

Hemodynamic Stress Response in Controlled Hypertensive Patients: A Randomized Comparison of I-Scope Video Laryngoscope and Macintosh Laryngoscope

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ABSTRACT

Background: Laryngoscopy and intubation cause activation of the sympathetic nervous system and can result in tachycardia, arrhythmias and hypertension. Hypertensive patients demonstrate a relatively greater rise in catecholamine secretion and an increased sensitivity to them. Aim of the study is to compare the haemodynamic stress response associated with orotracheal intubation using videolaryngoscope or Macintosh laryngoscope in controlled hypertensive patients.

Methods: Sixty hypertensive, American Society of Anesthesiologist's class II, patients were randomly divided into two groups. In group V (videolaryngoscope), intubation was done with i-scope videolaryngoscope. In group M (Macintosh), intubation was done using Macintosh laryngoscope. Primary objectives of the study were pulse rate (PR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean blood pressure (MBP) were noted immediately after and at 1, 2, 3, 5 and 10 minutes after intubation.

Results: The demographic data were comparable in both groups. There was no significant difference at baseline for mean (SD) PR, SBP, DBP and MBP at baseline and after induction/before intubation ($p > 0.05$). The mean (SD) PR, SBP, DBP and MBP were significantly higher in Macintosh laryngoscope group as compared to i-scope videolaryngoscope immediately after intubation, 1, 2, 3, 5 and 10 minutes after intubation ($p < 0.001$).

Conclusion: We found that intubation with the use of i-scope videolaryngoscope results in less haemodynamic stress response than Macintosh laryngoscope in controlled hypertensive patients.

Laryngoscopy and intubation cause activation of the sympathetic nervous system and can lead to cardiovascular adverse effects such as tachycardia, arrhythmias and hypertension [1-2]. The mechanism behind these changes has been attributed to the sympathetic stimulation of the upper respiratory tract and increased plasma catecholamine levels.

Hypertensive patients demonstrate a relatively greater rise in catecholamine concentration and an increased sensitivity to them. There is an increase in myocardial oxygen demand and decrease in oxygen supply with possibility of cardiac arrhythmias, myocardial infarction,

pulmonary edema and cerebrovascular hemorrhage [3-5]. The degree of haemodynamic changes seen during laryngoscopy and tracheal intubation are associated with the degree of manipulation in oropharyngo-laryngeal structures, which are richly innervated by sympathetic as well as parasympathetic fibers supplied by glossopharyngeal and vagus nerves [3].

Macintosh laryngoscope, has been considered the 'gold standard' device for laryngoscopy and intubation [6]. During laryngoscopy with Macintosh laryngoscope; the oral, pharyngeal and laryngeal axis need to be aligned, for which a relatively high forward and upward force needs

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to be applied [7]. Of late, different types of commercial video laryngoscopes (VL) have become available. As compared to direct laryngoscope, VL does not require alignment of oropharyngeal axis for visualisation of vocal cords and a lesser degree of manipulation of the airway is required [4]. Since the view is independent of the line of sight, a relatively less upward lifting force is required during laryngoscopy and intubation [8-9]. Also, less neck movement is required when tracheal intubation is done with a video laryngoscope. Hence, less haemodynamic changes are expected in these patients. [4,9-10].

I-scope VL has an angulated blade that not only allows better laryngeal view, but also aids in laryngoscopy and intubation with the head in neutral position [4]. Therefore, the VL might attenuate the haemodynamic responses to endotracheal intubation, which would be more helpful in hypertensive patients [4,7]. A Study claims that the VL does not provide any additional benefits in terms of attenuating the haemodynamic response [8]. Thus, the utility of VL to reduce the pressor response to laryngoscopy and intubation remains debatable [8,11].

Previous studies have been done in non-hypertensive patients but there are no clear data to show the benefit in controlled hypertensive patients, who are more prone to as well as vulnerable for damages from changes in the haemodynamic response [4, 7-8].

We hypothesise that orotracheal intubation using the i-scope VL will induce less haemodynamic stress response as compared to the Macintosh laryngoscope in controlled hypertensive patients. Aim of the study was to compare the haemodynamic stress response associated with orotracheal intubation using VL or Macintosh laryngoscope in controlled hypertensive patients.

Methods

This prospective randomised study was conducted after approval from institutional ethics committee and registration with clinical trial registry of India (CTRI/2020/08/027461) between 1st November 2018 to 31st March, 2020.

Inclusion criteria were patients of either sex, age between 18 to 65 years belonging to American Society of Anesthesiologists (ASA) Grade II, controlled hypertensive patients, posted for elective surgery under general anaesthesia. According to American Heart Association 2017 guidelines, hypertension is defined as blood pressure more than 130/80 mm Hg and were included in this study. [12] Patients with uncontrolled hypertension (blood pressure more than 140/90 mmHg despite on regular treatment), [13] known coronary or cerebrovascular disease, patients with anticipated difficult airway, pregnant patients, patients with body mass index ≥ 30 kg/m² and patient's refusal to participate in study were excluded.

Sample size was calculated based on a previous study [4] in which haemodynamic changes following endotracheal intubation with glidescope videolaryngoscope in patients with untreated hypertension were observed and found that mean values of mean blood pressure (MBP) and pulse rate (PR) at 1 min after intubation in Macintosh group was 94.30 ± 9.34 and 78.20 ± 7.41 respectively and in VL group was 105.34 ± 11.14 and 86.37 ± 14.09 respectively. Taking these values as reference, the minimum required sample size is 60 patients (30 patients in each group) with 80% power of study and 5% level of significance.

Formula for calculating sample size was: comparing mean of two groups

$$N \geq 2(\text{standard deviation})^2(Z_{\alpha} + Z_{\beta})^2 / (\text{mean difference})^2$$

Where Z_{α} is value of Z at two-sided alpha error of 5% and Z_{β} is value of Z at power of 80% and mean difference is difference in mean values of two groups.

For MBP: Pooled standard deviation = square root $((9.34^2 + 11.14^2)/2) = 10.28$

$$n \geq (2 * 10.28^2 * (1.96 + 0.84)^2) / (105.34 - 94.30)^2 = 13.59 = 14 (\text{approx.})$$

For PR: Pooled standard deviation = square root $((7.41^2 + 14.09^2)/2) = 11.26$

$$n \geq (2 * 11.26^2 * (1.96 + 0.84)^2) / (86.37 - 78.20)^2 = 29.78 = 30 (\text{approx.})$$

A written informed consent taken from all the patients one day prior to surgery and 60 patients were randomly divided into two group of 30 patients each by computer generated random number.

A proper pre-anaesthetic evaluation was done in all patients. All patients were kept nil per oral at least for 8 hours for solid oily food and 2 hours for water. Patients were given the morning dose of their prescribed antihypertensive drugs two hours pre-operatively. In the operation theatre, standard monitors non-invasive blood pressure, pulse oximeter and 5 lead electrocardiogram were attached and baseline readings for PR, systolic blood pressure (SBP), diastolic blood pressure (DBP), MBP and oxygen saturation (SpO₂) were recorded. An IV cannula (18 G or 20G) is secured in hand and ringer lactate were started. Patients were given Inj. Midazolam 0.03 mg/kg and Inj. Fentanyl 2mcg/kg i.v. Pre-oxygenation was done with 100% oxygen at the rate of 6 liter/minute using circle breathing system for 3 minutes using appropriate size face mask. Anaesthesia was induced with Inj. Propofol 2 mg/kg i.v. After facemask ventilation was established, 0.1 mg/kg vecuronium bromide was given intravenously. Endotracheal Intubation was carried out after 3 minutes, with appropriate sized endotracheal tube (ETT) using the device undertaken for the study, by an experienced anaesthesiologist with more than 4 years of anaesthesia experience. Allocation concealment was done by a sequentially numbered opaque envelop.

Group V: Intubation with i-scope videolaryngoscope (M/s VBM India Co., India, Model I-scope) was done. After introducing the blade along the midline of the

tongue, the laryngeal opening was observed on the screen and endotracheal tube introduced.

Group M: Intubation was done using Macintosh laryngoscope. The laryngoscope was advanced by displacing tongue laterally till the tip of the blade reaches the vallecula. The epiglottis was lifted till vocal cord structures were seen and then ETT was inserted.

Confirmation of tracheal intubation was done with five-point auscultation and capnography.

If the airway could not be secured using Macintosh or videolaryngoscope even after three attempts, failure of insertion was declared and an alternative device was inserted and these patients were excluded from the study.

The PR, SBP, DBP, MBP and SpO₂ were noted immediately after intubation and at 1, 2, 3, 5 and 10 minutes after intubation. Anaesthesia was maintained with oxygen and nitrous oxide (50:50), intermittent vecuronium and IMAC isoflurane.

Primary objectives of the study were haemodynamic changes like PR, SBP, DBP and MBP and these parameters were recorded at baseline, before intubation, immediately after intubation and at 1, 2, 3, 5 and 10 minutes after intubation. Secondary objectives of the study were number of attempts and duration of each attempt (measured from the time the face mask is taken away from the face until the end-tidal CO₂ curve appears on the monitor) and any adverse effect like soft tissue injuries.

In statistical analysis categorical variables were presented in number and percentage (%) and continuous variables were presented as mean \pm SD and median. Normality of data was tested by Kolmogorov-Smirnov test. Quantitative variables were compared using Independent t test. Mann-Whitney Test (when the data

sets were not normally distributed) between the two groups. Qualitative variables were compared during Chi-Square test/Fisher's Exact test. A p value of <0.05 was considered statistically significant. The analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.

Results

Total 73 patients were assessed and 60 patients included and completed the study. Total assessed, excluded, recruited and randomised patients are shown in consort diagram (Figure 1). The mean age in Group V was 48.13 ± 6.21 years and in group M was 48.7 ± 7.62 years and statistically similar. Age distribution with respect to less than 40 years, 40 to 50 years and more than 50 years were also similar in both groups. There was statistically similar gender distribution, body mass index (BMI), modified Mallampatti score in both groups (Table 1).

There was no significant difference at baseline and after induction/immediately before intubation in mean (SD) PR per minute, DBP in mmHg, SBP in mmHg and MBP in mmHg between group V and group M (Figure 2-5). The mean (SD) PR, SBP, DBP and MBP after intubation in group M were significantly higher ($p < 0.001$) as compared to group V, immediately after intubation, 1 min, 2 min, 3 min, 5 min and 10 min after intubation (Figure 2-5). Secondary outcomes of study like number of attempts for intubation and time taken for first intubation attempt were also similar in both the groups. One patient in each group had soft tissue injury.

Table 1- Demographic details

		GroupV (n=30)	GroupM (n=30)	P value
Age in years		48.13 ± 6.21 (38-61)	48.7 ± 7.62 (36-64)	0.753
Age Distribution in years	≤ 40	4 (13.33)	5 (16.67)	0.883
	41-50	16 (53.33)	14 (46.67)	
	> 50	10 (33.33)	11 (36.67)	
Gender	Male	19 (63.33)	12 (40)	0.071
	Female	11(36.67)	18(60)	
MMP Score	1	3(10)	8 (26.67)	0.691
	2	27(90)	20(66.67)	
	3	0	2(6.67)	
BMI in kg/m ²		22.88 ± 2.61 (18.5-28.7)	22.81 ± 1.57 (19.8-25.1)	0.812
Number of intubation attempts	1	28 (93.33)	26 (86.67)	0.671
	2	2 (6.67)	4 (13.33)	
Duration of first intubation attempt in seconds		27.03 ± 2.65 (20-32)	26.23 ± 8.7 (18-65)	0.632

Data is represented as Mean \pm SD (Range) or n(%). BMI: Body mass index; MMP: Modified Mallampatti Score; SD: Standard Deviation

Figure 1- Consort diagram

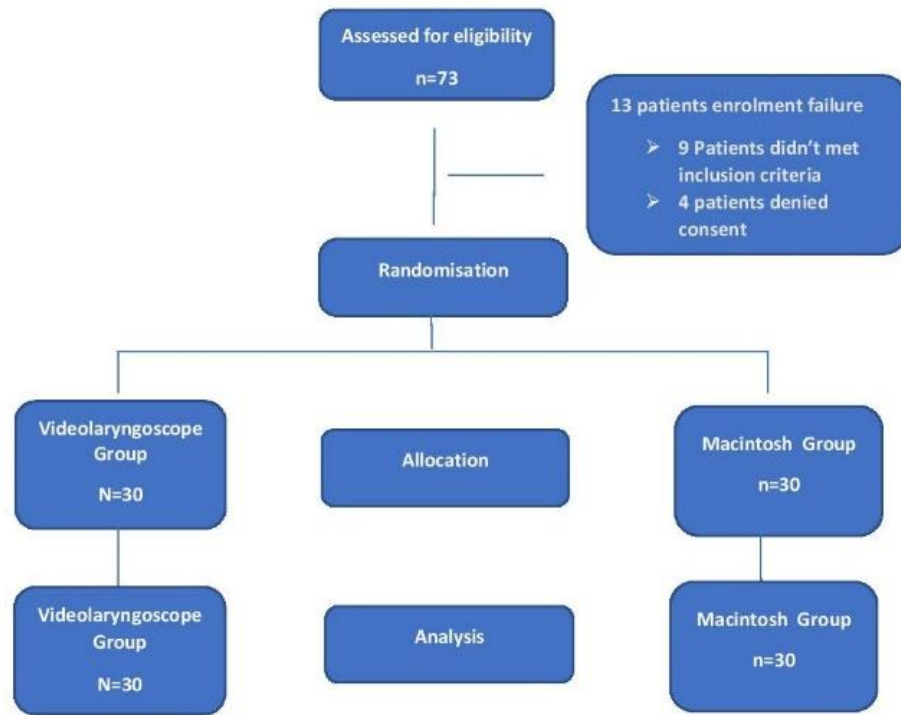


Figure 2- Comparison of pulse rate in two groups

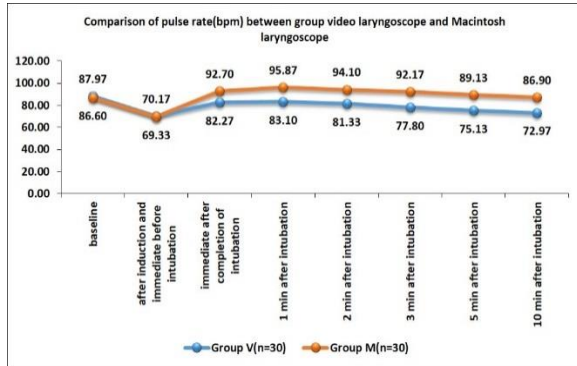


Figure 4- Comparison of diastolic blood pressure in two groups

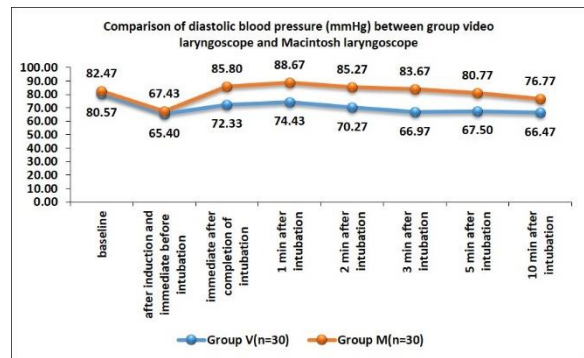


Figure 3- Comparison of systolic blood pressure in two groups

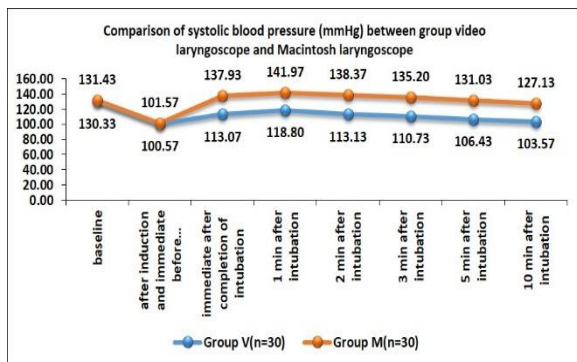
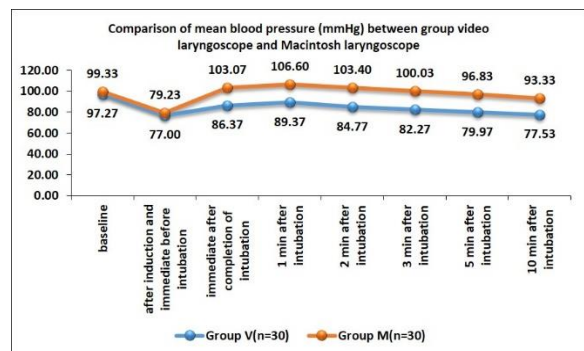


Figure 5- Comparison of mean blood pressure in two groups



Discussion

Attenuating the haemodynamic stress response to laryngoscopy and tracheal intubation is main concern for anaesthesiologist. Haemodynamic stress response associated with many serious complications, special attention is needed in patients with comorbidities such as hypertension and cardiovascular diseases.[14] Due to its specially designed blade structures and video assisting during procedures reducing the forces required for lifting the epiglottis and less movements at cervical spine are required to visualize the glottis, and that is considered as the reason for lower haemodynamic stress responses and helps in easy passage of the tracheal tube in case of difficulty.[4, 15-17] Multiple studies show that in healthy patients, haemodynamic stress responses were same in both videolaryngoscope and Macintosh laryngoscopes. [9, 18,19] However, evidence is scant about the use of VL in hypertensive patients. [9]

We found that VL maintained haemodynamic stability during intubation better than Macintosh laryngoscope; with comparable attempts and duration of attempts

We found that, PR was similar in both group at baseline and just before intubation. However, PR was on higher side till 10 minutes of study period after intubation in Macintosh group as compared to VL. In our studies PR was relatively low in VL group may be due to less intubation time and use of soft tip malleable guide, which caused less irritation of vocal cord structures. Our study is in agreement to study by Peirovifar A et al, [19] who compared haemodynamic responses to orotracheal intubation in hypertensive patients using Macintosh laryngoscope and VL and found that heart rate during laryngoscopy as well as immediately and 1 minute after intubation was significantly lower in VL group than Macintosh group. Mogahed et al, [16] reported that heart rate was significantly increased in Macintosh group at 2 and 5 minutes after intubation compared to VL (P=0.001). Recently, Cengiz S et al, [20] compared haemodynamic response in hypertensive and normotensive patients with both VL and Macintosh laryngoscope and concluded that only the difference in pulse rate measurements at 5 minutes reading was statistically significant.

We also observed that SBP, DBP and MBP at baseline, after induction and immediately before intubation between VL and Macintosh group were similar and then these parameters were higher in Macintosh group after intubation for 10 minutes of study period. In a study by Peirovifar A et al,[19] SBP during laryngoscopy and immediately and 1 minute after intubation was significantly lower in glidescope group than Macintosh group which is similar to that in our study. At two, three, and four minutes after intubation, no difference was found among the two groups; however, at five minutes after intubation, SBP was lower in Macintosh group as

compared to VL. They showed no difference in DBP between groups during laryngoscopy as well as immediately and one minute after intubation. At five minutes after intubation, DBP was lower in VL. MBP during laryngoscopy as well as immediately and one minute after intubation was significantly lower in VL (Glidescope) than Macintosh group. At two, three, and four minutes after intubation, MBP was significantly lower in VL group. [18] Dashti et al, also found that SBP, DBP and MBP were similar at the baseline in both groups. These blood pressure parameters increased after intubation and were significantly higher in the Macintosh group than the VL group in the first 3 minutes after intubation. However, the values returned to pre-intubation levels after 5 minutes in both groups. [4]

One more similar study done by Abdelgawad et al, in hypertensive patients, that SBP and DBP were similar at the baseline in both groups, but were significantly higher in Macintosh group than VL at 1,2,3 minutes after intubation (p<0.005). [21]

Mogahed MM et al, found that MBP was significantly increased in Macintosh group at 2- and 5-minute post-intubation compared to VL group (P=0.001). This study results were similar to our study. [14]

Complications related to laryngoscopy were contradictory in different studies. Ali QE et al showed more complications in Macintosh group whereas Hst WT et al showed more complications in VL. [18, 22] In our studies only 2 patients (one in each group) had soft tissue injury. The adverse events are quite common with incidence up to 90%. Postoperative hoarseness and sore throat are also very common due to laryngoscopy, intubating aids and ETT itself. [23]

There is a dearth of studies regarding comparison of haemodynamic stress response associated with orotracheal intubation using video laryngoscope and Macintosh laryngoscope in controlled hypertensive patients who are more susceptible to these changes. Thus, our study can act as a stepping zone for further larger studies to find out better technique for endotracheal intubation. Many of our results corroborated with other studies done at different times and in different places. This study, thus, add to the already existing literature about the use of video laryngoscope and Macintosh laryngoscope in controlled hypertensive patients.

Our study has certain limitations, first, we could not blind the anaesthesiologist to the laryngoscope being used. Secondly, results of the study may have differed in the hands of inexperienced or less experienced anaesthesiologist and lastly, it was difficult to homogenize some patient factors while conducting the study on hypertensive patients such as drug therapy which may affect haemodynamics.

In conclusion, we found that intubation with the use of i-scope videolaryngoscope results in less haemodynamic

stress response compared to Macintosh laryngoscope in controlled hypertensive patients.

Conclusion

We found that intubation with the use of i-scope videolaryngoscope results in less haemodynamic stress response compared to Macintosh laryngoscope in controlled hypertensive patients.

References

- [1] Ko DD, Kang H, Yang SY, Shin HY, Baek CW, Jung YH, et al. A comparison of hemodynamic changes after endotracheal intubation by the Optiscope™ and the conventional laryngoscope. *Korean J Anesthesiol.* 2012; 63(2):130-5.
- [2] Kanchi M, Nair HC, Banakal S, Murthy K, Murugesan C. Haemodynamic response to endotracheal intubation in coronary artery disease: Direct versus video laryngoscopy. *Indian J Anaesth.* 2011; 55(3):260-5.
- [3] Aggarwal H, Kaur S, Baghla N, Kaur S. Hemodynamic response to orotracheal intubation: comparison between Macintosh, McCoy, and C-MAC video laryngoscope. *Anesth Essays Res.* 2019; 13(2):308-312.
- [4] Padavarahalli Thammanna P, Marasandra Seetharam K, Channasandra Anandaswamy T, Rath P, Chamanhalli Rajappa G, Joseph J. Comparison of Haemodynamic Response to Intubation with KingVision and C-MAC® Videolaryngoscope in Adults. *Arch Anesth & Crit Care.* 6(2):65-0.
- [5] Nalini K, Gopal A, Iyer S, Mungasuvalli N. A Comparative Crossover Randomized Study of Miller and Macintosh Blade for Laryngoscopic View and Ease of Intubating Conditions in Adults. *Arch Anesth & Crit Care.* 7(2):58-2.
- [6] Pournajafian AR, Ghodrati MR, Faiz SH, Rahimzadeh P, Goodarzynejad H, Dogmehchi E. Comparing GlideScope Video Laryngoscope and Macintosh Laryngoscope Regarding Hemodynamic Responses During Orotracheal Intubation: A Randomized Controlled Trial. *Iran Red Crescent Med J* 2014; 16(4):e12334.
- [7] Kihara S, Brimacombe J, Yaguchi Y, Watanabe S, Taguchi N, Komatsuzaki T. Hemodynamic responses among three tracheal intubation devices in normotensive and hypertensive patients. *Anesth Analg.* 2003; 96(3):890-895.
- [8] Jakusenko N, Kopeika U, Mihelons M, Nagode D, Putina AV, Pavars A. Comparison of Stress Response Performing Endotracheal Intubation By Direct Laryngoscopy, Fiberoptic Intubation And Intubation By The Glidescope Laryngoscope. *Proc Latvian Acad Sci.* 2008; 62:176-81
- [9] Li XY, Xue FS, Sun L, Xu Ya-C, Liu Y, Zhang GH, et al. Comparison of hemodynamic responses to nasotracheal intubations with Glide Scope videolaryngoscope, Macintosh direct laryngoscope, and fiberoptic bronchoscope. *Zhongguo Yi Xue Ke Xue Yuan Xue Bao* 2007; 29(1):117-23
- [10] Chemsian RV, Bhananker S, Ramaiah R. Videolaryngoscopy. *Int J Crit Illn Inj Sci.* 2014; 4(1):35-41
- [11] Sperati G, Felisati D, Bouchut, O'Dwyer and laryngeal intubation in patients with croup. *Acta Otorhinolaryngol Ital* 2007; 27(6):320-3.
- [12] Vital Signs: Awareness and Treatment of Uncontrolled Hypertension Among Adults — United States, 2003–2010. Available at URL: <https://www.cdc.gov/mmwr/preview/mmwrhtml/m6135a3.htm> [last accessed on 27th September, 2020]
- [13] New ACC/AHA High Blood Pressure Guidelines Lower Definition of Hypertension. Available at URL: <https://www.acc.org/latest-in-cardiology/articles/2017/11/08/11/47/mon-5pm-bp-guideline-aha-2017> [last accessed 06th Sept 2020]
- [14] Mogahed MM, Elghamri MR, Anwar AG. Comparative Study of Intubation Performance between Macintosh, the Channeled KingVision and the C-MAC D-Blade Videolaryngoscope in Controlled Hypertensive Patients. *J Anesth Clin Res.* 2017; 8:780
- [15] Kumar D, Gombar S, Ahuja V, Malhotra A, Gupta S. GlideScope versus D-blade for tracheal intubation in cervical spine patients: A randomised controlled trial. *Indian J Anaesth.* 2019; 63(7):544-50
- [16] Kapoor D, Jindal S, Gombar S, Bajaj N, Atter P, Dalal U. Comparative Evaluation of ProSeal LMA vs. Cuffed Endotracheal Tube in Patients Undergoing Laparoscopic Cholecystectomy under General Anesthesia. *Arch Anesth & Crit Care.* 4(4):527-34.
- [17] Solanki SL, Kaur J. "Two-hand-manoeuver" during nasotracheal intubation. *Saudi J Anaesth.* 2017; 11:512
- [18] Ali QE, Amir SH, Jamil S, Ahmad S. A comparative evaluation of the Airtraq and King Vision video laryngoscope as an intubating aid in adult patients. *Acta Anaesthesiol Belg.* 2015; 66:81-5
- [19] Peirovifar A, Mostafa Gharehbaghi M, Azarfarin R, Karimi L. Comparison of hemodynamic responses to orotracheal intubation in hypertensive patients: laryngoscopy via Macintosh blade versus GlideScope video laryngoscope: 19AP4-2. *Euro J Anaesthesiol.* 2012; 29:235
- [20] Cengiz S, Yilmaz S. The effect of intubation with video and conventional laryngoscopy on hemodynamic response. *GKDA Derg.* 2019; 25:31-42
- [21] Abdelgawad AF, Shi QF, Halawa MA, Wu ZL, Wu ZY, Chen XD, et al. Comparison of cardiac output and hemodynamic responses of intubation among different videolaryngoscopies in normotensive and hypertensive patients. *J Huazhong Univ Sci Technol*

- Med Sci. 2015; 35: 432–8.
- [22] Hsu WT, Hsu SC, Lee YL, Huang JS, Chen CL. Penetrating injury of the soft palate during GlideScope intubation. *Anesth Analg* 2007; 104:1609–610
- [23] Najafi A, Imani F, Makarem J, Khajavi MR, Etezadi F, Habibi S, et al. Postoperative sore throat after laryngoscopy with macintosh or glide scope video laryngoscope blade in normal airway patients. *Anesth Pain Med* 2014; 4:e15136.