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Comparison of ease of intubation and glottic visualisation using Miller (paraglossal approach) and Macintosh laryngoscope in adults: A randomised crossover study

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ABSTRACT

Background: Previous randomised controlled trials have produced inconclusive results about the initial success rates of intubation when comparing the adult Miller and Macintosh blades. A prospective randomised crossover study involving 200 adult ASA I or II patients scheduled for elective surgery under general anaesthesia.

Aim & Objective: This study aimed to evaluate the efficacy of intubation with the adult Miller blade using a paraglossal approach compared to the Macintosh blade in adult patients. To compare the ease of orotracheal intubation and glottic visualisation using the adult Miller and Macintosh blades.

Materials and Methods: After obtaining approval from the ethical committee, 200 adult patients satisfying inclusion criteria were enrolled. Group allocation was determined by the order of blade usage during laryngoscopy, with randomisation conducted via computer-generated random numbers. Patients were divided into two groups: Group MAC (where the initial laryngoscopy was performed using the Miller blade, followed by intubation with the Macintosh blade) or Group MIL (where the initial laryngoscopy was performed using the Macintosh blade, followed by intubation with the Miller blade). Following standard anaesthesia protocols, the first laryngoscopy was carried out with the randomly assigned blade, accompanied by the administration of a 10% Lignocaine spray. After one minute of mask ventilation, the second laryngoscopy was performed with the alternate blade, and intubation was completed. Parameters were documented, including the first attempt intubation success rate, Cormack-Lehane grade, intubation duration, utilisation of ancillary devices for intubation, and hemodynamic measures.

Results: The first attempt success rate was 92% and 95% in Group MIL and Group MAC, respectively (P=0.081). Cormack-Lehane grade I was seen in 73% of cases in Group MIL and 68% of in Group MAC (P=0.022). The average intubation time was 16.42±1.60 seconds in Group MIL and 16.68±1.38 seconds in Group MAC (P=0.221).

Conclusion: Utilizing the Miller laryngoscope and paraglossal technique for adult intubation demonstrates comparable first-attempt intubation success rates to the Macintosh blade while providing superior glottic visualisation.

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1. Introduction

Airway management is a crucial responsibility of anaesthesiologists, encompassing securing and maintaining the airway during anaesthesia's induction and recovery phases.[1] The failure to effectively manage the airway poses severe risks, including the potential for hypoxic brain damage.[2] Laryngoscopy, an essential component of airway management, offers a clear view of the vocal cords, enabling smooth orotracheal intubation. To accomplish this, anaesthesiologists use various techniques, such as optimising head and neck positioning and different types of laryngoscopes to achieve an optimal glottis view.[3] The Macintosh and Miller blades are the most commonly used laryngoscopes in routine practice. The Macintosh blade is typically preferred for adult intubation, while the Miller blade is predominantly used for pediatric patients. However, numerous blades with unique features are tailored for specific airway scenarios.[4,5]

The adult Miller blade features a straight tongue with a curved tip in cross-section, creating a C shape with the flange, web, and tongue. It includes a light source, which can be either a bulb or fibreoptic, that activates when the circuit between the handle and the blade is complete.[6] Although the straight blade is not commonly used for routine adult intubation, there is limited literature comparing its effectiveness to the curved Macintosh blade regarding ease of orotracheal intubation. Earlier reviews suggested a better glottis view with the adult Miller blade, although the ease of orotracheal intubation had inconclusive results based on limited randomised control trials.[3] We used a randomised crossover study to recognise the gaps in existing literature, particularly with a scarcity of data utilising a crossover design for adult Miller and Macintosh laryngoscope comparison. Our study primarily focused on assessing the first attempt success rate, with secondary outcomes including intubation time, Cormack-Lehane grading (CLG), use of assisted manoeuvres, and hemodynamics.

2. Materials and Methods

This randomized crossover trial was approved by the Institutional Research and Ethics Committee (PG DISSERTATION/02/2019/64) and was registered with the Clinical Trial Registry of India (CTRI/2019/09/021054). Between March 2019 and May 2020, 200 patients classified as American Society of Anesthesiologists (ASA) physical status I and II, including both genders and aged 18-60 years, scheduled for elective surgeries under general anaesthesia necessitating orotracheal intubation, were recruited from a tertiary care hospital in south India. Participants were selected through convenience sampling, excluding those anticipated to have difficult airways, emergency surgery cases, and patients requiring rapid sequence induction of anaesthesia. Enrolled patients adhered to standard nil per oral (NPO) guidelines and received oral premedication with alprazolam 0.5 mg, ranitidine 150 mg the night before and morning of surgery, and metoclopramide 10 mg on the morning of surgery. Upon entering the operating room, standard monitoring was initiated, including electrocardiography (ECG), non-invasive blood pressure (NIBP), oxygen saturation (SPO2), end-tidal carbon dioxide (ETCO2), and baseline hemodynamic parameters were recorded. After establishing intravenous (IV) access, patients received 1 mg of midazolam and 0.1 mg/kg of morphine IV. Following 5 minutes of preoxygenation, induction was carried out with IV Propofol at 2 mg/kg. The adequacy of mask ventilation was evaluated before administering muscle relaxants. If ventilation was adequate, IV Vecuronium at 0.1 mg/kg was given to facilitate direct laryngoscopy (DL) and intubation. Computer-generated random numbers concealed within sealed envelopes were used to determine the sequence of laryngoscopy. The patients were assigned to either Group MAC (where the first laryngoscopy was performed with the Miller blade and intubation with the Macintosh blade) or Group MIL (where the first laryngoscopy was performed with the Macintosh blade and intubation with the Miller blade). Laryngoscopy was performed twice on each patient using a Macintosh laryngoscope size 3 and an adult Miller laryngoscope size 3 in the sniffing position. Following the first laryngoscopy, the cords were sprayed with 10% Lignocaine, and mask ventilation with 50% oxygen, 50% nitrous oxide, and sevoflurane ensued. Tracheal intubation occurred after the second laryngoscopy using an appropriately sized cuffed endotracheal tube by an experienced anaesthesiologist. Mechanical ventilation sustained lung function throughout the procedure, with anaesthesia using 50% nitrous oxide, 50% oxygen, and Isoflurane.

Ease of orotracheal intubation, defined as a single passage of the endotracheal tube without assisting manoeuvres such as bougie, stylet, or backwards, upward, rightward pressure (BURP), along with Cormack-Lehane grade (CLG), was noted. Intubation duration was recorded from the insertion of the second laryngoscope to the appearance of the first capnographic waveform. Hemodynamic parameters, including systolic blood pressure, heart rate, and mean arterial pressure, were documented at various time points throughout the procedure.

Sample size determination was based on a previous study by Kulkarni et al. with an assumed 97% success rate for the Miller laryngoscope for first-attempt intubation.[3] With an alpha error of 0.05 and power of 80%, each group included 100 patients, totalling 200. Data were sequentially entered into an MS Excel spreadsheet, with group decoding

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after completing all cases. Statistical analysis utilised the Statistical Package for Social Sciences (SPSS) version 25 (IBMSPSS Corp; Armonk, NY, USA). Categorical variables were expressed as percentages, and continuous variables as mean ± standard deviation. The significance of mean differences was assessed using an unpaired t-test, with $P < 0.05$ considered statistically significant.

3. Results

A total of 200 patients were screened for eligibility using the convenience sampling method, and all were deemed eligible, leading to their inclusion in the study (Diagram 1). No patients were excluded after randomization. Demographic data, including age, weight, height, BMI, and ASA physical status, were comparable between Group MAC and Group MIL (Table 1). The first attempt success rate was 95% in Group MAC and 92% in Group MIL, with no statistically significant difference observed (P=0.081) (Table 2). Cormack-Lehane grading (CLG) revealed that 68% of Group MAC and 73% of Group MIL had a grade 1 view of the glottis, showing a statistically significant difference (P=0.022). CLG 2, indicating a partial view of the glottis, was observed in 19% of Group MAC and 15% of Group MIL, with statistical significance (P=0.035). CLG 3, where only the epiglottis or none of the glottis was visible, accounted for 13% of Group MAC and 12% of Group MIL, showing no significant difference (P=0.327). CLG 4, denoting no visibility of either glottis or epiglottis, was not observed in any participants (Table 2). Secondary outcomes, including intubation time (Table 2) and hemodynamic parameters such as mean arterial blood pressure (MAP) and heart rate, demonstrated no statistically significant differences between the two groups.

4. Discussion

The Miller laryngoscope is commonly used for paediatric intubation, but its application in visualising adult airways has become less common compared to the Macintosh and McCoy laryngoscopes and video laryngoscopes.[7,8] With the widespread adoption of video laryngoscopes, the Miller laryngoscope has received less attention from researchers evaluating airway management devices. Several studies have compared Miller and Macintosh blades in the paediatric population, but there is a noticeable gap in the available literature for adults. Existing randomized control trials have yielded inconsistent results, particularly regarding the first-attempt success rate with the adult Miller laryngoscope, which is a critical finding in our study.[9,10] Our research has demonstrated a comparable first-attempt success rate without using ancillary devices such as bougie/stylet or BURP with the adult Miller laryngoscope (92%) and Macintosh laryngoscope (95%) (P = 0.081). Notably, both laryngoscopies in our study were performed by competent anaesthesiologists with experience in 50 intubations using the Miller blade before the study. This differs from a study by Kulkarni et al. which reported a first-attempt success rate of 86% with the Miller blade, significantly lower than the 100% success rate observed with the Macintosh blade.[3] Our study utilized the paraglossal technique, contrasting with the midline technique used in other studies to achieve a better view of the glottis.[11] Our findings are consistent with those of William B. et al. who reported a 96.2%.success rate with the miller blade.[12]

A recent significant study by Landry WB et al. examined the attributes of potentially difficult airways using the Miller blade in 978 ASA I-III patients. The authors concluded that the Miller laryngoscope is an effective and safe device for intubating patients undergoing elective surgeries under general anaesthesia, with low rates of difficult visualisation and orotracheal intubation.[11] However, this study did not directly compare the Miller blade with the Macintosh blade within the same patient population, nor did it establish which blade is superior for individual patients. Nonetheless, many authors assert that the Miller blade provides better glottic visualisation compared to the Macintosh blade.[12,13] Cormack Lehane's grading in our study indicated a statistically significant better laryngoscopic view with the Miller laryngoscope than the Macintosh laryngoscope. For example, Kulkarni et al. compared four blades (Truview, Miller, McCoy, and Macintosh) using Cormack and Lehane grading. They found that the Trueview laryngoscope provided the highest percentage of Grade 1 views (87%), followed by the Miller (83%), McCoy (77%), and Macintosh (63%).[3] The Miller blade has shown improved glottic views in adult population. Nadkarni et al. reported Grade I views in 97% of cases using Miller's blade, compared to 88% with the McCoy and 72% with the Macintosh blade.[1] In a similar study, Achen et al. evaluated laryngeal visualisation using the Miller blade and paraglossal technique, finding a Grade 1 Cormack and Lehane view in 96.5% of cases, compared to 85% in the Macintosh group.[11] Arino et al. reported that the Miller blade provided optimal glottic visibility in 96% of cases, compared to 72% with the Macintosh blade.[14] The superior visibility offered by the Miller laryngoscope is due to reduced cervical vertebrae movement and less tissue volume in the oropharynx with the paraglossal approach. In contrast, the Macintosh blade requires more tongue displacement into the submandibular space to achieve the same glottic view as with the Miller blade. This difference is especially important in morbidly obese patients, who have a greater accumulation of oral tissue compared to those of normal weight.[15–17]

Regarding intubation time, our study found similar durations between the two groups (16.42±1.60 sec in Group MIL and 16.68±1.38 sec in Group MAC), emphasising the reliability of straight blades in challenging airway scenarios.

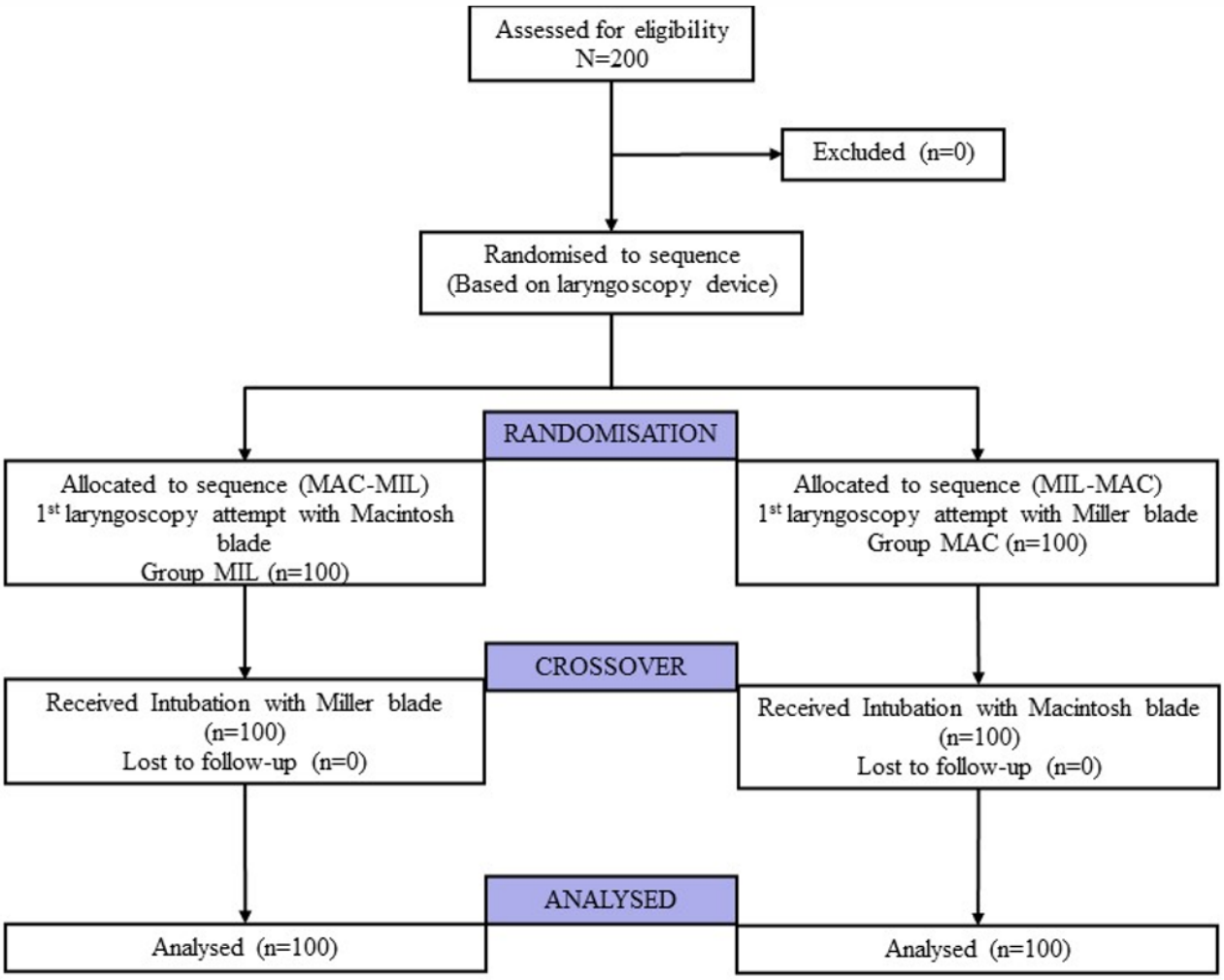

Diagram 1: The consort flow diagram

Table 1: Demographic characteristics

Variables	Group MAC (N=100)	Group MIL (N=100)
Age in years	36.81(12.32)	35.53(10.58)
Gender (male/female)	54/46	47/53
Weight in kg	62.43(10.82)	59.9(10.58)
Height in cm	160.1(8.54)	158.27(8.09)
BMI kg/m^2	24.35(3.87)	23.88(3.69)
ASA I/II	64/66	36/34

Values are mean (SD) or number; BMI: Body mass index; ASA: American Society of Anesthesiologists.

This contrasts with the study by Amornyotin et al. where significant time differences were noted, possibly due to the use of nursing postgraduates unfamiliar with the straight blade insertion technique.[18] Hemodynamic parameters, including blood pressure and heart rate, showed no notable changes, and desaturation incidents were absent in both groups. Ancillary device usage and assisted manoeuvres were comparable between groups, with no significant differences.

Chaoin Chen et al. in their recent study, highlighted the potential resurgence in the use of the traditional Miller blade and its associated external pressure intubation technique in adult patients. They demonstrated that certain patients with flaccid, drooping, or aplastic glottis may not achieve significant results with the classic Macintosh laryngoscope or its variants.[19] In our view, adopting the traditional intubation technique with the Miller blade could decrease the number of attempts required in patients

Table 2: Showing primary & secondary outcomes: First attempt success rate, Intubation time, Glottic view & use of ancillary devices

Variables		Group MAC (N=100)	Group MIL (N=100)	P Value
First attempt success		95	92	0.081
Intubation time (sec)		16.68(1.38)	16.42(1.6)	0.22
Cormack-Lehane grading	Grade I	68	73	0.022*
	Grade II	19	15	0.035*
	Grade III	13	12	0.32
Use of ancillary device/ manoeuvre	BURP	3	5	0.14
	Bougie	2	1	0.42
	BURP+Bougie	0	2	0.11

Values are mean (SD) or percentage; BURP: Backward-upward-rightward pressure.* denotes significant P value.

facing unexpected intubation challenges and minimise the occurrence of local and general complications. Numerous authors also advocate for the comprehensive education of young anaesthesiologists to include a wide range of equipment and intubation techniques, including the often-overlooked Miller blade and its associated method of visualising airway entry.[20]

The study limitations include the exclusion of patients with expected difficult airways, potential inter-performer variation not considered, lack of blinding due to study design, and a small incidence of sore throat, which resolved spontaneously. Despite these limitations, our findings suggest that the adult Miller blade could be a suitable alternative to the Macintosh blade for orotracheal intubation. A deeper understanding of different blade types and their functionalities can enhance clinical practice.

5. Conclusion

In conclusion, using the Miller laryngoscope and paraglossal technique for intubation in adults yields a similar first-attempt intubation success rate compared to the Macintosh laryngoscope. Additionally, the Miller laryngoscope offers superior glottic visualisation than the Macintosh while causing minimal cervical vertebrae movement and tongue volume displacement. This feature can be particularly beneficial in unexpected difficult intubations due to restricted neck movements and inadequate submandibular compliance.

6. Source of Funding

None.

7. Conflict of Interest

None.

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