Ease of intubation and hemodynamic responses to nasotracheal intubation using C-MAC videolaryngoscope with D blade: A comparison with use of traditional Macintosh laryngoscope

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Abstract

**Background and Aims:** Nasal intubation with traditional Macintosh laryngoscope usually needs the use of Magill’s forceps or external laryngeal manipulation. The primary objective of this study was to assess the ease of intubation during C-MAC videolaryngoscope-assisted nasal intubation using D blade and to compare it with traditional Macintosh laryngoscope-aided nasal intubation. The secondary objectives were comparison of intubation time, attempts, trauma, and hemodynamic stress responses.

**Material and Methods:** Sixty patients requiring nasal intubation were randomized into two groups, M and V. Patients in both the groups received general anesthesia as per a standardized protocol. Laryngoscopy was performed using the traditional Macintosh laryngoscope in group M and with Storz® C-Mac videolaryngoscope with D-blade in group V. Chi-square test, Mann–Whitney test, and independent samples t-test were used as applicable for data analysis.

**Results:** Intubation was significantly easy in 70% of the patients in group V compared to only 3.3% in group M. Time to intubate was significantly shorter in group V (24 vs 68 s). Though majority of patients were intubated in the first attempt in both groups, the number was more in group V (96.7 vs 70%). There was no case of esophageal intubation in group V, but 2 patients (6.7%) had esophageal intubation in group M. Mucosal trauma was significantly more frequent in group M. There was no statistically significant difference in hemodynamics in both groups.

**Conclusion:** C MAC videolaryngoscope-aided nasotracheal intubation using D blade is superior in view of easier, quicker, and less traumatic intubation compared to the use of traditional Macintosh laryngoscope.

**Keywords:** Hemodynamics, intubation, laryngoscopes

Background

Nasotracheal intubation is indicated in patients undergoing oral, maxillofacial, or dental procedures or when orotracheal intubation is not feasible because of limited mouth opening, tumors of tongue, or oropharynx. During nasal intubation with the traditional Macintosh laryngoscope, use of Magill’s forceps or external laryngeal manipulation is usually required to facilitate intubation. We hypothesized that videolaryngoscope-assisted nasal intubations could be technically easier, and hence, might be associated with an attenuated hemodynamic stress response.

The primary objective of this study was to assess the ease of intubation during C-MAC videolaryngoscope-assisted nasal intubation using D blade compared to the traditional Macintosh laryngoscope-aided nasal intubation. The secondary objectives were comparison of intubation time, attempts at intubation, trauma, and hemodynamic stress responses to laryngoscopy and intubation with these two techniques.

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How to cite this article: Rajan S, Kadapamannil D, Barua K, Tosh P, Paul J, Kumar L. Ease of intubation and hemodynamic responses to nasotracheal intubation using C-MAC videolaryngoscope with D blade: A comparison with use of traditional Macintosh laryngoscope. J Anaesthesiol Clin Pharmacol. 2018;34:381-5.
Material and Methods

Following approval from the Institutional Ethical Committee, this prospective, randomized, single-blinded study was conducted from March 2017 to October 2017. Sixty consenting patients aged 18–60 years of American Society of Anesthesiologists (ASA) physical status 1–2, who were undergoing head and neck surgeries such as wide local excision and reconstruction surgeries for carcinoma of tongue, buccal mucosa, alveolus, maxilla, and ameloblastoma, requiring nasal intubation were included in the study. Patients with anticipated difficult intubation such as those with restricted mouth opening or tongue protrusion, who had received radiation over neck or oral cavity, hypertensives on rate controlling medications, hyperthyroids, and those with ischemic heart disease were excluded.

The patients were randomized into two equal groups, M and V, based on computer-generated random sequence of numbers and allocation concealment of the randomization sequence was done using sequentially numbered, opaque-sealed envelopes. The patency of nostrils was assessed after decongesting with 0.1% xylometazoline and asking to exhale forcefully while occluding the opposite, and the more patent nostril was chosen for intubation. Patients in both the groups received general anesthesia as per a standardized protocol and were premedicated with intravenous glycopyrrolate 0.2 mg, midazolam 1 mg, and fentanyl 2 μg/kg. Following 3 min of preoxygenation, anesthesia was induced with propofol 1.5–2.5 mg/kg till there was loss of response to verbal commands. The patients were mask ventilated with isoflurane 1% in oxygen. Neuromuscular blockade was provided with vecuronium 0.1 mg/kg, and 3 min later laryngoscopy was performed using the traditional Macintosh laryngoscope in group M and with Storz® C-Mac videolaryngoscope (Karl Storz- Endoskope 8403 ZX, Germany) with D-blade in group V. In both groups, patients were nasally intubated using a Ring, Adair, and Elwyn (RAE) endotracheal tube with 7 mm internal diameter in males and 6.5 mm in females, 1 mm smaller than that for oral intubation. Correct endotracheal tube placement was confirmed with auscultation and end-tidal capnography.

Ease of intubation was assessed as easy, moderate difficulty, major difficulty, and impossible intubation. Intubation difficulty is usually assessed on the basis of Intubation Difficulty Score (IDS), which is used for direct laryngoscopy. As it is less useful to assess the ease of intubation with videolaryngoscopes, we used a modified IDS which was adapted to suit indirect laryngoscopy as well [Table 1]. Time to intubate was calculated from the beginning of introduction of the endotracheal tube in the nostril till appearance of end-tidal carbon dioxide waveform which was recorded by an anesthesia technician not actively participating in the anesthetic procedure. Intubation attempt was terminated if there was desaturation to less than 95%. Patients were mask ventilated with 100% oxygen till saturation returned to 100%. In multiple attempts, time to intubate was calculated from the beginning of the procedure till appearance of end-tidal carbon dioxide waveform. The same was applied for esophageal intubations as well. Failure to intubate within three attempts warranted use of fiberoptic bronchoscope for intubation.

Heart rate (HR) and mean arterial pressures (MAP) were recorded at preinduction, after induction, immediately after intubation, and thereafter at 1 min, 3 min, 5 min, and 10 min following intubation. Number of attempts taken to intubate, Mallampati score of patients, glottic view as assessed similar to Cormack Lehane grade, incidence of mucosal or soft tissue trauma as evidenced with blood on the tip of laryngoscope blade or tube, and esophageal intubation were also noted. To avoid inter-user variation, all patients were intubated by the same anaesthesiologist with 6 years of experience, who had been using C-MAC videolaryngoscope regularly for past 2 years for intubation.

As there are no similar studies published in the past, the present study was initiated as a pilot study with 20 patients and the sample size was calculated based on the proportion of easy intubations in groups V and M (70 vs 10%). With 95% confidence interval and 99% power, the estimated total sample size was 32. However, we recruited 60 patients in our study. Chi-square test was used to compare the ease of intubation and gender among groups. Mann–Whitney test was used to compare the intubation time in group C and M. Independent t-test was used to compare the hemodynamic and anthropometric data. Statistical analysis was done using IBM SPSS Statistics 20 Windows (SPSS Inc., Chicago, USA).

Results

Sixty patients were recruited in the study [Figure 1]. Mean age, height and weight, distribution of sex, and ASA physical status

Table 1: Modified intubation difficulty score

| Ease of intubation | Maneuvers needed to guide endotracheal tube to glottis |
|--------------------|-------------------------------------------------------|
| Easy               | Need to adjust force on laryngoscope ±               |
| Moderate difficulty| external manipulations or neck movements required, in addition to (a) |
| Major difficulty   | Need to use Magill’s forceps ± need to adjust force on laryngoscope, external manipulations or neck movements |
| Impossible intubation | Require other techniques like fiberoptic intubation or intubation via laryngeal mask airway |
were comparable in both the groups [Table 2]. Significantly lower number of patients in group M had a Mallampatti score of 3 and 4 compared to group V (23.3 vs 46.6%) [Figure 2]. 66.7% in group M had glottic view similar to Cormack Lehanke grade 2, whereas 60% of patients in group V had glottic view similar to grade 1.

Intubation was easy in 3.3% in group M versus 70% of patients in group V, and the difference was significant [Table 3 and Figure 3] (P < 0.001). Percentage of patients who required Magill’s forceps to aid intubation in Group M and Group V were 66.7% vs 6.67%, who required external manipulation or neck movements were 30% vs 23.33%, and those who needed neither were 3.33% vs 70%, respectively. There was no patient who was impossible to be intubated or who required fiberoptic or laryngeal mask assisted intubation in both the groups. Time to intubate was significantly longer in Group M compared to Group V (68 vs 24s, P < 0.001). There was no significant desaturation in both the groups, with the lowest saturation recorded in Group V being 99% (n = 1) and 98% (n = 2) in Group M.

Though the majority of patients were intubated in the first attempt in both groups, the number was lower in group M (70 vs 96.7%). In group M, 10% of the patients could be intubated in the third attempt only, whereas in group V all patients were intubated in the first or second attempt itself. Two patients (6.7%) had esophageal intubation in group M, with no case of esophageal intubation in group V, and the difference was statistically insignificant (P = 0.492). Mucosal trauma was significantly more frequent in group M compared to group V (46.7 vs 10%, P 0.003) [Table 3]. There was no significant difference in HR and MAP between groups at any time (P > 0.05) [Table 4].

**Discussion**

It was observed that nasal intubation using C-MAC videolaryngoscope with D blade resulted in technically easier and quicker intubation compared to the use of traditional
Macintosh laryngoscopes despite a majority of group V patients having higher Mallampatti scores. However, the hemodynamic stress response to laryngoscopy and intubation were comparable in both groups. The incidence of mucosal trauma and chance of esophageal intubation were also reduced with the use of C-MAC videolaryngoscope.

While using Macintosh laryngoscope, high forward and upward force (approximately 35–50 N) is usually needed to align the oral, pharyngeal, and laryngeal axes to visualize the glottis.[4] This is achieved by advancing the tip of the laryngoscope to the vallecula and indirectly lifting the epiglottis by applying pressure on the hyoepiglottic ligament to align the different axes. Though visualization of the glottis becomes optimal, the larynx will be lifted away from the tip of the advancing nasotracheal tube, which usually lies along the posterior pharyngeal wall, necessitating the use of Magill’s forceps to guide the tube into the glottis. Though ideally part of the tube proximal to the cuff should be held, most of the time the tube is held at the cuff which could damage it resulting in leaks and subsequent re-intubation. The chance of oropharyngeal mucosal trauma is also high with the use of Magill’s forceps, especially if tissue is maneuvered with the forceps resulting in significant trauma and bleeding.

As videolaryngoscopes have higher curvature blades, they require less upward lifting force, of approximately 5–14 N,[5] to obtain a good indirect view of the glottis as there is no need to align the different axes to a straight line. Because lifting of the glottis during laryngoscopy is minimal with use of videolaryngoscopes, there is less chance of malalignment between glottic opening and an advancing nasotracheal tube. Hence, it becomes easier to advance a nasotracheal tube to the glottis with minimal instrumentation.

Most of the time glottis will be in line with the nasal tube and can be advanced into the larynx. If the glottis appears higher up, reducing the force on laryngoscope will help to align the glottis in line with the tube aiding the intubation. When the tube gets lodged in the tissue surrounding the epiglottis and cannot be advanced into the trachea, external laryngeal manipulation may help to overcome the difficulty. Similarly, when the nasotracheal tube gets inserted into the esophagus repeatedly, extending the neck to raise the tube tip could be helpful.[6] An alternative technique to raise the tip of the tube is by inflating the tracheal tube cuff.[7] When measures such as flexion or extension of the head or external laryngeal manipulation fail, Magill’s forceps may be used to guide the tube into the larynx. It has been recommended that nasotracheal intubation may be attempted with the head in the neutral position initially and then changed to a more appropriate position, if necessary, on an individual basis.[6] We had two cases of esophageal intubation while using Macintosh laryngoscope, which were diagnosed immediately and the trachea was intubated following a repeat scopy.

Use of the C-MAC videolaryngoscope for oral intubation has been shown to result in a greater hemodynamic response than with the Macintosh laryngoscope.[8] In pediatric patients undergoing tonsillectomy, Storz C-MAC® videolaryngoscope provided better glottic visualization and less intubation time with less need for Magill’s forceps during nasal intubation compared to the conventional Macintosh direct laryngoscope, but with a high need for external manipulations.[9] In a case series Das et al.[10] concluded that the use of McGrath® videolaryngoscope produced excellent laryngoscopic views in patients with normal airways. They used Schroeder stylet to overcome the impaction of nasotracheal tube on posterior nasopharyngeal wall, resulting in a higher intubation time. Use of the stylet helped in negotiation of the tube through the nasopharynx.[11] Compared with the Macintosh laryngoscope, the GlideScope.
videolaryngoscope was also found to facilitate nasotracheal intubations with more ease and shortened intubation time in patients undergoing oromaxillofacial surgery.[12]

In general, with traditional direct laryngoscopy, nasal intubation requires more time compared to the oral route. Therefore, the hemodynamic changes during nasotracheal intubation will be more intense and last significantly longer than those following oral intubation.[13] The attenuated cardiovascular stress response observed with the use of videoscopes during nasal intubation could be attributed to less force exerted during laryngoscopy and less need of instrumentation resulting in a shorter intubation time compared to the traditional Macintosh laryngoscopes.

We anticipated a difficult airway in most of our patients as they were undergoing head and surgery. We excluded only those who might require elective fiberoptic-aided intubation such as those with restricted mouth opening or tongue protrusion and who had received radiation over the neck or oral cavity. Patients with Mallampatti score 3 and 4 were also included. The unequal distribution of patients with high Mallampatti scores and Cormack Lehance grade 2 did not affect the ease of intubation in Group V.

Our expectation of lower hemodynamic changes with the use of videolaryngoscope was not borne out by the data. This could be because significantly higher number of patients in group V had higher Mallampatti score which resulted in higher stress response to laryngoscopy and intubation. The strong point of our study was that all the intubations were performed by a single anesthesiologist eliminating subjective errors due to varying levels of experience. The main limitation of the study was that it was an open label study and no blinding was possible.

**Conclusion**

C-MAC videolaryngoscope-aided nasotracheal intubation using D blade is superior in view of easier, quicker, and less traumatic intubation compared to the use of traditional Macintosh laryngoscope.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

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