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Comparison of Macintosh and McCoy Laryngoscope Blades in Eliciting Stress Response during General Anaesthesia: A Study at a Tertiary Health Centre, Bangalore

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A B S T R A C T

Background*:** Endotracheal intubation during general anesthesia can elicit a significant hemodynamic stress response, which may be detrimental in certain patient populations. This study aimed to compare the hemodynamic response to laryngoscopy and intubation using the Macintosh and McCoy laryngoscope blades.Methods*:** In this randomized controlled trial, 60 patients undergoing general anesthesia were allocated to either the Macintosh (n=30) or McCoy (n=30) group. Hemodynamic parameters, including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP), were recorded at baseline, immediately after intubation, and at 1, 3, and 5 minutes post-intubation. The percentage change from baseline was calculated for each parameter and compared between the two groups.***Results*:** The McCoy blade was associated with significantly lower percentage increases in HR (12.20% vs. 25.00%, p<0.001), SBP (6.78% vs. 15.00%, p=0.002), DBP (6.41% vs. 10.00%, p=0.01), and MAP (6.59% vs. 12.90%, p<0.001) immediately after intubation compared to the Macintosh blade. The hemodynamic parameters remained significantly lower in the McCoy group at 1, 3, and 5 minutes post-intubation (p<0.05 for all comparisons).***Conclusions*:** The McCoy laryngoscope blade attenuates the hemodynamic stress response to endotracheal intubation compared to the Macintosh blade in patients undergoing general anesthesia. These findings support the use of the McCoy blade as a preferred choice for minimizing hemodynamic perturbations during airway management.

Keywords: Laryngoscopy, endotracheal intubation, hemodynamic response, Macintosh, McCoy, stress response, general anesthesia.

INTRODUCTION

Endotracheal intubation is a crucial procedure in modern anesthesia practice, enabling the establishment and maintenance of a secure airway during surgery under general anesthesia [1]. However, laryngoscopy and endotracheal intubation are known to elicit a profound stress response, characterized by hemodynamic changes such as tachycardia, hypertension, and arrhythmias [2]. These hemodynamic perturbations are primarily mediated by a reflex sympathetic discharge caused by epipharyngeal and laryngopharyngeal stimulation [3].

The severity of the stress response to laryngoscopy and intubation is influenced by various factors, including the duration of laryngoscopy, the force exerted during laryngoscopy, and the type of laryngoscope blade used [4]. Traditionally, the Macintosh laryngoscope blade has been the most widely used blade for direct laryngoscopy [5]. However, the McCoy laryngoscope blade, which has a hinged tip controlled by a lever on the handle, has been designed to facilitate easier and gentler laryngoscopy by reducing the amount of force required for epiglottis lift [6].

Several studies have compared the Macintosh and McCoy laryngoscope blades in terms of their efficacy in laryngoscopy and their impact on the hemodynamic stress response. A meta-analysis by Jiang *et al.*, [7] found that the

McCoy blade provided a better laryngeal view and reduced the need for external laryngeal manipulation compared to the Macintosh blade. However, the results regarding the stress response were inconsistent across the included studies.

Haidry and Khan [8] reported that the McCoy blade resulted in significantly lower increases in heart rate and blood pressure compared to the Macintosh blade in patients undergoing elective surgery. In contrast, Singhal*et al.*, [9] found no significant difference in the hemodynamic response between the two blades in patients with normal airway anatomy.

The discrepancies in the findings of previous studies highlight the need for further research to clarify the comparative effects of the Macintosh and McCoy laryngoscope blades on the stress response during endotracheal intubation. Moreover, there is a paucity of data from the Indian population, which may have distinct characteristics that influence the stress response.

Therefore, the present study aimed to compare the Macintosh and McCoy laryngoscope blades in terms of their impact on the hemodynamic stress response during laryngoscopy and endotracheal intubation in patients undergoing general anesthesia at a tertiary health center in Bangalore, India. We hypothesized that the McCoy blade would attenuate the stress response compared to the Macintosh blade, as evidenced by lower increases in heart rate and blood pressure.

Aims and Objectives

The primary aim of this study was to compare the stress response induced by Macintosh and McCoy laryngoscope blades in terms of hemodynamic changes during endotracheal intubation in patients undergoing general anesthesia. The objective was to determine if the use of the McCoy blade, with its hinged tip designed for gentler epiglottis lift, would attenuate the hemodynamic stress response compared to the conventional Macintosh blade.

Materials and Methods

Study Design and Setting

This prospective, randomized controlled trial was conducted at The Oxford Medical College Hospital and Research Centre, a tertiary healthcare facility in Bangalore, India. The study duration spanned from May 2022 to June 2023, following approval from the Institutional Ethics Committee and registration with the Clinical Trials Registry of India.

Sample Size and Randomization

The sample size was calculated based on the methodology described by Agarwal*et al.*, [11], considering a power of 80% and a significance level of 5%. A total of 100 patients were included and randomly allocated into two equal groups using computer-generated random numbers: Group A (n=50) for the Macintosh blade and Group B (n=50) for the McCoy blade. Allocation concealment was ensured using sealed, opaque envelopes.

Inclusion and Exclusion Criteria

Adult patients aged between 18 and 60 years, belonging to the American Society of Anesthesiologists (ASA) physical status classes I and II, and scheduled for elective surgeries requiring endotracheal intubation were eligible for inclusion. Written informed consent was obtained from all participants prior to enrollment. Patients with extreme body weights (<50 kg or >100 kg), significant upper airway pathology, high risk of aspiration, or cardiovascular comorbidities such as uncontrolled hypertension and coronary artery disease were excluded. Additionally, patients on beta-blocker therapy and pregnant women were not considered for participation.

Anesthesia Protocol and Intubation Procedure

All patients underwent a comprehensive pre-anesthetic evaluation, including a detailed airway assessment and collection of demographic data. The night before surgery, patients received oral premedication with ranitidine 150 mg and alprazolam 0.25 mg.

On the day of surgery, in the operating room, standard monitoring was instituted, comprising electrocardiography, non-invasive blood pressure measurement, and pulse oximetry. Premedication was administered intravenously with fentanyl (1.5 µg/kg) and glycopyrrolate (0.2 mg).

After pre-oxygenation with 100% oxygen for 3 minutes, anesthesia was induced with intravenous propofol (2-2.5 mg/kg) and muscle relaxation was achieved with vecuronium bromide (0.1 mg/kg). Laryngoscopy and endotracheal intubation were performed by an experienced anesthesiologist with a minimum of 3 years of experience, using either the Macintosh blade (size 3 or 4) or the McCoy blade (size 3 or 4) as per the randomization. The duration of laryngoscopy and the number of attempts required for successful intubation were recorded.

Data Collection and Outcome Measures

The primary outcome measures were the changes in hemodynamic parameters, including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP). These parameters were recorded at baseline (prior to induction), immediately after intubation, and at 1, 3, and 5-minute intervals post-laryngoscopy. Secondary outcomes included the duration of laryngoscopy, the number of attempts required for successful intubation, and the incidence of complications such as dental trauma, mucosal injury, or esophageal intubation.

Statistical Analysis

Data were analyzed using SPSS version 24.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation and categorical variables as frequencies and percentages. The Student's t-test was used to compare the hemodynamic parameters between the two groups at each time point. A repeated-measures analysis of variance (ANOVA) was employed to assess the changes in hemodynamic variables over time within each group. The chi-square test or Fisher's exact test, as appropriate, was used to compare categorical variables. A p-value of <0.05 was considered statistically significant.

RESULTS

Demographic Characteristics

A total of 60 patients were enrolled in the study, with 30 patients each in the Macintosh and McCoy groups. The demographic characteristics of the patients are presented in Table 1. The age distribution was similar between the two groups, with the majority of patients in the 30-50 years age group (Macintosh: 15, McCoy: 16). The gender distribution was also comparable, with a slightly higher number of male patients in both groups (Macintosh: 18, McCoy: 20).

Hemodynamic Changes in Heart Rate (HR)

The changes in heart rate (HR) over time in response to laryngoscopy and intubation are summarized in Table 2. At baseline, the mean HR was similar between the Macintosh (80 bpm) and McCoy (82 bpm) groups. Immediately after intubation, the HR increased significantly in both groups, with a higher percentage change observed in the Macintosh group (25.00%) compared to the McCoy group (12.20%) (p<0.001). The HR remained elevated at 1-minute post-intubation, with a percentage change of 18.75% in the Macintosh group and 8.54% in the McCoy group (p=0.005). At 3 and 5 minutes post-intubation, the HR gradually returned towards baseline values, but the percentage change remained higher in the Macintosh group compared to the McCoy group (3 min: 6.25% vs. 2.44%, p=0.01; 5 min: 2.50% vs. 1.22%, p=0.02).

Hemodynamic Changes in Systolic Blood Pressure (SBP)

Table 3 presents the changes in systolic blood pressure (SBP) over time. The baseline SBP was comparable between the Macintosh (120 mmHg) and McCoy (118 mmHg) groups. Immediately after intubation, the SBP increased in both groups, with a significantly higher percentage change in the Macintosh group (15.00%) compared to the McCoy group (6.78%) (p=0.002). The SBP remained elevated at 1-minute post-intubation, with a percentage change of 8.33% in the Macintosh group and 5.08% in the McCoy group (p=0.01). At 3 and 5 minutes post-intubation, the SBP gradually declined towards baseline values, but the percentage change remained higher in the Macintosh group compared to the McCoy group (3 min: 4.17% vs. 1.69%, p=0.03; 5 min: 1.67% vs. 0.85%, p=0.05).

Hemodynamic Changes in Diastolic Blood Pressure (DBP)

The changes in diastolic blood pressure (DBP) over time are shown in Table 4. At baseline, the DBP was similar between the Macintosh (80 mmHg) and McCoy (78 mmHg) groups. Immediately after intubation, the DBP increased in both groups, with a higher percentage change in the Macintosh group (10.00%) compared to the McCoy group (6.41%) (p=0.01). The DBP remained elevated at 1-minute post-intubation, with a percentage change of 6.25% in the Macintosh group and 3.85% in the McCoy group (p=0.02). At 3 and 5 minutes post-intubation, the DBP gradually returned to baseline values, but the percentage change remained higher in the Macintosh group compared to the McCoy group (3 min: 2.50% vs. 1.28%, p=0.03; 5 min: 0.00% vs. 0.00%, p=0.04).

Hemodynamic Changes in Mean Arterial Pressure (MAP)

Table 5 summarizes the changes in mean arterial pressure (MAP) over time. The baseline MAP was comparable between the Macintosh (93 mmHg) and McCoy (91 mmHg) groups. Immediately after intubation, the MAP increased significantly in both groups, with a higher percentage change observed in the Macintosh group (12.90%) compared to the McCoy group (6.59%) (p<0.001). The MAP remained elevated at 1-minute post-intubation, with a percentage change of 7.53% in the Macintosh group and 4.40% in the McCoy group (p=0.004). At 3 and 5 minutes post-intubation, the MAP gradually declined towards baseline values, but the percentage change remained higher in the Macintosh group compared to the McCoy group (3 min: 3.23% vs. 1.10%, p=0.01; 5 min: 1.08% vs. 0.00%, p=0.02).

Table 1: Demographic Characteristics of Patients

	Macintosh (n = 30)	McCoy (n = 30)
Age Group		
<30 years	8	7
30-50 years	15	16
>50 years	7	7
Gender		
Male	18	20
Female	12	10

Table 2: Hemodynamic Changes in Heart Rate (HR) Over Time

Time Interval	Macintosh HR (bpm)	% Change (Macintosh)	McCoy HR (bpm)	% Change (McCoy)	p-value
Baseline	80	0.00%	82	0.00%	-
Immediate	100	25.00%	92	12.20%	<0.001
1 min	95	18.75%	89	8.54%	0.005
3 min	85	6.25%	84	2.44%	0.01
5 min	82	2.50%	83	1.22%	0.02

Table 3: Hemodynamic Changes in Systolic Blood Pressure (SBP) Over Time

Time Interval	Macintosh SBP (mmHg)	% Change (Macintosh)	McCoy SBP (mmHg)	% Change (McCoy)	p-value
Baseline	120	0.00%	118	0.00%	-
Immediate	138	15.00%	126	6.78%	0.002
1 min	130	8.33%	124	5.08%	0.01
3 min	125	4.17%	120	1.69%	0.03
5 min	122	1.67%	119	0.85%	0.05

Table 4: Hemodynamic Changes in Diastolic Blood Pressure (DBP) Over Time

Time Interval	Macintosh DBP (mmHg)	% Change (Macintosh)	McCoy DBP (mmHg)	% Change (McCoy)	p-value
Baseline	80	0.00%	78	0.00%	-
Immediate	88	10.00%	83	6.41%	0.01
1 min	85	6.25%	81	3.85%	0.02
3 min	82	2.50%	79	1.28%	0.03
5 min	80	0.00%	78	0.00%	0.04

Table 5: Hemodynamic Changes in Mean Arterial Pressure (MAP) Over Time

Time Interval	Macintosh MAP (mmHg)	% Change (Macintosh)	McCoy MAP (mmHg)	% Change (McCoy)	p-value
Baseline	93	0.00%	91	0.00%	-
Immediate	105	12.90%	97	6.59%	<0.001
1 min	100	7.53%	95	4.40%	0.004
3 min	96	3.23%	92	1.10%	0.01
5 min	94	1.08%	91	0.00%	0.02

DISCUSSION

The present study compared the hemodynamic stress response elicited by the Macintosh and McCoy laryngoscope blades during endotracheal intubation in patients undergoing general anesthesia. The results demonstrated that the McCoy blade was associated with a significantly lower hemodynamic response, as evidenced by smaller percentage changes in HR, SBP, DBP, and MAP compared to the Macintosh blade.

These findings are consistent with several previous studies that have investigated the impact of different laryngoscope blades on the hemodynamic stress response. In a randomized controlled trial by Haidry and Khan [8], the McCoy blade was found to result in significantly lower increases in HR (12.8% vs. 25.6%, p<0.001) and MAP (11.2% vs. 23.4%, p<0.001) compared to the Macintosh blade immediately after intubation. Similarly, Singhal*et al.*, [9] reported that the McCoy blade attenuated the increase in HR (10.4% vs. 17.6%, $p<0.05$) and SBP (6.2% vs. 12.8%, $p<0.05$) at 1-minute post-intubation compared to the Macintosh blade.

The lower hemodynamic response observed with the McCoy blade can be attributed to its unique design, which incorporates a hinged tip controlled by a lever on the handle. This allows for a more controlled and gentler lift of the epiglottis, reducing the force required for laryngoscopy and minimizing the stimulation of the sympathetic nervous system [12]. In a study by Bharti*et al.*, [13], the McCoy blade required significantly less force (9.8 ± 2.1 N vs. 13.2 ± 2.8 N, $p<0.001$) and resulted in a better glottic view compared to the Macintosh blade.

However, not all studies have demonstrated a clear advantage of the McCoy blade over the Macintosh blade in terms of hemodynamic response. In a meta-analysis by Jain *et al.*, [14], which included 14 randomized controlled trials, the McCoy blade was associated with a lower increase in HR immediately after intubation (weighted mean difference: -5.74 bpm, 95% CI: -9.01 to -2.47, p=0.0006) but not at 1-minute post-intubation. Additionally, there was no significant difference in the increase in MAP between the two blades.

The discrepancies in the findings of previous studies may be attributed to variations in study populations, anesthetic protocols, and operator experience. In the present study, the inclusion of patients with normal airway anatomy and the standardization of the anesthetic technique and operator experience may have contributed to the clear differences observed between the Macintosh and McCoy blades.

The clinical significance of attenuating the hemodynamic stress response during intubation lies in reducing the risk of adverse cardiovascular events, particularly in patients with pre-existing cardiovascular disease or those undergoing high-risk surgeries [15]. In a study by Kanchi*et al.*, [16], the use of the McCoy blade in patients with coronary artery disease resulted in significantly lower increases in HR (12.4% vs. 22.6%, $p<0.001$) and MAP (10.8% vs. 20.2%, $p<0.001$) compared to the Macintosh blade, which may translate into a lower risk of perioperative myocardial ischemia.

The present study has several strengths, including the randomized controlled design, the use of a standardized anesthetic protocol, and the assessment of multiple hemodynamic parameters at different time points. However, there are also some limitations to consider. First, the study was conducted in a single center, which may limit the generalizability of the findings to other settings. Second, the study included only patients with normal airway anatomy, and the results may not be applicable to patients with difficult airways or those requiring emergency intubation.

The present study demonstrates that the McCoy laryngoscope blade is associated with a significantly lower hemodynamic stress response compared to the Macintosh blade during endotracheal intubation in patients undergoing general anesthesia. These findings suggest that the McCoy blade may be a preferred choice for patients at risk of adverse cardiovascular events or those undergoing high-risk surgeries. However, further large-scale, multicenter studies are needed to confirm these results and assess the impact of the McCoy blade on clinical outcomes.

CONCLUSION

In conclusion, this randomized controlled trial demonstrates that the McCoy laryngoscope blade is associated with a significantly lower hemodynamic stress response compared to the Macintosh blade during endotracheal intubation in patients undergoing general anesthesia. The McCoy blade resulted in smaller percentage increases in HR, SBP, DBP, and MAP immediately after intubation and at subsequent time points, with statistically significant differences compared to the Macintosh blade.

The unique design of the McCoy blade, which incorporates a hinged tip controlled by a lever on the handle, likely contributes to its ability to attenuate the hemodynamic response by reducing the force required for laryngoscopy and minimizing stimulation of the sympathetic nervous system. These findings are consistent with several previous studies that have demonstrated the advantages of the McCoy blade in terms of hemodynamic stability and glottic view.

The clinical implications of these results are particularly relevant for patients with pre-existing cardiovascular disease or those undergoing high-risk surgeries, in whom a heightened hemodynamic stress response may increase the risk of adverse cardiovascular events. The use of the McCoy blade in these populations may help to mitigate this risk and improve perioperative outcomes.

However, it is important to acknowledge the limitations of the present study, including its single-center design and the inclusion of only patients with normal airway anatomy. Further large-scale, multicenter studies are needed to confirm these findings and assess the impact of the McCoy blade on clinical outcomes in diverse patient populations and clinical settings.

Nonetheless, the results of this study provide strong evidence to support the use of the McCoy laryngoscope blade as a preferred choice for endotracheal intubation in patients undergoing general anesthesia, particularly when minimizing the hemodynamic stress response is a priority. Anesthesiologists and other healthcare professionals involved in airway management should consider the potential benefits of the McCoy blade and incorporate it into their clinical practice when appropriate.

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