

A Prospective Randomized Comparative Study Between Clinical Efficacy of Miller Laryngoscope Blade and Macintosh Laryngoscope Blade in Adult Patients with Predicted Normal Airway Undergoing Elective Surgery

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Abstract:

Background: Airway management is a fundamental aspect of anaesthesia, and direct laryngoscopy with either Miller or Macintosh blades remains among the most widely practised techniques. Variations in glottic visualization, hemodynamic response, and ease of intubation may significantly affect patient outcomes.

Aims and Objectives: To compare the clinical efficacy of the Miller straight blade (no. 2) and the Macintosh curved blade (no. 3) in adult patients undergoing elective surgery under general anaesthesia. The objectives included evaluating hemodynamic responses (heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and SpO₂), assessing ease of intubation using POGO score, Cormack–Lehane grading, number of attempts, and intubation time, and recording complications associated with each blade.

Methods: In this prospective, randomized, single-blind study, 80 ASA I–II patients aged 18–65 years undergoing elective surgery at SVBP Hospital, Meerut, were enrolled. Participants were randomly allocated into two groups: Group A (Miller blade, n=40) and Group B (Macintosh blade, n=40). Hemodynamic parameters were measured at baseline, immediately after intubation, and at 1, 3, 5, and 10 minutes. Intubation characteristics and complications were documented. Data were analyzed using SPSS software, with $p < 0.05$ considered statistically significant.

Results: Baseline demographic characteristics were comparable between the groups. At 0 and 1 minute post-intubation, heart rate and blood pressures were significantly higher in the Miller group ($p < 0.05$). The Macintosh group showed a shorter mean intubation time (13.7 ± 1.58 seconds vs. 17.97 ± 1.30 seconds, $p < 0.001$) and fewer complications (2.5% vs. 7.5%). Although glottic visualization was superior with the Miller blade, overall ease of intubation was better with the Macintosh blade.

Conclusion: The Macintosh laryngoscope was associated with shorter intubation times, fewer hemodynamic changes, and easier intubation, making it more suitable for routine use in adult patients with normal airways. In contrast, the Miller blade offered superior glottic visualization and may be beneficial in cases of large epiglottis or when a difficult airway is anticipated.

Keywords: Airway Management, Laryngoscopy, Miller Blade, Macintosh Blade, Intubation, Hemodynamic Response.

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Introduction

Airway management is a fundamental skill in anaesthesiology, ensuring patient safety by maintaining a patent airway and facilitating effective ventilation and oxygenation during induction, maintenance, and recovery from general anaesthesia. Although complications are relatively uncommon, they may be life-threatening,

underscoring the importance of meticulous technique and preparation. The primary objective of airway management is to secure the airway, thereby preventing adverse events and ensuring adequate gas exchange [1].

Among airway management strategies, endotracheal intubation remains the gold standard. This procedure

involves inserting an endotracheal tube into the trachea under direct visualization using a laryngoscope. The design of the laryngoscope blade plays a crucial role in determining glottic visualization and intubation success. The two most frequently used blades are the Macintosh curved blade and the Miller straight blade. The Macintosh blade is placed in the vallecula to indirectly elevate the epiglottis, while the Miller blade directly lifts the epiglottis, often providing a clearer glottic view, particularly in paediatric patients [2].

The choice of blade is influenced by patient anatomy, age, and the clinical scenario. However, improper use of a laryngoscope may result in complications ranging from minor mucosal trauma to vocal cord injury [3]. Careful blade selection and precise technique are therefore essential. The present study was conducted to compare the Miller and Macintosh blades in terms of hemodynamic responses, intubation success, glottic visualization, and complications. While video laryngoscopy has advanced airway management practices, direct laryngoscopy with these blades continues to be a cornerstone of routine anaesthetic practice, especially in resource-limited settings [4,5].

Materials and Methods

Study Design and Ethical Approval: This prospective, randomized, single-blind study was conducted at SVBP Hospital, Meerut, after approval from the Institutional Ethics Committee of Chaudhary Charan Singh University, Meerut. Written informed consent was obtained from all participants before enrolment.

Study Population: A total of eighty patients, aged between 18 and 65 years and classified as ASA physical status I or II, scheduled to undergo elective

surgery under general anaesthesia, were enrolled in the study. These patients were randomly allocated into two equal groups. Group A (n = 40) underwent intubation using a Miller straight blade (no. 2), while Group B (n = 40) underwent intubation with a Macintosh curved blade (no. 3). The inclusion criteria comprised adult patients within the age range of 18–65 years, ASA grade I or II, with a predicted normal airway, and undergoing elective surgical procedures. Patients with airway pathology, edentulous status, restricted mouth opening, or severe systemic illness were excluded from the study.

Anaesthesia Protocol: Patients were premedicated with glycopyrrolate (0.01 mg/kg) and midazolam (0.05 mg/kg). Induction was achieved with propofol (1.5–2.5 mg/kg), followed by vecuronium (0.08–0.1 mg/kg) for muscle relaxation. Intubation was performed with either Miller or Macintosh blades as per group allocation. Intubation success, glottic view (POGO score, Cormack–Lehane grade), attempts, and complications were recorded.

Outcome Measures: Hemodynamic parameters (HR, SBP, DBP, MAP, SpO₂) were measured at baseline, 0, 1, 3, 5, and 10 minutes post-intubation. Primary outcomes were hemodynamic changes; secondary outcomes included ease of intubation, time taken, number of attempts, and complications.

Statistical Analysis: Data were analyzed using SPSS software. Continuous variables were compared using independent t-test; categorical variables using chi-square test. A p-value < 0.05 was considered statistically significant.

Results

Demographics: Both groups were comparable in terms of age, sex, and BMI (Table 1).

Table 1: Demographic profile of study participants

Parameter	Group A (Miller)	Group B (Macintosh)	p-value
Age (years)	37.07 ± 15.36	39.6 ± 14.05	0.194
Sex (M/F)	22/18	24/16	–
BMI (kg/m ²)	22.05 ± 1.65	22.15 ± 1.78	0.389

Hemodynamic Responses: At 1-minute post-intubation, HR, SBP, DBP, and MAP were

significantly higher in Group A (Miller) than in Group B (Macintosh) (Table 2).

Table 2: Hemodynamic responses at 1 minute after intubation

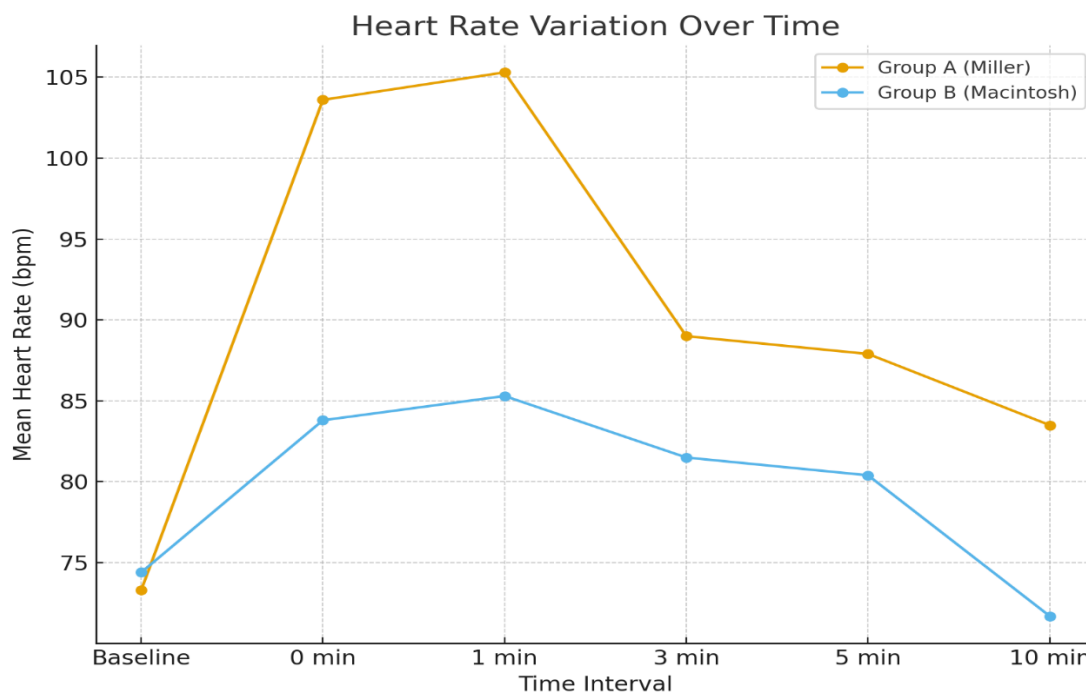
Parameter	Group A (Miller)	Group B (Macintosh)	p-value
Heart Rate (bpm)	105.3 ± 8.9	85.3 ± 8.0	<0.01*
Systolic BP (mmHg)	139.05 ± 7.1	123.6 ± 4.7	<0.01*
Diastolic BP (mmHg)	79.6 ± 5.7	70.1 ± 6.2	<0.05*
Mean Arterial Pressure	99.5 ± 5.2	87.9 ± 4.8	<0.05*

Intubation Characteristics: Macintosh demonstrated shorter intubation times, fewer

complications, and similar first-attempt success rates compared to Miller (Table 3).

Table 3: Intubation characteristics

Parameter	Group A (Miller)	Group B (Macintosh)	p-value
First attempt success (%)	87.5%	92.5%	—
Mean intubation time (sec)	17.97 ± 1.30	13.7 ± 1.58	<0.001*
Complications (%)	7.5%	2.5%	—

**Figure 1: Heart rate variation over time (Baseline to 10 minutes).**

Discussion

This study compared the Miller and Macintosh blades in terms of hemodynamic responses, glottic view, intubation characteristics, and complications. Both groups were matched demographically, thereby minimizing potential confounding factors. Hemodynamic responses were significantly greater with the Miller blade at 0 and 1 minute after intubation, consistent with the findings of Gaurav Dwivedi et al. [6] and Somchai Amornyotin et al. [7]. Altun D, Ali A and colleagues [8] similarly observed that advanced devices such as McGrath video-laryngoscopes minimize cardiovascular stimulation. The exaggerated sympathetic response with Miller can be explained by greater stimulation of supraglottic structures during intubation.

In terms of intubation attempts, both blades had high success rates, though our findings agree with Dr. Manali Nadkarni and R. D. Patel [9], who noted that Miller may require more attempts compared to Macintosh or McCoy. Glottic visualization was superior with the Miller blade, corroborating findings from Jose J. Arino et al. [10] and Ashok Kumar B K et al., yet Macintosh provided easier intubation conditions, as also observed by Gaurav Dwivedi et al. [6].

The mean intubation time was significantly shorter with Macintosh, consistent with Somchai Amornyotin and Ungkab Prakanrattana [7] and Ashok Kumar B K et al. Minor complications such as lip trauma were more frequent with Miller, although rates remained comparable to previous studies reporting low complication rates [7,9].

Limitations: This study was single-centre with a relatively small sample size and restricted to ASA I–II patients with predicted normal airways. Findings may not be generalizable to patients with difficult airways, higher ASA grades, or emergency cases. Furthermore, video-laryngoscopes were not included for comparison, which limits applicability in modern practice.

Taken together, while Miller provides superior laryngeal visualization, Macintosh is associated with shorter intubation times, less hemodynamic response, and fewer complications, making it more appropriate for routine adult airway management.

Conclusion

The Macintosh laryngoscope proved superior for routine use, with shorter intubation time, fewer attempts, and reduced hemodynamic changes compared to the Miller blade. However, the Miller blade provided better glottic visualization and may

be advantageous in cases of large epiglottis or anticipated difficult airway.

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