A randomised trial to compare Truview PCD®, C-MAC® and Macintosh laryngoscopes in paediatric airway management

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Abstract

Aim: To evaluate and compare the Truview PCD and C-MAC laryngoscopes to the standard Macintosh laryngoscope in paediatric patients.

Methods: One hundred and fifty ASA I-II patients in the age group of 1–6 years (10–20 kg) scheduled for elective surgery were randomised into three equal groups for laryngoscopy and intubation with either Truview PCD (Group T), C-MAC (Group C) or Macintosh (Group M) laryngoscopes under general anaesthesia. Percentage of glottic opening (POGO) score, application of external laryngeal manoeuvre, time to intubation, number of attempts at intubation, failed intubations, episodes of desaturation and trauma caused were recorded and statistically analysed. A p value of <0.05 was taken as significant.

Results: POGO scores were significantly better with Truview PCD as compared with C-MAC and Macintosh laryngoscopes (94.7 ± 12.9/82 ± 25.0/85.1 ± 17.1; p < 0.01). There were no failed attempts, episodes of desaturation or trauma in any of the patients. The mean intubation time taken was 19.2 s in group T, 12.3 s in group C and 10.7 s in group M, respectively. There is a statistically significant difference among groups (p < 0.01). Eight patients in group T, 21 out of 50 patients in group C and 19 out of 50 patients in group M needed OELM, respectively. There is significant difference among the groups (p < 0.01).

Conclusion: Using Truview PCD to assist intubation offers excellent view field of glottic opening after OELM and the mean time taken is less than 20 s. The Truview PCD tool is suitable for paediatric patients.

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1. Introduction

Paediatric airway management requires careful clinical evaluation and experienced execution due to anatomical, physiological and developmental considerations. Prediction of difficult airway is not always possible in a child as measurement of mentohyoid, thyromental, mandibular and inter-incisor lengths are not validated. A plethora of airway devices have flooded the market to overcome the inadequacy of difficult airway prediction in children.

The Truview Picture Capture Device (PCD) blade is based on a combination of an optical system with a specially profiled slim steel blade. The optical apparatus provides a 48° angled deflection view through a 15-mm eyepiece. The eyepiece can be connected to the Picture Capture Device (PCD). In addition, the Truview PCD blade has a port that connects to the auxiliary oxygen flow of the anaesthesia machine (flow rate of 4–6 l min⁻¹), which prevents misting and clears secretions from the lens and provides continuous oxygen insufflation during intubation. Truview EVO2® has been shown to have distinct advantages over the conventional Macintosh (M) blade in adults1,2 and provides a better view of the glottis as compared to the Miller blade in infants and children.3

Shaped and handled like the conventional Macintosh blade, the C-MAC laryngoscope provides an 80° field of view and the image can be captured electronically in the video or in still format and displayed on the dedicated monitor.4 The C-MAC laryngoscope has been proved to provide an equal if not better view of the glottis with less trauma as compared to the conventional Macintosh blade in adults.5

Although the Truview PCD and C-MAC videolaryngoscopes have been compared with Macintosh laryngoscope in infants, to the best of knowledge there are no reports of such a comparison in older paediatric population. We have therefore designed this study to evaluate and compare the laryngeal view provided by two videolaryngoscopes to the standard Macintosh laryngoscope in paediatric patients.
2. Methods

After approval from the Institutional Ethical Committee, 150 ASA physical status I–II patients in the age group of 1–6 years (10–20 kg) scheduled for elective surgery at Kalawati Saran Children’s Hospital and Srimati Sucheta Kripiani Hospital, New Delhi, India, requiring general anaesthesia and endotracheal intubation were recruited for the study between March 2012 and September 2013. The patients were randomised into three equal groups: Group T – to be intubated using Truview PCD (size 2), Group C – to be intubated with C-MAC laryngoscope (size 2) and Group M – to be intubated with the aid of Macintosh (size 2) laryngoscope. The random numbers were delivered to the operating room in sealed opaque envelopes and the laryngoscope used was decided at the time of induction of anaesthesia. Patients with an ASA physical status grade > II, presence of raised intracranial pressure, high risk for pulmonary aspiration of gastric contents; coagulopathy and presence of any pathology of head and neck were excluded.

After a thorough pre-anaesthetic assessment, fasting as per ASA guidelines and a written informed consent from parents/guardian, the patient was wheeled into the operating room and routine monitors applied. Patients received fentanyl 2 μg kg⁻¹ for analgesia and anaesthesia was induced by propofol 2 mg kg⁻¹. Ventilation was maintained by N₂O in O₂ (60:40) and sevoflurane 1–2% by bag and mask. Neuromuscular blockade was facilitated by rocuronium bromide 0.9 mg kg⁻¹ and anaesthesia was induced by propofol 2 mg kg⁻¹.

Kumar) with a previous experience of at least twenty intubations were performed by the senior anaesthesiologists (Dr. Singh and Dr. Kumar) with a previous experience of at least twenty intubations. POGO after application of OELM was also noted. The time to intubation was measured from the time the laryngoscope entered the patient’s mouth until the time it was taken out after the placement of endotracheal tube in the trachea. If a tube change was deemed necessary, the time taken for the placement of only the first tube inside the trachea was noted. The number of attempts was defined as withdrawing the tube to the angle of the mouth and reintroducing it. Any fall in oxygen saturation to <95% on the pulse oximeter was noted and the lungs were ventilated with 100% oxygen. If more than three attempts or >60 s were required after combined attempts to secure an endotracheal tube, it was considered as failed intubation. Oesophageal intubation if any was also noted. The trauma caused during laryngoscopy and need for external manoeuvres were also noted. Trauma was defined as any bleeding or abrasion on the lips, gums and angle of mouth of the child or blood on the laryngoscope blade after intubation. Apart from the POGO score, all data were noted by an independent observer not involved in the study. The statistician was also blinded to the allocation of the groups.

3. Statistical analysis

POGO score was taken as the primary outcome. Sample size was calculated after a pilot study to detect a difference of at least 25% in the POGO scores between the three groups using a commercial statistical software (Medcalc software version 9.2.10, Mariakerke, Belgium) with an α error of 0.05 to achieve a power of 0.8. A p value of <0.05 was considered to indicate statistical significance. Data is presented as mean or median with range or standard deviation (SD) as appropriate.

The ANOVA test was used to compare the time taken to intubate and POGO score. Bonferroni/Tamhane’s T2 correction was applied for intergroup analysis. Number of attempts required for intubation was analysed using Kruskal Wallis test. The incidence of failed intubations, number of episodes of desaturation, trauma caused and need for external manoeuvres was compared using the Chi square test.

4. Results

Patient characteristics are described in Table 1. Data for all 150 patients was analysed. POGO scores were significantly better with Truview PCD as compared to C-MAC and Macintosh laryngoscopes (94.7 ± 12.9%/82 ± 25.0%/85.1 ± 17.1%; p < 0.01). There were no oesophageal intubations, failed attempts, episodes of desaturation or trauma in any of the patients. The mean intubation time taken was 19.2 s in group T, 12.3 s in group C and 10.7 s in group M, respectively. There is a statistically significant difference among groups (p < 0.01). Using Truview PCD provided an excellent view of glottic opening; there is a significant difference of POGO exposure in the group T and group C and group M. In addition, 8 patients in group T (16%), 21 out of 50 patients in group C (42%) and 19 out of 50 patients in group M (38%) needed OELM, respectively. There is significant difference among the groups (p < 0.01). However, group T patients may spend more time for intubation than the group C and group M. The mean POGO scores after OELM were 100% in group T and M as compared to 97.1% in group C. Laryngoscopy and intubation parameters are depicted in Table 2.

5. Discussion

We found that the glottic view (POGO score) was clinically and statistically better with Truview PCD as compared to C-MAC and Macintosh laryngoscopes and fewer patients in the Truview PCD group required OELM to improve the view. However the time taken to intubate the trachea was more as compared to the C-MAC and Macintosh laryngoscopes, which was statistically significant (7–9 s more with Truview PCD). The C-MAC and Macintosh laryngoscopes

<table>
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<tr>
<th>Table 1</th>
<th>Patient characteristics (values expressed as mean ± standard deviation).</th>
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<tr>
<td></td>
<td><strong>Group T (n = 50)</strong></td>
</tr>
<tr>
<td>Sex</td>
<td>Female (32%)</td>
</tr>
<tr>
<td></td>
<td>Male (68%)</td>
</tr>
<tr>
<td>Age</td>
<td>Years 3.8 ± 2.0</td>
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<tr>
<td>Weight</td>
<td>kg 14.7 ± 3.9</td>
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The user satisfaction score was lowest with the Truview EVO2® fi 26 s). However, time taken for intubation was much longer in all although it has a built-in camera, the angle of the curvature is same like the conventional Macintosh laryngoscope which the anaesthesiologist with C-MAC and Macintosh was also comparable. C-MAC is shaped like the Macintosh in our study was the same. The time taken for intubation was thus difficult of intubation with the Truview EVO2® because of unfamiliarity with the instrument.15

Riveros et al, however, found that videolaryngoscopes such as Truview PCD and Glidescope do not improve the view as compared to conventional laryngoscopy in children. Also, the time taken was more with Truview PCD as compared to conventional laryngoscopy (44 vs 23 s).16

The basic difference in the use of direct and indirect laryngoscopes lies in the fact that although the view of the cords is much better with the indirect laryngoscopes, intubation is considered comparatively difficult. While direct laryngoscopy provides a real image of the cords by actually aligning the laryngeal axis with the line of the view, indirect laryngoscopes create a virtual image of the cords that is captured by the camera. Achieving endotracheal intubation is thus difficult because better hand-eye co-ordination is required for the parallax to be countered. The Truview PCD is thus supplied with an optisheath® preformed stylet which is designed to nullify the parallax created by the laryngoscopic image and directs the endotracheal tube towards the vocal cords. The use of the stylet and a learning curve for better hand-eye coordination may explain the longer time required for intubation with the Truview PCD.

The POPO score visualised by both C-MAC and conventional Macintosh in our study was the same. The time taken for intubation with C-MAC and Macintosh was also comparable. C-MAC is shaped like the conventional Macintosh laryngoscope which the anaesthesiologists are already conversant and experienced with. Although it has a built-in camera, the angle of the curvature is same as that of the conventional Macintosh laryngoscope (22°). The camera of C-MAC is advantageous as it provides a clear magnified and a high resolution image on the monitor and is therefore an excellent teaching tool.

Since we had included patients with normal airways, there were no failure attempts and POPO <75% improved to nearly 100% in all cases after OELM. There were no undesirable effects such as oxygen desaturation. This was due to oxygen insufflation through the Truview PCD during a longer time required for intubation and fogging was also prevented. However in a few cases, the secretions formed a meniscus on the lens of Truview PCD due to flow of oxygen which did not impair the view of the glottis.

The limitations of our study include absence of blinding, non-inclusion of difficult airways and lack of crossover. Also, POPO is subjective leading to a certain bias during assessment by the laryngoscopist.

To conclude, using Truview PCD to assist intubation not only offers the best laryngeal view over C-MAC and Macintosh blades but also the time taken is less than 20 s. Truview PCD, provides better views than the conventional Macintosh laryngoscope, while the C-MAC provides a good resolution and is a teaching tool.

Ethical approval
Institutional Ethical Committee — IEC Project No. 89 Dated 6.2.12.

Trial registration
Clinical Trial Registry of India (www.ctri.nic.in) Regn. No. CTRI/2012/09/003011.

Conflicts of interest
None.

Funding source
The Truview Picture Capture Device (PCD)® was provided by Truphatek India, Mumbai, India for the purpose of the study. The C-MAC® paediatric blade was provided by Karl Storz Endoscopy, New Delhi, India for the purpose of this study.

Authors’ contribution
RS: Study design, acquisition of data, critical revision, final approval.
NK: Study design, acquisition of data, analysis and interpretation of data, first draft and critical revision, final approval.
AJ: Study design, critical revision, final approval.

References


