Effect of C-MAC Video Laryngoscope-aided Intubations Using D-Blade on Incidence and Severity of Postoperative Sore Throat

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Abstract

Background: Video laryngoscope-aided intubations require less force to align oral, pharyngeal, and laryngeal planes to visualize the glottis opening during intubation. Aim: The primary objective of the study was to assess the incidence and severity of postoperative sore throat (POST) in patients who were intubated with C-MAC video laryngoscope using D-blade versus traditional Macintosh laryngoscope.

Settings and Design: This prospective, randomized, open label study was conducted in a tertiary care institution. Subjects and Methods: A total of 130 patients undergoing short elective laparoscopic surgeries lasting <2 h were recruited. All patients received general anesthesia as per a standardized protocol. Laryngoscopy was performed using traditional Macintosh laryngoscope in Group M and with Storz® C-MAC video laryngoscope using D-Blade in Group V. The endotracheal tube cuff pressure was maintained at 20–22 cm of H2O intraoperatively. Statistical Analysis Used: Pearson’s Chi-square test, Fisher’s exact test, and Independent sample t-test were used in this study. Results: As compared to Group M, number of patients who had POST, hoarseness of voice, and cough was significantly low in Group V at 2, 6, 12, and 24 h. Severity, as well as the incidence of all these symptoms, showed a downward trend in both groups with time. Significantly more number of patients in Group M required rescue therapy for POST (44.6% as compared to 7.7%, \( P < 0.001 \)). Conclusion: C-MAC video laryngoscope-aided intubations using D-blade significantly reduced the incidence and severity of POST, hoarseness of voice, and cough following orotracheal intubation as compared to use of traditional Macintosh laryngoscope.

Keywords: Cough, hoarseness, intubation, laryngoscope, pharyngitis

INTRODUCTION

With the standard practice of tracheal intubation becoming an integral part of general anesthesia, the risk of pulmonary aspiration during maintenance of anesthesia has become a rarity. However, the direct laryngoscope-aided intubation is invariably associated with a high risk of postoperative sore throat (POST). We hypothesized that as video laryngoscope-aided intubations require less force to align the oral, pharyngeal, and laryngeal planes to visualize the glottis opening, the incidence and severity of POST would be less.

Aim of study

The primary objective of our study was to assess the incidence and severity of POST in patients who were intubated with C-MAC video laryngoscope using D-blade versus traditional Macintosh laryngoscope. The secondary objectives included the comparison of postoperative hoarseness of voice and postoperative cough in these patients.

SUBJECTS AND METHODS

Following approval from the Institutional Ethical Committee (IEC-AIMS-2017-ANES-237), this prospective, randomized, open label study was conducted. Based on the previous study by Najafi et al.,[1] considering the incidence of POST in videolaryoscope as well as Macintosh-assisted intubations (22.7% compared to 54%) with a confidence interval of 95% and power of 90, the sample size was calculated as 62 per group. One hundred and thirty consenting patients aged 18–60 years, of American Society of Anesthesiologists (ASA) physical status 1–2 with Mallampatti score of 1–2, undergoing short elective laparoscopic surgeries lasting <2 h (laparoscopic...
sterilization, diagnostic laparoscopy) were included in the study. Patients with anticipated difficult intubation, who required more than two attempts at intubation or nasogastric tube insertion and those with upper respiratory tract infection, were excluded from this study.

The patients were randomized into two equal Groups, M and V, based on computer generated random sequence of numbers. All patients 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, the patients were induced with propofol 1.5–2.5 mg/kg and 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 traditional Macintosh laryngoscope in Group M and with Storz® C-MAC video laryngoscope (Karl Storz-Endoskope 8403 ZX, Germany) using D-blade in Group V. In both the groups, patients were intubated using a low pressure, high-volume-cuffed polyvinyl chloride endotracheal tube with 8-mm internal diameter in males and 7 mm in females. Correct endotracheal tube placement was confirmed with auscultation and end-tidal capnography.

Endotracheal tube cuffs were filled with the minimal volume of air required to prevent an audible leak. The endotracheal tube cuff pressure was checked immediately after intubation and thereafter half hourly using Cuff Inflator/Pressure Gauge PORTEX (Smiths Medical) cuff pressure monitor. Intracuff pressure was maintained at 20–22 cm of H₂O. Patients who required three or more attempts at laryngoscopy or nasogastric tube insertion were excluded from the study.

Anesthesia was maintained using oxygen in air (1:2) with 1%–1.2% end-tidal isoflurane. Neuromuscular block was maintained with intermittent vecuronium 1 mg which was repeated at half an hour interval. Supplemental analgesia was given with paracetamol 1 g intravenously half an hour after induction. Tachycardia and/or hypertension, that is, >20% increase from the baseline values, was initially treated with increasing isoflurane to 1.5%–2% and thereafter with intravenous fentanyl 20 µg as boluses.

At the end of surgery, the residual muscle paralysis was reversed with neostigmine 0.05–0.07 mg/kg and glycopyrrolate 10 µg/kg. Ondansetron 4 mg was given intravenously as antiemetic and nasogastric tube was suctioned and removed before extubation. Following gentle oropharyngeal suctioning under vision patients were extubated once awake with return of protective airway reflexes. Postoperative analgesia was provided with intravenous paracetamol 1 g 8 hourly and tramadol 100 mg on demand. If this failed to control surgical site pain, fentanyl 20 µg boluses were given. Total intraoperative and postoperative fentanyl consumptions were documented.

POST, cough, and hoarseness of voice were assessed at 2, 6, 12, and 24 h based on the scales described in Table 1. Those with grade III score throat were managed with dispersible aspirin 75 mg gargle which was repeated as many times as needed till there was relief from the symptoms and number of times rescue therapy had been required was noted.

Pearson’s Chi-square test or Fisher’s exact test was used to compare the categorical variables like gender, ASA status, number of attempts at intubation, use of bougie, Mallampatti score, incidence and severity of POST, hoarseness of voice, and cough. Independent sample t-test was used to compare the continuous variables such as age, weight, intraoperative opioid consumption, and duration of intubation among the groups. Statistical analyses were done using SPSS Version 20.0 for Windows (IBM Corporation ARMONK, NY, USA).

**RESULTS**

Both groups were comparable with respect to demographic variables, distribution of ASA, physical status, and Mallampatti score. Percentage of patients who were intubated at the first attempt and those who needed bougie during intubation were similar among the groups. Both Group M and V had comparable duration of intubation (89.15 ± 20.89 compared to 97.77 ± 17.12 min) as well as intraoperative opioid consumption [Table 2].

While comparing the presence or absence of POST, hoarseness of voice, and cough among the groups, it was found that as compared to Group M, number of patients who had these symptoms was significantly low in Group V at 2, 6, 12, and 24 h [\(P < 0.001, \) Table 3]. Severity, as well as the incidence of POST, showed a downward trend in both groups with time and by 24 h no patient in Group V had sore throat. In Group M, only 32.3% had no sore

| Postoperative sore throat | Grade |
|---------------------------|-------|
| No sore throat at any time since the operation | 0     |
| Minimal - patient answered in the affirmative when asked about sore throat | 1     |
| Moderate - patient complained of sore throat on his/her own | 2     |
| Severe - patient is in obvious distress | 3     |

| Postoperative cough |
|---------------------|
| No cough at any time since the operation | 0     |
| Minimal | 1     |
| Moderate | 2     |
| Severe | 3     |

| Postoperative hoarseness of voice |
|----------------------------------|
| No complaint of hoarseness at any time since the operation | 0     |
| Minimal - minimal change in quality of speech. Patient answers in the affirmative only when enquired about | 1     |
| Moderate - moderate change in quality of speech of which the patient complains on his/her own | 2     |
| Severe - gross change in the quality of voice perceived by the observer | 3     |
thrott at 24 h [Figure 1]. Similar trend was seen with hoarseness of voice and cough as well. From 12 h onward, no patient in Group V had hoarseness of voice while 13.8% continued to have grade 1 symptoms even at 24 h in Group M [Figure 2]. About 4.6% in Group V and 23.1% in Group M continued to have postoperative cough at 24 h [Figure 3]. Significantly more number of patients in Group M required rescue therapy for POST (44.6% compared to 7.7%, \( P < 0.001 \)).

**DISCUSSION**

Although POST is considered a common self-limiting complication following endotracheal intubation, the symptoms can be quite distressing to the patients. The incidence rates vary, but could be as high as 90%. A number of factors may be responsible, namely, direct trauma of the airway during laryngoscopy, mucosal damage caused by the presence of endotracheal tube, or pressure caused by tube cuff. Younger patients, females, long intubation time, and blood-stained tracheal tube on extubation are associated with the maximum risk. Other compounding factors are intubation without muscle relaxants, use of double-lumen tubes, high cuff pressures, tracheal tube size, type of tube, cuff contours, multiple attempts at intubation, and also the type of surgery. \(^{2,3}\)

Although various modalities of treatments are recommended for the treatment of POST, every effort should be executed to prevent its occurrence. Despite the etiology being multifactorial, one of the major contributing factors is the resultant tissue trauma following laryngoscopy. A short and gentle laryngoscopy obviously reduces the incidence of POST. The type of laryngoscope used also influences the occurrence.

In the routine anesthetic practice, intubations are performed with the aid of traditional Macintosh laryngoscope. While using a Macintosh laryngoscope, high forward and upward force is usually needed to align the oral, pharyngeal, and laryngeal axes to visualize the glottis. \(^{4}\) Varying degrees of head extension, neck flexion, and external laryngeal manipulations may be required during laryngoscopy which is mainly dependent on the patient characteristics. It had been shown that about 35–40 N force is generally required to expose glottis while using Macintosh laryngoscopes. The associated hemodynamic stress

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**Table 2: Comparison of variables**

| Continuous variables          | Mean±SD       | \( P \)  |
|-----------------------------|--------------|--------|
| Age (years)                  | 39.4±9.5     | 44.0±11.4 | 0.015 |
| Weight (kg)                  | 66.6±6.0     | 68.9±11.4 | 0.069 |
| Fentanyl consumption (µg)    | 160.46±44.03 | 153.38±32.08 | 0.053 |
| Duration of intubation (min) | 89.15±20.89  | 97.77±17.12 | 0.011 |

| Categorical variables | Group M, \( n \) (%) | Group V, \( n \) (%) | \( P \)  |
|-----------------------|-----------------------|-----------------------|--------|
| Gender                |                       |                       |        |
| Male                  | 21 (32.3)             | 27 (41.5)             | 0.276  |
| Female                | 44 (67.7)             | 38 (58.5)             |        |
| ASA physical status   |                       |                       |        |
| I                     | 29 (44.6)             | 40 (61.5)             | 0.053  |
| II                    | 36 (55.4)             | 25 (38.5)             |        |
| Mallampatti score     |                       |                       |        |
| 1                     | 36 (55.4)             | 41 (63.1)             | 0.053  |
| 2                     | 29 (44.6)             | 24 (36.9)             |        |
| Number of attempts    |                       |                       |        |
| 1                     | 54 (83.1)             | 53 (81.5)             | 1.000  |
| 2                     | 11 (16.9)             | 12 (18.5)             |        |
| Use of bougie         |                       |                       |        |
| No                    | 53 (81.5)             | 62 (95.4)             | 0.025  |
| Yes                   | 12 (18.5)             | 3 (4.6)               |        |
| Rescue therapy        |                       |                       |        |
| No                    | 36 (55.4)             | 60 (92.3)             | <0.001 |
| Yes                   | 29 (44.6)             | 5 (7.7)               |        |

SD=Standard deviation, ASA=American Society of Anesthesiologists
responses, risk of soft tissue, dental and cervical spine injuries depend mainly on the force applied.

It had been shown that fiberoptic bronchoscope-guided nasotracheal intubation was associated with less POST than Macintosh laryngoscope-aided intubation as direct laryngoscopy is avoided during fiberoptic intubations. No significant differences in the incidence and severity of POST was observed when a curved blade or a straight laryngoscope blade like Miller was used during direct laryngoscopic attempts for intubation.

As video laryngoscopes have higher curvature blades, they require lesser upward lifting force, of about 5–14 N, to obtain a good indirect view of the glottis. There is no need to align the oral, pharyngeal, and laryngeal axes to a straight line resulting in an attenuated cardiovascular stress response. Risks of soft-tissue injury are also reduced with the use of videoscopes. This could be the reason for the reduced incidence and severity of POST and hoarseness of voice found after tracheal intubation using Glide Scope and AirWay Scope as compared to Macintosh laryngoscope.

While using videoscopes, it had been documented that the time taken for intubation is usually longer as the easy visualization of the glottis, which can be attributed to the higher curvature of the blade, does not guarantee easy passage of endotracheal tube to the larynx. Most of the time additional airway devices such as stylet or a bougie are required to accomplish oral endotracheal intubation. The main distinguishing feature of the D-blade of C-MAC video laryngoscope is its shape, which is considerably different from both Macintosh and Miller blades. It has an elliptically tapered shape and is more curved than most video laryngoscope blades. It is particularly useful in patients with anticipated difficult airway and may help to avoid fiberoptic intubation in certain cases.

In this study, we used styletted endotracheal tubes in both the groups. It had been demonstrated that in patients with cervical spine surgery with neck stabilization, use of styletted endotracheal tubes significantly reduced the intubation difficulty while using C-MAC video laryngoscopes. Similarly, while using McGrath video laryngoscope, a 60° angled stylet resulted in faster orotracheal intubation as compared to use of 90° angled stylet. As an alternative, the use of nonstyletted endotracheal tube with exaggerated curvature has shown to have a similar effect as styletted tube with a hockey-stick curvature. We used stylets which were angled at 60° distally in Group V to aid intubation.

Trauma to the laryngeal structures during endotracheal intubation is the most common cause of postoperative hoarseness of voice which has an incidence of 14.4%–50%. In majority of patients, this symptom is temporary and lasts for 2–3 days. Cause of prolonged hoarseness is usually arytenoid cartilage dislocation. Use of smaller-sized tubes and periodic measurement of cuff pressure greatly reduce mucosal damage and thereby hoarseness. Use of larger-sized endotracheal tubes and laryngeal trauma are considered to be the common reasons for postoperative cough. Hence, use of proper-sized tubes and careful laryngoscopy may be helpful in attenuating this complication.

We chose to conduct our study in patients undergoing short laparoscopic procedures such as laparoscopic sterilization and diagnostic laparoscopy as postoperative pain following these procedures would be minimal. It had been documented that in the presence of significant postoperative surgical pain, patients tend to ignore less intense pain such as sore throat or myalgia following use of suxamethonium. Another strong point of our study was that all intubations were performed by two anesthesiologists with an almost identical experience of >5 years, thereby eliminating subjective error due to differences in skill. Limitations of our study were that it was not blinded.

**Conclusion**

C-MAC video laryngoscope-aided intubations using D-blade significantly reduced the incidence and severity of POST, hoarseness of voice, and cough following orotracheal

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**Table 3: Comparison of incidence of postoperative sore throat, cough, and hoarseness of voice**

| Time  | Occurrence | Group M, n (%) | Group V, n (%) | P    |
|-------|------------|----------------|----------------|------|
|       |            | 24 h           | 12 h           | 6 h  | 2 h  | 6 h  | 12 h | 24 h |
|       |            | 34 (52.3)      | 31 (47.7)      | 32 (49.2) | 30 (46.2) | 20 (30.8) | 34 (52.3) | 51 (78.5) |
|       |            | 14 (21.5)      | 14 (21.5)      | 32 (49.2) | 30 (46.2) | 20 (30.8) | 34 (52.3) | 51 (78.5) |
|       |            | 55 (84.6)      | 51 (78.5)      | 55 (84.6) | 51 (78.5) | 46 (70.8) | 51 (78.5) | 65 (100.0) |
|       |            | <0.001         | <0.001         | <0.001    | <0.001    | <0.001    | <0.001    | <0.001    |

n=Number of patients
intubation as compared to use of traditional Macintosh laryngoscope.

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Conflicts of interest
There are no conflicts of interest.

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