Original Article

Evaluation of performance of C-MAC® video laryngoscope Miller blade size zero for endotracheal intubation in preterm and ex-preterm infants: A retrospective analysis

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ABSTRACT

Background and Aims: The preterm and ex-preterm babies form a separate group among the paediatric population with unique airway anatomy. The utility of C-MAC® Video laryngoscope (VL) for routine intubation of preterm babies has not been evaluated. The purpose of this study is to report the performance of C-MAC® VL Miller blade size-0 for endotracheal intubation in preterm babies at our institute. **Methods:** After Institute Ethics Committee approval, a retrospective study was designed to evaluate the performance of C-MAC® VL for intubation in preterm and ex-preterm babies. The medical files, and video recordings of preterm babies up to 60 weeks of post-gestational age who had undergone surgery for retinopathy of prematurity from January 2014 to April 2016 were reviewed. All babies were intubated with C-MAC® Miller blade size-0. Demographic parameters, time to best glottic view (TTGV), time to intubate (TTI), ease and number of intubation attempts were assessed. Episodes of desaturation and complications related to intubation were recorded. **Results:** Data of 37 preterm and ex-preterm babies were analysed. The mean age and weight at the time of surgery were 40.5 (±4.9) weeks and 2532 (±879) grams respectively. The median TTGV and TTI were 11.0 and 22.0 seconds. A total of 32 babies (86.5%) were intubated on initial attempt and five were intubated on second attempt. Stylet was used to facilitate intubation in all infants. There was no incidence of desaturation, mucosal injury or bleeding. **Conclusion:** C-MAC video laryngoscope Miller blade size 0 is suitable for endotracheal intubation in preterm and ex-preterm infants.

Key words: Airway, devices, laryngoscopes, neonate

INTRODUCTION

The paediatric airway differs from adult airway in multiple ways requiring special equipment and expertise. Among the paediatric patients, preterm and ex-preterm babies form a separate group with unique airway anatomy. The respiratory and airway related complications are the major causes for perioperative mortality and morbidity.[1,2] Preterm and ex-preterm babies allow a very short apnoea time during induction of anaesthesia. Intubation should be quickly achieved within this narrow safety period. Low functional reserve capacity, high oxygen consumption, difficulty in mask ventilation and intubation are the factors affecting this safety margin.[3] Advent of pulse oximetry and capnography greatly reduced adverse events during induction of anaesthesia. Video laryngoscopes (VLs) are the further

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addition in the armamentarium in an effort to reduce complications during intubation.

Video laryngoscopes are gaining popularity among paediatric anaesthesiologist for its usefulness in difficult intubation. Hackell *et al.* reported successful intubation in seven infants including two ex-preterm babies with C -MAC® VL after failure of direct laryngoscopy.[4] However, the use of VLs for intubation of preterm babies is not well defined. The recent meta-analysis that compared video laryngoscopes with direct laryngoscope in paediatric intubation excluded neonates.[5] Similarly, most of the published studies on VLs in paediatric population excluded preterm babies. This could be due to non-availability of appropriate size VL, physiological and anatomical uniqueness of preterm babies from the rest of the paediatric age groups and for safety issues. Among the available VLs, C-MAC® VL with Miller blade size 0 is appropriately designed for new born.[6] We have been using C-MAC® VLs for routine intubation of preterm and ex-preterm babies coming for retinopathy of prematurity surgery (ROP). We report here our institutional experience in intubating preterm and ex-preterm babies with C-MAC® VL Miller blade size-0.

METHODS

After Institute Ethics Committee approval and registration at Clinical trial registry of India, a retrospective study was designed. The study was conducted by analysing medical records; anaesthesia charts and video recordings of preterm and ex-preterm babies who underwent C-MAC® VL guided intubation. Preterm babies of post gestational age up to 60 weeks posted for retinopathy of prematurity (ROP) were included for the analysis. The study period was from January 2014 to April 2016.

Anaesthesia management and all intubations were done by one of the two-paediatric anaesthesiologists (first and second author). Anaesthesia was induced by incremental increase in dial concentration of sevoflurane in 100% Oxygen. After securing intravenous cannula, atracurium 0.5 mg/kg was used for muscle relaxation. After three minutes of mask ventilation, endotracheal intubation was attempted with appropriate sized, uncuffed endotracheal tube (ETT). C-MAC® VL Miller blade size-0 (Karl Storz GmbH and Co. KG, Tuttlingen, Germany), was inserted from the right angle of the mouth and tongue was displaced towards left side and tip of the blade was positioned in the vallecula to visualise the glottis. The shoulder roll was used for optimal positioning in all infants. An assistant from right side retracted the cheek to create adequate space to insert ETT in all cases. External laryngeal manoeuvre was applied only if required after assessing the glottic view on C-MAC screen. Anaesthesiologist in sitting position performed all intubations.

Gestational age, weight at birth and at the time of surgery were recorded. First three authors of the study analysed video recording of all intubations and their average was taken as final parameter. From the video recordings, the time for best glottic view, time for intubation, Percentage of glottic opening (POGO) score, number of attempts for successful intubation and ease of intubation were noted. Time for glottic view was counted from the insertion of C-MAC® blade at the level of lips till to achieve best possible glottic view. Time for intubation was defined as time from insertion of C-MAC® blade at the level of lips till the endotracheal tube crosses vocal cords. The POGO score represents the percentage of glottic opening visualised from the anterior commissure to inter arytenoid notch. POGO score 100% represents a full glottic view from anterior commissure to inter arytenoid notch. A POGO score of zero means, even the inter arytenoid notch was not seen.[7] Ease of intubation was graded on a scale of 5, grade 1 means simple and grade 5 indicates maximum difficulty in intubation. Injury or bleeding from mucosa while intubation was also recorded from the video. Any desaturation episode- SpO_2 less than 90% during intubation process was noted from anaesthesia records.

Data was analysed by statistical software STATA 14.0. Quantitative data expressed as mean (SD) and median (min-max). The categorical data was expressed as frequency and percentage. Correlation between 2 variables was estimated by Pearson/Spearman correlation coefficient. $P < 0.05$ was considered as statistically significant.

RESULTS

Data of 37 preterm and ex-preterm babies were retrieved and analysed [Table 1]. Mean age and weight at birth were 29.1 (±2.5) weeks and 1248 (±327) grams respectively. The mean post-gestational age (PGA) and weight at the time of surgery were 40.5 (±4.9) weeks and 2532 (±879) grams respectively. The median time for best glottic view and time to intubate were

11 seconds and 22 seconds respectively [Table 2]. The time for best glottic view in our study was 50% of the total time required to intubate (11 out of 22 seconds). A total of 32 babies (86.5%) were intubated on initial attempt and five were successfully intubated on second attempt. The glottic view assessed by POGO score and the ease of intubation is charted in Table 3. The common view of glottis as assessed by POGO score was 3 and 4 (72.9%). There were no episodes of desaturation, mucosal injury or bleeding in any of the intubation attempts. The correlation coefficient for post-gestational age and time to intubate was 0.3 (two tailed significance- 0.07). Similarly, no correlation was found between weight at the time of surgery and intubation time (correlation coefficient – 0.28, two tailed significance- 0.09).

DISCUSSION

In the present study, intubation with C-MAC® Miller blade size 0 was possible in all patients at first [32 (86.5%)] or second [5 (13.5%)] attempt. Induction followed by securing a definitive airway is a crucial period in the perioperative management of preterm babies. They allow minimum apnoea time because of high oxygen consumption and immature lung.[3] Moreover, these babies will be frequently receiving some respiratory support in the form of CPAP in pre-operative period. All these demands laryngoscopy and intubation in a minimum possible time. Failed or multiple intubation attempts can lead to rapid desaturation and a high airway morbidity in this age group.

Table 1: Demographic parameters

	Mean	SD	Minimum-Maximum
Age at Birth (weeks)	29.1	2.5	25-34
Age at Surgery (weeks)	40.5	4.9	33-55
Birth weight (g)	1248	327	850-2200
Weight at surgery (g)	2532	879	1100-5000

Table 2: Time to best glottic view (TTGV) and Time to intubate (TTI)

	Median	Percentiles (25^{th}, 75^{th})	Minimum-Maximum
Time to Best Glottic View (sec)	11	7.5, 13	5-43
Time to intubate (sec)	22	18.5, 25.5	16-85

There are previous studies comparing intubation with direct laryngoscope and video laryngoscope in paediatric age group. But there was wide variation in the type and design of VLs used in those studies. Furthermore most of the studies excluded neonates especially preterm babies.[5] Studies on intubation in neonates were mainly done in neonatal ICU or labour ward where neonatologists performed intubation.[8,9] The present study is first of its type, highlighting time and success of intubation in preterm babies with C-MAC® Miller blade. In this study, youngest infant was of 33 weeks post gestational age with weight of 1100 grams.

In the present study, two-experienced paediatric anaesthesiologists performed all intubations. Despite the retrospective nature of the study, we were able to retrieve all relevant information of time and success of intubation with the help of saved video recordings and anaesthesia chart.

The median intubation time in the present study was 22 seconds, which closely correlate with the recommended 20 seconds for an attempt by the Neonatal resuscitation council.[10] O'Donnell *et al.* analysed 31 neonates with mean PGA and weight of 28 weeks and 1227 grams admitted in NICU and found that the mean duration of successful intubation with direct laryngoscopy by consultants, paediatric fellows and residents were 25, 32 and 51 seconds respectively.[11] Their study concluded that intubation times are often prolonged beyond 20 seconds limit fixed by neonatal resuscitation council even if done by experienced consultants. Intubation time by consultants in O'Donnell study coincides with the present study (25 vs 22 seconds).

A recent meta-analysis on paediatric video laryngoscopy vs. direct laryngoscopy concluded that video laryngoscopy improved glottic visualisation but the total intubation time was prolonged by 4.9 seconds compared to direct laryngoscopy.[12] Subgroup analysis in neonates and infants suggested that VL lead to prolongation of intubation time (3.3 sec, 95% CI: 1.6-4.9 sec). In this meta-analysis, different types of VL were compared and Storz DCI miller blade was

Table 3: Number of attempt, POGO score and Ease of intubation

	Attempt		Percentage of glottic opening (POGO) Score					Ease of intubation				
	1	2	0	1 (1-25%)	2 (>25-50%)	3 (>50-75%)	4 (>75-100%)	1	2	3	4	5
Number (*n*)	32	5	0	3	15	12	7	17	10	5	5	0
Percentage (%)	86.5	13.5	0	8.1	40.5	32.4	18.9	46	27	13.5	13.5	0

used only in one study in children below 4 yrs.[13] Total time to intubate with VL varied widely with the type of VL used and anaesthesiologist experience with that particular VL.[12] C-MAC® Miller blade was designed on the basis of conventional Miller straight blade. It is made of metal alloy accounting for its lightweight and robustness. Edges are rounded and blunt to prevent mucosal injury during intubation. It has low blade height, thereby creating adequate space to insert and manipulate the ETT. The camera is located close to the tip and hence it provides a wide and magnified view.[6,14] This helps in easy identification of small glottic structures in neonates. The learning curve of C-MAC® VL is also steep due to the familiarity of the blade.[6] It also provides a good quality image with the homogenous illuminated oropharynx without any fogging of laryngoscope camera with real time recording facility of video and still images. Likewise other VLs, external laryngeal manoeuvre by the assistant can be adjusted by visualising C-MAC® screen. Moreover, endotracheal intubation confirmation can be done real time by visualising entry of tube through glottis as many times the end tidal carbon dioxide trace was not obvious in preterm due to low tidal volume and leak around the tube.

There are many factors, which can affect success and time of intubation like awake intubation, intubation without muscle relaxant, position during intubation, anaesthesiologist experience, and technique of intubation. In our study, muscle relaxant was used to obtain adequate intubation condition without straining which is the main factor for increased intraocular and intracranial pressure. Authors have a good experience with C-MAC® VL for paediatric intubation, which may be the reason for no incidence of complications in our study.

In our study considerable time was spent to get the best glottic view (50% of total intubation time). This signifies that for successful and quick intubation without trauma, enough time should be spent to obtain a good glottic view before attempting to pass endotracheal tube in preterm babies. We analysed our data to evaluate whether intubation time was prolonged in babies with younger age and lower weight. But no correlation was found between post gestational age or weight with the total time taken to intubate.

Only 3 patients in our study had a POGO score less than 25%. Poor glottic view can be attributed to long floppy epiglottis falling over anterior portion of the vocal cords as the epiglottis was not lifted directly with Miller blade.[15]

A total of five out of 37 (13.5%) babies required second attempt for intubation. The same anaesthesiologist who performed the first one made all second intubation attempts. Two babies required second attempt because of inappropriate endotracheal tube size selection. They were intubated with smaller size tube without any difficulty. In both cases 3.5 mm ID ETT could not be negotiated beyond vocal cords. Mask ventilation was done in between and then intubated with 3 mm ID ETT without any difficulty. In three babies, there was difficulty in guiding ETT through the glottis as it was passing posterior to arytenoids. In those cases, shape of the stylet was modified to increase the anterior curvature of the ETT. One out of 37 children required ETT change due to significant leak around the tube. A 2.5 mm ID uncuffed ETT was changed to 3 mm ID uncuffed ETT.

There are few limitations in our study mainly because of the retrospective nature where size selection of ETT, shape of the stylet, maximum time allowed for first attempt was not standardised. The study results should not be extrapolated to novice anaesthesia trainees as trained paediatric anaesthesiologists did all intubations in our study. Similarly, our study findings should be cautiously extrapolated to extremely preterm babies less than 28 weeks PGA as smallest baby in our analysis was 33 weeks PGA.

CONCLUSION

In conclusion, C-MAC video laryngoscope Miller blade size 0 is suitable for intubation of preterm neonates. However, further prospective studies are required to corroborate our findings and recognise possible complications.

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Nil.

Conflicts of interest
There are no conflicts of interest.

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