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COMPARATIVE STUDY OF C-MAC VIDEO LARYNGOSCOPE VERSUS MACINTOSH LARYNGOSCOPE FOR INTUBATION IN ELECTIVE SURGERY

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ABSTRACT

Background: The aim of the study is to compare the C-MAC video laryngoscope with Macintosh laryngoscope for intubation in patients for elective surgery. **Methods**: This was a prospective and interventional randomized comparative single blinded study in Asian Institute of Medical Sciences (AIMS) Faridabad, after due approval from Institutional Ethics Committee from November 2020 to May 2021. 70 patients of age 18-60 years with American society of Anaesthesiologist (ASA) category I and II and Mallampati Classification I and II under elective surgery were included in the study. Patients were then randomly allocated into C-MAC group (Group A) and the Macintosh Laryngoscope group (Group B) by simple random sampling technique. The comparison among the two groups was based on the total time and number of attempts required for intubation, the glottic view obtained, need for external laryngeal maneuver and/or stylet, and hemodynamic variations observed during the procedure. The statistical analysis was done using SPSS version 21.0. $p < 0.05$ was considered as significant. **Results:** Hemodynamic parameters in C-MAC group showed lesser fluctuations compared to Macintosh group. C-MAC group required significantly less attempts, less external manoeuvre with a better glottic exposure among the two groups. Mean duration of intubation(sec) in Macintosh group was significantly higher as compared to CMAC group (30.66 ± 7.33 vs 18.57 ± 4.31, $p < 0001$). **Conclusion:** C-MAC video laryngoscopy showed better ease of intubation along with advantages such as less hemodynamic changes, less attempts, less external maneuver, better glottic exposure, lesser duration of intubation and less hemodynamic fluctuations when compared to Macintosh laryngoscope.

Keywords: Video laryngoscopy, Macintosh, laryngoscope

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INTRODUCTION

Endotracheal intubation is considered the definitive technique for resuscitation and airway management. Securing the airway with a tube in the trachea is still one of the most important skills in anaesthesia. However, the placement of a tracheal tube can be expectedly or unexpectedly difficult or even impossible.[1–6]The Macintosh laryngoscope (ML) is the most commonly used device for directly visualizing the structures of larynx and facilitating tracheal intubation. Insufficient laryngoscopic view remains a leading reason for difficult intubations thus considerably contributing to anesthesia related morbidity and mortality.[7-9]Anesthesiologists continue to experience poor visibility during laryngoscopy and intubation. Direct laryngoscopy and passage of endotracheal tube through the larynx is a noxious stimulus, which can provoke untoward hemodynamic stress response in normotensive patient. It is more exaggerated inpatients with hypertension, coronary artery disease or cerebral vascular disease. Over 20 years back, American Society of Anesthesiologists (ASA) closed claims analysis concluded that the main reason of anesthesia related injury was the inability to intubate the trachea and secure the airway.[10] With advanced digital technology, complementary metal oxide semiconductors (CMOS) video chip was produced by a number of manufacturers. This led to the development of the video laryngoscopes to see the glottis while intubating the trachea.[11] Recent studies have shown that video laryngoscopes improve laryngeal view and ease intubation difficulty across various airway scenarios.

The C-MAC Video Laryngoscope (VL) holds a promising future in the management of both normal and difficult airway. C-MAC 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.[12] 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. Video laryngoscopy-assisted tracheal intubation has extensively been applied in airway management because of several significant advantages like 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.[13] Improved laryngeal visualization without the need for aligning 3 airway axes, especially in difficult airway conditions. Multi-person visualization feature can facilitate communication and cohesion of team, improve coordination between intubating anaesthesiologist and assistant and thus simply change difficult airway management from “I” to “we”.[14, 15] Furthermore the ability of video laryngoscopy to provide a shared view can make it useful for teaching tracheal intubation.[16] The improved view is due to a magnified video image, anterior curvature of the blade, and reduced need to set a direct visual alignment. While Direct Laryngoscopy may be associated with intubation failure when an adequate laryngeal view cannot be achieved, Video Laryngoscopy frequently overcomes this obstacle. An improved laryngeal view is vital to successfully intubate patients at risk for poor laryngeal view with Direct Laryngoscopy. Purpose of this study was to compare C-MAC Video Laryngoscope and Macintosh Laryngoscope for intubation in elective surgery with respect to total time and number of attempts required for intubation, the glottic view obtained, need for external laryngeal maneuver and/or stylet, and hemodynamic variations observed during the procedure.

AIM: The aim of the study is to compare the C-MAC video laryngoscope with Macintosh laryngoscope for intubation in patients for elective surgery.

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OBJECTIVES

I. Primary:

To compare,

1. Total time for intubation
2. Number of attempts required for intubation
3. Glottic view

II. Secondary:

To compare,

1. Need for external laryngeal manoeuvre
2. Need for stylet
3. Haemodynamic changes

MATERIAL AND METHODS

This prospective and interventional randomized comparative single blinded study was conducted among 70 patients undergoing general anaesthesia in Asian Institute of Medical Sciences (AIMS), Faridabad, Haryana; A tertiary care super-specialty centre in Delhi NCR from 1st November 2020 to May 2021 after receiving an approval from the Institutional Ethics Committee and receiving written verbal informed consent from the patient and their relatives.

Block Randomization:

In this study block randomization with sealed envelope system was used. We prepared ten randomly generated treatment allocations within sealed opaque envelopes assigning A and B in 5 envelopes each, where A represents C-MAC and B represent Macintosh. Once a patient gave consent to enter a trial an envelope was opened and the patient was then offered the allocated group. In this technique, patients were randomized in a series of blocks of ten. The patient was not aware which treatment was allocated to him/her making the study single blinded.

Study intervention

A thorough pre-anaesthetic examination was done prior to the surgery and all the comorbid conditions, medications of the patient was noted and classified into appropriate ASA 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. Preoperatively all patients were kept nil by mouth for 8 hours prior to surgery. Patients were then randomly allocated into C-MAC group (Group A) or the Macintosh Laryngoscope group (Group B) by Simple Random sampling technique. (SNOSE: Serially Numbered Opaque Sealed Envelope) and C-MAC video laryngoscope (C-MAC) or Macintosh laryngoscope was used for laryngoscopy respectively. Monitors used intra operatively were pulse oximeter, electrocardiogram and noninvasive blood Pressure. $EtCO_2$, baseline readings of heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and oxygen saturation (SpO2) was recorded before induction. All patients were then pre-medicated with 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

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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 40 successful laryngoscopies and endotracheal intubations with both Macintosh and C-MAC video laryngoscope) with C-MAC video laryngoscope or Macintosh laryngoscope, as per the group patients are allocated into. Trachea was intubated using an appropriate sized endotracheal tube. Placement of ETT was confirmed by bilateral chest auscultation and Et CO_2 wave form and Endotracheal Tube was secured. Haemodynamic variables such as SBP, DBP, HR $EtCO_2$ and SpO_2 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 neuromuscular blockade was reversed, patients were, extubated and shifted to postoperative ward for further monitoring.

Methods of Measurement of Outcome of Interest

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 anesthesiologist picked up the scope in hand until the first breath of the patient was confirmed by capnography. For obtaining the Cormack lehane grading, the scope monitoring case of C-MAC and direct visualization of the glottis in case of Macintosh laryngoscope was used.

On laryngoscopy with either of the scopes if glottis 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.

Sample size

In the study of Archana K.N.[17]et al observed that mean intubation time in C-MAC group was 26.6±3.71 seconds and in Macintosh group was 29.7±4.68 seconds. Taking these values as reference the minimum required sample size with 80% power of study and 5% level of significance is 30 patients in each study group. To reduce margin of error, total sample size taken is 70 (35 patients per group).

STATISTICAL ANALYSIS

Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean ±SD and median. Normality of data was tested by Kolmogorov-Smirnov test. If the normality is rejected then non parametric test was used. Statistical tests were applied as follows-Quantitative variables were compared using Unpaired t-test between the two groups. Qualitative variables were compared using Chi-Square test /Fisher's exact test. P value of <0.05 was considered statistically significant. The data was analyzed using Statistical Package for Social Sciences (SPSS) version 21.0.

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RESULTS AND OBSERVATIONS

Demographic data was comparable to each other in the both group in this study. There was no significant difference seen between airway assessment parameters between the group A and B with P values of 0.854 and 0.208 for mouth opening and neck circumference respectively. Total duration of intubation in the group A was 18.57+4.31 and group B was 30.66 ± 7.33 with P 0.0001 which was statistically significant and the duration of intubation was more in group B. There was significant difference seen in number of attempts for intubations in Group B as compared to group A with P value of 0.006. Proportion of patients who needed external laryngeal manoeuvre was significantly lower in group A (5.71%) patients as compared to group B (74.29%) patient. During intubation, stylet was used in 11 (31%) patients in Group A and 10 (28%) patients in group B. There was no significant difference seen in hemodynamic parameters between group A and group B at rest. In both Groups A and B, heart rate and BP (SBP, DBP) showed a trend of increase from the baseline (at resting) just before intubation, followed by sudden rise at 1 minute and then a continuous fall till 5 minutes after intubation. However, the increase in HR, SBP and DBP was significantly less in C-MAC group compared to ML group. ($p < 0.05$).

Thus, C-MAC video laryngoscopy guided intubation required less duration for intubation, less number of attempts and better hemodynamic stability as compared to Macintosh laryngoscopy.

Table 1: Demographic profile of patient

DEMOGRAPHIC DATA	GROUP A	GROUP B	P VALUE
Age	33.83 ± 10.33	37.51 ± 10.73	0.148*
Male/ female	6/29	10/25	0.255‡
Weight (kg)	72.42 ± 10.51	74.14 ± 8.49	0.899*
Height (cm)	164.21 ± 8.812	166.140 ± 7.930	0.871*
BMI (kg/m)2	26.8 ± 3.33	26.9 ± 4.37	0.279*
ASA 1/2	21/14	22/13	0.806‡
Time taken for intubation	18.57 ± 4.31	30.66 ± 7.33	0.0001*

‡Chi Square Test *Independent t Test

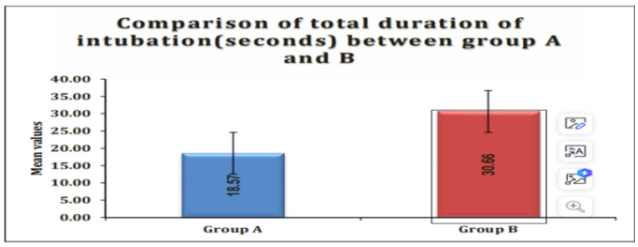

Figure 1: Comparison of intubation time between group A and B.

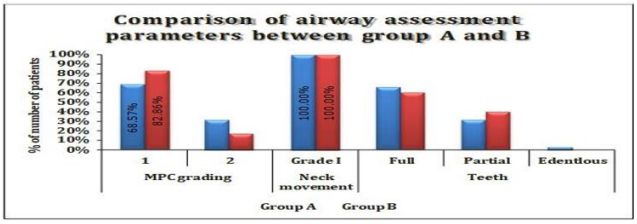

Figure 2: Comparison of airway assessment parameters between group A and B

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Table2: Comparison of airway assessment parameters between group A and B.

Airway assessment Parameters	GroupA(n=35)	GroupB(n=35)	Total	Pvalue
MPC grading				
1	24 (68.57%)	29 (82.86%)	53 (75.71%)	0.163‡
2	11 (31.43%)	6 (17.14%)	17 (24.29%)	
Neck movement				
GradeI	35(100%)	35 (100%)	70(100%)	Nopvalue
Teeth				
Full	23 (65.71%)	21(60%)	44 (62.86%)	
Partial	11 (31.43%)	14 (40%)	25 (35.71%)	0.618†
Edentlous	1 (2.86%)	0 (0%)	1(1.43%)	
Mouth opening(cm)				
Mean± SD	4.8 ± 0.35	4.81 ± 0.3	4.81 ± 0.32	
Median(25th-75th percentile)	5(4.5-5)	5(4.5-5)	5(4.5-5)	0.854*
Range	4-5	4-5	4-5	
Neck circumference(cm)				
Mean± SD	36.33 ± 1.8	35.84 ± 1.42	36.08 ± 1.62	
Median(25th-75thpercentile)	36.6(35.6-37.55)	35.6(34.8-37.25)	36.15(34.85-37.4)	0.208*
Range	31-38.8	33.4-38.2	31-38.8	

***Independent t test ,†Fisher's exact test ,‡Chi square test**

Table 3:Comparison of number of attempts between group A and B.

Numberof attempts	Group A(n=35)	Group B(n=35)	Total	Pvalue
1	31 (88.57%)	21 (60%)	52 (74.29%)	0.013†
2	4 (11.43%)	14 (40%)	18 (25.71%)	
Mean± SD	1.11 ± 0.32	1.4 ± 0.5	1.26 ± 0.44	
Median(25th-75thpercentile)	1(1-1)	1(1-2)	1(1-1.75)	0.006*
Range	1-2	1-2	1-2	

Independent t test, †Fisher's exact test

Table 4: Comparison of glottic view between group A and B.

Glottic view(CormackLehane grading)	GroupA(n=35)	GroupB(n=35)	Total	Pvalue
CL1	18 (51.43%)	13 (37.14%)	31 (44.29%)	
CL2a	15 (42.86%)	11 (31.43%)	26 (37.14%)	0.041†
CL2b	1 (2.86%)	8 (22.86%)	9 (12.86%)	
CL3a	1 (2.86%)	3 (8.57%)	4 (5.71%)	
Total	35 (100%)	35 (100%)	70 (100%)	

†Fisher's exact test

Table 5:Comparison of need for external laryngeal manoeuvre between group A and B.

Need for external laryngeal manoeuvre	GroupA(n=35)	GroupB(n=35)	Total	Pvalue
No	33(94.29%)	9 (25.71%)	42(60*%)	
Yes	2 (5.71%)	26 (74.29%)	28 (40%)	<.0001†
Total	35 (100%)	35 (100%)	70 (100%)	

†Fisher's exact test

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Table 6: Comparison of need for stylet between group A and B.

Need of stylate	GroupA	GroupB	Total	P value
No	24(68.57%)	25 (71.43%)	49(70%)	0.794‡
Yes	11(31.43%)	10 (28.57%)	21 (30%)	
Total	35 (100%)	35 (100%)	70 (100%)	

Table 7: Comparison of Hemodynamic parameters between group A and B.

PARAMETER	GROUP	AT REST	AT 1 MIN	AT 3 MIN	AT 5 MIN
HR	**GROUP A**	86.6+/- 7.33	94.8+/-6.03	86.29+/-4.49	77.91+/-4.04
	GROUP B	84.03+/- 8.54	104.91+/-8.42	92.09+/-5.7	84.4+/-45.62
	P VALUE	0.181	<0.0001	<0.0001	<0.0001
SBP	**GROUP A**	133.7+/-14.07	139.11+/-8.91	128.43+/-8.03	122.03+/-6.59
	GROUP B	131.54+/-8.77	155.17+/-10.96	143.63+/-12.16	128.4+/-10.6
	P VALUE	0.43	<0.0001	<0.0001	0.004
DBP	**GROUP A**	84.2+/-10.55	86.77+/-7.92	79.03+/- 8.17	74+/-8.79
	GROUP B	83.89+/-9.44	97.31+/-6.13	90.11+/-7.44	82.29+/-8.19
	P VALUE	0.896	<0.0001	<0.0001	0.0001

*** Unpaired t-test**

DISSCUSSION

We preferred to use the term laryngoscopy time as time taken from insertion of blade between the teeth until the cuff of endotracheal tube is directly visualized passing through vocal cords. In the index study, we noted a significant difference in duration of intubation (sec) between group A and B. Mean duration of intubation time (sec) in Macintosh group was significantly higher as compared to C-MAC group 30.66 ± 7.33 vs 18.57 ± 4.31 with p <0.05 In our study 1st attempt success rate of intubation by C-MAC was higher 88.57% (31 patients) as compared to macintosh group 60% (21 patient) and 2nd attempt of intubation was more in macintosh group 40% (14 patients) as compared to C-MAC group 11.43% (4 patient). Thus success rate , ease of intubation were more in C-MAC group compared to Macintosh group (P < 0.05) Similar result found by Aziz et al.[18] C-MAC lead to more successful intubations on first attempt than Macintosh group (93% vs. 84%, P = 0.026). Also Rajan S et al.[19] found that number of patients intubated in the first attempt was more in C-MAC group (96.7 vs 70%). The findings are also supported by study of Kiliçaslan et al.[20], where C-MAC provided rapid intubation than Macintosh. Also, the number of intubations attempts, or optimization manoeuvres needed for the C-MAC was lesser than that required for the Macintosh. The higher success rate provided by the C-MAC is possibly associated with the anterior extension as well as magnification of laryngeal view, which is shown on the screen; this is not accessible at the time of conventional direct laryngoscopy.

In our study in C-MAC group, use of stylet and external laryngeal manipulation were needed less than Macintosh group. (24% vs. 37%, P= 0.020). Similarly, Mogahed et al.[21] found significant difference between group Macintosh and group CMAC when using external laryngeal manipulation. Tracheal intubation using the C-MAC needed less external laryngeal manipulation or the application of a gum-elastic bougie, implying that a better laryngeal vision and familiar blade curve of the C-MAC blades made intubation easier.[18]

In our study in both Groups A and B, heart rate and BP (SBP, DBP) showed a trend of increase from the baseline (at resting) just before intubation, followed by sudden rise at 1

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minute and then a continuous fall till 5 minutes after intubation. However, the increase in HR, SBP and DBP was significantly less in C-MAC group as compared to Macintosh laryngoscope group. ($p< 0.05$). Similar to our study, Archana et al.[17] observed that the increase in SBP at 1st (121.43) and 3rd minutes (116.60) after laryngoscopy was significantly lower in C-MAC group (127.77and 122.31, respectively) ($p< 0.05$). Physical stimulation of the larynx by direct laryngoscopy and endotracheal intubation gives rise to a serious sensitivity in the upper respiratory airway by activating the sympathetic nervous system such as increased heartbeat, raised blood pressure. The advantage of C-MAC laryngoscope over the macintosh laryngoscope is enabling laryngoscopy without aligning the oral cavity, pharynx and larynx axes thereby resulting in less fluctuations in haemodynamic parameter and also beneficial in cases with cervical spine anomalies and difficult airway,

STRENGTHS OF THE STUDY

- The study holds strength in nullifying the bias caused due to different experience of the operators since all the procedures for both groups of patients were carried out by a single investigator.
- Many of our results corroborated with other studies thus, adding to the already existing literature about the comparative use of C-MAC and Macintosh.
- Present study compared intubation success with C-MAC VL with Macintosh in a study population with no difficult airway, covering only elective surgical patient population.

LIMITATIONS OF THE STUDY

- The study results must be interpreted under certain limitations. Firstly, since it was impossible to blind the investigator to the device being applied, this study is not a double- blind trial and the potential for bias may exist.
- Secondly, this study was conducted on normal patients and its results cannot be extrapolated to patients with hypertension, to those who are anticipated to have difficult oro-tracheal intubation or having other co morbidities.
- Lastly, ideally invasive BP monitoring by inserting an arterial line could have been more informative to capture more frequent BP readings; however, it was unjustifiable to use invasive BP readings

CONCLUSION

C-MAC video laryngoscopy showed better results owing to advantages such as less hemodynamic changes, less attempts, less external maneuver, and better glottic exposure when compared to Macintosh laryngoscope. Thus, video laryngoscopy may be more reliable in cases with limited cardiovascular and central nervous system reserves for the hemodynamic response to intubation.

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