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Comparison of the stress response and intubating performance in endotracheal intubation with Macintosh and McCoy laryngoscopes - A randomized study

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***Abstract*---**Introduction: Laryngoscopy and intubation cause stress response and sympathetic stimulation within the body. Attenuation of these changes by pharmacological means and improved technique with modified instruments is of absolute importance, for stable hemodynamics of the patients. Aim: Comparison of stress response to laryngoscopy and intubation, Intubation Difficulty Score (IDS) using Macintosh and McCoy laryngoscopes. Material and methods: After obtaining institutional ethical committee approval and patient consent in this randomized study, sixty patients of ASA grade I and II, posted for elective surgery under general anaesthesia were intubated with Macintosh or McCoy laryngoscopes. Changes in heart rate, mean arterial pressure, systolic and diastolic blood pressure were observed upto 15 minutes after laryngoscopy, along with IDS. Results: McCoy group when compared with Macintosh group had significant reduction

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in heart rate at T0 (p value <0.0001), systolic blood pressure at T0, T1 and T15 (p value < 0.001), diastolic blood pressure at T0, T10 and T15 (p value <0.05), mean arterial blood pressure at T0, T10 and T15 (p value <0.05) was observed in this study. Conclusion: Hemodynamic stress response with McCoy blade laryngoscope was reduced in magnitude in comparison with Macintosh blade laryngoscope.

***Keywords*---**IDS, Laryngoscopy, Macintosh, McCoy laryngoscope.

Introduction

Patient's airway control during general anaesthesia is generally provided by endotracheal intubation, with the help of a laryngoscope. Direct laryngoscopy and intubation lead to mechanical stimuli. Mechanical stimulus causes reflex responses in cardiovascular and respiratory systems [1]. The usual circulatory responses to laryngeal and tracheal stimulation in anaesthetized patient are tachycardia and a rise in mean arterial pressure (MAP), as a result of reflex sympathoadrenal stimulation. That response reaches its maximum level within 1 min and ends in 5 to 10 min after intubation [2].

Laryngoscopy and tracheal intubation are noxious stimuli that evoke a transient but marked increase in heart rate (HR), blood pressure due to lifting force exerted by the laryngoscope blade on the base of the tongue while lifting the epiglottis [3]. The haemodynamic responses are due to increase in the sympathetic and sympatho-adrenal activity, as evidenced by increase in plasma catecholamine's concentrations found in patients under general anaesthesia causing biochemical stimulus [4]. Catecholamine release leads to hypertension, tachycardia and arrhythmia. Tachycardia generates a more powerful load on the heart when compared with hypertension as it increases oxygen consumption of the myocardium, decreases diastolic filling and finally reduces coronary blood supply [5].

Sudden rise in blood pressure due to sympathoadrenal stimulation may cause left ventricular failure, myocardial ischemia, and cerebral hemorrhage [6]. These complications are more likely in the presence of coronary or cerebral atheroma, or in patient with hypertension [7]. The frequency and degree of these responses in normotensive patients are less certain.

These hemodynamic changes can be detrimental in vulnerable patients, example, those with ischemic heart disease, cerebrovascular disease, etc., and need to be prevented. Anaesthetic literature focused more on the pharmacological methods for obtundation of the response, and literature related to non-pharmacological methods, specifically laryngoscopy blade design, is limited [8].

Attenuation of hemodynamic responses to laryngoscopy and tracheal intubation are of concern and important to achieve smooth anaesthesia as adverse cardiovascular events might develop in patients with or without cardiovascular disease [9].

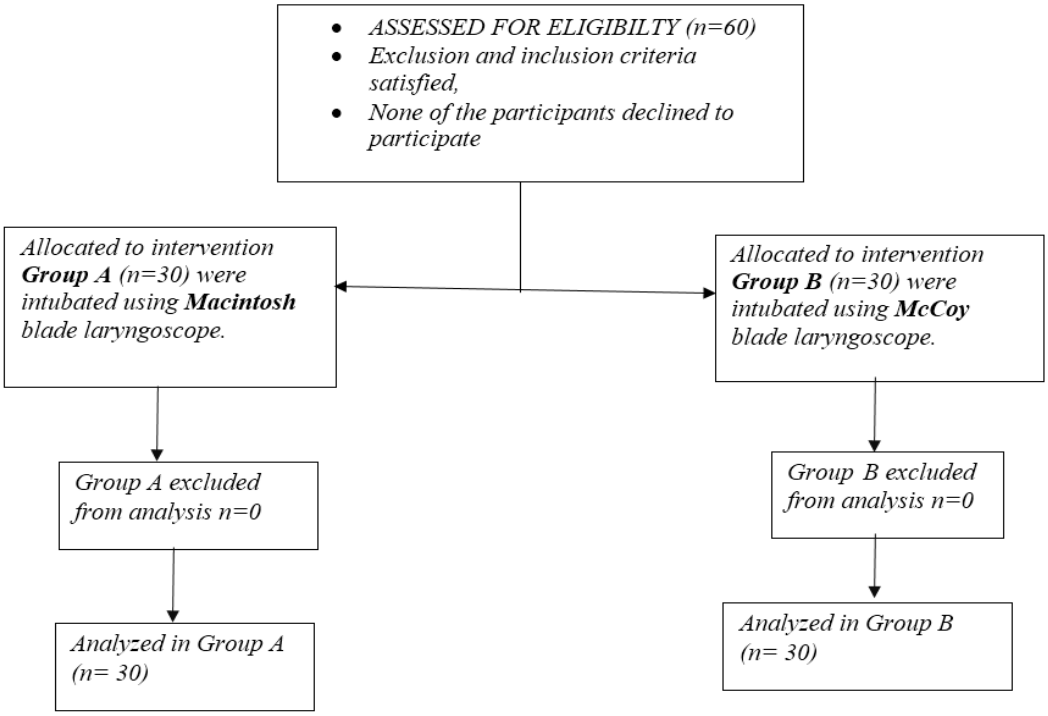
By altering the shape and type of laryngoscope blade, lifting force can be reduced which helps attenuate the stress response by minimizing stimulation of sympathoadrenal response [10]. Pharmacological methods are also available for the same.

This study was carried out to find the effectiveness of McCoy laryngoscope to attenuate the stress response secondary to laryngoscopy, compared to standard Macintosh laryngoscope in adult patients undergoing elective surgery under general anaesthesia. Intubation difficulty score (IDS) was used to compare the intubating conditions of laryngoscopy by using McCoy and Macintosh blades [11].

Material and Methods

After obtaining approval from the institutional ethical committee (approval number SVIEC/ON/MEDI/BNPG18/D19168) this randomized study was carried out in the department of Anaesthesiology at a tertiary health care centre from 16th November 2019 to 31st May 2021. A total of 60 patients of either sex, 18 to 70 years, belonging to ASA grade I or II, scheduled for elective surgeries under general anaesthesia without any history of drug allergy, sensitivity or other form of reaction, having a Mallampatti grade 1 or 2 were included in this study. Patients belonging to ASA grade III or IV, with history of coagulopathy, bronchial asthma, on beta blocker medication, having cardiovascular diseases, requiring nasal intubation, with anticipated difficult airway like Mallampatti grade 3 or 4 were excluded from the study. The patients were allocated in a randomized manner by chit method into two equal groups of 30 patients each.

Table/Figure I: Study flow diagram



Pre-operative management

Detailed pre anaesthetic checkup of all the patients posted for elective surgery was done a day prior to surgery. They were assessed for height, weight and general parameters, vitals namely heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), respiratory rate (RR), temperature. Airway assessment was carried out and Mallampatti score was recorded. Systemic examination of respiratory system, cardiovascular system, gastrointestinal system and central nervous system were done. The patients were investigated for complete blood count, random blood sugar, renal function test (serum creatinine and urea), liver function test (SGOT, SGPT, direct & indirect bilirubin), ECG, Chest x-ray PA view. All the patients were kept nil by mouth for at least 6 hours prior to induction of anaesthesia. On the day of surgery the patients were brought to the operation theatre (OT), multipara monitors were attached and baseline parameters were recorded.

All patients were pre-medicated with inj. glycopyrrolate 0.004mg/kg i.v. inj. midazolam 0.02mg/kg i.v. and inj. ondansetron 0.08mg/kg i.v. Analgesic supplementation in the form of pre medication was avoided during the study. The baseline vitals were recorded before induction of general anaesthesia. The patients were pre oxygenated with 100% O_2 for 5 minutes. Anaesthesia was induced with inj. thiopentone 5-7mg/kg i.v. followed by inj. succinylcholine 2mg/kg i.v. Laryngoscopy with either of the laryngoscopes (Macintosh or Mc coy) was performed by the consulting anaesthesiologist with 2 years of experience with standard blade size for the patient and airway was secured with appropriate sized endotracheal tube. Tube was fixed after confirmation of bilateral equal air entry. The IDS was noted after successful intubation with either of the laryngoscopes. The HR, SBP, DBP, MAP and pulse oximetry (SPO_2) were recorded at 0, 1, 3, 5, 10 and 15 minutes interval and data was tabulated accordingly. Anaesthesia was maintained with oxygen (O_2) 2 l/min, nitrous oxide (N_2O) 2 l/min, Isoflurane and inj. Atracurium (loading dose of 0.5 mg/kg and maintenance dose of 0.1 mg/kg) i.v. using closed system. All other stimuli like positioning, removal of clothes of the patients were avoided before and during laryngoscopy and intubation. IV fluid ringer lactate was given as per Holiday Segar formula. After 20 minutes of induction of general anaesthesia patients were given inj. Tramadol 50 mg i.v. At the end of the surgery patients were reversed with inj. glycopyrrolate 0.008 mg/kg i.v. and inj. neostigmine 0.05mg/kg i.v.

Post induction monitoring

HR, SBP, DBP, MAP, SpO2, before laryngoscopy and at 0, 1, 3, 5, 10 & 15 min after the laryngoscopy were observed and recorded. Patients of both the groups were assessed for stress response and intubating performance to the respective laryngoscope blade used for tracheal intubation.

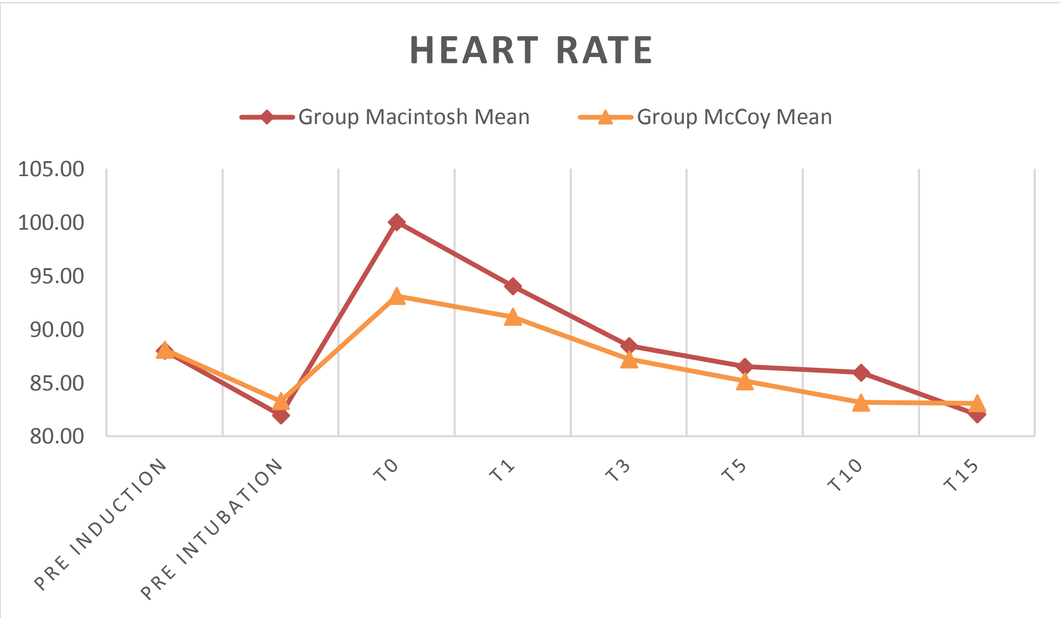
Observation and results

Data was collected, tabulated. Numerical variables were presented as mean and standard deviation (SD) while categorical variables were presented as frequency and percentage. As regard numerical variables, unpaired student – t test was used whenever appropriate between-group comparisons; while for categorical variables, chi–square test was used. A difference with significant level ($p<0.05$) was considered statistically significant.

Table/Figure II: Demographic parameters between two groups.

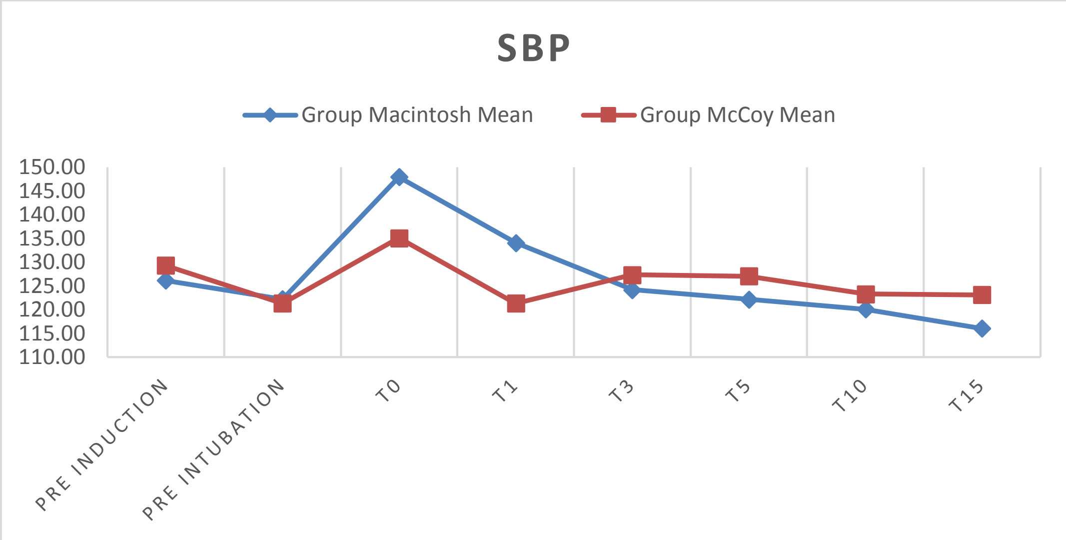
Demographic profile	Group Macintosh (n=30)	Group McCoy (n=28)	P-value
Mean age (years)	44.3 ±6.24	42.73 ±8.3	0.4110
Mean weight (kg)	53.8 ±6.71	54.2 ±6.33	0.8131
Male	14 (46.67%)	15 (50%)	
Female	16 (53.33%)	15 (50%)	
ASA GRADE I	15 (50%)	17 (56.67%)	
ASA GRADE II	15 (50%)	13 (43.33%)	

All the patients of both the groups were identical in terms of age, weight, gender and ASA grading.



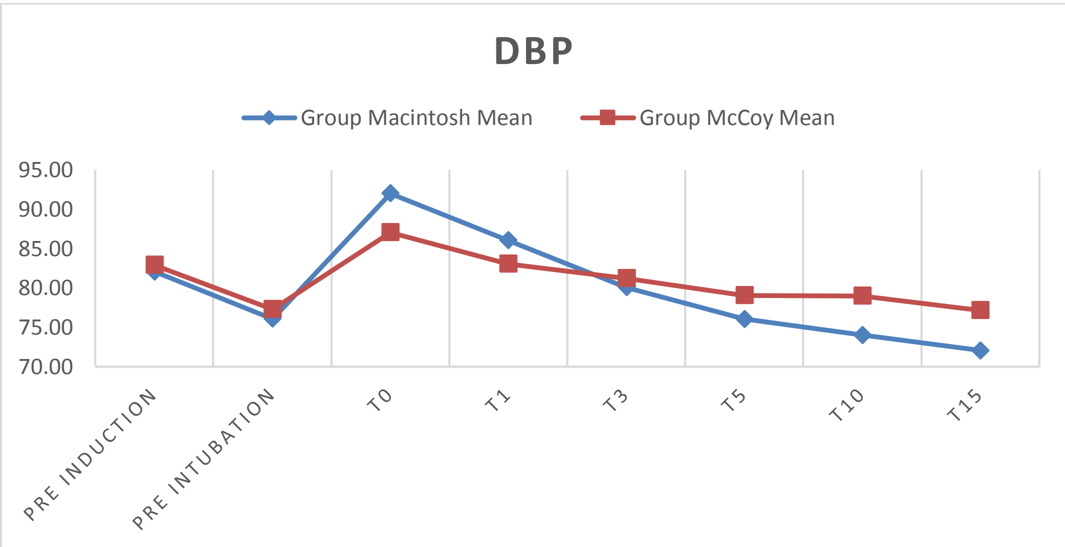
Table/Figure III: Graph showing changes in mean heart rates of Macintosh and McCoy group

In this study statistically significant reduction in the systolic blood pressure was seen at T0, T1 and T15 (p value < 0.001). There was significant reduction in the heart rate at T0 (p value <0.0001) in Mc Coy group when compared to Macintosh group. Systolic blood pressure was similar in distribution in both the group at all other time interval (p value > 0.05).



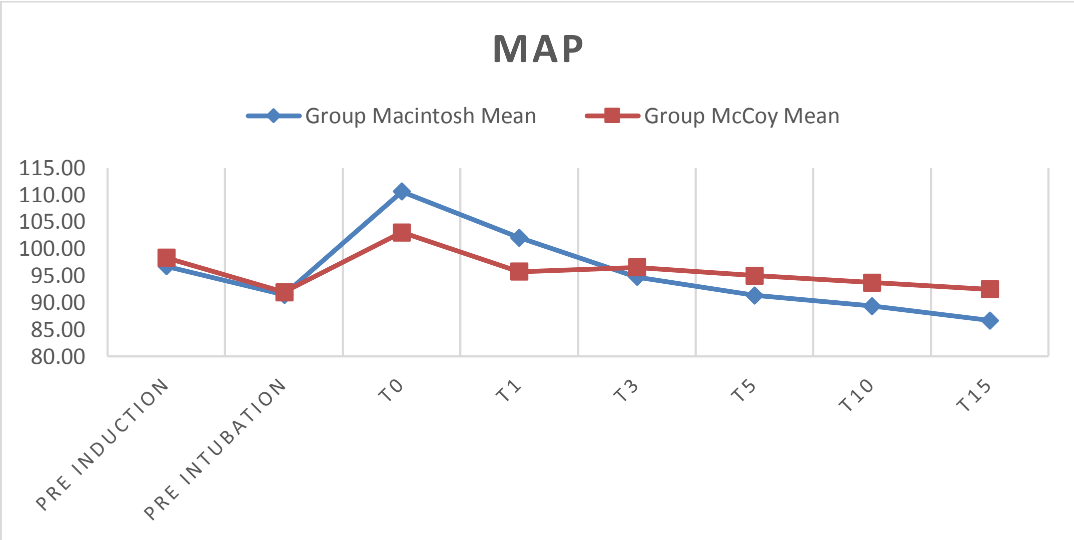
Table/Figure IV: Graph showing changes in mean SBP between Macintosh and McCoy group

In this study statistically significant reduction in the systolic blood pressure was seen at T0, T1 and T15 (p value < 0.001). Systolic blood pressure was similar in distribution in both the group at all other time interval (p value > 0.05).



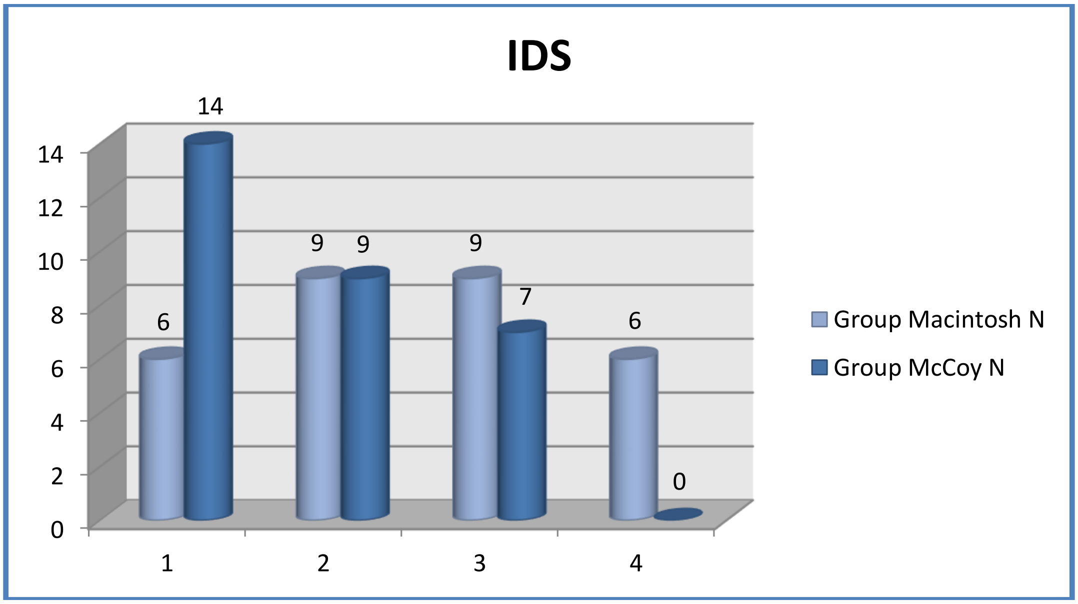
Table/Figure V: Graph showing changes in DBP between Macintosh and McCoy group

In this study there was significant reduction in the diastolic blood pressure at T0, T10 and T15 (p value <0.05) in McCoy group when compared to Macintosh group. No significant reduction in the diastolic blood pressure was found at other time interval between the two groups (p value >0.05).



Table/Figure VI: Graph showing changes in MAP between Macintosh and McCoy group

In this study there was significant reduction in the mean arterial blood pressure at T0, T10 and T15 (p value <0.05) in McCoy group when compared to Macintosh group. No significant reduction in the mean arterial blood pressure was found at other time interval between the two groups (p value >0.05).



Table/Figure VII: Graph showing IDS of Macintosh and McCoy group

Statistically significant reduction in the Intubation Difficulty Score was found in McCoy group when compared to Macintosh group in this study.

Discussion

Haemodynamic changes that occur during laryngoscopy and intubation is one of the major concerns for the anaesthesiologists[10]. Different pharmacological methods like topical anaesthesia, beta blockers, opioids, calcium channel blockers have been tried with varying success[11].The effect of different laryngoscopy blades on hemodynamic parameters for patients undergoing elective intubation needs to be studied in depth for better understanding on how to improve laryngoscopy along with intubation performance. The increase in the HR, SBP, DBP and MAP were noted in both the groups due to sympathetic stimulation. These haemodynamic parameters settled down thereafter.

Table/Figure VIII: Table showing statistically significant hemodynamic parameters at various time intervals in different studies

	Present study result	Study done by Hitesh Aggarwal [12]	Study done by Mehtab A. Haidry [3]
Heart rate	T0 (p value < 0.0001)	T0 (p value < 0.001), T1 (p value 0.02) and T2 (p value 0.003)	T0 (p value < 0.0001)
Systolic blood pressure	T0, T1 and T15 (p value < 0.0001)	T0 (p value < 0.001) and T1 (p value 0.015).	at T0 (p value < 0.001) and T1 (p value 0.015)
Diastolic blood pressure	T0 (p value < 0.0019), T10 (p value < 0.0020), T15 (p value < 0.0015)	T0 (p value < 0.001) and T1 (p value 0.028)	T0 (p value < 0.0001)
Mean arterial blood pressure	T0 and T1 (p value < 0.0001), T10 (p value < 0.0061), T15 (p value < 0.0004)	T0 (p value < 0.001) and T1 (p value 0.009)	T0 (p value < 0.0001)

In this study the reduction in the stress response and IDS by Mc Coy blade in comparison with Macintosh blade was as a result of shorter duration of time, less number of laryngoscopy attempts, minimum optimization manoeuvre’s and better laryngeal view while attempting endotracheal intubation. Previous studies have shown that these hemodynamic responses were less with the Mc Coy blade when compared with different types of laryngoscopes used in their studies. This may be due to function of the Mc Coy blade via a lever on its proximal end that decreases the force on glossoepiglottic fold, thus helping reduce the stress response. This reduced response with McCoy blade is of clinical benefit, as it decreases the dosage of drugs that are required to attenuate this response hence decreasing the side effects accompanying them. Tewari et al [13] compared the Macintosh and McCoy blades for laryngoscopy and intubation in 160 neurosurgical patients. Showing that, the use of McCoy laryngoscope resulted in lesser changes in heart rate and blood pressure compared to Macintosh blade when fentanyl was not used for obtundation of haemodynamic response. But when fentanyl was used as an analgesic, no difference was observed between the two groups. On the other hand, a study conducted by Han et al [14] did not find statistically significant difference between Macintosh and McCoy laryngoscopes in comparison of hemodynamic responses after laryngoscopy and endotracheal intubation. This may be due to use of fentanyl in their study or difference in inclusion, exclusion criteria. Our results support the studies with lesser haemodynamic response seen with the use of McCoy laryngoscope.

Limitations of this study

Some of the limitations regarding our study was that blinding of the anaesthesiologist who was observing hemodynamic response to laryngoscopy could not be achieved. Non-invasive measurement of blood pressure was used as the use of invasive blood pressure monitoring in healthy patients was not justified and thus avoided.

Conclusion

From our study we can conclude that by using McCoy blade for laryngoscopy and intubation, better attenuation of sympathetic stimulation can be achieved compared to traditional Macintosh blade. Attenuation of hemodynamic stress response to direct laryngoscopy and intubation is advisable in all patients, especially those with cardiovascular diseases.

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