ORIGINAL ARTICLE ASIAN JOURNAL OF MEDICAL SCIENCES

To compare the haemodynamic stress response of direct laryngoscopy and oro-tracheal intubation using McCoy and Macintosh blade in general anaesthesia

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Submission: 14-10-2020 Revision: 27-01-2021 Publication: 01-03-2021

ABSTRACT

Background: Direct Laryngoscopy and intubation lead to extensive stress response and sympathetic stimulation in the body which can be critical for some patient subsets like cardiac ischemia, raised intracranial tension, cerebral aneurysm, open globe injury, glaucoma etc. Hence reduction of the intense stress response is of utmost importance for a stable and safe hemodynamics in those patients. **Aims and Objectives:** 1. To find out the hemodynamic stress response exerted by the Macintosh blade and McCoy blade. 2. To compare the hemodynamic stress responses between the two blades. **Materials and Methods:** In this study we had selected 60(male and female in equal number) ASA grade-1 and grade- 2 patients posted for elective general surgery. They were randomly divided into two groups - group 1(laryngoscopy done by McCoy blade)and group 2(laryngoscopy done by Macintosh blade). Systolic Blood Pressure, Diastolic Blood Pressure , Mean Blood Pressure and Heart Rate were recorded before and after anaesthesia induction, just after intubation and one, three and six minutes after orotracheal intubation. **Results:** The results were compared over time between the two groups. Mean values of Systolic Blood Pressure, Diastolic Blood Pressure, Mean Blood Pressure and heart rate were significantly higher in group 2 as compared to group 1(with p values as 0.009, 0.008, 00.004 and 0.000 respectively). **Conclusion:** Thus we conclude that the stress response was significantly higher when laryngoscopy was done with Macintosh blade as compared with McCoy blade. We would also like to stress that the art of laryngoscopy should just not be mastered but all anaesthesiologists should think of and practise techniques which would make laryngoscopy smooth and less stressful for our patients. Intubation with McCoy laryngoscope blade is one such technique.

Key words: Anaesthetic induction; Direct laryngoscopy; Haemodynamic stress response; Macintosh blade; McCoy blade; Orotracheal intubation

Access this article online

Website:

http://nepjol.info/index.php/AJMS

DOI: 10.3126/ajms.v12i3.32101

E-ISSN: 2091-0576

P-ISSN: 2467-9100

INTRODUCTION

Laryngoscopy and intubation are not only a vital part of anaesthesia but also extremely important components of critical care and emergency medicine. A good laryngoscopy is a skill which is perfected over time. Laryngoscopy can be both direct as well as indirect. It was due to the pioneering effort of three anaesthesiologists - Alfred Kirstein (1863 - 1922),[1] Chevalier Jackson (1865 - 1958)[2] and Gustav Killian (1838-1912)[2] that the first use of laryngoscopy came into existence. Robert A Macintosh[3] and Robert A Miller[4] also contributed significantly to the development of modern laryngoscopes. Since then, laryngoscopes of various sizes, shapes,[5] handles[6] and blades[7] have been developed to facilitate different clinical situations.[8]

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There are various studies to understand the technique of laryngoscopy[9] and the physiological changes caused by it.[10] Direct Laryngoscopy and intubation lead to extensive stress response and sympathetic stimulation in the body which can be critical for some patient subsets like cardiac ischemia, raised intracranial tension, cerebral aneurysm, open globe injury, glaucoma etc. Hence reduction of the intense stress response is of utmost importance for a stable and safe hemodynamics in those patients.

Various pharmacological measures have been used to blunt this stress response. Various adaptations in the designs of the laryngoscope blades have also been tried. The time duration of laryngoscopy also contributes to the stress response and hence duration of less than 15 seconds is said to be ideal. No technique has yet proved to be perfect.

Thus it is a must for all anesthesiologists to understand the physiology of this stress response and also to know the measures to reduce it. Various studies have been carried out in the past and they have shown that the difference in amount of stretch and force caused by different designs of blades leading to varied degrees of stress responses.[11] It is interesting to see how this simple technique of changing the laryngoscope blade design changes the degree of stress response. As laryngoscope blades are reused, therefore it is also a very cost effective measure. There have been various studies on the stress response. But as mostly no consensus came from those studies, this study was undertaken amongst the West Bengal population in India to compare the results of the two laryngoscopic blades.

MATERIALS AND METHODS

The study was conducted in a government medical college of West Bengal for a period of approximately one year (March 2011 to February 2012) on 60 patients (male and female in equal numbers) of ASA grade 1 and 2 and within the age group of 20 to 55 years, posted for elective surgery under general anesthesia with orotracheal intubation. Patients with anticipated difficult intubation, ASA grade 3 and 4, suffering from hypertension, diabetes or other systemic diseases, taking antihypertensive drugs were discarded. It is a prospective randomized observational single blind study.

Ethical committee clearance was obtained before commencement of the study. The patients were explained about the whole procedure and a written consent was obtained from each patient.

Among 60, 30 males and 30 female patients were selected and divided randomly into group 1 and 2 such that each group contains 15 males and 15 female patients.

A detailed pre-anaesthetic check-up was done on the day before surgery including history of present illness and its management, previous medical and surgical illness, previous anaesthetic exposure, drug and allergy history. A detailed examination of the airway, other systems of the body and spine were also done. All routine blood investigations, ECG and chest X ray were checked. The height and weight of the patient were also recorded. All patients were given suggestions regarding the preoperative preparations. After patient identification and checking the consent for surgery and anesthesia the patients were shifted to the operating table with an intravenous line for infusing Ringer's Lactate.

Monitors like noninvasive blood pressure cuff, pulse oximeter, 12 lead ECG, capnograph and temperature probe were attached to the patients.

All patients were given intravenous Ondansetron 4mg, injection Fentanyl 2 mcg / kg, three minutes before induction of anaesthesia. Pre-oxygenation was done for 5 minutes and then induction of Anaesthesia was done with Injection 2% Propofol 2mg/kg and Injection Atracurium 0.5mg/kg was used as muscle relaxant. After 3 minutes of bag mask ventilation laryngoscopy and intubation were done. Laryngoscopy was done in less than 15 seconds in all cases. Endotracheal tube size 7.5 mm was used for females and 8.5mm was used for males. The tube was secured with adhesive tapes after the tube position was being confirmed by auscultation and capnography. Anaesthesia was maintained with 66 percent N_2O and 33 percent O_2 with intermittent intravenous Fentanyl and Atracurium as required.

Monitoring

1) Heart rate, systolic blood pressure, diastolic blood pressure and mean arterial pressure before and after induction, 1 minute, 3 minute and 6 minute after intubation.
2) ECG lead 2 and lead 5 continuously for any rhythm disturbance.
3) End tidal CO_2 by capnography.

Data analysis

Data was analyzed by SPSS version 19. Student's t-test was applied to find the difference between the mean values of the parameters of the two groups at the base line and after induction with Propofol. Two-way mixed model repeated measures ANOVA was used to find the main effect of the influence of time on the mean values of the parameters averaged across both the groups, the group x time interaction and between group effects. Greenhouse-Geisser's correction for the degrees of freedom was considered where assumption of sphericity was violated. A 'p' value less than .05 was considered to be significant.

RESULTS

The mean age in the two groups (38.63 ± 6.53 vs. 38.77 ± 5.56) did not vary significantly [t (58) = .085 p = .933].

Mean systolic BP

The mean systolic BP did not vary significantly between the two groups either at the baseline [t (58) = 1.08 p = .286] or after induction with Propofol [t (58) = .82 p = .415]. But it varied significantly over time averaged across both the groups [F (5, 188.54) = 171.54 p = .000] and the rate of change also varied significantly across the groups (p =.000). On an average, the mean systolic BP was significantly higher in Group 2 than in Group 1 [F (1, 58) = 7.39 p = .009] (Table 1, Figure 1). On an average, the mean systolic BP between the two groups did not vary significantly either with age (p = .79) or with sex (p = .97).

Mean diastolic BP

The mean diastolic BP did not vary significantly between the two groups either at the baseline [t (58) = 1.08 p = .286] or after induction with Propofol [t (58) = .72 p = .475]. But it varied significantly over time averaged across both the groups [F (5, 236.08) = 90.27 p = .000] and the rate of change also varied significantly across the groups (p =.000). On an average, the mean diastolic BP was significantly higher in Group 2 than in Group 1 [F (1, 58) = 7.65 p = .008] (Table 2, Figure 2). However on an average, the mean diastolic BP between the two groups did not vary significantly either with age (p = .86) or with sex (p = .92).

MAP

The mean of MAP did not vary significantly between the two groups either at the baseline [t (58) = 1.93 p = .06] or after induction with Propofol [t (58) = .52 p = .608]. But it varied significantly over time averaged across both the groups [F (5, 239.90) = 120.66 p = .000] and the rate of change also varied significantly across the groups (p =.000). On an average, it was significantly higher in Group 2 than in Group 1 [F (1, 58) = 9.23 p = .004] (Table 3, Figure 3). However on an average, the mean of MAP between the two groups did not vary significantly either with age (p = 46) or with sex (p = .92).

Mean heart rate

The mean heart rate at the baseline did not vary significantly between the two groups [t (58) = 1.93 p = .06] but was found to be significantly lower in Group 1 than Group 2 after induction with Propofol [t (58) = 2.48 p = .016]. It varied significantly over time averaged across both the groups [F (5, 201.80) = 48.30 p = .000] and the rate of change also varied significantly across the groups (p = 000). On an average, it was significantly lower in Group 1 than in Group 2 [F (1,

Table 1: Mean systolic BP of the two groups over time

Mean systolic BP at different time periods	Group1 (mean±SE) (in mm of Hg)	Group 2 (mean±SE) (in mm of Hg)
1	131.30±2.48	127.77±2.14
2	105.67±2.49	103.20±1.69
3	131.03±2.81	136.10±1.75
4	134.00±2.60	151.03±1.46
5	128.43±2.52	140.97±1.21
6	121.70±2.33	132.30±1.20

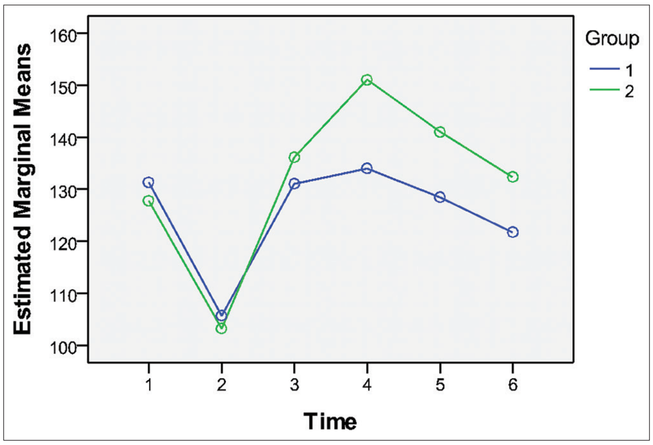

Figure 1: Estimated Marginal means of systolic Blood pressure

Table 2: Mean diastolic BP of the two groups over time

Mean diastolic BP at different time periods	Group1 (mean±SE) (in mm of Hg)	Group 2 (mean±SE) (in mm of Hg)
1	79.40±1.60	76.57±1.73
2	64.87±1.54	63.33±1.49
3	80.43±2.47	86.77±1.71
4	87.00±2.65	95.53±0.84
5	79.23±1.88	90.00±1.11
6	75.37±1.61	82.73±1.44

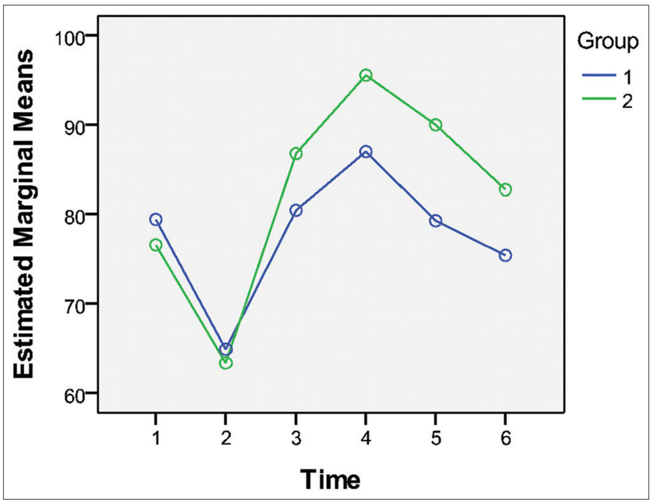

Figure 2: Estimated Marginal means of diastolic Blood pressure

Table 3: Mean of mean arterial pressure of the two groups over time

Mean of MAP at different time periods	Group1 (mean±SE) (in mm of Hg)	Group 2 (mean±SE) (in mm of Hg)
1	94.90±1.89	90.03±1.68
2	77.47±1.50	76.43±1.35
3	94.00±2.43	100.77±1.80
4	100.53±2.25	112.60±1.01
5	94.67±1.90	104.57±1.18
6	88.43±1.94	98.73±1.30

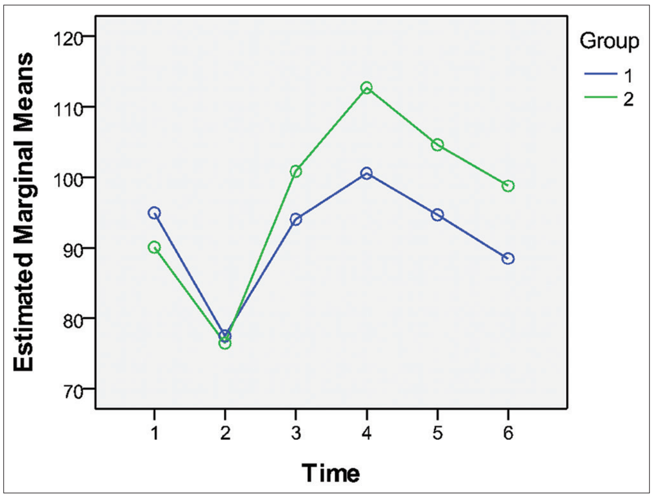

Figure 3: Estimated Marginal means of Mean Blood pressure

Table 4: Mean heart rate of the two groups over time

Mean heart rate at different time periods	Group 1 (mean±SE) (in mm of Hg)	Group 2 (mean±SE) (in mm of Hg)
1	82.07±2.06	79.47±1.48
2	78.43±1.96	85.03±1.80
3	88.03±1.71	95.03±1.32
4	88.27±2.20	101.13±1.40
5	84.23±2.06	94.77±1.07
6	78.90±1.97	89.87±1.04

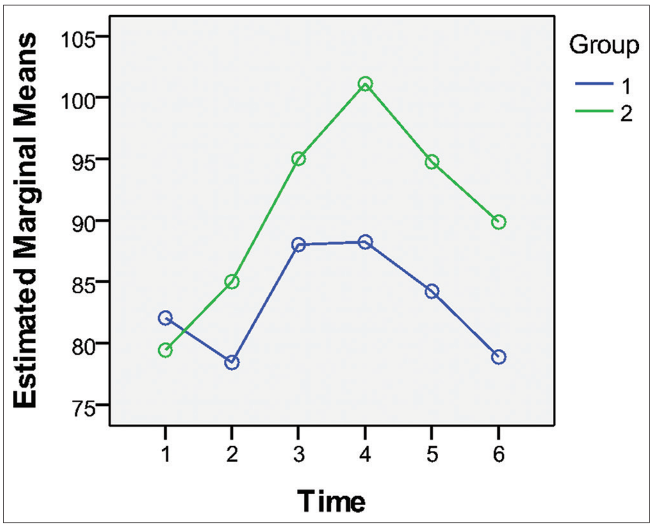

Figure 4: Estimated Marginal means of Heart rate

58) = 15.47 p = .000] (Table 4, Figure 4). However on an average, the mean heart rate between the two groups did not vary significantly either with age (p = .09) or with sex (p = .78).

DISCUSSION

In our study we have seen that the amount of stress response generated by McCoy laryngoscope is significantly less than that of Macintosh blade. The systolic, diastolic and mean arterial blood pressure and heart rate in both the groups did not vary significantly at baseline after induction with Propofol .But they all varied significantly across the groups after laryngoscopy and intubation. On an average the systolic, diastolic ,mean arterial blood pressure and heart rate in group 2 were significantly higher than group 1 (with p values as 0.009, 0.008, 00.004 and 0.000 respectively).

There are significant intra-group variations of the mentioned parameters. Though, their values did not vary significantly at baseline in both the groups, their values fell down in both groups after induction which can be attributed to the vasodilatory property of Propofol. There is a rise in systolic, diastolic, mean arterial blood pressures as well as heart rate immediately after intubation and one minute after intubation. But on an average their mean values were more in group 2 as compared to group 1. Thereafter their values had fallen down but they were consistently higher in group 2 as compared to group 1, after 3 minutes and 6 minutes of induction.

These results are in concurrence with studies by McCoy EP and others.[1,2] However a study carried out and published by H Jung Shin and others shows conflicting results showing no significant difference between the change of systolic and diastolic blood pressure of McCoy and Macintosh group.[4]

Both sympathetic and parasympathetic nervous systems are involved in heart rate response which maintains a balance between cardiac sympathetic excitation and cardiac vagal withdrawal.[5] Aging is also associated with decreased autonomic reflex function.[6] Elderly patients have lesser chronotropic effect associated with tracheal intubation[7] However the impact of age is not significant in our study as there is not significant age difference between the age in the 2 groups.

The findings of our study correlates well with many studies like the study carried out by Norris TJ and others,[11] Barak M and others[12] and Xue FS and others[13] which all concluded that the stress response by McCoy blade was significantly less as compared to the stress response by Macintosh blade. The difference is mainly due to a lesser force exerted by the McCoy laryngoscope. The blood pressure and heart rate settled down in both the groups over time as the stress response decreased gradually.

The hemodynamic changes seen with laryngoscopy and intubation are a result of rise in catecholamine levels. Studies have shown an increase in noradrenaline level with laryngoscopy.[12] However, some studies failed to show a rise in adrenaline level.[12,13] One of the limitations of our study is that we have not measured the catecholamine levels. Measuring of catecholamine levels would have been of great relevance to quantify and to find the exact pharmacology behind the stress response. We have also not been able to measure the cortisol levels in the patients which is the marker of any stress response.

Another major limitation of the study is that in both groups of patients were given i.v Fentanyl (2 microgram / kg) before laryngoscopy and intubation. This drug is used to decrease the stress response. But as both the groups had received the same amount of fentanyl, we are able to compare the haemodynamic response evoked by different laryngoscopic blades.

Our study includes only ASA 1 and 2 patients, neither of them was hypertensive, diabetic or on any drug therapy. There are various studies which show that autonomic neuropathy associated with diabetes mellitus leads to an altered stress response to laryngoscopy and intubation.[8] Also more studies should be carried out on hypertensive patients on antihypertensive therapy to study laryngoscopy induced stress response. More studies should also be planned for patients with endocrinological disorders.

CONCLUSION

Direct Laryngoscopy and intubation lead to extensive stress response and sympathetic stimulation in the body, which can be critical for some patient subset. In our study we conclude that the stress response was significantly higher when laryngoscopy was done with Macintosh blade as compared with McCoy blade. So using McCoy blade in high risk patients will subsequently reduce complications caused by adverse sympathetic surge. The cause of less stress response by McCoy blade is due to less force or traction exerted by McCoy blade during direct laryngoscopy.

ACKNOWLEDGEMENT

The authors take the opportunity to thank all the patients who volunteered to participate willingly and other technical staff of operation theatre for their continuous support throughout the study.

REFERENCES

1. Hirsch NP, Smith GB and Hirsch PO. Alfred Kirstein: Pioneer of direct laryngoscopy. Anesthesia 1986; 41: 42-45. https://doi.org/10.1111/j.1365-2044.1986.tb12702.x
2. Jackson C. Tracheobronchoscopy, esophagoscopy and gastroscopy. St Louis, CV, Mosby 1907.
3. Miller R. A new laryngoscope. Anesthesiology 1941; 2: 317-320. https://doi.org/10.1097/00000542-194105000-00008
4. Macintosh R. A new laryngoscope. Lancet 1943; 1:205. https://doi.org/10.1016/S0140-6736(00)89390-3
5. Dhara SS and Cheon TW. An adjustable multiple angle laryngoscope adapter. Anaesth Inters Care. 1991; 19: 243-245. https://doi.org/10.1177/0310057X9101900217
6. Patil VU, Stehling LC and Zauder HL. An adjustable laryngoscope handle for difficult intubation. Anesthesiology. 1984; 60: 609. https://doi.org/10.1097/00000542-198406000-00025
7. Drino JJ and Velasco JM. Straight blades improve visualization of the larynx while curved blades improve intubation. Can J Anaesth. 2003; 50: 501-506. https://doi.org/10.1007/BF03021064
8. MC Intyre JWR. Laryngoscope design and the difficult adult tracheal intubation. Can J Anaesth. 1989; 36: 94-98. https://doi.org/10.1007/BF03010896
9. Crosly ET. Airway management in adults after cervical spine trauma. Anesthesiology. 2006; 104: 1293-1318. https://doi.org/10.1097/00000542-200606000-00026
10. Rose DK and Cohen MM. The airway problems and predictions in 18500 patients. Can J Anaesth. 1994; 41: 372-383. https://doi.org/10.1007/BF03009858
11. Nerris TJ and Baysinger CL. Heart rate and blood pressure response to laryngoscopy. The influence of laryngoscopic technique. Anesthesiology. 1985; 63: 560. https://doi.org/10.1097/00000542-198511000-00020
12. Buck MJL, Vangul RTM, Scheck PAE and Stijnen T. Cardiovascular effects of forces applied during laryngoscopy. The importance of tracheal intubation. Anaesthesia. 1992; 47: 10029-1033. https://doi.org/10.1111/j.1365-2044.1992.tb04195.x
13. Barak M, Ziser A, Greenberg A, Lischinsky S and Rosenberg B. Hemodynamic and catecholamine response to tracheal intubation: direct laryngoscopy compared with fibreoptic intubation. J Clin Anesth. 2003; 15: 132-136. https://doi.org/10.1016/S0952-8180(02)00514-7

Author's Contribution:
AM-Concept and design of the study, data collection, critical revision of manuscript; **SM**-Performed literature research, coordination of overall study, statistical analysis, result interpretation, manuscript editing.

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Source of funding: None, **Conflict of Interest:** None.