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Araştırma / *Research Article*

The Effect of Intubation with Video and Conventional Laryngoscopy on Hemodynamic Response

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Video ve Konvansiyonel Laringoskobinin Hemodinamik Yanıt Üzerine Etkisi

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ABSTRACT

Introduction: *Endotracheal intubation is the gold standard for providing adequate ventilation. During laryngoscopy and endotracheal intubation, airway stimulation results in reflex sympathetic system activation and unfavorable hemodynamic response. We aimed to evaluate the effect of videolaryngoscope (C-MAC VL) and conventional Macintosh direct laryngoscopy (DL) applications in endotracheal intubation under general anesthesia on hemodynamic response and time duration in patients with and without hypertensive.*
Method: *Normotensive (n=100) and hypertensive (n=100), aged between 18 and 75 years old (ASA I-II) who were scheduled to undergo elective surgery under general anesthesia, were included in the prospective study. Hypertensive patients were further divided into two subgroups; those intubated with videolaryngoscopy (group HV, n=50) and those with conventional direct laryngoscopy (group HD, n=50). Normotensive patients were also divided into two subgroups as videolaryngoscopy subgroup (group NV, n=50) and conventional direct laryngoscopy subgroup (group ND, n=50). Hemodynamic parameters, airway evaluation measurements, procedure duration and patients demographic characteristics were recorded.*
Results: *There was no significant change in the hemodynamic parameters other than heart rate in the four groups compared to baseline measurements. The median intubation time of all videolaryngoscopy group (HV and NV) (10 sec) was shorter than that of all direct laryngoscopy group (HD and ND) (11.5 sec).*
Conclusion: *Hemodynamic response behaves alike in all goups. However, intubation time takes least amount of time with the C-MAC VL than the conventional Macintosh DL. We think that using VL during intubation is practical and useful in the cases with sudden loss of consciousness, in which airway tone cannot be maintained.*

Keywords: *endotracheal intubation, videolaryngoscopy, conventional direct laryngoscopy, hemodynamic parameters*

ÖZ

Amaç: *Endotrakeal entübasyon, anestezide yeterli ventilasyon sağlamak için kullanılan altın standart yöntemdir. Laringoskopi ve endotrakeal entübasyon sırasında, hava yolunun uyarılmasıyla refleks sempatik sistem deşarjı ve istenmeyen hemodinamik yanıtlar oluşmaktadır. Genel anestezi altında, endotrakeal entübasyon yapılan, hipertansif olan ve olmayan hastalarda, videolaringoskop (VL) ve geleneksel Macintosh direkt laringoskop (DL) kullanımının, entübasyon sırasında oluşan hemodinamik yanıt ve entübasyon süresine etkisi, bu çalışmada değerlendirildi.*
Yöntem: *Genel anestezi altında, elektif cerrahi planlanan, 18-75 yaş arası (ASA I-II), normotansif (n=100) ve hipertansif (n=100) hasta bu prospektif çalışmaya dâhil edildi. Hipertansif hastalar ayrıca; videolaringoskopla (grup HV, n=50) ve konvansiyonel direkt laringoskopla entübe edilenler (grup HD, n=50) olarak 2 alt gruba ayrıldı. Normotansif hastalar da videolaringoskopla (grup NV, n=50) ve konvansiyonel direkt laringoskopla entübe edilenler (grup ND, n=50) olarak 2 alt gruba ayrıldı. Hemodinamik parametreler, hava yolu değerlendirme ölçümleri, işlem süresi ve hastaların demografik özellikleri kaydedildi.*
Bulgular: *Kalp hızı dışındaki hemodinamik parametrelerde bazal ölçümlere kıyasla 4 grupta da anlamlı bir değişiklik saptanmadı. Videolarengoskop gruplarının medyan entübasyon süresi (grup HV ve NV) (10 (4.2) sn), direkt laringoskop gruplarından (grup HD ve ND) (11,5 (4.4) sn.) daha kısa saptandı.*
Sonuç: *Hemodinamik yanıtlar bütün gruplarda aynı şekilde bulundu. Bununla birlikte, hipertansiyondan bağımsız olarak C-MAC VL ile geleneksel Macintosh DL'ye göre entübasyon süresinin daha kısa olduğu saptandı. Hava yolunun korunamadığı, ani bilinç kaybı durumlarında, entübasyon sırasında VL kullanmanın, pratik ve kullanışlı olduğunu düşünüyoruz.*

Anahtar kelimeler: *endotrakeal entübasyon, videolaringoskop, konvansiyonel direkt laringoskop, hemodinamik parametreler*

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INTRODUCTION

Endotracheal intubation (ET) is the gold standard method used to provide adequate ventilation in anesthesiology. ET is primarily used in patients, who need long-term mechanical ventilation support and bear aspiration risk, when it is difficult to maintain airway passage [1].

During laryngoscopy and ET, airway stimulation results in reflex sympathetic system activation and unfavorable hemodynamic responses such as tachycardia, blood pressure increase and arrhythmia [2]. Among these hemodynamic responses, hypertension (HT) and tachycardia are the important determinants of cardiac morbidity in the perioperative period [3]. In particular, tachycardia leads to more excessive load on the heart than blood pressure increase and may result in intraoperative myocardial ischemia [4]. These hemodynamic responses, which are often temporary, increase morbidity in patients with cardiac problems.

It has also been suggested that the use of a videolaryngoscope (VL), which provides a wide laryngeal view, may reduce undesired hemodynamic response by reducing laryngeal irritation [5]. Using videolaryngoscopy, especially in case of emergencies and with inexperienced staff, intubation can be performed successfully at the first attempt [6,7]. There are a number of studies comparing the advantages and disadvantages of videolaryngoscopes in the literature [6,8,9]. However, there are a limited number of studies comparing the use of VL with the use of direct laryngoscopy (DL) in patients with hypertension [10].

Laryngoscopy and intubation procedures raise heart rate (HR) and blood pressure (BP). We hypothesized that these hemodynamic parameters (BP and HR) would change less with C-MAC VL than Macintosh DL, and also the response in HT patients would be greater than in those without HT.

MATERIALS and METHODS

The study was performed between June 2016 and March 2018, in the-institute the authors were all employed, following the approval by local ethics committee (Protocol no: 2016/855). Written informed consent was obtained from all participants. A total of 200 patients, 100 normotensive and 100 hypertensive, aged between 18 and 75 years who were scheduled to undergo elective surgery under general anesthesia, were included in the study. Patients receiving anti-hypertensive medication were included in the hypertensive group (group H, n=100), and those without HT diagnosis and had preoperative visit, at least 2 measurements averaged, systolic arterial pressure (SAP) <140 mmHg and diastolic arterial pressure (DAP) <90 mmHg were included in the normotensive group (group N, n=100) [11]. Normotensive and hypertensive patients were randomly assigned to the videolaryngoscope (V) (Storz C-MAC ™Karl Storz, Tuttlingen, Germany) and conventional laryngoscope (D) (Macintosh laryngoscope (HEINE® classic Macintosh bleyd- Germany) subgroups with the help of computer (Figure 1a-b). Hypertensive patients were further divided into two subgroups; those intubated with videolaryngoscopy (group HV, n=50) and those with conventional direct laryngoscopy (group HD, n=50). Normotensive patients were also divided into two subgroups as videolaryngoscopy subgroup (group NV, n=50) and conventional direct laryngoscopy subgroup (group ND, n=50) (Figure 2). And also, the C-MAC VL was inserted while viewed indirectly.

The power analysis of the study was done based on the study by Abdelgawad et al., entitled “Comparison of cardiac output and hemodynamic responses from intubation to different videolaryngoscopies in normotensive and hypertensive patients”. In a hypertensive patient group, we calculated that at least 42 patients should be included in each group to carry out this study, with the effect size of 22, alpha=0.05 and statistical power=90% to compare the effect of Macintosh and UE videolaryngoscope intubation

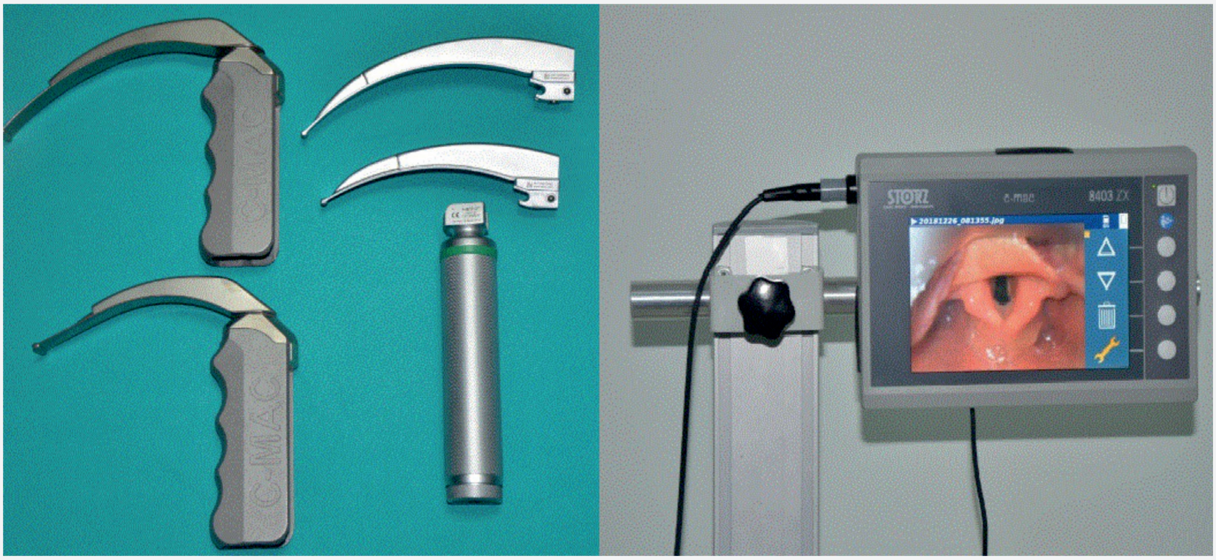

Figure 1. (a) Direct Macintosh laryngoscope b) Storz C-MAC videolaryngoscope).

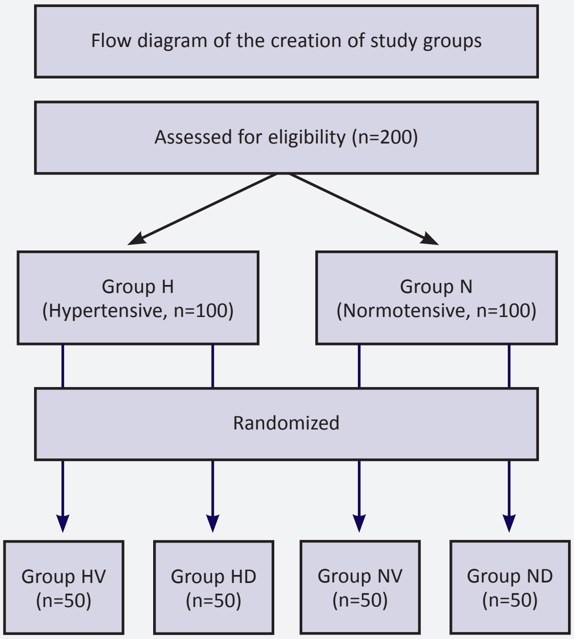

Figure 2. Flow diagram of the creation of study groups.

styles on systolic blood pressure (measured 1 min after intubation) [10].

Hypertensive patients took their antihypertensive medications at the same time of day before surgery. In addition, co-morbid diseases of were questioned in all cases participating in the study.

Patients less than 18 years of age, those with a known difficult intubation history, ejection fraction of less than 40%, a mallampati score of 3-4, ASA 4-5 and preoperative SAP>180 mmHg or DAP>100 mmHg were excluded from the study.

All patients received 2 mg intravenous (I.V) midazolam for premedication 30 minutes before surgical intervention.

In the pre-operative assessment, mallampati score, thiromental distance (TMD), sternomental distance (SMD), mouth opening (MO), neck circumference were measured, neck restriction and upper lip biting test (ULBT) tests were done. In addition, Cormack & Lehane score was evaluated with laryngoscopy before intubation and recorded. The anesthesiologist who collect intra-operative data were blinded to the study groups.

In the operating room, all patients underwent routine monitorization including electrocardiography (ECG), pulse oximeter, noninvasive blood pressure, and neuromuscular monitorization (Train of Four -

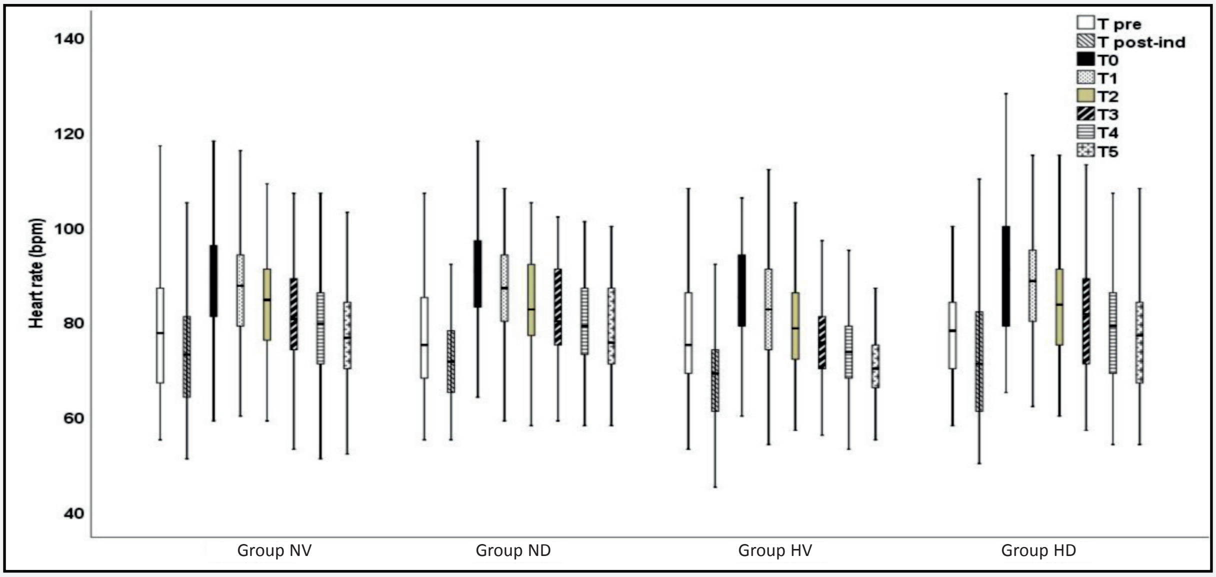

Figure 3a. Change in HR with time.

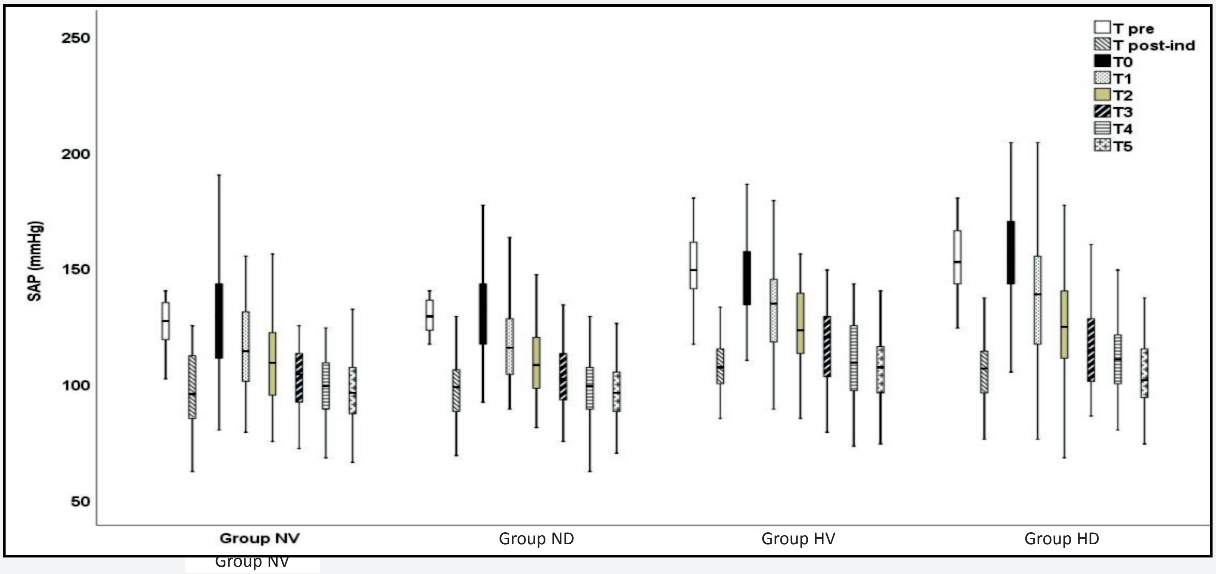

Figure 3b. Change in SAP with time.

TOF), and gas sampling system. In addition, patients were laid in a supine position with a silicone pillow under head at a height of 5-7 cm.

During anesthesia induction 1 mcg/kg fentanyl and 2-2.5 mg/kg propofol were administered sequentially following IV 1 mg/kg of lidocaine injection. 0.6 mg/kg of rocuronium was administered after ventilation with the mask. All ET procedures were performed after the TOF value was zero by the same anesthetist who had 3 years of experience (Approximate experience=with conventional laryngoscope (Macintosh DL) >1500 times, and with videolaryngoscope (C-MAC VL) >100 times). The anesthesiologist who performed intubation was blind to the patient groups. The choice of tube size in endo-

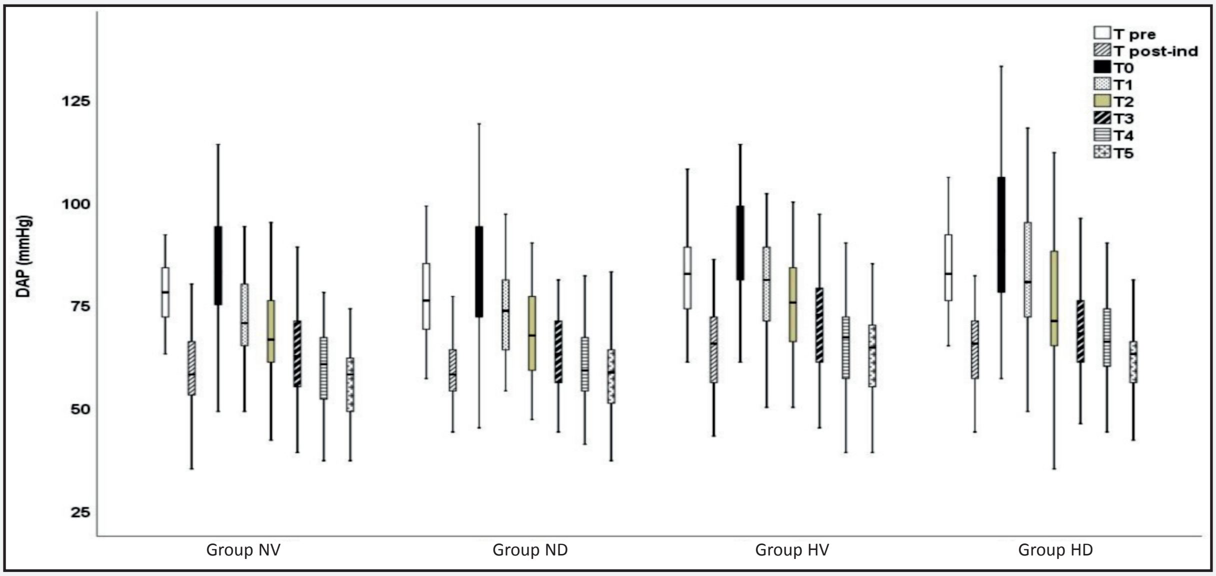

Figure 3c. Change in DAP with time.

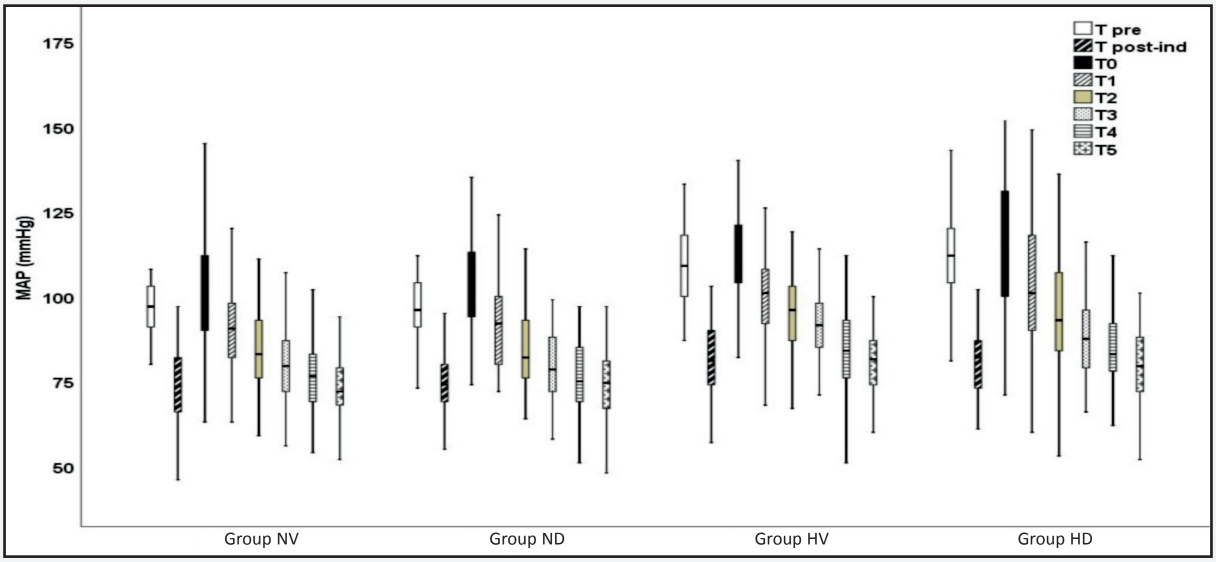

Figure 3d. Change in MAP with time.

tracheal intubation was determined by the physical characteristics of the patient, the type of the operation planned and intraoperative position of the patient. Laryngoscopy blade of number 3 was used in female patients and number 4 in male patients. Intubation time was recorded as the time interval between entry and exit of the laryngoscope blade through the patient's lips. The number of intubation attempts, the presence of difficult ventilation, and the presence of straining and tear were recorded by another anesthetist. Blood pressure and heart rate values measured noninvasively were recorded before entrance into the operating room (TPre), after induction (Tpost-ind), immediately after intubation (T0), and at each minute for the first 5 minutes (T1, T2, T3, T4, T5).

Statistical Analysis

Normal distribution of quantitative variables was examined by the Kolmogorov-Smirnov test. In the comparison of the variables that fit the normal distribution, two independent groups were compared using T test while more than 2 groups were compared with One-way ANOVA and descriptive statistics were expressed as mean±standard deviation (sd). In the analysis of the variables which did not fit normal distribution, Mann Whitney U or Kruskal Wallis tests were used according to the number of groups and descriptive statistics were shown as median (interquartile range (IQR)). The chi-square test was used to compare the groups in terms of qualitative variables and frequency and percentage values were given as descriptive statistics. Logistic regression analysis was used to determine the effect of age, sex, TMD, SMD, MO, ULBT, diabetes mellitus (DM), mallampathi classification, ASA, height, weight, laryngoscopy method and Cormack & Lehane score (CL) classification on intubation time. The results were considered statistically significant when $p<0.05$.

RESULTS

Our study was conducted with a total of 200 patients

Table 1. Demographic and clinical characteristics of patients.

	Group H (n=100)	Group N (n=100)	p value
Demografic values			
Gender (F/M, %)	69/31	61/39	0.236
Age (year)*	53.8±9,8	51.1±9.7	0.053
Height (cm)*	165.1±7.6	164.8±8.8	0.792
Weight (kg)*	79.4±13.0	74.2±13.9	0.008
BMI (kg/m^2)*	29.3±5.2	27.1±4.5	0.002
ASA (1 / 2)	0 / 100	77 / 23	<0.001
Preop SAP (mmHg)**	150 (21)	128 (15)	<0.001
Preop DAP (mmHg)**	82.5 (15)	77.5 (15)	<0.001
Preop MAP (mmHg)**	109.5 (16)	97 (12)	<0.001
Preop HR (bpm)**	77 (14.7)	75.5 (18)	0.706
Difficult intubation measurements			
Mallampati score (I / II) (n)	46/54	55/45	0.203
Thiromental distance (cm)**	8.5 (0.7)	8.7 (2.2)	0.046
Sternomental distance (cm)**	14.5 (2)	15.5 (2.7)	0.007
Mouth opening (cm)**	4.4 (0.8)	4.3 (0.7)	0.882
Neck circumference (cm)**	38 (4)	37.6 (5)	0.017
Upper lip biting test (I / II / III) (n)	88/12/0	80/20/0	0.177
Cormack Lehane score (1/2) (n)	80/20	77/23	0.731
Comorbid Diseases			
Diabetes mellitus (n)	23/77	11/89	0.038
Goiter (n)	15/85	5/95	0.018
Psychiatric disorders (n)	3/97	2/98	0.651
Coronary artery disease (n)	7/93	0/100	0.007
Chronic Obstructive Pulmonary Disease (n)	10/90	4/96	0.096
Others (n)	4/96	4/96	1.00
Antihypertensive Drugs			
Diuretics (%)	48	0	
ARBs (%)	46	0	
CCB (%)	30	0	
ACE-i (%)	24	0	
B blockers (%)	17	0	

**= mean ± SD, **= Median, Interquartile range (IQR), BMI: Body mass index, ASA: American Society of Anesthesiologists, SAP: Systolic arterial pressure; DAP: Diastolic arterial pressure, MAP: Mean arterial pressure, HR: Heart rate, ARBs: Angiotensin II receptor blockers(ARBs);CCB: Calcium channel blockers; ACE-i: Angiotensin-converting enzyme (ACE) inhibitors;*

scheduled for surgical operation under general anesthesia, 135 of whom were women and the mean age was 52.4 years. The study sample consisted of 100 hypertensive patients (group H) and 100 normotensive patients (group N). Each group was randomly intubated with videolaryngoscope (V) (n=50) method or traditional direct laryngoscope (n=50) method. Table 1 presents the demographic and clinical data of both groups.

Measurements of body mass index (BMI), ASA score, pre-op SAP-DAP- mean arterial pressure (MAP) were significantly higher in group H than group N (p<0.05, for all). There were no differences between the two groups in terms of other variables. TMD and SMD measurements of the hypertensive group were significantly lower than those of the normotensive group while the mean neck circumference was significantly higher in hypertensive patients than normotensives. However, mask ventilation of all patients was easy and there was no difficult intubation case. Furthermore, in the HT group, the rate of patients using more than one antihypertensive treatment was 59%; the most requently used additional antihypertensive agent (48%) was diuretics.

When the two groups were compared in terms of the distribution of surgical procedures, the most frequent operations performed in group H were otorhinolaryngological (30%) and gynecologicaloperations (26%) and the most frequently performed operations were neuro surgical (26%) and gynecological (26) operations in group N.

When hemodynamic parameters of hypertensive and normotensive patients were compared with respect to time, the mean HR measurements at T4 and T5 time-points were significantly lower in group H than those in group N and SAP, DAP and MAP values were higher in group H at all time-points (TPre, Tpost-ind, T0, T1, T2, T3, T4, T5) (p<0.05, for all).

The comparison of the hemodynamic parameters between four subgroups (group HV, group HD, group NV, group ND) is presented in Table 2. When in-group comparisons were done, there was a significant decrease in HR, SAP, DAP and MAP measurements after induction (Tpost-ind) compared to baseline values in HT groups (group HV-group HD) (p<0.05); in the normotensive group (group NV-group ND), there was a decrease after induction (Tpost-ind) in all hemodynamic parameters except for HR compared to baseline values (p<0.05). Along with that, there was a significant increase in HR after laryngoscopy and ET (T0) in all groups, compared to the baseline values (TPre) (p<0.05). In addition, there was no significant change in the hemodynamic parameters (SAP-DAP-MAP) other than HR in the four groups, as measured in the later periods, compared to baseline measurements (p>0.05, for all).

When we examined the effect of intubation method on hemodynamic parameters in Group H, we found that though all measurements of HR and SAP up to 4th min of ET were higher in group HD than in group HV, this difference was not statistically significant (p>0.05, for all). In addition, there was no significant difference between HD and HV subgroups in terms of post-intubation MAP and DBP values (p>0.05) (Table 2).

When the effect of HT on hemodynamic parameters in patients who underwent intubation with VL method was examined, although HR measurements of HV subgroup were lower than NV subgroup, only the difference in HR measurements between HV and NV subgroups at T5 time-point was statistically significant (p<0.05). On the other hand, DAP at T1-5 and SAP-MAP measurements at all time-points were significantly higher in group HV compared to group NV (p<0.05) (Table 2).

When the effect of HT on hemodynamic parameters in patients who underwent intubation with direct laryngoscopy method was examined, there was no significant difference between HD and ND subgroups in terms of HR measurements (p>0.05). In addition, among all other hemodynamic parameters SAP and MAP at all time-points, and DAP at Tpre, Tpost-ind, T1-4 measurements were significantly higher in subgroup HD compared to subgroup ND (p <0.05, for all; Table 2) (Figure 3a-d).

The median intubation time of group V was shorter than that of group D (median (IQR)=10 sec (4.2 sec) vs. 11.5 sec (4.4 sec), p=0.001). In the evaluation of the subgroups, median intubation time of group HV was significantly shorter than that of group HD (8.5 sec (3.5 sec) vs. 11.1 sec (4.5 sec), p=0.041); when it

Table 2. Comparison of hemodynamic data of four subgroups.

	Hypertensive		Normotensive	
Time	**Group HV [a] n=50**	**Group HD [a] n=50**	**Group NV [a] n=50**	**Group ND [a] n=50**
HR (bpm)				
TPre	75 (17.5)	78 (14.2)	77.5 (20.5)	75 (14.2)
Tpost-ind	69 (13)*	71 (11.2)*	73 (18)	71.5 (13.5)
T0	85 (17)*	91 (21.5)*	89 (15.7)*	90,5 (15.2)*
T1	82.5 (17.3)*	88.5 (15.3)*	87.3 (15.2)*	87 (14.2)*
T2	79.9 (14.5)	83.5 (17)	84.5 (15.3)*	82.5 (5)*
T3	75.5 (11.2)	81.5 (18.2)	80.5 (15.2)	80 (16.8)
T4	73.5 (11)*	79 (17.7)	79.5 (15.8)	79 (14.7)
T5	70 (19.8)* [b]	77 (17.2)	76.5 (14.2)	75.5 (16.5)
SAP (mmHg)				
TPre	149.8 (20) [b]	152.5 (13.3) [c]	127 (16.3)	129 (13)
Tpost-ind	107 (15.3)* [b]	106.5 (19.5)* [c]	95.5 (27.7)*	98.5 (18)*
T0	147.5 (23.5) [b]	155.5 (29.5) [c]	129.5 (33)	132 (26.3)
T1	134.5 (27.5) [b]	138.5 (38.5) [c]	114 (31.5)	115.5 (25.2)
T2	123 (26.7)* [b]	124.5 (29.5)* [c]	109 (28)*	108 (22.5)*
T3	120 (26.7)* [b]	114.5 (27.3)* [c]	104 (21.2)*	102 (20.2)*
T4	109 (28.3)* [b]	110.5 (21)* [c]	99 (20.7)*	99 (18.3)*
T5	107 (20.2)* [b]	101.5 (12.5)* [c]	96 (20)*	96 (18.5)*
DAP (mmHg)				
TPre	82.5 (15.2)	82.5 (16.3) #	78 (12.2)	76 (16.2)
Tpost-ind	65.5 (16.5)*	65.5 (14.2)* #	58 (13)*	58 (10)*
T0	88 (18.7)	88 (18.3)	83 (19.8)	83.5 (22.8)
T1	81 (18.2) [b]	80.5 (12.5) [c]	70.5 (15.7)	73.5 (17.5)
T2	75.5 (18.5) [b]	71 (13.7)*	66.5 (15.7) *	68.3 (18)
T3	72.5 (18.2)* [b]	68 (15.3)*	62.5 (16.3)*	63 (15.2)*
T4	67 (15.5)*	66 (14.3)* [c]	60.5 (15.2)*	59 (13.3)*
T5	64.5 (15.5)* [b]	63 (11)*	58 (13.5)*	58.5 (13)*
MAP (mmHg)				
TPre	109 (18) [b]	112 (16.3) [c]	97 (12)	96 (13.3)
Tpost-ind	81 (16.3)* [b]	82 (14.5)* [c]	73.5 (16.5)*	74 (11.2)*
T0	109 (18) [b]	115.5 (30.7) [c]	99 (22.5)	100.5 (19.5)
T1	101 (17) [b]	101 (28.3) [c]	90.5 (17)	92 (11)
T2	96 (16.3)* [b]	93 (23.5)* [c]	83 (17.7)*	82 (12.7)*
T3	91.5 (14.5)* [b]	87.5 (18.3)* [c]	79.5(15.5)*	78.5 (16)*
T4	84 (17.5)* [b]	83 (14.3)* [c]	76.5 (13.8)*	75 (16.2)*
T5	81.5 (13.5)* [b]	79.5 (16.3)* [c]	72 (11.8)*	74.5 (14.2)*

[a] *Median (IQR)* TPRE–compared to baseline p<0.05,*
[b] *Compared to subgroup NV, p<0.05,*
[c] *Compared to subgroup ND, p<0.05,*
HR: Heart rate; SAP: Systolic arterial pressure; DAP: Diastolic arterial pressure; MAP: Mean arterial pressure

comes to comparison of median intubation time in the normotensive group, it was shorter in subgroup NV compared to subgroup ND, but this difference was not statistically significant (10.8 sec (3.9 sec) vs. 12.6 sec (4.6 sec), p=0.315) (Figure 4).

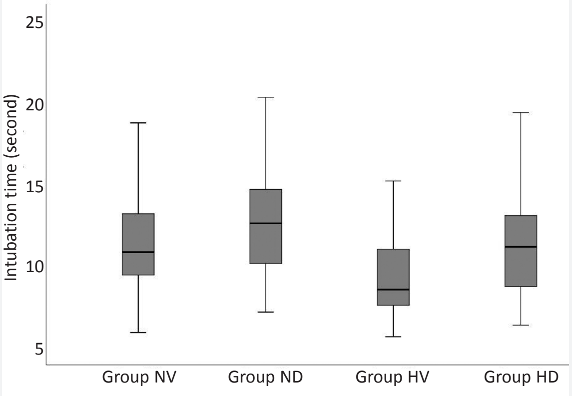

Figure 4. Comparison of intubation time between four subgroups.

The median intubation time of whole study population was 10.8 sec. The durations over 10.8 sec were reclassified as long intubation time and those under 10.8 sec were reclassified as short intubation time. Logistic regression analysis showed that age, gender, TMD, SMD, MO, ULBT, DM, mallampati classification, ASA score, height and weight had no effect on intubation time. Sensitivity was 48%, specificity was 80% and accuracy was 64%. We found that the Cormack & Lehane score of 2 was associated with 2.7 and using the conventional Macintosh DL was associated with 2.4 times longer intubation time (p<0.05) (Table 3).

Table 3. Logistic regression analysis to determine the predictive variables on intubation time.

		95% C.I. for OR		
	OR	**Lower limit**	**Upper limit**	**p value**
Laryngoscopy method (Macintosh DL)	2.472	1.364	4.479	0.003
Cormack & Lehane score (class 2)	2.783	1.305	5.933	0.008

DISCUSSION

Hemodynamic responses are observed during intubation due to stress, and it is known that the mentioned risk is especially higher in direct laryngoscopy method [12]. There are few studies comparing the hemodynamic effects of intubation with C-MAC VL and traditional Macintosh DL methods [13,14].However, to the best of our know-ledge, there is no study to compare the hemodynamic effects of these two intubation methods in hypertensive and normotensive patients in the literature.

If difficult intubation measurements are present in a patient, this situation can make intubation difficult and cause prolonged duration of intubation and negatively affect hemodynamic parameters. There were no difficult intubation parameters in our study population. However, TMD and SMD measurements were shorter and the neck circumference was thicker in the HT group than in the normotensive group. It is known that among anti-hypertensive drugs beta-blockers and calcium channel blockers decrease hemodynamic response to laryngoscopy and ET [15]. More than half of the hypertensive patients in our study were using multiple antihypertensive drugs, 30% of which were calcium channel blockers and 17% of which were beta blockers. We think that medical treatments used by patients play a role in the lack of exaggerated hemodynamic changes after ET in hypertensive patients compared to normotensives.

It is very important to reduce sympathetic response to laryngoscopy and ET in patients with cardiovascular disease and HT. Especially increased HR increases the risk of cardiovascular events by increasing myocardial oxygen consumption [3]. Different results have been reported in studies that explored the effects of VL and DL on hemo-dynamic response in the literature [10,13,14,16-18]. In some studies, the effects of VL and conventional DL methods on hemodynamic response were found to be similar [14,16,17]. The hemodynamic parameters immediately after ET and at the 2nd min were reported as similar in patients scheduled for cardiac surgery and intubated with C-MAC VL (Macintosh blade) and conventional Macintosh DL methods [14]. In a similar study conducted with 30 patients who underwent coronary artery bypass grafting due to CAD, hemodynamic changes after ET with the Pentax Airway Scop (AWS) method, a different VL device, and conventional Macintosh DL method were not different between the two groups [16]. In addition, this study also showed that there was sign of myocardial ischemia in the ECG monitor during the surgical procedure [17]. Unlike these results, there are few studies reporting that there was an increased hemodynamic response with VL [13]. On the other hand, there are studies showing that there was a decreased hemodynamic response with the VL method compared to the DL method [10,18]. In a study using UE VL stylet, it was shown that VL method caused less hemodynamic side effects compared to conventional Macintosh DL in hypertensive patients while there was no difference between two methods in normotensive patients [10]. This result was consistent with our study results. However, differently from our study, the UE VL method can be used especially in cases with difficult airway intu-bation, and when the intubation training is on the frontline. In our study, all HR and SAP values measured after ET with DL in hypertensive patient group were higher than those in the conventional C-MAC VL method, but the difference was not statistically significant. We think that this can be a sign of overactive sympathetic system. It is also known that tracheal stimulation during ET is more potent in increasing HR and blood pressure. Along with that, the similarity in hemodynamic parameters between the two intubation methods in normotensive patients might be due to the fact that the two laryngoscopes have the same blade design and they cause similar stress response in the oral cavity / pharynx. Moreover, we believe that the non-standard drug dosing of narcotic analgesics and lidocaine used during anesthesia induction in different studies might be the cause of the differences in hemodynamic response to laryngoscopy and ET in different studies the literature.

Different studies have reported different results about the effect of VL on the duration of intubation [10,14,16,19,20]. In a study comparing the conventional Macintosh DL and UE VL, it was shown that the duration of intubation was shorter in VL method (26.1±3.2 vs. 19.1±2.4, respectively) [11]. On the other hand, there are also studies suggesting that the use of VL causes prolong intubation [14,19]. Although these studies have indicated that anesthetists had experience of using VL, the number of previous applications had not been specified. In other studies conducted with Pentax airway scope VL, the prolonged duration of intubation compared to traditional Macintosh DL might be associated with the necessity of adjusting the glottic view to the target point in the center of the screen and the location of the blade at the side wing, on which the intubation tube is placed [16,20]. In our study, we used Storz Macintosh C-MAC VL, there was no target on its screen, and there was no side channel in the blade design and the blade provides a wide field of view at 80° in the horizontal axis and at 60° in the vertical axis. We think that these features contributed to shortening the duration of intubation. Along with that, we found that Cormack & Lehane score class 2 was associated with a 2.7-fold increase in intubation duration and the use of conventional Macintosh DL was associated with 2.4-fold increase in intubation duration. Eventually, we think that since our anesthesiologist had high number of previous interventions experience and the patients who had difficult intubation findings in preoperative anesthesiologic evaluation were not included in the study, the mean intubation duration was shorter in our results.

There were some limitations of this study. Firstly, the anesthesiologist was not blind to the method of laryngoscopy, which may have led to prejudice. Secondly, there was no data regarding the duration of HT diagnosis and use of anti-hypertensive drugs in the hypertensive group. In addition, the effects of different classes of anti-hypertensive drugs on hemodynamic changes could not be analyzed because the distribution of antihypertensive drugs used in the HT patient group was not regular and the number of patients using the same class of medications was low.

The effect of intubation with C-MAC VL and conventional Macintosh DL on hemodynamic response was similar in patients with and without hypertension. We think that increase in HR and blood pressure after laryngoscopy and ET are independent of the two devices used. Along with that, the use of C-MAC VL was associated with shorter intubation duration compared to the use of Macintosh DL. Therefore, we think that using VL during intubation is practical and useful in the cases with sudden loss of consciousness, in which airway tone cannot be maintained, and in situations requiring rapid intubation such as non-fasting patient and failure in ventilation.

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