

The effect of body mass index on blood pressure and heart rate in patients undergoing tooth extraction

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Original Article

Abstract

BACKGROUND AND AIM: Alterations in blood pressure (BP) and variability of heart rate (HR) throughout dental procedures were not clearly understood. The aim of this study is to evaluate the effects of body mass index (BMI) on BP and HR in patients undergoing tooth extraction.

METHODS: Based on BMI, 831 patients who underwent single tooth extraction were divided into two groups; group 1: underweight and normal-weight patients, group 2: overweight and obese patients. BP and HR were monitored before local anesthesia and after tooth extraction. For statistical analysis of the data, Number Cruncher Statistical System (NCSS) 2007 program was used. Mann-Whitney U test and Student's t-test was used for comparing the differences between groups.

RESULTS: The initial and final BP measurements of overweight and obese patients were found to be significantly higher than underweight and normal-weight patients ($P < 0.01$). There was no statistically significant difference between groups in terms of initial and final HR measurements ($P > 0.05$).

CONCLUSION: Overweight and obese patients are more likely to have increased BP; therefore, monitoring of BP and HR during tooth extraction is crucial in this group of patients to prevent possible complications.

KEYWORDS: Body Mass Index; Blood Pressure; Heart Rate; Tooth Extraction

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Hypertension (HTN) is the most frequently encountered systemic disease in patients admitted to dentists.¹ Blood pressure (BP) values are categorized as normal: under 120/80 mmHg, high normal: systolic among 120-129 mmHg and diastolic under 80 mmHg, stage 1 HTN: systolic among 130-139 mmHg or diastolic among 80-89 mmHg, and stage 2 HTN: systolic minimum 140 mmHg or diastolic minimum 90 mmHg.² HTN is a risk factor for cardiovascular disorders and renal insufficiency.²⁻⁴

Heart rate (HR) is an important indicator of individual's health status. It measures the number of heart beats per minute (bpm). The HR in healthy individuals ranges from 60 to

100 bpm while resting.^{5,6}

Increases in BP and HR are common during dental treatments especially in the course of tooth extraction. However, the increase is influenced by many factors such as psychological and physical stress, painful stimuli, and the action of catecholamines present in local anesthetic solutions.^{6,7} Cheraskin and Prasertsuntarasai⁸ reported higher systolic BP (SBP) and diastolic BP (DBP) values prior to oral surgery in comparison with the day after the surgical intervention.

In the literature, articles studied the changes in BP and HR before and after dental procedures (dental extraction, periodontal surgeries, restorative treatments, etc.) by

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means of anxiety, dental fear, and various types of local anesthetic and vasoconstrictor agents with different combinations and concentrations.^{9,10} Besides these, personal characteristics like age, gender, and body mass index (BMI) are important factors that can affect the BP and HR of individuals.¹¹ Studies have demonstrated that obesity is related to SBP and DBP elevation.¹² Therefore, the aim of this study is to evaluate the effects of BMI on BP and HR in healthy individuals undergoing tooth extraction.

Methods

This observational study was conducted on patients who underwent single tooth extraction in Department of Oral and Maxillofacial Surgery, School of Dentistry, Van Yuzuncu Yil University, Van, Turkey from May 2017 to May 2018. The study was approved by Clinical Trials Ethics Committee of Van Yuzuncu Yil University (number: 20171804-01) and conducted in compliance with the ethical standards laid down in the 1964 Helsinki Declaration and its later amendments. Informed consent was obtained from all participants. Patients over 18 years old, patients with BP lower than 180/110 mmHg, patients without systemic disease (according to the anamnesis taken from the patient), patients who had tooth extraction, and patients who volunteered to participate in the study were included. Cases in whom we were unable to measure the BP due to a previous operation or an anomaly, pregnant women and breastfeeding mothers, patients who had undergone any medical or dental intervention on the same day, patients who feel pain during extraction despite local anesthesia, patients requiring more than 2 ml anesthesia, any complicated tooth extraction procedure that necessitated separation of the roots, bone removal, or suturing and took more than 5 minutes, and individuals who drank alcohol or smoked cigarettes were excluded. Based on BMI, patients were divided into two groups: group 1: underweight and normal-weight patients,

group 2: overweight and obese patients.

Medical and dental histories were obtained from the patients. Clinical examination was accompanied by radiographic evaluation. The patients were asked to complete the anamnesis form containing information about age, gender, carrier status, height, and weight. The BMI of each patient was calculated according to the formula of weight/height² (kg/m²).¹² BP and HR measurements were performed as it was described by Cordeiro et al.¹³ The patients were informed that their tooth would be extracted.

In all patients; BP and HR were measured at the same time with digital BP monitor (OMRON M6 Comfort, OMRON Corp., Japan) by the same medical staff while the patient rested in seated position at least ten minutes, the subjected arm was flexed and supported on the chair. The flexed elbow was at the level of the heart, arm cuff was placed over 1 cm to cubital fossa, and tube was in the middle of the fossa. BP was measured from two arms and the higher measurement was accepted as baseline. Also the arm with the higher BP was used for further measurements.

Extraction procedures were performed by the same physician. After that all measurements for BP and HR were completed, local anesthesia with 2 ml of 40 mg/ml articaine + 0.012 mg/ml epinephrine (Maxicaine Fort, VEM ILAC, Turkey) was performed. All tooth extractions were performed under local anesthesia. After negative aspiration for blood, the solution was injected slowly in approximately 30-45 seconds. The clinician waited for 5 minutes for nerve blockage before extraction. The tooth was extracted approximately in 5 minutes. After 5 minutes of rest, re-evaluation of BP and HR was accomplished.

For statistical analysis of the data, Number Cruncher Statistical System (NCSS) 2007 (Kaysville, Utah, USA) program was used. In the evaluation of the data, descriptive statistical methods [mean, standard deviation (SD), median, frequency, ratio, minimum,

maximum] were used. Conformity of the quantitative data to normal distribution was tested with Shapiro-Wilk test and graphical evaluations. Student's t-test was used for two groups' comparisons of the variables with normal distribution. Mann-Whitney U test was used for two groups' comparisons of the variables without normal distribution. Paired samples t-test was used for intra-group comparisons of quantitative variables with normal distribution. Pearson chi-square test was used to compare qualitative data. P-values < 0.05 were considered statistically significant.

Results

The study included 831 patients, 382 (46.0%) men and 449 (54.0%) women. The mean age of the patients was 34.40 ± 11.11 years. It was observed that 51.6% (n = 429) of the cases were underweight and normal-weight whereas 48.4% (n = 402) were overweight and obese. Based on HTN classification, 22.6% (n = 188) of the patients had normal BP, 37.4% (n = 311) had high normal BP, 30.3% (n = 251) had stage 1 HTN, and 9.7% (n = 81) had stage 2 HTN.

Evaluation of descriptive characteristics according to BMI: According to age, there was a statistically significant difference between groups. In overweight and obese patients, the rate of being 50 years of age and over was found to be higher than underweight and normal-weight patients ($P < 0.01$). There were statistically significant

differences between groups according to gender. In overweight and obese patients, the male ratio was found to be higher than underweight and normal-weight patients ($P < 0.05$). There was a statistically significant difference between the groups based on the HTN classification. In overweight and obese patients, the rate of stage 1 and stage 2 HTN was found to be higher than those in underweight and normal-weight patients ($P < 0.01$) (Table 1).

Evaluation of SBP measurements according to BMI: The initial and final SBP measurements of overweight and obese patients were found to be significantly higher than underweight and normal-weight patients ($P < 0.01$). The increase in SBP measurements of underweight and normal-weight patients was found to be significantly higher than those who were overweight and obese ($P < 0.01$) (Tables 2 and 3).

Evaluation of DBP measurements according to BMI: The initial and final DBP measurements of overweight and obese patients were found to be significantly higher than underweight and normal-weight patients ($P < 0.01$). In underweight and normal-weight patients, the reduction in the final DBP measurements with respect to initial measurements was found to be statistically significant ($P < 0.05$). In overweight and obese patients, the change in the final DBP measurements was not statistically significant with respect to initial measurements ($P > 0.05$) (Tables 2 and 3).

Table 1. Evaluation of descriptive properties according to body mass index (BMI)

Variable		Underweight and normal-weight (n = 429)	Overweight and obese (n = 402)	P (Pearson chi-square test)
Age (year)	< 50	406	332	0.001**
	≥ 50	23	70	
Gender	Male	180	202	0.017*
	Female	249	200	
HTN classification	Normal	113	75	0.001**
	High normal	183	128	
	Stage 1	106	145	
	Stage 2	27	54	

* $P < 0.05$; ** $P < 0.01$
HTN: Hypertension

Table 2. Evaluation of systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) measurements based on body mass index (BMI)

Variable		Underweight and normal-weight (n = 429)	Overweight and obese (n = 402)	P
		Mean ± SD	Mean ± SD	
SBP	Initial measurement	120.76 ± 9.76	124.23 ± 11.63	0.001 ^{#*}
	Final measurement	120.20 ± 11.70	123.01 ± 12.60	0.001 ^{#*}
	P ^{***}	0.294	0.011 [¥]	
	Initial-final difference (Δ)	-0.56 ± 11.02	-1.22 ± 9.62	0.558 ^{**}
DBP	Initial measurement	75.20 ± 8.53	77.16 ± 8.32	0.001 ^{#*}
	Final measurement	74.30 ± 9.45	76.94 ± 9.33	0.001 ^{#*}
	P ^{***}	0.023 [¥]	0.577	
	Initial-final difference (Δ)	-0.90 ± 8.17	-0.22 ± 8.03	0.159 ^{**}
HR	Initial measurement	74.67 ± 7.77	73.82 ± 7.34	0.106 [*]
	Final measurement	74.59 ± 7.81	73.67 ± 7.26	0.079 [*]
	P ^{***}	0.761	0.479	
	Initial-final difference (Δ)	-0.07 ± 5.08	-0.15 ± 4.16	0.834 ^{**}

*Student's t-test; **Mann-Whitney U test; ***Paired samples t-test; ¥P < 0.05; #P < 0.01

SBP: Systolic blood pressure; DBP: Diastolic blood pressure; HR: Heart rate; SD: Standard deviation

Evaluation of HR measurements according to BMI: There was no statistically significant difference between groups in terms of initial and final HR measurements ($P > 0.05$). The amount of increase and decrease in HR measurements according to the groups did not show statistically significant difference ($P > 0.05$) (Tables 2 and 3).

Evaluation of increase in SBP, DBP, and HR measurements based on BMI and according to age, gender, and HTN stage: The amount of increase in SBP measurements was significantly high in underweight and

normal-weight patients at the age of 50 and over and in underweight and normal-weight male patients than those in overweight and obese patients ($P < 0.01$) (Table 3).

Discussion

Cardiovascular responses during tooth extraction are associated with several factors such as treatment-related fear and anxiety, local anesthesia-related fear and anxiety, cardiovascular effects of the local anesthetics as well as age and gender of the patient.¹⁴

Table 3. Evaluation of the amount of increase in systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) based on body mass index (BMI)

Amount of increase		Underweight and normal-weight	Overweight and obese	P*	
		Mean ± SD	Mean ± SD		
Age (year)	< 50	SBP	12.86 ± 5.06	11.70 ± 3.78	0.100
		DBP	10.33 ± 2.21	10.12 ± 1.08	0.718
		HR	4.56 ± 3.15	3.95 ± 2.23	0.264
	≥ 50	SBP	20.00 ± 5.77	11.82 ± 4.04	0.005 [#]
		DBP	10.00 ± 0.00	10.00 ± 0.00	> 0.999
		HR	3.86 ± 0.90	4.23 ± 2.26	0.845
Gender	Male	SBP	14.45 ± 5.98	10.93 ± 2.94	0.001 [#]
		DBP	10.38 ± 2.37	10.00 ± 0.00	0.522
		HR	4.42 ± 2.86	4.03 ± 2.03	0.955
	Female	SBP	12.32 ± 4.58	12.32 ± 4.26	0.880
		DBP	10.27 ± 2.02	10.18 ± 1.35	0.993
		HR	4.61 ± 3.26	4.00 ± 2.42	0.210

*Mann-Whitney U test; #P < 0.01

SBP: Systolic blood pressure; DBP: Diastolic blood pressure; HR: Heart rate; SD: Standard deviation

In the literature, there are a few studies evaluating the effects of BMI on SBP, DBP, and HR in patients undergoing oral surgery. In the present study, the prevalence of being overweight and obese was found to be higher in men and in individuals at the age of 50 and over. BP measurements of overweight and obese patients were significantly higher than underweight and normal-weight patients. Marciani et al.¹⁵ investigated the BMI of the subjects applying to oral and maxillofacial surgery clinic without undergoing any surgical procedure. Controversially, the prevalence of being overweight or obese was found to be higher in women. It was reported that BMI did not lead to any change in SBP, DBP, HR, and body temperature of individuals. Studies evaluating the alterations of BP and HR in individuals who underwent tooth extraction generally appear to focus on fear and anxiety before the procedure and on fear and anxiety related to local anesthesia.^{14,16} Silvestre et al.¹⁷ reported that the changes in BP and HR measurements after local anesthesia and after extraction were not significantly different with the measurements before local anesthesia. Gungormus and Buyukkurt¹⁸ reported that the changes in BP and HR measurements performed before local anesthesia and 5 minutes before and after the tooth extraction did not differ between normotensive and hypertensive individuals. In the present study, in contrast to the findings of previously-mentioned studies, the increase in SBP measurements of underweight and normal-weight patients was significantly high according to measurements performed before local anesthesia and after tooth extraction. The increase in SBP was also high in male patients at the age of 50 and over. The decrease in DBP measurements of underweight and normal-weight patients was found to be statistically significant.

As it was seen from the findings of various studies, BP and HR increased during the local anesthesia and immediately after the local

anesthesia.^{19,20} It was reported that this was due to the fear of the injection and the pain created during needle insertion.²¹ Intravascular injections may also cause these changes.¹⁸ In addition, the systemic effects of epinephrine in the local anesthetics proceed for about 10 minutes.²² In this study, in order to minimize the cardiovascular effects of local anesthetic agent, 2 ml anesthetic solution was injected slowly after negative aspiration for blood in individuals without any systemic disease. We included the first 10 patients who referred to our clinic in the morning every day to keep the possible effects of daily physical activities and dietary factors in minimum. In order to minimize the factors associated with tooth extraction, simple and atraumatic single tooth extraction which took a maximum time of 5 minutes was performed after that successful anesthesia of whole soft and hard tissues were achieved.

Conclusion

Within the limitations of this study is that overweight and obese patients are more likely to have increased BP. However, the elevation of SBP throughout the tooth extraction procedure was statistically significant in underweight and normal-weight male patients at the age of 50 and over. As BP increases are considered to be more important clinically, it is suggested to perform BP and HR controls routinely to prevent possible complications during tooth extractions especially in this group of patients. In addition, detection of underdiagnosed high BP in patients who apply for tooth extraction will enable the correct life style and dietary habits and will regulate the BP in early periods.

Conflict of Interests

Authors have no conflict of interest.

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