Effect of Cricoid Pressure on Laryngeal View During Macintosh, McGrath MAC X-Blade and GlideScope Video Laryngoscopies

Macintosh, McGrath MAC X-Blade ve GlideScope Videolaringoskopları Sırasında Uygulanan Krikoid Basıncın Laryngeal Görüntüye Etkisi

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Introduction

Maintaining airway security is the major responsibility of an anaesthetist. Although Macintosh laryngoscopy is the gold standard, complications due to failed laryngoscopy may be life-threatening (1). Applying cricoid pressure is a preferred method in unfasted patients who require emergency intubation and who are at high risk of aspiration...
or regurgitation. Both speed and success of tracheal intuba-
tion improve survival (2, 3).

The McGrath MAC X-Blade video laryngoscope (Air-
craft Medical Ltd., Edinburgh, UK) is the lightest video laryng-
scope (4). It has a liquid crystal display screen and a removable
plastic slim X-Blade. The McGrath MAC X-Blade video laryngoscope provides a better glottis view than the Macin-
tosh laryngoscope in difficult airways (5).

The GlideScope video laryngoscope (Saturn Biomedical Sys-
tems, Burnbary, BC, Canada) has a high-resolution camera
eMBEDDED WITHIN THE BLADE, a light-source and a 60° curved
blade. The GlideScope video laryngoscope has been shown
to reduce the number of intubation attempts and improve
the glottal structure view compared with direct laryngoscopy,
particularly in difficult airways (6). These two video laryn-
goscopes are compact and portable. Thus, they can be used both
inside and outside the hospital.

In 2015, the Difficult Airway Society published the unantic-
ipated difficult airway guideline and recommended to release
the cricoid pressure if intubation is impossible, as it worsened
the Cormack-Lehane grade of some videolaryngoscopes (7).

To the best of our knowledge, this is the first prospective ran-
donised study that primarily aimed to compare the Macintosh,
McGrath MAC X-Blade and GlideScope video laryngoscopes
with respect to their laryngoscopic views with or without cri-
coid pressure. The secondary aim of this prospective randomised
study was to compare the X-Blade of the McGrath MAC and
GlideScope video laryngoscopes with the Macintosh laryngo-
scope with respect to the insertion and tracheal intubation times,
success rates, need for optimisation manoeuvres, effects on hae-
modynamic parameters and postoperative minor complications.

Methods

Official approval was obtained from the Local Human Re-
search Ethics Committee (KOU KAEK 2015/267) and written
informed consent was obtained from the patients. The study
was registered at ClinicalTrials.gov (registration number:
NCT 02588157).

We recruited 120 patients in this study. Inclusion criteria in-
cluded patients with American Society of Anesthesiologists
I-II, who were between 18 and 65 years of age and were un-
dergoing elective surgery that required tracheal intubation.
Exclusion criteria included the presence of laryngeal or pha-
ryngeal pathology, a known or expected difficult airway (i.e.
interincisor distance <2.5, Mallampati 3-4, thyromental dis-
tance <6 cm, sternomental distance <12 cm and body mass
index<35 kg m⁻²), high cardiac or respiratory system insuffi-
ciency, recent upper respiratory tract infection (during the past
10 days) and pregnancy.

After an intravenous (iv) cannula was inserted at the preoper-
ative care unit, midazolam (0.03 mg kg⁻¹ iv) was administered
for premedication. After arriving in the operating theatre,
patients were monitored using electrocardiography, pulse ox-
imetry (SpO₂), heart rate (HR), non-invasive blood pressure
and expiratory end-tidal carbon dioxide levels. Patients were
preoxygenated for 3-5 min with 100% oxygen using a face
mask. We recorded the patients’ preoperative demographic
and airway variables, including age, sex, weight and height;
sternomental, thyromental and interincisor distances; Mal-
lampati classification with phonation; mandibular protrusion
(type A, lower incisors protrude anterior to the upper incisors;
type B, lower incisors can be brought edge to edge with the
upper incisors and type C, lower incisors cannot be brought
dge to edge with the upper incisors); tooth morphology (full/lacking/none); macroglossia or microglossia.

Patients were randomised into three groups, i.e. Macintosh,
McGrath MAC X-Blade and GlideScope, using a sealed en-
velope technique. All steps were then applied concordant with
an While oxygenation was applied using a facemask, propofol
(2-3 mg kg⁻¹ iv) and fentanyl (1 mgr kg⁻¹) were administered
for anaesthesia induction. Subsequently, succinylcholine (1 mg
kg⁻¹) was rapidly administered. Cricoid pressure was applied
during all the intubations by an unblended independent an-
esthesia resident with at least 4 years experience. Cormack-Le-
hane grades under cricoid pressure were taken as the baseline
view and then, as the cricoid pressure was gradually decreased,
the change in the laryngeal view was recorded (8). During the
intubation procedure, a pillow was placed beneath the patients’
head and the head was in the neutral position.

Patients were intubated using one of the three laryngoscopes
for 1 min following succinylcholine administration. All intu-
bations were performed by the staff with at least 5 years
of experience and who had performed at least 50 successful
intubations using each device. The men were intubated using
an 8.0-mm polyvinylchloride endotracheal tube and women
were intubated using a 7.5 mm tube. Patients were intubated
according to the manufacturers’ recommendations (9, 10).
For the McGrath MAC X-Blade, a conventional, angled malle-
able stylet-shaped like the McGrath MAC was used. For the
GlideScope, its dedicated stylet GlideRite was used.

The primary outcome measure included the determination
of the effect of cricoid pressure on the laryngeal view during
intubation using the three videolaryngoscopes. Secondary
outcome measures were the insertion time, intubation times,
number of intubation attempts (success rate), mucosal dam-
age, need for optimisation manoeuvres, oesophageal intuba-
tion, effects on haemodynamic parameters and minor post-
operative complications.

The insertion time was defined as the time that elapsed from
the moment the device entered the oral cavity until optimal
glottic visualisation was achieved (including optimisation
manoeuvres). To determine the optimal glottic visualisation,
managing force and reinsertion manoeuvres were used in Gli-
deScope and McGrath MAC X-Blade groups.
The intubation time was defined as the time that elapsed from the moment the device entered the oral cavity until the endotracheal tube was clearly visualised entering the vocal cords. If the first attempt failed and the second attempt succeeded, the intubation time was defined as the time that elapsed from the moment the device first entered the oral cavity until successful intubation.

The need for manoeuvres, number of intubation attempts, bloodstains on the device (mucosal damage), mouth/tooth/tongue damage, presence of oesophageal intubation and hypoxaemia (decrease in saturation to <92%) were also recorded.

The mean arterial pressure (MAP) and HR of patients were recorded preoperatively (baseline), after induction, after device insertion (post-insertion) and at 1, 2 and 3 min after intubation. No other medications were administered during data collection. Near the end of surgery, however, tramadol (1 mg kg⁻¹ iv) and ondansetron (0.5 mg kg⁻¹ iv) were administered to prevent postoperative pain and vomiting.

If the duration of endotracheal intubation exceeded 120 s or if intubation was deemed impossible after three attempts, it was recorded as ‘failed’. In addition, episodes of hypoxaemia (SpO₂), postoperative sore throat, dysphagia, coughing, hoarseness, bronchospasm and aspiration were recorded by an independent, blinded observer just after the surgery in the postanesthesia care unit.

Statistical analysis
Statistical analyses were performed using the Statistical Package for the Social Sciences version 20.0 (IBM SPSS Statistics; Armonk, NY, USA). The Kolmogorov-Smirnov test was used for assessing the assumption of normality. Continuous variables that were normally distributed were expressed as mean± standard deviation (SD) and those which were non-normally distributed were expressed as medians (25–75 percentiles). Relations between two categorical variables were compared using the X² test (Monte Carlo). For non-normally distributed continuous variables, differences between the groups were analysed using the Kruskal-Wallis test. Pair-wise multiple comparisons were made using Tukey’s and Dunn’s tests. Friedman’s two-way ANOVA was used to determine differences between repeated measures. A value of p<0.05 was considered to indicate statistical significance.

From data by Corda et al. (11) and to detect a 20% worsened Cormack-Lehane grade and a 90% power with a=0.05, we calculated our sample size to be 29 per group (a total of 87 for the three groups). Then, we decided to enrol 40 patients per group (a total of 120) with consideration of possible exclusions.

Results
Overall, 120 patients (40 patients per group) were included in this trial. No patients were excluded from the study. Demographic variables and airway characteristics of the patients were similar in the three groups (Tables 1, 2). Mandibular protrusions were type A, except for two patients in each group. First-attempt intubation was 100% with Macintosh video laryngoscope, 95% with McGrath MAC X-Blade video laryngoscope and 98% with GlideScope video laryngoscope (Table 2). All intubations were successful at the second attempt. Cormack-Lehane grades were not changed or improved in Macintosh or McGrath MAC X-Blade groups on apply-

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Macintosh group (n=40)</th>
<th>McGrath MAC X-Blade group (n=40)</th>
<th>GlideScope group (n=40)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (F/M)</td>
<td>35/5</td>
<td>33/7</td>
<td>32/8</td>
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<tr>
<td>Age (years)</td>
<td>42 (31.5-49.8)</td>
<td>47 (29-56.8)</td>
<td>40 (33-57.8)</td>
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<tr>
<td>Height (cm)</td>
<td>162 (156-167)</td>
<td>163 (160-168)</td>
<td>163 (160-167.8)</td>
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<tr>
<td>Weight (kg)</td>
<td>68.4±13.9</td>
<td>70.2±13.9</td>
<td>65.8±11.8</td>
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<td>ASA (I/II)</td>
<td>27/13</td>
<td>25/15</td>
<td>26/14</td>
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</tr>
<tr>
<td>Mallampati (I/II)</td>
<td>21/19</td>
<td>22/18</td>
<td>22/18</td>
<td>1.0</td>
</tr>
<tr>
<td>Interincisor distance (cm)</td>
<td>4.5 (4-5)</td>
<td>4.5 (4-5)</td>
<td>4.5 (4-5)</td>
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<tr>
<td>Thyromental distance (cm)</td>
<td>8 (7.6-10)</td>
<td>8.8 (7-9)</td>
<td>8 (7.5-9)</td>
<td>0.7</td>
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<tr>
<td>Sternomental distance (cm)</td>
<td>15 (14-16)</td>
<td>16 (14.3-16.8)</td>
<td>15 (14-17)</td>
<td>0.7</td>
</tr>
<tr>
<td>Tooth morphology (Full/lacking/absent)</td>
<td>33/4/3</td>
<td>30/6/4</td>
<td>29/6/5</td>
<td>0.9</td>
</tr>
</tbody>
</table>

The values are shown as the numbers or means±SD or as medians (25–75 percentiles).
ASA: American Society of Anesthesiologists
ing cricoid pressure but worsened in the GlideScope group (p<0.001). Insertion times for Macintosh and McGrath MAC video laryngoscopes were similar. Insertion times for the GlideScope video laryngoscope were similar to that for the Macintosh video laryngoscope, but were longer than those for the McGrath MAC X-Blade video laryngoscope (p=0.02) (Table 2). Intubation times for Macintosh and McGrath MAC X-Blade video laryngoscopes were similar, whereas the intubation time for the GlideScope video laryngoscope was statistically significantly longer than that for the other two laryngoscopes (p<0.001 and p=0.003, respectively) (Table 2). Need for optimisation manoeuvres were similar among the groups.

The Macintosh and GlideScope devices significantly increased MAP after insertion compared with the post-induction value (p=0.004 and p=0.001, respectively) (Figure 1). McGrath MAC X-Blade laryngoscopy increased MAP, but the difference was not statistically significant. All three devices increased HR after insertion compared with the post-induction HR value (p<0.001) (Figure 2).

Mucosal damage occurred in two patients each in the McGrath MAC X-Blade and GlideScope groups. Mouth damage was found in two patients in the McGrath MAC X-Blade group and in one patient in the GlideScope group. Tooth damage occurred in one patient in the McGrath MAC group. Postoperative hoarseness was detected in only one patient, who was in the Macintosh group. Bronchospasm was not observed in any patient.

**Discussion**

The main result of this study was that the laryngeal view change under cricoid pressure and the tracheal intubation time for the McGrath MAC X-Blade video laryngoscope was similar to that for the Macintosh laryngoscope. Cricoid pres-
Cricoid pressure is a part of patient safety in rapid sequence induction intubation. It is used to prevent the regurgitation of gastric contents (12). However, the effect of cricoid pressure on laryngeal view is controversial. It was previously shown that cricoid pressure worsened the view in 12.5% cases when using the Macintosh blade (13). A large published study found that pressing on the neck greatly affected the laryngeal view obtained from the curved blade on 106 cadavers. Cricoid pressure frequently worsened (29%) the Macintosh laryngoscopy (14). Randomised studies examined the effect of cricoid pressure and showed that it worsened the laryngeal view by approximately 20% during Macintosh laryngoscopy (15, 16). If the cricoid pressure was released, tracheal intubation became easier (17). In our study, none of the view worsened under cricoid pressure during Macintosh laryngoscopy. However, the laryngeal view did not change under cricoid pressure in 61.5% patients and was improved in 38% patients in the Macintosh group.

Loughnan et al. (18) showed that 41% of the views were improved when cricoid pressure was applied during intubation with a C-MAC video laryngoscope and 45% of the views were unchanged and 14% of the views worsened. The standard C-MAC video laryngoscope has only a Macintosh blade with an additional video camera and no angle as the GlideScope or the others like the C-MAC D-Blade.

Some authors reported that the video laryngoscope improved laryngeal visualisation under the Sellick manoeuvre during rapid sequence induction (19). Corda et al. (11) showed that there was no statistically significant difference in glottis grade (39% of glottis grade improved and 20% worsened) when using GlideScope under cricoid pressure in 100 patients. However, it significantly decreased the glottis area by forcing vocal cord apposition. According to our results, 5% improved, 30% worsened and 65% were unchanged in the GlideScope group. We thought that inserting the GlideScope video laryngoscope through the midline of the mouth and the angle of the tip are the main problem for worsening of the view of the GlideScope under cricoid pressure.

Oh et al. (20) recorded the effects of cricoid pressure on laryngeal view, using a pillow under the patients’ head. We put a pillow under the patients’ head in the neutral position as well. They demonstrated that cricoid pressure worsened the glottis view obtained from the Pentax-AWS. We already knew that according to the published literature, video laryngoscopes do not require extension of the head. In addition, it was shown that the sniffing position increased the difficulty in inserting and placing the tip of the video laryngoscope (21). Further investigation is needed with or without a pillow. The main problem for Pentax-AWS is inserting it through the midline of the mouth. It is probable that this problem will also be the same with Airtraq, which has a similar shape as Pentax-AWS. Another study showed that cricoid pressure impeded intubation using the WuScope system (22). The WuScope system is also inserted from the midline.

There are some limitations of our study. First, the operators were not blinded to the devices being used in this trial. Second, this study was conducted in fasted patients undergoing elective surgery; the results would be different in a real emergency procedure. Third, this study was not powered to detect differences between the success rates, haemodynamic parameters or minor complications.

**Conclusion**

Although all three devices were useful for normal or difficult intubation, cricoid pressure improved the Cormack-Lehane grades of Macintosh and McGrath MAC X-Blade video laryngoscopes, but statistically significantly worsened those of the GlideScope video laryngoscope.

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**Ethics Committee Approval:** Ethics committee approval was received for this study from the ethics committee of Kocaeli Human Researchs Ethics Committee.

**Informed Consent:** Written informed consent was obtained from patients who participated in this study.

**Peer-review:** Externally peer-reviewed.


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