COMPARATIVE EVALUATION OF MILLER AND MACINTOSH LARYNGOSCOPE BLADES FOR LARYNGOSCOPIC VIEW AND EASE OF INTUBATION IN INFANTS AND SMALL CHILDREN

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ABSTRACT

Background: There is widespread use of Miller blades in paediatric anaesthesia especially in infants, without many studies to support the superiority of the Miller straight blade over the Macintosh blade.

Material and methods: We designed a prospective randomized study with 60 patients allocated into two groups. In Group ML Miller laryngoscope was used for first laryngoscopy followed by Macintosh blade for second laryngoscopy and intubation. Group MC Macintosh laryngoscope was used for first laryngoscopy followed by Miller blade. The laryngoscopic view with both blades tips placed at vallecula, one after other, was graded using Cook’s modification of Cormack and Lehane grading. Optimal external laryngeal manipulation (OELM) was done if laryngoscopic grade is 2a or above. Trachea was intubated using an uncuffed endotracheal tube after second laryngoscopy. The laryngoscopic view, time of intubation and ease of intubation was recorded for comparison.

Results: The difference in laryngoscopies with Miller blade and Macintosh blade without OELM was statistically significant (p=0.035). However, the difference of CL grading after application of OELM was statistically insignificant (p=0.559). The comparison of time to intubation, number of intubation attempts and ease of intubation between both blades was statistically insignificant.

Conclusion: Our study suggests that though Miller blade provides better laryngoscopic view as compared to Macintosh blade if OELM is not used, either Miller or Macintosh blade can be used with blade tips placed at the valleculae in infants and small children with similar laryngoscopic views and ease of intubation provided head is extended and OELM is applied.

INTRODUCTION

Different types of laryngoscope blades are available to facilitate endotracheal intubation, Macintosh curved blade and Miller blade being commonly used.1 The anatomical and physiological differences of the paediatric patient require alterations in instruments, devices and techniques to aid airway management.2 The epiglottis in children is long floppy, more “U” shaped (compared to flat in adults). This feature makes many anaesthesiologists prefer semi-straight laryngoscope blades such as a Miller which are designed to directly lift the epiglottis out of view.3 However, poor straight-blade technique hindered laryngoscopy and set the stage for an innovative approach of lifting epiglottis indirectly by insertion in valleculae and the development of Macintosh laryngoscope.4 5

Though Miller blade is widely used in paediatric anaesthesia, there is a lack of evidence to support the benefits of the Miller blade over commonly used Macintosh blade.6-7 Therefore, we conducted this prospective randomized study to compare the laryngoscopies with the Miller and Macintosh blades in infants and children under two years of age.

Experimental Section

After approval from Institute’s Ethical and Research committee, and written and informed consent from parents/guardians, 60 pediatric subjects aged between 1-24
months of age of either sex, were included in the study. The inclusion criteria was American society of anesthesiologist (ASA) grade I, II subjects undergoing various elective surgeries under general anesthesia and requiring endotracheal intubation.

Patients having high risk of pulmonary aspiration, anticipated difficult airway, patients having coagulopathy or patients with increased intracranial tension were excluded. Patients were randomly allocated into two groups. Group ML (n=30) - Miller laryngoscope was used for first laryngoscopy followed by Macintosh blade for second laryngoscopy and intubation. Group MC (n=30) - Macintosh laryngoscope was used for first laryngoscopy followed by Miller blade for second laryngoscopy and intubation.

Randomization was done by computer-generated numbers and allocation into groups by opening a sealed opaque envelope immediately before surgery. Laryngoscopy and intubation was carried out by an investigator with an experience of at least one year in anaesthesia and who had carried out more than 20 successful intubations using each laryngoscope in children. All patients were kept fasting preoperatively as per ASA recommendation and were pre-medicated with oral midazolam 0.5 mg/kg 30-45 minute prior to induction of anaesthesia. After shifting the patient to operation theatre, patients was monitored using electrocardiogram (ECG), non-invasive blood pressure (NIBP) and pulse oximeter. Patient was placed supine. Anaesthesia was induced by using the sevoflurane 8% in oxygen. A peripheral intravenous access was secured at appropriate site and intravenous injection fentanyl 2µgm/kg was given to patients. This time of giving fentanyl was recorded as time zero. At one minute intravenous injection vecuronium 0.1 mg/per kg was given to patients. Controlled mask ventilation was given for three minutes, using Jackson Rees modification of Ayres T-piece circuit with 3% sevoflurane in oxygen. Laryngoscopy was carried out by using the first laryngoscope blade according to group allocation. The tip of laryngoscope was placed in the vallecula and epiglottis lifted indirectly by lifting the base of the tongue. The laryngoscopic view was graded using Cook’s modification of Cormack and Lehane grading.\(^8\) The blade was removed and patient mask ventilated for 30sec and second laryngoscopy performed with the other blade. The laryngoscopic view graded and trachea was intubated using an appropriate size uncuffed endotracheal tube. The ease of intubation was recorded as easy or difficult by the anaesthesiologist performing the laryngoscopy. The endotracheal tube was connected to the breathing circuit and controlled ventilation resumed using 66% nitrous oxide with 2% sevoflurane in oxygen. The placement of endotracheal tube was confirmed by auscultation of chest and presence of square wave capnography.

Optimal external laryngeal manipulation (OELM) was done if laryngoscopy grade is 2a or above and any change in the view recorded. The best view after OELM thus obtained was recorded. The manoeuvres required for facilitating the placement of endotracheal tube like retraction of angle of mouth or use of a stylet was recorded.

Time to intubation was measured from the time the laryngoscope blade starts entering the patient’s mouth till the appearance of square wave capnograph. A maximum of one minute time was allowed for laryngoscopy. If intubation is not achieved within one minute, laryngoscope blade was removed and mask ventilation was given for thirty seconds before the second attempt is allowed. A maximum of two attempts were allowed. The intubation time in such a situation was the sum of time taken in these attempts. In cases, where the patient cannot be intubated in the two attempts, the case was recorded as a failure and the airway was managed according to difficult airway protocol. In case, the spO\(_2\) fell to less than 92% any time during laryngoscopy, the attempt had to be aborted; the laryngoscope blades removed and mask ventilation given to patient using 3% sevoflurane in oxygen.

All the intubations were done with uncuffed endotracheal tube with Murphy’s eye. The correct position of the tracheal tube was confirmed by capnography and by auscultation for bilateral breath sounds. All the patients were monitored using ECG, Pulse oximetry, Capnography and NIBP throughout the anaesthesia procedure. At the end of the procedure and removal of tracheal tube all patients were transferred to the post operative recovery room. Any trauma in oral cavity or lips or blood on ETI was also recorded. A comparative analysis was done between Macintosh and Miller blades on the basis of observed laryngoscopic view and ease of intubation.

**Statistical Analysis**

It is a prospective randomized controlled study. The sample size was calculated on the basis of assumption as a good Laryngoscopic view (Grade 1 & 2A) can be obtained in at least 50% of the children of 1month to 2years of age and there is no difference in between Miller’s and Macintosh laryngoscope in context to the proportion of children (1month to 2years of age) having a good laryngoscopic view. Therefore, assuming precision of 10% with 95% confidence level, the minimum required sample size was calculated as 47 patients. To be conservative we enrolled 60 patients in the study who fulfilled the inclusion criteria randomized into two groups of 30 each for sequence of blade use. Cook's modification of Cormack and Lehane laryngoscopy grade was considered to be the primary outcome. Requirement of Optimal External Laryngeal Manipulation (OELM) and change in laryngoscopy grade if any, subjective ease of intubation by laryngoscopist as easy or difficult, time to intubate and manoeuvres used to facilitate intubation were recorded as secondary outcomes. For comparison between the two blades CL grade 1 and CL grade 2a were taken to be ‘Good Laryngoscopic view’. Any CL grade above CL 2a was taken to be ‘Poor Laryngoscopic view.’

The Data was collected and obtained results were analyzed using software Microsoft office Excel 2010 and Statistical package for social science (SPSS) statistical software 23.0 (SPSS Inc., Chicago, IL, USA). Percentages and proportions were calculated for each groups related to the demographic variables like age, weight and outcomes like time to intubation using Student’s unpaired t-test. Chi square test was applied to compare qualitative data in between the groups and to test for difference between proportions, i.e. comparison of gender distribution, laryngoscopic view, ease of intubation and
intubation attempts between both the groups. P value < 0.05 was considered statistically significant.

RESULTS

Sixty patients were included in study and randomly allocated to one of the two groups- MC and Group ML, comprising 30 patients each (Figure 1). All patients were subjected to laryngoscopy by both Miller and Macintosh blades. Intubation was achieved using Miller blade in group MC and Macintosh blade in group ML. Comparable pattern was seen in the demographic and physical characteristics of all 60 patients. There were relatively more male patients in group MC as compared to group ML (p value=0.020) (Table 1).

The distribution of CL grading of laryngoscopic view without OELM was noted (Table 2). OELM was used in patients who had CL grade 2a or more on laryngoscopy. OELM was used in 21 out of 60 (35%) laryngoscopies with Miller blade as compared to 30 out of 60 (50%) laryngoscopies with Macintosh blade (Table 3). 50 out of 60 (83%) laryngoscopies without OELM with Miller blade were ‘Good’ as compared to 40 out of 60 (66%) laryngoscopies without OELM with Macintosh blade. This difference was statistically significant between two blades (p=0.035) (Table 3). Application of OELM resulted in 58 out of 60 (96.67%) laryngoscopies as Good view with Miller blade as compared to 59 out of 60 (98.33%) laryngoscopies with Macintosh blade. The difference of CL grading as Good view (CL 1 and 2a) after application of OELM was statistically insignificant (p=0.559) (Table 3).

DISCUSSION

There are significant differences in anatomy of adult and paediatric airway which require modifications in laryngoscopy which includes the positioning of patient as well as modification in the equipment required for visualisation of larynx. The two most widely used laryngoscopy blades in small children are Macintosh curved blade and Miller straight blade. Previously, comparison of different blades have been done in adult population by Amornyotin S, Achen B, Asai T and Arino JJ.9-12 However Jones M et al., Varghese E, Y.Passi and Yadav P in their respective studies compare paediatric laryngoscope blades.7,13-15 Our study differs from these previous studies in terms of patient age, blades used and outcome variables (Table 4).
In our study, we compared the laryngeal views using a Miller or Macintosh blade in 60 infants and children 1 month to 2 years having American Society of Anaesthesiologists I or II status, planned for elective surgical procedures. Children less than 1 month were not included to avoid the two laryngoscopies required in our study and the associated hemodynamic and stress responses in neonates. Only the patients planned for elective surgeries were included as we did not want to stress the emergency cases with the study protocol. As our study protocol required two laryngoscopies, the patients requiring rapid sequence induction or those with high risk of aspiration were excluded. The crossover design for comparing laryngoscopy ensured that both groups were the same with respect to laryngoscopy and the view obtained by one blade could be compared to the view obtained with the other blade in each individual patient. However, ethically we did not wish to perform intubation twice in children, which requires removal of the first placed ETT to intubate again using second blade. Hence, intubation was performed only once during laryngoscopy with only the second blade.

The size of the head allows axes alignment without any pillow, therefore no pillow or head raise was used under the head but head was extended to achieve best view. Varghese E13 kept all children in neutral position at the time of laryngoscopy. Y. Passi14 did not mention initial position of head but laryngeal view was optimized by positioning the head. A Miller size 1 blade was used in all the children aged 1–24 months as recommended by Litman.16 A Macintosh size 1 blade was used in children aged 1–12 months and a size 2 Macintosh blade was used in infants aged 12–24 months.

In our study tips of both blades Miller and Macintosh were placed in the valleculae indirectly lifting epiglottis. The classic description for using the Miller blade is that the tip be placed posterior to the epiglottis. Miller had suggested that ‘if the operator desires it can be used to indirectly lift the epiglottis after the method of Macintosh’.17 Zauder HL has mentioned that he had observed pediatric anesthesiologist to use a straight blade in much the same manner as the Macintosh blade.18 However, many anesthesiologists considering the long floppy epiglottis, place the tip of the Miller blade beyond the epiglottis. This increases the chances of stimulating the vagus nerve causing laryngospasm, bronchospasm, bradycardia and it also increases the chances of trauma to larynx.18,19

The same laryngoscopist observed both laryngoscopic views with the Miller and Macintosh blades and assessed using Cook’s Modification of Cormack and Lehane (CL) grade.5 It is classified into grade 1, 2a/2b, 3a/3b, 4. Another scoring system for glottis view is the percentage of glottis opening (POGO) score.20 In the study conducted by Y Passi14 POGO score was used for comparison of laryngoscopic views with Miller and Macintosh blades. However it is best representative of only CL grades 1 and 2 and requires that glottis be photographed, which was not easily possible while using Macintosh laryngoscope. Benumof has highlighted the usefulness of the OELM in adult patients, with an improvement in the laryngoscopic grade.21 In this study OELM was performed by laryngoscopist if the grading was 2a or more and an improvement in laryngoscopy grading was noted. Also in previous study by Y. Passi14 external pressure was applied to the larynx until the best view was obtained but it has neither defined that when was OELM applied nor any comparison between the views obtained after OELM has been done. In study by Varghese E13 OELM was performed by the laryngoscopist if the grading was 2a or more and improvement in laryngoscopy was noted. We defined the time to intubation from the time of laryngoscope blade insertion into the patient’s mouth till the appearance of square wave capnogram. Varghese E15 had also compared time to first and second laryngoscopy and time for tracheal intubation but Y. Passi14 had made no such comparison in their study.

In our study out of 60 patients grade of laryngoscopy was similar with Miller and Macintosh blade in 51 (85%) patients. Varghese E13 showed that the laryngoscopic view was similar with both blades in 52/120 (43%) children and differed in the remaining 68 (57%) children. The difference between the results of our study and previous studies may be explained by the fact that the views obtained were optimal with both blades when head was kept in extended position in our study as compared to neutral position in study by Varghese E13.

Although the incidence of ‘good view’ laryngoscopy was similar in our study and Varghese E13 study using a Macintosh blade, we found a greater incidence of ‘good view’ Laryngoscopy (83% versus 65%) when we used Miller blade. But the difference of CL grading as Good view after application of OELM was statistically insignificant between two blades (p=0.559). The views provided by Varghese E14 are the best views i.e. after OELM if CL grade was 2a or more. No separate comparison between views before OELM and after OELM has been made by them.13 However comparative analysis of time to intubation, number of intubation attempts and ease of intubation yields no significant difference between Macintosh and Miller blades. This finding is consistent with the results of previous study.11

Our study had the limitation that the similar laryngoscopic views and ease of intubation achieved by using Miller and Macintosh blades may not be always be seen in patients with known difficult airways. Also as we had not sub-divided our study population in less than 1 year and more than 1 year, we cannot suggest the superiority of any particular blade in these subgroups.

**CONCLUSIONS**

Our study suggests that though Miller blade provides better laryngoscopic view as compared to Macintosh blade if OELM is not used, either Miller or Macintosh blade can be used with blade tips placed at the valleculae in infants and small children.
with similar laryngoscopic views and ease of intubation provided head is extended and OELM is applied.

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References


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