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CLINICAL RESEARCH

Comparison of haemodynamic response to tracheal intubation with two different videolaryngoscopes: A randomized clinical trial

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Abstract
Background: Endotracheal intubation (ETI), which is the gold standard in coronary artery bypass grafting (CABG), may cause myocardial ischaemia by disturbing the balance between haemodynamic changes and oxygen supply and consumption of the myocardium as a result of sympathetic stimulation. In this study, we aimed to compare two different videolaryngoscopes (C-MAC and Airtraq) in the hemodynamic response to ETI.
Methods: Fifty ASA II–III CABG surgery patients were randomly assigned to C-MAC or Airtraq. The hemodynamic data included arterial blood pressure [systolic (SAP), diastolic (DAP) and mean (MAP)] and heart rate (HR) and were recorded at six different points in time: before laryngoscopy-T1, during laryngoscopy-T2, immediately after intubation-T3, and 3 (T4), 5 (T5) and 10 (T6) minutes after intubation. Intraoperative complications were recorded. Patients were questioned about postoperative complications 2 and 24 hours following extubation.
Results: The hemodynamic response to ETI was significantly greater with C-MAC. The increase in HR started with the laryngoscopy procedure, whereas increases in SAP, DAP, and MAP started immediately after ETI ($p = 0.024$; $p = 0.012$; $p = 0.030$; $p = 0.009$, respectively). In group analyses, T1–T2, T2–T3 and T1–T3 comparisons did not show any significant differences in HR with Airtraq. However, with C-MAC, HR after intubation increased significantly compared to the pre-laryngoscopy values (T1–T3) ($p = 0.004$). The duration of laryngoscopy was significantly reduced with C-MAC ($p < 0.001$), but the duration of intubation and total intubation were similar ($p = 0.36$; $p = 0.79$).
Conclusions: Compared to C-MAC, the hemodynamic response to ETI was less with Airtraq. Thus, Airtraq may be preferred in CABG patients for ETI.

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Introduction

Endotracheal intubation (ETI) is the gold standard for airway maintenance in patients who are scheduled to undergo coronary artery bypass grafting (CABG) surgery under general anesthesia. Laryngoscopy and intubation lead to sympathetic stimulation, resulting in hypertension, tachycardia, and dysrhythmia.[1] These hemodynamic changes during ETI may cause myocardial ischemia by disrupting the balance between the oxygen supply and consumption in the myocardium in patients with coronary artery disease. Due to this instability in hemodynamic parameters, the severity of the condition will further increase.[2,3] Therefore, prevention of the hemodynamic response to ETI in coronary artery disease patients who are scheduled for CABG is more crucial than that in non-cardiac affected patients.

Another problem related to patients who are scheduled to undergo cardiac surgery is that the possibility of a difficult airway (DA) is greater than that of other patient groups due to comorbid diseases.[4] Given that the possibility of a DA is a factor that is independent of anesthetists, it is important to reduce the hemodynamic response to ETI.

During ETI, stimulation of the supraglottic area by laryngoscopy, passage of the endotracheal tube (ETT) through the vocal cords, and inflating the cuff of the ETT in the infraglottic area induce a hemodynamic response.[2] Laryngoscope design, laryngoscopy time, and lifting power are important in the magnitude of this response.[5] Videolaryngoscopes (VLs) are airway devices developed for use in a DA, and unlike standard direct laryngoscopes, VLs allow endotracheal intubation without the need for the oral, pharyngeal and laryngeal axes to be aligned.[6] VLs improve glottic visualization and reduce trauma to laryngeal structures.[7] The C-MAC VL (Karl Storz GmbH and Co. KG, Tuttlingen, Germany) is a fourth-generation VL and provides clear image quality; its camera has complementary metal-oxide semiconductor (CMOS) technology. It has original Macintosh blade shapes (sizes 2, 3, and 4), and it has a D-Blade shape for adults with DAs. The blade is manufactured from stainless steel, and the proximal finish has a pronounced flat form. The image is viewed on a 7-inch (18 cm) monitor connected to the electronic module attached to the laryngoscope.[8]

The Airtraq VL (Prodol, Meditec S.A., Vizcaya, Spain) has a preformed curvature and two channeled blades. While one channel provides placement of the tracheal tube, the other channel ends with a distal lens. Reusable blades are available for adult and pediatric patients. A battery-operated light source is located at the end of the blade. The image is transmitted to the proximal area using lens and prism combinations.[9] Niforopoulou P. et al.[10] described the Airtraq's blade as anatomically shaped. We measured the angle at which the tangent lines cross the outermost points of the handle and blades cross with each other (C-MAC size three blade and blade size 3 [the blue blade] for the Airtraq). We found that this angle was 45 degrees for the C-MAC and 78 degrees for the Airtraq VL (Fig. 1A and B). We hypothesized that owing to its blade shape, the Airtraq VL may result in a less severe hemodynamic response due to decreased stimulation of oropharyngeal structures and less lifting force used during laryngoscopy. In addition, we concluded that the presence of an ETT in the canal during intubation would reduce contact with the oropharyngeal structures, thus reducing the hemodynamic response to ETI. We aimed to compare the C-MAC and Airtraq VLs in terms of hemodynamic response to ETI in CABG surgery.

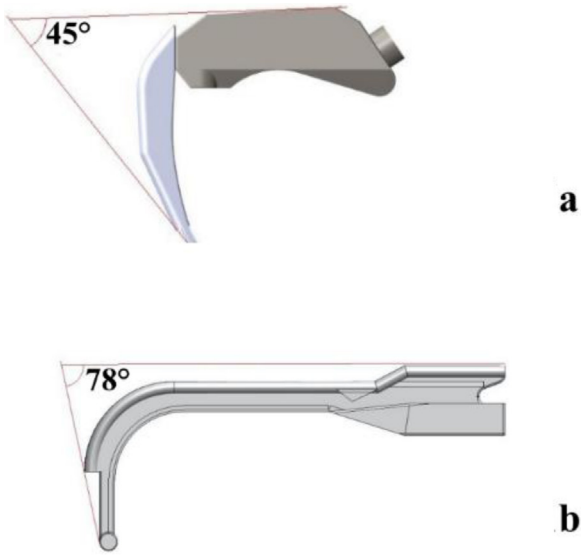

Figure 1 The angles at which the tangent lines cross the outermost points of the handle and blades between the Airtraq and C-MAC VL.

Methods

Fifty patients aged between 40 and 70 years, classified as ASA II–III and scheduled for elective CABG surgery between April 2018 and March 2019 were included in this prospective randomized study after ethics approval was obtained from the local ethics committee of the university (KOU-KAEK 2017-405, NCT number: 03483285). The patients were informed about the study, and written consent was obtained. Those with a history of difficult intubation or anticipated DA (thyromental distance < 6 cm, mouth opening < 3 cm, Mallampati score of 3 or 4, temporomandibular and atlantooccipital joint movement restriction, previous head and neck surgery), pregnancy, abnormal respiratory function test, hypoxia or hypercapnia in arterial blood gas, left main coronary artery disease, poor ventricular ejection fraction (ejection fraction < 35%), body mass index (BMI) greater than 35 $kg.m^{-2}$, cardiac valvulopathy and cardiovascular autonomic dysfunction, and hemodynamic instability requiring manipulation and medical treatment (hypertension, hypotension, bradycardia, and tachycardia) were excluded from the study. All antihypertensive and antianginal medications were continued until the morning of surgery, except angiotensin-converting enzyme inhibitors, and angiotensin receptor blockers.

The patients were premedicated with 0.03 $mg.kg^{-1}$ intravenous (IV) midazolam before being transferred to the operating room. Then, 5 $L.min^{-1}$ oxygen was administered via a face mask, and peripheral venous access was achieved in the antecubital area using an 18G catheter. Heart rate (HR) was measured by 5-channel electrocardiography, and standard peripheral oxygen saturation (SpO_2) and nonin-

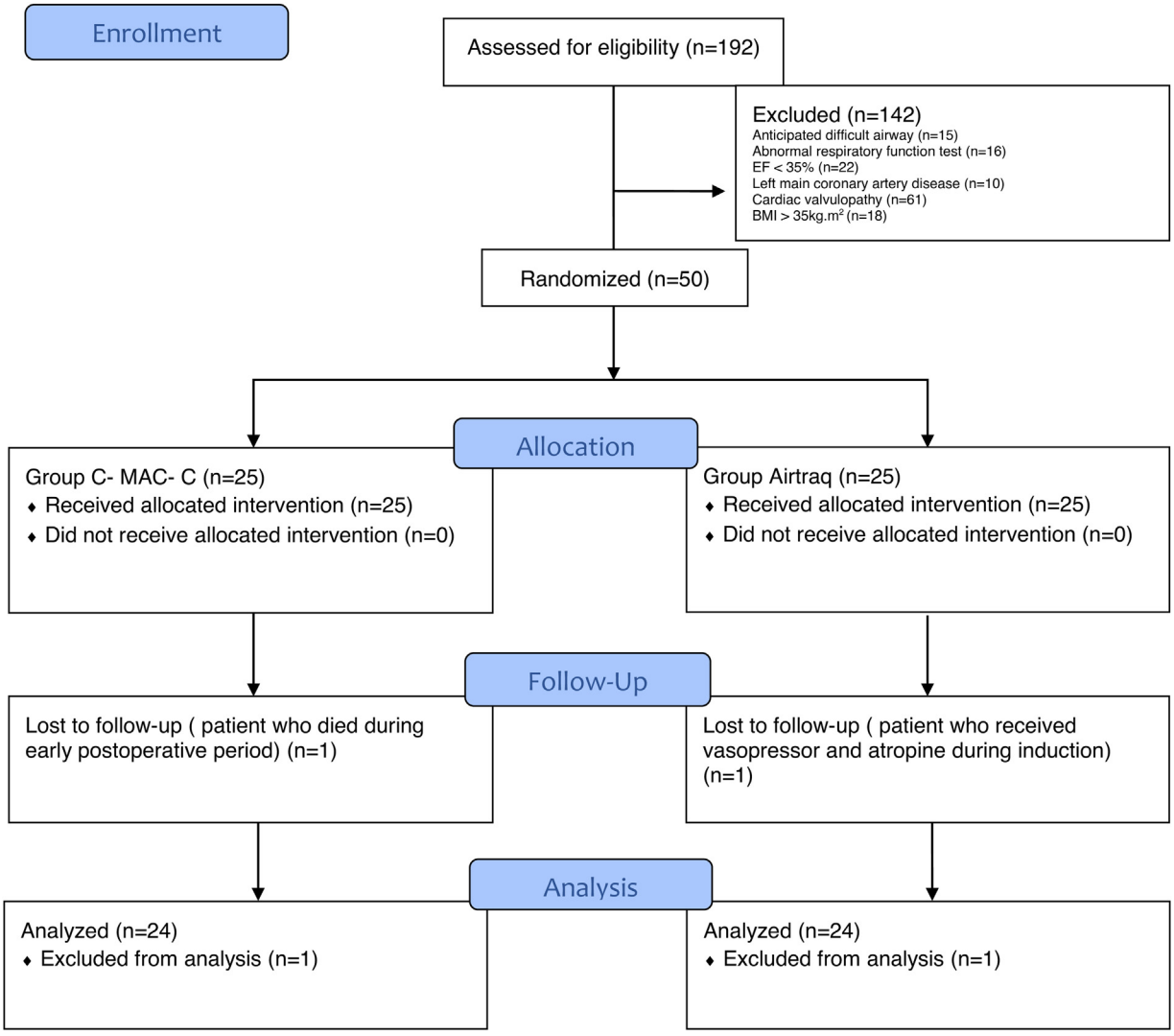

Figure 2 Consort flow diagram.

vasive blood pressure monitoring were performed. After local anesthesia with 2% lidocaine and 1 $\mu g.kg^{-1}$ IV fentanyl were administered, an arterial catheter was placed before anesthesia induction. Anesthesia was induced with 2 $mg.kg^{-1}$ thiopental, 5–7 $\mu g.kg^{-1}$ fentanyl, and 1 $mg.kg^{-1}$ IV rocuronium in all patients following preoxygenation. ETI was performed with a donut-shaped pillow (20.5 × 7.5 × 4.5 cm, Action Ltd., Maryland, USA) under the head, with the head in neutral position and when the train-of-four response was not achieved. Randomization was achieved using a sealed envelope technique performed by a blinded anesthesia resident.

In the C-MAC group, a conventional (C) size three blade was used. The tongue was placed to the left side, while the blade was advanced into the mouth. The lower end of the blade was placed in the vallecula, and videolaryngoscopy was suspended until laryngeal structures were visualized on the screen. Then, the patient was intubated, and the cuff was inflated. For the Airtraq group, the Airtraq Avant VL (Prodol Meditec, Las Arena, Spain) and a size 3 blade were used. First, the ETT was loaded into the channel, and then the Airtraq VL was advanced into the mouth using the standard technique. Once the view of the glottis was optimized, the tracheal tube was passed through the vocal cords, and the cuff was inflated. The tube was then held in place as the Airtraq VL was removed. The images were received from a video system incorporating a video camera attached to the Airtraq device and a wireless monitor. A cuffed tracheal tube was used (size 7.0 in women and size 8.0 in men), and the cuff pressure of the ETT was maintained within 20 cm H_2O in the two groups until extubation of the patients. In the C-MAC group, BURP (consisting of backward, upward, and right-sided pressure on the thyroid and cricoid cartilage) and considerable lifting force maneuvers were used to achieve an optimal glottic view. A semi-rigid stylet was used in cases of unsuccessful intubation on the first attempt. In the Airtraq group, reinsertion and excessive lifting force for laryngoscopy and anti-clockwise rotation maneuvers were used for intubation. Correct placement of the ETT was confirmed by auscultation of bilateral breath sounds.

Anesthesia was maintained with 40%/60% O_2/air + desflurane and remifentanil infusion. All decisions

about these manipulations were made by the consultant anesthetist performing anesthesia induction.

All airway insertions were performed by the same anesthesiologist with 10 years of experience who had performed at least 30 intubations with the two airway devices in a clinical setting before the study. If the time to successful intubation exceeded 2 minutes or after three attempts, the attempt was considered a failure. Cormack-Lehane (C–L) grades were recorded. The duration of laryngoscopy was defined as the time that elapsed from insertion of the blade between the incisors until optimal glottic visualization was achieved. The duration of intubation was defined as the time interval from optimal glottic structure visualization to inflation of the tracheal tube cuff. The duration of total intubation was defined as the time from insertion of the blade between the incisors until inflation of the tracheal tube cuff.

Hemodynamic data, including the invasive arterial blood pressure [systolic arterial pressure (SAP), diastolic arterial pressure (DAP) and mean arterial pressure (MAP)] and HR, were recorded at six different time points: before laryngoscopy (T_1), during laryngoscopy (T_2), immediately after intubation (T_3), and three (T_4), five (T_5) and ten (T_6) minutes after intubation. Intraoperative complications, such as mucosal, lip, and dental damage, were recorded. Data were collected by unblinded anesthesia residents in the operating room. The patients were questioned about postoperative complications (sore throat, hoarseness, and dysphagia) by a blinded anesthesiologist 2 and 24 hours following extubation in the postoperative cardiovascular intensive care unit.

The primary aim of this study was to compare the increase in HR between the Airtraq and C-MAC devices during intubation. Our secondary aims were to measure blood pressure, laryngoscopy and intubation time, total tracheal intubation time, stylet use, maneuvers used for an optimal glottic view and minor postoperative complications, such as mucosal, dental and lip damage, sore throat, dysphagia, and hoarseness.

Sample size

In a previous study, immediately after intubation, the HR was not increased after tracheal intubation with the Airtraq VL in cardiac surgery patients.[11] Another study assessed the HR changes during intubation and reported that compared to other VLs, the C-MAC device increased the HR significantly after intubation (baseline 83.00 ± 16.80 vs. 93.65 ± 15.50 beats.min^{-1}).[12] According to these findings, we hypothesized that the increase in HR during ETI with the Airtraq VL would be 20% lower due to the available form of the device. Twenty-two patients were required for each group. Thus, the alpha was 0.05, and the power was 80%. Considering the possibilities, we planned for 25 patients in each group.

Statistical analysis

The analyses in this study were performed with the Statistical Package for the Social Sciences version 21. In all analyses, 0.05 was used as the level of significance. The Kolmogorov-Smirnov test was used to assess normality, and Levene's test was used to determine homogeneity. Normally distributed data are presented as the mean ± standard deviation, and the median and 1 st (Q1) and 3rd quartile (Q3) (25–75%) values are presented for non-normally distributed variables. Frequencies and percentages are presented for non-parametric variables.

For normal and homogeneous distributions, independent *t*-tests were applied for between group comparisons. For normal and non-homogeneous distributions, the Mann-Whitney U test was applied for between-group comparisons. The association between two categorical variables was examined by Chi-square test. The Bonferroni test was used to assess repeated variables.

Results

One patient in the Airtraq group died in the early postoperative period, and this patient was excluded because postoperative complications could not be evaluated. Another patient in the C-MAC group who received vasopressors and atropine for severe hypotension and bradycardia during induction was excluded from the study. Data from 48 patients were included in the analysis (Fig. 2).

Patients were similar in terms of demographic characteristics and medications. Airway characteristics and laryngoscopic views as assessed by the C-L grades were similar. The duration of laryngoscopy was significantly shorter with the C-MAC device ($p < 0.001$), but the duration of intubation and total intubation were similar between the groups ($p = 0.360$; $p = 0.793$). Intubation success rates on the first attempt were similar ($p = 0.752$). Intubation was achieved in all patients. The numbers of patients requiring maneuvers for laryngoscopy and ETI were similar (Table 1).

The HR was significantly higher from the beginning of laryngoscopy (T_2) until 5 minutes after intubation (T_5) in the C-MAC group.

The SAP, DAP, and MAP were increased significantly at the end of intubation (T_3) in the C-MAC group, and this increase continued until 5 min after intubation (T_5) for the SAP and until 10 minutes after intubation (T_6) for the DAP and MAP (Table 2).

In group analyses, T_1–T_2, T_2–T_3 and T_1–T_3 comparisons did not reveal any significant increases in HR in the Airtraq group. However, in the C-MAC group, the HR after intubation was significantly increased compared to the prelaryngoscopy value (T_1-T_3) ($p = 0.004$). No significant increases in arterial blood pressure were observed in the Airtraq group. However, in the C-MAC group, the SAP and MAP were significantly increased after intubation compared to the values recorded during laryngoscopy (T_2–T_3) ($p = 0.036$; $p = 0.014$, respectively) (Table 3).

The incidence of hoarseness was significantly increased in the Airtraq group compared with the C-MAC group at the 2nd hour after extubation (45.8%; 8.3%, $p = 0.008$) and decreased to a similar rate at the 24th hour after extubation ($p = 0.609$). Other complication rates were similar (Table 4).

Discussion

According to the results of our study, the hemodynamic response to ETI was increased with the C-MAC VL. When planning our study, we predicted that the HR would increase by an additional 20% at the end of ETI when using the C-

Table 1 Demographic variables and airway management data.

	Group C-MAC	Group Airtraq	*p*
Gender (Male/Female); *n (%)*	17(70.80)/7(29.20)	19(79.20)/5(20.80)	0.740
Age (years); *mean ± SD*	64.54 ± 7.71	61.45 ± 7.14	0.158
ASA (II/III); *n (%)*	9(37.50)/15(62.50)	7(29.20)/17(70.80)	0.760
BMI (kg. m^{-2}); *mean ± SD*	27.27 ± 3.01	28.20 ± 3.59	0.339
Mallampati score; 1/2 *n (%)*	12(50.00)/12(50.00)	13(54.20)/11(45.80)	1.000
Mouth opening[a] (cm); *med(Q_1–Q_3)*	4.00(4.00–5.00)	4.00(4.0–5.00)	0.520
Thyromental distance[a],[b] (cm); *med(Q_1–Q_3)*	7.00(6.00–7.00)	7.00(6.00–7.00)	0.878
Sternomental distance (cm); *mean ± SD*	13.96 ± 1.00	14.33 ± 1.05	0.211
Mandibular protrusion (A/B/C); *n (%)*	22(91.70)/2(8.30)/0(0.00)	23(95.8)/1(4.2) / 0(0.0)	1.000
Dentition (own/partial/edentulous); *n (%)*	10(41.70)/8(33.30)/6(25.00)	12(50.00)/6(25.00)/6(25.00)	0.792
Comorbidity (HT/Diabet/COAH); *n (%)*	18(75.00)/3(12.50)/2(8.30)	18(75.00)/4(16.70)/1(4.20)	0.924
Medication (Beta blocker/Ca Antag/Bronchodilator); *n (%)*	20(83.03)/2(8.30)/2(8.30)	21(87.50)/2(8.30)/1(4.20)	0.836
Antiplatelet medication; *n (%)*	4(16.70)	6(25.00)	0.724
EF (%); *mean ± SD*	0.52 ± 0.11	0.56 ± 0.10	0.118
Ventilation (one hand/two hands/two hands with flush/impossible); *n (%)*	14(58.3)/10(41.7)/0(0.0)/0(0.0)	15(62.5)/9(37.5)/0(0.0)/0(0.0)	0.766
Duration of laryngoscopy [a] (s); *med(Q_1–Q_3)*	4.00 (3.00–4.00)	6.50(5.00–8.75)	**< 0.001**
Duration of intubation (s); *mean ± SD*	11.63 ± 7.16	9.79 ± 6.56	0.360
Duration of total intubation (s); *mean ± SD*	16.04 ± 8.54	16.67 ± 7.82	0.793
Maneuver requirement of optimal glottic view; *n (%)*	6(25.00)	6(25.00) /	1.000
Cormack–Lehane scores (1/2/3/4); *n (%)*	12(50.0)/7(29.16)/4(16.66)/1(4.16)	15(62.5)/4(16.66)/4(16.66)/1(4.16)	0.765
Maneuver requirement for intubation; *n (%)*	6(25.00)	8(33.30)	0.752
First attempt success rate of intubation; *n (%)*	18(75.00)	16(66.70)	0.752
SpO_2 ; *med(Q_1–Q_3)*[a]	97.00(96.00–97.00)	97.00(96.00–97.50)	0.659
SpO_2<90; *n (%)*	2(8.30)	1(4.20)	1.000
Duration of surgery (min); *mean ± SD*	338.13 ± 73.35	307.29 ± 79.70	0.170
Time to extubation (h); *mean ± SD*	9.21 ± 3.83	10.38 ± 8.73	0.550

ASA, American Society of Anesthesiologists; BMI, Body mass index; BSA, Body surface area; EF, Ejection fraction; HT, Hypertension; SD, Standard deviation.
Normal distributed parametric variables were calculated by t-test.
Non-normal distributed parametric variables were calculated by Mann-Whitney U Test.
Data are presented as mean ± SD, median (Q_1– Q_3) (25–75 percentile) or frequency (and %) of patients.
[a] Not normal distributed in C-MAC VL.
[b] Not normal distributed in Airtraq VL.

Table 2 Hemodynamic variability data are compared between the Groups.

		Group C-MAC	Group Airtraq	Difference % between groups	$p^{a,b}$	
Heart Rate	T_1	70.83 ± 12.33	65.33 ± 9.80	8%	0.094
	T_2	72.79 ± 12.79	64.75 ± 11.10	12%	**0.024**
	T_3	79.71 ± 13.31	66.46 ± 11.44	20%	**0.001**
	T_4	69.75 ± 7.78	64.75 ± 7.88	8%	**0.032**
	T_5	71.54 ± 16.28	61.33 ± 10.83	17%	**0.014**
	T_6	70.63 ± 12.96	63.92 ± 13.07	10%	0.081
Systolic	T_1	123.08 ± 12.60	118.42 ± 14.22	4%	0.235
Arterial	T_2	110.25 ± 28.75	107.58 ± 20.38	2%	0.713
Pressure	T_3	129.00 ± 24.39	112.25 ± 19.90	15%	**0.012**
	T_4	114.50 ± 11.80	103.46 ± 12.83	11%	**0.003**
	T_5	108.88 ± 11.33	96.21 ± 17.59	13%	**0.005**[b]
	T_6	99.83 ± 7.45	97.71 ± 11.09	2%	0.440
Diastolic	T_1	67.88 ± 7.86	64.63 ± 8.68	5%	0.181
Arterial	T_2	60.50 ± 5.28	58.38 ± 5.19	4%	0.166
Pressure	T_3	66.58 ± 11.53	58.13 ± 14.53	15%	**0.030**
	T_4	63.08 ± 9.35	56.08 ± 8.31	12%	**0.009**
	T_5	61.17 ± 9.00	55.38 ± 4.86	10%	**0.039**[b]
	T_6	62.79 ± 5.12	59.42 ± 4.50	6%	**0.019**
Mean	T_1	86.28 ± 7.37	82.56 ± 8.86	5%	0.120
Arterial	T_2	77.08 ± 11.57	74.78 ± 8.13	3%	0.429
Pressure	T_3	87.39 ± 14.23	76.17 ± 14.42	15%	**0.009**
	T_4	80.22 ± 8.26	71.88 ± 7.43	12%	**0.001**
	T_5	77.07 ± 8.40	68.99 ± 7.85	12%	**0.001**
	T_6	75.14 ± 4.52	72.18 ± 4.96	4%	**0.036**

T_1, Before laryngoscopy; T_2, During laryngoscopy; T_3, Immediately after intubation; T_4, Three minutes after intubation; T_5, Five minutes after intubation; T_6, Ten minutes after intubation.
Values were presented as mean ± sd.
[a] t-test is used for analyzing the difference of means between groups.
[b] Since the homogeneity was not achieved. Mann-Whitney U Test was applied.

Table 3 Variables among groups at different measure times.

	Group C-MAC		Group Airtraq	
	Difference %	*p*	Difference %	*p*
Heart Rate	$T_1 - T_2$	2.76	1.000	-0.89	1.000
	$T_1 - T_3$	12.53	**0.004**[a]	1.72	1.000
	$T_2 - T_3$	9.50	0.060	2.64	1.000
Systolic	$T_1 - T_2$	-10.43	0.831	-9.15	0.076
Arterial	$T_1 - T_3$	4.81	1.000	-5.21	0.716
Pressure	$T_2 - T_3$	17.01	**0.036**[b]	4.34	1.000
Diastolic	$T_1 - T_2$	-10.87	**0.004**[c]	-9.67	**0.029**[c]
Arterial	$T_1 - T_3$	-1.90	1.000	-10.06	0.397
Pressure	$T_2 - T_3$	10.06	0.099	-0.43	1.000
Mean	$T_1 - T_2$	-10.66	**0.036**[c]	-9.42	**0.002**[c]
Arterial	$T_1 - T_3$	1.29	1.000	-7.74	0.498
Pressure	$T_2 - T_3$	13.37	**0.014**[b]	1.86	1.000

T_1, Before laryngoscopy; T_2, During laryngoscopy; T_3, Immediately after intubation.
Bonferroni Test was used to find difference between measured times.
[a] Within-group comparison of T_1 and T_3.
[b] Within-group comparison of T_2 and T_3.
[c] Within-group comparison of T_1 and T_2.

MAC VL. Table 2 reveals that the T_3 value was 20% higher in the C-MAC group, and these results support our initial hypothesis. While the increase in HR with the C-MAC VL started with the laryngoscopy procedure, the ETI procedure was effective in increasing blood pressure. As noted in our initial hypothesis, we suggest that due to the anatomical

Table 4 Postoperative complications.

	Group C-MAC	Group Airtraq	*p*
Mucosal damage	0(0.0)	2(8.3)	0.489
Lip damage	1(4.2)	0(0.0)	1.000
Dental damage	2(8.3)	0(0.0)	0.489
Sore throat 2nd h	2(8.3)	0(0.0)	0.751
Sore throat 24th h	1(4.2)	0(0.0)	1.000
Dysphagia 2nd h	1(4.2)	3(12.5)	0.609
Dysphagia 24th h	1(4.2)	1(4.2)	1.000
Hoarseness 2nd h	2(8.3)	11(45.8)	**0.008**
Hoarseness 24th h	1(4.2)	3(12.5)	0.609

Data were expressed as frequency (%) of patients.

shape of the Airtraq VL, the wide angle between the handle and blade reduces the hemodynamic response by reducing compression of the laryngeal structures during laryngoscopy. The increased blood pressure response during ETI was longer than the increase in HR.

According to Table 3, which presents the changes within groups at different times, it can be argued that almost no hemodynamic response was obtained with the Airtraq VL.

Although the increases in HR and MAP of greater than 10% achieved with the C-MAC VL are below the value that would be considered clinically significant, these increases may lead to important consequences in hypertensive and tachycardic patients during CABG surgery.[2,3]

In our study, the duration of laryngoscopy with the C-MAC VL was reduced compared to that with the Airtraq VL. The C-MAC is a Macintosh-type VL. The shorter laryngoscopy time with the C-MAC VL may be related to our familiarity and practice with Macintosh laryngoscopy, which has been used since the first day of anesthesia training. Macintosh laryngoscope blades were defined by Macintosh in 1943 and have since been indispensable for intubation applications in and out of the operating room.[13] Ng I Hill et al.[14] also reported that anesthetists were more familiar and comfortable with the Macintosh blades on the C-MAC VL. Although reports suggest that the hemodynamic response increases with increasing laryngoscopy time, some studies support that shorter laryngoscopy periods do not always result in fewer hemodynamic responses.[15,16] In our study, although the laryngoscopy time with the C-MAC VL was shorter than that with the Airtraq VL, the hemodynamic response did not decrease, which supports the studies that indicated that the laryngoscopy duration and the hemodynamic response are not always directly proportional.

The Airtraq is a tube-channeled VL. Although some authors argue that tube-channeled VLs result in shorter intubation times than non-channeled VLs, others have reported the opposite finding.[17,18] We evaluated the laryngoscopy time, intubation time and total intubation time separately to investigate the contribution of the channel in the Airtraq VL to the intubation time and the hemodynamic response that occurs during these times. In our study, the intubation time was similar in both VLs, showing that Airtraq's channel does not provide any advantage in intubation. Both the VL intubation and total intubation times were similar; however, the hemodynamic response was greater with the C-MAC VL, indicating that the intubation time was not always directly proportional to the hemodynamic response. In tube-channeled VLs, such as the Airtraq, pre-insertion of the ETT into the guide channel was reported to reduce the need for a stylet and external laryngeal manipulation for intubation, which would reduce the hemodynamic response and provide an advantage in favor of tube-channeled VLs.[5] In our study, the number of patients who required maneuvers to obtain optimal laryngeal visualization and intubation were similar in both groups. Therefore, we suggest that the effect of the Airtraq VL regarding prevention of the hemodynamic response to ETI was not based on reducing the need for a stylet and maneuvers. At the end of ETI, the decreased hemodynamic response with the Airtraq VL can be explained by the fact that the ETT has less contact with the oropharyngeal structures due to the channel. In our study, the incidence of hoarseness was higher with the Airtraq VL at the 2nd hour after extubation and regressed to similar levels to the C-MAC VL at 24 hours. Postoperative hoarseness is observed in 14.5–50% of patients who undergo ETI and is mostly transient.[19] Its causes include edema, hematoma, laceration, damage to the tracheal muscle layer and cartilage tissue, arytenoid subluxation, vocal cord granuloma, and laryngeal stenosis. Various reports have indicated that the shape of the Airtraq blade is associated with an increased risk of airway trauma.[20] Especially in patients with limited mouth opening, the Airtraq VL may cause oropharyngeal trauma and mucosal damage on the right side, depending on the tube channel, if adequate care is not taken. The authors therefore noted that a manufacturing modification is required for the Airtraq VL.[20] In our study, macroscopic signs and symptoms that would indicate trauma to the upper airway mucosa were identical with both laryngoscopes. Perhaps a study including routine endoscopic laryngeal examination following extubation of patients intubated with the Airtraq VL should be planned to detect microscopic damage. An attempt was made to exclude other factors that may contribute to hoarseness by maintaining a constant cuff pressure at 20 cmH_2O, using an ETT size 8.0 in men and ETT size 7.0 in women and performing similar anesthesia methods in both groups.

The limitation of our study is moderately high-dose fentanyl (5–7 $\mu g.kg^{-1}$) which may suppress the hemodynamic response and cannot be generalized for the non-cardiac surgery population in routine anesthesia practice.

The reasons for differences in results of studies comparing the performance of the C-MAC and Airtraq VL

in non-cardiac surgery may include the experience of practitioners,[21,22] position of the head and neck during laryngoscopy (cervical spine immobile-neutral-inline stabile-neutral), primary outcomes,[23,24] study groups, and anthropologic differences.[25,26]

Until the conclusion of the present study, there were no published studies comparing the C-MAC and Airtraq VL in cardiac surgery were available, but the C-MAC and Airtraq VL were individually compared to the Macintosh DL. One of these studies reported that the Airtraq laryngoscope provided better hemodynamics than the Macintosh laryngoscope.[11] In the other study, the C-MAC and Macintosh laryngoscopes provided similar and stable haemodynamics.[27] In their non-randomized study, Schälte et al.[3] found the Airtraq VL to be safe as it provided stable intubation in patients undergoing high-risk cardiac surgery.

In conclusion, the hemodynamic responses to ETI were less common with the Airtraq VL compared to the C-MAC. Thus, the Airtraq VL may be preferred for ETI of CABG patients. Further investigations are needed to demonstrate the clinical superiority of the Airtraq VL.

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Conflict of interest

The authors declare no conflicts of interest.

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