First experience of the use of the C-MAC PM videolaryngoscope in a clinical setting by anesthetic nurses: A comparison with anesthetists

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Abstract: Background: The Storz C-MAC videolaryngoscope has been found to facilitate endotracheal intubation and to be easy to use by novice users. However, it has never been studied in those who will probably use it most, anesthetists and anesthetic nurses. The aim of the present study was to identify the number of attempts needed before the participants were able to intubate 2 consecutive patients within 30 seconds.

Methods: Following a didactic session, 22 anesthetists and 21 anesthetic nurses were included in the study and attempted to intubate 184 patients with predicted easy laryngoscopy scheduled to undergo elective surgery. The number of attempts before achieving 2 consecutive successful intubations and time to intubation were recorded for both groups of participants. Perception of ease of use for the device was also recorded.

Results: Overall, anesthetic nurses required more attempts before achieving 2 consecutive successful intubations (5.9 ± 3.24 vs 2.73 ± 1.67, p < 0.0005). They also had significantly more failures until 2 consecutive successful intubations were achieved, compared to anesthetists (4.1 ± 2.8 vs 1.32 ± 1.25, p < 0.0005). A significantly higher percentage of anesthetic nurses required more than 3 attempts before achieving 2 consecutive intubations (75% vs 36%, p = 0.016). Regarding the intubation time, no significant differences were recorded between specialties. Anesthetic nurses assessed the C-MAC as easier to use than anesthetists did.

Conclusions: This is the first clinical study assessing the use by inexperienced anesthetic nurses of a widely used videolaryngoscope by inexperienced anesthetists and anesthetic nurses indicating that it is easy to learn and to use in their hands.

Key words: C-MAC videolaryngoscope ; endotracheal intubation ; anesthetists ; anesthetic nurses.

INTRODUCTION

Endotracheal intubation constitutes an important part of anesthetic nurses’ responsibilities. On several occasions, anesthetic nurses will be called to manage the airway of a patient either during elective surgery or in emergency setting (1-3). Despite the fact that endotracheal intubation is part of the training curriculum of anesthetic nurses in several countries, it is logical that they will be less often called to intubate a patient than anesthesiologists will be. Furthermore, it is well known that endotracheal intubation is a difficult skill to acquire and to maintain if it is performed infrequently (4-7) leading in this case in unacceptably high failure rates compromising thus patients’ safety (5-9).

During the last decade videolaryngoscopes have emerged as valuable alternatives in airway management. These devices do not only seem to provide better glottic views, facilitating thus intubation conditions even in difficult airways (10-12), but they also seem to have short learning curves and extremely high success rates in the hands of inexperienced healthcare professionals in manikin settings (10, 13-15). Despite the fact that the use of these devices has been studied in various settings and in various healthcare professionals (10, 11, 16, 17), their use by anesthetic nurses (inexperienced in their use) in clinical setting has never been assessed.

Hence, the aim of the present study was to assess the use by inexperienced anesthetic nurses of a widely used videolaryngoscope, the Storz C-MAC PM, in patients scheduled for elective surgery and compare it with its use by anesthetists also inexperienced with this device.

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METHODS

After obtaining Athens “Metropolitan” hospital ethics committee approval (protocol Nr 1, 02/03/2012) and patients’ written informed consent, 21 anesthetic nurses and 22 anesthetists were included in the study. Anesthetists or anesthetic nurses with previous experience with any videolaryngoscope were excluded from the study. Only consultant anesthetists participated in this study as there are no anesthesiology residents in this hospital. Since an established curriculum for anesthetic nurses does not exist in Greece it was arbitrarily decided to include in the study anesthetic nurses with an experience of at least 5 years in the operating theatre. After a 1-hour educational session including PowerPoint and clinical presentation by one of the investigators, participants were allowed to perform endotracheal intubation in patients scheduled to undergo elective surgery. Patients with ASA I-III physical status and no respiratory problems scheduled to undergo non-cardiac surgery were recruited in the study. Only patients with a predicted easy laryngoscopy were included as indicated by a Mallampati I or II score. Patients under 18 years of age, with limited cervical spine movement, thyromental distance < 6 cm, mouth opening < 4 cm, history of difficult intubation, morbid obesity or scheduled for ENT surgery were excluded from the study.

Each patient was routinely monitored during the entire procedure by electrocardiography, pulse oximetry, capnography, and noninvasive blood pressure measurements displayed in a multifunction monitor (S/5 Anaesthesia Monitor; Datex Ohmeda Division, P.O. Box 900, Fin 00031, Helsinki, Finland). Cannulation of a peripheral vein was performed with an 18-gauge catheter in all cases. Arterial and central venous cannulation was undertaken in several cases according to the patient’s needs or the demands of the surgical procedure. Preoxygenation was performed in all cases for 4 min by a face mask breathing 100% O₂. Anaesthesia was induced with fentanyl 1–2 μg·kg⁻¹ and intravenous propofol 2 mg·kg⁻¹ (i.v.). Bag–mask ventilation was always adequate. Rocuronium 0.6–0.8 mg·kg⁻¹ i.v. was administered for muscle relaxation. A peripheral nerve stimulator (Innervator 252; Fisher & Paykel Electronics Ltd, Auckland, New Zealand) placed above the ulnar nerve confirmed full neurological blockade (Train of Four 0). Afterwards, intubation attempt was initiated as follows: regarding only the LCD monitor after passage of the teeth, the operator inserted the Storz C-MAC PM (Karl Storz, Tuttingen, Germany), into the oral cavity, in the middle of the tongue, the uvula was identified and used as the first landmark to ensure that the blade was in the midline and correctly oriented; the blade was preferentially introduced into the vallecula or posterior to the epiglottis, if the latter obscured the glottis. All instruments and devices were ready in a trolley next to the person performing the intubation. Endotracheal tubes were used according to patient’s sex and weight (in most cases the internal diameter of the tubes used was 7 to 7.5 mm for women and 8 to 8.5 mm for men). No stylet was used in any intubation attempt as it was not deemed necessary in a predicted easy airway setting.

The primary endpoints were the ability to perform 2 consecutive endotracheal intubations in 2 separate patients, the number of attempts needed to achieve that and the duration of successful intubation attempt for each group of participants. The duration of each attempt was defined as the time taken from insertion of the blade between the teeth until the endotracheal tube placement and cuff inflation by each participant. A single researcher using always the same stopwatch recorded the time elapsed and confirmed correct tube placement. The ability to ventilate with a self-inflating bag the patient as confirmed by visible bilateral chest rise, waveform capnography and auscultation of both lungs was considered as a successful attempt. A failed intubation attempt was defined as an attempt in which the trachea was not intubated or an insertion attempt lasting more than 30 seconds. In the event of an unsuccessful intubation attempt the participant was not allowed a second attempt on the same patient as the institutional ethics committee did not permit more than one attempt per patient for novice users. In that case, an experienced anesthetist was taking over and intubated the patient. Participants were not allowed to watch each other during any of the intubation attempts, in order to avoid any learning effects throughout the procedure.

The secondary endpoint was the perception of ease of use with the Storz C-MAC videolaryngoscope. Each participant was asked to assess the ease of use of each device using a visual analogue scale (0 = extremely difficult and 5 extremely easy).

Continuous data are presented as means ± standard deviation (SD). The Kolmogorov-Smirnov test was utilized for normality analysis of the parameters. Categorical data are presented either as median and range or as frequencies and percentages. Data for the successful intubation attempt were analyzed using Chi square test, whereas time for successful intubation was analyzed using two-way ANOVA including the factors “specialty” and “successful
effort" as main effects. Data for the ease of use of the videolaryngoscope were analyzed using Fisher’s exact test. All tests were two-sided. The level of statistical significance for all analyses was set as p < 0.05. The SPSS statistical package (SPSS, Chicago ILL Version 17 for Windows) was used for all analyses.

RESULTS

The C-MAC was ultimately used on 184 patients. Overall, anesthetic nurses performed more attempts (6.95 ± 3.23 vs 3.73 ± 1.66, p < 0.0005), when compared to anesthetists. Furthermore, they required more attempts than anesthetists before achieving 2 consecutive successful intubations (5.9 ± 3.24 vs 2.73 ± 1.67, p < 0.0005). Anesthetic nurses had significantly more failures until 2 consecutive successful intubations were achieved, compared to anesthetists (4.1 ± 2.8 vs 1.32 ± 1.25, p < 0.0005). Further analysis revealed that a significantly higher percentage of anesthetic nurses required more than 3 attempts before achieving 2 consecutive intubations (75% vs 36%, p = 0.016). Regarding the intubation time, no significant differences were recorded between specialties (anesthetic nurses vs anesthetists, Table 1), nor between attempts for each group of participants (Table 2). In fact, intubation times in all cases in both groups were practically similar, between 25 and 26 seconds. Lastly, both groups found the Storz-C Mac as an easy device to use (median value = 4 for both groups) whereas between group analysis revealed that anesthetic nurses assessed this videolaryngoscope as easier to use (4.3 ± 0.66 vs 3.86 ± 0.71, p = 0.046) than anesthetists did. In none of the cases did any adverse effects occur (dental damage, airway oedema, bleeding in the oral cavity or in the airway).

DISCUSSION

The specialty of anesthetic nurse requires significant theoretical knowledge and various demanding technical skills among which is endotracheal intubation (1, 2). It is well known that intubation is a skill difficult to acquire and to maintain especially if it is performed infrequently (4-7). On the other hand, videolaryngoscopes represent a recent promising addition in airway management devices. They do not only improve glottic exposure facilitating thus probably intubation conditions but they also appear to be easy to learn even in the hands of healthcare professionals inexperienced in endotracheal intubation (10). Despite the fact that the studies assessing the learning curves of these devices were performed in manikins (13-15) and hence their results cannot be directly transferred into clinical practice, their results are extremely encouraging and they are further supported by studies assessing the introduction of videolaryngoscopes in the clinical setting (16, 18, 23).

One of the newest videolaryngoscopes is the Storz C-MAC videolaryngoscope which has an original Macintosh steel blade shape which is flattened, resulting in a blade profile of no more than 14 mm and its edges are slanted to avoid damage to the mouth and teeth. It also incorporates an extremely small (2-mm) digital camera and a high-power light-emitting diode, located laterally in the distal third of the blade. In addition, the embedded optical lens has an increased aperture angle of 80° resulting in a view that includes the tip of the blade and, hence, allows visual guidance of the tip of the blade into the vallecula. A color image is displayed

**Table 1**

Comparison of times to successful intubation times between the 2 groups. SD = standard deviation, SE = standard error

<table>
<thead>
<tr>
<th>Attempt</th>
<th>Group</th>
<th>Mean time (secs)</th>
<th>SD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st attempt</td>
<td>anesthesiologists</td>
<td>25.73</td>
<td>3.86</td>
<td>0.674</td>
</tr>
<tr>
<td></td>
<td>anesthetic nurses</td>
<td>25.25</td>
<td>3.40</td>
<td></td>
</tr>
<tr>
<td>2nd attempt</td>
<td>anesthesiologists</td>
<td>26.27</td>
<td>2.59</td>
<td>0.576</td>
</tr>
<tr>
<td></td>
<td>anesthetic nurses</td>
<td>25.75</td>
<td>3.40</td>
<td></td>
</tr>
<tr>
<td>overall</td>
<td>anesthesiologists</td>
<td>26.000</td>
<td>0.03</td>
<td>0.495</td>
</tr>
<tr>
<td></td>
<td>anesthetic nurses</td>
<td>25.500</td>
<td>0.528</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2**

Comparison of times to successful intubation times between the attempts. SD = standard deviation, SE = standard error

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean time (secs)</th>
<th>SD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>anesthesiologists</td>
<td>1st attempt</td>
<td>25.73</td>
<td>3.86</td>
</tr>
<tr>
<td></td>
<td>2nd attempt</td>
<td>26.27</td>
<td>2.58</td>
</tr>
<tr>
<td>anesthetic nurses</td>
<td>1st attempt</td>
<td>25.25</td>
<td>3.40</td>
</tr>
<tr>
<td></td>
<td>2nd attempt</td>
<td>25.75</td>
<td>3.40</td>
</tr>
</tbody>
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flects the different levels of pre-existing experience in endotracheal intubation between the 2 groups and it is certainly further enhanced by the lack of a specific core-curriculum for Greek anesthetic nurses.

The times to successful intubation for both groups were in accordance with those reported by previous studies (18, 23-25) including healthcare professionals and hence it is quite logical that no difference was observed between the times for successful intubation between the 2 groups. It seems that extensive laryngoscopic experience affects the number of efforts needed in order to successfully use a videolaryngoscope, but after the technique is learned, the speed of performance is the same. The fact that anesthetists did not assess the C-MAC as easy to use as the anesthetic nurses did is probably also attributed to time to intubation since an experienced operator usually takes much shorter time to intubate with a Macintosh blade (26, 27). Furthermore, as mentioned above, endotracheal intubation is difficult to learn and when a device that facilitates that process it is logical for it to be more positively assessed by inexperienced healthcare professionals than those who perform endotracheal intubation in everyday practice.

The present study has several important limitations. First of all, since there is no curriculum for the specialty of anesthetic nurses in Greece, it was not possible to have a uniform sample with the same training or experience. Furthermore, the group of anesthetists was highly experienced in endotracheal intubation and that fact possibly affected their success rates. However, it has to be noted that the anesthetists were also novice users regarding the C-MAC. On the other hand, the aim of the present study was not to assess its use by users with the same level of experience in endotracheal intubation as it has already been proven that inexperienced healthcare professionals are equally effective in learning different skills of airway management, which is logical since it is a process that mostly involves practical skills (28). This study rather tried to simulate normal hospital setting where anesthetists are more experienced in endotracheal intubation than anesthetic nurses are.

Lastly, the 30 second goal time-frame was shorter than other studies which used either 60 or 120 seconds. We believe that 1 or 2 minutes in apnea may constitute a significant danger for several surgical patients. Furthermore, despite the extensive search in the international literature, we failed to discover any recommendations regarding the acceptable time to intubation. In addition to the above, we also wanted to define how much time

Fig. 1. — The Storz C-MAC videolaryngoscope. Lateral view. The LCD screen is deployed and the videolaryngoscope is ready to use.
should an easy intubation attempt take. This was a demand of the hospital’s ethics committee based on the assumption that a prolonged intubation attempt (and by novices) although successful could albeit compromise patient’s safety. The only report in the international literature relating intubation time and intubation difficulty, was the paramount report by Adnet et al. (29), reporting a significant correlation between time and intubation difficulty score (IDS) with a median time of 18 sec (25th-75th range 14-25 sec) associated with IDS = 0, leading us to the choice of the 30sec time frame.

In conclusion, the present study demonstrated that despite the fact inexperienced anesthetic nurses require more attempts than inexperienced anesthesiologists for achieving 2 consecutive successful endotracheal intubations with the Storz C-MAC videolaryngoscope, the overall number of attempts is still relatively small and the times to successful intubation do not differ from those of the anesthesiologists. Given the fact that endotracheal intubation is a skill difficult to learn and the complications of a failed intubation may be detrimental for the patient, videolaryngoscopes may constitute a promising alternative in the hands of those who will be infrequently called to intubate. Certainly, further studies have to be undertaken in order to elucidate in which context videolaryngoscopes should be used by anesthetic nurses. To our knowledge, this is the first study to assess the use of a videolaryngoscope by anesthetic nurses in the clinical setting and it adds some evidence in the existing literature about videolaryngoscopes.

References


