Comparative Study between C-MAC Video Laryngoscopy Versus Flexible Fiberoptic Laryngoscopy in Patient with Anticipated Difficult Airway in Increasing Success Rate and Decreasing Time of Intubation

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Abstract

Background: Tracheal intubation is an essential skill in the care of the unconscious, anaesthetized or critically ill patients. Tracheal intubation can be difficult and may result in many complications. This disastrous outcome happens when the airway cannot be secured by intubation and face mask ventilation becomes difficult.

Patients and Methods: 120 adult patients divided into 2 groups each is 60 patients in each group using Storz C-MAC videolaryngoscope in group 1 and fiberoptic bronchoscopy in Group 2. Intubation time success rate and number of attempts were recorded.

Results: There were no significant differences between both groups in demographic data, the success rate was 100% in both groups, intubation time was significantly higher in Group 2 compared to Group 1, as regard number of attempts, all of intubation were successful on the first attempt in Group 1.

Conclusion: Using C-MAC video laryngoscope in patients with anticipated difficult airway has high success rate from the first attempts compared to fiberoptic laryngoscopy.

Key Words: C-MAC – Fiberoptic laryngoscopy – Intubation – Difficult airway.

Introduction

TRACHEAL intubation is an essential skill in the care of the unconscious, anaesthetized or critically ill patients. Tracheal intubation can be difficult and may result in many complications, the most serious being hypoxemic brain damage and death. Soft tissue damage, sometimes fatal, can be caused by traumatic attempts at intubation. Maintenance of oxygenation must take precedence over all other considerations when difficulty with intubation is experienced and intubation attempts should be deferred until oxygenation is restored [1].

Laryngoscopy occupies a unique position in anaesthesia because it is a procedure which is only a means to an end. The ultimate aim is to safely and atraumatically intubate the trachea and secure the airway [1].

The unexpected difficult airway is always a challenge for experts as well as for trainees. Fiberoptic intubation is still the gold standard in the management of the difficult airway. A good alternative for difficult intubation is the videolaryngoscope with indirect laryngoscopy which may be as effective as flexible laryngoscopy in difficult airway patients.

Patients and Methods

The study will be conducted on (one hundred and twenty) adult patients divided into two groups each is (sixty) patients in each group using Storz C-MAC videolaryngoscope in Group (1) and fiberoptic bronchoscopy in Group (2) in Kasr El-Aini Hospital after obtaining written informed consent from the patients and approval of the Ethics and Research Committee of the Anesthesiology Department in Faculty of Medicine, Cairo University during 2014.

Inclusion criteria were ASA I, II, Elganzuri score as 2, 3, 4, elective surgeries, ages between (20-50 years old). Exclusion criteria were, ages >50 years or <20 years, ASA III, IV, Elganzuri score (AS) 0, 1, 5, patients who need a surgical airway (e.g. patients with highly obstructing laryngeal lesions such as cancer), patients with laryngeal trauma, especially in those with suspected, cricotr-
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cheal separation, patients with craniofacial trauma, emergency surgeries.

Study groups:
The two study groups were:
• Group 1, patients intubated with C-MAC laryngoscopy.
• Group 2, patients intubated with fiberoptic laryngoscopy.

Operating room preparation:
- Difficult airway cart that includes different size oral airways, endotracheal tubes, different size face masks and laryngeal airway masks was prepared.
- Suction apparatus was ready for use.
- C-MAC video laryngoscopy.
- The fiberscope used was (Karl Storz size 2.8mm, tuttlingen, germany). The tube was mounted over the fiberscope before the procedure.

Anesthetic management:
Routine pre operative assessment including, history taking, clinical examination, and laboratory tests. Patients are first admitted to the operating room with a small 20G IV cannula on the dorsum of the hand.

1- Monitoring:
Standard cardiovascular monitoring devices including ECG, noninvasive blood pressure, peripheral oxygen saturation (pulse oximeter) and (capnography were attached after induction of anaesthesia).

Induction and maintenance:
Patients were then preoxygenated via face mask for three minutes and atropinized using 0.01mg/kg atropine then general anesthesia was induced using fentanyl 1-2mic/kg followed by propofol 2mg/kg and atracurium 0.5mg/kg the patient is mechanically ventilated using face mask until full relaxation is established after 3-5 minutes. Then intubation is done using C-MAC laryngoscopy in Group 1 or using fiberoptic laryngoscopy in Group 2.

1- Group 1, patients intubated with C-MAC laryngoscopy:
Introduce the video laryngoscope: With the patient appropriately positioned, the operator uses the left hand to introduce the VL into the midline of the oro-pharynx and gently advances until the blade tip pass the posterior portion of the tongue.

With the scope now inserted, the operator turns his or her eyes to the video screen in order to manipulate the scope and obtain the best view of the glottis, the glottic view is optimized by a combination of advancing or withdrawing the laryngoscope slightly while increasing the tilt on the blade to seat the device in the vallecula or on the posterior surface of the epiglottis to obtain the best glottic view. All of this is done using video visualization with the eyes directed at the video screen the entire time. When the VL is appropriately positioned, the glottic aperture is seen in the center of the upper third of the video display.

The operator immediately starts to insert the ETT and attempt to navigate it through the glottic aperture while continuously visualizing the video screen, it is better to maintain the laryngoscopic position in the mouth with the left hand but to avert the eyes from the video screen back to the patient's open mouth. The ETT, which is shaped by the stylet to match the bend of the VL blade, is then inserted under direct vision until the distal tip of the ETT is judged to be very near the distal tip of the laryngoscope blade.

Returning one's eyes to the video screen allows one to see the glottic aperture as before (sometimes slight readjustment of the blade is required) and, near it, the tip of the ETT. Using video visualization, the ETT is then advanced on a smooth curve through the glottis and intubation proceeds. Viewing the entire insertion step on the video screen allows the operator to quickly become facile with the motion of gently rotating or angling the tube using the right hand to redirect as necessary.

II- Group 2, patients intubated with fiberoptic laryngoscopy:
Patients can be positioned supine with the endoscopist standing at the head of the bed. Simple chin lift and jaw thrust may improve the view through the fiberscope and also help to prevent airway obstruction. Alternatively, the patient may be seated facing the operator. The endotracheal tube lumen should be lubricated to facilitate its subsequent advancement into the trachea. It must be appreciated that the tip of the scope can be flexed in up and down using the control lever located at the handle. Movement of the tip of the scope in right and left requires rotation of the entire instrument. Generally, the proximal control section of the laryngoscope held in the non dominant hand with the index finger on the suction port and the thumb on the lever which regulates the distal tip angulations. The other hand holds the shaft of the scope distally and guides its advance. The tongue can be grasped by an assistant with gauze or Magill forceps. Pass the scope superior to the tongue into
the oropharynx. Pass the fiberoptic laryngoscopy between the vocal fold until visualization the tracheal ring and carina. The endotracheal tube is then threaded over the distal tip of the scope, fed proximally and fixed in position adjacent to the control handle. Once the endotracheal tube is in place, the scope is removed, and the patient is ventilated. Fiberoptic intubation is often performed with the endoscopist looking through the eyepiece of the fiberoptic scope. However, connecting the scope to a monitor is often advantageous.

Measured parameters:
1- Intubation time:
   It is defined as the time from initiation of intubation (application of the laryngoscope into mouth) to ETCO\(_2\) detection from the ETT. In cases with failed intubation it was considered from initiation of intubation till failure.

   These times were recorded using a stop watch.
2- Success rate and number of attempts:
   Airway instrumentation was interrupted if oxygen saturation decreased below 92% and patients were ventilated via a face mask. After 3 failed trials the procedure was considered unsuccessful. When endotracheal intubation was unsuccessful classical LMA of appropriate size was inserted, correct placement was confirmed by capnography, the patient was ventilated manually with 100% oxygen and the patient was awakened.

Statistical analysis:
Data were coded and entered using the statistical package SPS S version 2.1. Data was summarized using mean, Standard Deviation (SD), median, minimum and maximum for quantitative variables and frequencies (number of cases) and relative frequencies (percentages) for categorical variables. Comparisons between groups were done using unpaired *t*-test in normally distributed quantitative variables while non-parametrical Mann-Whitney test was used for non-normally distributed variables. For comparing categorical data, Chi square (\(\chi^2\)) test was performed. Exact test was used instead when the expected frequency is less than 5. *p*-values less than 0.05 were considered as statistically significant.

Results

One hundred and twenty adult patients were enrolled in this study in Cairo University Kasr El-Ainy Hospital. Patients were randomly assigned into 1 of 2 groups, 60 patients intubated by video laryngoscopic intubation (Group 1). The other 60 patients intubated by fiberoptic laryngoscopic intubation (Group 2) and all of them were successfully intubated.

Demographic data analysis:
Demographic data analysis including sex, age, weight, height, body mass index, sex and ASA status between both groups and showed that there were no statistically significant differences between the study groups as regards patients data (*p*-value <0.05). (Table 1).

Predictors for potentially difficult airway:
All patients were assessed by El-Ganzouri scoring system and there were no significant differences between the two studied groups as regard interincisor gap, thyromental distance, head and neck movement, mallampati classification, buck teeth and history of difficult intubation (Table 2).

Analysis of time for intubation, number of attempts, success rate:
The success rate was 100% in both groups, Intubation time was significantly higher in Group 2 compared to in Group 1. (Table 3).

![Fig. (1): Duration of intubation in both studied groups (seconds). Values were presented as mean ± SD.](image)

### Table (1): Patients’ demographic characteristics. Data were presented as (mean ± SD) or no. (%).

<table>
<thead>
<tr>
<th></th>
<th>Group 1 (n=60)</th>
<th>Group 2 (n=60)</th>
<th><em>p</em>-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td>38.13±7.41</td>
<td>37.00±8.19</td>
<td>0.428</td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td>93.77±16.02</td>
<td>90.03±10.88</td>
<td>0.138</td>
</tr>
<tr>
<td><strong>Height (cm)</strong></td>
<td>167.23±6.42</td>
<td>166.57±6.92</td>
<td>0.585</td>
</tr>
<tr>
<td><strong>Body mass index (kg/cm²)</strong></td>
<td>32.31±2.55</td>
<td>32.51±2.53</td>
<td>0.677</td>
</tr>
<tr>
<td><strong>Sex (no, %):</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>34 (56.7%)</td>
<td>44 (73.3%)</td>
<td>0.056</td>
</tr>
<tr>
<td>Female</td>
<td>26 (43.3%)</td>
<td>16 (26.7%)</td>
<td></td>
</tr>
<tr>
<td><strong>ASA (no, %):</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASA I</td>
<td>28 (46.7%)</td>
<td>30 (50.0%)</td>
<td>0.715</td>
</tr>
<tr>
<td>ASA II</td>
<td>32 (53.3%)</td>
<td>30 (50.0%)</td>
<td></td>
</tr>
</tbody>
</table>
Table (2): Predictors for potentially difficult airway were presented as (mean ± SD) or no. (%).

<table>
<thead>
<tr>
<th></th>
<th>Group 1 (n=60)</th>
<th>Group 2 (n=60)</th>
<th>p* value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interincisor gap (cm)</td>
<td>4.93±.45</td>
<td>5.00±.58</td>
<td>0.504</td>
</tr>
<tr>
<td>Thyromental distance (cm)</td>
<td>7.38±.61</td>
<td>7.27±.67</td>
<td>0.321</td>
</tr>
<tr>
<td>Head &amp; neck movement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• &gt;=90°</td>
<td>46 (76.7%)</td>
<td>53 (88.3%)</td>
<td>0.093</td>
</tr>
<tr>
<td>• &gt;90°</td>
<td>14 (23.3%)</td>
<td>7 (11.7%)</td>
<td></td>
</tr>
<tr>
<td>• &lt;90°</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>Malampati classification:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Class 1</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>1</td>
</tr>
<tr>
<td>• Class 2</td>
<td>22 (36.7%)</td>
<td>22 (36.7%)</td>
<td></td>
</tr>
<tr>
<td>• Class 3</td>
<td>38 (63.3%)</td>
<td>38 (63.3%)</td>
<td></td>
</tr>
<tr>
<td>Buck teeth:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Can prognath mouth</td>
<td>60 (100.0%)</td>
<td>60 (100.0%)</td>
<td></td>
</tr>
<tr>
<td>• Can prognath teeth</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>• Can’t prognath</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>History of difficult intubation:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• No</td>
<td>60 (100.0%)</td>
<td>60 (100.0%)</td>
<td></td>
</tr>
<tr>
<td>• Yes</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>• Questionable</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
</tbody>
</table>

Table (3): Time for intubation, number of attempts, success rate in both studied groups (second). Data were presented as (mean ± SD) or no. (%).

<table>
<thead>
<tr>
<th></th>
<th>Group 1 (n=60)</th>
<th>Group 2 (n=60)</th>
<th>p* value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of intubation (seconds)</td>
<td>22.13±2.83</td>
<td>62.97±37.54</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Number of attempts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 1 attempts</td>
<td>60 (100.0%)</td>
<td>44 (73.3%)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>• &gt;1 attempts</td>
<td>0 (0%)</td>
<td>16 (26.7%)</td>
<td></td>
</tr>
<tr>
<td>Success rate</td>
<td>60 (100.0%)</td>
<td>60 (100.0%)</td>
<td></td>
</tr>
</tbody>
</table>

*: p<0.05 between the two groups.

Discussion

The American Society of Anesthesiologists (ASA) states that an important cause of anesthesia-related injury is the inability to intubate the trachea and secure the airway (can’t ventilate, can’t intubate scenario) [2-4]. In the majority (85%) of these cases, the outcome is fatal, resulting in death or brain damage [2]. The morbid nonfatal events [5-8] are also increased. The latter refers to damage to soft tissue of the oropharynx (e.g. lips, tongue, palatopharyngeal fold), and more seriously damage to the glottis entrance (e.g. vocal cords, arytenoids and epiglottis).

The C-MAC video laryngoscope is a relatively new device with the unique advantage that it provides the possibility to obtain both a direct laryngoscopic view and a camera view that is displayed on the video screen, in contrast to many previous video laryngoscopes that provide an indirect camera view only [9].

In this thesis the intubating conditions were studied and prospectively evaluated in 120 patients; 60 in each group using Storz C-MAC video laryngoscope, in (Group 1) and fiberoptic bronchoscope in (Group 2).

The results of the present study showed statistically significant difference in intubation time between the two studied groups. It was significantly longer (p-value <0.05) 62.97±37.54 seconds in patients intubated using the fiberoptic laryngoscopy compared to 22.13±2.83 seconds in patients intubated using the new C-MAC laryngoscopy.

These results were in line with results of Ofelia L. et al., [11] who compared tracheal intubation with the C-MAC video laryngoscope device versus fiberoptic bronchoscope in patients undergoing cervical spine surgery. They concluded that the procedures times (including the time required to obtain glottic view, and to secure the airway with a tracheal tube confirmed by end tidal CO₂ waveform tracing) was significantly shorter in C-MAC group (60±30 seconds vs. 84±30 seconds, p-value <0.05) in fiberoptic group.

The result of the present study coincides also with the study done by Tomasz Gaszy ‘nski [12] who evaluated the use of V-MAC video laryngoscope (an earlier version of the C-MAC) in the morbidly obese. It was proved to be very effective and easy to use even for anesthetists with limited experience of using video laryngoscopes.

In contrast to the present study, Abelmalak et al., [13] who compared the use of glidoscope (another type of video laryngoscope) versus fiberoptic laryngoscopy in obese patients found that time of tracheal intubation under general anesthesia in either technique was comparable and less than one min. Also, Xue et al., [14] reported similar results in time-to-intubate in their study on 56 patients, although the patients were healthy and not obese.

The differences in duration of intubation between the present study and studies of Abelmalak, et al., and Xue et al., may be due to the additional cognitive processing required for indirect laryngoscope. It may affect the total intubation time and success rate when used in routine clinical practice particularly when used by new trainees. The first stage of learning is the verbal cognitive phase, where the operator needs to understand what is to be achieved; whilst the second stage is task execution [15]. Stage one of cognitive learning would have been a learned skill, requiring minimal cognitive processing. Therefore, they may hypothesize that delay in time to achieve laryngoscope and
intubation, using the video laryngoscope, must reflect the second stage of learning, which is in task execution [15]. This explain why C-MAC video laryngoscopes may not guarantee an easy tracheal intubation [10] and may prolong the time required for successful intubation inspite of providing a good view of the larynx.

As concerned the number of intubation attempt: The result of the present study showed high success rate with video laryngoscope on first attempt (100%) compared to (73.3%) on first attempts, (23.3%) on second attempts and (3.3%) patients on the third attempt in fiberoptic laryngoscope.

Mosier et al., [16] also noticed in a study, done to investigate the intubations performed in the ICU by mostly trainees with limited experience, that video laryngoscope significantly improved first attempt and ultimate success rates, grade of laryngoscopic view and decreased esophageal intubations compared to direct laryngoscopy.

Also, Michael [17] compared effectiveness of the C-MAC video laryngoscope versus direct laryngoscopy in the setting of the predicted difficult airway. This was the first study done to compare intubation success with video laryngoscopy with direct laryngoscopy in a diverse difficult airway patient population and among a large group of anesthesia providers. They found that intubation success in the predicted difficult airway was higher with the C-MAC (93%) compared with direct laryngoscopy using a conventional Macintosh blade (84%). Laryngeal views were better and maneuvers to facilitate intubation were less with the C-MAC.

The current study explained higher success rate with video laryngoscope to magnify the view of the airway and allowing the operator to view the airway in greater detail. The anterior angulations of the blade and placement of the video camera guarantees a field of view of at least 60º and thereby an optimal overview of the oropharynx and allow the operator to see structures that would be difficult or even impossible to see under direct vision.

Conclusion and recommendations:
The study concluded that C-MAC video laryngoscope provides excellent visualization of laryngeal structures in shorter time with less intubation attempts than traditional flexible fiberoptic laryngoscopy. Both devices are comparable as regards hemodynamic response and incidence of complication during endotracheal intubation. However, FB is still the standard care for elective anesthesia patients with predictors of difficult airways after unsuccessful laryngoscopy. The study recommends increasing sample size and measuring learning curve and need for additional maneuvers and tools (e.g. stylets) in further researches will be beneficial.

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