Ease of Intubation with C-MAC Videolaryngoscope: Use of 60° Angled Styletted Endotracheal Tube versus Intubation over Bougie

Pulak Tosh, Sunil Rajan, Lakshmi Kumar
Department of Anaesthesiology, Amrita Institute of Medical Sciences, Amrita University, Kochi, Kerala, India

Abstract

Background: Although videolaryngoscopes improve glottic visualization, their actual usefulness in intubation is not yet established. Aims: The primary objective was to compare the ease of oral intubation with the use of 60° angled styletted endotracheal tube versus that performed over bougie inserted under videolaryngoscopic guidance. The secondary objectives were assessment of incidence of airway loss, hemodynamic changes, and number of attempts at intubation. Settings and Design: This prospective randomized study was conducted in a tertiary care institution. Patients and Methods: Seventy surgical patients requiring oral intubation were randomly allotted to Group S or Group B. Laryngoscopy was performed with Storz® C-MAC videolaryngoscope using D-Blade. In Group S, patients were intubated with a 60° angled styletted endotracheal tube. In Group B, a bougie was introduced into the trachea and endotracheal tube was railroaded over the bougie. Statistical Analysis Used: Chi-square test and independent sample t-test were used as applicable. Results: The ease of intubation was significantly more in patients of Group S as compared to Group B (88.6% vs. 25.7%, respectively, \( P < 0.001 \)) with significantly shorter intubation time (16.97 ± 7.91 vs. 77.43 ± 35.55 s, respectively, \( P < 0.001 \)). The requirement of more than one attempt at intubation was significantly higher in Group B [57.1% vs. 5.7% \( P < 0.001 \), respectively]. Group B showed a significantly high mean arterial pressure at 1 and 3 min following intubation with no significant change in heart rate. Conclusion: Use of 60° angled styletted endotracheal tube resulted in easier and faster intubation as compared to intubation over a bougie when used with C-MAC videolaryngoscope.

Keywords: Bougie, endotracheal tube, intubation, stylet, videolaryngoscope

Introduction

The introduction of videolaryngoscopes into clinical practice had resulted in varied responses regarding their utility in intubation. It is unquestionable that it improves glottic visualization, but not many studies have looked into the actual usefulness such as the time needed for intubation and success rate at the first attempt of intubation while using videolaryngoscopes. Whether it can be a potential replacement to traditional direct laryngoscopy in the daily anesthetic practice is yet to be elucidated.[1]

Aim of the study

The primary objective of the present study was to compare the ease of oral intubation with the use of 60° angled styletted endotracheal tube versus that performed over bougie inserted under videolaryngoscopic guidance. The secondary objectives included a comparison of the incidence of airway loss, hemodynamic changes, number of attempts taken, and the time required for intubation with each of these techniques.

Patients and Methods

This prospective randomized study was conducted in seventy surgical patients aged 18–70 years, of American Society of Anesthesiologists (ASA) Physical Status 1 and 2, of Mallampati score of 3 and 4 requiring general anesthesia with oral endotracheal intubation after obtaining Institutional Ethical Committee clearance and patient consent. Those with uncontrolled hypertension, coronary artery disease,
thyrotoxicosis, pheochromocytoma, pregnancy, valvular heart diseases, raised intracranial and intraocular pressures were excluded from the study. Those patients in whom glottis opening was not visualized during laryngoscopy were also excluded from the study.

Following a detailed preanesthetic assessment, patients were kept fasting 6 h for solids and 2 h for clear fluids. Alprazolam 0.5 mg was orally administered on the night prior to surgery and on the morning of surgery. On arrival at the operation theater, monitors including an electrocardiogram, pulse oximeter, and noninvasive blood pressure monitors were attached and baseline hemodynamic parameters were recorded. A large bore intravenous cannula was placed under local anesthesia. Following preoxygenation for 3 min, patients were given midazolam 2 mg, fentanyl 2 µg/kg, and propofol 2–2.5 mg/kg till there was a loss of response to verbal commands. After confirming the ability to mask ventilate, 1.5 to 2 mg/kg succinylcholine was administered and the patients were mask ventilated with 1% isoflurane in oxygen.

The patients were randomly allotted to either Group S or Group B based on computer-generated random sequence of numbers. One minute after induction, laryngoscopy was performed with Storz® C-MAC videolaryngoscope (Karl Storz-Endoscope 8403 ZX, Germany) using D-Blade in both groups. In Group S, patients were intubated with a proper-sized 60° angled styletted endotracheal tube, whereas in Group B, a bougie, with an endotracheal tube loaded at the distal part, was introduced through the glottic opening and was advanced about 5–6 cm into the trachea. The endotracheal tube was then railroaded over the bougie into the trachea keeping the videolaryngoscope in view of the laryngeal inlet.

Correct placement of the endotracheal tube was further confirmed with the presence of end-tidal capnogram and auscultation. Patients were then mechanically ventilated keeping the end-tidal carbon dioxide levels between 30 and 35 mmHg and were maintained with 1% isoflurane in oxygen-nitrous oxide mixture (1:2). Tachycardia and hypertension were defined as an increase of 30% from the baseline value and were treated with 20–30 mg bolus of propofol and by increasing the inspired concentration of isoflurane to 1.5%–2% transiently.

The ease of intubation was assessed and scored as good, satisfactory, and poor based on visualization of glottis, need of manipulations to aid intubation, and success at the first attempt at intubation [Table 1]. Intubation time was noted as the time from introduction of the videolaryngoscope into oral cavity to appearance of end-tidal carbon dioxide waveform by an anesthesia technician not directly involved in the intubation process. Number of attempts taken for intubation, fogging during the procedure, and incidence of loss of airway, such as esophageal intubation, were also noted. The heart rate (HR), systolic, diastolic, and mean arterial pressures (MAPs) were documented before induction (baseline), immediately after induction, immediately after intubation, and thereafter at 1, 3, 5, 10, and 15 min after intubation.

As there are no similar studies published in the past, we proposed this as a pilot study conducted in twenty patients. Taking into account the ease of intubation as the primary outcome (10% vs. 100% in Group B vs. Group S, respectively), with 95% confidence interval and 90% power, the sample size was calculated as 18 in each group. However, we recruited seventy patients in the present study with 35 in each group.

Chi-square test was used to compare ease of intubation, number of attempts at intubation, loss of airway, and gender between the groups. Independent sample t-test was used to compare the time and hemodynamic parameters. Statistical analyses were done using SPSS software Version 20.0 for Windows (IBM Corporation Armonk, NY, USA).

### RESULTS

Mean age and weight, distributions of sex, ASA physical status, and Mallampati scores among patients in Groups S and E were comparable [Table 2]. The ease of intubation was significantly more in patients of Group S as compared to Group B (88.6% vs. 25.7%, respectively, *P* < 0.001) with significantly shorter intubation time [16.97 ± 7.91 vs. 77.43 ± 35.55 s, respectively, *P* < 0.001, Table 3]. Ease was poor in 40% of patients in Group B as compared to none in Group S [Figure 1]. The requirement of more than one attempt at intubation was significantly higher in Group B [57.1% vs. 5.7%, respectively, *P* < 0.001, Table 3]. Although there were two cases of loss of airway in Group S, this did not show any statistical difference from Group B [Table 3]. The baseline hemodynamic parameters were comparable in both groups. Group B showed a significantly high MAP at 1 and 3 min.

### Table 1: Assessment of ease of intubation

| Variables       | Good                      | Satisfactory          | Poor                      |
|-----------------|---------------------------|-----------------------|---------------------------|
| Glottis visualized adequately and intubation accomplished easily | Glottis visualized adequately but required external manipulation over larynx and lifting force of laryngoscope to be adjusted to aid intubation | Glottis visualized adequately but failed to intubate in the first attempt irrespective of external manipulation and adjusting force of laryngoscope |

### Table 2: Comparison of demographics and Mallampati scores

| Variables       | Mean±SD                  | *P*       |
|-----------------|--------------------------|-----------|
| Group S         | Group B                  |           |
| Age (years)     | 42.2±14.8                | 40.1±14.4 | 0.541 |
| Height (cm)     | 159.2±8.9                | 157.4±10.5 | 0.436 |
| Weight (kg)     | 65.7±11.5                | 66.2±13.5 | 0.857 |
| Mallampati score 3 (%) | 68.7                     | 72.6      | 0.528 |
| Mallampati score 4 (%) | 31.3                     | 27.4      |       |

SD=Standard deviation
following intubation [Table 4]. There was no significant change in HR at any time point between the groups [Table 5].

**DISCUSSION**

Video laryngoscopes were inducted to the armamentarium of airway gadgets with the belief that they would facilitate endotracheal intubation as they provide a direct visualization of the glottis. However in reality, the actual usefulness during the intubation process was shown to be not very promising. Video laryngoscopes with higher curvature blades have been the most controversial as additional airway devices such as stylet or a bougie were very often required to accomplish oral endotracheal intubation. Use of these devices reduced the intubation time and was associated with a blunted hemodynamic stress response. However, during nasotracheal intubations, compared to Macintosh blades, video laryngoscopes are far better in terms of glottic visualization, intubation time, and need for external manipulations.[2]

It had been shown that use of styletted endotracheal tubes significantly reduced the intubation difficulty while using C-MAC video laryngoscopes during intubation in patients with cervical spine surgery with neck stabilization.[3] While using McGrath video laryngoscope, the 60° angled stylet facilitated faster oroendotracheal intubation than 90° angled stylet.[4] 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.[5]

The endotracheal tube introducer, commonly termed as “gum elastic bougie,” is an effective and inexpensive adjunct in the airway management of those with unanticipated difficult airway. It is made up of a braided polyester base with a resin coating and is flexible but stiff at room temperature. A 15 Fr, 60 cm long bougie is routinely used during adult intubation. It has also been recommended as an alternative to stylet while using video laryngoscopes. The angled tip of the endotracheal tube introducer makes it easy to be guided into the larynx.

The common problem associated with the use of a styletted endotracheal tube is that the angled tip abuts the anterior laryngeal wall and the stylet needs to be withdrawn to advance the tube further. Pulling the stylet out with just the tip of the tube inside the larynx carries a risk of loss of the airway as the tube can slip out and could result in esophageal intubation when tube is pushed in. Introducing a bougie into the trachea and railroading the endotracheal tube over it greatly reduce this risk as adequate length of the bougie being inside the trachea provides more stability during these manipulations.

The disadvantages of using bougie as an aid to intubate are that, unless used gently, there is a potential chance for damage or perforation of the trachea, bronchi, or even esophagus as it is stiff. It is always advisable to introduce it only up to

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**Table 3: Comparison of ease of intubation, attempts at intubation, intubation time, and loss of airway**

| Group | Ease of intubation | P |
|-------|--------------------|---|
|       | Poor or satisfactory, n (%) | Good, n (%) |
| S     | 4 (11.4)           | 31 (88.6) | <0.001 |
| B     | 26 (74.3)          | 9 (25.7)   |

| Number of attempts | One, n (%) | More than one, n (%) | P |
|--------------------|------------|---------------------|---|
| S                  | 33 (94.3)  | 2 (5.7)             | <0.001 |
| B                  | 15 (42.9)  | 20 (57.1)           |   |

| Intubation time (s), mean±SD | S | B |
|------------------------------|---|---|
|                             | 16.97±7.91 | 77.43±35.55 |
|                             | <0.001     | <0.001    |

| Loss of airway | No, n (%) | Yes, n (%) | P |
|----------------|-----------|------------|---|
| S              | 33 (94.3) | 2 (5.7)    | 0.493 |
| B              | 35 (100.0)| -          |   |

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**Table 4: Comparison of mean arterial pressures**

| Time            | Comparison of MAP (mean±SD) | P   |
|-----------------|-------------------------------|-----|
| S               | 104.6±14.9                   |     |
| B               | 98.1±19.2                    |     |
|                 | 0.118                        |     |
| After induction | 84.8±12.5                    |     |
| S               | 86.1±11.6                    | 0.658|
| B               | 110.4±24.1                   |     |
|                 | <0.001                       |     |
| 1 min after intubation | 89.1±15.7               |     |
| S               | 78.2±11.1                    | 0.006|
| B               | 88.8±18.7                    |     |
| 5 min after intubation | 79.5±16.0               |     |
| S               | 81.6±11.9                    | 0.550|
| B               | 81.7±12.5                    |     |
| 10 min after intubation | 80.2±11.9               |     |
| S               | 83.0±12.6                    | 0.366|
| B               | 83.0±12.6                    |     |

SD=Standard deviation, MAP=Mean arterial pressure

**Table 5: Comparison of heart rate**

| Time            | Comparison of HR (mean±SD) | P   |
|-----------------|----------------------------|-----|
| S               | 89.9±15.9                  |     |
| B               | 84.9±18.5                  | 0.232|
| After induction | 89.5±16.1                  |     |
| S               | 85.4±18.1                  | 0.322|
| B               | 97.2±12.6                  |     |
| 3 min after intubation | 89.7±14.4               |     |
| S               | 91.9±13.5                  | 0.528|
| B               | 83.8±12.2                  |     |
| 5 min after intubation | 85.9±14.4               |     |
| S               | 88.3±12.2                  | 0.460|
| B               | 84.2±13.5                  |     |
| 10 min after intubation | 84.0±13.7               |     |
| S               | 81.7±11.9                  | 0.727|
| B               | -                           |     |

SD=Standard deviation, HR=Heart rate
mid-trachea and an assistant should hold it stationarily when endotracheal tube is being introduced to prevent inadvertent passage deeper into the trachea to prevent airway trauma.

Endotracheal intubation using Macintosh laryngoscope is the time-tested and the most commonly adopted technique in the daily anesthetic practice. While using a Macintosh laryngoscope, to visualize the glottic opening, high forward and upward force is needed to align the oral, pharyngeal, and laryngeal axes. Varying degrees of head extension, neck flexion, and laryngeal manipulation will be required depending on patient characteristics. It had been estimated that about 35–40 N force is required to expose glottis while using Macintosh laryngoscopes. The associated hemodynamic stress responses, risk of soft tissue and cervical injury, and dental damage are greatly proportional to the force applied.

While using videolaryngoscopes with higher curvature blades, lesser upward lifting force, of about 5–14 N, is mandated to obtain a good indirect view of the glottis as there is no need to align the oral, pharyngeal, and laryngeal axes to a straight line. This attenuates the magnitude of the cardiovascular stress responses and soft tissue injury associated with the use of videoscopes. However, it had been documented that the time taken for intubation is usually longer, especially with angled blade, 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. This has been aptly termed as “laryngoscopy paradox.” In effect, the resultant hemodynamic responses could be similar or even greater than that observed with the use of Macintosh laryngoscope for intubation. However, the use of additional airway gadgets such as a stylet or bougie could result in shorter intubation time and hence blunting of the stress response is possible.

Our observation that the intubation was easy and less time-consuming with the styletted endotracheal tube could be attributed to the curvature of the endotracheal tube which was more in alignment with the curvature of the blade. The bougie that was used in our study was angulated only at the tip and the body was straight. We found that most often during laryngoscopy, the tip of bougie was posterior to arytenoid cartilages and manipulating it into the glottis required several attempts and was time-consuming. Even trying to align the glottic opening by adjusting the force needed to perform the scope or with external manipulation did not always succeed. Repeated attempts, longer intubation time, and greater force exerted for performing the scope were evident as the reasons for the exaggerated hemodynamic response observed in the bougie group. It is possible that bending the bougie to match the curvature of the laryngoscope blade could have altered the alignment and increased the speed and comfort of intubation.

Some common problems reportedly faced during videolaryngoscopy are obscuration of view by fogging and due to the presence of blood or secretions and loss of depth perception as it is a two-dimensional view which could lead to significant upper airway injury. Fogging can be greatly reduced by applying an anti-fog solution or by immersing blade in warm water. However, we did not encounter any of these issues during our study.

Our study had limitations as it could not be blinded. Also, although all intubations were performed by anesthetists with a minimum 5 years of experience, subjective variation could have happened.

**Conclusion**

The use of 60° angled styletted endotracheal tube resulted in easier and faster orotracheal intubation as compared to intubation over a bougie when used with a C-MAC videolaryngoscope. The stylette-guided intubation also provided a better attenuation of hemodynamic responses to intubation in comparison to the bougie group.

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**Conflicts of interest**

There are no conflicts of interest.

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