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Comparison of the Conventional Macintosh Blade, C-MAC Videolaryngoscope and High-Angle C-MAC D-Blade Use for Double-Lumen Tube Placement

Çift Lümenli Tüp Yerleştirilmesi için Geleneksel Macintosh Bleyd, C-MAC Videolaringoskop ve Yüksek Açılı C-MAC D-Bleyd Kullanımının Karşılaştırılması

Esra Yetis[1], Gulcin Buyukbezirci[2], Atilla Erol[2], Resul Yilmaz[2]

[1]Yuksekova State Hospital, Clinic of Anesthesiology and Reanimation, Hakkari, Türkiye
[2]Necmettin Erbakan University, Faculty of Medicine, Department of Anesthesiology and Reanimation, Konya, Türkiye

ABSTRACT

Objective: Videolaryngoscopes are devices used for intubation under more optimal conditions and their frequency of use has increased with the pandemic. Videolaryngoscopes have been reported to offer a superior laryngoscopic view for orotracheal intubation. However, the high-angle videolaryngoscope blades may affect intubation comfort. Although they are often preferred over conventional laryngoscopes in terms of patient safety and comfort, there are only a few studies that investigate their superiority in double-lumen tube placement. In this study, we investigated the superiority of the C-MAC videolaryngoscope, the high-angle C-MAC D-blade, and the conventional Macintosh blade over each other in double-lumen tube placement.

Method: A prospective, randomized-controlled, single-blinded study was designed and 105 patients were included.

Results: No difference was observed between the groups in terms of tube size, tube design, percentage of glottis opening score, Burp maneuver, difficulty in placing the laryngoscope, and number of intubation attempts. In all the groups, a high rate of success was achieved in the first intubation attempt, while a longer intubation time ($p<0.01$) and difficulty in tube advancement ($p=0.038$) were detected for the high-angle C-MAC D-blade videolaryngoscope.

Conclusion: In patients in whom a difficult airway is not expected, a conventional Macintosh D-blade or a C-MAC videolaryngoscope may be preferred as the first choice for double-lumen tube intubation as the high-angle C-MAC D-blade prolongs the intubation time.

Keywords: Intubation, one-lung ventilation, laryngoscopes

ÖZ

Amaç: Videolaringoskoplar daha optimal şartlarda entübasyon yapılabilmesi için geliştirilmiş cihazlardır ve pandemi ile birlikte kullanım sıklıkları artmıştır. Videolaringoskopların orotrakeal entübasyon için üstün bir laringoskopik görünüm sağladığı gösterilmiştir. Ancak özellikle yüksek açılı videolaringoskop bleydleri entübasyon konforunu etkileyebilir. Hasta güvenliği ve konfor açısından sıklıkla konvansiyonel laringoskoplara tercih edilseler de çift lümenli tüp yerleşiminde üstünlükleri ile ilgili az sayıda çalışma mevcuttur. Bu çalışmada çift lümenli tüp yerleşiminde C-MAC videolaringoskop, yüksek açılı C-MAC D-bleyd ve geleneksel Macintosh bleydin birbirlerine üstünlükleri araştırılmıştır.

Yöntem: Prospektif, randomize-kontrollü, tek kör olarak dizayn edilen çalışmaya 105 hasta dahil edildi.

Bulgular: Gruplar arasında tüp çapı, tüp dizaynı, glottik açıklığın yüzdesi skoru, Burp manevrası, laringoskopu yerleştirmede zorluk ve entübasyon deneme sayıları açısından fark yoktu. Tüm gruplarda ilk entübasyon denemesinde yüksek oranda başarı sağlanırken, yüksek açılı C-MAC D-bleyd videolaringoskopta daha uzun entübasyon süresi ($p<0,01$) ve tüp ilerletmede zorluk tespit edildi ($p=0,038$).

Sonuç: Zor havayolu beklenmeyen hastalarda, çift lümenli tüp entübasyonunda yüksek açılı C-MAC D-bleyd entübasyon süresini uzattığından ilk seçenek olarak geleneksel Macintosh bleyd veya C-MAC videolaringoskop tercih edilebilir.

Anahtar sözcükler: Entübasyon, tek akciğer ventilasyonu, laringoskoplar

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***Corresponding author:** Gulcin Buyukbezirci • drgulcin81@gmail.com
Esra Yetis 0000-0002-3897-5669 / Gulcin Buyukbezirci 0000-0002-9438-3414
Atilla Erol 0000-0002-2376-2759 / Resul Yilmaz 0000-0002-5527-2893

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INTRODUCTION

One-lung ventilation is needed for various surgical procedures and some clinical conditions, with thoracic surgeries being the most common indication. The double-lumen endobronchial tube is one of the commonly used airway devices in thoracic anesthesia practice (1). Double-lumen endobronchial tubes are wider, more rigid, and occupy a larger space in the mouth than conventional single-lumen endotracheal tubes. Due to these physical characteristics, it is difficult to place double-lumen tubes in the correct position and the possibility of causing airway injuries is high (2). Although videolaryngoscopes were developed for difficult airway management, they are used more frequently in routine anesthesia practice with the pandemic experience (3). While several studies have investigated the use of different blade types in single-lumen endotracheal tube placement, the number of studies evaluating the performance of videolaryngoscopes in double-lumen endobronchial tube placement is limited. Especially high-angle D-blade videolaryngoscopes facilitate glottic visualization, but they may make double-lumen tube placement difficult because of their angles (1).

This study aims to compare the superiority of the C-MAC videolaryngoscope, the high-angle C-MAC D-blade, and the conventional Macintosh blade laryngoscope in double-lumen tube placement. Our hypothesis is that the use of a high-angle C-MAC D-blade will impair intubation comfort in double-lumen tube placement.

MATERIAL and METHODS

This prospective, randomized, controlled, single-blind study was carried out from December 2022 to June 2023. The study was conducted in accordance with the principles stated in the Declaration of Helsinki. Local ethics committee (decision dated 23.11.2022 and numbered 2022/981) and Ministry of Health ethics committee (approval dated 18.01.2023 and numbered E-66175679-514.13.02-988910) approvals were obtained for the study. The study included 105 patients and written informed consent forms were obtained from all patients. Patients with an ASA physical score of I to III, aged 18 to 90 years, and who were undergoing an elective thoracotomy or a video-assisted thoracoscopic surgery (VATS) and were intubated with a double-lumen endotracheal tube were included in the study. Patients who were planned for rapid-serial induction, had an increased risk or history of gastroesophageal reflux, were pregnant, had a tracheostomy, were expected to require prolonged postoperative ventilation, had an American Society of Anesthesiologists (ASA) score ≥ IV, had a history of difficult endotracheal intubation or difficult mask ventilation, had severe pulmonary dysfunction, cervical spine instability, and expected difficult airway (incisor spacing < 3 cm, body mass index (BMI) > 30 kg m^{-2}, Mallampati score ≥ 3, thyromental distance < 6 cm) were excluded from the study. The selection of laryngoscope used for each patient was determined in the operating room by an uninvolved healthcare professional using the closed opaque envelope method. All intubations were performed by the same anesthesiologist, who had experience with each laryngoscope at least 30 times. Three different laryngoscopes were used: the C-MAC videolaryngoscope (Karl Storz, Tuttlingen, Germany), the high-angle C-MAC D-blade videolaryngoscope (Karl Storz, Tuttlingen, Germany), and the conventional Macintosh blade laryngoscope (plusMED 5712-CS-03/097, Türkiye). Patients intubated with the C-MAC videolaryngoscope were named as Group I, patients intubated with the high-angle C-MAC D-blade were named as Group II, and patients intubated with the conventional Macintosh blade laryngoscope were named as Group III. All patients underwent the same general anesthesia and a thoracotomy or VATS was performed by the same surgical team. All the anesthesia methods and monitoring were routinely applied, and no special application was performed for the study. Patients admitted to the operating room were monitored by an electrocardiogram, pulse oximetry (SpO_2), an invasive arterial pressure measurement, and a neuromuscular transducer all of the patients were preoxygenated with 100% O_2 at a fresh gas flow of 6 L min^{-1} for 3 minutes. Anesthesia induction was performed with 1 µg kg^{-1} fentanyl (Fentaver, Haver, İstanbul, Türkiye), 2 mg kg^{-1} propofol (Propofol 1% Fresenius, Fresenius Kabi AB, Upsala, Sweden) and 0.6 mg kg^{-1} rocuronium (Myocron, VEM, Tekirdağ, Türkiye). The patients were intubated when the Train of Four count was 0 and anesthesia maintenance was achieved by sevoflurane (Sevoflurane, Baxter Healthcare Corp., Guayama, Puerto Rico) inhalation in a 50% oxygen-air mixture and an intravenous (IV) remifentanil (Rentanil, VEM, Tekirdağ, Türkiye) infusion. Sevoflurane and remifentanil were titrated so that vital values were within 20% of admission values. Tidal volume and respiratory rates were adjusted to keep end-tidal CO_2 levels between 35 and 40 mmHg. For general anesthesia, routine practice was followed and no new drugs were used. Endotracheal intubation of the patients was performed using a double-lumen endobronchial tube (Shiley Endobronchial Tube, Covidien, Ireland), which allowed us to perform one-lung ventilation. A 35 Fr or 37 Fr endobronchial tube was preferred for the female patients and a 37 Fr, 39 Fr, or 41 Fr endobronchial tube was preferred for the male patients. The tracheal and bronchial cuffs of the tube were lubricated with a sterile surgical lubricant. The original stylet of the double-lumen tube was used as the internal stylet, except for the C-MAC D-blade. For the D-blade, the stylet of the videolaryngoscope was used by adjusting it to the angle of the D-blade. After both cuffs of the tube passed the rima glottis, the tube was turned 90° in the direction of the bronchus in which the

tube was to be placed and gently advanced until resistance was felt. Intubation success was confirmed by three complete capnographic cycles and bilateral chest auscultation. If it was not possible to pass the bronchial cuff through the rima glottis or if the patient's oxygen saturation (SpO_2) level was < 85%, the attempt was considered failed and mask ventilation was started. When the patient's SpO_2 level was > 98%, a new tracheal intubation was attempted using the same laryngoscope. In case of a second failure, the anesthetist switched to the other laryngoscope. The C-MAC videolaryngoscope was the second choice for the conventional Macintosh blade laryngoscope, the high-angle C-MAC D-blade videolaryngoscope was the second choice for the C-MAC videolaryngoscope, and the C-MAC videolaryngoscope was the second choice for the high-angle C-MAC D-blade videolaryngoscope.

Age, gender, BMI, ASA scores, Mallampati scores, mouth opening, thyromental distances, duration of anesthesia, duration of surgery, and the type of surgery performed were recorded for each patient. Additionally, the blade type used in endotracheal intubation, blade number, double-lumen endotracheal tube size, tube design (right/left), successful intubation time, percentage of glottis opening (POGO) score , the number of intubation attempts, whether the first attempt was successful or not, whether the burp maneuver was needed or not, whether there was difficulty in placing the laryngoscope blade into the mouth (0, 1, 2, 3, 4), whether there was difficulty in advancing the endotracheal tube (0, 1, 2, 3, 4), being < 85% of SpO_2 during intubation, bronchospasm, cardiac arrhythmia, need for atropine and/or ephedrine, tongue, lip, or tooth trauma, cuff rupture, esophageal intubation, and presence of blood on the blade were also recorded. Increased respiratory pressures, desaturation, decreased tidal volume, and increased end-tidal CO_2 were considered to indicate the presence of bronchospasm. Any ventricular or supraventricular premature beat, or any sustained rhythm other than sinus rhythm, was considered an arrhythmia. Arrhythmias occurring for the first time within the first three minutes after intubation were attributed to intubation. Ephedrine (Ephedrine Hidrochloride, Osel, İstanbul, Türkiye) 5 mg was administered if the systolic blood pressure of a patient fell below 80 mmHg and atropine (Atropine Sulfate, Turktıpsan, Ankara, Türkiye) 0.01 mg kg^{-1} IV was administered if a patient's heart rate fell below 40 per minute. Heart rate, systolic-diastolic pressure and the mean arterial pressure as hemodynamic parameters were recorded before induction, after induction, during intubation, and after intubation at 1, 3, and 5 minutes. In all the patients, the accuracy of tube placement by fiberoptic bronchoscope (FOB) (Ambu aView, Taiwan) was confirmed by a thoracic surgeon blinded to the groups. The presence of trauma symptoms such as edema, erythema, hemorrhage, or hematoma in the parts of airway that can be evaluated by FOB (distal part of trachea, carina, or bronchi) were also recorded by FOB. All of the patients were questioned about sore throat, dysphagia, hoarseness, and cough at the 1st and 24th postoperative hours. Sore throat was graded as follows: 0 = no pain, 1 = mild (pain with swallowing), 2 = moderate (persistent pain that increased with swallowing), and 3 = severe (pain that prevented eating and required analgesic medication). Hoarseness was defined as an acoustic quality different from the patient's previous voice quality and was initially assessed as present or absent. If the answer was "present", hoarseness was graded on a scale of one to three: 1 = recognized by the patient, 2 = obvious to the observer, and 3 = aphonia. Dysphagia and cough were initially assessed as present or absent. If the answer was "present", the severity was graded as 1 = mild, 2 = moderate, or 3 = severe. All perioperative measurements and data collection were performed by an anesthetist blinded to the groups.

The primary outcome measure of the study was time to successful intubation. Time to successful intubation was defined as the time from placing the patch in the mouth to observing three capnograph cycles. The secondary outcome measures were the number of intubation attempts, complications during and after intubation, and difficulty experienced.

Statistical Method

The data obtained in the study were analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 24.0 (IBM, Armonk, NY, USA). All continuous variables were given as mean ± SD. Categorical variables were given as both number and percentage (%) values. The normality of continuous variables was assessed using the Shapiro–Wilk test, and the homogeneity of variances was evaluated using Levene's test. Based on these assessments, non-normally distributed continuous and ordinal variables were compared among the three groups using the Kruskal–Wallis test. In the event of a statistically significant result, pairwise comparisons were conducted using the Mann–Whitney U test, and the Bonferroni correction was applied to adjust for multiple comparisons (adjusted significance level: $p<0.017$). A chi-square test was used to analyze categorical data. As a result of the analyses, *p* values below 0.05 were considered statistically significant.

Calculation of the Sample Size

The sample size of the study was calculated with the G*Power software, version 3.1.9.2 for Windows (Universität Düsseldorf, Düsseldorf, Germany) based on the data set of the pilot study consisting of nine patients. According to the results of the pilot study, the mean intubation time of Group I was 71.66 ± 5.31 seconds, Group II was 82.33 ± 7.58 seconds and Group III was 60.66 ± 4.32 seconds respectively. The sample size of the study was determined to be 105 patients with a

margin of error of 0.01 and 90% power when a 10-second difference in successful intubation time between the groups was considered significant.

RESULTS

A total of 105 patients who underwent elective one-lung ventilation in the thoracic surgery operating room from December 2022 to June 2023 were included in the study. Table I presents the demographic data of the patients.

No unexpected difficult airway was encountered in the patients included in the study. There was no significant difference between the groups in terms of Mallampati scores or anatomical features of the airway (Table II).

All the patients in Group I were intubated with No. 3 blade, all the patients in Group II were intubated with a No. 4 blade, 7 (20%) patients in Group III were intubated with a No. 3 blade, and 28 (80%) patients in Group III were intubated with a No. 4 blade. The first intubation attempt was successful in 80% of patients in Group I, in 85.7% of patients in Group II, and in 80% of patients in Group III. Two patients in Group II who failed in the second attempt and required blade exchange. Both patients had Mallampati score I and there was no anatomical difficult airway symptom. The mean intubation time was 76.31 ± 26.56 seconds in Group I, 88.20 ± 29.81 seconds in Group II, and 67.00 ± 22.41 seconds in Group III and a statistically significant difference was found between Group I-Group II (p=0.011) and Group II-Group III (p=0.001) (Table II). An analysis of the rates of 2nd and 3rd degree difficulty in double-lumen tube advancement showed that these rates were significantly higher in Group II (p=0.033). Table III presents information about the endobronchial tube used and intubation comfort for each patient group.

Complications arising during and immediately after intubation (SpO_2 < 85%, bronchospasm, cardiac arrhythmia, bradycardia, hypotension, tongue trauma, dental trauma, lip trauma, cuff rupture, and/or esophageal intubation) were not significantly different between the groups (p>0.05). No statistically significant difference was found between the groups when the hemodynamic parameters (heart rate, systolic blood pressure, diastolic blood pressure, and mean blood pressure) were analyzed before induction, after induction, during intubation, and after intubation at 1 minute, 3 minutes, and 5 minutes.

Table I. Demographic Data

	Group I (Mean ± SD or %)	Group II (Mean ± SD or %)	Group III (Mean ± SD or %)	p-value
Age (years)	57.00 ± 13.68	54.37 ± 12.33	44.66 ± 18.61	**0.009***
BMI (kg m^{-2})	26.2 ± 3.85	26.86 ± 4.91	25.60 ± 5.11	0.365
Gender				
Female	25.7	28.6	31.4	0.869
Male	74.3	71.4	68.6	
ASA Score				
I	0	0	8.6	
II	62.9	48.6	62.9	0.076
III	37.1	51.4	28.6	

SD: Standard Deviation, **BMI:** Body Mass Index, **ASA:** American Society of Anesthesiology, ***There is a statistically significant difference.
Compared using Kruskal-Wallis test due to ordinal nature of data. The difference was statistically significant (p<0.05).

Table II. Airway Assessment and Intubation Times

	Group I (n=35/Mean ± SD)	Group II (n=35/Mean ± SD)	Group III (n=35/Mean ± SD)	p-value
Mallampati (I/II/III/IV)	5/28/2/0	5/25/5/0	9/21/5/0	0.666
Mouth Opening (cm)	4.41 ± 0.60	4.72 ± 0.82	4.94 ± 1.10	0.053
Thyromental Distance (cm)	8.21 ± 1.76	7.91 ± 1.33	7.65 ± 1.92	0.566
Intubation Time (sec)	76.31 ± 26.56	88.20 ± 29.81	67.00 ± 22.41	<0.017*

SD: Standard Deviation, **cm:** centimeter, **sec:** second,***There is a statistically significant difference.
Compared using Kruskal-Wallis test due to ordinal nature of data. After Bonferroni correction (adjusted p<0.017), the pairwise comparison showed a statistically significant difference between the groups on intubation time. Group I and Group II (p=0.011), Group II and Group III (p=0.001), Group I and Group III (p=0.079).

No significant difference was found between the groups in terms of airway trauma (presence of edema, erythema, hematoma, and/or hemorrhage) in the assessment by FOB. In 14 (40%) patients in Group I, 13 (37.1%) patients in Group II, and 10 (28.5%) patients in Group III, the tube was found to be in the right place (Table IV).

The most common postoperative complication was sore throat at the 1st hour and cough at the 24th hour. No statistically significant difference was observed between the groups in terms of the incidence of complications (Figure 1).

Table III. Information on Endobronchial Tube and Comfort of Intubation

	Group I (n=35)	Group II (n=35)	Group III (n=35)	p-value
Tube No (Fr) (35/37/39/41)	4/7/18/6	4/7/21/3	6/11/11/7	0.356
Tube Design (Right/Left)	4/31	8/27	4/31	0.307
POGO Score (%) (70/80/90/100)	6/7/17/5	4/14/15/2	3/9/11/12	0.079
Burp Maneuver (Yes/No)	24/11	24/11	26/9	0.833
Difficulty in placing the laryngoscope (0/1/2/3)	21/8/6/0	17/15/3/0	24/8/2/1	0.353
Difficulty in advancing the tube (0/1/2/3)	10/14/6/5	5/9/12/9	6/16/9/4	**0.033***
Number of intubation trials (1/2/3)	28/7/0	30/3/2	28/7/0	0.172

Fr: French, **sec:** seconds, **POGO:** percentage of glottis opening, ***There is a statistically significant difference.
Compared using Kruskal-Wallis test due to ordinal nature of data, Chi-square test was used to compare categorical variables among the three groups. For variables with expected cell counts less than 5, the Monte Carlo simulation method was applied. Statistical significance was considered at p<0.05.

Table IV. Verification of Tube Location with Fiberoptic Bronchoscope

	Group I, n (%)	Group II, n (%)	Group III, n(%)	p-value
In the right place	14 (40)	13 (37.2)	10 (28.6)	0.851
Backward	10 (28.6)	11 (31.4)	15 (42.9)	
Forward	10 (28.6)	10 (28.6)	8 (22.8)	
In the opposite bronchus	1 (2.8)	1 (2.8)	2 (5.7)	

The distribution of categories among the three groups was not statistically significant (Chi-square test, p=0.851).

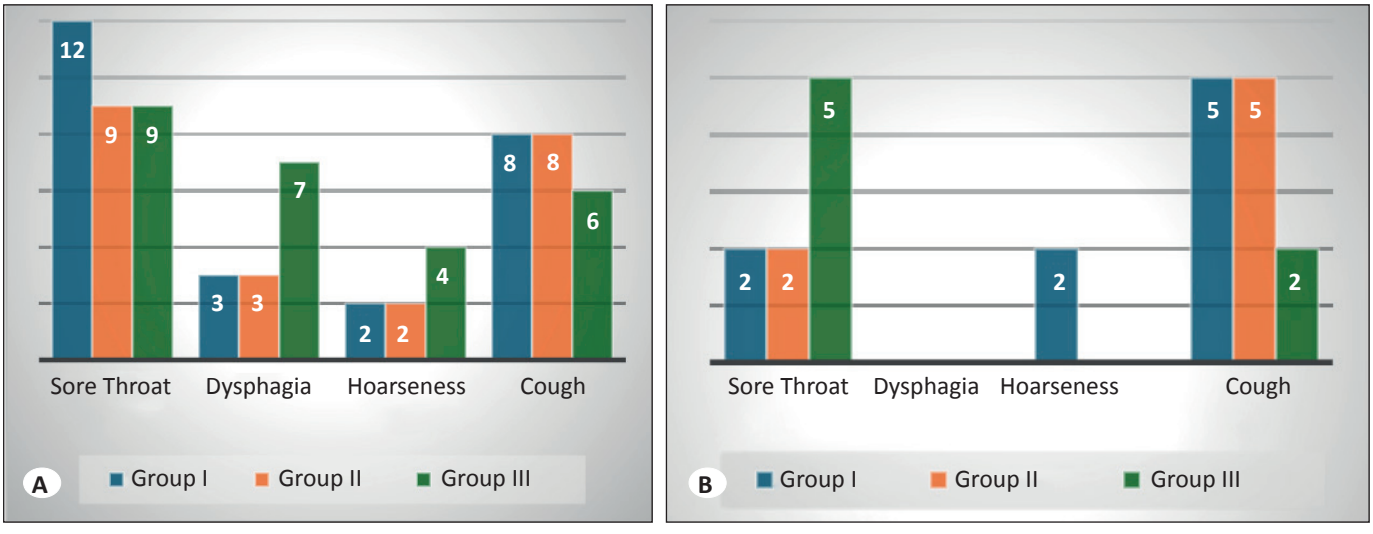

Figure 1. A) Postoperative 1st hour complications and **B)** Postoperative 24th hour complications.

DISCUSSION

This study investigated the superiority of the conventional Macintosh blade laryngoscope, the high-angle C-MAC D-blade videolaryngoscope, and the C-MAC videolaryngoscope over each other in double-lumen tube placement. The results of the study revealed a high rate of success in the first intubation attempt with all three laryngoscopes, while longer intubation time and difficulty in tube advancement were detected with the high-angle C-MAC D-blade videolaryngoscope.

Videolaryngoscopes facilitate intubation by providing a better visualization of a patient's airway. In recent years, due to the pandemic, videolaryngoscopes have been frequently used not only in patients with a difficult airway but also in all intubation attempts. However, there are limited studies investigating the ease of use of videolaryngoscopes in double-lumen tube placement and there are different results regarding the effects on intubation time. Studies comparing the conventional Macintosh laryngoscope with the C-MAC videolaryngoscope indicated that even though the videolaryngoscope provided better image quality, it was not superior in terms of intubation success rates, hemodynamic parameters, or complications, but different results were obtained in terms of the effect on intubation times (4-6). In studies comparing the high-angle C-MAC D-blade videolaryngoscope with the conventional laryngoscope, different results were obtained regarding intubation time. In contrast to the study showing that faster intubation was achieved with D-blade in nasotracheal intubation, it was found that the D-blade videolaryngoscope prolonged the intubation time in the study conducted in orotracheal intubation in 2020 (7,8). In a study comparing the C-MAC Macintosh videolaryngoscope with the high-angle C-MAC D-blade videolaryngoscope in children with cervical trauma, it was found that better glottic visualization was provided with the D-blade videolaryngoscope, but there was no difference in terms of intubation times (9). In a study investigating the efficacy of laryngoscopes in different airway scenarios, shorter intubation times were found for the C-MAC Macintosh videolaryngoscope and the conventional Macintosh laryngoscope compared to the high-angle C-MAC D-blade videolaryngoscope in patients without difficult airways. In difficult airway scenarios, intubation time was found to be shorter with the C-MAC Macintosh videolaryngoscope (10). In our study, the longest intubation time was achieved with the high-angle C-MAC D-blade videolaryngoscope and the shortest intubation time was achieved with the conventional Macintosh laryngoscope, and this difference was statistically significant. No significant difference was found in intubation times between the C-MAC Macintosh videolaryngoscope and conventional Macintosh laryngoscope. Although all the aforementioned studies were performed with a single-lumen tube, the authors emphasized that tube advancement may be affected by the blade angle, which may have an effect on intubation times. In our study, when we investigated the difficulty in tube advancement, it was found that the difficulty in the 2nd-3rd degree was significantly higher in the group intubated with a high-angle C-MAC D-blade videolaryngoscope than in the other groups. We believe that the difficulty in advancing the double-lumen tube due to the high angle of the D-blade is the main factor prolonging the intubation time.

Double-lumen tubes have a larger outer diameter, are relatively rigid, and technically more difficult to place than single-lumen tubes. Reviewing the studies on double-lumen tube intubation in the literature, we detected that the study carried out by Huang et al. in 2020 was in parallel with our study in terms of the choice of blade. In this study, the GlideScope videolaryngoscope, the C-MAC D-blade videolaryngoscope, and a conventional laryngoscope were compared, and the GlideScope videolaryngoscope had the longest intubation time (1). The results of the study revealed that the intubation time prolonged as the blade angle increased and that intubation success decreased in the first attempt. The blade angle of the GlideScope videolaryngoscope is 60 degrees, while the angle of the D-blade is 40 degrees. The manipulation in the oropharyngeal space is restricted with high-angle blades, which leads to prolonged intubation time. The specific stylets of high-angle videolaryngoscopes are similarly high-angled so that the tip of the tube can be directed into the glottis, which is another factor that makes it difficult to advance the tube in the mouth and prolongs the intubation time (11,12). We used the specific stylet of the videolaryngoscope to reach the glottis more easily in patients for whom C-MAC D-blade was used. We believe that the high angle of the blade and the stylet prolong the intubation time. However, contrary to what Huang et al. argued, we believe that the same situation increases intubation success in the first attempt. We think that the reason for this is that it provides a good glottic view and the harmony of the stylet and the blade angle makes it easier to reach the glottic target.

Regarding the accuracy of tube placement with FOB, more than 50% of the patients in all groups were placed at the wrong level (forward or backward). This result suggests that incorrect level placement is not related to the laryngoscope used and that tube placement must be confirmed with FOB in accordance with the literature (1).

The stress caused by laryngoscopy has been reported to cause hemodynamic changes such as arrhythmia and hypertension (13). This may cause serious complications in patients with low cardiac reserve. The duration of the laryngoscopy procedure is also significant in terms of cardiovascular responses to endotracheal intubation (14). However, no

difference was found in terms of hemodynamic responses in patients undergoing major cardiac surgery, although the duration of intubation with videolaryngoscope was longer in Sarkılar et al.'s study (6). Tempe et al. also compared the hemodynamic responses to conventional laryngoscopes and different videolaryngoscopes in patients undergoing cardiac surgery and found that the responses were similar (15). In our study, similar to the literature, no difference was found in laryngoscopy-induced hemodynamic changes. This result suggests that videolaryngoscopes do not reduce the stress response caused by a laryngoscopy procedure but do not cause any extra stress. This suggests that videolaryngoscopes and conventional laryngoscopes are not superior to each other in terms of maintaining hemodynamic stability in patients undergoing one-lung ventilation. Therefore, it would be a correct approach that reservations about the maintenance of hemodynamic stability should not be a determinant in the choice of laryngoscope while planning airway management.

Although postoperative sore throat and hoarseness are the most common complications related to double-lumen tube placement, there are controversial results in the literature regarding the incidence of postoperative complications. There are studies indicating that videolaryngoscopy procedures cause less hoarseness and sore throat compared to the conventional laryngoscopy procedure, as well as studies showing no difference (16-18). In our study, the most common complication was sore throat at the 1st hour postoperatively and cough at the 24th hour postoperatively, but there was no difference in the incidence of complications between the patient groups. Mucosal and dental trauma during and immediately after intubation was also low (<5%) and no difference was observed between the patient groups. Cuff rupture in the double-lumen tube was detected only in two patients in Group II. These results contrast with those of Shah et al's study. Shah et al. found 4-fold higher trauma and 5-fold higher cuff rupture in intubations performed with the conventional Macintosh blade compared to the D-blade (19). We attribute this low rate of complications to the fact that all three laryngoscopes were used by the same practitioner with a certain level of experience. We think that the two cuff ruptures seen in Group II were due to more difficult guidance and advancement of the double-lumen tube in the mouth compared to the other groups due to the high angles of the D-blade and the original stylet.

Our study had some limitations. First, the anesthesiologist performing intubation was not blinded to the randomization of the laryngoscope, which may have prevented objective interpretation of the results. Second, the fact that the blade size of the videolaryngoscopes used were fixed while the conventional laryngoscope blade was interchangeable may have affected the results in favor of the conventional laryngoscope. Third, the D-blade developed for difficult airway management used in patients without difficult airways may have affected the results. For the clarification of this situation, in future studies, it would be appropriate to include a higher-angle videolaryngoscope blade as a separate group in addition to the blades we investigated.

CONCLUSION

Longer intubation time and difficulty in tube advancement were detected with the high-angle C-MAC D-blade videolaryngoscope compared to the conventional Macintosh blade laryngoscope and the C-MAC videolaryngoscope in double-lumen tube placement in patients whom a difficult airway is not expected . The shortest intubation time was detected for the conventional Macintosh blade laryngoscope. There was no difference in intubation success, hemodynamic parameters, or complications. Therefore, the conventional Macintosh blade laryngoscope or C-MAC videolayngoscope can be used as the first choice for double-lumen tube placement in patients with a normal airway but in whom prolonged intubation is anticipated to cause complications.

AUTHOR CONTRIBUTIONS

Conception or design of the work: EY, GB, AE, RY
Data collection: EY, GB, RY
Data analysis and interpretation: EY, GB, AE
Drafting the article: EY, GB, AE, RY
Critical revision of the article: EY, GB, AE, RY
Other (study supervision, fundings, materials, etc): GB, AE, RY
The author (EY, GB, AE, RY) reviewed the results and approved the final version of the manuscript.

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