mean (SD)	Elder Mean (SD)
After induction	-9.96 (09.02)	-3.16 (5.02)*	-5.92 (3.62)**
One minute after LMA insertion	8.00 (10.58)	11.39 (7.04)*	5.40 (5.15)**
Two minutes after LMA insertion	0.66 (11.27)	4.37 (5.78)*	-0.60 (6.07)**
Three minutes after LMA insertion	-5.17 (11.31)	-0.72 (6.26)*	-6.06 (6.08)**
Four minutes after LMA insertion	-10.87 (9.93)	-5.87 (6.57)	-10.51 (5.55)
Five minutes after LMA insertion	-15.74 (9.21)	-11.48 (7.13)	-13.76 (5.52)
N	30	30	30

* Young is significantly different from middle.
** Middle age group is significantly different elderly age group.

After LMA insertion a statistically significant difference was seen between the middle group and the other two groups at 1, 2 and 3 minute post LMA insertion. DBP came to baseline value at 3 minutes in the young and elderly age group.

Mean Blood Pressure

Maximum fall in the **mean blood pressure** (MAP) was seen in the young age group (9%) that was significantly different from middle and elderly age group (Table 6). Post LMA insertion maximum rise (10%) was seen in the middle aged group which was significantly different from young and elderly at 1, 2, 3 and 4 minutes. MAP

reached baseline later in the middle aged at 3 minutes, in young and elderly group it came back to baseline at 2 minutes. The changes mimicked the change seen in the DBP.

Table 6
The percentage change in mean blood pressure (SD) at different times in relation to the age group.

Percent change from Baseline &	**Age Group**		
	Young Mean (SD)	Middle Mean (SD)	Elder Mean (SD)
After induction	-9.26 (07.16)	-3.27 (4.20)**	-4.77 (2.80)
One minute after LMA insertion	*	10.19 (5.92)**	3.82 (3.51)***
Two minutes after LMA insertion	5.97 (08.74)	3.16 (3.40)**	-0.87 (4.23)***
Three minutes after LMA insertion	-0.61 (08.64)	-0.97 (3.69)**	-5.70 (4.76)***
Four minutes after LMA insertion	-5.37 (10.20)	-5.38 (4.00)**	-8.92 (6.66)***
Five minutes after LMA insertion	-10.20 (08.72) -14.74 (07.99)	-9.70 (3.97)	-12.49 (4.44)
N	30	30	30

* Young age group is significantly different from elderly age group.
** Young age group is significantly different from middle age group.
*** Middle age group is significantly different from middle and elderly age group.

Discussion

Laryngoscope guided tracheal intubation (LG-TI) causes a 25-50% increase in blood pressure (BP) and heart rate (HR)[8]. By comparison, LMA insertion is less stimulating to the pharynx, and non-stimulating to the larynx and trachea. It has been known since the early 1980s that there are fewer afferent neural pathways responsive to noxious stimuli in the pharynx than the larynx[9]. Brude and colleagues[10] in 1989, hypothesized that the hemodynamic response would be lower for LMA insertion than LG-TI. The authors subsequently confirmed their hypothesis and suggested that this was primarily related to avoidance of laryngoscopy, which entailed "excessive and protracted wall stimulation" and secondarily to the avoidance of penetrating the highly sensitive larynx and trachea.

There are now 30 studies investigating hemodynamic responses to LMA[11]. Out of these 24 studies compare the hemodynamic response of LMA verses tracheal tube in normal patients. In 18 of these studies, the

LMA was found to have an attenuated response[11]. Meta analysis of these data reveals that the mean heart rate, blood pressure and plasma catecholamine levels were higher after LG-TI by 17%, 23% and 56% respectively[11]. These differences last for 2-3 minutes. Interestingly, one group found that the increase in sympathetic nerve activity was lower (66% vs. 600% increase) and returned more rapidly to baseline values with LMA[12]. One group also reported that the hemodynamic stress response was unaffected by the use of muscle relaxants[13].

Our study supports this evidence when comparison is drawn between the hemodynamic responses after LMA insertion in 90 patients of different age groups. The maximum change observed was not more than 14% from baseline in all the groups.

Age can affect the response to laryngoscopy and intubation. This was first studied by Bullington[6] who found a lesser chronotropic response to intubation in elderly patients. In a previous study[7] the authors found lesser chronotropic and higher systolic blood pressure response in the elderly patient, as compared to young and middle aged patients. Aging is associated with an increase in coexisting disease, such as hypertension, ischemic heart disease, cardiac conduction defects, CCF etc[14]. Therefore, the principal advantage of the LMA over tracheal tube for elderly patients is that it is less likely to interfere with cardio respiratory physiology. The frequency of LMA use in the elderly is unknown, but Verghese and Brimacombe[15] in a survey of 11,910 patients managed with LMA, reported that 14% were 66-80 yrs old and 4% were 80 years old.

There are 26 publications providing useful information about the LMA in elderly patients[16]. None of the studies, however, have compared the hemodynamic response of LMA insertion with younger age group. Our study tried to evaluate if any clinically significant difference existed between the different age groups when LMA is used versus LG-TI[6,7].

Aging is associated with deterioration in organ function with progressive decrease in function of major systems by 1-1.5% per annum[16] including the autonomic cardiovascular control mechanism[17]. Arterial baroreflex contribute to blood pressure regulation through their influence

on parasympathetic outflow to sinus node and sympathetic outflow to the peripheral circulation[17]. Sinus arrhythmia in older individual suggests that parasympathetic control of sinus node function decline with age[17]. In contrast, elevated basal levels of plasma catecholamine and muscle sympathetic nerve activity (MSNA) indicate that sympathetic outflow is enhanced with age[17]. Some investigators have found no difference in the sympathetic nerve activity between old and young group[18,19]. Thomas et, al[18] have found that dynamic baroreflex control of sympathetic outflow and the vascular responses to sympathetic stimulation are well maintained in the moderately old, healthy, free-living active individuals. Similarly, D'O Mahony and colleagues[19] demonstrated no significant difference between young and elderly groups when they tested the efferent sympathetically mediated heart rate/blood pressure to the stress test battery.

In our study no significant difference was found between the young and elderly groups. The maximum response was seen in the middle age group, which was significantly different from the young and elderly group.

Most studies done on hemodynamic responses to intubation, group the young and middle-aged patients together[20] or include the entire three groups as a single entity[21]. There is only one comparative study[22] of LMA comparing the MAC for sevoflurane between the elderly and the young. They have also combined the young and middle aged together in the age range of 18-50 yrs.

Our study varies, because we separated the young and middle aged patients in different age groups, and a different response in the middle aged patients was revealed. The possible explanation could be that a period of hypersensitivity in the middle age resulted in greater pressure response. An alternative explanation could be that the response between the middle age and the other two groups is different, because of the variation in the balance between sympathetic and parasympathetic outflow. Even though middle-aged patients had a higher response compared to the other two age groups, the response compared to the

baseline was not significant to have any clinical implication.

The clinical implication of the hemodynamic stress response to airway management is unknown. There is well-established relationship between acute hypertension, tachycardia and myocardial ischemia[23,24] but there is only anecdotal evidence that is harmful to patients[25,26]. The main outcome is probably the brevity of these changes.

In conclusion no significant change from baseline were observed with LMA insertion in any group. Middle-aged patients had the greatest arterial pressure and chronotropic response following LMA insertion as compared to the young and old age group, but compared to the baseline, the change was so small that it does not seem to have any clinical relevance.

Our study stands as a preliminary vanguard for further research into the hemodynamic response to LMA insertion in the middle age group. The exact mechanism responsible for the higher pressor response in the middle age group and why it takes longer for this response to come to the baseline and why does the response come down with age to the levels seen in young patients, needs further investigation.

References

1. WOOD ML, FORREST ET: The haemodynamic response to the insertion of the laryngeal mask airway: a comparison with laryngoscopy and tracheal intubation. *Acta-Anaesthesiol-Scand*; 38(5):510-3, Jul, 1994.
2. IDREES A, KHAN FA: A Comparative study of positive pressure ventilation via laryngeal mask airway and endotracheal tube. *J-Pak-Med-Assoc*; 50(10):333-8, Oct, 2000.
3. LAMB K, JAMES MF AND JANICKI PK: The laryngeal mask airway for intraocular surgery: effects on intraocular pressure and stress response. *Br. J. Anaesthesia*; 69(2):143-7, Aug, 1992.
4. PERNERSTORFER P, KRAFT P, FITZGERALD RD, ET AL: Stress response to tracheal intubation and direct laryngoscopy compared with blind oral intubation. *Anesthesia*; 50:17-22, 1995.
5. CHARLTON AJ, GREEN HOUGH SG: Blood pressure response of neonates to tracheal intubation. *Anaesthesia*; 43:744-746, 1998.
6. BULLINGTON J, MOUTON PERRY SM, RIGBY J, ET AL: The effect of advancing age on the sympathetic response to laryngoscopy and trachealintubation. *Anesth Analg*; 68:603-608, 1989.
7. ISMAIL S, AZAM SI, KHAN FA: Effect of age on haemodynamic response to tracheal intubation. A comparison of young, middle-aged and elderly patients. *Anaesth Intensive Care*; 30:608-614, 2002.
8. NG WS: Pathophysiological effects of tracheal intubation. In Latto IP, Rosen M, Eds. *Difficulties in tracheal intubation*. London: Bailliere Tindall, 12-35, 1984.
9. SANT'AMBROGIO G, MATHEW OP, FISHER JT, SANT'AMBROGIO FB: Laryngeal receptors responding to transmural pressure, airflow and local muscle activity. *Resp Physiol*; 54:317-330, 1983.
10. BRAUDE N, CLEMENTS EA, HODGES UM,ANDREWS BP: The pressor response and laryngeal mask insertion. A comparison with tracheal intubation. *Anaesthesia*; 44:551-554, 1989.
11. Pathophsiology. In *Laryngeal Mask Anaesthesia.* Brimacombe JR Eds. London: Saunders Elsevier Limited, 107-108, 2005.
12. AKBAR AN, MUZI M, LOPATKA CW, EBERT TJ: Neurocirulatory responses to intubation with either an endotracheal tube or laryngeal mask airway in human. *J Clin Anaesthesia;* 8:194-197, 1996.
13. DYER RA, LLEWELLYN RL, JAMES MFM: Total IV anaesthesia with propofol and the laryngeal mask for orthopaedic surgery. *Br J Anaesthesia;* 123-128, 1995.
14. WEI JY: Age and the cardiovascular system. *New Engl J Med;* 327:1735-1739, 1992.
15. VERGHESE C, BRIMACOMBE J: Survey of laryngeal mask airway usage in 11910 Patients; safety and efficacy for conventional usage. *Anesth Analg;* 82:129-133, 1996.
16. Co-existing disease. In *Laryngeal Mask Anaesthesia.* Brimacombe JR, ed. London: Saunders Elsevier Limited, 399, 2005.
17. INGALL TJ, JG, MCLEOD AND PCO'BRIEN: The effect of aging on autonomic nervous system function. *Aust NZJ Med;* 570-577, 1990.
18. THOMAS J ELBERT, BARBARA J MORGAN, JILL A BARNEY, TONI DENAHAN AND JAMES J SMITH: Effects of aging on baroreflex regulation of sympathetic activity in humans. *American Journal of Physiology;* 263, H798-803, 1992.
19. O'MAHONY D, BENNETT C, GREEN C, SINCLAIR AJ: Reduced baroreflex sensitivity in elderly human is not due to efferent dysfunction. *Clin Sci;* 98:103-110, 2000.

20. HALL AP, THOAMS JP, LESLIE NA, FOX AJ, KUMAR N, ROWBOTHAM DJ: Comparison of different doses of remifentanyl on the cardiovascular response to laryngoscopy and tracheal intubation. *Br J Anaesth;* 84:100-102, 2000.
21. LAXTON CH, MILNER Q, MURPHY PJ: Haemodynamic changes after tracheal intubation in cigarette smokers. *Br J Anaesthesia;* 82:422-443, 1999.
22. TANAKA M, WATANABE S, NISHIWAKA T: Minimum Alveolar Sevoflurane concentration required for insertion of cuffed oropharyngeal airway and the laryngeal mask airway: a comparative study. *Anaesthesia;* 54:1155-1160, 1999.
23. SLOGOFF S, KEATS AS: Does perioperative myocardial ischemia lead to postoperative myocardial infarction? *Anesthesiology;* 62:107-114, 1985.
24. SLOGOFF S, KEATS AS: Further observation on perioperative myocardial ischemia. *Anesthesiology;* 65:539-542, 1986.
25. FOX EJ, SKLAR CS, HILL CH, VILLANUEVA R, KING BD: Complication related to the pressor response to endotracheal intubation. *Anesthesiology;* 47:524-525, 1977.
26. FORBES AM, DALLY FG: Acute hypertension during induction of anaesthesia and endotracheal intubation in normotensive man. *Br J Anaesth;* 42:618-624, 1970.