

# A comparison of intubating conditions for nasotracheal intubation with standard direct Macintosh laryngoscope versus C-MAC® video laryngoscope employing cuff inflation technique in adult patients

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## ABSTRACT

**Background and Aims:** While performing laryngoscopy during nasotracheal intubation (NTI), the tip of the advancing endotracheal tube (ETT) generally lies along the posterior pharyngeal wall. The inflation of the ETT cuff brings it anterior towards the glottis. The present study was planned to compare the intubating conditions for NTI with standard direct Macintosh laryngoscope versus C-MAC® video laryngoscope (VL) employing ETT cuff inflation technique.

**Methods:** This prospective randomised study was carried out on 50 patients, American Society of Anesthesiologists physical status I–II, age 18–60 years of either sex with an indication for NTI under general anaesthesia. They were randomly divided into two groups: group VL ( $n = 25$ ): C-MAC® VL and group ML ( $n = 25$ ): Macintosh laryngoscope. The primary outcome was to compare the total duration of NTI (T), while the secondary outcomes were to compare the need for cuff inflation or assistance with Magill forceps for successful NTI, the total number of attempts to achieve successful NTI, haemodynamic effects and complications.

**Results:** T was significantly higher in group ML than group VL ( $P < 0.001$ ). The intubation was successful with cuff inflation in all the patients in group VL, however, six patients of group ML required assistance with Magill forceps ( $P = 0.022$ ). The haemodynamic parameters were all significantly higher at 3 min in group ML in comparison to group VL. **Conclusion:** The cuff inflation technique when used along with C-MAC® VL had more success rate, required lesser time and had minimal postoperative complications in comparison to the Macintosh laryngoscope.

**Key words:** C-MAC® video laryngoscope, Macintosh laryngoscope, nasotracheal intubation

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## INTRODUCTION

Nasotracheal intubation (NTI) is the most common method used for providing anaesthesia in patients undergoing oropharyngeal and maxillofacial surgeries.<sup>[1]</sup>

Various techniques can be used for NTI including blind intubation, conventional laryngoscopy, video laryngoscope (VL), or under fiberoptic guidance. The advantages of Macintosh direct laryngoscopy are familiarity, direct glottic visualisation, cost-effectiveness, and a steep learning curve.<sup>[2]</sup>

C-MAC® VL (Karl Storz, Tuttlingen, Germany) is a type of non-channelled VL introduced by Kaplan and Berci in 2003.<sup>[3]</sup> It has been widely used to assist difficult

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intubation, reduces intubation time, and causes less incidence of complications like failed intubation, hypoxia, haemodynamic changes and trauma.<sup>[4]</sup>

While performing NTI, the tip of the advancing endotracheal tube (ETT) generally lies along the posterior pharyngeal wall. When laryngoscopy is done, it lifts the larynx anteriorly, away from the ETT tip. This necessitates the need to bring the tip of the ETT anteriorly to enter the glottis. Various modalities that are available to bring the ETT towards the glottis include the external laryngeal manipulation (ELM), inflation of ETT cuff, and the use of Magill forceps.<sup>[5]</sup> However, they may lead to airway trauma, haemodynamic instability and risk of cuff perforation. The cuff inflation technique is less traumatic, minimises intubation stress response, obviates the need for instrumentation and reduces intubation time.<sup>[6,7]</sup>

The present study was planned to compare the intubating conditions for NTI with standard direct Macintosh laryngoscope versus C-MAC® video laryngoscope (VL) employing ETT cuff inflation technique to bring the ETT anteriorly in line with the glottis. Our primary outcome was to compare the total duration of NTI (T), while the secondary outcomes were to compare the need for cuff inflation or assistance with Magill forceps for successful NTI, the total number of attempts to achieve successful NTI, haemodynamic effects and complications if any.

## METHODS

This study was conducted in a multispeciality hospital in North India from September 2020 to February 2021, after the approval of the Institutional Ethical Committee and Clinical Trials Registry-India (CTRI) registration. Fifty patients undergoing elective oropharyngeal and maxillofacial surgeries with an indication for NTI under general anaesthesia were enrolled for this study. The patients with ages between 18 and 60 years of either sex belonging to the American Society of Anesthesiologists (ASA) physical status I-II and Mallampati grades (MPGs) I, II with mouth opening more than 3 cm were included. The patients who refused to give consent, those with significant systemic disease and those having contraindications for NTI were excluded from the study. After obtaining written informed consent, allocation concealment was done with sealed numbered opaque slips into two groups of 25 each. Group VL patients were intubated nasotracheally using C-MAC®

VL (Macintosh blade size 3) and group ML patients were intubated nasotracheally using the Macintosh laryngoscope (blade size 3).

After a thorough pre-anaesthetic check-up, the nasal patency was assessed. The nostrils were decongested with 0.1% xylometazoline (two drops in each nostril), 5–10 min prior to the induction of anaesthesia. After connecting routine monitors, the heart rate (HR), oxygen saturation (SpO<sub>2</sub>), systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean blood pressure (MBP) were recorded. All NTIs were performed by an experienced anaesthesiologist who had performed more than 50 such intubations.

In both groups, the patients received general anaesthesia as per institutional protocol. Following 3min of pre-oxygenation, the patients were pre-medicated with intravenous (IV) glycopyrrolate 0.2 mg, midazolam 1 mg, and fentanyl 2 µg/kg. The anaesthesia was induced with propofol 1.5–2.5 mg/kg till the loss of response to verbal commands. After check ventilation, neuromuscular blockade was provided with IV vecuronium 0.1 mg/kg. The patients were mask ventilated with sevoflurane 1% in oxygen for 3 min. Lubricated, appropriately-sized cuffed polyvinyl chloride (PVC) ETT (Portex®, Smiths Medical, Minnesota, USA) was introduced into the selected nostril with the head in a neutral position. ETT size 7.0–7.5 mm was used for female patients whereas size 7.5–8.0 mm was used for male patients. Once the ETT reached the oropharynx, laryngoscopy was performed as per group allocation in sniffing position.

An independent, unblinded observer collected all the demographic and perioperative data like haemodynamic and intubation parameters. Cormack Lehane (CL) grading of the laryngoscopic view was done by the anaesthesiologist securing the airway. If CL grading was found to be III or more than III, the patient was excluded from the study and another modality of airway management was taken. Once the glottic opening was seen, the ETT was navigated from the oropharynx to the glottis by bringing it anteriorly, with the modality of ETT cuff inflation technique. In the first instance, the ETT cuff inflation was done with 15 cc air. If the ETT could not be navigated up to the glottis, an additional 5 cc of air was added to the cuff. Subsequently, the cuff was deflated and the tube tip was navigated into the vocal cords. The tip was advanced till the cuff was inside the cords and the

black guide mark on the ETT was between the cords. If NTI was unsuccessful with this technique, Magill forceps was used. Successful endotracheal intubation was confirmed by end-tidal capnography and chest auscultation. The maintenance of general anaesthesia was done with sevoflurane 1% in nitrous oxide and oxygen in the ratio of 1:1.

The failure to intubate within three attempts, or within 120 s by the above technique, was defined as failed NTI and oral intubation was performed. The total duration of NTI (T) was defined as the time taken for ETT introduction from the selected nostril till the glottis in seconds ( $T = T_1 + T_2$ ).  $T_1$  was defined as the time taken for ETT introduction from the selected nostril to the oropharynx and  $T_2$  was defined as the time taken from the introduction of the laryngoscope at the level of maxillary incisor to the visual confirmation of the passage of the tube into the vocal cords. The haemodynamic parameters including the HR, SpO<sub>2</sub>, SBP, DBP, MBP were measured at the baseline, just before and 1, 3, 5, 7 and 10 min after intubation.

The following parameters were noted: CL grading, the total number of attempts, cuff inflation with 15 cc air, use of additional 5 cc air, use of Magill forceps and haemodynamic parameters. At the end of the surgery, the reversal of the neuromuscular blockade and extubation was done. The patients were observed in the postoperative care unit for 24 h for complications like sore throat and bleeding.

A previous study was used for sample size calculation.<sup>[8]</sup> Assuming a difference of 5 s in the time taken for NTI between the two groups as clinically significant, a sample size of a minimum of 21 patients per group was considered necessary to detect statistical significances with an effect size of 1.0 at alpha 0.05 and power of 90%. However, we enrolled twenty five patients in each group to increase the power of the study.

Statistical analysis was performed with International Business Machines Statistical Package for the Social Sciences (IBM SPSS) Statistics for Windows, version 21 (IBM Corp., Armonk, NY, USA). The categorical variables were presented in the form of absolute numbers and percentages. The continuous variables were presented as mean  $\pm$  standard deviation (SD). Data were checked for normality before statistical analysis. The normally distributed continuous variables were compared using the unpaired *t*-test. The categorical variables were analysed using either

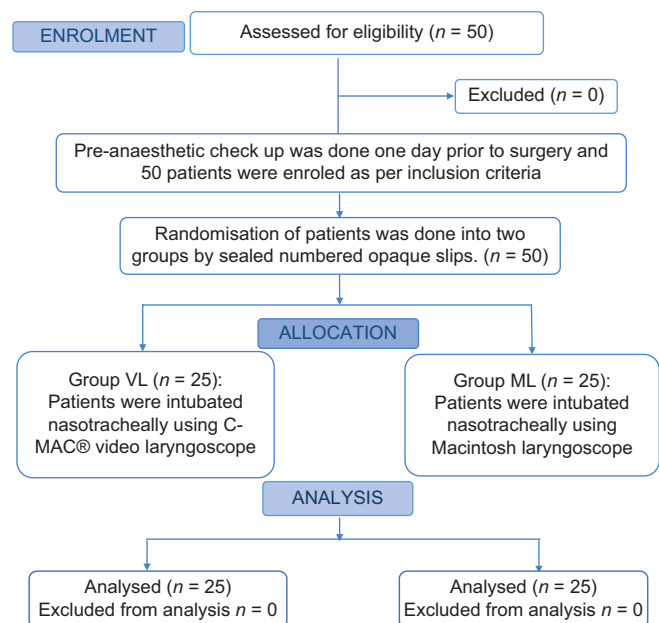
the Chi-square test or Fisher's Exact test.  $P < 0.05$  was considered statistically significant.

## RESULTS

A total of 50 patients were assessed for eligibility. The allocation of the patients is shown in the CONSORT diagram [Figure 1]. The demographic profile, gender distribution, ASA status and CL grade of the patients between the two groups were comparable [Table 1]. All our patients were either CL grade I or II.

Successful NTI could be performed in all the 50 patients in both groups.  $T_1$  was comparable between both the groups.  $T_2$  was higher in group ML than VL and the difference was found to be statistically significant ( $P$  value  $< 0.001$ ).  $T$  was higher in group ML than in group VL and this difference was also found to be statistically significant ( $P$  value  $< 0.001$ ) [Table 2].

The successful placement of ETT was possible with cuff inflation with 15 cc of air in 22 out of 25 patients in group VL and only in 8 out of 25 patients in group ML. The remaining 3 patients of group VL and 11 patients of group ML required an additional 5 cc of air for cuff inflation for successful intubation. Six patients of group ML required assistance with Magill forceps for successful intubation whereas none of the patients in group VL required Magill forceps assistance ( $P$  value = 0.022) [Table 3].



**Figure 1:** CONSORT flow chart

All haemodynamic parameters were significantly higher at 3 min in group ML in comparison to group VL [Table 4]. The DBP was significantly higher 1 min after intubation in group ML.

Postoperative sore throat was seen in 12% of the patients in group VL and 28% of the patients in group ML ( $P = 0.289$ ). Postoperative nasal bleed was seen in 16% of the patients in group VL and 44% of the patients in group ML ( $P = 0.062$ ).

**DISCUSSION**

The malalignment between the tip of ETT and the glottic inlet poses a challenge while performing NTI. The use of Magill forceps or ELM for directing the ETT tip into the glottis may lead to trauma, haemodynamic changes and damage to the ETT cuff.<sup>[9]</sup> The cuff inflation facilitates intubation and obviates the use of other manipulations, and therefore, prevents the complications associated with them. This study was undertaken to compare the intubating conditions using the cuff inflation technique while comparing the C-MAC<sup>®</sup> VL with the Macintosh laryngoscope.

In our study, the total time taken for NTI with C-MAC<sup>®</sup> VL was significantly less in comparison to the Macintosh laryngoscope ( $P < 0.001$ ). Similar findings have been suggested by other authors; however, they have utilised other modalities like tube rotation, ELM and Magill forceps and not the cuff inflation technique.<sup>[8,10]</sup> Jones et al.<sup>[10]</sup> compared the Macintosh laryngoscope and the GlideScope VL for NTI. They observed that the median intubation time with the GlideScope VL (43.5 s) was shorter in comparison to DL (66.7 s) ( $P = 0.0023$ ). Patil et al.<sup>[3]</sup> reported that a significantly higher number of paediatric patients were intubated nasally within 2 min with the help of C-MAC<sup>®</sup> VL in comparison to the Macintosh laryngoscope ( $P = 0.001$ ). Similarly, Rajan et al.<sup>[8]</sup> reported shorter intubation time with the use of C-MAC<sup>®</sup> VL D blade while performing NTI ( $P < 0.001$ ). Hence, it is established that VL-assisted NTI takes lesser time. This higher success rate of intubation may be attributed to the design of C-MAC<sup>®</sup> VL. The blade of C-MAC<sup>®</sup> VL has an anterior angulation and a slim profile. The laryngoscopic view is magnified for the operator and there is extra space for tube manipulation.<sup>[11-13]</sup> Nevertheless, the use of VL requires skill and practice. Inexperienced operators may face difficulty while performing NTI with VL leading to prolonged intubation time.

Patil et al.,<sup>[3]</sup> Rajan et al.<sup>[8]</sup> and Jones et al.<sup>[10]</sup> have compared the total duration for NTI. However, it is not clear from these studies whether it took more time for navigating the tube from the nostrils to the oropharynx or further into the vocal cords.<sup>[3,8,10]</sup> Shah et al.<sup>[6]</sup> defined the duration of NTI as the time taken from the insertion of the VL through the incisors till the passage of ETT through the vocal cords. Similarly, we have separately noted T1 as the time taken for ETT introduction from the selected nostril to the oropharynx and T2 as the time taken from the introduction of the laryngoscope at the level of the maxillary incisors till the visual confirmation

**Table 1: Demographic profile, ASA grade, MPG, CL grade and thyromental distance**

Variables	VL Group Mean±SD	ML Group Mean±SD	P
Age (Years)	35.36±10.92	36.52±13.18	0.736
Weight (kg)	58.56±7.13	60.16±8.63	0.478
Height (m)	1.58±0.08	1.62±0.10	0.104
BMI (kg/m <sup>2</sup> )	23.53±3.53	22.73±1.32	0.296
Gender (M/F)	17/8 (%)	13/12 (%)	0.248
ASA (I/II)	21/4 (%)	15/10 (%)	0.114
MPG (I/II)	13/12 (%)	13/12 (%)	1.000
CL Grade (I/II)	16/9 (%)	18/7 (%)	0.544
Thyromental distance	7.99±0.52	8.16±0.40	0.186

ASA: American Society of Anesthesiologists, MPG: Mallampati grade, CL Grade: Cormack-Lehane grade, SD: Standard deviation, BMI: Body mass index

**Table 2: Time taken for nasotracheal intubation (seconds)**

Time taken for nasotracheal intubation (seconds)	VL GROUP Mean±SD	ML GROUP Mean±SD	P
T1 (Time taken for ETT introduction from selected nostril till oropharynx)	13.08±1.68	12.80±1.56	0.544
T2 (Time taken for ETT navigation from oropharynx till the cords)	19.60±10.53	33.08±13.43	<0.001
T (Time taken for ETT introduction from selected nostril till the glottis)	31.48±10.72	45.88±13.47	<0.001

ETT: Endotracheal tube, SD: Standard deviation

**Table 3: Frequency of modality used for intubation**

	VL group n	Frequency %	ML group n	Frequency %	P
Successful intubation using cuff inflation	25	100.0%	19	76.0%	0.022
15 mL of cuff inflation	22	88.0%	8	32.0%	<0.001
20 mL of cuff inflation	3	12.0%	11	44.0%	0.026
Magill forceps	0	0.0%	6	24.0%	0.022

Table 4: Haemodynamic characteristics of both groups

	Heart rate			Systolic BP (mmHg)			Diastolic BP (mmHg)			Mean BP (mmHg)		
	Group VL	Group ML	P	Group VL	Group ML	P	Group VL	Group ML	P	Group VL	Group ML	P
	Mean±SD	Mean±SD		Mean±SD	Mean±SD		Mean±SD	Mean±SD		Mean±SD	Mean±SD	
Basal	84.48±13.89	81.68±14.15	0.484	115.72±11.42	115.56±10.69	0.559	74.52±7.72	75.24±7.29	0.736	88.32±6.95	88.64±7.09	0.872
Before NTI	80.36±10.42	78.0±13.42	0.491	115.16±12.27	118.76±12.5	0.309	76.28±10.18	77.92±8.45	0.538	81.88±8.58	79.84±8.16	0.393
1 min	84.52±6.70	86.8±11.44	0.394	119.4±10.14	127.00±16.39	0.056	79.04±7.10	85.48±8.86	0.007	84.12±7.21	87.2±10.76	0.240
3 min	81.12±7.06	87.40±11.32	0.024	112.4±23.63	124.08±13.20	0.036	78.96±6.45	86.2±7.51	0.001	83.84±6.68	89.08±9.28	0.026
5 min	81.92±5.99	80.28±10.82	0.51	118.88±10.37	123.12±12.21	0.192	78.96±6.92	82.52±7.18	0.080	84.72±7.28	83.84±6.91	0.663
7 min	82.64±6.46	79.68±9.95	0.218	118.72±9.41	119.28±9.97	0.839	78.00±8.11	81.60±6.33	0.087	81.92±5.72	82.88±8.37	0.638
10 min	81.88±7.14	78.60±8.72	0.152	119.32±8.44	119.72±9.97	0.879	77.36±4.79	81.64±6.23	0.109	83.92±5.13	83.48±7.51	0.810

NTI: Nasotracheal intubation, SD: Standard deviation, BP: Blood pressure

of the passage of the tube into the vocal cords. We found T1 to be comparable among both the groups; however, T2 was significantly lesser with C-MAC® VL ( $19.60 \pm 10.53$  vs.  $33.08 \pm 13.43$  s) ( $P < 0.001$ ).

Jones *et al.*<sup>[10]</sup> and Rajan *et al.*<sup>[8]</sup> used Ring-Adair-Elwyn (RAE) tube, however, we used the cuffed polyvinylchloride (PVC) ETT (Portex®) for our study. Kumar *et al.*<sup>[14]</sup> conducted a study on the laryngoscope-guided NTI by using the cuff inflation technique. They compared three different types of endotracheal tubes: wire reinforced (WR), silicone-tipped WR and PVC. They found that the oropharyngeal insertion of all three types of ETTs of varying stiffness consistently improved by using the cuff inflation technique. The use of softer ETTs for NTI necessitates the use of Magill forceps to facilitate their alignment with the laryngeal inlet. This difficulty in insertion is faced because these tubes tend to remain along the posterior pharyngeal wall and do not conform to the airway curvature.<sup>[15,16]</sup>

Various authors have used the cuff inflation technique with 15–20 cc of air and reported a good success rate of intubation.<sup>[6,17]</sup> Chung *et al.*<sup>[17]</sup> demonstrated that the cuff inflation technique significantly increased the correct alignment of the ETT with the glottis and resulted in a successful blind NTI in 84% of their patients. Similarly, Baddoo *et al.*<sup>[18]</sup> reported successful NTI in their patients by using this technique with the help of C-MAC® VL. Shah *et al.*<sup>[6]</sup> used the TA scope (the Anaesthetist Society scope) for NTI. They concluded that the cuff inflation technique has a good intubation success rate with minimum additional assistance (ELM and Magill forceps) in video laryngoscopic nasal intubation. In concordance with Shah *et al.*<sup>[6]</sup> Badoo *et al.*,<sup>[18]</sup> and Kumar *et al.*,<sup>[14]</sup> we found that it was possible to intubate successfully all the patients in group VL and 76% of the patients in group ML ( $P = 0.022$ ); 24% of the patients of group ML required assistance with the Magill forceps for successful intubation.

In a study by Kwak *et al.*,<sup>[19]</sup> the Magill forceps was used for navigation of ETT towards the glottis in 34% of the patients while using the Macintosh laryngoscope and in only 6% of the patients while using McGrath VL. Jones *et al.*<sup>[10]</sup> reported that the Magill forceps had to be used for tube alignment in 49% of the patients with the Macintosh laryngoscope, however, with GlideScope VL, none of the patients required the Magill forceps.

Shah *et al.*<sup>[6]</sup> in their study found that the cardiovascular parameters including HR and blood pressure were

increased while using direct laryngoscope whereas it was stable when a C- MAC<sup>®</sup> VL was used. Similarly, Liu *et al* [20] reported that the elevation in HR and SBP from baseline was more in patients intubated with Macintosh laryngoscope compared to McGrath laryngoscope. In our study, all the haemodynamic parameters were significantly higher at 3 min after intubation in group ML in comparison to group VL such as HR ( $P = 0.024$ ), SBP ( $P = 0.036$ ), DBP (0.001) and MBP (0.026). This could be attributed to more time required for intubation and the use of the Magill forceps that increased sympathetic stimulation in group ML.

Jones *et al.* [10] observed that the use of Magill forceps increases the incidence of sore throat and trauma to the oral mucosa. We observed that the incidence of postoperative sore throat and bleeding was higher in group ML, however, this difference was found to be statistically insignificant. This may be attributed to the use of Magill forceps in group ML.

Our study has a few limitations. This study was carried out in 50 patients with MPG grades I and II with adequate mouth opening. Further studies are required in patients with difficult airways to know the utility of this technique. Also, blinding of the anaesthesiologist performing the NTI was not possible. Since all the NTIs were performed by an experienced practitioner, similar results may not be extrapolated to inexperienced operators.

## CONCLUSION

The usage of the cuff inflation technique with C-MAC<sup>®</sup> VL for NTI provides a good glottic view and a good success rate while maintaining haemodynamic stability. By obviating the need for instrumentation, it reduces the incidence of complications like bleeding and postoperative sore throat.

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## Conflicts of interest

There are no conflicts of interest.

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