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Comparison of the C-MAC video laryngoscope to the Macintosh laryngoscope for intubation of blunt trauma patients in the ED

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ABSTRACT

Objectives: We aimed to compare the performance of the C-MAC video laryngoscope (C-MAC) to the Macintosh laryngoscope for intubation of blunt trauma patients in the ED.
Material and methods: This was a prospective randomized study. The primary outcome measure is overall successful intubation. Secondary outcome measures are first attempt successful intubation, Cormack–Lehane (CL) grade, and indicators of the reasons for unsuccessful intubation at the first attempt with each device. Adult patients who suffered from blunt trauma and required intubation were randomized to video laryngoscopy with C-MAC device or direct laryngoscopy (DL).
Results: During a 17-month period, a total of 150 trauma intubations were performed using a C-MAC and DL. Baseline characteristics of patients were similar between the C-MAC and DL group. Overall success for the C-MAC was 69/75 (92%, 95% CI 0.83 to 0.96) while for the DL it was 72/75 (96%, 95% CI 0.88 to 0.98). First attempt success for the C-MAC was 47/75 (62.7%, 95% CI 0.51 to 0.72) while for the DL it was 44/75 patients (58.7%, 95% CI 0.47 to 0.69). The mean time to achieve successful intubation was 33.4 ± 2.5 s for the C-MAC versus 42.4 ± 5.1 s for the DL ($p = 0.93$). There was a statistically significant difference between the DL and C-MAC in terms of visualizing the glottic opening and esophageal intubation in favor of the C-MAC ($p = 0.002$ and $p = 0.013$ respectively).
Discussion and conclusion: The overall success rates were similar. The C-MAC demonstrated improved glottic view and decrease in esophageal intubation rate.

1. Introduction

Endotracheal intubation is the most convenient technique for securing the airway of critically ill patients. The foremost method of securing the airway in the emergency department (ED) is direct laryngoscopy (DL).[1] This method was introduced into clinical practice more than 50 years ago. With advances in technology, many video laryngoscopes have been introduced into the market and are used by Emergency Physicians (EPs). Video Laryngoscopes incorporate a camera at the tip of the blade with different blade angles, which is in contrast to DLs, which present the laryngeal view directly.

The C-MAC video laryngoscope (Karl Storz, Tutlingen, Germany) is a relatively new airway device, resembling the Macintosh blade but with the addition of a micro camera at the tip of the blade. Its resemblance to Macintosh laryngoscope makes it more user-friendly and allows the operator to use it as a direct laryngoscope when there is a malfunction in the attached camera.

Endotracheal intubations of trauma patients deserve special attention, as trauma patients are assumed to have an unstable cervical spine (C-spine) until proven otherwise. Immobilizing the neck of the patient with a cervical collar restricts mouth opening and impedes the alignment of the oral, pharyngeal and laryngeal axes. Trauma patients may have additional factors that make intubation difficult, such as blood and other secretions in the airway, facial trauma, hemodynamic instability and respiratory compromise.[2]

Various studies have shown that different video laryngoscope devices improve glottic exposure over direct laryngoscopy in

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controlled environments, such as the simulation center or operation room.[1] It is not clear if this finding may be translated into real emergency situations in terms of resulting in faster, easier or more successful intubations, however.[3]

The aim of the present study is to compare the performance of the C-MAC video laryngoscope (C-MAC) to the Macintosh laryngoscope for intubation of blunt trauma patients in the ED. The primary outcome measure is overall successful intubation. Secondary outcome measures are first attempt successful intubation, Cormack–Lehane (C–L) grade and indicators of the reasons for unsuccessful intubation at the first attempt with each device.

2. Methods

2.1. Study design

This prospective randomized study was conducted at an urban tertiary care facility with an annual intake of approximately 90,000 patients (May 2013 to October 2014). The ED has an accredited 4-year emergency medicine residency program. The study was approved by the institutional review board.

2.2. Study setting and population

Those patients over the age of 16, arriving at the ED due to blunt trauma requiring endotracheal intubation to secure the airway, were included in the study. Patients presenting to the ED with penetrating trauma, age under 16 and intubated before ED arrival were excluded from the study.

2.3. Study protocol

Either a C-MAC or a DL was randomly selected through the use of sequentially numbered, opaque, sealed envelopes. The data was collected by the emergency residents. The duration of intubation was measured by the nurses or paramedics preparing the intubation materials and opening the sealed envelopes. The operators were residents and attending physicians of the ED. The data pertaining to the study included the following information: patient demographics (age, sex, estimated height, estimated weight, body mass index); the postgraduate year (PGY) of the resident who initially attempted the intubation, the number of intubation attempts (an attempt was defined as an introduction of the laryngoscope into the mouth and its removal regardless of whether an ET tube was inserted); the number of operator(s) performing the procedure (in case of failed intubation); the need to switch to a different device or a different operator; the reasons for intubation failure on the first attempt (i.e. when the glottic opening could not be seen, ETT could not be directed, ETT could not pass the glottic opening, esophageal intubation, the presence of secretions and/or blood); the device(s) used; the duration of intubation (the duration of tracheal intubation was defined as the time taken from insertion of the blade between the teeth until the lungs were inflated with a bag-valve mask); the minimum oxygen saturation measured during the procedure, and; C–L grades recorded during ET intubation. At the end of each intubation, every participant graded the ease of use of each device on a 10 cm visual analog scale (VAS). ET tube placement was confirmed by traditional methods (auscultation, fogging in the tube) and $ETCO_2$ measurement. The primary intubation method was rapid sequence intubation; only those patients in cardiac arrest were intubated with no medications as and when necessary. First pass success was defined as correct placement of the ETT in the trachea in a single attempt. C-MAC blades sized 3–4 and Macintosh blades sized 3–4 were used. A stylet was used in the ETT for all intubations. The total time of tracheal intubation was documented, regardless of the number of attempts. In trauma patients, during the intubation period, a C-collar was removed and manual in-line immobilization was performed to all the patients.

3. Primary Data Analysis

The study data were analyzed in SPSS 16.0 for Windows (SPSS Inc., Chicago, Illinois, USA). Demographic and baseline characteristics were summarized as a mean ± SD for continuous variables, and as a percentage of the group for categorical variables. Non-normally distributed data are presented as medians (inter-quartile range). The normality analysis was performed with the Kolmogorov–Smirnov test. The chi-square test or Fisher's exact test, where appropriate, was used to compare the proportions. The Mann–Whitney U test was used to compare the ordinal and non-normally distributed variables. A p value of less than 0.05 was considered to indicate a statistically significant result.

For a two-sided test with a Type 1 error rate of 0.05, power-equaled 0.80 to detect a 20% difference with 60% success of ET intubation, each group required 82 patients.

4. Results

During the study period, a total of 150 patients were intubated secondary to blunt trauma. Of these 150, 75 were intubated with the DL and 75 were intubated with the C-MAC. The mean age (35 ± 15.5 years in the DL group and 39 ± 19 years in the C-MAC group), as well as ratio of males to females were similar between the groups [2 (2.7%) females in the DL group and 5 (6.7%) female patients in the C-MAC group], the exception being the postgraduate year status of the resident performing the intubation (Table 1). The main indication for endotracheal intubation was head trauma in 50 (33.3%) patients, cardiac arrest in 27 (18%) patients, multiple trauma in 8 (5.3%) patients, airway control in 27 (18%) patients, facial trauma in 5 (3.3%) patients, and low GCS in 9 (6%) patients. The median GCS of the patients in the DL group was 7,[3–11] while in the C-MAC it was 7.[3–10] In 36 (48%) patients in the DL group and 25 (33%) patients in the C-MAC group oxygen saturation was below 90%. EM attending physicians performed 11 (7.3%) tracheal intubations. 58.7% (95% CI 0.47 to 0.69) of ET intubations with the DL and 62.7% (95% CI 0.51 to 0.72) of intubations with the C-MAC were successful at the first attempt. The overall success rates were similar between the devices. First pass success did not differ in both groups (58.7% for DL vs. 62.7% for C-MAC p = 0.61). The reasons for

Table 1
Patient characteristics.

	C-MAC n = 75	Direct laryngoscopy n = 75	p-value
Mean age (years) (range)	39 ± 19	35 ± 15.5	0.185
Median BMI	24 (IQR 23–29)	24 (IQR 22–26)	0.2
Indication for intubation			
Head Trauma	30 (40%)	20 (26.7%)	
Airway control	14 (19%)	13 (17.3%)	
Low GCS	4 (5.3%)	5 (6.7%)	
Multiple Trauma	3 (4%)	5 (6.7%)	
Cardiac arrest	11 (14.7%)	16 (21.3%)	
Facial/Neck Trauma	0	5 (6.7%)	
Post graduate year			
PGY-1	2	11	
PGY-2	18	17	
PGY-3	19	15	
PGY-4	29	27	
Attending physician	7	5	
First attempt success	56 (62.7%)	44 (58.7%)	
Second attempt success	13 (17.3%)	21 (28%)	