Original Research Paper

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COMPARISON OF PAEDIATRIC C-MAC VIDEO LARYNGOSCOPE WITH MILLER LARYNGOSCOPE FOR ENDOTRACHEL INTUBATION IN PAEDIATRIC PATIENTS POSTED FOR ELECTIVE SURGERY UNDER GENERAL ANAESTHESIA

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ABSTRACT **Background:** Rapid desaturation is an impediment to managing the paediatric airway, thus emphasising the need for optimal intubating conditions. This study aims to compare the conventional straight blade Miller laryngoscope with the C-Mac Video laryngoscope for the ease of intubation in paediatric patients undergoing General endotracheal anaesthesia. **Aim :** To determine the ease of intubation in terms of glottic view by modified Cormack Lehane Grade (MCLG), number of attempts, time taken for intubation and external laryngeal manipulation required for optimal view. **Methods:** In this study sixty children aged 2-8 years undergoing surgery under general anaesthesia were randomly allocated into two groups. After induction with Sevoflurane and Inj.Succinylcholine, laryngoscopy was done with either Miller size 2 (Group ML) or Paediatric C-MAC laryngoscope (Group CM). MCLG, number of attempts, time taken, requirement of ELM and complications of intubation were recorded. Data were compared by Mean ± Standard deviation, Chi-square test and ANOVA using SPSS version 20. P- value of <0.05 was considered significant. **Results:** MCLG was statistically significant (P=0.001) with better visualisation in the Group CM. Time taken to secure the airway was statistically lower with a mean of 25.17 ± 2.08s in Group CM and 29.67 ± 2.66s in group ML (P <0.001). Requirement of ELM was found to be higher with 43.3% in Group ML and only 6.6% in Group CM (P<0.001), whereas no significant difference was found for number of attempts at intubation between the groups. **Conclusion:** Paediatric C-MAC produces more desirable intubating conditions than Miller blade laryngoscope.

KEYWORDS : Intubation, CMAC, Millers

INTRODUCTION

Quicker onset of hypoxia and bradycardia leading to rapid deterioration are particularly bothersome in the peri-operative management of a child. Minimising the snags attributable to unanticipated difficulties in intubating conditions is quintessential. Since paediatric airway has noteworthy structural differences, it cannot be considered as a mere duplication of adult airway [(1)]. Alternative transcutaneous approaches to the airway being more complex, owing to anatomical differences, its strongly discouraged in children less than 10 years of age [(2)]. It becomes imperative to tackle the large omega shaped epiglottis in children. Precedence to Miller laryngoscope addresses this aspect by directly lifting the epiglottis [(3)].

However, the better views offered in adults, by C-MAC - a video laryngoscope [(4)], paves way to analyse and compare with conventional straight blade in optimising the laryngoscopic conditions in paediatric patients. To our knowledge there are no other studies comparing Miller conventional laryngoscope with paediatric C-MAC video laryngoscope. Through this study, we intend to establish the superiority between the two, in paediatric patients in the age group of 2-8 years for laryngoscopy and intubation.

Aim

To compare the Paediatric C-MAC size 2 video laryngoscope with Miller size 2 conventional laryngoscope for laryngoscopy and intubation in paediatric patients posted for elective surgery under general endotracheal anaesthesia with

Primary Objective

Glottic view by Modified Cormack Lehane grading.

Secondary Objectives

1. The number of attempts taken for intubation.
2. To measure the time duration required for successful intubation.
3. Requirement of external laryngeal manipulation (ELM).
4. Incidence of adverse events diagnosed and documented immediately after endotracheal intubation viz., desaturation, esophageal intubation, violations of the teeth and injury to soft tissue, pharynx, larynx, aspiration and regurgitation.

MATERIALS AND METHODS

Paediatric patients of American Society of Anaesthesiologists physical status (ASA PS) Class I & II, scheduled to undergo surgeries requiring general anaesthesia and endotracheal intubation, fulfilling the inclusion criteria at a tertiary care hospital, were enrolled into this study. This prospective, comparative, randomised, single- blind, parallel group study was conducted from November 2018- July 2020.

Inclusion Criteria

- ASA physical status I and II patients of either sex.
- Age 2-8 years

Exclusion Criteria

- Parental refusal for the procedure.
- Oropharyngeal anomalies and anticipated difficult airway.
- Any signs of respiratory tract infections.

Following approval from the Institutional Ethical Committee and CTRI registration done (CTRI/2021/02/031441), informed consent was taken from parent/guardian of the 60 subjects satisfying the inclusion criteria. They were randomly allocated into 2 groups of 30 patients in each, by shuffled sealed opaque envelope method.

1. Group ML (n=30) :- Miller laryngoscope (Size 2) was used for intubation.
2. Group VL (n=30) :- C-MAC video laryngoscope (Size 2 Macintosh blade - Karl Storz) was used for intubation.

Preoperatively, child's detailed birth history, family history and previous medical or surgical history were recorded and detailed local and systemic examination were done.

On the day of surgery, 1 hour prior to the procedure, Eutectic mixture of local anaesthetics (EMLA) cream was applied with occlusive dressing over the dorsum of the left hand for Intravenous (IV) access. The operation theatre was readied with appropriate airway equipment, anaesthetic and emergency drugs and thorough machine and monitor check. Pre-medication was given with 0.5mg/kg body weight of Midazolam orally 1 hour before induction. The sedated child was taken into the operation theatre and standard monitoring devices attached, including noninvasive arterial blood pressure, ECG and oxygen saturation probe and baseline readings were recorded. Induction with Sevoflurane in gradually increasing concentration upto 6% in 100% oxygen using appropriate size face mask and Jackson Rees modification of Ayres t-piece was done. Once the eye lash reflex was lost, IV access was secured using 22G IV cannula and pre-medicated with IV Inj.Ondansetron 0.1mg/kg and Inj. Fentanyl 1.5mcg/kg. Neuromuscular blockade was achieved by Inj.Succinylcholine 1.5mg/kg body weight, to facilitate intubation.

The patient was supported on a firm pillow or shoulder roll to achieve the Jackson's position. Laryngoscopy was done after 1 minute by an experienced single Anaesthesiologist either with Paediatric C-MAC video laryngoscope or Miller blade and parameters such as glottic view assessed by Modified Cormack Lehane grading (MCLG), number of attempts and time taken for intubation (Stop watch) were recorded. In case of modified CL grade of more than 2a, external laryngeal manipulation (ELM) was applied by the assistant in consonance with

the monitor display of larynx or instructions from the intubating anaesthesiologist. The complications during intubation were recorded.

1. Miller Direct laryngoscopy: The laryngoscope blade was introduced from the right angle of the mouth, sweeping the tongue to the left of the flange. The blade was advanced in a midline approach. The tip of the blade was placed beyond the epiglottis and a 45^0 lifting force applied to expose the glottic opening. Then, an endotracheal tube was inserted.
2. C-MAC video laryngoscopy: The laryngoscope blade was introduced in the midline of the oral cavity without displacing the tongue, then advanced beyond the tongue base until the blade reached the vallecula, or a position posterior to the epiglottis. The glottic opening was exposed, an endotracheal tube was inserted.

After intubation, the child was maintained under balanced anaesthesia till the completion of the surgery. Later, was reversed, extubated and shifted to the post anaesthesia care unit for observation.

Study Assessments Of End Points:

1) Glottic view was assessed by using: Modified Cormack and Lehane grading: [5]
   Grade I: Visualisation of entire vocal cords. Grade IIa: Partial view of the glottis
   Grade IIb: Arytenoids or posterior part of the vocal cords only just visible Grade III: Visualisation of epiglottis
   Grade IV: No glottic structure seen
2) Time required for successful intubation, defined as total time in seconds from the first insertion of the laryngoscope blade into the mouth, until final confirmation of ETT placement by capnography.
3) The number of attempts for intubation defined as withdrawing the laryngoscope to the angle of the mouth and reintroducing it.
4) Experienced Anaesthesiologist: An experienced anaesthesiologist was defined as one, who has performed more than 25 laryngoscopies with C- MAC Video laryngoscope and Miller laryngoscopes.
5) Failed intubation: If laryngoscopy and intubation could not be done with Miller or Macintosh laryngoscope in the respective group then C-MAC video laryngoscope or fiber optic bronchoscope was used to intubate the child and such children were excluded from the study.

Statistical Analyses: For sample size calculation we used Cochran's formula, $n=Z^2pq/d^2$,

- n=Sample size
- Z=Standard score
- p=Prevalence
- q=(1-p)
- D d=Precision limit

n= (1.96x1.96x0.04x0.94) / (0.05x0.05) = 57 (Accepted to 60 considering the number of dropouts)
With confidence interval 95%
Descriptive statistics of demographics, time taken for intubation were expressed in terms of mean ± Standard deviation.

RESULTS

Statistically there was no significant difference in the patients characteristics such as age, gender or ASA grading between the two groups.

Table 01

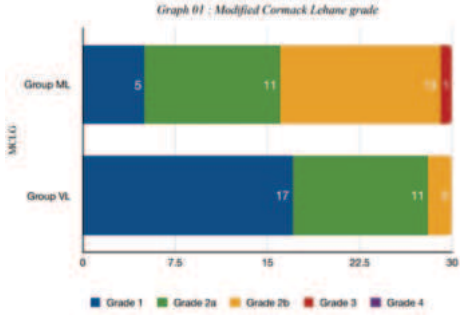
Sl no.	Variables	Group ML	Group VL	p value
01	Age (years) *	5.03±2.07	4.6±2.06	0.149
02	Gender (M/F) ‡	28/2	23/7	0.067
03	Weight (Kgs) *	14.8±2.9	14.5±2.9	0.236
04	ASA Grade (1/2) ‡	29/1	27/3	0.585
05	Modified CL Grade (1/2a/2b/3/4) ‡	5/11/13/1/0	17/11/2/0/0	0.001
06	Time for successful intubation (s) *	29.67±2.66	25.17±2.08	<0.001
07	External laryngeal pressure(Yes/No) %	43.3/56.6	6.6/93.3	<0.001
08	Complications	Nil	Nil	

* Data presented as Mean±SD

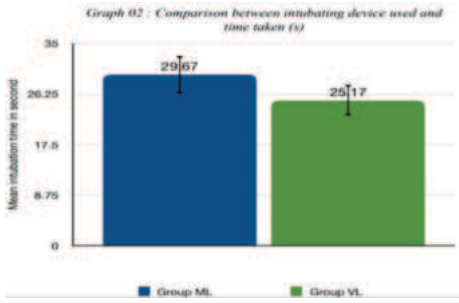
‡ Data presented as number of patients

% Data presented as percentage

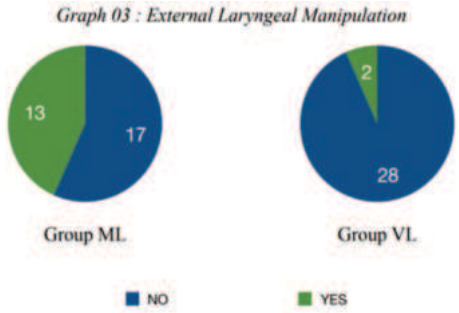
In our study we observed that modified CL grade was better with C-MAC video laryngoscope with 56.7% of grade 1, 36.7% of grade 2a and 6.7% grade 2b when compared to Miller laryngoscope showing 16.7% grade 1, 36.7% grade 2a, 43.3% grade 2b and 3.3% grade 3 with significant p-value 0.001.



All the patients in both the groups were intubated in first attempt without any incidences of adverse effects. Time taken for intubation in by C-MAC laryngoscope was 25.17±2.08 whereas it was 29.67±2.66 by Miller laryngoscope which is statistically highly significant (p<0.001).



In C-MAC laryngoscope group only 6.6% of the patients required External laryngeal manipulation when compared to Miller laryngoscope group 43.3% requiring ELM which is statistically significant with p<0.00.



No complications where noted in both the groups.

DISCUSSION

Smooth intubation is an important factor for successful paediatric anaesthesia. The conspicuous differences from the adult airway and physiology make the paediatric population more vulnerable to magnification of otherwise minor hitches in airway management.

Glottic View

Various scoring systems have been devised to classify glottis visualisation. Modified CL grade and percentage of glottis opening (POGO) are the commonly used scoring systems for glottis visualisation. The change in trend of difficulty in intubation across various age groups, has prompted the wide acceptance of MCLG. Due to its greater sensitivity and simplicity, POGO score has been popular in various studies for glottic visualisation. Even so, MCLG 3b and 4 would be considered as POGO 0%, thus only quantifying the laryngeal exposure but offering no discriminating information. Many authors have considered MCLG score in their studies, for glottic visualisation. [6,7,8,9,10,11,12] To ensure uniformity regarding the scoring of the glottic view, MCLG was considered and chosen in our study.

In our study, Miller laryngoscope showed MCLG 1 in 16.7% and 2(a+b) in 80% of the subjects which was comparable with the study by

M. Wojewodzka-Zelezniakowicz et al [13] in which 10.5% had CLG 1 and 60.5% had CLG 2 in paediatric manikins using 2 size miller blade.

C-MAC group in our study showed 56.6% of MCLG 1 and 43.3% of MCLG 2(a+b)

which is comparable to the study by Chandrashekariah et al, [14] in which 56.7%, 36.7% and 6.7% subjects showed CLG of 1, 2 and 3 respectively.

Number of Attempts

The number of attempts at intubation is a critical factor owing to multiple reasons. Attempts at laryngoscopy may lead to oral trauma, raised vagal tone resulting in bradycardia or even laryngospasm. They also augment the time duration for laryngoscopy, during which the patient neither receives oxygen nor ventilation, thus prolonging the intubation time. This is especially climacteric in paediatric patients.

All the patients in our study were successfully intubated in the first attempt itself, in consonance with a study by Weiss et al, [9] who noted successful intubation in the first attempt in all patients of age less than 10 years.

Time Taken For Intubation

Apnoea time could be prolonged by upto 168 seconds by de-nitrogenation for 3 minutes in the paediatric age group of 1-8 years. [15] However, this may not hold good in case of emergency and rapid sequence intubation (RSI) where desaturation can be detrimental. Therefore, appropriate mode of laryngoscopy to reduce the intubation time may require more comprehensive research under these settings.

In our study, the time taken for intubation with Miller blade (29.67 ±2.6s) was 4.5 seconds higher than C-MAC (25.17±2.08s). While intubating using C-MAC, there is a possibility for the endotracheal tube (ETT) to get caught on the anterior wall of the trachea. The smallest manoeuvres on the ETT translate to exponential movements on the screen owing to the distal location of camera and light source, thus leading to a magnified view of glottis. This makes the manipulation of the ETT challenging, thus increasing the time taken for intubation. It can nevertheless be subjugated with practice. Though the view is better with video laryngoscope, the intubation may be comparatively difficult because of obligatory better hand eye co-ordination. [16]

Confirmation of tube placement with C-MAC may not mandate capnographic evidence, owing to direct validation of tube position on the screen. This not only reduces the time taken, but also mitigates the possibility of observer bias at tube placement.

External Laryngeal Manipulation (ELM)

ELM was required in 6.6% patients with C-MAC, while it was 43.3% with Miller. This was highly significant with p value of <0.001. Very few studies have emerged comparing ELM in the paediatric population.

C-MAC not only minimises the requirement of ELM, but also enables effective ELM. When the airway assistant can self-assess from the glottic view on the screen, the requirement of complex instructions and increased time to deliver appropriate ELM can be optimised.

None of the patients in our study required alternate technique for intubation. Video laryngoscopes have been popularly used as rescue devices for difficult airway situations. Many studies have provided evidence for improvement in glottis visualisation with video laryngoscopes, like Piepho et al,[17] where 72 out of 1151 patients had CLG of 3 or more on direct laryngoscopy, which improved significantly with C-MAC video laryngoscope ($p<0.001$). Considering the strong resemblance of the C-MAC to Macintosh laryngoscope, the similarity and ease of its use makes it conducive for preference. The learning curve may also be influenced by it. It may also be an ideal tool for training purposes, where real-time, objective visualisation can enable the trainee to be instructed and educated more effectively.

In our study, C-MAC appeared to be a more prudent instrument of choice for paediatric intubation in comparison with Miller laryngoscopes.

Limitations

1. Observer blinding was not possible owing to the different laryngoscopes used for the study.
2. More comprehensive classification to grade the glottic visualisation, to minimise subjective errors could have been included.
3. We have studied in the age group 2-8 years. A study could have been conducted considering children less than 2 years of age, attributing to their aberrant airway anatomy.
4. Comparison could have included Miller video laryngoscope or conventional Macintosh laryngoscope as well.

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