Hemodynamic Response to Tracheal Intubation Using New Airway Intubating Devices

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Abstract

Background: Cardiovascular responses (stress response) to endotracheal intubation have been well documented for direct laryngoscopy and are caused by the noxious stimuli to the oropharyngeal structures, the larynx and trachea. The improved glottic view provided by indirect video laryngoscopy reduces the need for excessive manipulation during intubation.

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, there was no significant difference in hemodynamic changes (systolic and diastolic blood pressure and heart rate) comparing to baseline value and the other group at the same time and intervals. And the incidence of complications (sore throat mucopharyngeal injury and esophageal intubation).

Conclusion: Using C-MAC video laryngoscope and fiberoptic laryngoscopy in patients with anticipated difficult airway are comparable as regards hemodynamic response and incidence of complication during endotracheal intubation.

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

Introduction

OVER the past 40 years, different techniques of tracheal intubation have been introduced, the most effective under different conditions being fiberoptic intubation.

A good alternative for difficult intubation is the video laryngoscope with indirect laryngoscopy, which may be as effective as flexible laryngoscopy in difficult airway patients. However, the judgment of the clinician is critical to avoid the inappropriate use of a video laryngoscopy when flexible bronchoscopy is the better choice. 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 [1].

On the other hand, this may be very helpful for educational purposes, since the student is enabled to follow an ideal intubation process on the video screen, and thereafter the instructor may directly observe the student's intubation attempts.

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, El-Ganzuri 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, El-Ganzuri 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, cricotho-
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.

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.

I- 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 fibrescope 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 is 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- Hemodynamic parameters:

- Heart rate (beat/minute).
- Mean blood pressure (mmHg).

Both were measured during baseline (just before induction of anesthesia), intubation, 1 minute, 2 minutes and 5 minutes post intubation.

2- Incidence of complications: (e.g.: Sore throat, mucopharyngeal injury, and esophageal intubation.

Statistical analysis:

Data were coded and entered using the statistical package SPSS version 21. 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. Comparisons between values measured at baseline, at intubation and after 1, 2 and 5 minutes were done using repeated measure ANOVA. 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).

<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>Age (years)</td>
<td>38.13±7.41</td>
<td>37.00±8.19</td>
<td>0.428</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>93.77±16.02</td>
<td>90.03±10.88</td>
<td>0.138</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>167.23±6.42</td>
<td>166.57±6.92</td>
<td>0.585</td>
</tr>
<tr>
<td>Body mass index (kg/cm²)</td>
<td>32.31±2.55</td>
<td>32.51±2.53</td>
<td>0.677</td>
</tr>
<tr>
<td>Sex (no, %):</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>ASA (no, %):</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>
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Hemodynamic changes (heart rate and blood pressure changes) in both groups:

There was no significant difference in hemodynamic changes (systolic and diastolic blood pressure and heart rate) comparing to baseline value and the other group at the same time and intervals.

<table>
<thead>
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<th>Group 2 (n=60)</th>
<th>p-value</th>
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</thead>
<tbody>
<tr>
<td>Heart rate baseline (beat/min)</td>
<td>77.00±18.26</td>
<td>81.97±8.79</td>
<td>0.185</td>
</tr>
<tr>
<td>Heart rate at intubation</td>
<td>97.03±14.32</td>
<td>101.23±12.03</td>
<td>0.085</td>
</tr>
<tr>
<td>Heart rate 1min after intubation</td>
<td>92.60±14.11</td>
<td>99.10±11.32</td>
<td>0.054</td>
</tr>
<tr>
<td>Heart rate 2min after intubation</td>
<td>88.97±12.52</td>
<td>92.82±9.13</td>
<td>0.057</td>
</tr>
<tr>
<td>Heart rate 5min after intubation</td>
<td>82.63±11.42</td>
<td>83.23±8.40</td>
<td>0.817</td>
</tr>
</tbody>
</table>

Fig. (1): Heart rate changes between both groups (beat/minute). Values were presented as mean ± SD.
Table (3): Systolic and diastolic blood pressure changes in both groups. (mmHg) data were presented as mean±SD.

<table>
<thead>
<tr>
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<th>Group 2 (n=60)</th>
<th>p-value</th>
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<tbody>
<tr>
<td><strong>Systolic blood pressure</strong> (mmHg):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>133.43±11.88</td>
<td>129.67±11.63</td>
<td>0.220</td>
</tr>
<tr>
<td>At intubation</td>
<td>148.83±20.23</td>
<td>148.50±28.29</td>
<td>0.958</td>
</tr>
<tr>
<td>1 min after intubation</td>
<td>144.73±16.53</td>
<td>148.67±12.41</td>
<td>0.302</td>
</tr>
<tr>
<td>2 min after intubation</td>
<td>139.53±16.86</td>
<td>144.87±11.20</td>
<td>0.154</td>
</tr>
<tr>
<td>5 min after intubation</td>
<td>132.57±16.53</td>
<td>131.10±12.12</td>
<td>0.697</td>
</tr>
<tr>
<td><strong>Diastolic blood pressure</strong> (mmHg):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>78.20±9.89</td>
<td>76.37±8.32</td>
<td>0.441</td>
</tr>
<tr>
<td>At intubation</td>
<td>90.63±8.90</td>
<td>92.47±8.91</td>
<td>0.429</td>
</tr>
<tr>
<td>1 min after intubation</td>
<td>85.33±8.23</td>
<td>89.00±8.77</td>
<td>0.100</td>
</tr>
<tr>
<td>2 min after intubation</td>
<td>82.10±7.51</td>
<td>85.43±8.37</td>
<td>0.110</td>
</tr>
<tr>
<td>5 min after intubation</td>
<td>76.53±8.12</td>
<td>76.17±6.26</td>
<td>0.845</td>
</tr>
</tbody>
</table>

Complications:

As regard the incidence of complications (sore throat mucopharyngeal injury and esophageal intubation). There was no significant difference in the two groups (Table 4).

Discussion

Although Fiberoptic Bronchoscope (FB) is considered the gold standard for tracheal intubation in patients with anticipated difficult intubation [2]. The aim of the present study was to investigate the laryngoscopic view and intubation success using the new C-MAC in comparison with traditional flexible fiberoptic laryngoscopy in randomized trials in patients with anticipated difficult airway. It may be very helpful for educational purposes, since the student is enabled to follow an ideal intubation process on the video screen, and the instructor may directly observe the student’s intubation attempts. So it is an ideal tool for teaching and learning endotracheal intubation. Video laryngoscope is far superior to the exclusive ‘look over my shoulder’ training available with direct laryngoscope alone. Additionally, video laryngoscope can be used as a research tool in airway management. This better teaching modality is mainly based upon the fact that the instructor sees what the student viewing. Therefore, both the student and instructor have a view of the airway. This facilitates teaching while also improving safety. Immediate modifications in technique can be performed to optimize safety of the patient [3].

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).

In this study, hemodynamic changes (systolic, diastolic blood pressure and heart rate) were well maintained and were comparable in both groups, inspite of prolonged duration of intubation in fiberoptic group and need for additional maneuvers for laryngoscopy and intubation in C-MAC group.

Cardiovascular responses (stress response) to endotracheal intubation have been well documented for direct laryngoscopy and are caused by the noxious stimuli to the oropharyngeal structures (laryngoscopy) and the larynx and trachea (exerted by the tracheal tube insertion). The improved glottic view provided by indirect video laryngoscopy reduces the need for excessive manipulation during intubation.
In line with the present study was the study done by Aqil [4] who compared the stress response to endotracheal intubation comparing glidescope and flexible fiberoptic bronchoscope. It did not find any significant difference in Hemodynamic Stress Response (HDSR) using either, glidescope or flexible fiberoptic bronchoscope.

Also, Khudad [5] studied hemodynamic response to orotracheal intubation using direct laryngoscopy versus fiberoptic bronchoscopy. He found that after anesthetic induction, SBPs, DBPs and HRs increased in both groups, in comparisons to the baseline values after tracheal intubation and the increase was statistically insignificant. This suggests that there are no differences between FOB and DLS in attenuating the cardiovascular response to orotracheal intubation. These results also in line with the result of the study done by F. Xue et al. [6] who investigated stress response during intubation in 50 patients scheduled for elective plastic surgery under general anesthesia requiring orotracheal intubation. They demonstrated that the orotracheal intubations using a FOB and a DLS produced similar hemodynamic responses.

However contrarily, Nata et al. [7] found significantly increased HDSR with FFB in comparison to GLS. The prolonged time of intubation, which was more than double in FFB group compared to that of GLS group (120 vs. 59 seconds) was due to their encountering difficulties in visualizing the glottis leading to greater airway manipulation. Since, the two main components that determine HDSR, are the degree and the duration of pharyngeal and tracheolaryngeal stimulation, [8,9] so the higher HDSR response with FFB in their study [10] was explained by prolonged intubation.

Also, Katsnelson et al. [11] found that the advancement of the tracheal tube over the FOB is often impeded when the Murphy’s tip catches on the downward sagging epiglottis, arytenoid cartilage, vocal cords and anterior tracheal wall. On such occasions, the successful intubation often requires some specific maneuvers e.g. rotating the tracheal tube, further lifting jaw upward and adjusting the patient’s head-neck position which can result in hypertension and tachycardia. All these procedures are invasive, and may further stimulate pharyngolaryngeal structures and the trachea. Also during fiberoptic intubation, the insertion cord of the FOB must be placed into the trachea for guidance followed by advancing the tracheal tube over the insertion cord into the trachea and then the FB is removed. This can cause repeated friction and irritation to the trachea leading to increase in HDSR [11].

As regard to the incidence of complication:
The current study showed that incidence of minor mucosal injury was (10%) cases in C-MAC group compared to (8%) cases in FB group. Also sore throat was (16.7%) in C-MAC group compared to (23.3%) in FB group. There was no esophageal intubation in both groups.

This data correspond to Ofelia et al., [12] who found that the number of patients complaining of a sore throat after surgery was non-significantly higher in the C-MAC group (5 vs. 1 in the fiberoptic group, p-value=0.102). Also mucosal injury and change in voice was insignificant.

Also, Abdelmalak et al., [10] found that minor and severe laryngeal trauma has been previously reported with both fiberoptic intubation and the glidescope (for example 3% trace bleeding and 10% incidence of even moderate sore throat in their cohort).

Conclusion and Recommendation:
The study concluded that C-MAC video laryngoscope is an efficient and suitable intubating device in patients with anticipated difficult airway. 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, as it is more reliable at obtaining high-grade views of the larynx especially in patients with limited or no neck mobility and limited mouth opening capacity using awake technique by experienced anesthetists. The study recommends its use in certain surgical disciplines like ENT (ear, nose and trachea), CMF (craniomaxillofacial) surgery, emergency surgeries and patients with laryngeal trauma.

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