

Assessing the efficacy of video versus direct laryngoscopy through retrospective comparison of 436 emergency intubation cases

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Received: 19 June 2012 / Accepted: 30 May 2013 / Published online: 13 June 2013
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Abstract Video laryngoscopy has become a common practice for tracheal intubations. However, information on its efficacy in emergency intubations is minimal. The external video monitor may act as a means for assistance by present staff, heighten teaching ability, and improve intubation outcomes. We conducted a retrospective review consisting of 436 patients requiring emergency intubation outside the operating room to evaluate the application of a C-MAC video laryngoscope for emergency intubation(s). Nine cases were removed, 315 underwent direct laryngoscopy, 73 underwent video laryngoscopy, and 39 underwent both methods. The C-MAC laryngoscope provided a significantly better visualization of the glottis ($p = 0.02$). The C-MAC also provided successful intubation on the first attempt in 82 % of the 39 direct laryngoscopy cases subsequently intubated with the C-MAC. The presence of the attending anesthesiologist (while the resident intubates) had no effect on complication rates; the number of attempts required and the grade view obtained were nonsignificant ($p = 0.91$ and $p = 0.34$, respectively). Overall, use of the C-MAC video laryngoscope provided a better view of the airway structures during an emergency intubation. The success of the C-MAC laryngoscope in

intubation after failed direct laryngoscopy suggests the importance of the video laryngoscope as the primary intubation approach during an emergency intubation.

Keywords Emergency intubation · Video laryngoscopy · Direct laryngoscopy · Airway · C-Mac

Introduction

Tracheal intubation is performed daily in the operating room with minimal complications. However, emergency intubations performed outside the operating room carry greater risks and complications, such as hypoxia, aspiration, and bradycardia [1–3]. A prospective investigation of 297 tracheal intubations outside the operating room was associated with a high frequency of major complications. However, researchers found that complications associated with emergency tracheal intubations did not increase in the absence of supervision by an attending anesthesiologist, so long as the intubation was performed by an individual trained in airway management [1].

To minimize the risks often associated with emergency intubations, techniques utilizing nondirect visualization of the laryngeal airway, such as the use of the C-MAC video laryngoscope, have recently become pervasive in easing an emergency intubation [2, 3]. Numerous studies have shown video laryngoscopy allows for better intubating conditions with a higher success rate, as well as an improved laryngeal view, when compared to conventional direct laryngoscopy [4–10]. Although these studies seem to depict video laryngoscopy as a be-all and end-all intubation technique, information is limited on the use of the C-MAC laryngoscope for difficult intubations outside the operating room setting [9, 11–14].

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This study was intended to review the use and effectiveness of the C-MAC video laryngoscope compared with direct laryngoscopy in the emergency setting. By retrospective analysis, we statistically compared the number of attempts made at intubation and the Cormack–Lehane (C–L) laryngeal grade view obtainable for optimum conditions between the C-MAC and the direct approach. We also analyzed the association between complications and the presence/absence of the attending anesthesiologist responsible for the case. At the time this study was conducted, to our knowledge, it was the first of its kind to assess these outcome measures for emergency cases outside the operating room, utilizing the C-MAC, to provide a successful intubation after failed direct laryngoscopy.

A retrospective cohort study was performed in our Academic Tertiary Care Hospital (ATCH). Ethical approval for this study was provided by the Institutional Review Board of the University of Nebraska Medical Center, Omaha, Nebraska. The study included 436 adult patients requiring emergency intubation outside the operating room or emergency room at our ATCH from November 2008 to May 2010.

With each intubation performed, data were collected and recorded on standardized forms by the anesthesia providers. The data collected included indication for intubation, whether an attending anesthesiologist was present or available, medications used, immediate complications,

number of attempts made to intubate, the C–L laryngeal view (I–IV), and whether the C-MAC laryngoscope or direct laryngoscopy (or both) was used. The number of attempts, and the subsequent success rate, was the primary outcome measure. The C–L grading system of four different view ratings was used: I = vocal cords visible; II = partial view of the glottis; III = only the epiglottis is visible; and IV = neither the epiglottis nor the glottis is visible [3]. A successful attempt was defined as entry of the laryngoscope and endotracheal tube into the trachea on the first attempt. A failed attempt was defined as the inability to place the endotracheal tube, shifting to a different device, and/or varying of the physician [10]. The documentation was completed by the anesthesia resident performing the intubation, and the present or available anesthesiologist reviewed this documentation. The data were then analyzed using the number of attempts and C–L grade view obtained as the outcome variables. Statistical significance for all measures was considered at $p < 0.05$.

A total of 436 cases were initially analyzed. Five cases were removed from consideration because they were exchange catheter procedures (tracheal tube exchanges), 3 were removed because they conducted under fiberoptic laryngoscopy, and 1 was removed because no view or attempt information was provided, which left 315 direct laryngoscopy cases, 73 C-MAC laryngoscopy cases, and 39 cases utilizing both techniques (Fig. 1) for this review.

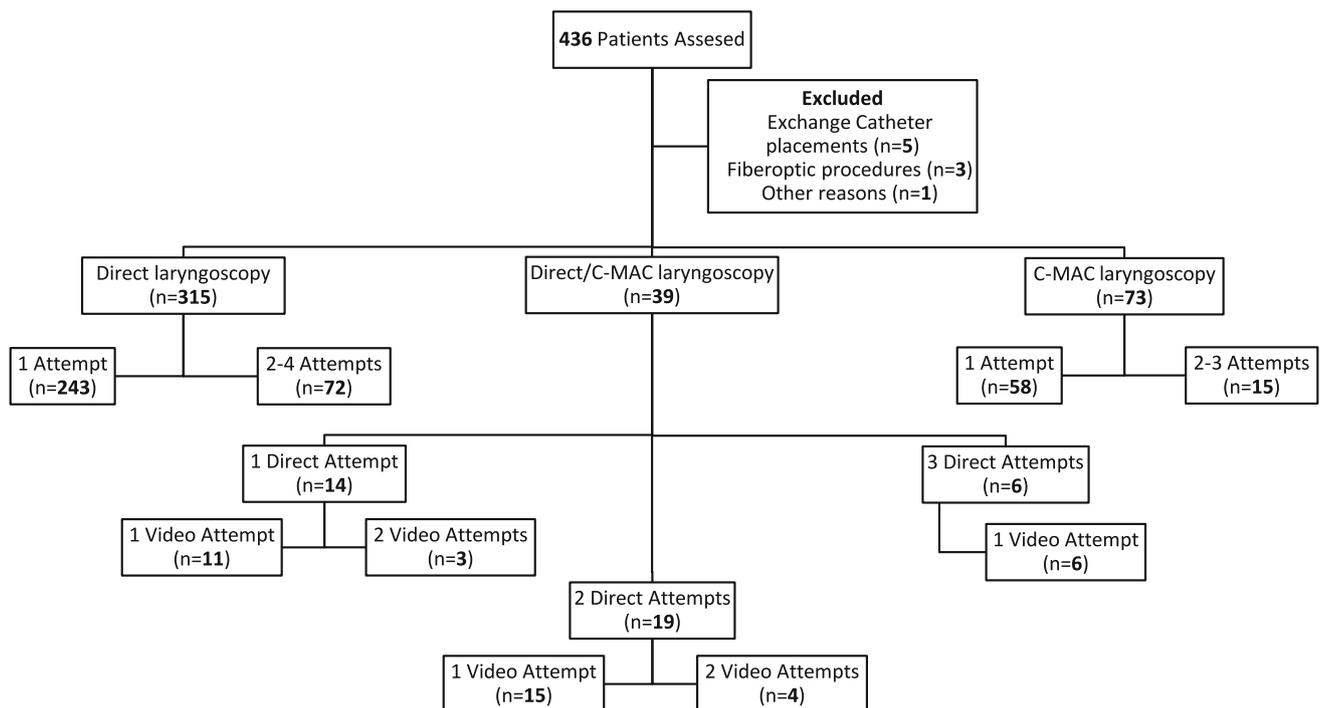


Fig. 1 Flow chart analysis of case distribution by method of laryngoscopy and number of attempts to successful intubation. For those cases in which both direct and video scopes were used, initial

attempts using direct laryngoscopy are recorded followed by number of attempts using the video laryngoscopy method

The total proportion of successful intubations in those patients requiring only direct laryngoscopy or only video laryngoscopy was 78 % (301/388). The proportion of success was 79 % (58/73) and 77 % (243/315) for the C-MAC and direct laryngoscopy, respectively, resulting in no significant difference in success rate between the two methods ($p = 0.812$). When comparing the C–L view obtained, those cases utilizing the C-MAC laryngoscope provided a significantly better glottis visualization during emergency intubation ($p = 0.024$). The proportion of a C–L view I was 71 % (52/73) for the C-MAC group and 60 % (188/315) for the direct laryngoscopy group.

In 39 cases, the primary intubation approach failed. The primary intubation technique in all cases was direct laryngoscopy with either a Macintosh blade or a Miller blade. Of these 39 cases where direct laryngoscopy was unsuccessful, 82.1 % (32/39) of the cases were subsequently successfully intubated with the C-MAC laryngoscope. Of the remaining 7 cases, intubation was established on the second attempt with the C-MAC (Fig. 2). A second Mantel–Haenszel chi-square test found no evidence of association between the initial direct view and the corresponding C-MAC view ($p = 0.284$). The C-MAC provided a grade view of I in 82.1 % (32/39) of the cases, whereas a grade view of I was never seen through the direct approach.

In this study, the C-MAC video laryngoscope was found to be associated with comparable or better glottis visualization than direct laryngoscopy. Obtaining the best visualization of the glottis is of first concern and top priority when performing laryngoscopy. During emergency intubations, conditions are less ideal, complications are more often seen, and experience and availability of the resident and anesthesiologist become key factors. A setting such as this may be optimal for designating video laryngoscopy as a primary intubation approach [15–18].

In a randomized, controlled crossover study composed of 150 patients requiring intubation, the proportions of

successful C-MAC intubations and direct laryngoscope intubations were 100 % (55/55) and 88 % (44/50), respectively [10]. The high proportions of successful intubations in this study are similar to the results of our study, likely because a similar proportion of complications was seen in both intubation methods; although every intubation case in our study was an emergency intubation, the complications recorded were minimal. If more complications and difficult airway characteristics were to be seen, and if the “Rescued Cases” population was larger, it can be expected that the efficacy and intubation success rate would be unaffected for the C-MAC but significantly poorer for the direct laryngoscope [2].

In a study performed under similar guidelines and circumstances as ours (at an Academic Tertiary Care Hospital with patients requiring tracheal intubation), it was found that supervision by an attending anesthesiologist was associated with a decreased incidence of complications during emergency intubations [19]. Our data did not coincide with these results; complications were not increased as a result of the presence or absence of the attending physician. The decreased complication rate provided by supervision by the attending anesthesiologist seen in the previously mentioned study is likely because the intubations were performed using direct laryngoscopy. In our study, the residents had the choice of using either the C-MAC or direct laryngoscopy. The better intubating dimensions offered by the C-MAC laryngoscope may explain why supervision by an attending anesthesiologist did not affect complication rates in our study.

Some limitations to this study can be attributed to certain aspects of the procedure that were not recorded. The time to visualization and the time to intubation (TTI) were not recorded for either method of intubation. A comparison of TTIs between the two methods could provide further analysis on their relationship. Video laryngoscopy has been found to have a longer median time to successful intubation. For those cases under extreme emergency conditions, this extra time is clinically important; however, the multiple attempts at intubating associated with direct laryngoscopy may take up just as much time to establish a successful intubation [15]. Also, the C–L grading system does not quantify the exposure of the glottis in the best qualitative way when comparing the two methods [7]. For instance, in patients who underwent both methods of intubation, where direct laryngoscopy provided a grade view of III or IV, video laryngoscopy provided a grade view of I or II, implying that the view obtained with the C-MAC laryngoscope is, overall, better than that observed during direct laryngoscopy.

In summary, the C-MAC provided a highly improved visualization of the glottis opening when compared to direct laryngoscopy. For emergency intubations where

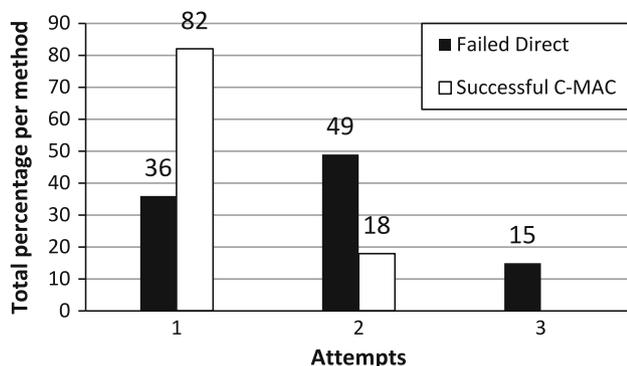


Fig. 2 Comparison of the number of attempts required by laryngoscopy type for those persons unsuccessfully intubated with a direct laryngoscope but subsequently successfully intubated with the C-MAC laryngoscope

direct laryngoscopy was unsuccessful, the C-MAC was able to provide a successful intubation 82.1 % of the time. The results from this study are highly relevant because the two laryngoscopy techniques were compared in the emergency setting, outside the operating room, where difficult airways are often seen. These data provides insight into the importance of video laryngoscopy as an applicable alternative for the management of the airway in an emergency setting.

Conflict of interest All authors declare no conflicts of interest.

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