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alessandrouepb@gmail.com
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Sindel, Alper; Ali Altay, Mehmet; Yldrmyan, Nelli; Özalp, Öznur
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Original Article

Does Third Molar Surgery Alter Cardiac Parameters? A Retrospective Study

Alper Sindel[1], Mehmet Ali Altay[1], Nelli Yıldırımyan[1], Öznur Özalp[1]

[1]Department of Oral and Maxillofacial Surgery, School of Dentistry, Akdeniz University, Antalya, Turkey.

Author to whom correspondence should be addressed: Assistant Professor Dr. Alper Sindel, Department of Oral and Maxillofacial Surgery, School of Dentistry, Akdeniz University. Dumlupınar Bulvarı 07058 Kampüs, Antalya, Turkey. Phone: +902422274400. Fax: +902423106967. E-mail: dtalpersindel@gmail.com.

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Abstract

Objective: To investigate perioperative changes in the cardiac parameters of anxiety, which are blood pressure and heart rate, in patients undergoing surgical extraction of third molars. **Material and Methods:** Patients who reported anxiety before scheduled procedures were monitored for cardiac parameters before, during and after the surgery. The obtained data were analyzed to determine if there is a certain pattern of change within these values in systemically healthy patients. Alterations in selected parameters with regard to duration and difficulty of operation were also studied. IBM SPSS Statistics was used for data analysis. Repeated-measures of analysis of variance (ANOVA), paired samples t-test and Kruskal-Wallis tests were applied and a significance level of 5% was assessed. **Results:** Difficulty was categorized as minimally, moderately or very difficult in 9, 28 and 3 patients respectively. Mean operation time was 36.18 minutes with a range of 8 to 91 minutes. Operation time showed no variations with different levels of difficulty ($p = 0.268$). No statistical differences in any of the parameters listed above could be identified. **Conclusion:** Despite the common belief that dental procedures initiate anxiety, this study reveals that physiological parameters of anxiety show no significant changes over the course of third molar surgery, likewise difficulty and duration of surgery do not cause noteworthy changes in these parameters.

Keywords: Dental Anxiety; Blood Pressure; Heart Rate; Molar, Third.

Introduction

Traditional vital signs are temperature, pulse, blood pressure and respiratory rate, and they are essential as part of physical examination in medicine [1]. Non-physiological changes in the body are expressed through abnormalities of these signs. Two well-known factors, which influence vital signs, especially pulse and blood pressure, are stress and anxiety [2].

Medical procedures, whether invasive (e.g. cardiac surgery) or non-invasive (e.g. sigmoidoscopy) are shown to increase anxiety in patients [3,4]. However, when dental procedures are concerned, even a simple visit to the dental clinic aggravates anxiety [5]. Anxiety stimulates adrenal medulla to secrete endogenous epinephrine. Hence, the direct effect of epinephrine on cardiac system causes an increase in blood pressure and heart rate [6].

Epinephrine is also used on a daily basis at dental clinics as the vasoconstrictor component of local anesthetic solutions. Some authors are against this usage of epinephrine advocating that there is a high risk of systemic absorption, which may cause unwanted cardiovascular effects [7]. However epinephrine used in these solutions are relatively lower in dosage and are shown not to have significant effects on blood pressure and heart rate compared to the secretion of high levels of endogenous epinephrine during an anxiety-inducing conditions [6].

Third molar surgery is one of the most common surgical procedures in dental clinics. However whether there is a pattern of blood pressure or heart rate change regarding third molar surgery specifically within anxious patients is not yet known [5]. Therefore in this present study, we monitored changes in blood pressure, both systolic and diastolic, and heart rate before, during and after third molar surgery in systemically healthy but anxious patients and evaluated any relationship within and between these values, and operation time or the complexity of surgery as well as age and gender.

Material and Methods

Data Collection

Patients who were scheduled for operation and reported to be intimidated by their operation or mentioned being anxious regarding their surgical procedure were monitored and documented for blood pressure and heart rate in the Oral and Maxillofacial Surgery Clinic at Akdeniz University, School of Dentistry.

Local anesthesia was achieved by injection of 4% articain and 1:80,000 epinephrine (Fullcain Fort, Onfarma Ilac, Samsun, Turkey) for all patients. Data on operation time was obtained from the hospital records and noted in minutes. The difficulty of surgical extraction was evaluated using the classification systems of Pell, Gregory and Winter [6,8,9].

Blood pressure and pulse of each patient were measured and recorded three times over the course of surgery using the same monitor (KMA-900, PETAS, Ankara, Turkey) and were noted as pre-operative, intra-operative and post-operative. Pre-operative measurements were performed after patients sat down on the dental chair and before the injection of local anesthetic solution. Intra-

operative measurements were held two minutes after the mucoperiosteal flaps were raised. Finally, post-operative measurements were recorded after removal of the surgical drapes.

Values obtained from each parameter were compared within themselves for three peri-operative measurements separately. Additionally age, gender, operation duration and complexity were analyzed to seek any associations with these values.

Surgical Procedures

All operations were performed by the same surgeon who also pre-operatively assessed patients' medical history and current general health conditions. Local anesthesia was achieved for lower third molars by inferior alveolar block anesthesia and infiltration of the buccal nerve. After the injection, peri-oral tissues were cleaned with 10% povidone-iodine (Poviiodeks, Kim-Pa Ilac, Istanbul, Turkey) and the surgical field was isolated with surgical drapes so that the nose and mouth of the patient were the only exposed areas. After confirming anesthesia at the surgical field, incision was made from the buccal gingival sulcus of the second molar to the retromolar trigone after which the mucoperiosteal flaps were raised. Osteotomy or tooth sectioning were carried out if necessary. Following the molar tooth removal, surgical field was curetted and washed with sterile saline solution. Finally mucoperiosteal flap was repositioned and sutured with 3/0 glycolide-co-lactide sutures (Pegelak, Dogsan, Trabzon, Turkey). Sterile wet sponges were placed on the wound in order to maintain hemostasis by pressure.

Ethical Aspects

This retrospective study conforms to the values laid down in the Declaration of Helsinki and has been approved by the relevant ethical committee related to our university in which it was performed with approval number 2017/28. All patients signed an informed consent before their scheduled operation.

Statistical Analysis

IBM SPSS Statistics version 22.0 (IBM Corp. Armonk, NY, USA) was used for data analysis. Repeated-measures of analysis of variance (ANOVA), paired samples t-test and Kruskal-Wallis tests were applied and a significance level of 5% was assessed.

Results

From the group of 58 patients, 10 were excluded from the study due to having a cardiac condition or being on medication altering blood pressure or heart rate. 8 other patient files had missing information thus leaving a group of 40 patient files to be included in this study. 17 males and 23 females were included in this study with a mean age of 24.03 years (range, 15 to 55 years). Difficulty was categorized as minimally, moderately or very difficult in 9, 28 and 3 patients

respectively. Mean operation time was 36.18 minutes with a range of 8 to 91 minutes. Operation time showed no variations with different levels of difficulty (F=1.37, df=2, p=.268).

Systolic Blood Pressure (SBP)

Overall mean pre-operative, intra-operative and post-operative systolic blood pressures were 126.83 ± 15.7mmHg, 125.93 ± 16.8mmHg and 122.05 ± 15.20mmHg respectively. Change in systolic blood pressure was not found to be of statistical significance over the course of surgery (Table 1). First three rows of Table 2 show individual mean values for minimally, moderately and very difficult cases. Statistical analysis failed to show any significance between changes in blood pressure and level of difficulty as well as operation time (Table 3). Similarly, gender or age were also not found to have an association with peri-operative measurements of systolic blood pressure (p>0.05).

Table 1.Comparisons of perioperative changes in blood pressures and heart rate.

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	SD	SEM	Lower	Upper	t	df	Sig.
Pair 1	PreSBP - IntraSBP	.900000	15.167103	2.398130	-3.950675	5.750675	.375	39	.709
Pair 2	IntraSBP - PostSBP	3.875000	13.097636	2.070918	-.313827	8.063827	1.871	39	.069
Pair 3	PreSBP - PostSBP	4.775000	12.583032	1.989552	.750751	8.799249	2.400	39	.210
Pair 1	PreDBP - IntraDBP	1.575000	12.787990	2.021959	-2.514798	5.664798	.779	39	.441
Pair 2	IntraDBP - PostDBP	1.300000	9.530518	1.506907	-1.748007	4.348007	.863	39	.394
Pair 3	PreDBP - PostDBP	2.875000	12.436892	1.966445	-1.102511	6.852511	1.462	39	.152
Pair 1	PreHR - IntraHR	-1.800000	11.017934	1.742088	-5.323706	1.723706	-1.033	39	.308
Pair 2	IntraHR - PostHR	3.850000	8.420214	1.331353	1.157085	6.542915	2.892	39	.060
Pair 3	PreHR - PostHR	2.050000	11.993481	1.896336	-1.785701	5.885701	1.081	39	.286

SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate; SD = Std. Deviation; SEM = Std. Error Mean; df = degree of freedom; Sig = significance.

Table 2. Mean blood pressure (systolic and diastolic) and heart rate data among different levels of difficulties.

Difficulty	Slightly	Moderately	Very
Pre-operative SBP	123.00 ± 14.11	127.29 ± 15.78	126.67 ± 17.66
Intra-operative SBP	119.33 ± 9.45	126.11 ± 18.46	127.56 ± 13.64
Post-operative SBP	113.67 ± 14.74	122.39 ± 14.57	123.78 ± 18.05
Pre-operative DBP	73.33 ± 5.68	75.71 ± 12.05	71.89 ± 11.24
Intra-operative DBP	67.33 ± 1.53	73.93 ± 15.04	72.44 ± 10.50
Post-operative DBP	67.00 ± 4.58	72.96 ± 12.76	69.78 ± 14.86
Pre-operative HR	82.00 ± 13.00	89.46 ± 18.10	79.22 ± 14.13
Intra-operative HR	78.00 ± 5.00	91.21 ± 16.53	83.11 ± 14.30
Post-operative HR	72.00 ± 6.24	87.00 ± 13.48	81.11 ± 10.29

SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate.

Table 3. Systolic blood pressure analysis of variance according to operation time and difficulty.

Variable		Sum of Squares	Df	Mean Square	F	Sig.
Operation Time						
PreSBP	Between Groups	6690.275	30	223.009	.675	.800
	Within Groups	2971.500	9	330.167		
	Total	9661.775	39			
IntraSBP	Between Groups	7138.775	30	237.959	.552	.893
	Within Groups	3880.000	9	431.111		
	Total	11018.775	39			
PostSBP	Between Groups	7084.900	30	236.163	1.101	.469
	Within Groups	1931.000	9	214.556		
	Total	9015.900	39			
Difficulty						
PreSBP	Between Groups	50.061	2	25.030	.096	.908
	Within Groups	9611.714	37	259.776		
	Total	9661.775	39			
IntraSBP	Between Groups	155.208	2	77.604	.264	.769
	Within Groups	10863.567	37	293.610		
	Total	11018.775	39			
PostSBP	Between Groups	240.999	2	120.500	.508	.606
	Within Groups	8774.901	37	237.159		
	Total	9015.900	39			

Diastolic Blood Pressure (DBP)

Overall mean pre-operative, intra-operative and post-operative diastolic blood pressures were 74.68 ± 11.44mmHg, 73.10 ± 13.51mmHg and 71.80 ± 12.75mmHg respectively. Change in diastolic blood pressure was not found to be of statistical significance over the course of surgery (Table 1). Fourth, fifth and sixth rows of Table 2 show individual mean values for minimally, moderately and very difficult cases. No significance was found between changes in diastolic blood pressure and level of difficulty or operation time (Table 4) as well as gender and age ($p>0.05$).

Heart Rate (HR)

Overall heart rate values of mean pre-operative, intra-operative and post-operative measurements as beats per minute (BPM) were 86.60 ± 17.22, 88.40 ± 15.90 and 84.55 ± 12.99 respectively. Change in heart rate was not found to be of statistical significance over the course of surgery (Table 1). Last three rows of Table 2 show individual mean values for minimally, moderately and very difficult cases. Statistical analysis failed to show any significance between changes in heart rate and level of difficulty as well as operation time (Table 5). Although heart rate did not show an important change over the course of surgery at different age groups, gender-wise females had significantly higher heart rates at all three peri-operative measurements ($p=0.032$, 0.002, 0.009 respectively).

Table 4. Diastolic blood pressure analysis of variance according to operation time and difficulty.

Variable		Sum of Squares	Df	Mean Square	F	Sig.
Operation Time						
PreDBP	Between Groups	3417.775	30	113.926	.609	.852
	Within Groups	1685.000	9	187.222		
	Total	5102.775	39			
IntraDBP	Between Groups	5864.100	30	195.470	1.406	.306
	Within Groups	1251.500	9	139.056		
	Total	7115.600	39			
PostDBP	Between Groups	4938.900	30	164.630	1.053	.501
	Within Groups	1407.500	9	156.389		
	Total	6346.400	39			
Difficulty						
PreDBP	Between Groups	105.505	2	52.753	.391	.679
	Within Groups	4997.270	37	135.061		
	Total	5102.775	39			
IntraDBP	Between Groups	122.854	2	61.427	.325	.725
	Within Groups	6992.746	37	188.993		
	Total	7115.600	39			
PostDBP	Between Groups	143.880	2	71.940	.429	.654
	Within Groups	6202.520	37	167.636		
	Total	6346.400	39			

Table 5. Heart rate analysis of variance according to operation time and difficulty.

Variable		Sum of Squares	Df	Mean Square	F	Sig.
Operation Time						
PreHR	Between Groups	10026.600	30	334.220	1.960	.145
	Within Groups	1535.000	9	170.556		
	Total	11561.600	39			
IntraHR	Between Groups	7982.100	30	266.070	1.277	.367
	Within Groups	1875.500	9	208.389		
	Total	9857.600	39			
PostHR	Between Groups	4703.400	30	156.780	.752	.737
	Within Groups	1876.500	9	208.500		
	Total	6579.900	39			
Difficulty						
PreHR	Between Groups	783.080	2	391.540	1.344	.273
	Within Groups	10778.520	37	291.311		
	Total	11561.600	39			
IntraHR	Between Groups	797.997	2	398.998	1.630	.210
	Within Groups	9059.603	37	244.854		
	Total	9857.600	39			
PostHR	Between Groups	747.011	2	373.506	2.369	.108
	Within Groups	5832.889	37	157.646		
	Total	6579.900	39			

Discussion

Dental anxiety is encountered very commonly in the population [10]. It may reach to a level that causes avoidance or cancellation of dental visits and eventually leads to deterioration of oral health for some patients [11]. Although the main etiological factors are not fully understood, previous traumatic events, observation of others undergoing trauma or demonstrating fearfulness and informational transmission may be blamed [12]. Nearly three out of four adult patients with severe dental anxiety report to have a previous traumatic dental experience [13].

Increased respiration, muscle tension and blood pressure are some of the physiological manifestations of anxiety [5]. Some authors reported that even the idea of future dental treatments is a source of stress and causes hemodynamic and cardiovascular changes like high blood pressure [14]. Therefore, physiological responses may be expected during the actual procedures as well. These responses occur as a result of hypothalamus-pituitary-adrenal axis activation, which results in cortisol secretion and thus an enhanced sympathetic activity [12,15].

Several studies report on hemodynamic changes during dental surgical procedures. However results of those studies are contradictory. Brand et al. [15] claim that dental extractions cause both systolic and diastolic pressures to rise. On other hand Gungormus and Buyukkurt [16] report no statistically significant changes in systolic and diastolic blood pressures. Contradicting to them as well as our results, Cheraskin and Prasertsuntarasai [17] found significant changes in blood pressure before and after dental extractions. Moreover, Nichols [18] state that blood pressure values are always higher at the pre-operative period. Anxiety or fear-related endogenous epinephrine release is thought to be responsible for this outcome [18]. In the present study mean values for systolic and diastolic blood pressures are also recorded to be the highest at pre-operative measurements with an exception of diastolic pressure measurements for minimally difficult cases where intra-operative mean diastolic blood pressure is recorded higher than the mean pre-operative value. Although there are differences between pre-, intra- and post-operative measurements, these differences failed to show any significance for both systolic and diastolic blood pressures. Parallel to our findings, Beck and Weaver state no apparent blood pressure changes before and after dental treatments as well [19].

On the other hand, contradicting to our results, Alemany-Martinez et al. [6] report pre-operative systolic and diastolic blood pressures to be lower than intra-operative measurements and the highest during the intra-operative period as well. Although they found no significance in the pattern of change in diastolic pressure, their study revealed a significant pattern of change in systolic blood pressure [6]. Although some researchers find similar results about systolic blood pressure measurements, their results additionally reveal that diastolic blood pressure shows a significant increase at the intra-operative period [12]. However the same study notes no association between dental anxiety levels and blood pressure [12]. Another study conducted with hypertensive patients undergoing dental extractions also mentions the lowest measurements in both systolic and diastolic blood pressures during the pre-operative period [16].

Anxiety-induced endogenous epinephrine release from the adrenal medulla has a direct impact on heart rate as well [20]. However whether there is a pattern in heart rate changes over the course of dental treatments is also unclear. Alemany-Martinez et al. [6] report heart rate to be the lowest during the pre-operative period, although overall results of their experiments failed to reveal any significance in the pattern of heart rate changes. Liau et al. [12] inform lowest mean heart rate values during the pre-operative period as well. In our study overall results for both pre and post-operative mean values are similarly lower than intra-operative mean heart rate values. Contradicting with our results, Paramaesvaran and Kingon [21] mention higher pre-operative heart rate values than intra-operative measurements. Our results are parallel to Gungormus and Buyukkurt [16] who report no statistically significant changes in heart rate over the course of dental surgical procedure.

Although shown insignificant, it is important to emphasize that mean post-operative values for all three parameters were noted to be the lowest. It is suggested that anxiety continues until the moment of tooth extraction for third molar surgeries, which may be the reason why post-operative measurements are found to be lowest in all three parameters [5].

The literature consists of contradictory findings on this issue but this contradiction may be attributed to the way these studies define dental anxiety [6,12,15,16,21]. First, it is important to understand that not all anxious patients are in fact diagnosed with the condition. Three main factors which are duration, intensity and frequency determine the difference between pathological and normal anxiety. Thus if anxiety prolongs (duration), interferes with normal life (intensity) or becomes chronic (frequency) then a true dental anxiety may be diagnosed [22]. Physicians should keep in mind that just like stress, normal anxiety is a natural adaptive reaction but pathological anxiety is an interference with the ability to cope successfully with various challenges or stressful events [23].

So if these patients had not showed up to their appointment or even when they did show up, if significant cardiovascular changes were in fact observed in these patients, then we might have talked about a true pathological anxiety. However anxiety, simply claimed by patients, is not enough for a diagnosis of dental anxiety because patient-reported anxiety may not always have a physiological basis [22]. Also as seen in the present study, blood pressure and heart rate do not vary significantly before, during and after the surgery. Also surgical difficulty and duration cause no significant changes on physiological markers of anxiety.

A different study, to assess changes in blood pressure in middle aged patients, reports larger blood pressure increments during surgery. Therefore since our study group consisted of a young group of patients with a mean age of 24, this may be the reason why there is a lack of significance in blood pressure and heart rate changes [24].

Most patients who visit dental clinics for surgical purposes are already misinformed or are in a perception that their surgical procedure will be the toughest, the most complicated surgical procedure of all. Since these patients who show up to their appointments are not truly suffering from an anxiety disorder, their state of anxiety may be reduced or even eliminated by pre-operative

conversations and reassurance, which in return may allow the surgeon to optimally function through the procedure, without worrying about the psychological state of the patient, even if any intra-operative complications occur.

Conclusion

Despite the common belief that dental procedures initiate anxiety, this study verifies that patient-reported anxiety does not have physiological basis and similarly surgical difficulty and duration cause no significant changes on blood pressure and heart rate which are known as the physiological markers of anxiety. Dentists should keep in mind there are and will be patients who report being anxious, fearful, phobic, or panicky; nonetheless they will go to see the dentist, and if additionally these patients allow dental procedures and do not experience enormous health effects, then their reported conditions are not enough for a dental anxiety diagnosis. However there are not enough studies on how patient anxiety effects surgical manipulations, post-operative healing processes or complication rates. Authors advise to plan new studies to reach more conclusive results in the future.

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