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Comparison of Laryngoscopic Glottic Views Obtained via Macintosh vs Miller Blade in Adults Undergoing General Anesthesia with Endotracheal Intubation

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Author`s Contribution

[1,2,4,6]Substantial contributions to the conception or design of the work, acquisition, analysis, or interpretation of data for the work,[3,5]Drafting the work or revising it critically for important intellectual content, Final approval of the version to be published

Funding Source: None
Conflict of Interest: None

Received: April 9, 2023
Accepted: Sept 12, 2023

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ABSTRACT

Objective: To compare the glottic views obtained through Miller and Macintosh blade laryngoscopy in adults undergoing general anesthesia with endotracheal intubation.

Methodology: This quasi-experimental study was conducted at Holy Family Hospital, Rawalpindi, from June 2022 to September 2022. Sixty patients scheduled for elective surgery under general anesthesia with endotracheal intubation were enrolled. Patients were randomly assigned to two groups: Miller blade group (n=30) and Macintosh blade group (n=30). The anesthesiologist conducting the intubation recorded the Cormack Lehane grade obtained. Data analysis utilized SPSS version 27.0, employing independent-sample t-tests, Mann-Whitney U tests, chi-square, or Fisher's exact tests as appropriate. A p-value <0.05 was considered statistically significant.

Results: In the Miller blade group, comprising 30 patients, the mean age was 44.60+13.310 years, and 53.3% were male. Cormack-Lehane grades were distributed as follows: 76.7% grade I, 20.0% grade II, and 3.3% grade III. In the Macintosh blade group, with 30 patients, the mean age was 40.93+12.798 years, and 46.7% were male. Cormack-Lehane grades were distributed as follows: 30.0% grade I, 50.0% grade II, 13.3% grade III, and 6.7% grade IV.

Conclusion: The study concluded that Miller blade laryngoscopy provides superior glottic views compared to Macintosh blade laryngoscopy. However, the ease of intubation and the time taken for intubation were not investigated, suggesting areas for exploration in future studies.

Keywords: Miller blade, Macintosh blade, direct laryngoscopy, Cormack Lehane grade, glottic view.

Cite this article as: Zulfiqar H, Ghafoor H, Anwar MH, Zahir J, Bokhari FM, Haq IU. Comparison of Laryngoscopic Glottic Views Obtained via Macintosh vs Miller Blade in Adults Undergoing General Anesthesia with Endotracheal Intubation. Ann Pak Inst Med Sci. 2023; 19(3):266-271. doi. 10.48036/apims.v19i3.830

Introduction

Direct laryngoscopy for endotracheal intubation is the cornerstone of airway management during general anesthesia. During the tracheal intubation process, it is significant to overcome anatomical challenges posed by the angled airway to establish a clear view of glottis. To accomplish this, direct laryngoscopes are mostly utilized to align the oral, laryngeal and pharyngeal axes, as well as to raise the epiglottis.[1,2] However, cases of difficult laryngoscopy have always been there, prompting the anesthesiologists to use various sizes and designs of laryngoscope blades to aid in the process.[3]

According to the American Society of Anesthesiologists (ASA) Task Force on Management of the Difficult

Airway, difficult laryngoscopy is defined as the inability to visualize the vocal cords despite optimal efforts and proper positioning.[4] This life-threatening event boosts the morbidity as well as mortality risks for the patients who are under anesthesia during the procedure.[5] However, the incidence of inadequate glottic visualization is observed in approximately 1 to 9 percent of intubation attempts, mostly the success can be attained with extra force, manipulation of larynx outwardly, or along with the assistance of stylets and gum-elastic bougies. Difficult laryngoscopy, often characterized by inadequate glottic exposure, typically necessitates multiple intubation attempts and may lead to potential complications such as hypoxia and injury to the airway and dentition.[6]

Several tests are available that can be used to foresee the difficult laryngoscopy for example, Mallampati test, inter incisor gap, thyromental distance, mandibular rim length, mandible subluxation, chin protrusion & atlantooccipital extension and Cormack-Lehane (CL) grading system.[7,8] The CL grading system is extensively utilized to assess the glottic view obtained during laryngoscopy, wherein laryngoscopic view is categorized as Grade-I to -IV.[9-11] Based upon the laryngeal structure view through direct laryngoscopy, Cormack & Lehane put the Grade-I: when complete glottis is visible, Grade-II: when the posterior commissure of glottis is visible and Grade-III: when only the epiglottis is visible while Grade-IV: when any part of the laryngeal structure is not visible.[12]

The design of laryngoscope has several forms but two most frequently utilized blades are Miller and Macintosh, that are straight and curved, respectively. Miller blades offers vocal cord better view while Macintosh blade is easy to use. The selection of these blades is based on the preferences and expertise of the anesthesiologists.[13,14]

The popularity of Macintosh laryngoscope in the world of anesthesia is beyond any doubt. Designed by Sir Robert Macintosh, Professor of Anesthetics at University of Oxford in 1943, it has revolutionized the conduct of intubation in anesthesia. In 1940s, when the use of straight Miller blade was common and many anesthetics were struggling with the intubations particularly due to lack of the discovery of muscle relaxants, Macintosh designed a curved blade laryngoscope and suggested to place its tip in the valecullae, thus lifting the epiglottis and improving the view for intubation. The ease of intubation with this device made it popular over a quick span of time. Macintosh laryngoscope is still regarded by most of the anesthetists as an easier to master device and a gold standard for intubation even though larynx cannot be viewed properly in 1-3% of the cases by its use.[3,15]

The use of laryngoscopes is unlikely to change significantly since people who learn laryngoscopy using the Macintosh blade will most likely continue to do so. However, it is important to note that the miller blade may offer advantages in certain circumstances such as patients with long and floppy epiglottis, difficult dentition, and large tongue in relation to mandibular space. Miller is a straight blade that has no curvature and because of anatomy of the tongue and mouth as well as large epiglottis, Miller blade offers clear view of the laryngeal inlet.[13,16]

Several researches have been conducted to compare the Miller and Macintosh blades for intubation among children. However, video laryngoscopy has been more extensively studied in the adult population, leaving a gap in evidence for the use of Miller and Macintosh blades in adults. By comparing the glottic views obtained with these two blades, this study provides important insights into the relative advantages and disadvantages of each blade in clinical practice and also furnish support for considering the inclusion of Miller laryngoscopy as a possible competency requirement for anesthesia residency programs.

Methodology

From June 2022 to September 2022, Holy Family Hospital conducted a quasi-experimental investigation. Adult patients of both genders who were scheduled for elective surgery under general anesthesia and in need of endotracheal intubation and who met the inclusion criteria for the study were eligible to participate. The study excluded patients who had a history of problematic airway breathing, cervical spine injuries, or any other condition that would have made using Miller or Macintosh laryngoscope blades inappropriate.

Ethical approval for the study was obtained. A total of 120 patients were assessed for eligibility, out of which 60 were randomized using a computer-generated randomization table into two groups, i.e., Miller blade group (n=30) and Macintosh blade group (n=30). Informed consent was obtained from all the patients before their enrollment in the study.

The procedure was performed by experienced anesthesiologists (at least 2 years of anesthesia experience) who were trained in both Miller and Macintosh blade techniques. After the patient was induced with general

anesthesia, laryngoscopy was performed using either Miller or Macintosh blade. The anesthesiologist performing the intubation recorded the Cormack-Lehane grade obtained. The Cormack-Lehane grade was assessed based on the best view of the vocal cords obtained during laryngoscopy, which ranged from grade I (the best view) to grade IV (the worst view).

SPSS version 27.0 was used to analyze the data. Demographic details such as age, gender, BMI, mallampati grade, and thyromental distance (normal, ≥ 6.5 cm or narrow < 6.5 cm) were presented as frequencies and percentages or as means ± standard deviation (SD). The main metric used to assess the results was the Cormack-Lehane score during laryngoscopy. As appropriate, independent-sample t-tests or Mann-Whitney U tests were used to evaluate continuous data. When applicable, Fisher's exact test or chi-square test were used to assess categorical variables. A p-value of <0.05 was considered statistically significant. Stratification was done for Mallampati grade, thyromental distance and BMI and post-stratification analysis was done to compensate for confounding variables.

Results

The mean age of patients in the Miller blade group was 44.60±13.310 years, while in the Macintosh blade group, it was 40.93+12.798 years. In the Miller blade group, 53.3% (16/30) of the patients were males and 46.7% (14/30) were females. Similarly, in the Macintosh blade group, 46.7% (14/30) were males and 53.3% (16/30) were females. The mean body mass index for patients in the Miller blade group was 26.317 ± 5.622, and for patients in the Macintosh blade group, it was 26.087±4.923 (Table I).

Table I: Characteristics of patients.

	Miller blade group (n = 30)	Macintosh blade group (n = 30)	P-value
Age (years)			
≤30	5 (16.7%)	8 (26.7%)	0.347
31-50	12 (40.0%)	15 (50.0%)	
>50	13 (43.3%)	7 (23.3%)	
Mean±SD	44.60±13.310	40.93±12.798	
Gender			
Male	16 (53.3%)	14 (46.7%)	0.606
Female	14 (46.7%)	16 (53.3%)	
Body mass index			
18.5–24.9	12 (40.0%)	15 (30.0%)	0.459
25.0–29.9	9 (30.0%)	8 (26.7%)	
≥30	9 (30.0%)	7 (23.3%)	
Mean±SD	26.317±5.622	26.087±4.923	

Normal weight 18.5–24.9, Overweight 25–29.9, Obesity ≥30

Table II exhibits that among 30 patients of Miller blade group, 6 (20.0%), 8 (26.7%), 11 (36.6%) and 5 (16.7%) patients had Mallampati grade I, II, III and IV, respectively. Among 30 patients of Macintosh blade group, 3 (10.0%), 9 (30.0%), 12 (40.0%) and 6 (20.0%) patients had Mallampati grade I, II, III and IV, respectively.

Table II: Comparison of Mallampati grade between both groups.

Grade	Miller blade group (n = 30)	Macintosh blade group (n = 30)	P-value
I	6 (20.0%)	3 (10.0%)	0.755
II	8 (26.7%)	9 (30.0%)	
III	11 (36.6%)	12 (40.0%)	
IV	5 (16.7%)	6 (20.0%)	

Figure 1 indicates that among 30 patients of Miller blade group, majority 29 (96.7%) had thyromental distance ≥6.5 cm (normal) and only 1 (3.3%) patient had <6.5 cm (narrow). Among 30 patients of Macintosh blade group, majority 28 (93.3%) had thyromental distance ≥6.5 cm (normal) and only 2 (6.7%) patients had <6.5 cm (narrow).

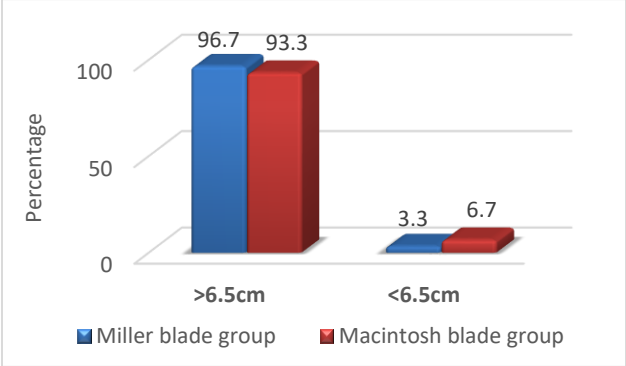

Figure 1. Comparison of thyromental distance between both groups.

Table III asserts that among 30 patients of Miller blade group, 23 (76.7%), 6 (20.0%), 1 (3.3%) and 0 (0.0%) patients had Cormack-Lehane grade I, II, III and IV, respectively. Among 30 patients of Macintosh blade group, 9 (30.0%), 15 (50.0%), 4 (13.3%) and 2 (6.7%) patients had Cormack-Lehane grade I, II, III and IV, respectively (p-value = 0.003).

Table III: Comparison of Cormack-Lehane grade between both groups.

Grade	Miller blade group (n = 30)	Macintosh blade group (n = 30)	P-value
I	23 (76.7%)	9 (30.0%)	0.003
II	6 (20.0%)	15 (50.0%)	
III	1 (3.3%)	4 (13.3%)	
IV	0 (0.0%)	2 (6.7%)	

Discussion

Obtaining a clear and optimal glottic view during laryngoscopy is critical for ensuring successful intubation and maintaining patient safety. The Macintosh and Miller laryngoscope blades, commonly employed in laryngoscopy, provide varying approaches for visualizing the glottis. While the Macintosh blade is frequently used in adult laryngoscopy, the Miller blade is less commonly utilized, particularly with the rising popularity of video laryngoscopes in modern practice. Therefore, the current study was carried out to compare the glottic views obtained via Miller and Macintosh blade laryngoscopy among adults undergoing general anesthesia with endotracheal intubation.

The mean age in our study (Miller: 44.60 ± 13.310 years, Macintosh: 40.93 ± 12.798 years) was comparable to the study group of Nalini et al.[17] (40.19 ± 13.265 years) and Swain et al. [18] (Miller: 44.8 ± 13.1 years, Macintosh: 48.2 ± 14.0 years). Patients in both groups were overweight on average as indicated by the mean BMI (Miller blade group: 26.317+5.623 kg and the Macintosh blade group: 26.087+4.923 kg). In contrast, the patients in the Swain et al[18] study had BMI within the normal range (Miller blade group: 22.8+3.0kg; Macintosh blade group: 21.9+3.1). It is pertinent to mention that there was no statistically significant difference between the mean age, BMI and Mallampati score amongst the two groups (p-value 0.347, 0.459, and 0.755 respectively). This reaffirms that the two groups within our study population exhibited comparable baseline characteristics, thereby increasing the reliability of any comparisons made.

Our study revealed that none of the patients in the Miller blade group had Cormack-Lehane grade IV view, with 76.7% having grade I, 20.0% grade II, and 3.3% having grade III view. On the other hand, the Macintosh blade group had 30.0% with grade I, 50.0% with grade II, 13.3% with grade III, and 6.7% with grade IV view. The difference observed was statistically significant (p-value 0.003). Limited research has been conducted to compare the Miller and Macintosh blades for adult tracheal intubations, with a particular emphasis on evaluating glottic view and ease of intubation. In a study conducted by Nalini et al. (2021) involving 172 adult patients undergoing elective surgeries under general anesthesia, the Miller blade was found to provide a superior laryngoscopic view compared to the Macintosh blade (32.6% versus 15.1%).[17] The study also revealed that the ease of intubation was significantly greater with the Miller blade compared to the Macintosh blade, with a higher percentage of grade 1 intubations (88.4% vs. 58.1%; P value: 0.0001). Similarly, a higher proportion of patients were intubated on the first attempt with the Miller blade compared to the Macintosh blade (93% vs. 75.6%; P value: 0.019). According to Swain et al. (2017), the Miller blade and paraglossal approach produced a better glottic view (92% with Grade-1 Cormack & Lehane view) than the Macintosh blade (68%).[18] According to Achen et al. (2008), laryngoscopy with the Miller blade revealed 100% of the vocal cords in 78% of instances, compared to 53% with the Macintosh blade.[19] According to Samel et al. (2019), the Macintosh blade only offered a 51.4% Grade-1 glottic view, while the Miller blade had a better view (91.4% Grade-1 Cormack & Lehane view).[20] Seo et al. (2012) found that the Miller blade demonstrated advantages in difficult tracheal intubation models, including shorter time factors and optimal glottic view.[21] These studies consistently highlight the superiority of the Miller blade in terms of glottic view. However, Macintosh blade continues to remain the preferred choice for most anesthesia providers around the globe, likely due to their extensive training and familiarity with its use.

On the other hand, Amornyotin et al. (2010)[22] found that orotracheal intubation using the Macintosh blade showed a higher success rate and shorter intubation time compared to the Miller blade in non-experienced individuals. However, these findings are applicable only to patients with normal airways (Mallampati I and II only). The Macintosh group achieved a 100% success rate on the first attempt, while 21.6% of patients in the Miller group experienced intubation failure (P < .001). Additionally, the intubation time was significantly shorter in the Macintosh group compared to the Miller group (P < .001). We only studied glottic view obtained upon laryngoscopy in our study. It is imperative to realize that achieving a good laryngeal view using the intubating device does not guarantee easy intubation. While a clear laryngeal view is important, the primary focus during laryngoscopic intubation should be on the accurate placement of the tracheal tube rather than solely visualizing the larynx. With that being said, it is always better to have a partial view of glottis at least rather than landing up with a grade IIIb or IV Cormack-Lehane view because one can always insert bougie and railroad the tube afterwards if the glottis is in sight, even if partially.

Conclusion

The study concluded that Miller blade laryngoscopy offers superior glottic views compared to Macintosh blade

laryngoscopy. However, aspects such as ease of intubation and the time taken for intubation were not investigated, leaving room for exploration in future studies.

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