Assessment of Relationship between Hemodynamic Changes and Anxiety in Patients During Lower Third Molar Surgery

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ABSTRACT

Objective: To investigate the relationship between anxiety and hemodynamic changes in patients who have undergone impacted third molar surgery under local anaesthesia.

Study Design: Observational clinical study.

Place and Duration of study: Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Gazi University, Ankara, Turkey, from January 2018 to December 2019.

Methodology: Normotensive patients aged over 18 years, not using antidepressant medicine and ASA I included. A total of 83 patients were monitored and operated on for impacted third molar surgery. Blood pressure, pulse, and oxygen saturation values of the patients were noted at eight different stages during the surgery. Only the mesioangular impacted lower third molars of the patients were removed by a surgical operation. STAI forms were given before the operation.

Results: There is a significant difference between values of blood pressure, pulse, and oxygen saturation and gender ($p<0.05$). However, there was found to be an increased blood pressure in male patients while an increase in pulse and oxygen saturation was observed in female patients ($p<0.05$).

Conclusion: Male patients were more concerned than female patients by having higher blood pressure which may cause longer postoperative bleeding.

Key Words: *Anxiety, Impacted third molars, Dental surgery, Hemodynamic changes.*

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INTRODUCTION

Dental treatments are usually accepted as being associated by anxiety, fear, and pain and also may cause changes in corticosteroid levels, blood pressure, and hemodynamic and cardiovascular changes in patients.[1,2] Most dental treatments are carried out under local anaesthesia and cause changes in blood pressure even in normotensive patients. Many factors can affect this increase, such as stress, painful stimuli, and catecholamines found in local anaesthetics.[3] In addition, other factors causing dental anxiety can be listed as congenital features, previous dental trauma, previous experiences of relatives and friends.[4] Moreover, using rotary tools and dental injections during dental surgery may also affect the level of anxiety.[5,6]

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Impacted third molar operations are one of the most common operations that are done at the authors' clinic. Being able to predict the patient's anxiety before the operation will greatly increase the comfort of both the patient and the surgeon during and after the operation.

The State-Trait Anxiety Inventory (STAI) is a commonly used measure of trait and state anxiety levels of patients in different cases. It can be used as a clinical measure to diagnose patients' anxiety levels prior to operation in order to control hemodynamic changes that may affect the course of the surgery.[2,6]

Hemodynamic changes may be affected by the anxiety levels of the patients and that may affect the surgical procedures. For this reason, the preoperative anxiety levels of the patients were measured by using STAI forms. Therefore, the aim of this study was to investigate the hemodynamic changes such as blood pressure, pulse, and oxygen saturation level that occur at certain stages during the surgical removal of the impacted lower third molar operation in otherwise healthy patients.

METHODOLOGY

It was designed as a prospective observational clinical study. The study population included patients referred to the Depart-

ment of Oral and Maxillofacial Surgery, Faculty of Dentistry, Gazi University for the extraction of impacted mandibular third molars, between January 2018 and December 2019. Only otherwise healthy subjects with mesioangularly impacted lower third molars were selected as a study subjects among patients referred to the department of oral and maxillofacial surgery.

The protocol of this study was approved by the clinical research ethics review committee of the Faculty of Dentistry, Ankara University, Ankara, Turkey (Number 36290600/113). The informed consent forms were obtained from all participants. This study followed the Declaration of Helsinki on medical protocol and ethics.

All of the patients included in the present study were aged over 18 years, normotensive, do not use antidepressant drugs and ASA I. Only the mesioangular impacted lower third molars of the patients were removed in accordance with this study. In order to provide standardisation only the patients having mesioangularly impacted third molars were included as class I according to Pell and Gregory classification and class A according to Archer classification. Before the operation STAI-I forms were given first to each patient to be filled out in order to determine the petient's general anxiety situation and then taken into operation. Patients were monitored during the operation for following the hemodynamic changes. Systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse (P), and saturation (S) values were recorded at the following time stages: Before surgery, during local anaesthesia, mucosal incision, flap elevation, osteotomy, tooth elevation, suturing, and 10 minutes after suturing. All the recordings were done by the dental assistant.

Extraction of impacted lower third molars was performed under local anaesthesia with articaine 4% with 1:100,000 epinephrine. The surgical procedure included a gingival incision, a mucoperiosteal flap elevation, and an ostectomy of the contiguous bone with a round burr. Sterile low speed (20,000 rpm) hand pieces and sterile saline solution were used for bone removal. Mucoperiosteal flap was sutured with a 3-0 silk suture. All the patients were prescribed amoxicilline and nonsteroidal anti-inflammatory agents postoperatively. Patients were monitored throughout the entire procedure using "Eretna Vitascope 190 VT19-10001 (Turkey)" for hemodynamic changes.

The STAI was developed by Spielberger *et al*.[7] to assess state and trait anxiety levels. Forms included 40 questions, 20 of which assess state anxiety and the other 20 trait anxiety. Patients were asked to answer each question using a 4-point scale, where 1 represented no anxiety and 2, 3, and 4 represented mild, moderate, and severe anxiety, respectively. The points for each question were calculated separately as total STAI-I (state) and STAI-II (trait) scores. A predetermined and unchanging constant of 50 for the state anxiety scale and 35 for the trait anxiety scale was added to the number found. Consequently, the score for either STAI-I or STAI-II could range from 20 to 80, with the higher score representing more severe anxiety. The last value is accepted as the anxiety score of each patient, and the higher score was considered as a high anxiety level and the lower score as a low anxiety level.

The data were analysed using the SPSS 25.0 program (Statistical Package for Social Sciences). Descriptive statistical methods (number, percentage, mean, standard deviation, minimum, median, and maximum) were utilised. In addition, the normal distribution of the data used was assessed using Kolmogorov-Smirnov and Shapiro Wilk test. In the study, whether there is a statistically significant difference between dependent measurements was tested by using independent t-test, Spearmann correlation analysis and Mann-Whitney U test. Independent t-test was used to determine whether there is any statistical significance between STAI-II and gender. In addition, Spearman correlation was performed to analyse the statistical relation between STAI-II and SBP, DBP, P, and S values. Moreover, Mann-Whitney U test was used to analyse the relation between SBP, DBP, P, and S values by gender. A p-value less than 0.05 was considered statistically significant for all statistical analyses.

RESULTS

A total of 83 patients, 47 females (56.6%) and 36 males (43.4%), aged between 17 and 53 years (mean 24.79±6.57) were included in this study. The minimum, maximum, and average values of vital signs measured at the specified time stages are calculated. The average values for the SBP, DBP, P, and S are displayed in Table I.

According to the mean values, it was determined that the vital values of the patients increased mostly during the osteotomy stage and decreased by the elevation of the tooth.

The relationship between mean values of vital signs and gender were evaluated and displayed in Table II. The highest value for SBP was determined at the stage of tooth elevation mostly in male patients (T6), and for females highest at the osteotomy stage (T5). For DBP, the highest value was observed at the osteotomy (T5) stage in both male and female patients. For P and S levels, the highest values for both male and female patients were recorded at the osteotomy stage (T5).

With the aim of testing whether there is a statistically significant difference between the STAI-II and gender, independent t-test was used, and determined that there was found to be no statistically significant difference ($p>0.05$).

Spearman correlation analysis was performed to test the relationship between STAI-II and SBP, DBP, P, and S variables. It was determined that there was no statistically significant relationship between STAI-II and any of the vital signs ($p>0.05$).

In addition, when the statistical relation was controlled between SBP, DBP, P, and S values and gender by Mann Whitney U analysis, it was determined that there was a statistically significant difference between the SBP, DBP, P, and S values and gender ($p<0.05$), male patients have higher SBP and DBP values than female patients and lower P and S values (Table III).

Table I: The average values for the SBP, DBP, P and S.

		*T1	*T2	*T3	*T4	*T5	*T6	*T7	*T8
SBP	N	83	83	83	83	83	83	83	83
	Minimum	79,00	101,00	76,00	96,00	93,00	95,00	97,00	13,00
	Median	127,00	126,00	126,00	124,00	129,00	128,00	123,00	122,00
	Maximum	158,00	157,00	176,00	166,00	168,00	173,00	160,00	152,00
	Average	127,27	126,52	125,69	126,60	128,58	128,20	124,10	121,22
	Sd	13,79	12,77	16,04	14,12	14,65	14,94	14,09	18,28
DBP	N	83	83	83	83	83	83	83	83
	Minimum	62,00	65,00	4,00	59,00	56,00	7,00	53,00	60,00
	Median	81,00	78,00	77,00	78,00	79,00	78,00	76,00	76,00
	Maximum	104,00	105,00	118,00	111,00	115,00	115,00	103,00	104,00
	Average	81,28	79,70	77,70	78,81	79,87	77,80	77,13	76,71
	Sd	9,18	9,02	14,39	10,28	10,26	12,54	9,58	8,75
P	N	83	83	83	83	83	83	83	83
	Minimum	8,00	67,00	66,00	72,00	69,00	65,00	58,00	61,00
	Median	92,00	95,00	98,00	97,00	98,00	94,00	86,00	85,00
	Maximum	137,00	144,00	152,00	157,00	166,00	158,00	152,00	132,00
	Average	91,02	96,58	97,51	99,34	99,45	95,43	89,71	87,49
	Sd	16,75	15,83	15,87	16,25	16,38	15,13	14,73	12,14
S	N	83	83	83	83	83	83	83	83
	Minimum	89,00	94,00	84,00	96,00	94,00	90,00	87,00	87,00
	Median	99,00	99,00	99,00	99,00	99,00	99,00	99,00	98,00
	Maximum	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00
	Average	98,18	98,65	98,61	98,95	98,82	97,60	98,28	98,24
	Sd	1,88	1,34	2,15	1,09	1,46	9,95	2,06	1,86

**T1: Before surgery, T2: During local anaesthesia, T3: Mucosal incision, T4: Flap elevation, T5: Osteotomy, T6: Tooth elavation, T7: Suturing, T8:10 mins after suturing.*

Table II: Relationship between gender and vital signs.

SBP	***T1**	***T2**	***T3**	***T4**	***T5**	***T6**	***T7**	***T8**
Male	131,67±11,06	131,31±12,37	131,94±15,07	133,31±14,54	134,44±15,49	135,69±15,3	130,47±13,33	125,78±22,69
Female	123,89±14,8	122,85±11,95	120,89±15,23	121,47±11,52	124,09±12,34	122,47±11,92	119,21±12,74	117,72±13,25
DBP	T1	T2	T3	T4	T5	T6	T7	T8
Male	83,53±8,92	82,86±9,37	81,33±16,86	82,69±11,14	83,5±11,64	81,14±15,82	80,94±9,59	80,31±8,63
Female	79,55±9,1	77,28±8,02	74,91±11,6	75,83±8,55	77,09±8,14	75,23±8,63	74,21±8,58	73,96±7,88
P	T1	T2	T3	T4	T5	T6	T7	T8
Male	87,67±19,78	92,97±14,69	93,92±14,84	94,03±13,79	95±14,48	91±12,46	84,53±10,74	83,72±10,08
Female	93,6±13,66	99,34±16,27	100,26±16,23	103,4±16,95	102,85±17,07	98,83±16,21	93,68±16,19	90,38±12,87
S	T1	T2	T3	T4	T5	T6	T7	T8
Male	98,36±1,33	98,58±1,52	98,67±1,64	98,78±1,24	98,56±1,68	95,97±15,01	98,03±1,92	98,22±1,49
Female	98,04±2,21	98,7±1,2	98,57±2,48	99,09±0,95	99,02±1,24	98,85±1,2	98,47±2,17	98,26±2,11

**T1: Before surgery, T2: During local anaesthesia, T3: Mucosal incision, T4: Flap elevation, T5: Osteotomy, T6: Tooth elavation, T7: Suturing, T8: 10 mins after suturing.*

Table III: Difference between SBP, DBP, P, and S by gender.

	Gender	**n**	**Average**	**Standard deviation**	**Median**	**Test statistic**	**p**
SBP	Male	36	131,83	12,15	131,31	t=4,076	<0,001*
	Female	47	121,57	10,71	119,50		
DBP	Male	36	82,04	8,68	81,56	U=493,000	0,001*
	Female	47	76,01	7,13	73,88		
P	Male	36	90,35	11,90	89,81	U=585,500	0,017
	Female	47	97,79	14,49	95,00		
S	Male	36	97,72	2,21	97,75	U=436,500	<0,001*
	Female	47	98,95	0,85	99,13		

**p<0,05, t: Independent sample t-test, U: Mann Whitney U.*

The relationship between operation time and hemodynamic changes was tested by Spearman correlation analysis. It was observed that there found to be no statistically significant relationship between operation time and hemodynamic changes (p>0.05).

In order to test whether there was a statistically significant difference between SBP, DBP, P, and S values and the presence of previous pain (patient who have already severe pain because of impacted tooth) and the degree of difficulty in tooth position independent t-test was run for the measurements of normal distribution, and Mann-Whitney U analysis was performed for the measurements without normal distribution. According to the results of the analysis, it was determined that there was no statistically significant difference between the SBP, DBP, P and S values according to the presence of previous pain and the degree of difficulty in tooth position (p>0.05).

DISCUSSION

Hemodynamic and cardiac changes occur in patients who visit the dentist for treatment due to anxiety.[8,9] Anxiety may cause serious problems during dental operations. Therefore, the authors conducted a study in otherwise healthy volunteers who were not on any medication or any systemic diseases, being ASA I. Moreover, adrenergic vasoconstrictors given by local anaesthetics were reported to be interacted with SBP, DBP, P, and S values,[10] all the surgeries were performed with monitoring the patients throughout the entire procedure.

Hemodynamic changes such as SBP, DBP, P, and S values have already been evaluated by previous studies because mainly the local anaesthetics with vasoconstrictors were used for dental operations.[11,12] There are many studies evaluating the various effects of different anaesthetic solutions used in impacted third molar surgery.[13-17] In this study, a single anaesthetic solution was used to ensure standardisation.

In a study conducted by Silvestre *et al*.,[18] a local anaesthetic containing a vasoconstrictor substance was used, they noticed p-value increased following anaesthesia and decreased following the tooth extraction and also S value decreased following anaesthesia. The results of the present study support the findings on p-value that decreased as well following anaesthesia (Table I). Nevertheless, Hollander *et al*.[19] determined that p-value was highest during incision and alveolotomy.

In addition, Gadve *et al*.[20] evaluated the hemodynamic parameters and gender at different time intervals during lower third molar surgeries. SBP and DBP displayed significant changes; the highest value was observed at the time of osteotomy and tooth sectioning. Maximum p-value was recorded 4min following local anaesthetic injection and the lowest p-value was recorded at the end of tooth extraction and suturing. Moreover, they noticed a significant increase in p-values among female patients. According to the results of this study the hemodynamic changes such as SBP, DBP, P, ans S values of the patients increased mostly during the osteotomy stage and decreased during the elevation of the tooth ($p>0.05$) (Table II). Similarly, Matsumura *et al*.[21] pointed out significant changes in SBP, DBP, and p-values in patients undergoing tooth exctractions. The results suggested that middle-aged and older patients have a greater increase in SBP, and DBP values in comparison with younger patients. In this study, no age-related evaluation was observed, but differences in gender were significant ($p<0.05$) (Table III).

In a study by Tarazona-Alvarez *et al*.,[22] females experienced greater anxiety than males, the maximum and minimum values for SBP were observed at the time of incision and suturing respectively. Maximum and minimum values for DBP were reported before the beginning of surgery and during extraction respectively. However, p had the highest value during incision and the lowest value during suturing. In the present study, differences in SBP, DBP and p-values according to STAI-II presented no statistical significance ($p>0.05$). However, differences in SBP, DBP, and S values by gender presented statistically significant differences ($p<0.001$), blood pressure was higher in male patients than in female patients while the opposite was determined for the S values (Table III).

Raocharernporn *et al*.[23] also performed a study about hemodynamic changes in third molar surgery and reported a significant decrease in the SBP, DBP, and p-value during the preoperative period. The authors concluded that experiencing impacted tooth surgery could reduce subsequent preoperative anxiety in healthy patients. Music therapy has also been found to reduce blood pressure, induce relaxation, and normalise arrhythmias during operations performed under local anaesthesia.[19] In a study of Erakman *et al*.,[24] similar results were also reported that music helps to reduce the patient's anxiety level. The need for additional anaesthesia was significantly less in the group of patients who listened to music. Unfortunately, music was not listened by the patients of the present study.

CONCLUSION

During impacted third molar operations, there may be hemodynamic changes due to anxiety. As a result of this study, it was determined that patients had no significant anxiety related to impacted third molar surgery according to STAI forms. Nevertheless, results displayed that male patients were more concerned than female patients by having higher blood pressure while female patients had more fear than male patients by having increased pulse and saturation rates. Postoperative bleeding related to high blood pressure is a great concern for surgeons so this study's results may give a clue about the anxiety status of patients about postoperative bleeding that may take longer time in male patients. However, this study has certain limitations. Due to the standardisation, only mesioangularly impacted third molars, which is one of the most frequently referred cases to the clinic, were included in this study.

ETHICAL APPROVAL:

The present study protocols were approved by the clinical research ethics review committee of the Ankara University, Faculty of Dentistry, Ankara, Turkey (No. 36290600/113).

PATIENTS' CONSENT:

Informed consent were obtained from all participants included in the study.

COMPETING INTEREST:

The authors declared no competing interest.

AUTHORS' CONTRIBUTIONS:

OY: Contributed to conception and design, drafted and critically revised manuscript.

KT, NM: Contributed to conception, design, and data analysis, drafted and critically revised the manuscript.

All authors gave final approval and agreed to be accountable for all aspects of the work.

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