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Comparison of Haemodynamic Response to Endotracheal Intubation with Videolaryngoscopy and Direct Laryngoscopy in Hypertensive Patients- A Randomised Clinical Trial

ANASUYA HEGDE[1], DEEPAK REVADIHAL MALIKARJUN[2], KUMARESAN CHINNATHAMBI[3]

ABSTRACT

Introduction: Cardiovascular responses to direct laryngoscopy and endotracheal intubation have been well documented and are caused by noxious stimuli. A videolaryngoscope facilitates visualisation of the vocal cords with minimal stretch on the airways.

Aim: To compare the haemodynamic responses to endotracheal intubation with videolaryngoscopy and direct laryngoscopy in hypertensive patients.

Materials and Methods: A randomised clinical trial conducted in 90 hypertensive patients. The patients were divided into two groups- group D in whom conventional (Macintosh) direct laryngoscopy was used and group V in whom (C-MAC) videolaryngoscopy was used. Haemodynamic parameters were monitored postintubation and to also study the number of intubation attempts, total time taken for intubation, assessment of Cormack-Lehane grade (C-L grade) between C-MAC videolaryngoscopy and direct laryngoscopy. Between the group analyses done using student's t-test. Multiple paired t-test was used for within group data analysis. Chi-square was used to compare categorical data between the two groups. The $p<0.05$ will be considered statistically significant.

Results: The mean age of the participants in group D and group V was 51±8 and 52±7, respectively. There was no significant difference in haemodynamic response to intubation between both videolaryngoscopy and direct laryngoscopy groups after intubation ($p>0.05$). Glottic visualisation was significantly better in videolaryngoscopy group using C-L grade (p-value=0.0313). There was no significant difference between the two groups with respect total time taken for laryngoscopy (p-value=0.072).

Conclusion: Videolaryngocopy does not have any added advantage over direct laryngoscopy as per haemodynamic response is considered. Though the visualisation of the glottis is better with videolaryngoscope, duration of laryngoscopy does not differ from routine laryngoscopy.

Keywords: Cormack and lehane grading, General anaesthesia, Laryngoscopy and intubation

INTRODUCTION

Laryngoscopy and intubation are intensely stimulating procedures and induce marked sympathetic responses. An increase in Heart Rate (HR), systemic arterial pressure, pulmonary arterial pressure, capillary wedge pressure and also raised intracranial pressure were observed with intubation and laryngoscopy [1]. Hypertension and tachycardia are of concern due to increase in myocardial oxygen demand, decreased oxygen supply and possibility of cardiovascular accidents.

Direct laryngoscopy stretches the oropharyngeal tissue, causing hemodynamic variation [2]. Though both laryngoscopy and intubation separately result in sympathetic stimulation, the catecholamine rise seen with intubation is more than that with laryngoscopy alone [3]. Although a transient haemodynamic change is of little consequence to healthy people [4], these may be detrimental to patients with hypertension, unstable coronary artery disease or those with elevated intracranial pressure or cardiovascular disease [5].

The video laryngoscope, by virtue of the fiberoptic bundle incorporated in it, facilitates visualisation of the vocal cords with minimal stretch on the airways and gives a good view in the liquid-crystal display (LCD) screen [6]. Kaplan MB et al., introduced Storz videolaryngoscope [7]. This scope is built like a standard Macintosh laryngoscope with fibreoptic fibers incorporated into the end of the blade which allows a direct view like that with a normal Macintosh blade, by virtue of a camera at the end of the blade which projects images in real time to a portable video system with the option to record sequences or pictures [8]. Use of videolaryngoscope as a difficult airway tool is very well studied. There were few studies which demonstrated better intubation scores with Macintosh (MAC) blade videolaryngoscopy compared to videolaryngoscopy using other blades, but there is paucity of data regarding haemodynamic response to intubation using a C-MAC videolaryngoscope [9,10].

Hence, this study was done to compare the haemodynamic response to endotracheal intubation between C-MAC videolaryngoscopy and direct laryngoscopy in hypertensive patients. It was also aimed to study the total time taken for laryngoscopy and intubation with either technique, assessment of C-L grade with either technique.

MATERIALS AND METHODS

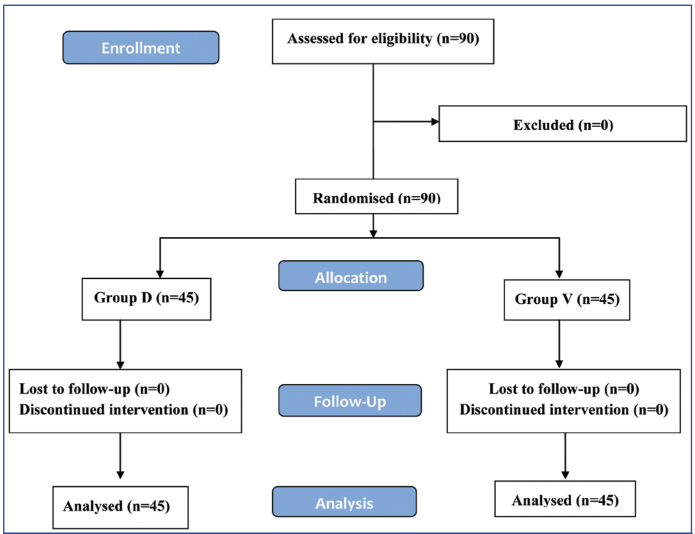
This was a single-centre open label randomised clinical trial, conducted from October 2014 to October 2015. Institutional Ethical Committee (IEC) clearance was obtained (dated 22nd August 2014).

Inclusion criteria: Ninety hypertensive patients having Systolic Blood Pressure (SBP) less than 150 mmHg and Diastolic Blood Pressure (DBP) less than 90 mmHg, preoperatively of either sex, American Society of Anaesthesiology (ASA) grade II, aged 18-60 years, coming for elective surgery under general anaesthesia were recruited for the study. All recruited patients were asked to continue their regular antihypertensive medications till the day of surgery.

Exclusion criteria: Patients with history of or anticipated difficult airway with mouth opening <3 cm, history of cardio-respiratory abnormalities (New York Heart Association heart failure grades 3 and 4), bronchial asthma, chronic obstructive pulmonary disease and restrictive lung disease, pregnancy, renal or liver disorders and Body Mass Index (BMI) >35 kg/m^2 were excluded from the study.

A written informed consent was taken from all recruited patients in their own language. A computer generated simple randomisation table (www.randomisation.com) with seed number 18500 was used to allocate patients into two groups: group D in whom conventional (Macintosh) direct laryngoscopy, and group V in whom (C-MAC) videolaryngoscopy was used.

Sample size calculation: Sample size was calculated based on the study by Xue FS et al., [11]. Overall, 38 patients were required to study in each group. Adding 20% to compensate for loss to follow-up, 45 patients in each group were studied [Table/Fig-1].



[Table/Fig-1]: CONSORT flowchart.

Study Procedure

Intraoperative monitoring included electrocardiography, capnography, non invasive blood pressure and pulse oximetry. Preinduction HR, SBP, DBP and Mean Arterial Pressure (MAP) were noted after connecting monitors. Patients were induced with 1.5-2 mg/kg propofol, 2 μ/kg fentanyl and 1.5 mg/kg lignocaine hydrochloride. For muscle relaxation patients received atracurium 0.5 mg/kg. Anaesthesia was maintained with sevoflurane in air: O_2 (50:50), atracurium 0.3 mg/kg/hr infusion or boluses and fentanyl 0.5 mcg/kg/hr infusion or boluses. Preintubation (baseline) HR, SBP, DBP and MAP were noted. Patients were intubated either with direct laryngoscopy or C-MAC videolaryngoscope three minutes after administration of atracurium. The epiglottis was lifted while performing videolaryngoscopy. Analgesia was supplemented with intravenous paracetamol 1 g and 75 mg aqueous diclofenac infusion intraoperatively. HR, SBP, DBP and MAP were noted as baseline (preintubation), after intubation every minute for first five minutes, there after every five minutes for first 30 minutes.

Intubating conditions like C-L grade, duration of laryngoscopy and intubation, was noted as below [12].

I=vocal cords visible

II=less than half of the glottis or only the posterior commissure is visible

III=only the epiglottis is visible

IV=none of the structures are visible

Duration of laryngoscopy and intubation: Time taken from insertion of the laryngoscope blade between the teeth until the endotracheal tube is placed through vocal cords, as evidenced by visual confirmation by anaesthesiologist performing laryngoscopy.

Hypertension and tachycardia (>30% of baseline value) was treated with esmolol 30 mg intravenously. Hypotension (<30% of baseline value) was treated with mephenteramine bolus 6 mg intravenously. Bradycardia (<30% of baseline value) was treated with atropine 0.6 mg intravenously. The occurrence of any other adverse event like desaturation or bronchospasm was appropriately managed.

STATISTICAL ANALYSIS

Continuous data was expressed as mean±Standard Deviation (SD). Categorical data was expressed as number (%). Chi-square was used to compare categorical data between the two groups. Between the group analyses was done using student's t-test. The $p<0.05$ was considered statistically significant. Multiple paired t-test was used for within group data analysis. After application of Bonferroni's correction $p<0.005$ was considered to be statistically significant. Collected data were analysed with Statistical Package for the Social Sciences (SPSS) for Windows, Version 17.0.

RESULTS

Both the groups were comparable with respect to demographic characteristics age, sex, height and weight [Table/Fig-2]. Preinduction and preintubation (baseline) values of HR, SBP, DBP and MAP were comparable between two groups [Table/Fig-3].

Variables	Group D	Group V	p-value
Age (yrs)	51±8	52±7	0.388
Sex (M:F)	16:29	21:24	0.283
Height (cms)	160±8	164±9	0.067
Weight (Kgs)	70±12	74±13	0.082

[Table/Fig-2]: Demographic data.
*All values are expressed as mean±SD; M: Male; F: Female

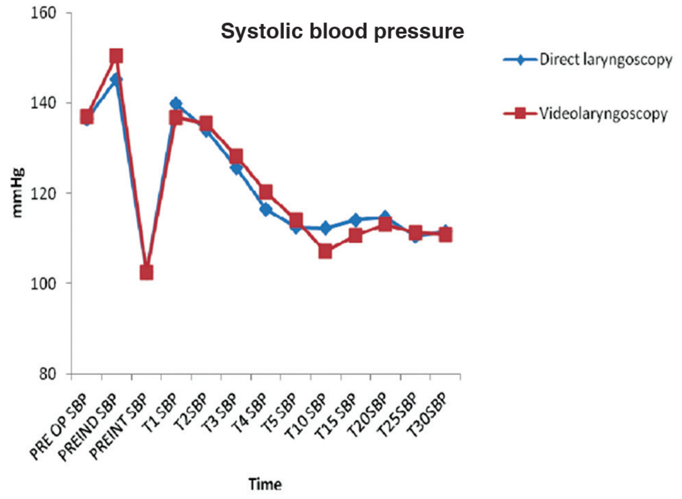
Variables	Group D	Group V	p-value (Student's test)
Preinduction	Mean±SD	Mean±SD	
HR (bpm)	88±17	86±19	0.572
SBP (mmHg)	145±17	150±17	0.167
DBP (mmHg)	86±9	86±10	1
MAP (mmHg)	106±10	108±11	0.418
Preintubation (baseline)			
HR (bpm)	78±14	77±15	0.711
SBP (mmHg)	103±19	103±19	1
DBP (mmHg)	65±16	62±14	0.445
MAP (mmHg)	78±16	76±14	0.496

[Table/Fig-3]: Preinduction and preintubation values.

The SBP increased above the baseline value by 37±24 mmHg (35±33%) and 34±30 mmHg (33±33%) in group D and group V, respectively (p=0.624). But there was no significant difference between the two groups with respect to changes in SBP, at various points of time after intubation [Table/Fig-4,5].

Time	Group D (mmHg)	Group V (mmHg)	p-value
Preoperative	136±10	137±10	0.804
Preinduction	145±17	150±17	0.167
Preintubation (baseline)	103±19	103±19	1
1 min	140±26	137±26	0.594
2 mins	134±24	136±26	0.785
3 mins	126±23	128±24	0.595
4 mins	117±20	120±21	0.390
5 mins	112±18	114±18	0.664
10 mins	112±17	107±17	0.170
15 mins	114±18	111±15	0.313
20 mins	115±18	113±17	0.661
25 mins	111±20	111±20	1
30 mins	112±18	111±22	0.899

[Table/Fig-4a]: Comparison of systolic blood pressure.
D: Direct laryngoscopy; V: Videolaryngoscopy; mins: Minute; All values are expressed as mean±SD; p-value: Student t-test



[Table/Fig-4b]: Systolic blood pressure.

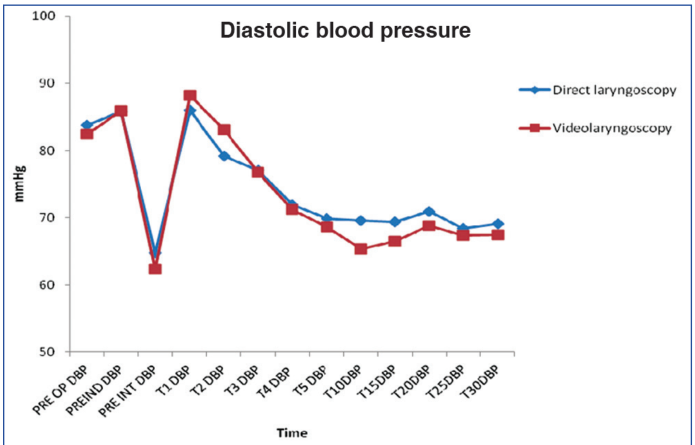
SBP	Group D	Group V	p-value
Baseline (mmHg)	103±19	103±19	1
Max. value (mmHg)	140±26	137±26	0.594
Magnitude of increase above baseline (mmHg)	37±24	34±30	0.624
% increase above baseline	35±33	33±33	0.669

[Table/Fig-5]: Variation from baseline systolic blood pressure.

There was no statistically significant difference in DBP between the groups. Time at which the maximum values occurred after intubation in both the groups was at 1st minute after intubation (p=0.599) [Table/Fig-6,7].

Time	Group D (mmHg)	Group V (mmHg)	p-value
Preoperative	84±6	82±7	0.330
Preinduction (baseline)	86±9	86±10	1
Preintubation	65±16	62±14	0.445
1 min	86±19	88±20	0.599
2 mins	79±17	83±19	0.312
3 mins	77±17	77±18	1
4 mins	72±14	71±17	0.817
5 mins	70±14	69±14	0.668
10 mins	70±16	65±15	0.205
15 mins	69±15	67±13	0.323
20 mins	71±15	69±15	0.514
25 mins	68±15	67±16	0.751
30 mins	69±14	68±16	0.612

[Table/Fig-6a]: Comparison of diastolic blood pressure between the groups.
D: Direct laryngoscopy; V: Videolaryngoscopy; mins: Minute; All values are expressed as mean±SD; p-value: Student t-test



[Table/Fig-6b]: Diastolic blood pressure.

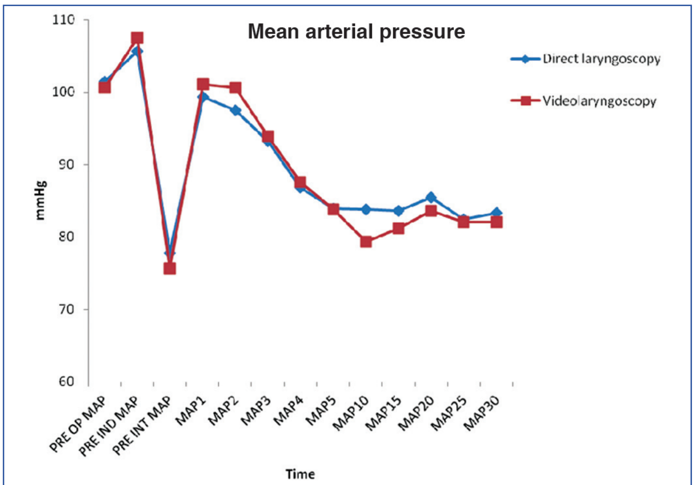
DBP	Group D	Group V	p-value
Baseline (mmHg)	65±16	62±14	0.445
Max. value (mmHg)	86±19	88±20	0.599
Magnitude of increase above baseline (mmHg)	21±20	26±30	0.520
% increase above baseline	24±33	30±33	0.549

[Table/Fig-7]: Variation from baseline diastolic blood pressure.

There was no statistically significant difference in the maximum values of MAP after intubation between the two groups which was 99±17 mmHg in Group D and 101±19 mmHg in Group V (p=0.655) at 1st minute after intubation [Table/Fig-8,9].

Time	Group D (mmHg)	Group V (mmHg)	p-value
Pre operative	101±7	101±7	1
Preinduction	106±10	107±11	0.418
Preintubation (baseline)	78±16	76±14	0.496
1 min	99±17	101±19	0.655
2 mins	97±18	101±21	0.456
3 mins	93±18	94±19	0.862
4 mins	87±15	88±17	0.823
5 mins	84±15	84±14	1
10 mins	84±16	79±15	0.165
15 mins	84±16	81±12	0.416
20 mins	85±15	84±14	0.542
25 mins	82±15	82±16	1
30 mins	83±14	82±17	0.708

[Table/Fig-8a]: Comparison of mean arterial pressure between the groups.
D: Direct laryngoscopy; V: Videolaryngoscopy; mins: Minute; All values are expressed as mean±SD; p-value: Student t-test



[Table/Fig-8b]: Mean arterial pressure.

MAP	Group D	Group V	p-value
Baseline (mmHg)	78±16	76±14	0.496
Max value (mmHg)	99±17	101±19	0.655
Magnitude of increase above baseline (mmHg)	21±12	25±23	0.650
% increase above baseline	21±23	24±30	0.500

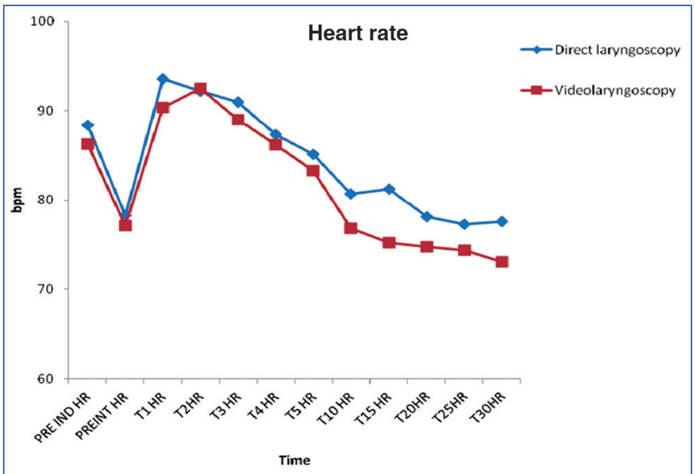
[Table/Fig-9]: Variation from baseline mean arterial pressure.

There was an increase in HR in both the groups after intubation above baseline 16±11 bpm (20±16%) and 15±12 bpm (19±17%) in group D and group V respectively (p=0.537)], but there was no significant difference between the two groups with regard to changes in HR at various points of time after intubation [Table/Fig-10,11].

The mean time taken for laryngoscopy in group D was 19.1±10 seconds and in group V it was 24.9±18.9 seconds (p=0.072) which was clinically not significant. Glottis visualisation was statistically better in group V as compared to group D (p=0.03) [Table/Fig-12].

Time	Group D (bpm)	Group V (bpm)	p-value
Preinduction	88±17	86±19	0.572
Preintubation (baseline)	78±14	77±15	0.711
1 min	94±15	90±17	0.353
2 mins	92±14	92±18	1
3 mins	91±13	89±19	0.557
4 mins	87±13	86±18	0.736
5 mins	85±14	83±17	0.575
10 mins	81±15	77±15	0.209
15 mins	81±15	75±12	0.040
20 mins	78±13	75±12	0.219
25 mins	77±14	74±13	0.305
30 mins	78±12	73±12	0.089

[Table/Fig-10a]: Comparison of heart rate.
D: Direct laryngoscopy; V: Videolaryngoscopy; m: minute. All values are expressed as mean±SD, p-value: Student t-test



[Table/Fig-10b]: Heart rate.

Heart rate	Group D	Group V	p-value
Baseline (bpm)	78±14	77±15	0.711
Max value (bpm)	94±15	92±18	0.655
Magnitude of increase above baseline (bpm)	16±11	15±12	0.537
Increase above baseline (%)	20±16	19±17	0.636

[Table/Fig-11]: Variation from baseline (Heart rate).

Cormack and Lehane grades	Group D n (%)	Group V n (%)	p-value (Student's t-test)
Grade 1	9 (20)	17 (38)	0.0313
Grade 2	27 (60)	26 (58)	
Grade 3	9 (20)	2 (4)	
Grade 4	0	0	

[Table/Fig-12]: Cormack and Lehane grade.

There were no events of myocardial ischaemia as monitored by surface electrocardiography, desaturation or bronchospasm during the study period in either of the groups.

DISCUSSION

Reflex circulatory responses to direct laryngoscopy and tracheal intubation during general anaesthesia are well documented [13]. This response is potentially harmful in patients with pre-existing hypertension, cardiac disease or increased intracranial pressure [14]. Roy WL et al., found a high incidence of myocardial ischaemia during non cardiac surgical procedures in patients with coronary artery disease [15]. Pressor responses to intubation can cause cardiao-respiratory complications like ST segment changes, ventricular arrhythmias, pulmonary oedema [16].

These haemodynamic changes are due to varying degree of sympathetic stimulation. The pressure exerted at the base of the tongue, elevation of the epiglottis during laryngoscopy and placement of the endotracheal tube within the trachea may result in a sympathetic reflex (somato-visceral reflex) response causing intense circulatory responses [17].

The advent of videolaryngoscopy obviated the need for achieving a line-of-sight view by tissue compression, distraction and external force [18]. Videolaryngoscopy helps to provide better laryngeal view as compared to direct laryngoscopy. Videolaryngoscopy is useful for cases of difficult intubation and reintubation as well as for teaching laryngoscopy and intubation [19]. Better intubation scores are achieved with Macintosh blade videolaryngoscopy compared to videolaryngoscopy using other blades [9,10].

The primary outcome of this study was haemodynamic responses to laryngoscopy and intubation between direct laryngoscopy and C-MAC videoaryngoscopy. There was no statistically significant difference with respect to SBP, DBP, MAP and HR in response to intubation between the two groups.This was similar to a study done by Sarkılar G et al., who found no significant change between the direct and C-MAC videolaryngoscope in terms of the haemodynamic response [20].

Kanchi M et al., compared intubation using direct laryngoscopy and videolaryngoscopy in patients with ischaemic heart disease. They noted that neither technique had any advantage over the other, with respect to haemodynamic response [21].

However, Abdelgawad AF et al., compared intubation response in normotensive and hypertensive patients using direct laryngoscopy and videolaryngoscopy, and found significant increase in SBP and DBP in hypertensives in direct laryngoscopy group [22].

Aggarwal H et al., found that McCoy laryngoscope provided better attenuation of haemodynamic responses to laryngoscopy and intubation, whereas, Macintosh and C-MAC video laryngoscope did not show any attenuation of haemodynamic response [23]. Buhari FS and Selvaraj V evaluated the haemodynamic response to oral endotracheal intubation with C-MAC laryngoscopy and McCoy laryngoscopy compared to that of Macintosh laryngoscopy in adult patients under general anaesthesia. They concluded that C-MAC videolaryngoscope has a comparatively greater haemodynamic response than Macintosh laryngoscope [24]. Overall, it can be stated that videolaryngoscope is not useful as a tool for attenuating haemodynamic response.

Secondary objectives in this study were glottis visualisation and time taken for laryngoscopy. Glottic visualisation was significantly better with videolaryngoscopy as compared to direct laryngoscopy (p=0.03). Thus 80% patients in group D had C-L grade 1 and 2 view compared to 96% patients in group V. This finding was similar to the study by Sakles JC et al., [25]. Aggarwal H et al., reported that gottic visualisation was significantly better with C-MAC videolaryngoscope as compared to Macinthosh and McCoy laryngoscope [23]. Therefore, it can be used for intubation in patients with difficult intubation scores.

The mean time taken for laryngoscopy and intubation was statistically not significant (p=0.072). Similarly, Cattano D et al., found no significant difference in laryngoscopy time in direct laryngoscopy and C-MAC videolaryngoscopy groups (p=0.06) [26].

However, in a study done by Kanchi M et al., [21]. duration of laryngoscopy and intubation was significantly longer with videolaryngoscopy intubation as compared direct laryngoscopy [21]. Aggarwal H et al., also fund that the time taken to perform endotracheal intubation was the longest with the C-MAC videolaryngoscope as compared to Macintosh and McCoy laryngoscope blades [23]. Therefore, videolaryngoscope does not have any added advantage over direct laryngoscopy in terms of speed of intubation which can reduce the chance of desaturation if any.

Limitation(s)

The learning curve of the new technique of laryngoscopy with C-MAC videolaryngoscope has not been established, and this would have affected the haemodynamic response to endotracheal intubation. Experience of the anaesthetist performing the laryngoscopy might affected the outcome. As this study was done on ASA II hypertensive patients, other co-morbidies like diabetes and hypothyroidism etc which affect the haemodynamic response to oral endotracheal intubation can be associated in these patients. Types of antihypertensive drug used were not categorised, which might have affected the haemodynamic response.

CONCLUSION(S)

Videolaryngocopy does not have any added advantage over direct laryngoscopy as per haemodynamic response was considered. However, videolaryngoscope can be used in cases of predicted difficult intubation because of the better gottic visualisation.

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PARTICULARS OF CONTRIBUTORS:
1. Assistant Professor, Department of Anaesthesiology, SSIMS, Davangere, Karnataka, India.
2. Assistant Professor, Department of Anaesthesiology, SSIMS, Davangere, Karnataka, India.
3. Professor, Department of Anaesthesiology, Manipal Hospital, Bengaluru, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Anasuya Hegde,
1st Main, 2nd Cross, Davangere, Karnataka, India.
E-mail: hegdeanasuya@gmail.com

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