

# A RANDOMIZED PROSPECTIVE COMPARATIVE STUDY TO EVALUATE THE EASE OF INTUBATION USING CONVENTIONAL MACINTOSH LARYNGOSCOPY AND VIDEO LARYNGOSCOPY DURING ROUTINE INDUCTION OF ANAESTHESIA

Pavithra Devaraj<sup>1</sup>, Vinobarathi K<sup>2</sup>, Elanchezhian D<sup>3</sup>

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Corresponding Author:  
**Dr. Vinobarathi K,**  
Email: vinobarathik@gmail.com

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<sup>1</sup>Assistant Professor, Department of Anaesthesiology, JR Medical College and Hospital, Villupuram, Tamil Nadu, India.

<sup>2</sup>Associate Professor, Department of Anaesthesiology, JR Medical College and Hospital, Villupuram, Tamil Nadu, India.

<sup>3</sup>Senior Resident, Department of Community Medicine, JR Medical College and Hospital, Villupuram, Tamil Nadu, India.

## ABSTRACT

**Background:** Macintosh direct laryngoscopy is still the standard method of endotracheal intubation, but it frequently causes challenges in certain circumstances, and can be associated with increased haemodynamic responses. Video laryngoscopes, such as the C-MAC, have been developed in order to improve glottic visualization and potentially ease and safety of intubation. The present study has been designed to compare the achievement of intubation conditions using the conventional Macintosh laryngoscope and C-MAC video laryngoscope in adult patients undergoing elective procedures. **Materials and Methods:** This was a randomized, prospective comparative study involving 150 adult patients aged 18-60 years of ASA physical status I & II undergoing elective surgeries under general anaesthesia. Participants were divided into two groups, Group M (Macintosh laryngoscope, n = 75) and Group C (C-MAC video laryngoscope, n = 75). Intubation was done in accordance with standard anaesthetic protocols. The outcomes measured: ease of intubation, Cormack Lehane grading, number of intubations, duration of intubation, requirement for stylet and any complications. **Result:** Both groups were similar for demographic and baseline variables ( $p > 0.05$ ). Intubation was rated as easy in a greater proportion of patients of the C-MAC group (88.0%) compared with the Macintosh group (72.0%) ( $p = 0.014$ ). First pass success was significantly higher with C-MAC (96.0% vs. 76.0%,  $p = 0.002$ ). The mean number of attempts was less (1.04 vs. 1.29,  $p < 0.001$ ), and the mean time to successful intubation were less (1.95 vs. 2.20 min,  $p = 0.030$ ) with the video laryngoscope. Use of stylet was less common in the C-MAC group (4.0% vs. 18.7%,  $p = 0.033$ ). C-MAC group had an Intubation Difficulty Score (IDS) of 0 observed more frequently than in the control group (62.7% vs. 20.0%,  $p < 0.001$ ). Although glottic visualization (Grade I view) was more common with C-MAC (66.7% vs. 52.0%), the difference was not statistically significant ( $p = 0.087$ ). **Conclusion:** Compared with the Macintosh laryngoscope, the C-MAC video laryngoscope offered better conditions of intubation with greater ease, higher success with first attempt intubation, shorter times of intubation and less difficulty score. These results are suggestive that C-MAC may be a more effective device for routine airway management under general anaesthesia.

## INTRODUCTION

Intubation of the endotracheal is one of the most important skills of anaesthesiologists, which guarantees the airway clearance in general anesthesia and the ease of mechanical ventilation. Patient safety depends on a successful intubation, and a number of

approaches are used to this end. The most widely used method of endotracheal intubation is the laryngoscopy. The Macintosh laryngoscope has traditionally been the gold standard in this procedure, providing first hand visualization of the vocal cords to assist in tube placement. Nevertheless, with the development of video laryngoscopy (VL), a new form of airway management has been implemented,

which has the potential benefits in some clinical scenarios.<sup>[1]</sup>

The cornerstone of airway management over decades has been Macintosh laryngoscopy which was invented in the middle of the 20<sup>th</sup> century. It involves direct visualization of the larynx by offering a view through the mouth cavity by the use of a handheld apparatus. Although it works in most situations, the technique may be technically difficult especially in patients with recalcitrant airways.<sup>[1,2]</sup> The visualization of the glottis may become harder by factors that include: limitation of the mouth opening, immobility of the cervical spine, or anatomical disorders, resulting in extended intubation experiences or ineffective procedures. These complications expose the patient to the risk of complications, including hypoxia or airway trauma.<sup>[3,4]</sup>

Conversely, video laryngoscopy has been identified as a new technology in airway management. Video laryngoscopes offer a better view of the airway by offering to show the observer real-time images of the larynx through a monitor. The technique is the indirect visualization of the airways and it makes the process of intubation potentially easier and more precise even in patients with hard airways. The capability to see into the glottis without necessarily positioning the laryngoscope in line with the view has seen it become more and more popular in routine and emergency practice. Video laryngoscopes are thought to diminish the necessity of a forceful manipulation that will enhance the safety and comfort of patients.<sup>[5-7]</sup>

Although video laryngoscopy has the potential to offer several advantages, issues on its cost, complexity and learning curve have been raised. The differences between video and conventional laryngoscopy have been studied in numerous research works, however, the findings were not consistent. It is a prospective comparative study that aims at comparing the ease of intubation between traditional Macintosh laryngoscopy and video laryngoscopy in the routine performance of anesthesia induction.<sup>[7-10]</sup> The comparison of the two approaches will help the study to bring meaningful information on the relative effectiveness, safety, and appropriateness of these two methods in the normal clinical practice. The results of the research might inform future practice-based recommendations regarding airway management in elective anesthesia and emergency anesthesia.

## MATERIALS AND METHODS

### Study Setting

This randomized controlled trial project was carried out at the Department of Anaesthesiology, Santosh hospital, Bangalore, in the period between September 2019 and August 2021.

### Study Population

The population sampling entailed both male and female patients aged between 18 and 60 years that were undergoing elective surgeries under general anesthesia.

### Inclusion Criteria

Patients were selected as follows:

- Age between 18 and 60 years.
- I and II physical status of ASA (American Society of Anesthesiologists).
- Planned elective surgery under general anesthesia using oral endotracheal intubation.

### Exclusion Criteria

Patients were eliminated on the following grounds;

- Pregnancy.
- Mouth opening  $\leq 4$  cm.
- Oral pathology or mass.
- Gastric aspiration is at high risk.
- Urgent necessity induction of sequence.
- Nasal intubation is required.
- Patients who underwent intubation before surgery.

### Sample Size Calculation

The sample size was determined based on the research by Erol Cavus et al., which found the average intubation time of video laryngoscopy ( $8.11 \pm 1.4$  seconds) and the direct laryngoscopy ( $21 \pm 2.4$  seconds). The sample size required was 61 patients per group, which was found to have 95% confidence interval and power of 80. To consider a 20 percent dropout rate, the adjusted final sample size was set to be 75 per group, and 150 patients were considered.

### Sampling Technique

A random number table based on a computer-generated random number table was used to assign eligible participants to two groups randomly:

- Group M (n = 75): Intubation done using the traditional Macintosh direct laryngoscope.
- Group V (n = 75): Intubation with the use of C-MAC video laryngoscope.

### Method of Data Collection

The pre-anaesthetic assessment was conducted in detail, comprising of medical history, physical examination, and airway Inspection. Measurement of items in atlanto-occipital joint mobility, temporomandibular joint function, upper lip bite test (ULBT), thyromental and sterna-mental distances, neck circumference and neck-modified Mallampati grading were assessed. The patients were then brought to the operating room and a standard ASA monitoring (ECG, NIBP, pulse oximetry) was placed and an intravenous line made. The protocol was followed as follows:

1. Check equipment, video laryngoscope battery.
2. Choose the proper diameter of the endotracheal tube.
3. Baseline hemodynamic values (heart rate, blood pressure, SpO<sub>2</sub>).
4. Institute premedication of IV glycopyrrolate (0.2 mg) and midazolam (1 mg).
5. Place anesthesia and do it according to a standard.

6. Observation of vitals before intubation.
7. Conduct group assignment tracheal intubation using the Macintosh or C-MAC video laryngoscope. In the case of the C-MAC group, video laryngoscopy was carried out in the D-Blade technique and the adequate angulation of the indirect glottic observation.

#### Parameters Assessed

The parameters evaluated and compared were:

- Ease of intubation.
- CormackLehane grading of glottic visualization.
- Number of attempts at intubation.

- Use of a stylet.

#### Statistical Analysis

The data have been entered into the Microsoft Excel and analyzed by the use of SPSS version 22 (IBM SPSS Statistics, Somers NY, USA). Frequency and percentage were used to describe categorical data and Chi-square used to compare the same. Continuous data were reported in the form of mean differences and standard deviation and analyzed through the independent t-test. A p-value less than 0.05 was taken to represent a statistical significance.

## RESULTS

**Table 1: Demographic characteristics of patients across two groups**

Parameter	Macintosh Group (n = 75)	C-MAC Group (n = 75)	p-value
Age (years), Mean $\pm$ SD	38.45 $\pm$ 12.012	35.71 $\pm$ 11.706	0.596
Sex (Female / Male)	34 / 41	37 / 38	0.624
Height (cm), Mean $\pm$ SD	159.1 $\pm$ 4.5	159.2 $\pm$ 4.5	0.871
Weight (kg), Mean $\pm$ SD	64.6 $\pm$ 6.7	64.7 $\pm$ 6.4	0.97
BMI (kg/m <sup>2</sup> ), Mean $\pm$ SD	25.4 $\pm$ 1.9	25.5 $\pm$ 1.8	0.972
ASA Physical Status (I / II)	47 / 28	42 / 33	0.406
Mallampati Class (I / II / III / IV)	4 / 60 / 8 / 3	3 / 54 / 14 / 4	0.525
Thyromental Distance (<6 cm / $\geq$ 6 cm)	71 / 4	68 / 7	0.347

Baseline characteristics of both groups of subjects (Macintosh and C-MAC) were similar. The mean age of the participants of the Macintosh group was calculated as 38.45  $\pm$  12.012 years, while the mean age of the participants of the C-MAC group was calculated to be 35.71  $\pm$  11.706 years; there was no statistically significant difference ( $p = 0.596$ ). Regarding sex distribution, 34 females and 41 males were in the Macintosh group compared to 37 females and 38 males in the C-MAC group and this difference was also not statistically significant ( $p = 0.624$ ). The mean height was comparable for both groups with the Macintosh group at 159.1  $\pm$  4.5 cm and the C-MAC group at 159.2  $\pm$  4.5 cm ( $p = 0.871$ ), while the mean weight was 64.6  $\pm$  6.7 kg for the Macintosh group and 64.7  $\pm$  6.4 kg for the C-MAC group ( $p = 0.97$ ). Both groups had a similar Body Mass Index (BMI) with the Macintosh group mean 25.4  $\pm$  1.9 kg/m<sup>2</sup> and mean for C-MAC group 25.5  $\pm$  1.8 kg/m<sup>2</sup> ( $p =$

0.972). In terms of ASA physical status, in the presence of the Macintosh group there were 47 patients with ASA I and 28 patients with ASA II, and in the presence of the C-MAC group in the presence of 42 patients with ASA I and 33 patients with ASA II and did not find any difference between the two groups ( $p = 0.406$ ). The same result was seen with no significant difference with 4, 60, 8, and 3 patients in classes I, II, III, and IV in the Macintosh group, respectively, and 3, 54, 14, and 4 in the C-MAC group ( $p = 0.525$ ). Finally, there was similarity in terms of thyromental distance with 71 patients in the Macintosh group and 68 in the C-MAC group with distance  $\geq$ 6 cm and the rest of the participants with distance <6 cm with no significant difference ( $p=0.347$ ). These results confirm that the baseline characteristics of both groups were balanced, decreasing the chance of factors that could lead to a difference in results. [Table 2]

**Table 2: Comparative analysis of intubation between Macintosh and C- Mac**

Ease of Intubation	Macintosh Group (n = 75)	%	C-MAC Group (n = 75)	%
Easy	54	72.00%	66	88.00%
Difficult	21	28.00%	9	12.00%
<b>Total</b>	<b>75</b>	<b>100</b>	<b>75</b>	<b>100</b>

The ease of intubation was significantly better in the C-MAC group (88.0% of intubations rated as "easy") than in the Macintosh group (72.0%) ( $p = 0.014$ ).

Correspondingly, the proportion of difficult intubations was higher in the Macintosh group (28.0%) than in C-MAC group (12.0%). [Table 2]

**Table 3: Cormack - Lehane grading scale Macintosh group and C- Mac**

Cormack-Lehane Grade	Macintosh Group (n = 75)	%	C-MAC Group (n = 75)	%
Grade 1	39	52.00%	50	66.70%
Grade 2A	15	20.00%	16	21.30%
Grade 2B	20	26.70%	9	12.00%
Grade 3	1	1.30%	0	0.00%
<b>Total</b>	<b>75</b>	<b>100</b>	<b>75</b>	<b>100</b>

Cormack-Lehane (CL) grading indicated better glottic visualization using the C-MAC laryngoscope (Grade 1 view in 66.7% vs 52.0% in Macintosh),

however the difference was not statistically significant ( $p = 0.087$ ). [Table 3]

**Table 4: Number of Intubation attempts between Macintosh and C- mac**

Number of Attempts	Macintosh Group (n = 75)	%	C-MAC Group (n = 75)	%	p-value
1 Attempt	57	76.00%	72	96.00%	<b>0.002*</b>
2 Attempts	14	18.70%	3	4.00%	
3 Attempts	4	5.30%	0	0.00%	
<b>Total</b>	<b>75</b>	<b>100</b>	<b>75</b>	<b>100</b>	
<b>Mean <math>\pm</math> SD</b>	<b>1.29 <math>\pm</math> 0.56</b>		<b>1.04 <math>\pm</math> 0.20</b>		0.001*

The number of intubation attempts required was significantly less in the C-MAC group. First attempt success was achieved in 96.0% of the patients using C-MAC compared to 76.0% in the Macintosh group

( $p = 0.002$ ). The mean number of attempts also was less in the C-MAC group (1.04  $\pm$  0.20) than in the Macintosh group (1.29  $\pm$  0.56) and this was statistically significant ( $p < 0.001$ ). [Table 4]

**Table 5: Time to intubation distribution comparison between two groups**

Number of Attempts	Macintosh Group (n = 75)	%	C-MAC Group (n = 75)	%	p-value
1 Attempt	57	76.00%	72	96.00%	<b>0.002*</b>
2 Attempts	14	18.70%	3	4.00%	
3 Attempts	4	5.30%	0	0.00%	
<b>Total</b>	<b>75</b>	<b>100</b>	<b>75</b>	<b>100</b>	
<b>Mean <math>\pm</math> SD</b>	<b>1.29 <math>\pm</math> 0.56</b>		<b>1.04 <math>\pm</math> 0.20</b>		0.001*

Time to intubation was significantly reduced in the C-MAC group with 84.2% of patients intubated within 2 minutes compared to the Macintosh group (73.3%),  $p = 0.030$ . The mean time to intubation was

also significantly reduced in the C-MAC group (1.95 $\pm$ 0.40 min) compared to the Macintosh group (2.20 $\pm$ 0.66 min). [Table 5]

**Table 6: Need of Stylet and Bougie distribution comparison between two groups**

Need of Stylet and Bougie	Macintosh Group (n = 75)	%	C-MAC Group (n = 75)	%
None	61	81.30%	72	96.00%
Bougie	4	5.30%	1	1.30%
Bougie + Stylet	4	5.30%	0	0.00%
Stylet	6	8.00%	2	2.70%
<b>Total</b>	<b>75</b>	<b>100</b>	<b>75</b>	<b>100</b>

Difference in the need for adjuncts such as a stylet or bougie was significantly different between the two groups. In the Macintosh group, 81.3% (61 out of 75) of patients did not need any adjuncts, and in the C-MAC group, 96% (72 out of 75) of the patients did not require any external aids. The use of a bougie was necessary in 5.3% of the patients in the Macintosh group (4 of 75) and only 1.3% in the C-MAC group (1 of 75). Additionally, 5.3% of the Macintosh group needed both a bougie and stylet (4 out of 75), whereas

no patients of the C-MAC group needed this combination. The need for a stylet alone was higher in the Macintosh group (8%, 6 out of 75) as compared to the C-MAC group (2.7%, 2 out of 75). These results suggest the C-MAC video laryngoscope has reduced the need for adjuncts, suggesting it may be used to facilitate easier and more effective intubation when compared to the conventional Macintosh laryngoscope. [Table 6]

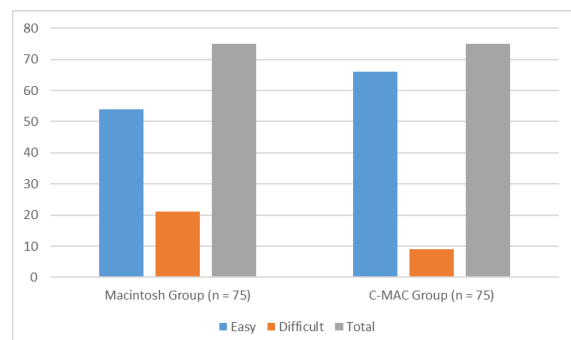
**Table 7: Difficulty in intubation - Score between two groups**

Intubation Difficulty Score (IDS)	Macintosh Group (n = 75)	%	C-MAC Group (n = 75)	%
0	15	20.00%	47	62.70%
1	11	14.70%	15	20.00%
2	16	21.30%	13	17.30%
3	15	20.00%	0	0.00%
4	15	20.00%	0	0.00%
5	3	4.00%	0	0.00%
<b>Total</b>	<b>75</b>	<b>100</b>	<b>75</b>	<b>100</b>

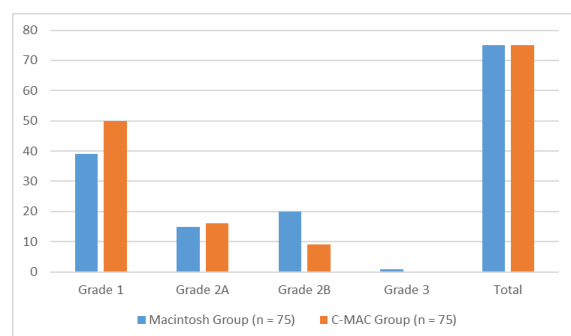
Intubation Difficulty Score (IDS) in a further confirmation of these results, 62.7% of patients in the

C-MAC group achieved IDS of 0 (non-difficulty) versus only in 20.0% in the Macintosh group.

Difficulties scores (IDS  $\geq 3$ ) were reported only in the Macintosh group, with the difference in the IDS distribution of the two groups being very significant ( $p < 0.001$ ). [Table 7] These results showed that C-MAC video laryngoscope exhibited better intubation conditions than the conventional Macintosh laryngoscope in terms of ease, first attempt success, time and difficulty.



**Figure 1: Graph showing the Ease of intubation between the Macintosh and C- Mac**



**Figure 2: Cormack - Lehane scale**

## DISCUSSION

This randomized controlled trial was done to compare the effects of C-MAC video laryngoscope and traditional Macintosh laryngoscope in patients with elective surgeries under general anesthesia. There are 150 patients aged between 18 and 60 years were randomly divided into two groups Macintosh and C-MAC where 75 patients were allocated in each group.

The primary hypotheses of the study were to establish whether C-MAC video laryngoscope had any benefits over the Macintosh laryngoscope in relation to several variables such as the number of attempted intubation, Cormack-lehane grade, time to successful intubation, the use of external maneuvers or adjuncts, and after intubation hemodynamic recovery.

The baseline characteristics, such as age, gender distribution, and ASA, anthropometric measurements, and BMI were equal in both groups, which indicates that the randomization process was effective and had minimized possible confounding factors.

It was found that a much larger proportion of patients in the C-MAC group (88%) achieved an easy Cormack-Lehane (CL) grade than the Macintosh

group (72%). This was statistically significant and indicated that the increased glottic visualization using C-MAC device might be explained by the fact that it has an anatomically curved blade and better view on the video camera. These findings follow the findings of Jungbauer et al. and Parasa et al. both of which also found an improvement in glottic visualization using video laryngoscopy<sup>(11,12)</sup>.

Also, the success rate of the first attempt was significantly greater in C-MAC group (96%) than in Macintosh group (76%). The average number of tries was also less in C-MAC group (1.04 0.197 vs 1.29 0.564). This observation is comparable to Silverberg et al., who revealed that the video laryngoscopy had a high rate of first-pass success. Nevertheless, research conducted by Lascarrou et al. did not show any significant difference in the first-pass success of C-MAC and direct laryngoscopy, which is the opposite of the present research.

In addition, more patients in the Macintosh group (18.6 percent) had to be assisted with the help of adjuncts, such as a bougie or stylet, to carry out intubation than only 4 percent of patients in the C-MAC group. This shows that the video laryngoscope must have ensured an easier insertion of the tube, which further supports the ergonomic advantage of the C-MAC system.

The average intubation duration in the C-MAC group (1.95 minutes 0.40) was also significantly reduced, as compared to the Macintosh group (2.20 minutes 0.66). Although the results presented in this study indicate the superiority of C-MAC video laryngoscope in the context of easier intubation, improved vision, reduced attempts, as well as the reduced necessity of external maneuvers in comparison to the conventional Macintosh laryngoscope, there are certain limitations. There was no control over the skill level of the anesthetist and their experience as well as the results might not be generalizable to pediatric patients or difficult airways which might alter the results.

## CONCLUSION

In conclusion, this study suggests that the C-MAC video laryngoscope has a lot of advantages compared with the Macintosh laryngoscope and that those advantages include decreased intubation time, increased ease of intubation, good glottic visualization properties, decreased number of intubation attempts, and decreased need for adjuvant maneuvers. These results support the use of video laryngoscopy as a preferable option for regular intubation procedures in elective surgical procedures under general anesthesia.

**Conflict of interest:** Nil

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