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C-MAC Video Laryngoscope versus Macintosh Laryngoscope for Intubation in Elective Surgery: A Clinical Trial

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Abstract

Background: CMAC is a video laryngoscope with the unique advantage of having a blade design very similar to the most commonly used Macintosh laryngoscope. We conducted this study to compare the efficacy of intubation with the conventional Macintosh Laryngoscope and CMAC laryngoscope as measured by total time for successful intubation, number of attempts, laryngeal view, hemodynamic changes and airway morbidity. *Material and Method:* Seventy patients (n=35 in each group) were randomly allocated to be intubated with either CMAC or Macintosh laryngoscope (ML). Parameters measured were time taken for successful intubation, number of attempts, Cormack Lehane grading of laryngoscopic view, airway morbidity, blood pressure and heart rate at first, third and fifth minutes after Intubation. *Results:* The total intubation time was 26.6±3.71 seconds in CMAC group and 29.7±4.68 seconds in ML group. All the patients were intubated in first attempt. The increase in systolic blood pressure at first (121.43±9.71) and third minutes (116.60±9.53) following laryngoscopy was significantly lower in CMAC group as compared with Macintosh group (127.77±13.53 and 122.31±12.23 respectively) p=0.027 at minute 1 and p=0.021 at minute 3**.** Heart rate too showed a significantly lesser increase in CMAC group than in ML group (p =0.001, 0.02 and 0.009 at first, third and fifth minutes respectively). *Conclusion:* Intubation with CMAC is associated with shorter intubation time and better hemodynamic profile compared to conventional Macintosh laryngoscope in patients with no predicted airway difficulties.

Keywords: Cormack Lehane Grading; Endotracheal Intubation; Video Laryngoscopes.

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Introduction

Endotracheal intubation is considered the definitive technique for resuscitation and airway management. The Macintosh laryngoscope (ML) is the most commonly used device for directly visualizing the structures of larynx and facilitating tracheal intubation. In recent years, the use of video laryngoscopes based on the principles of indirect laryngoscopy have been introduced into clinical practice. Recent studies have shown that video laryngoscopes improve laryngeal view and ease intubation difficulty across various airway scenarios [1].

C-MAC videolaryngoscope [Karl Storz GmbH, Tuttlingen, Germany] has a Macintosh steel blade with no edges and gaps for hygienic traps and is available in 3 sizes. It has a flattened slim blade profile

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with slanted edges to avoid damage to mouth and teeth [2]. The C-MAC Video Laryngoscope (VL) holds a promising future in the management of both normal and difficult airway. C-MAC VL blade 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. The clinical advantages provided by C-MAC VL include: ability to convey a video image, less stress imposed on the airway, helps to view larynx with less mouth opening and can be handled with a skill similar to that of conventional direct laryngoscope [1]. In contrast to many previous video laryngoscopes, the C-MAC scope has the unique advantage of obtaining both direct laryngoscopic view and a camera view that is displayed on the video screen. This may be very helpful for educational purpose, because the instructor is able to follow and guide the student's laryngoscopy and intubation technique [2]. Moreover, the very clear camera view may be stored as an image or video stream on a commercially available secure digital card and subsequently used for education or documentation.

The aim of our study was to compare the ease and success rate of intubation with C-MAC VL and Macintosh laryngoscope as assessed by total intubation time and number of attempts. Additionally we also compared the glottic view, need for external laryngeal manoeuvres, hemodynamic changes and airway morbidity in these two groups.

Materials and Methods:

After obtaining ethics committee approval, 70 adults patients in the age group of 18-60 yrs under American Society of Anaesthesiologists-physical status (ASA-PS) < 3, with Mallampatti grade (MP) 1and 2 undergoing elective surgery under general anesthesia were enrolled for the study. Exclusion criteria included Mallampatti grade III and IV, short neck with large circumference, limited mouth opening (<3cm), limited neck movements, short thyromental distance (<6 cm) & obesity (body mass index of > 30kg/m2), presence of a large tongue, presence of any airway pathology and pregnancy.

A thorough pre-anaesthetic examination was done 24 hours prior to the surgery and all the comorbid conditions, medications of the patient were noted and classified into appropriate ASA-PS grading. BMI was calculated after measuring the patient's height and weight. The airway was assessed using Mallampatti grading. Written informed consent was obtained from the patient. Patients were then randomly allocated into C-MAC group (Group C) or the MacIntosh Laryngoscope group(Group M) by Simple Random sampling technique. (SNOSE: Serially Numbered Opaque Sealed Envelope) [1] and C-MAC video laryngoscope (C-MAC) or MacIntosh laryngoscope were used for laryngoscopy respectively. Pre operatively all patients were advised 150mg of Ranitidine orally the night before surgery and kept nil by mouth.

Monitors used intra operatively were Pulse oximeter, Electrocardiogram and Non Invasive Blood Pressure. Baseline readings of heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and oxygen saturation (SpO2) were recorded before induction. All patients were then pre-medicated with Injection Ondansetron 0.05mg/kg and Inj Fentanyl 1mcg/kg. Following pre-oxygenation with 100% oxygen for 3 minutes, patients were induced with Injection Propofol 2mg/kg. After confirming the adequacy of bag and mask ventilation, injection vecuronium 0.1mg/kg was given for neuromuscular blockade. After three minutes, laryngoscopy was done by an experienced Anaesthesiologist,(who has performed a minimum of 20 successful laryngoscopy and endotracheal intubations with both Macintosh and C-MAC video laryngoscope) with C-MAC VL or Macintosh laryngoscope as per the group patients were allocated into. Trachea was intubated using an appropriate sized endotracheal tube. Placement of ETT was confirmed by bilateral chest auscultation and $EtCO_2$ waveform and tube secured. Haemodynamic variables such as SBP, DBP, and HR were documented at first, third and fifth minute following endotracheal intubation. Further management of the patient was carried out by the concerned Anaesthesiologist as per institutional protocol. At the end of the procedure patients were reversed, extubated and shifted to postoperative ward for further monitoring.

On laryngoscopy with either of the scopes if glottic visualization was not adequate, an experienced second assistant was directed to give external laryngeal manipulation (BURP maneuver-backward, upward, rightward pressure) to bring the glottis in alignment for a proper visualization of the vocal cords and to facilitate endotracheal intubation. In cases where difficulty was faced in negotiating the endotracheal tube through the oropharynx and past the glottis, a malleable stylet was used to facilitate intubation. For obtaining the Cormack Lehane grading, the scope monitor in case of C-MAC and direct visualisation of the glottis in case of Macintosh laryngoscope was used. Successful intubation attempt was defined as an attempt in which the ETT was placed in the trachea as confirmed visually by the passage of the ETT through the glottis. If more than two attempts were needed for successful intubation, then it was considered as a failure. Successful intubation time was defined as the time from when the anaesthesiologist picked up the scope in hand until the first breath of the patient was confirmed by capnography.

Following laryngoscopy with either of the scopes, trauma or any amount of blood seen on the scope, lips, gums, orophanyx and tongue and breakage or trauma to the teeth were considered as airway morbidity. The detached tooth (if any) in the oral cavity, was retrieved using a Magill's forceps. Firm pressure was applied if any bleeding was noticed.

Based on a previous study [1], we calculated the sample size as 35 in each group, assuming a standard deviation of 19 seconds and 9 seconds of total intubation time in each group and a difference of 10 seconds as clinically significant. For a power of 90% and an Alpha error of 5%, a total of seventy patients were needed.

The data obtained were tabulated and represented as absolute numbers with or without percentages or as mean±standard deviation (SD). For analysis of continuous variables, independent sample t-test was applied and for categorical variables chi-square test was used. Value of $p < 0.05$ was considered significant in this study.

Laryngoscopy and intubation characteristics in terms of time taken for successful intubation, number of attempts, manipulations required, hemodynamic responses of the patient, airway morbidity in each group were recorded and compared and the values were statistically analysed and tabulated.

Results

Seventy patients (35 each in ML and CMAC group) with normal airway anatomy undergoing elective surgery were enrolled for this study. The baseline parameters data is provided in Table 1. Baseline patient characteristics such as age, gender, BMI and ASA-PS grading did not show any statistically significant difference between two groups.

The data on primary outcome is given in Table 2. The time taken for intubation was significantly shorter in CMAC group than ML group (26.6±3.17 seconds versus 29.7±4.68 seconds). All the patients were intubated in first attempt in both the C-MAC and Macintosh groups. Cormack-Lehane grading was grade 1 in 31 patients and grade 2 in 4 patients in C-MAC group whereas in Macintosh group, there were 32 patients with grade 1 and 3 patients had grade 2. This was not found to be statistically significant.

In C-MAC group, 2 patients required manipulation with use of stylet, whereas in Macintosh group 4 patients required manipulation with 3 requiring BURP and one patient needing use of stylet.

The heart rate at first minute was 79.03+7.98 and 92.26+11.68 in C-MAC and Macintosh group respectively. (p=0.0001). At third minute it was 116.60±9.53 and 122.31 respectively (p=0.021). At

Table 1: Baseline variables in CMAC VL and ML groups

	CMAC group	Mac Intosh group	P value
Age of patient (years ± SD)	35.09 ± 11.7	33.46 ± 9.1	0.68
Male: Female	19:16	27:8	0.07
BMI	24.06± 3.5	22.32 ± 3.21	0.03

Table 2: Duration of intubation and Cormack Lehane grading in CMAC and ML groups

	CMAC group	Mac Intosh group	P value
Intubation time (seconds ± SD)	26.6 ± 3.71	29.7 ± 4.68	0.003
Cormack Lehane grade I	26	27	NS
Cormack Lehane grade II	9	8	NS

Table 3: Comparison of heart rate between CMAC and ML group

	C-MAC Mean ± SD	MacIntosh Mean ± SD	P value
Basal HR	73.8 ± 8.3	79.7 ±8.4	0.004
At 1Min HR	79.0 ± 7.9	92.2 ± 11.6	<0.001
At 3min HR	116.6 ± 9.5	122.3 ± 12.2	0.02
At 5 min HR	74.4 ± 7.7	80.9 ± 10.6	0.009

Table 4: Systolic blood pressure changes at first, third and fifth minute after intubation

	C-MAC Mean + SD	MacIntosh Mean + SD	P value
Basal SBP	114.8 + 9.5	113.6 + 8.9	0.64
At 1Min SBP	121.4 + 9.7	127.7 + 13.5	0.02
At 3min SBP	116.60 + 9.53	122.31 + 12.23	0.02
At 5 min SBP	113.26 + 9.1	113.66 + 9.8	0.08

Table 5: Diastolic blood pressure changes at first, third and fifth minute after intubation

	C-MAC Mean + SD	MacIntosh Mean + SD	P value
Basal DBP	77.8 + 6.8	75.8 + 6.2	0.19
At 1Min DBP	82.2 + 7.0	85.4 + 9.0	0.10
At 3min DBP	77.06 + 5.9	80.9 + 10.6	<0.009
At 5 min DBP	74.2 + 7.3	73.1 + 7.7	0.54

fifth minute, it was 74.43±7.77 and 80.97±10.62 respectively (p=0.009). Thus a statistically significant difference was seen with lesser increase in heart rate noted in C-MAC group. (Table 3)

The data on changes in systolic blood pressure and diastolic blood pressure are given in table IV and V respectively. A lesser increase in systolic blood pressure was noted at first (p=0.027) and third (p=0.021) minute in C-MAC group.

There were no obvious airway injuries or morbidity noted in the two groups except for one patient in Macintosh group who had slight bleeding from the lips following laryngoscopy and intubation.

Discussion

During the past few years, video laryngoscopes have been introduced into clinical practice and have become increasingly common across a wide spectrum of airway scenarios. Video laryngoscopes can facilitate tracheal intubation by providing an improved view of the larynx and direct observation of the tracheal tube during passage through the vocal cords. As a result, video laryngoscopy may decrease intubation difficulties and ultimately increase first-attempt and overall intubation success rate [3].

Video Laryngoscopes offer many advantages such as improved laryngeal visualization, less cervical spine movement, short learning curve, less force required as compared to direct laryngoscopy and higher success rate.

In this present study, patients were selected with no history and predictors of difficult ventilation or intubation. In order to use the video laryngoscopes effectively during anticipated or unanticipated difficult intubation it is essential that the user have enough experience using the scope in patients with a normal airway. Mallampatti grading was thus restricted to 1 and 2 in our study and morbidly obese patients with BMI of more than 35, which is a potential predictor of difficult airway, were not included.

In our study we found a lesser mean time required for intubation using C-MAC VL compared with ML, consistent with the findings in a similar study conducted by Hodgett et al. [1] Another study comparing 100 patients belonging to ASA I and II also measured lesser intubating times with CMAC (24.8±8.5) compared to 33.8±9.12 seconds using ML [4]. The number of attempts for successful intubation were not significant statistically with all 70 patients being intubated in first attempt itself. This probably can be explained by the similar blade structure and insertion technique of C-MAC and ML. Our findings reinforce the findings of a study comparing CMAC VL and ML in critically ill patients in ICU. CMAC resulted in more successful intubation on first attempt as compared with ML. (34/43, 79% vs 21/38,55% p=0.03) [3].

Cormack Lehane grading was not statistically significant in our study. However in a study comparing the effectiveness of CMAC VL vs ML in patients with predicted difficult airway, a better Cormack Lehane view was seen in CMAC group with p<0.01 [5]. A randomised cross over study on manikins too has demonstrated that CMAC significantly improved the Cormack Lehane grade and the success rate of intubation [6].

In our study, 4 patients in ML group required manipulations in form of BURP and use of malleable stylet compared to 2 patients in CMAC group.

Similar findings were found in a study comparing the above two laryngoscopes in predicted difficult airway conditions, where use of gum elastic bougie and/or external laryngeal manipulation was required less often in CMAC intubtions (p=0.02) [5]. Another study too has reported reduced need for manipulations in CMAC group as compared with Macintosh and Mc Coy laryngoscope [7].

A study comparing hemodynamic responses in patients undergoing cardiac surgeries when intubated with CMAC and ML reported no significant hemodynamic benefits [8]. However, in our study we have observed significantly lesser hemodynamic alterations of SBP at first, third minute following laryngocscopy (p=0.027 and 0.021 respectively). Also the heart rate changes too showed little variation in CMAC group compared to ML group, p=0.0001,0.02, 0.009 at first, third and fifth minutes respectively. Thus we can conclude that CMAC produces lesser stress response to laryngoscopy and intubation compared with ML.

The better performance of CMAC VL in our study in terms of shorter intubation times, higher success rate and lesser requirement of optimising manoeuvres has been reflected in a similar study carried out in difficult airway scenario [1].

Video laryngoscopes thus offer a number of benefits, however there are some disadvantages too like difficulty in passage of the ETT in spite of a good Cormack Lehane score, fogging and secretions obscuring the view, loss of depth perception and different techniques of laryngoscopy and intubation with different types of video laryngoscope [9].

Conclusion

CMAC can be used with higher success rate for intubating patients with no known predictors of difficult airway compared to Macintosh Laryngoscope. The unique combination of the conventional direct laryngoscopic blade design and video monitor in one device makes CMAC a preferred choice in both routine and difficult airway management and also for educational purposes.

Support: Nil

Conflicts of interest: Nil

Permissions: Not applicable

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