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ORIGINAL RESEARCH **AIRWAY MANAGEMENT**

A comparative study of hemodynamic stress response to laryngoscopy with McCoy blade versus Macintosh blade in patients undergoing elective surgeries under general anesthesia

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ABSTRACT

Background & objective: Endotracheal intubation is considered the gold standard for airway management. It has been shown that different types of laryngoscope blades effect the hemodynamic response differently. We evaluated hemodynamic stress response before, during and after laryngoscopy with McCoy and Macintosh laryngoscope blades.

Methodology: A total of 68 patients were enrolled in the study and randomly allocated to the two study groups using computer-generated random numbers. Patients undergoing endotracheal intubation using the MacIntosh blade were labelled as Group MI, and those in which McCoy blade was used, were labelled as Group MC. Endotracheal tube placement and anesthesia maintenance were standardized for both study groups. The hemodynamic parameters, including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) were recorded before induction, before laryngoscopy, and at 1, 2, 3, 4, 5 and 10 min after laryngoscopy.

Results: The groups were comparable in terms of age and body mass index with similar mean values in the two studies and also concerning the ASA physical status and Mallampati classification. All the hemodynamic parameters, including HR, SBP, DBP, and MAP increased after laryngoscopy and intubation in both the study groups, but McCoy laryngoscope showed significantly lower values of SBP, DBP, and MAP at 1st and 2nd min after intubation.

Conclusion: McCoy's laryngoscope may be advantageous when compared to the Macintosh blade in situations where minimizing hemodynamic responses is crucial.

Abbreviations: DBP: diastolic blood pressure; MAP: mean arterial pressure: SBP: systolic blood pressure

Keywords: Airway management; Endotracheal intubation; Hemodynamic stress response; Laryngoscopy; McCoy blade; MacIntosh blade

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1. INTRODUCTION

In anesthetic practice airway management is crucial and the endotracheal intubation is the gold standard method. Rigid direct laryngoscopes are most commonly used to view the larynx and adjacent structures under direct vision for endotracheal intubation.[1] During laryngoscopy and intubation due to laryngotracheal stimulation, there is reflex sympathetic stimulation causing an increase in the heart rate and the mean blood pressure.[2-4] In healthy individuals this hemodynamic stress response to laryngoscopy is transient, generally of short duration, and has little consequence. But for patients with systemic hypertension, cerebrovascular diseases, and coronary artery diseases, it might be life-threatening.[5,6]

To date, pharmacological methods like local anesthetics, vasodilators, beta-blocking agents, calcium channel blockers, opioids, and volatile anesthetic agents have been used for the attenuation of the hemodynamic stress response to laryngoscopy.[7,8] Recently, it has been observed that the design of a laryngoscope blade has also reduced the magnitude of the hemodynamic stress response due to a reduced stimulation of the oropharynx.[9-11]

Hence, the choice of a laryngoscope blade is a crucial decision made by the anesthetist. If one blade type consistently demonstrates a lower hemodynamic response profile, it could influence clinical practice guidelines and decision-making, especially for patients with heightened cardiovascular risks.[12,13] In this study, the hemodynamic stress response (increased heart rate and increased mean arterial pressure) before, during, and after laryngoscopy with McCoy and Macintosh laryngoscope blades were compared. Based on the recent literature, we hypothesized that the McCoy laryngoscope blade is associated with less hemodynamic stress response.

2. METHODOLOGY

The present study was conducted in the Department of Anesthesiology of a tertiary care center in Mandya, Karnataka over 12 months, from May 2021 to April 2022, after obtaining approval from the Institutional Ethics Committee (MIMS/Mandya/IEC/24/2021-22). The study was conducted in accordance of the Ethical Principles for Medical Research Involving Human Subjects, outlined in the Helsinki Declaration of 1975 (revised 2013).

Patients aged 18-60 y, requiring oral endotracheal intubation under general anesthesia, and willing to participate were considered for the study. Patients with the ASA Physical status I & II, modified Mallampati class I & II were included in the study after explaining the study in their vernacular language and obtaining informed written consent. Patients with anticipated difficult intubation (limited mouth opening, limited movements in neck/temporomandibular joint, cervical spine pathologies), ASA grade III or higher, morbid obesity, coronary artery disease, history of cerebrovascular accidents, valvular heart diseases, and patients on anti-hypertensive or cardiac drugs were excluded from the study. The anesthesia protocol was the same for all of the study participants except for the intervention, i.e., using either Macintosh or McCoy laryngoscope.

The sample size was calculated based on previous research conducted by Paul A et al.,[11] using the mean arterial pressure at the 10th min after intubation among the study groups (McCoy group and MacIntosh group). The sample size was calculated to be 34 per group. A total of 68 patients were enrolled in the study and randomly allocated to the two study groups using computer-generated random numbers. Patients undergoing endotracheal intubation using the Macintosh blade were labeled as Group MI and those undergoing endotracheal intubation using the McCoy blade were labeled as Group MC. Endotracheal tube placement and anesthesia maintenance were standardized for both study groups.

Statistical analysis

Data on patient observations were recorded in a proforma throughout the procedure. The data collected was entered in the Microsoft Excel master sheet and analyzed using Statistical Package for Social Sciences (SPSS) version 20. Categorical data have been presented as numbers and percentages (%) and quantitative data in terms of mean and standard deviation. Categorical variables were analyzed using Pearson's chi-square test and Fisher exact tests (when the expected count of 20% of cells is less than 5). Quantitative variables were analyzed using the Student's T-test and ANOVA. A $P < 0.05$ is considered statistically significant.

3. RESULTS

A total of 68 patients were evaluated during the study period, and equally divided into one if the two groups (Group MC and Group MI). The initial assessment was carried out to compare the demographic and baseline characteristics of the participants in both study groups.

Table 1 presents comparative demographic and baseline characteristics of the two study groups. The study groups were comparable in terms of mean age and mean BMI. Group MC consisted of 24 (70.59%) females and 10 (29.41%) males, while Group MI had 19 (55.88%)

females and 15 (44.12%) males. The P-value of 0.209 suggests that the gender distribution between the two groups is not significantly different. Similarly, both Group MC and Group MI had an equivalent distribution among ASA Physical Status (ASA PS) and the Mallampati classification, with no significant differences.

Three parameters, e.g., mouth opening, thyromental distance and hyomental distance, were compared between Group MC and Group MI. There were no statistically significant differences in these anatomical parameters confirming the comparability between the two study groups (Table 2).

The mean duration of laryngoscopy in Group MC was 13.71 ± 1.14 sec and in Group MI was 14.56 ± 2.83 sec. Though the duration was slightly longer in Group MI, the difference was statistically not significant (P = 0.108).

Table 1: Comparison of demographic and baseline characteristics of study participants

Parameter	Group MC (n = 34)	Group MI (n = 34)	P-value
Age (y)	33.41 (10.43)	32.44 (12.10)	0.724
Body Mass Index (kg/m^2)	22.03 (1.68)	22.58 (1.30)	0.136
Gender			
Female	24 (70.59)	19 (55.88)	0.209
Male	10 (29.41)	15 (44.12)	
ASA Physical Status			
Class 1	18 (52.94)	20 (58.82)	0.625
Class 2	16 (47.06)	14 (41.18)	
Mallampati classification			
Class 1	08 (23.53)	09 (26.47)	0.779
Class 2	26 (76.47)	25 (73.53)	

Data presented as mean ± SD or n (%); P < 0.05 considered as significant

Table 2: Comparison of mouth opening, thyromental distance, and Hyomental distance between the study groups.

Parameter	Group MC (n = 34)	Group MI (n = 34)	p-value
Mouth opening (cm)	5.03 ± 0.23	5.04 ± 0.23	0.917
Thyromental distance (cm)	6.63 ± 0.13	6.62 ± 0.13	0.856
Hyomental distance (cm)	6.34 ± 0.20	6.35 ± 0.19	0.710

Data presented as mean ± SD; P < 0.05 considered as significant

Table 3 provides a comparison of changes in heart rate over time between the two study groups, Group MC and Group MI.

Before the induction, both groups exhibited comparable mean SBP values, with Group MC at 120.85 mmHg and Group MI at 120.38 mmHg, demonstrating no significant difference. However, as the procedure progressed, notable distinctions emerged. At the 1-min mark after laryngoscopy, Group MI displayed a significantly higher mean SBP compared to Group MC; 132.47 vs.123.00 mmHg (P < 0.001), indicating a pronounced acute elevation in blood pressure in the Group MI at 1-min and 2 min post-laryngoscopy (P = 0.003). Conversely, at other time points (3, 4 to 5 min post-laryngoscopy), the differences in SBP between the two groups were statistically insignificant (Figure 1).

Initially, before the induction of anesthesia, both groups exhibited similar mean DBP) values, suggesting no significant difference between the groups. At the first

Table 3: Comparison of heart rate changes over time between the study groups.

Recording time	Heart rate (beats/min)		P-value
	Group MC	Group MI	
Before induction	82.74 ± 8.44	83.85 ± 12.11	0.660
Before laryngoscopy	83.06 ± 8.58	86.24 ± 12.81	0.234
1 min after laryngoscopy	87.82 ± 8.86	95.03 ± 12.38	0.007
2 min after laryngoscopy	87.38 ± 9.06	93.26 ± 14.44	0.048
3 min after laryngoscopy	85.09 ± 9.61	89.56 ± 13.32	0.117
4 min after laryngoscopy	83.29 ± 9.17	85.91 ± 13.43	0.351
5 min after laryngoscopy	81.91 ± 9.56	82.97 ± 13.27	0.707
10 min after laryngoscopy	81.38 ± 8.69	81.26 ± 11.70	0.963

Data presented as mean ± SD; P < 0.05 considered as significant minute after laryngoscopy, Group MI displayed a significantly higher mean DBP of 91.88 mmHg compared to 86.00 mmHg in Group MC (P = 0.001), indicating a substantial acute increase in DBP in the

Group MI. This pattern persisted at the 2-min mark (DBP2), with Group MI again showing significantly higher DBP (87.97 mmHg) compared to Group MC (82.97 mmHg) with a P = 0.007. However, from DBP3 onwards (3 min to 10 min post-laryngoscopy), there were no statistically significant differences in diastolic blood pressure between the two groups (Figure 2).

Before the induction of anesthesia and before laryngoscopy, both groups demonstrated similar MAP values. At the first minute after laryngoscopy (MAP1), Group MI exhibited a significantly higher mean MAP of 105.41 mmHg compared to Group MC's 98.26 mmHg (P = 0.001), indicating a substantial acute increase in arterial pressure in the Group MI. This trend continued at the 2-min mark (MAP2), where Group MI again showed significantly higher MAP (101.62 mmHg) compared to Group MC (95.65 mmHg) with a P = 0.001. However, from MAP3 onwards (3 min to 10 min post-laryngoscopy), there were no statistically significant differences in MAP between the two groups (Figures 3).

4. DISCUSSION

It has been observed that the amount of force exerted during laryngoscopy and intubation is the key determinant for mechanical stimulation of stretch receptors present in the respiratory tract. Thus, the use of different types of laryngoscope

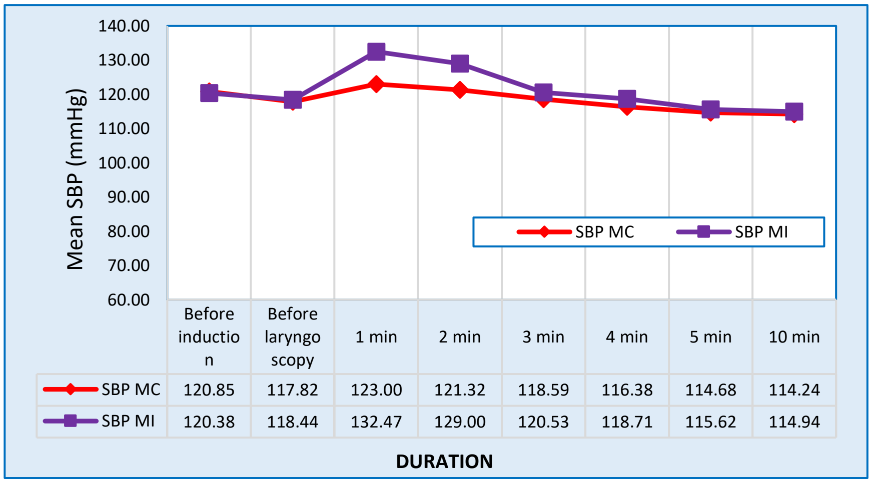

Figure 1: Comparison of mean SBP among study groups

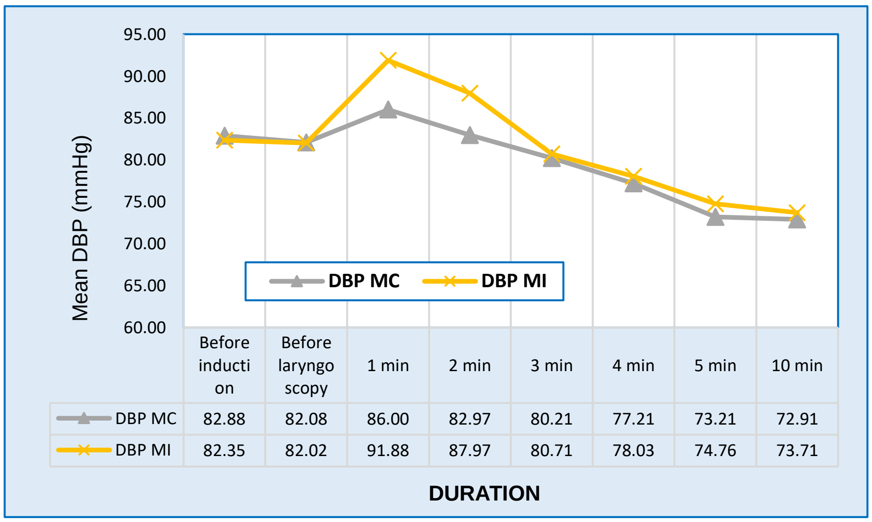

Figure 2: Comparison of mean DBP among study groups

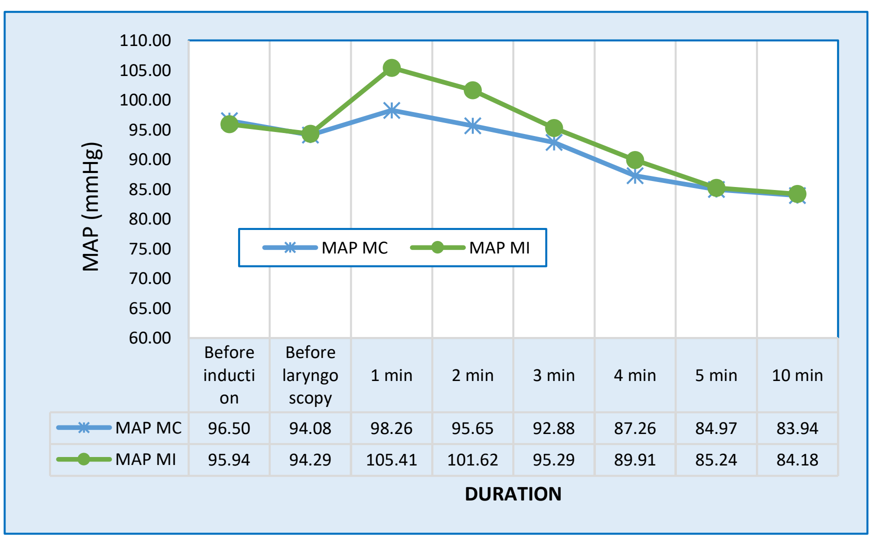

Figure 3: Comparison of mean MAP among study groups

blades can help decrease this response.[14, 15] In a study conducted by Arora G et al., the age group and ASA PS classification of study participants were comparable with our study.[16] The authors observed a rise in HR at 3 min following laryngoscopy in both the study groups, whereas the rise was significantly higher in the McCoy group. Similar findings were also observed concerning mean arterial pressure, wherein a rise in MAP was seen in both groups but was relatively lower in the McCoy group. In our study Macintosh group had a relatively higher mean HR (statistically not significant) whereas the SBP, DBP and MAP were significantly higher for the Macintosh group at one minute and two minutes post laryngoscopy.

Haidry et al., observed that HR increased significantly for 3 min following laryngoscopy in the Macintosh group and for 2 min in the McCoy group.[17] Similarly, in our study, the McCoy group showed statistically significant lower values immediately after and at 1 to 5 min following laryngoscopy. Haidry et al. noted that both study groups showed a significant rise in SBP, compared to baseline, immediately after laryngoscopy and at 1- and 2 min following laryngoscopy. The intergroup comparison revealed significantly lower values at 1 to 3 min following tracheal intubation in the McCoy group. In another study by Shin HJ et al., no significant difference was observed between the study groups using McCoy and Macintosh blades concerning blood pressure and HR.[18]

Tewari et al. showed that the use of the McCoy laryngoscope resulted in a lesser change in HR and BP, compared to the Macintosh blade, when fentanyl was not used in obtundation of response.[19] After using fentanyl as an analgesic, no difference was observed between the study groups. In another study by McCoy et al., HR and blood pressure showed a slight increase in the Macintosh group compared to the baseline values, but no significant difference was observed in HR between the two blades.[20]

In a study by Gotiwale K, SBP and DBP were significantly higher with Macintosh than McCoy group and the time required for intubation was significantly higher in the Macintosh group (19.5 ± 3.70 sec) than McCoy group (16.1 ± 2.61 sec) ($P < 0.05$).[21] In our study, the duration of laryngoscopy was 14.56 ± 2.8 sec versus 13.71 ± 1.14 sec with Macintosh and McCoy laryngoscope respectively which was statistically not significant ($P > 0.05$). Mukta J et al. conducted a prospective randomized study in 80 patients of ASA Grade I and II and observed that the laryngoscopy and intubation time was 10.80 ± 1.74 sec and 10.38 ± 1.69 sec with Macintosh and McCoy blades respectively ($P = 0.27$).[22]

5. LIMITATIONS

It was a single-center study and sample size was small which makes the generalization of the study results impossible. The changes in hemodynamic stress response due to co-morbid conditions could not be differentiated. The present study results will provide the basis for conducting similar research studies with larger sample sizes in future.

6. CONCLUSION

The present study results support the studies that conclude lesser hemodynamic response with the use of McCoy laryngoscope. In the current study, all the hemodynamic parameters were raised after laryngoscopy and intubation, but McCoy laryngoscope showed statistically significant lower values of systolic, diastolic, and mean arterial pressure at 1 and 2 min after intubation. Hence, the results we obtained reinforce the findings of earlier studies and show that the McCoy blade elicited lesser hemodynamic response compared to the Macintosh blade.

7. Data availability

The numerical data generated during this research is available with the authors.

8. Acknowledgement

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Mandya Institute of Medical Sciences, Mandya, Karnataka, India

9. Conflict of interest

The study utilized institutional resources only, and no external or industry funding was involved.

10. Authors' contribution

Arpitha R, Yuvashri M, Kiran A V designed the entire work. Yuvashri M, Kiran A V, Divakar S R contribute in making necessary correction and revision of the manuscript. The final draft was checked and approved by all of the authors.

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