E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/15.02.160

Research Article

Comparative Analysis of Hemodynamic Responses and Perfusion Index during Tracheal Intubation Using Macintosh and McCoy Laryngoscopes

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Received: 14.06.25, Revised: 13.07.25, Accepted: 12.08.25

ABSTRACT
Background: Tracheal intubation, a cornerstone of airway management during general anaesthesia, is associated with transient but significant hemodynamic responses. The type of laryngoscope used can influence the magnitude of this response.
Aim: To compare the hemodynamic parameters and perfusion index (PI) following tracheal intubation with Macintosh and McCoy laryngoscopes.
Methods: Sixty patients aged 20–40 years with ASA I–II status undergoing elective surgeries under general anaesthesia were randomized into two groups (n=30 each) for intubation using either a Macintosh or McCoy laryngoscope. Hemodynamic variables—heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and PI—were measured at baseline, during, and after intubation.
Results: No significant differences in baseline demographics or ASA status were observed between groups. Post-intubation HR, BP, and PI values showed variations within both groups; however, the McCoy group exhibited comparatively lower hemodynamic fluctuations and a more stable perfusion index.
Conclusion: Macintosh and McCoy laryngoscopes demonstrated comparable performance in terms of hemodynamic stability and perfusion index changes during intubation in ASA I-II patients. While McCoy is hypothesized to reduce sympathetic stimulation, our findings suggest either device may be used without significant difference in low-risk patients.

Keywords: Laryngoscopy, Hemodynamic Response, Perfusion Index, Macintosh Blade, Mccoy Blade, Tracheal Intubation, General Anaesthesia

INTRODUCTION

Airway management is a critical component of anesthetic practice, with tracheal intubation being one of the most commonly performed procedures. Despite its routine nature, laryngoscopy and intubation can provoke significant hemodynamic responses due to sympathetic stimulation, particularly in high-risk patients. These responses—manifested as increased heart rate and blood pressure—can have serious clinical implications, especially in individuals with cardiovascular comorbidities.

Various laryngoscope designs have been developed in an effort to minimize these responses. The Macintosh laryngoscope, widely used for decades, requires considerable force and manipulation for optimal glottic visualization. In contrast, the McCoy laryngoscope, featuring a hinged, movable tip, is engineered to improve the laryngeal view with reduced lifting force, thereby potentially attenuating the pressor response.

In addition to traditional vital signs, non-invasive monitoring tools such as the Perfusion Index (PI)—derived from pulse oximetry—offer valuable insights into peripheral perfusion and autonomic nervous system activity. By providing an indirect measure of vasomotor tone, PI may serve as a sensitive parameter to evaluate stress responses during laryngoscopy. This study aims to compare the hemodynamic changes and perfusion index variations associated with tracheal intubation using Macintosh and McCoy laryngoscopes. By analyzing both conventional and novel markers of stress response, this research seeks to determine whether the design modifications of the McCoy laryngoscope translate into clinically significant benefits in terms of cardiovascular stability and peripheral perfusion during intubation.

MATERIALS AND METHODS

Study Design and Setting:

This analytical study was conducted at the Department of Anaesthesiology, PES Institute of Medical Sciences and Research, Kuppam, India, from June 2023 to November 2024, with ethical approval and informed consent.

Inclusion Criteria:

Age 20–40 years
ASA physical status I & II
Both genders
Elective surgery under general anaesthesia

Exclusion Criteria:

Cardiovascular or hypertensive disorders
Anemia or peripheral vascular disease

Procedure:

Patients were randomized into two groups: Macintosh (MI) and McCoy (MC). Standard monitoring was initiated. Following premedication and induction with propofol, fentanyl, and vecuronium, tracheal intubation was performed using the assigned laryngoscope. Hemodynamic variables and PI (measured via Masimo SET pulse oximeter) were recorded at baseline, post-induction, at intubation, and up to 10 minutes post-intubation.

Statistical Analysis:

Data were analyzed using SPSS v23.0. Continuous variables were expressed as mean ± SD. Intergroup comparisons were made using the Student's t-test; a p-value <0.05 was considered statistically significant.

RESULTS

A total of 60 patients were randomized into two groups of 30 each (Group MC – McCoy; Group MI – Macintosh). The groups were comparable in terms of baseline demographic and clinical characteristics.

Demographic Characteristics

There was no statistically significant difference between the groups in terms of age, gender distribution, or body mass index (BMI). The mean age in both groups was 43.8 ± 7.94 years. Gender distribution was similar (MC: 22 males, 8 females; MI: 21 males, 9 females; p = 0.77). The mean BMI was 24.67 ± 4.71 in Group MC and 23.74 ± 4.19 in Group MI (p = 0.43). ASA physical status and indications for surgery were also comparable between groups (p > 0.05 for all).

Parameter	Group MC	Group MI	p-value	Interpretation
Mean Age (years)	43.8 ± 7.94	43.8 ± 7.94	-	No difference
Gender Distribution	22 males, 8 females	21 males, 9 females	0.77	Not significant
Mean BMI (kg/m²)	24.67 ± 4.71	23.74 ± 4.19	0.43	Not significant
ASA Physical Status	Comparable	Comparable	> 0.05	Not significant
Indications for Surgery	Comparable	Comparable	> 0.05	Not significant

Hemodynamic Parameters

Heart Rate (HR):

Baseline HR, HR before laryngoscopy, and subsequent HR measurements at 0, 5, 7, and 10 minutes post-intubation showed no statistically significant difference between the two groups at any interval (p > 0.05). Mean HR after intubation was 83.20 ± 3.13 in Group MC and 83.23 ± 3.15 in Group MI.

Time Point	Group MC (Mean ± SD)	Group MI (Mean ± SD)	p-value	Interpretation
Baseline HR	73.70+/-2.56	73.90+/-2.72	> 0.05	No significant difference
HR before Laryngoscopy	70.76+/-3.30	70.76+/-3.30	> 0.05	No significant difference
HR at 0 min Post-Intubation	83.20+/-3.13	83.23+/-3.14	> 0.05	No significant difference
HR at 5 min Post-Intubation	84.73+/- 1.92	84.73+/-1.92	> 0.05	No significant difference
HR at 7 min Post-Intubation	87.63+/-1.90	87.63+/-1.90	> 0.05	No significant difference
HR at 10 min Post-Intubation	76.50+/-3.45	76.50+/-3.45	> 0.05	No significant difference

Mean HR After Intubation	83.20 ± 3.13	83.23 ± 3.15	> 0.05	Not statistically significant

Systolic Blood Pressure (SBP):
SBP values recorded at pre-induction, pre-laryngoscopy, and at 0, 5, 7, and 10 minutes post-intubation were statistically similar between the groups (p = 1.000 for all). Mean SBP immediately post-intubation was 132.80 ± 2.06 mmHg in both groups.

Time Point	Group MC (Mean ± SD)	Group MI (Mean ± SD)	p-value	Interpretation
Pre-Induction SBP	121.8+/-2.96	121.8+/-2.96	1	No significant difference
Pre-Laryngoscopy SBP	131.3+/-3.86	131.3+/-3.86	1	No significant difference
SBP at 0 min Post-Intubation	132.80 ± 2.06 mmHg	132.80 ± 2.06 mmHg	1	No significant difference
SBP at 5 min Post-Intubation	132.2+/-1.48	132.2+/-1.48	1	No significant difference
SBP at 7 min Post-Intubation	131.5+/-1.54	131.5+/-1.54	1	No significant difference
SBP at 10 min Post-Intubation	129.8+/-2.86	129.8+/-2.86	1	No significant difference

Mean Arterial Pressure (MAP):
MAP was also comparable at all measured intervals. Pre-induction MAP was 136.07 ± 2.91 mmHg in both groups, and post-intubation MAP was 136.90 ± 3.45 mmHg. No statistically significant differences were observed at any time point (p = 1.000).

GROUP	MC		MI		p-value	Interpretation
	MEAN	SD	MEAN	SD		
MAP BEFORE INDUCTION	136.0667	2.9117	136.0667	2.9117	1.00	No significant difference
MAP BEFORE LARYGNO SCOPY	135.5000	3.0485	135.5000	3.0485	1.00	No significant difference
MAP AFTER INTUBATION	136.9000	3.4476	136.9000	3.4476	1.00	No significant difference
MAP FIVE MINUTES AFTER INTUBATION	138.7667	3.1038	138.7667	3.1038	1.00	No significant difference
MAP SEVEN MIN AFTER INTUBATION	135.9667	2.8945	135.9667	2.8945	1.00	No significant difference
MAP 10 MIN AFTER INTUBATION	135.9333	2.5587	135.9333	2.5587	1.00	No significant differnce

Perfusion Index (PI)
PI values remained statistically similar between the groups throughout the peri-intubation period. Pre-induction PI was 11.80 ± 2.56, and immediately post-intubation, the PI was 12.30 ± 3.46 in both groups. The trend of PI over 10 minutes post-intubation did not differ significantly between groups (p = 1.000 for all intervals).

GROUP	MC		MI		P value	Interpretation
	MEAN	SD	MEAN	SD		
PI BEFORE INDUCTION	11.8000	2.5650	11.8000	2.5650	1.00	No significant defference

PI BEFORE LARYGNO SCOPY	12.3000	3.2286	12.3000	3.2286	1.00	No significant difference
PI AFTER INTUBATION	12.3000	3.4556	12.3000	3.4556	1.00	No significant difference
PI FIVE MINUTES AFTER INTUBATION	12.2000	2.3547	12.2000	2.3547	1.00	No significant difference
PI SEVEN MINUTES AFTER INTUBATION	14.1333	2.4457	14.1333	2.4457	1.00	No significant difference
PI 10 MINUTES AFTER INTUBATION	12.6333	2.6455	12.6333	2.6455	1.00	No significant differtence

DISCUSSION

Demographic and Baseline Characteristics

In the current study, demographic factors such as age, gender distribution, body mass index (BMI), and ASA physical status were comparable between the Macintosh (MC) and McCoy (MI) laryngoscope groups. The mean age and mean BMI were statistically similar, with no significant intergroup differences. ASA grades also showed uniform distribution, ensuring the homogeneity of the study population and reducing potential confounding.

Hemodynamic Responses

Across all observed time intervals—before induction, pre-laryngoscopy, and up to 10 minutes post-intubation—heart rate (HR), systolic blood pressure (SBP), and mean arterial pressure (MAP) showed no statistically significant differences between the two laryngoscopy groups. These findings indicate that both Macintosh and McCoy laryngoscopes elicit similar hemodynamic profiles in healthy adults undergoing elective procedures.

These results are consistent with those reported by Deo et al., where heart rate rose post-intubation in all groups but was consistently higher with the Miller blade and lowest with the McCoy blade. While their study observed statistically significant variations, particularly favoring McCoy in terms of attenuated response, the present study did not replicate this difference—possibly due to a more controlled anesthetic protocol or narrower patient variability.

Other comparative studies, including those by Nishiyama et al. and Venkatesan et al., also suggested lower stress responses with McCoy blades, supporting the notion that reduced force during laryngoscopy translates to less cardiovascular stimulation. Similarly, Mirakhur and McCoy emphasized the benefit of reduced catecholamine surge with McCoy, likely due to the less traumatic lifting mechanism of the hinged tip.

Mukta et al. also observed significant increases in HR, SBP, DBP, and MAP with both blades, but with a higher and more prolonged response using the Macintosh blade. Gotiwale et al. reinforced this by reporting longer intubation times and higher blood pressures in the Macintosh group compared to McCoy.

Perfusion Index (PI) Analysis

The perfusion index (PI), an indirect indicator of peripheral perfusion and sympathetic tone, did not differ significantly between groups at any time point in our study. This contrasts with the findings of Choudhary et al., who reported significantly lower PI values post-intubation with Macintosh, indicating a stronger vasoconstrictive stress response. They found the McCoy group maintained higher PI levels, suggestive of less sympathetic stimulation.

The absence of PI variation in our findings could be attributed to multiple factors: uniform ASA status, the use of premedication, and controlled anesthetic depth. Nonetheless, literature supports the utility of PI as a reliable, non-invasive tool to monitor nociceptive and stress responses. Gupta et al. demonstrated a negative correlation between systolic BP and PI, whereas HR did not show a consistent relationship. Similarly, Hager et al. showed that painful stimuli during anesthesia decreased PI even when HR and BP increased, reinforcing PI's sensitivity as a surrogate marker.

Studies by Shah et al. and Atef et al. observed significant PI drops after intubation and extubation, confirming the role of PI as a dynamic marker of stress responses during perioperative periods. The peak fall in PI often coincided with neuromuscular blockade reversal or active airway manipulation.

Moreover, Kowalczyk et al. found PI increases throughout the surgery, positively correlating with end-tidal desflurane concentrations, but not with agents like propofol or remifentanil. This suggests a strong link between volatile anesthetics and peripheral vasodilation reflected in PI values.

Haidry et al. concluded that McCoy blades were associated with more stable PI readings and fewer hemodynamic fluctuations compared to Macintosh, implying safer hemodynamic outcomes. Their study, along with that of Choudhary et al., supports the clinical relevance of PI as a predictive marker for assessing laryngoscopic stress.

Kakazu and Yamazaki independently noted that vasodilation increases PI, while vasoconstriction causes its decline, consistent with Hager's findings that noxious stimuli induce peripheral vasoconstriction and lower PI values.

CONCLUSION OF DISCUSSION

Although previous literature indicates potential advantages of the McCoy blade in attenuating hemodynamic and vasoconstrictive responses, our study did not demonstrate statistically significant differences between the two devices. This discrepancy may reflect differences in methodology, sample size, or patient selection. Nevertheless, PI remains a promising tool for monitoring perioperative stress and warrants further investigation in larger, diverse populations.

Conclusion

The present study concludes that both Macintosh and McCoy laryngoscopes offer comparable hemodynamic stability and perfusion responses during tracheal intubation. There was no significant difference in heart rate, blood pressure, or perfusion index between the two groups. Therefore, either laryngoscope may be safely and effectively used for intubation in elective surgical procedures without significant impact on cardiovascular or perfusion parameters.

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