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A randomized Comparison of C-MAC Videolaryngscope Versus Macintosh Laryngoscope for Tracheal Intubation

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Abstract

Purpose: The present study compared the C-MAC videolaryngoscope (C-MAC) with Macintosh laryngoscope with regard to the laryngoscopic view, laryngoscopic time and time required to complete the tracheal intubation. We aimed to investigate any disadvantages that the C-MAC laryngoscope may have when used in routine clinical practice.

Methods: Ninety patients undergoing elective surgery requiring general anaesthesia and tracheal intubation were randomly allocated to receive tracheal intubation using the C-MAC or the Macintosh laryngoscope. Following a standardised general anaesthetic, data were collected during laryngoscopy and endotracheal intubation.

Results: The median laryngoscopic time (IQR) for the C-MAC and Macintosh laryngoscope respectively were 9.8 (4) and 8.1 (3.3) seconds (p = 0.037). The median total intubation time (IQR) for the C-MAC and Macintosh laryngoscope respectively were 29.2 (18.6) and 23.5 (9.4) seconds, (p = 0.011). There were no significant differences in the laryngoscopic view, additional airway manoeuvres and success rate of tracheal intubation between the two groups.

Conclusion: Although the differences in the laryngoscopic time and intubation time were statistically significant, they did not achieve clinical significance. Therefore we conclude that the C-MAC videolaryngoscope may be used in routine clinical practice for tracheal intubation.

Keywords: Laryngoscope: Video laryngoscope; C-MAC videolaryngoscope; Intubation: Tracheal intubation; Intubation time

Introduction

Endotracheal intubation is considered the definitive airway for resuscitation and airway management. The Macintosh laryngoscope is the most commonly used device for directly visualising the structures of the larynx and facilitating tracheal intubation. In recent years, videolaryngoscopes based on the principles of indirect laryngoscopy have been introduced into clinical practice [1-4]. When compared with direct laryngoscopy, video laryngoscopy can provide a significantly better view of the larynx, which may be useful in situations of difficult tracheal intubation [3,4].

The C-MAC video laryngoscope (Karl Storz Tuttlingen, Germany) blade design is similar to the Macintosh, with additional advantage of a video camera. The distal end of the blade incorporates a small digital camera and high power light emitting diode [5]. It can be used in a similar way to Macintosh for direct laryngoscopy and also for indirect laryngoscopy when the operator views the larynx on the video screen. Indirect laryngoscopic view on the video screen enables the assistant to see the effect of any external laryngeal manipulation on the laryngoscopic view in situation of difficult intubation. With the advantages that C-MAC has to offer in clinical practice, in this study we aimed to compare the C-MAC with Macintosh laryngoscope in terms of laryngoscopy time and total intubation time in anaesthetised patients.

Methods

After approval from local Research Ethics Committee, ninety patients ASA grade 1 to 3, undergoing elective surgery under general anaesthesia requiring tracheal intubation were recruited. During the pre-operative assessment, the participants were given a patient information sheet and time to read the material and any queries regarding the study were answered. The patients with anticipated difficult airways, children below eighteen years of age, any patient with recent respiratory tract infection, morbid obesity, gastro-oesophageal reflux and increased risk of aspiration were excluded. Preoperative airway assessment included modified Mallampati score [6], mouth opening, ability to protrude the lower jaw in front of the upper jaw and cervical spine movement. Patients with previous history of difficult intubation or presence of any two or more abnormal parameters on clinical examination were considered to have difficult airway and excluded. The patients were positioned supine with their head and neck at the optimum position for intubation. Prior to induction of anaesthesia, one of the two laryngoscopes (C-MAC or Macintosh) was chosen randomly, by opening a sealed and numbered opaque envelope. The named anaesthetists (CM and CH) conducted the pre-surgical checklist and started pre-oxygenation. The same two anaesthetists performed all tracheal intubation in the study group. Both of them have performed >10 laryngoscopies using the C-MAC on patients. Anaesthesia was induced with propofol 2-3 mg/kg and fentanyl 1.5 micrograms/kg. Following confirmation of adequate mask ventilation, atracurium 0.5 mg/kg was administered to facilitate muscle

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relaxation. Anaesthesia was maintained with oxygen, air and isoflurane. After confirming adequate muscle relaxation, using neuromuscular monitoring, laryngoscopy and endotracheal intubation was performed. C-MAC size 4 and Macintosh size 4 blades were chosen for all patients in the study. During induction and throughout the procedure, oxygen saturation, end-tidal CO_2, non-invasive blood pressure and heart rate were monitored. The tracheal tube sizes between 7.0 to 8.0 mm ID, and one of three tube types [standard tracheal tube (Sheriden, TFX medical Ltd), oral RAE (Mallinckrodt medical) and oral flexometallic (Mallinckrodt medical)] were used at the discretion of the anaesthetist. The data collected included laryngoscopic grade (Cormack and Lehane) [7], laryngoscopy time, intubation time, manoeuvres needed to facilitate intubation and the incidence of post operative sore throat. If the laryngoscopy was judged to be difficult, and lasted over 120 seconds or the oxygenation saturations fell below 95%, the intubation was considered as unsuccessful for the purpose of the study. The laryngoscopy time was defined as the time when anaesthetist picked up the laryngoscope in hand until they obtained the best view of the larynx (indirect view on the monitor with C-MAC and direct view with Macintosh). The intubation time was defined as the time when anaesthetist picked up the laryngoscope in hand until the first breath. Following tracheal intubation, correct placement of tracheal tube was confirmed by auscultation and capnography. All the patients were visited in 24-36 hours of post-operative period and enquired for sore throat.

We calculated the sample size based on a previous study where the standard deviation for total intubation time was 31 seconds [8]. We considered a difference of 20 seconds to be clinically significant in routine clinical practice whilst managing unanticipated difficult airway. For a power of 80% with type 1 error rate (α) of 0.05, ninety patients in total were needed. Normal probability plots suggested that total intubation times were not normally distributed. The analysis was therefore conducted using logarithms of the recorded times, as these were reasonably normally distributed. Linear modelling revealed that no demographical measure, nor the investigator or the type of tube used had an effect on the intubation time. Therefore the laryngoscopic and intubation times were compared using two-sample t-test. The difference between the two devices, with respect to the number of manipulations required after insertion and sore throat incidence were analysed using a linear trend test; namely the Mantel-Haenszel Chi-squared test for trend. The categories were merged for laryngoscopic view and Mallampati score data to ensure validity of statistical testing. Chi-squared tests were applied for the other variables. A type 1 error rate of α=0.05 was used throughout the analysis.

Results

The demographic variables were evenly distributed between the two groups (Table 1). The laryngoscopic time, intubation time (Figure 1), laryngoscopic view and additional manoeuvers required and types of tubes used are presented in table 2. The median laryngoscopic time (IQR) for C-MAC and Macintosh were 9.8 (4.0) and 8.1 (3.3) seconds respectively (p=0.037). The median intubation time (IQR) for the C-MAC and Macintosh were 29.2 (18.6) seconds and 23.5 (9.4) seconds, respectively (p = 0.011). The estimated ratio of geometric means for the C-Mac and Macintosh laryngoscopes was 1.240 (95% confidence interval [1.051, 1.462]) indicating that the geometric mean of the time taken for the C-Mac laryngoscope was 1.240 times that of the time taken for the Macintosh laryngoscope. There were no significant differences in laryngoscopic view or additional manoeuvers required. Indirect laryngoscopy with C-MAC revealed grade 1/2/3/4 (Cormack and Lehane) views in 33/12/0/0 patients respectively whereas direct laryngoscopy with Macintosh revealed 32/12/1/0 patients respectively.

The Mallampati scores were evenly distributed between the two groups. In the C-MAC group, 7 patients required external laryngeal manipulation (BURP manoeuvre), one patient required the use of gum elastic bougie and 5 patients required both BURP and gum elastic bougie to facilitate tracheal intubation. In the Macitnosh group one

Demographic Data	Macintosh (n = 45)	C-MAC (n = 45)	P value
Age (yrs)	46.4 (16.1)	53.7 (17.1)	ns
Height (cm)	169.2 (9.17)	168.1 (9.11)	ns
Weight (kg)	81.8 (19.9)	79.6 (19.8)	ns
BMI kg.m-2	28.8 (6.23)	27.4 (5.18)	ns
Mallampati Score 1/2/3/4/	24, 19, 2, 0	26, 17, 2, 0	ns

ns = not significant

Table 1: Patient demographics: mean and standard deviation.

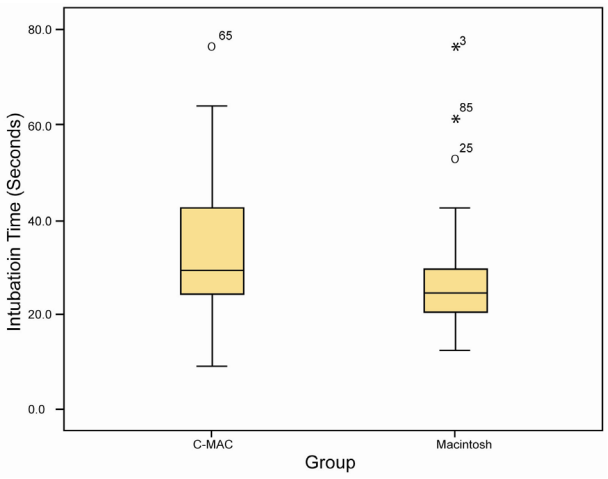

Figure 1: Distribution of intubation time for C-MAC and Macintosh laryngoscopes.

Intubation	C-MAC	Macintosh	P value
Intubation time; median (IQR) in seconds	29.2 (18.6)	23.5 (9.4)	0.011
Laryngoscopic time; median (IQR) in seconds	9.8 (4)	8.1 (3.3)	0.037
Laryngoscopic view: Cormack and Lehane grade 1, 2,3,4	33, 12, 0,0	32,13,1, 0	0.81
Additional manoeuvres required (BURP, Bougie or both)	13	8	0.244
Types of tracheal tubes used: Flexometalic/Standard/RAE	23/12/10	20/9/16	0.364
Success rate (%)	100	100	ns

ns: not significant

Table 2: Intubation time, grade of laryngscopy and success rate.

bougie to facilitate tracheal intubation. In the Macitnosh group one patient required BURP, 4 patients required the use gum elastic bougie and another 3 patients required both BURP and gum elastic bougie to facilitate tracheal intubation (p=0.244). The overall success rate of tracheal intubation was 100% in both groups. The types of tube used were equally distributed between the two groups (p=0.364). Eight patients (5 patients mild, 3 patients moderate to severe) in C-MAC group and 9 patients (6 patients mild, 3 patients moderate to severe) in Macintosh group reported postoperative sore throat, with no statistical difference between the two groups (p=0.586).

Discussion

Our results showed a small but statistically significant difference in the mean intubation time between C-MAC and Macintosh laryngoscopes. The protocol stated that a difference of more than 20 seconds is regarded as clinically significant. This corresponds to a ratio of median intubation times of more than 1.84. Adopting this value as a non-inferiority margin it can be concluded that using the C-MAC laryngoscope it takes significantly longer (on the logarithmic scale) to perform the procedure, however, the 95% percent confidence interval lies completely above the non-inferiority margin and therefore the intubation time difference is not clinically significant. The C-MAC and Macintosh blades are identical in design and the skills acquired using one device should be transferable to the other device when C-MAC is used as direct laryngoscope.

In anticipated difficult airway, C-MAC videolaryngoscope has been shown to perform better in terms of shorter intubation time, higher success rate and less number of optimising manoeuvres [5,8]. However the additional cognitive processing required for indirect laryngoscopy may affect the total intubation time and success rate when used in routine clinical practice, particularly when used by novices. The first stage of learning is the verbal cognitive phase, where the operator needs to understand what is to be achieved; whilst the second stage is task execution [9]. Stage one of cognitive learning would have been a learned skill, requiring minimal cognitive processing. Therefore, we may hypothesize that any delay in time to achieve laryngoscopy and intubation, using the video laryngoscope, must reflect the second stage of learning, which is in task execution [9]. Although video laryngoscopes provide a good view of the larynx, they may not guarantee an easy tracheal intubation [10,11] and may prolong the time required for successful intubation. Therefore we independently studied the laryngoscopic time and total intubation time. We wished to compare the performance of C-MAC with Macintosh in patients with a normal airway as the benefit has been demonstrated in potential difficult airways [8]. Recently introduced C-MAC difficult airway blade (D-blade) has been shown to improve the success rate of tracheal intubation in patients with anticipated difficult airway [12].

There was no significant difference between the two devices in terms of the laryngoscopy views and the number of manoeuvres required to facilitate intubation. This can be explained by the fact that the blades are of similar design similarity and the two patient groups were of similar demographics. We appreciate the difference in the way the C-MAC view is obtained using a camera but to achieve successful intubation without using a stylet or bougie, some alignment of oro-pharyngo-laryngeal axes is required. The patients in the C-MAC group had a higher number of manoeuvres even though the laryngoscopic views were almost identical in the two groups but this did not reach statistical significance.

In conclusion, C-MAC videolaryngoscope is suitable for tracheal intubation in routine clinical practice as an alternative to Macintosh laryngoscope.

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