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A comparison of the success of intubation using C-MAC D-Blade and McGrath MAC X3 Blade videolaryngoscopes during double lumen tube insertion in one-lung ventilation: A prospective, randomized clinical trial

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Abstract

Aim: To compare the effects of C-MAC D-Blade and McGrath MAC X3 Blade videolaryngoscopes (VLs) during double lumen tube (DLT) insertion in one-lung ventilation (OLV) in patients who underwent chest surgery in terms of intubation durations, hemodynamic responses, and intubation-induced complications.

Materials and Methods: Fifty patients aged 18—65 who were scheduled for OLV were included in this study. The patients were divided randomly into two groups: a Storz C-MAC D-Blade VL group (C-MAC group, n = 25) and a McGrath MAC X3 Blade VL group (McGrath group, n = 25). The results of a preoperative airway assessment, a number of intubation attempts and incidence of success at the first attempt, glottic view times, intubation times, Cormack—Lehane scores, percentage of glottic opening (POGO) scores, ease of intubation, comorbidities, hemodynamic responses, and intubation-related adverse events were recorded.

Results: The demographic characteristics and comorbidities of both groups were similar. The intubation characteristics of both groups were similar in terms of Cormack—Lehane scores, thyromental and intergingival distances, and POGO scores. In the C-MAC group, the glottic view times ($p = 0.001$) and intubation times ($p = 0.001$) were significantly shorter than those in the McGrath group. As shown by ease of intubation scores, ease of intubation in the C-MAC group was significantly better than that in the McGrath group ($p = 0.001$). All the patients in the C-MAC group were intubated at the first attempt, without a statistically significant difference. The two groups were similar with respect to intubation-related complications and hemodynamic responses (mean arterial pressure and heart rate).

Conclusion: We conclude that the C-MAC D-Blade VL is more beneficial for airway management due to shorter glottic view and intubation times, high success rates at the first attempt, and ease of intubation in patients intubated with a DLT in OLV.

Introduction

One-lung ventilation (OLV) in thoracic surgery, is frequently used to expand the field of view, facilitate the surgical intervention, and prevent the passage of blood, secretions, and infected material to the other lung [1]. Currently, the most common method used in OLV in thoracic surgeries is ventilation of the lung using an endobronchial double-lumen tube (DLT). Videolaryngoscopes (VLs) are increasingly used to facilitate intubation in difficult airway management [2]. According to research, the use of a VL increased success of intubation in patients with a risk of difficult intubation [3]. VLs are now popular tools in airway management, with intubation success rates increasing due to advanced cameras, improved viewing angles, and high-resolution screens, all of which provide ease of view.

The McGrath VL (Aircraft Medical Ltd, Edinburgh, UK) has a high-definition video camera, an angled blade of variable length, and a light source at the tip. Previous studies reported that it provided a better laryngeal view when compared to the conventional Macintosh laryngoscope [4,5]. The C-MAC VL (Karl Storz, Tuttlingen, Ger-

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many) is a conventional laryngoscope that can be used both for direct laryngoscopy and VL. Manufacturers have developed VL models with different shapes and features with the aim of improving the performance of laryngoscopes [6].

In our study, the primary outcome assessed was the time taken to intubate with a DLT using CMAC D-Blade and McGrath MAC X3 Blade VLs. The secondary outcomes assessed were the glottic view time, number of intubation attempts, hemodynamic responses, and incidence of intubation-related complications.

Materials and Methods

Study protocol

This trial was carried out in the Anesthesiology and Reanimation Department, Inonu University, Faculty of Medicine, Turgut Ozal Medical Center with the approval of the Local Ethics Committee (Approval number: 2017/01). This was a randomized, prospective clinical trial of 50 adult patients planned for elective OLV between 2017 and 2018.

Study participants

The patients (N = 50) were aged 18-65 years with American Society of Anesthesiologist (ASA) scores of I, II, or III and a body mass index (BMI) of <40 (kg/m^2) who were scheduled to undergo elective OLV for various reasons in thoracic surgery operating room. Before the study, all patients were informed about the study and their informed consent was obtained.

Exclusion criteria

Patients aged <18 or >65 and with a history of difficult intubation, severe cardiovascular and pulmonary diseases, severe cerebrovascular and psychiatric diseases, or propofol, fentanyl, or rocuronium allergies or contraindications were excluded in addition to pregnant women and patients who refused to attend into the trial.

Randomization

This trial was designed as a prospective, randomized clinical trial. For randomization, the patients were assigned to the study groups completely using MedCalc for Windows (Ostend, Belgium) statistical software (medcalc.com.tr.). The patients were randomly divided into two groups: a McGrath MAC X3 Blade VL group (McGrath group, n=25) and a C-MAC D-Blade VL group (C-MAC group, n=25).

Preoperative procedure

The preoperative demographic data (age, gender, height, weight, BMI, and ASA scores) of the patients were recorded. For preoperative airway evaluation of the patients, intergingival and thyromental distances and the Mallampati scores were determined. Premedication was not applied preoperatively. Standard monitoring, including electrocardiogram (ECG), noninvasive mean arterial pressure (MAP), and heart rate (HR), was performed. The ECG, MAP, and HR values were recorded at baseline, post-induction, first, second, third and fifth minute of intubation. All endotracheal DLTs used had their own stylets. For all patients, the general anesthesia protocol was standardized. All intubations were performed by the same experienced anesthesiologist whose intubation success rate over 90% at the first intubation attempt and at least 50 prior encounters with VL use.

General anesthesia

Peripheral vascular access was established following routine monitoring. In all patients, for general anesthesia, 1 mg/kg of lidocaine intravenously (IV), 1 µg/kg of fentanyl IV, 2 mg/kg of propofol IV, and 0.6 mg/kg of rocuronium IV were applied. In the McGrath group, intubations were done with a McGrath MAC X3 Blade VL, and in the Group C-MAC with a C-MAC D-Blade. The Cormack—Lehane grade was detected and recorded before VL intubation.

The patients were intubated with an endotracheal DLT (females, no: 35-37f; males: no: 39-41f). During all hemodynamic measurements made up to the 5th minute after intubation, 10 mg of ephedrine IV were administered if HR and MAP values decreased by 20% compared to basal values, and if the HR fell below 50 beats/minute, 0.5 mg of atropine IV was administered. If the HR and MAP increased by 20% compared to baseline values within the same period, 0.5 µg.kg^{-1} of fentanyl IV was administered.

Outcome measures

Hemodynamic data were measured at baseline, post anesthesia induction, and after the 1st, 2nd, 3rd, and 5th minutes of intubation. The measurements were terminated after 5 minutes. The intubation time was determined and recorded as the time elapsed from the moment the VL entered the oral cavity through the intergingival space after mask ventilation was terminated following induction until the time of completion of the intubation process and the appearance of two regular $EtCO_2$ waves. The glottic view time was recorded as the time from the moment the VL blade entered the oral cavity through the intergingival space to visualization of the glottis. Ease of intubation was graded using values of 0—100, with 0 denoting the easiest and 100 signifying the most difficult intubation. A Cormack—Lehane score of '1' was recorded if the entire vocal cords were visible during laryngoscopy, '2' if some of the vocal cords were visible, '3' if only the epiglottis was visible, and '4' if the epiglottis and glottis were not visible. POGO score (percentage of glottis opening) was used for the laryngeal view assessment [7]. Intubation-related complications were also recorded. Cuff burst was described as the inability to inflate the guiding balloon or the sound of leakage, despite the use of an appropriate tube. All the tubes were checked for cuff rupture before use. Bradycardia was defined as the HR below 50 beats/minute. Hypoxia was defined as the peripheric oxygen saturation value below 90%. A laryngospasm was defined as dyspnea, hypoxia, or inspiratory stridor after extubation. Bleeding in the oral cavity was defined as bleeding in the gingiva, palate, or lips after intubation.

Table 1. Demographic characteristics of the patients (mean ± SD or number).

	McGrath (n=25)	C-MAC (n=25)	p
n	25	25	
Sex M/F, n(%)	14(56%)/11(44%)	14(56%)/11(44%)	1.000
Age (year)	46.4 ± 14.9	48.4 ± 15.4	0.631
Weight (kg)	71.0 ± 13.0	70.6 ± 13.5	0.916
Height (cm)	167.5 ± 10.6	167.2 ± 10.6	0.926
BMI (kg/m^2)	25.2 ± 4.2	24.8 ± 4.5	0.785
MPS ½, n(%)	4(16%)/21(85%)	6(24%)/19(76%)	
ASA Score 1/2/3, n(%)	4(16%)/20(80%)/1(4%)	5(20%)/17(68%)/3(12%)	0.783
Thyromental distance (cm)	7.2 ± 0.8	7.2 ± 0.5	0.969
Intergingival distance (cm)	4.2 ± 0.5	4.3 ± 0.4	0.257

n: number of patients, M:male; F:female; BMI: body mass index; MPS: Mallapati Score; ASA: American Society of Anesthesiologists.

Table 2. Characteristics of Intubation (mean ± SD or number).

	McGrath (n=25)	C-MAC (n=25)	p
Glotic vision time (sec)	6.5 ± 3.5	3.8 ± 1.1	**0.001***
Intubation time (sec)	75.1 ± 24.3	49.6 ± 14.6	**0.001***
Ease of intubation score (0-100)	28.4 ± 12.1	14.0 ± 7.6	**0.001***
POGO scores (%)	70.4 ± 15.6	78.6 ± 18.4	0.322
Cormack-Lehane scores (1/2/3/4) n(%)	19(76%)/5(20%)/1(4%)/0	13(52%)/9(36%)/3(12%)/0	0.079
ETT direction, right/left n(%)	6(24%)/19(76%)	10(40%)/15(60%)	0.234
ETT number, 35fr/37fr/39fr/41fr n(%)	6(24%)/6(24%)/10(40%)/3(12%)	0/16(64%)/9(36%)/0	0.858
Successful first time attempt, n(%)	23(92%)	25(100%)	0.490

n: number of patients, POGO: percentage of glottic opening, VL: videolaryngoscope, DL: direct laryngoscope, ETT: endotracheal tube, fr: french. *: $p<0.05$, statistical significance.

Throat ache and hoarseness were evaluated after 24 hours postoperatively.

Sample size

The sample size was determined with a pilot study included 10 patients from the C-MAC VL group to calculate. In pilot group, intubation time to was 44±15.0 s [standard deviation (SD)] with the C-MAC VL. To show a difference of 11 s between the two groups, the minimum sample size required to detect a significance difference using this test should be at least 22, considering type I error (alfa) of 0.05, power (1-beta) of 0.9, effect size of 0.73 and two-sided alternative hypothesis (H1). According to these results, 25 patients per group were included in this study. A web-based software (http://biostatapps.inonu.edu.tr/WSSPAS/) was used for calculating the sample size.

Statistical analysis

Data are summarized as the arithmetic mean ± standard deviation and median (minimum-maximum). The Shapiro—Wilk test was used to examine whether group data conformed to a normal distribution. A t-test was used to determine whether there was a statistically significant difference between independent groups that met parametric test assumptions. The Mann–Whitney U test was used to determine whether there was a statistically significant difference between independent groups that did not meet the parametric test assumptions. A value of $p < 0.05$ was accepted as the statistical significance level. The IBM SPSS Statistics 22.0 package program was used for data analysis.

Results

The patient's demographic data are given in Table 1 and no significant difference was detected between groups. A flow diagram is presented in Figure 1. The intubation characteristics are showed in Table 2. The mean glottic

Table 3. Adverse Events of Intubation (mean ± SD or number).

	McGrath (n=25)	C-MAC (n=25)	p
Hoarseness, n(%)	0	0	-
Sore throat, n(%)	2(8%)	0	0.155
Intraoral bleeding, n(%)	1(4%)	0	0.322
Dental trauma, n(%)	0	0	-
Esophageal intubation, n(%)	0	0	-
Laryngospasm, n(%)	0	0	-
Bradycardia, n(%)	0	0	-
Desaturation, n(%)	0	0	-
ETT cuff burst, n(%)	0	0	-

n: number of patients, ETT: endotracheal tube, fr: french.

Table 4. Comorbidities (mean ± SD or number).

	McGrath (n=25)	C-MAC (n=25)	p
Hypertension, n(%)	3(12%)	6(24%)	0.269
Diabetes mellitus, n (%)	0	1(4%)	0.312
CAD, n(%)	2(8%)	3(12%)	0.637
Thyroid disease, n(%)	2(8%)	1(4%)	0.552
COPD, n(%)	0	2(8%)	0.149

n: number of patients, CAD: Coronary artery disease, COPD: chronic obstructive pulmonary disease.

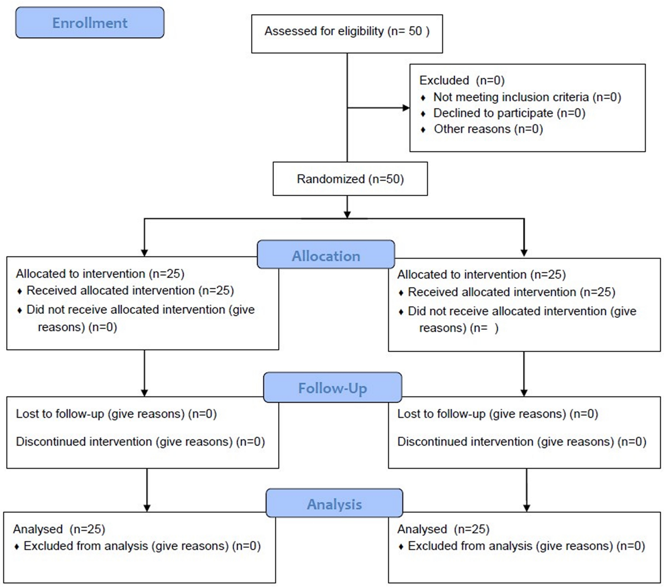

Figure 1. Flow Diagram. CONSORT flow chart for patients' recruitment.

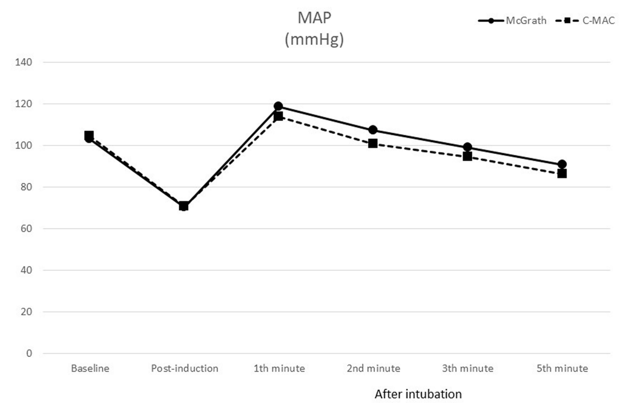

Figure 2. MAP values. Changes in MAP measurements in McGRATH and C-MAC groups. No significance was found between McGrath MAC and C-MAC groups (p > 0.05).

view time in the McGrath group was 6.5±3.5 sec, whereas it was 3.8±1.1 sec in the Group C-MAC. There was a statistically significant difference between the two groups according to the glottic view time (p=0.001). The mean intubation time of the patients in the McGrath group and C-MAC group was 75.1±24.3 sec and 49.6±14.6 sec, respectively (p=0.001). In terms of ease of intubation, the mean intubation of the patients in the Group McGrath and Group C-MAC was 28.4±12.1 sec and 14.0±7.6 sec, respectively (p=0.001). No significant difference was detected between the groups in terms of POGO scores, Cormack—Lehane scores, intubation tube direction and number, and first-time attempt, intubation-related side effects or comorbidities.

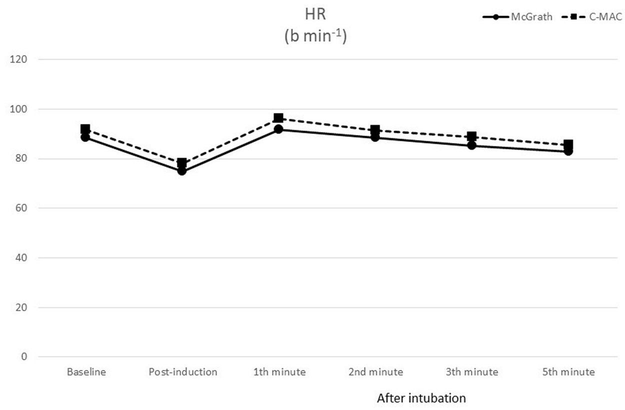

Figure 3. HR values. Changes in HR measurements in McGRATH and C-MAC groups. No significance was found between McGrath MAC and C-MAC groups (p > 0.05).

Tables 3 and 4 show the side effects and comorbidities of intubation, respectively. No significant difference was detected in MAP and HR values (Figure 2 and 3). All the patients in the two groups were successfully intubated, with no unsuccessful attempts. Esophageal intubation did not occur in either group.

Discussion

In this study, the intubation and glottic view times in the Group C-MAC were shorter than those in the McGrath group during intubation with a DLT. In addition, the number of successful first-time intubation attempts was higher in the Group C-MAC than in the Group McGrath, and intubation in the Group C-MAC was easier than in the Group McGrath. No significant difference was determined between the groups in terms of hemodynamic data during the procedure and postoperative complications.

Major cause of morbidity and mortality in daily anesthesia practice is difficult or unsuccessful intubation. VLs have advantages over Macintosh laryngoscopes in terms of intubation times and ease of use in patients with a difficult airway, as they provide a better glottic view. Previous studies reported that the C-MAC VL was easier to use and the time of intubation was shorter when compared to other VLs shaped as Macintosh blades [8,9]. In studies that compared the Macintosh laryngoscope, GlideScope VL, and C-MAC D-Blade VL in patients with a difficult airway, intubation time was significantly less with conventional direct laryngoscopy than both videolaryngoscopes

[10]. In morbidly obese patients, the intubation time was 17 sec using a Storz V-Mac VL, 33 sec using a GlideScope VL, and 41 sec using a McGrath VL [6]. The authors claimed that the Storz V-Mac VL was superior to the other VLs, as it reduced the intubation time [6]. In a study, the patients with a normal airway were divided into three VL groups (McGrath Series-5, GlideScope, and Storz V-Mac) after first evaluating their Cormack—Lehane scores with direct laryngoscopy [11]. In the study, intubation with the Storz V-MAC VL was easier and the intubation time was shorter than with the other VLs [11]. In a previous study, the intubation time with a McGrath VL (67 sec) was significantly longer than a C-MAC VL (50 sec) that with in patients with Mallampati scores of 3 or above, a difficult airway, and a high intubation risk [12]. In another study, the authors found no significant difference between the direct (Macintosh) laryngoscope (37.41 sec) and C-MAC D-Blade VL (32.27 sec) in terms of intubation times with DLTs [13]. In the same study, compared to the McGrath group, glottic view was better in the C-MAC group, and the intubation time was shorter. Another DLT intubation study reported a significantly shorter intubation time using an Airtraq VL (26.6 sec) than a McGrath VL (39.9 sec) [14]. Yi et al. [15] showed that the intubation time (36.6 sec) with an Airtraq VL was shorter than with a GlideScope VL (54.6 sec) ($p=0.002$). The shorter intubation time in a study as compared to that in our study (75.1 sec in the McGrath group and 49.6 sec in the C-MAC group) may be explained by differences in the definition of the "end of intubation time" in the two studies and differences in the shapes of the tubes used [15]. In our study, the intubation time ended with the occurrence of two regular end-tidal carbondioxide ($EtCO_2$) waves, which indicated that the tube was in the lungs. The intubation time was significantly shorter in the C-MAC group than other in our study. The VLs used in our study had a Macintosh-style blade structure and did not have a channeled structure. Therefore, tube placement difficulty was the same in both groups. In another study, the C-MAC D-Blade was superior to the McGrath MAC X3 Blade due to its shorter intubation time. The short duration of intubation and glottic visualization time in the Group C-MAC may be due to the high angulation of the D-blade in the horizontal plane.

Keeping the intubation time as short as possible with VLs is very important in hypoxia during intubation and difficult airway management. Despite the improvement in glottic view using VLs, the difficulty in inserting the endobronchial tube can increase the time of intubation. In our present study, the shorter time of intubation in the Group C-MAC as compared to that in the McGrath group can be attributed to the following: a decrease in image quality due to fogging of the camera lens and secretions in the McGrath group, the thinness of the McGrath MAC X3 blade, the tongue slipping and preventing the passage of the tube in the McGrath group due to the insertion of blade from the midline of the mouth, and the extra glottic compression maneuvers performed in the McGrath group to visualize the glottic space and larynx entrance. The level of experience of the operator must be considered when evaluating intubation times. In our study, the same anesthesiologist who had a success rate of over 90% at the first attempt in orotracheal intubation and at least 50 prior encounters with the use of VLs performed the intubations.

In intubation procedures involving hemodynamically unstable patients, negative consequences, such as increased blood pressure and HRs, even cardiac arrest may occur because of exposure to more sympathetic activation, depending on the difficulty and duration of intubation. In a previous study, although systolic blood pressure and HR values increased in some patients intubated with the McGrath Series 5 VL, the authors detected no statistically significant difference in these values as compared to those when applying a Macintosh direct laryngoscope [16]. Yie et al. [14] showed that although MAP and HR values in patients intubated with Airtraq and GlideScope VLs increased during the intubation period, no significant difference was detected between the two groups in terms of these parameters. They attributed this finding to difficulty in inserting the tube in the GlideScope group or exposure to increased sympathetic activity because of the longer intubation time in the GlideScope group. As reported previously, increased intubation time results in a greater hemodynamic response [17]. In a study that compared Truview VL, McGrath VL, and Macintosh laryngoscope, no significant difference was determined in terms of reducing the hemodynamic response between these devices [18]. However, in the same study, the intubation times increased significantly when the VLs were used, and the authors concluded that VLs were disadvantageous in terms of the hemodynamic data. In another study that compared the Macintosh laryngoscope and McGrath VL, the McGrath VL reduced the rate of hypertension development after tracheal intubation as compared to the Macintosh laryngoscope [19]. In the same study, the authors emphasized that less manipulation was required when using the McGrath VL, as the oropharyngeal axis did not need to be straightened. They proposed that the McGrath VL should be routinely used in the operating room but noted that the frequency of hypertension may increase when the VL is used by inexperienced operators. In our present study, although the time of intubation was shorter and the intubation success was higher in the C-MAC group, we observed no significant difference between C-MAC groups and the McGrath in terms of hemodynamic data. The X3 blade and D blade used in our study are difficult intubation blades and do not require the provision of the oropharyngeal axis and require less manipulation compared to other blades. The thickness of the intubation tube is one of the important factors in the difference in hemodynamic response. In our study, tubes numbered 35 Fr and 41 Fr were used in the McGrath Group, while tubes with these numbers were not used in the C-MAC group as a result of randomization. However, when the two groups were compared according to their intination tube numbers, no significant difference was detected between the groups ($p = 0.858$). Thus, standardization was achieved in this respect in our study.

Alternative tools, such as VLs, may be needed in tracheal intubation to provide a better glottic view due to airway difficulty. An advantage of using a VL is that it provides a better glottic view than a standard Macintosh blade, resulting in increased intubation success. Many studies that used C-MAC VLs showed that they indicate increase of success of intubation and better glottic view [20,21]. In previous studies, vocal cord imaging was better with a Storz VL, and the success rate of intubation was higher in patients with Mallampati scores of 3 and 4 [22]. In one study that included patients with Mallampati scores of 1, 2, and 3, an Airtraq VL provided a better glottic view than a GlideScope VL (p = 0.042) [15]. In another study that included an Airtraq VL, a McGrath VL, and a Macintosh laryngoscope, the glottic view obtained using the two VLs was similar and significantly improved compared to that obtained using the Macintosh laryngoscope [14]. The absence of a statistically significant difference in the glottic field of view in the two groups in our study may be explained by the existence of only patients with MP scores of 1 and 2. In our study, the glottic field of view, clarity, and intubation success in the C-MAC group were better than those in the McGrath group. Intubation with a VL has advantages compared to intubation with a Macintosh direct laryngoscope, such as requiring fewer maneuvers for tongue retraction and glottic visualization, not requiring the mouth-pharynx-trachea axes to be in the same plane and providing a wider area in the mouth as a result of the midline application of the procedure. In our study, we attribute the greater intubation success with C-MAC D-Blade to the fact that the same anesthesiologist with experience in VL performed all the procedures and that the procedure was quicker using the C-MAC D-Blade than using the McGrath MAC X3 Blade.

In oral tracheal intubation of patients with anatomical anomalies, a sore throat may be a side effect due to the difficulty in placement of the DLT. In a study conducted with a DLT, Yi et al. reported a sore throat in 6 (17%) patients in an Airtraq VL group and in 8 (23%) patients in a GlideScope VL group, with no significant between-group difference [15]. In our study, 2 (8%) patients in the McGrath group experienced a sore throat, but no significant difference was detected between the groups. The reason for the absence of a sore throat in the Group C-MAC may be due to the shorter intubation time and less manipulation required in this group as compared to these parameters in the Group McGrath.

In the intubation procedure, using stylet may be needed to direct the tube to the desired location and to reduce number of interventions, the intubation time, and soft tissue trauma in patients with a difficult airway. It may also be required to give the desired shape to the tube in cases where it is not necessary to bring the oropharyngolaryngeal axis to the same plane in VL intubation. In a previous study, the authors stated that the intubation tube should be shaped with a stylet shaped as a hockey stick to ease the intubation with the McGrath Series 5 VL [4]. In a study that used McGrath VL and Macintosh direct laryngoscope, the authors used stylets in all tubes for all patients and concluded that the use of stylets was necessary [16]. Another trial informed that the using stylet shortened the time of endotracheal intubation [23]. In a study that used the C-MAC D-Blade, although no significant difference between intubation times using three different types of styles in intubation was detected, significant difference was determined in terms of intubation time when stylets were not used [24]. In this present study, in which the patients were intubated with McGrath and C-MAC VLs, each endobronchial tubes had a stylet inside, and the stylet was used to form DLTs into a hockey stick shape. Using the stylets in the intubation tubes in each group to obtain tubes with particular shapes may have helped to shorten the intubation times, decrease the risk of desaturation, and decrease the number of intubation attempts, thereby possibly reducing soft tissue trauma and increasing the chance of intubation success.

The use of a VL may be preferred by students and anesthesiologists with less intubation experience because anatomical structures can be shown for educational purposes, and it is less traumatic. In a different study conducted with a VL, they stated that inexperienced anesthetists can primarily prefer it [25]. In another study, the intubation times were similar when compared Macintosh direct laryngoscope and McGrath Series 3 VL using by anesthetists with a limited intubation experience in patients without difficult airway [26]. However, the VL facilitated intubation and reduced intubation-related complications and hemodynamic responses [26]. As intubation with a VL is easy to learn, the use of VLs can be expected to become widespread among anesthesiologists with little intubation experience. In our study, same experienced anesthesiologist performed all the intubations. As compared to the McGrath MAC X3 Blade, the C-MAC D-Blade VL significantly facilitated intubation, the field of view and glottic view time were better, the intubation time was significantly shorter, and the intubation success was significantly increased.

Limitations

A limitation of our study was potential bias due to the same experienced anesthesiologist performing and evaluating the success of all the procedures. Another limitation of our study was that intubation in most previous studies was performed with single-lumen tubes [27,28]. The larger dimensions of DLTs and the maneuvers required when placing these tubes mean it is not possible to directly compare the results of our study with studies that used single-lumen tubes. Therefore, more experience may be required in terms of performing DLT intubation with VLs. In our study, although double lumen intubation tubes in different directions and thicknesses were preferred due to surgery location and patient gender, the standardization of the study was not compromised. Although tubes of different thicknesses were used (tubes numbered 35 Fr and 41 Fr were used in the McGrath Group, but not in the C-MAC Group), no significant difference was detected between the groups in terms of tube number (p = 0.858). In addition, the DLT was mostly applied in patients with lung pathology. So that standardization could not be achieved in our study in terms of operation types.

Conclusion

In conclusion of this study, there was no significant difference between the Groups McGrath and C-MAC in terms of hemodynamic responses and intubation-related complications. The C-MAC D- Blade VL was superior to the McGrath MAC X3 Blade VL in terms of intubation, and the C-MAC D- Blade VL decreased glottic view intubation times in DLT placement for OLV. In addition to shorter intubation and glottic view times, using the C-MAC D-Blade VL was associated with a higher first-attempt success rate, less intraoral bleeding, and less sore throats than the McGrath MAC X3 Blade VL.

Acknowledgments

This study was performed at Inonu University Hospital with the approval of the local clinical research ethics committee of Inonu University [2017-01]. This study was presented at an oral presentation competition at the 25th Thoracic, Cardiovascular Anesthesia and Intensive Care Congress (21–22 April 2019, Istanbul, Turkey). This manuscript was edited for proper English language, grammar, punctuation, spelling, and overall style by one or more of the highly qualified native English-speaking editors at Scribendy Editing and Proofreading Services for English Documents.

Potential conflicts of interest

None

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Trial registration

The trial is registered at the US National Institutes of Health (ClinicalTrials.gov) (NCT03826706).

Ethical approval

Inonu University, Faculty of Medicine, Turgut Ozal Medical Center with the approval of the Local Ethics Committee (Approval number: 2017/01).

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