

Research Article

Comparison of haemodynamic responses in normotensive and hypertensive patients among three intubation devices: macintosh laryngoscope, intubating laryngeal mask airway and lightwand

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ABSTRACT

Background: The pressor response to endotracheal intubation is of special concern, especially in the presence of comorbidities like diabetes, hypertension, obesity and ischemic heart disease (IHD). It is commonly assumed that insertion of laryngeal mask airway (LMA) is associated with lesser hemodynamic fluctuations than conventional laryngoscopy. Also, the lightwand (LW) is believed to provoke a milder pressor response as it does not involve elevation of epiglottis. We decided to evaluate the pressor response to all three devices in normotensive and hypertensive patients.

Methods: We conducted a randomized prospective study consisting of 126 patients posted for surgical procedures under general anesthesia. 63 hypertensive and 63 normotensive patients were randomly assigned to each intubation device: the macintosh laryngoscope (LS), the lightwand (LW), and the intubating laryngeal mask airway (ILMA). The peri-intubation hemodynamic parameters were recorded. Statistical analysis was done with SPSS version 17.0. Inter- and intra-group differences among the hemodynamic variables recorded over time were analyzed by using one-way analysis of variance for repeated measures with bonferroni post-test analysis as appropriate. All quantitative data were expressed as mean±standard deviation (SD). A p-value less than 0.05 was considered statistically significant.

Results: All 3 devices (LS, ILMA and LW) are comparable with respect to hemodynamic fluctuations in normotensive patients. However, in hypertensive patients conventional laryngoscopy was associated with greater hemodynamic fluctuations than ILMA or LW. However there was no significant difference in the hemodynamic fluctuations between ILMA and LW.

Conclusions: The ILMA and LW may be preferable to LS in hypertensive patients where attenuation of hemodynamic stress response is desired.

Keywords: Pressor response, Normotensive, Hypertensive

INTRODUCTION

Endotracheal intubation is one of the commonest interventions performed by an anaesthesiologist. The pressor response to endotracheal intubation is of special

concern, especially in the presence of comorbidities like diabetes, hypertension, obesity and ischemic heart disease (IHD).¹ It probably involves intense sympathetic discharge caused by stimulation of epipharynx and laryngopharynx. This suggests that direct laryngoscopy is

the major stimulus for pressor response with an additional stimulus caused by intubation.

It is commonly assumed that insertion of laryngeal mask airway (LMA) is associated with lesser hemodynamic fluctuations than conventional laryngoscopy.² Also, the lightwand (LW) is believed to provoke a milder pressor response as it does not involve elevation of epiglottis. Any device or technique that minimizes the pressor response is highly desirable in patients with cardiac disease, raised intra cranial tension and hypertension.

We decided to compare the hemodynamic fluctuations associated with three common devices the laryngoscope, the intubating laryngeal mask airway (ILMA) and the lightwand in normotensive and hypertensive patients.

The aim of our study is to compare the haemodynamic responses in normotensive and hypertensive patients using three intubation devices: macintosh, laryngoscope, intubating laryngeal mask airway and lightwand in terms of:

- Changes in systolic blood pressure (SBP).
- Changes in diastolic blood pressure (DBP).
- Changes in heart rate (HR).

METHODS

We conducted a randomized prospective study consisting of 126 patients posted for surgical procedures under general anesthesia. The Institutional Ethics Committee approval was obtained to conduct the study. 63 hypertensive and 63 normotensive patients were enrolled after written informed consent. They were randomly assigned to each intubation device: the macintosh laryngoscope (LS), the lightwand (LW), and the intubating laryngeal mask airway (ILMA). The ILMA which we have used was (LMA-Fastrach) whereas lightwand used was Dr. Talwalkar's Fibrelite stylet and handle. Noninvasive systolic blood pressure (SBP) and diastolic blood pressure (DBP) and heart rate (HR) were recorded immediately preinduction, immediately preintubation, and every minute for the first 5 min after successful intubation. Complications were recorded.

Inclusion criteria

- Patients in the age group of 18-60 years.
- Patients belonging to ASA grade I (Normotensive) and grade II (hypertensive)

Normotensive	:	No H/o Hypertension
	:	SBP < 140 mmHg
	:	DBP < 90 mmHg on admission
Hypertensive	:	H/o Hypertension and taking treatment. (according to classification of hypertension in JNC-7) ³

- Patients undergoing any surgical procedure under general anaesthesia with endotracheal intubation.
- Patients with MPC grade I and II.

Exclusion criteria

- Patients with anticipated difficult intubation i.e. MPC grade III and IV.
- H/o difficult intubation.
- Patients undergoing head or neck surgeries.
- Pregnant patients and full stomach patients.

Pre-anesthetic evaluation was performed as per departmental protocol. Airway assessment included MPC- grading, thyromental distance and mentosternal distance. Adequate starvation was confirmed.

Study procedure

Both types of patients were randomly allocated to undergo intubation using Macintosh laryngoscope, Lightwand or ILMA by picking up chits.

All hypertensive patients received their antihypertensive medication approximately 3 hours before induction.

After attaching monitors, pre-operative readings were noted.

- 18G IV angiocatheter was used to secure IV line.
- Patient were premedicated with injection ondansetron 4 mg IV and injection ranitidine 50 mg IV.
- IV RL was started.

Induction and intubation

Patients were placed in the supine position with the head on a head ring. 100% oxygen was administered via a face mask for 3 minutes. Lidocaine 0.5 mg/kg was given IV to reduce propofol injection pain. Anaesthesia was induced 30 seconds later with propofol 2.5 mg/kg IV and ventilation was checked.

Muscle relaxation was achieved with Succinyl choline 2 mg/kg. Patients were ventilated via a face mask until the fasciculations due to succinyl choline disappear. In the laryngoscopy (LS) group, the patients were intubated using conventional macintosh laryngoscope. In the ILMA group, an appropriate sized ILMA was inserted using a single handed movement in saggital plane

In LW group, LW was introduced into the endotracheal tube and the proximal end of the tube was bent to 90° angle. Room illumination was reduced during intubation and glow of light was observed at the patient's anterior neck. The detection of distinct central point of light without a halo at the cricothyroid membrane was taken as evidence that the tip of the tracheal tube was correctly

placed around the laryngeal inlet. The tracheal tube was then advanced until the glow disappeared behind the sternum as the stylet was withdrawn. Anaesthesia breathing circuit was connected.

End points

In all three type of procedures, successful tracheal intubation was confirmed by appearance of mist in the endotracheal tube, chest wall movement, auscultation and capnography. In all groups, only the successful first attempt at intubation was included.

Outcome measures and statistical analysis

Noninvasive blood pressure and heart rate was recorded immediately preinduction and every min for the first 5 min after successful intubation. Unless otherwise noted, data are presented as mean±SD, significance is taken as p <0.05.

All data was analyzed by using SPSS version 17.0. Descriptive data like age, ASA grading, thyromandibular

distance, sternomandibular distance, were tested using a factorial analysis of variance. Chi-square test was used to find out distribution of sex and MPC grading between normotensive and hypertensive groups. Inter- and intra-group differences among the hemodynamic variables recorded over time were analyzed by using one-way analysis of variance for repeated measures with Bonferroni post-test analysis as appropriate. All quantitative data were expressed as mean±standard deviation (SD). A p-value less than 0.05 was considered statistically significant.

RESULTS

Table 1 shows thyromental distance -ANOVA test applied. These values are comparable and p value was >0.05. SMD- Anova test applied. These values are comparable and p value was >0.05.

MPC grading was comparable and the difference was not statistically significant among all groups according to chi-square test and p value was >0.05.

Table 1: Comparison of airway assessment between the groups.

Parameters	Group	Group	Group	Group	Group	Group	P-value
	NTLS	NTILMA	NTLW	HTNLS	HTNILMA	HTNLW	
No of patients	21	21	21	21	21	21	21
TMD (cm)							
Mean	8.28	8.19	8.09	8.28	8.11	8.11	0.903
SD	0.66	0.74	0.75	0.73	0.77	0.77	
SMD (cm)							
Mean	14.85	15.64	15.04	15.024	15.16	15.00	0.573
SD	0.88	2.29	0.77	1.16	0.59	0.79	
MPC I (%) (%)	10 (47.61%)	10 (47.61%)	21 (52.39%)	21 (52.39%)	10 (47.61%)	10 (47.61%)	
	21 (52.39%)	21 (52.39%)	10 (47.61%)	10 (47.61%)	21 (52.39%)	21 (52.39%)	

Table 2: Comparison between three devices in each group for SBP.

Normotensive		Hypertensive	
Group	P value	Group	P value
Baseline	0.339	Baseline	0.640
Preintubation	0.120	Preintubation	0.732
1 minute	0.442	1 minute	0.013*
2 minute	0.831	2 minute	0.019*
3 minute	0.645	3 minute	0.185
4 minute	0.827	4 minute	0.630
5 minute	0.809	5 minute	0.921

Sign * denotes p value is statistically significant among devices used so pair-wise comparison of the mean values was assessed by Bonferroni-Dunn test.

In hypertensive patients, there was significant difference found at 1 min & 2 min. (P value < 0.05). Because SBP in the HTNLS group were significantly higher than the HTNILMA and HTN LW groups for 1 min& 2 min after

intubation.(P values in pair wise comparison i. e. by Bonferroni-Dunn test are 0.27 & 0.37 for HTLS which are significant.)

Table 3: Comparison between three devices in each group for DBP.

Normotensive		Hypertensive	
Group	P-value	Group	P-value
Baseline	0.258	Baseline	0.784
Preintubation	0.322	Preintubation	1.000
1 minute	0.005*	1 minute	0.24*
2minute	0.718	2 minute	0.21*
3 minute	0.818	3 minute	0.209
4 minute	0.561	4 minute	0.572
5minute	0.331	5 minute	0.503

Sign * denotes p value is statistically significant among devices used so pair-wise comparison of the mean values was assessed by Bonferroni-Dunn test.

In hypertensive patients, there was significant difference found at 1 min & 2 min. (P value < 0.05) because DBP in the HTNLS group was significantly higher than the HTNILMA and HTN LW groups for 1 min & 2 min after

intubation (P values in pair wise comparison i. e. by Bonferroni-Dunn test are 0.46&0.45 for HTLS which was significant.)

Table 4: Comparison between three devices in each group for heart rate.

Normotensive		Hypertensive	
Group	P-value	Group	P-value
Baseline	0.969	Baseline	0.551
Preintubation	0.001	Preintubation	0.954
1minute	0.224	1 minute	0.798
2 minute	0.351	2 minute	0.873
3 minute	0.719	3 minute	0.592
4 minute	0.843	4 minute	0.411
5 minute	0.120	5 minute	0.670

In normotensive patients, there were no differences in heart rate after intubation among the three devices. . (P values are > 0.05). In hypertensivepatients also there were no differences in heart rate among the devices. (P values are > 0.05)

Table 5: Comparison of complications between the groups.

Complications	NTLS	NTILMA	NLW	HTNLS	HTNILMA	HTLW
No. of patients	21	21	21	21	21	21
Gum trauma						
No.	3	1	2	1	1	1
Lip trauma						
No.	1	2	2	1	1	1

From the above table it can be seen that laryngoscopy group had only 4 patients with gum trauma, 2 patients with lip trauma. ILMA group had only 2 patients with gum trauma, 3 patients with lip trauma whereas lightwand group had only 3 patients with gum trauma, 3 patients with lip trauma. All of these were abrasions only. There was no incidence of sore throat.

DISCUSSION

The pressor response to endotracheal intubation can be associated with various dysarrhythmias and lead to adverse cardiovascular events. A technique for endotracheal intubation that is associated with minimal hemodynamic fluctuations is highly desirable in patients with limited cardiovascular reserve.

In the present study we have performed a comparative evaluation of the changes in heart rate and blood pressure associated with three different techniques of intubation namely macintosh Laryngoscope (LS), intubating laryngeal mask airway (ILMA) and lightwand (LW) 63 normotensive and 63 hypertensive adult patients of ASA I and ASA II status were included in our study. Each group of 63 patients was randomly allocated to three different techniques of intubation. All the hypertensive patients were on anti-hypertensive medications and well controlled. The sample size was selected to detect a 20 mmHg or 20 beats per minute difference in blood pressure and heart rate, respectively, for a type I error of 0.05 and a power of 0.8 and was based on data from a pilot study of 30 patients in which standard deviation of systolic blood pressure was observed as 20 mmHg. Allowable error was taken as 5%.

Demographic parameters and airway

The demographic parameters were comparable in all the groups. There was no significant difference between the groups with relation to MPC, thyromental distance and sternomental distance.

Number of attempts of intubation

When we performed a pilot study, we observed that the hemodynamic fluctuations were more pronounced when a second or third attempt at intubation was made. This was especially so in hypertensive patients Thus in our study, to avoid this bias, we included only those patients who were intubated at the first attempt.

Magnitude of pressor response

In principle, tracheal intubation techniques that avoid or minimize oropharyngolaryngeal stimulation might provoke a milder hemodynamic stress response or reduce the incidence of airway morbidity. In addition, hemodynamic responses after laryngoscope-guided tracheal intubation are more pronounced in hypertensive patients.^{4,5}

S. Kihara et al found that both the ILMA and the LW provoke a milder stress response to tracheal intubation compared with the LS in hypertensive patients but not in normotensive patients.⁶ Kohki Nishikawa et al concluded that the lightwand technique caused lesser hemodynamic changes in normotensive patients than the laryngoscope.⁷ In hypertensive patients the lightwand technique failed to attenuate increases in arterial blood pressure after intubation.

Systolic blood pressure

Our study shows that in all groups, there was a reduction in systolic blood pressure immediately preintubation compared with baseline values. This was the effect of the induction agent. In normotensive patients, there were no

differences in SBP among the three devices (p-values are > 0.05). In hypertensive patients, there was a significant difference found at 1 min and 2 min. (p value < 0.05). SBP in the HTNLS group was significantly higher than the HTNILMA and HTNLW groups for 1 min and 2 min after intubation (p-values in pair wise comparison i. e. by Bonferroni-Dunn test are 0.27 and 0.37 for HTLS which are significant) But there was no significant difference between ILMA and LW in hypertensive patients.

In a similar study, Kihara S et al concluded that in normotensive patients, there were no differences in systolic blood pressure among the three devices.⁶ In hypertensive patients, systolic blood pressure in the LS group was significantly higher than the ILMA and LW groups for 2 min after intubation.

Diastolic blood pressure

Our study shows that in all groups, there was a reduction in diastolic blood pressure immediately preintubation compared with baseline values. This was the effect of propofol. There were increases in diastolic blood pressure in the HTNLS group after intubation compared with baseline values.

In normotensive patients, there were no differences in DBP among the three devices except at 1 min. (p-value is <0.05) because DBP in the NTILMA group was significantly lower than NTLIS group. (p-values in pair wise comparison i. e. by Bonferroni-Dunn test are 0.005 for NTILMA which is significant).

In hypertensive patients, there was significant difference found at 1 min and 2 min. (p value < 0.05). Because DBP in the HTNLS group was significantly higher than the HTNILMA and HTN LW groups for 1 min and 2 min after intubation. (p-values in pair wise comparison i. e. by Bonferroni-Dunn test are 0.46 & 0.45 for HTLS which are significant). But there was no significant difference between ILMA and LW in hypertensive patients.

In a similar study by S Kihara et al, in normotensive patients, there were no differences in diastolic blood pressure among the three devices.⁶ In hypertensive patients diastolic blood pressure in the LS group was significantly higher than the ILM and LW groups for 2 min after intubation.

Heart rate

In normotensive patients, there were no differences in heart rate after intubation among the three devices (p values are >0.05). In hypertensive patients also there were no differences in heart rate among the three devices. (p values are > 0.05). In a similar study by Kihara S et al in all groups, heart rate increased after intubation compared with baseline values.⁶ There were no differences in heart rate among the three devices in normotensive or hypertensive patients.

Complications

Kihara S et al observed that airway injury was more frequent for the ILMA group than the LS group and LW group.⁶ Nishikawa K et al observed that the number of patients who complained of hoarseness was greater in the lightwand technique groups.⁷ Rhee KY et al observed that patients in Laryngoscopy group had more postoperative pharyngolaryngeal complaints.⁸ From Table 5, it can be seen that the incidence of gum trauma and lip trauma was low in all the groups. All these were minor abrasions only. There was no incidence of sore throat.

Our study concludes that all the 3 devices (LS, ILMA, and LW) are comparable with respect to hemodynamic fluctuations in normotensive patients. However, in hypertensive patients conventional laryngoscopy was associated with greater hemodynamic fluctuations than ILMA or LW. However there was no significant difference in the hemodynamic fluctuations between ILMA and LW. Thus the ILMA and LW may be preferable to LS in hypertensive patients where attenuation of hemodynamic stress response is desired.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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