Original Research Article

Indian Journal of Anesthesia and Analgesia
2019; 6(4) (Part - I): 1227-1234
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.6419.26

Comparative Study of Haemodynamic Response to Intubation with McCoy laryngoscope, Intubating LMA and Vividtrac® Videolaryngoscope in Controlled Hypertensive Patients

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Abstract

Laryngoscopy and intubation can result in significant haemodynamic response which is even more exaggerated in hypertensive patients. The magnitude of cardiovascular response is directly related to the force applied and duration of laryngoscopy. Various airway devices and drugs have been tried to limit this pressor response. We conducted a prospective, randomized study to compare haemodynamic response to intubation using McCoy laryngoscope, Intubating Laryngeal Mask Airway (ILMA) and VividTrac® videolaryngoscope in patients with controlled hypertension requiring general anaesthesia for various surgeries. *Methods:* The study included 90 controlled hypertensive patients of either sex, belonging to ASA grade II, between age group of 40-60 years, requiring general anaesthesia were divided into three groups. In group M, patients were intubated with McCoy laryngoscope. In group L, patients were intubated with intubating LMA. In group V, patients were intubated using VividTrac® videolaryngoscope. Haemodynamic response following intubation were compared among all the three groups. Intubation time, the success rate of intubation and complications, if any, were also compared in all the three groups. *Results:* It was observed that VividTrac® videolaryngoscope produced significantly less haemodynamic response compared to intubation with ILMA and McCoy laryngoscope. Intubation using McCoy laryngoscope was found to be comparatively a faster method to secure tracheal intubation when compared to ILMA and videolaryngoscope. Complications, like oesophageal intubation and sore throat were more with intubating LMA, whereas injury to oropharyngeal mucosa was found to be observed with VividTrac® videolaryngoscope. *Conclusion:* VividTrac® videolaryngoscopy and intubation causes less haemodynamic changes compared to Intubating LMA and McCoy laryngoscopy.

Keywords: General anaesthesia; Intubation; Haemodynamic response; Controlled hypertension.

How to cite this article:

Sangeetha C, Sowmya M Jois, Yeshaswini Katari *et al.* Comparative Study of Haemodynamic response to Intubation with McCoy laryngoscope, Intubating LMA and Vividtrac® Videolaryngoscope in Controlled hypertensive patients. Indian J Anesth Analg. 2019;6(4):1227-1234

Introduction

Endotracheal intubation is the gold standard in airway management to administer general anaesthesia. Laryngoscopy and intubation can result in significant haemodynamic response [1]. Mechanical stimulation of the respiratory tract induces reflex cardiovascular responses which

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Received on 22.06.2019, **Accepted on** 09.07.2019

is associated with increase in catecholamine levels [2]. The consequence of pressor response may cause tachycardia, hypertension and occasional dysrhythmias and in hypertensive patients it can lead to life threatening responses such as angina, myocardial infarction, pulmonary oedema and intracranial bleed [3]. Various drugs, laryngoscopes and airway devices have been compared for the haemodynamic responses during intubation [4,5,6]. Since there were not many studies done comparing VividTrac® videolaryngoscopes with intubating LMA and McCoy laryngoscopes in controlled hypertensive patients, we decided to conduct this randomized, comparative study.

Material & Methods

After obtaining Institutional ethical committee approval, this randomized, prospective study was conducted on 90ASA II adult patients aged between 40 to 60 years with controlled hypertension who were on antihypertensive medications with no clinical or laboratory evidence of new or worsening target organ damage undergoing various, elective surgical procedures with no anticipated difficulty requiring general anaesthesia with endotracheal intubation. Informed consent to participate in the study was taken in all patients enrolled in the study. Standard anaesthetic technique was followed in all patients. Patients were randomly allocated into either McCoy group (Group M), ILMA group (Group L) or VividTrac® video laryngoscope group (Group V) with 30 in each group by random number tables. Patients with uncontrolled hypertension, risk of gastric aspiration, anticipated difficult intubation, history of epilepsy or history of ischemic heart disease were excluded from the study. All the required parameters were collected by an independent observer anaesthesiologist. Tracheal intubation was performed in each patient by consultant anaesthesiologists who were experienced and who had performed at least 10 intubations with the new device in the clinical setting and who were not involved in the study.Thorough pre-anaesthetic evaluation was done. All antihypertensive drugs were continued till the morning of surgery with the exception of ACE inhibitors and angiotensin-receptor blockers which was stopped on the day of surgery. Baseline parameters, namely, heart rate (HR), systolic, diastolic and mean blood pressure (SBP, DBP and MBP), and arterial oxygen saturation (SpO_2) were recorded. Patients were premedicated with injglycopyrollate 5 mcg/kg, inj midazolam 1mg,inj fentanyl 1.5 /kg. After preoxygenation, induction was done with Inj propofol 2 mg/kg. All intubations were performed with appropriate sized cuffed endotracheal tube (ETT) using non-depolarising muscle relaxant Inj vecuronium 0.1 mg/kg. In group M, laryngoscopy was done with McCoy laryngoscope. In group L, intubation was done using intubating LMA. In group V, intubation was done using VividTrac® video laryngoscope. A failed intubation is defined as an attempt in which the trachea was not intubated even after three attempts or which required more than 120 sec to perform by the experienced anaesthesiologist. In such case, laryngoscopy and intubation was done by using Macintosh blade and case was excluded from the study. The time taken for the successful intubation attempt is the time taken from insertion of the blade or ILMA between the teeth until the position of the endotracheal tube was confirmed to be in the trachea by capnography. The heart rate, arterial blood pressure (systolic, diastolic, mean), SpO_2, end tidal carbondioxide ($EtCO_2$) were recorded at baseline, after anaesthetic induction (0 min), 1 min, 2 min, 3 min, 5 min, 7 min and 9 min after endotracheal intubation. $EtCO_2$ was maintained within 35 ± 5 to avoid the effects of hypercarbia on the haemodynamic variables. Complications of laryngoscopy and intubation like oropharyngeal trauma to lips, teeth, tongue, airway trauma and postoperative sore throat were noted.

Statistical methods

The statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0 and R environment ver 2.11.1 were used for the analysis of the data and Microsoft word and excel have been used to generate graphs, tables. Quantitative data were expressed as mean ± Standard deviation. Qualitative data were expressed as frequency and percentage. ANOVA, when comparing between more than two means were used.

Results

Ninety patients were included in the current study. The demographic data of the group M, Land V are presented in Table 1. There was no statistically significant difference among groups with respect to demographic characteristics.All patients belonged to ASA II.

In our study, intubation was faster in Group M (22.5 ± 1.00 sec) than Group L (38.8 ± 1.51 sec) and Group V (31.5 ± 1.59 sec), which was statistically significant ($p<0.001$) as shown in table 2 and graph 1.

Differences in time may be due to unfamiliarity to handle the laryngoscope while looking at the screen instead of looking directly at the larynx and the time required for guiding of endotracheal tube through ILMA. Similar results were obtained by Bilgin H *et al.* [7] who documented that total intubation time was significantly longer in the ILMA group than in the C-Trach and McCoy group.

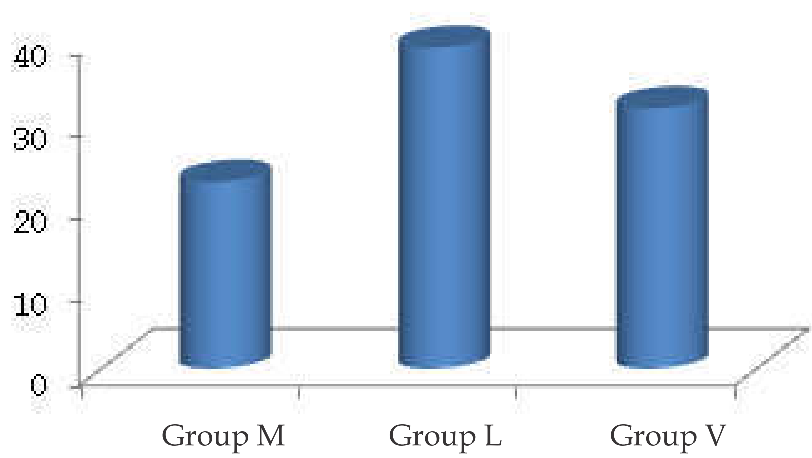
Haemodynamic variables i.e., heart rate, systolic blood pressure, diastolic blood pressure and mean arterial pressure were compared among the three groups which is shown in table 3 and graphs 2, 3, 4, 5. There was no statistical significane in the baseline haemodynamic parameters and immediately after IV induction p (>0.05) in all the three groups.

Table 1: Demographic characteristics

	Group M	Group L	Group V	p Value
Age(years)	48.875 ± 8.37	49.125 ± 7.34	47.875 ± 8.37	0.81
Weight (kg)	65.15 ± 5.91	64.325 ± 7.65	64.15 ± 5.91	0.81
Sex				
Male	18	17	17	0.95
Female	12	13	13	
Mallampati				
I	18	17	19	0.87
II	12	13	11	

Table 2: Time taken for first successful intubation and intubation success rate

	Mean(±SD)	Group M	Group L	Group V	p Value
Time for 1st successful intubation (in sec)		22.5 ± 1.00	38.8 ± 1.51	31.5 ± 1.59	<0.001
Intubation Success	1st attempt (%)	100%	80%(24)	86%(26)	
	2nd attempt (%)	Nil	13.3%(4)	10%(3)	
	3rd attempt (%)	Nil	6.6%(2)	3.3%(1)	

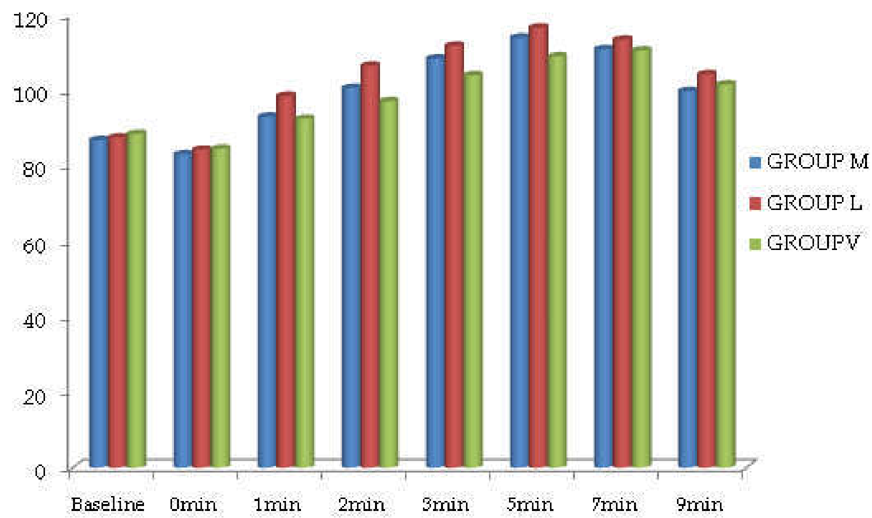


Graph 1: Time for 1st successful intubation in seconds between three groups

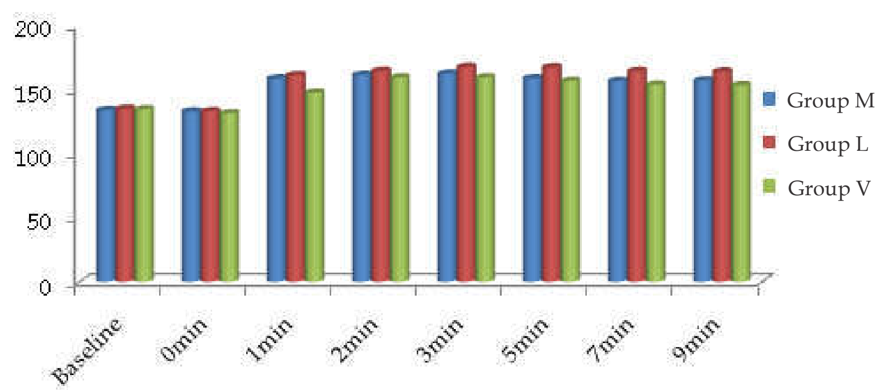
Table 3: Haemodynamic parameters

Vital Parameter	Group M	Group L	Group V	p Value
Baseline Heart Rate	86.7 ± 7.02	87.33 ± 5.68	88.3 ± 5.80	0.5
SBP	133.76 ± 5.55	134.73 ± 5.26	134.4 ± 5.31	0.7
DBP	80.66 ± 4.58	81.6 ± 4.82	81.53 ± 5.08	0.35
MAP	98.36 ± 3.54	99.311 ± 3.65	99.5 ± 4.11	0.45
T0 Heart Rate	82.83 ± 3.48	84.13 ± 5.89	84.36 ± 5.79	0.46
SBP	132.8 ± 4.88	133 ± 5.32	131.33 ± 3.83	0.33
DBP	79.73 ± 4.54	80.93 ± 4.57	79.66 ± 4.42	0.474
MAP	97.42 ± 3.44	98.28 ± 3.58	96.88 ± 3.28	0.28

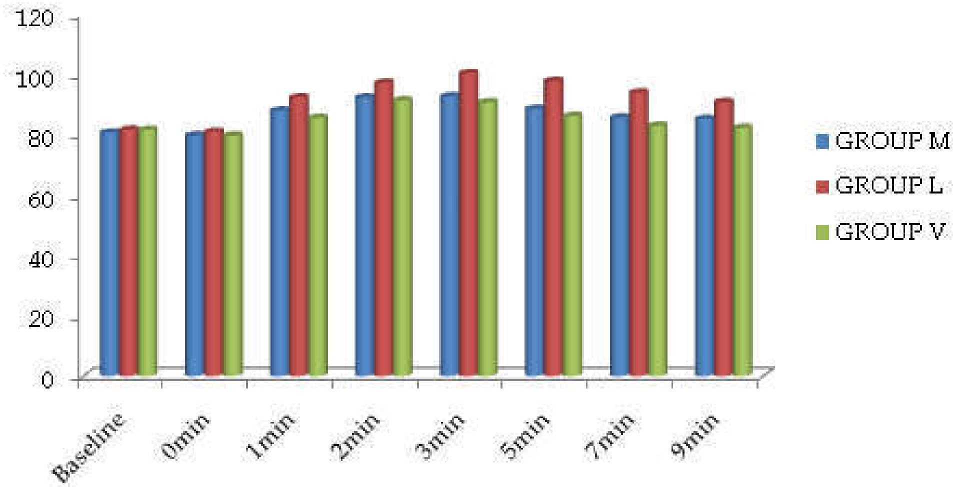
T1 Heart Rate	92.83 ± 3.48	98.33 ± 5.31	92.26 ± 5.98	<0.0001
SBP	158.46 ± 3.62	161 ± 3.62	147.53 ± 5.57	<0.0001
DBP	87.93 ± 2.70	92.26 ± 2.95	85.53 ± 3.04	<0.0001
MAP	111.44 ± 2.28	115.17 ± 1.84	106.2 ± 2.58	<0.0001
T2 Heart Rate	100.46 ± 3.78	106.3 ± 5.31	96.93 ± 5.93	<0.0001
SBP	161.26 ± 4.94	164.4 ± 3.16	159.26 ± 3.38	<0.0001
DBP	92.26 ± 5.29	97.13 ± 2.38	91.33 ± 2.48	<0.0001
MAP	115.26 ± 3.78	119.55 ± 2.13	113.97 ± 1.65	<0.0001
T3 Heart Rate	108.26 ± 4.01	111.56 ± 4.74	103.8 ± 5.75	<0.0001
SBP	162.33 ± 5.33	167.4 ± 2.04	159.33 ± 2.53	.000001
DPB	92.66 ± 4.67	100.3 ± 2.52	90.66 ± 1.98	<0.0001
MAP	115.88 ± 3.60	122.68 ± 1.99	113.55 ± 1.65	<0.0001
T5 Heart Rate	113.73 ± 3.92	116.43 ± 3.97	108.76 ± 5.23	<0.0001
SBP	158.53 ± 6.14	167.13 ± 1.79	156.53 ± 1.47	<0.0001
DBP	88.46 ± 5.05	97.8 ± 1.21	86.13 ± 2.22	<0.0001
MAP	111.82 ± 3.80	120.91 ± 1.19	109.6 ± 1.57	<0.0001
T7 Heart Rate	110.7 ± 3.74	113.2 ± 3.8	110.33 ± 4.72	0.015
SBP	156.46 ± 4.53	164.26 ± 2.39	153.53 ± 2.33	<0.0001
DBP	85.66 ± 4.03	93.93 ± 2.13	82.93 ± 2.39	<0.0001
MAP	109.26 ± 3.60	117.37 ± 1.90	106.466 ± 1.57	<0.0001
T9 Heart Rate	99.6 ± 3.58	104.1 ± 4.7	101.4 ± 4.58	0.0005
SBP	156.93 ± 5.91	163.93 ± 1.77	153.13 ± 2.55	<0.0001
DBP	85.2 ± 4.62	90.8 ± 1.789	82.2 ± 2.74	<0.0001
MAP	109.11 ± 4.02	115.17 ± 1.34	105.84 ± 1.88	<0.0001



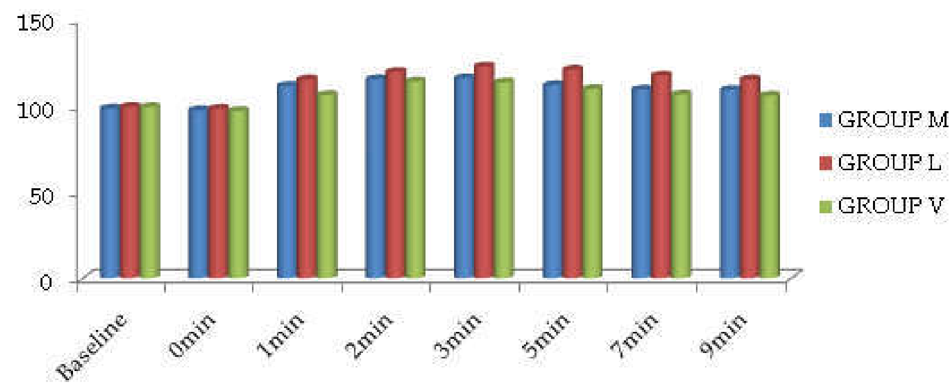
Graph 2: Graphical Representation of Heart Rate Between the Groups



Graph 3: Graphical Representation of Systolic Blood Pressure in mmHg Between the Groups



Graph 4: Graphical Representation of Diastolic Blood Pressure in mmHg Between the Groups



Graph 5: Graphical Representation of Mean Arterial Pressure in mmHg Between the Groups

Following intubation, there was statistically significant rise in HR, SBP, DBP and MAP in all the three groups($P<0.001$) but significantly less in VividTrac® videolaryngoscope group indicating that videolaryngoscope maintained hemodynamic stability during intubation than McCoy and intubating LMA. Repeated oro-pharyngeal and tracheal stimulation resulting from ILMA probably induced greater pressor response than video laryngoscope. Upward lifting force required to expose the glottis is much less with Video laryngoscope.

Table 4: Complications

Complications	Group M	Group L	Group V
Oropharyngeal Injury	2 (6.6%)	nil	4 (13.3%)
Esophageal intubation	nil	3 (10%)	nil
Desaturation	nil	nil	nil
Sore Throat	2 (6.6%)	6 (20%)	nil

Discussion

Laryngoscopy and endotracheal intubation are associated with sympathetic stimulation that leads to haemodynamic changes. These haemodynamic changes are more exaggerated in hypertensive patients when compared to normotensive patients. This stress response can cause increase in blood pressure, heart rate and cardiac dysrrhythmias in the crucial period of anaesthetic induction [8]. So, it is important to attenuate the sympathetic response to laryngoscopy and endotracheal intubation.

The haemodynamic response is regulated by the hypothalamo-pituitary-adrenocortical and sympathetic adreno-medullary response. This response leads to secretion of cortisol, norepinephrine and epinephrine. The secretion reaches its peaks at approximately 30-45 seconds after intubation. Plasma adrenaline, noradrenaline and vasopressin concentrations increase slightly in normotensive patients but there is three-fold increase in plasma noradrenaline inhypertensives. Further, an increase in plasma adrenaline level was observed in hypertensives, one minute after laryngoscopy.

Direct laryngoscopy involves stretching of the oropharyngeal tissues in order to straighten the angle between the mouth and the glottic opening. This stretch can cause pain and trigger a stress response.Though laryngoscopy and intubation separately result in sympathetic stimulation, the catecholamine rise and subsequent haemodynamic response with intubation exceeds that with laryngoscopy alone [9]. One of the major concerns during administration of general anaesthesia is to reduce the sympathetic stimulation by minimising the stretching of laryngopharyngeal structures. Various airway adjuncts, anaesthetic drugs, antihypertensives and analgesics have been used to blunt the level of stimulation and the stress response to the manipulation and stimulation of airway during laryngoscopy and intubation. McCoy levering laryngoscope has an adjustable hinged tip which improves the visualization of cords [6].

ILMA guidedoro-tracheal intubation does not directly stimulate the receptors of the larynx because it does not distort the base of the tongue [4]. A significant decrease in mean norepinephrine concentration was observed with ILMA guided intubation than in patients undergoing direct laryngoscopy [1]. VividTrac® video laryngoscope from Vivid Medical, Inc. is a rigid laryngoscope that can used to intubate patients with normal and difficult airways. Many studies have found that videolaryngoscopes cause less haemodynamic response [1].

McCoy blade has an adjustable tip which can be used to lift the epiglottis and decrease the force applied on the base of the tongue thereby reducing the pressor response [6].

ILMA is a device used to introduce the tracheal tube blindly which doesnot require exposure of glottis. So, theoretically causes less haemodynamic response. But the trial conducted by Sener *et al.* failed to attenuate the hemodynamic response with the use of ILMA, where, in contrary, there was higher response [4]. The longer duration, repeated airway manipulation, stimulation of supralaryngeal area which is rich in nociceptive receptors, removal of ILMA to advance the tracheal tube may have induced greater pressor response in these patients.

The video laryngoscope is a recent airway tool can reduce the degree of stretch on the airways. It incorporates video imaging into the bladewith LCD display and hence provides an improved glottis view without the need to alignoral, pharyngeal and laryngeal axis with minimal stretch. For the same reason these devices are useful in intubating patients with cervical injuries requiring immobilization. There is evidence to show that VLS caused less haemodynamic stimulation than the other laryngoscopes. Heart rate and blood pressure was not altered significantly with this device during intubation attempts [10].

In this randomized, prospective and comparative study, demographic characteristics, ASA grading and Mallampati grading were comparable. All patients had systemic hypertension and were on medications in whom blood pressure was well controlled.Following intubation, there was statistically significant rise in HR, SBP, DBP and MAP in all the three groups but significantly less in VividTrac® videolaryngoscope group indicating that videolaryngoscope maintained hemodynamic stability during intubation than McCoy and intubating LMA.

Our findings are similar to study done byPeirovifar A, et al. who documented that systolic blood pressure, mean blood pressure and heart rate during laryngoscopy as well as immediately and one minute after intubation was significantly lower in Glidescope group than Machintosh group [11].

A study done by Xue FS, *et al.* found that the hemodynamic responses to orotracheal intubation using a glidescope videolaryngoscope and Macintosh direct laryngoscopy were similar and they concluded that the glidescope videolaryngoscopy had no any special advantage over the direct laryngoscopy in attenuating the hemodynamic responses to orotracheal intubation [12].

Sener EB, *et al.* compared hemodynamic responses and upper airway morbidity following tracheal intubation via conventional laryngoscopy or intubating laryngeal mask airway in hypertensive patients. They postulated that the intense and repeated oropharyngeal and tracheal stimulation resulting from intubating laryngeal mask airway induces greater pressor responses than does stimulation resulting from conventional laryngoscopy in hypertensive patients [4].

A study was designed by Kavitha J, *et al.* who found direct laryngoscopy to be comparatively a faster method to secure tracheal intubation than Intubating Laryngeal Mask. In their study, ILMA offered no advantage in attenuating the hemodynamic responses compared to direct laryngoscope. The success rate of intubation through Intubating Laryngeal Mask was comparable with that of direct laryngoscopy [13].

Grisdale, *et al.* found that there was no difference between the Glidescope (®) and the direct laryngoscope regarding successful first-attempt intubation or time to intubation, although there was significant heterogeneity in both of these outcomes [14].

Liu *et al.* argued that the failure in achieving an acceptable larynx view in a great number of patients compromises the clinical value of VividTrac® videolaryngoscope [15].

In our study, complications like oesophageal intubation and sore throat was more with intubating LMA, whereas injury to oropharyngeal mucosa was found to be obsverved with VividTrac® videolaryngoscope. Soliman R, et al. noted that incidence of oral trauma and bleeding related tointubation was higher with glidescope than with Macintosh laryngoscope [16].

Limitation of our study is that firstly, the anaesthesiologist cannot be blinded for device being used. Secondly the efficacy of these devices in comparision with other promising devises such as Airtraq, McGrathw, Bullard laryngoscopes etc have not been determined.

Conclusion

Video laryngoscopes provides greater haemodynamic stability and better view of glottis than McCoy during intubation. Other advantages are ease of insertion, less need of assist manoeuvres for intubation, with less complications. Thus, it is beneficial to use VLS for intubation in hypertensive patients. The improved view due to a magnified video image, anterior curvature of the blade leads to reduced need to align. The time taken for intubation was significantly longer in the VividTrac® videolaryngoscope group and it is postulated that if the time taken for laryngoscopy and intubation could be reduced, we might be able to realise the benefit of video laryngoscope in terms of haemodynamic response. The mean time taken to achieve endotracheal intubation with video laryngoscopy was longer in this study probably because of two reasons, namely, extra time taken in visualization of vocal cords and sliding the endotracheal tube though the groove of the video laryngoscope. Further studies are required to evaluate the utility of the device in hypertensivepatients with a Mallampatti score of ≥2, both form the point of view of ease of endotracheal intubation and haemodynamic response.

Conflict of Interest: nil

Financial assistance: nil

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