Research Article

Perceived Sources of Stress and its Levels during Dental Extraction – An Exploratory Study

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Abstract

Background: Stress is ubiquitous and is an inseparable part of various activities. Stress toward dental procedures is widely prevalent among dental patients, especially among those undergoing dental extractions. There are very few studies reported in the literature which explore various aspects related to stress among patients during dental extractions. **Aim and Objectives:** To determine levels and perceived sources of stress during dental extraction appointments among patients seeking care at one of the private University hospitals in Riyadh, Saudi Arabia. **Materials and Methods:** Patients undergoing dental extraction in the outpatient clinics of college of dentistry Riyadh Elm University hospital were invited to participate in the study. Oral Maxillofacial residents performed the extraction procedure. Blood pressure, pulse rate, and temperature were recorded by using blood pressure, pulse rate monitor, and infrared thermometer for body temperature. **Results:** Systolic blood pressure was significantly raised during the step of forceps extraction than any other stage. Pulse rate was significantly higher at luxation (M=85.41, SD=14.38) than during the forceps extraction (M=70.03, SD=38.14); t(31)=2.435, p=0.021. Mean systolic BP during forceps extraction was found to be significantly higher among the group reporting previous bad extraction experience. **Conclusion:** Blood pressure was significantly higher during forceps extraction than any other stage, including the luxation step. The pulse rate was significantly higher at luxation than during the forceps extraction. Previous bad experience had a significant impact on blood pressure levels during forceps extraction. Clinicians should be sensitized towards patients' experience in managing stress during dental extraction procedures.

Keywords: Dental extraction; Elevators; Perceived stress; Levels of stress; Blood pressure

Introduction

Stress is a ubiquitous response mechanism observed among all individuals and is dependent on the circumstances, environment, and past experiences. Anxiety is one of the most pervasive emotions, and it can arise in response to apparently innocuous situations. Stress is the first line of defense mounted by the body in response to a wide array of stimuli, which may or may not be life-threatening. [1,2]

When stress is triggered in a life-threatening situation, it can have a positive impact on focus, alertness, and energy levels. Contrary, chronic stress can harm our physical and mental health. It can lead to depression, anxiety disorders, and cardiovascular disorder, etc. [3] Sudden emotional stresses can trigger heart attacks, arrhythmias, and even sudden death, especially among people who have cardiac diseases. [4] The actual threat to a human is referred to as the stressor, and the response to these is called the stress response. [5]

Stress can result from external factors (e.g., events, situations, and environment) or internal factors (e.g., expectations, attitudes, feelings). Everyday stressors include physical causes, such as illness or injury, and mental (psychological) causes, such as anxiety or fear. Following the perception of an acutely stressful event, there are changes in the nervous system, cardiovascular, endocrine, and immune systems. [6] These changes constitute the stress response and are generally adaptive. There are two features to make the stress response adaptive. First, stress hormones are released to make energy stores available for the body's immediate use. Second, a new energy pattern distribution emerges. Energy is diverted to the tissues that become more active during stress, primarily the brain and the skeletal muscles. [7,8]

The response of the body to stress is initiated and controlled by the central nervous system. In response to a stressful situation, the brain first signals the inner portion of the adrenal gland (called the adrenal medulla) to release hormones such as adrenaline, noradrenaline that initiate the "flight-or-fight"

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response. [6] Later, other hormones such as cortisol are released, which can have a profound impact on the stress response of an individual. The effects of these hormones include dilation of blood vessels, increased respiration rate, increased heart rate and blood pressure caused by increased blood flow to the brain, increased blood sugar levels to provide more energy, etc. [9-11]

The acute stress response can become maladaptive if it is repeatedly or continuously activated. [12] For example, chronic sympathetic nervous system stimulation of the cardiovascular system due to stress leads to an increase in blood pressure and vascular hypertrophy. [13] That is the muscles that constrict the vasculature thicken, producing elevated resting blood pressure and response stereotypy or a tendency to respond to all types of stressors with a vascular response. Chronically elevated blood pressure forces the heart to work harder, which leads to hypertrophy of the left ventricle. [14]

The stress response to various dental treatment procedures is widely prevalent. Patients might experience elevated stress levels during their dental appointments than they would encounter in their routine daily activities. [15] An oral surgical procedure, such as the removal of a tooth, is considered to be one of the most stressful dental procedures. [16] Dental syringes and dental extraction forceps might lead to elevated levels of stress among patients undergoing the extraction of their teeth. [17] Stress might adversely affect the procedural outcomes by interfering with wound healing. It can deregulate cytokines such as Interleukin-1, Interleukin-2, and (TNF) -tumor necrosis factor. [18]

Measurement of stress levels among patients can be a challenging exercise. Heart rate can be clinically monitored to detect stress. A pulse rate monitor can detect changes in heart rate. [19] Activation of the sympathetic nervous system might activate receptors called βeta-1 Adrenergic receptors in the heart, which might alter the rate of contraction of cardiac muscles. [20] Heart rate can, therefore, be an important clinical indicator of stress among patients undergoing dental extractions.

Depending on the treatment being rendered to the patients, stress can be managed in dental clinics by many different approaches. Good communication skills, building trust, and listening carefully to patients' concerns are central to stress management. Therefore, understanding the patient's needs is the most critical factor for managing stress. [17,21]

There are very few studies reported in the literature which explore various aspects related to stress among patients undergoing dental extractions. Instruments employed in the treatment procedure can also lead to stress among patients. Therefore, the present study was conducted to determine the levels and perceived sources of stress during dental extraction appointments among patients in Riyadh Elm University hospitals. The findings of the present study will pave the way for more effective and efficient patient management during dental extractions.

Materials and Methods

The present study was conducted in the dental clinics of the college of dentistry, Riyadh Elm University (REU), in Riyadh, Saudi Arabia. The data was collected from a total of forty-three male and female patients who are aged above 18 years old. The patients will also be referred to as the Oral Surgery Department at Riyadh Elm University for dental extraction. This study received ethical approval from the research center of Riyadh Elm University (RC/IRB/2018/1150).

Inclusion criteria consisted of patients indicated for dental extraction procedures and those who were willing to participate in the study. Exclusion criteria included medically compromised patients; patients with sleep disorders, diet and immunity disorders; patients on or with a history of psychological drugs and emergency extraction cases.

Information related to general demographic data and previous dental extraction experiences were collected from the patients. A specific Monitoring Devices (OMRON® M6 COMFORT & Geratherm® Infra-Red Non-Contact Thermometer) which was clinically validated by the Association of a medical instrument (AAMI), the European Society of Hypertension (ESH) and The British Hypertension Society (BHS) was employed to collect vital signs data such as heart rate, blood pressure, and body temperature. One of the investigators also collected behavior data and physical stress signs such as sweating, muscle contraction, and whining.

Measurement of vital signs and behavior data were performed during specific and key timings points in which the patient's stress level fluctuates. The first stage of observation was the pre-operative phase when the patient was seated and rested on the dental chair. The Second stage of observation was during the operative phase, during dental anesthesia, luxation/extraction by Straight Elevator, and extraction by dental forceps. The third and last stage of observation was undertaken 10 minutes after the completion of the entire procedure. The reliability of the measurement criteria was verified by conducting ten pilot cases.

Statistical analysis

Descriptive statistics of frequency distribution, percentages, and mean (SD) values were calculated for participants' characteristics and vital signs. A paired sample t-test was applied to compare the mean pulse rate, systolic blood pressure, diastolic blood pressure, and body temperature at different stages of extraction. Similarly, the physical status of the participants at various stages of extractions was also recorded. Further, ANOVA (Analysis of Variance) test was performed to compare the mean vital scores among participants with good, bad, and first-time experience of extraction. The level of significance was fixed at 5%.

Results

A total of forty-three patients participated in the study (M=37 and F=6). Most of the teeth were extracted due to non-restorable causes (n=88.4). Nearly 62.8% of participants had a previous history of extractions. Almost 73.8% of the extractions were performed by using local anesthetic agents containing epinephrine. The mean age of the study participants was 27.98 ± 9.70 years and the mean procedure duration was 15.98 ± 7.93 minutes [Table 1].

The physical status of the study participants was assessed by recording sweating, muscle contraction, and whining at different stages of tooth extraction. Most of the participants (10.8%) experienced sweating and muscle contraction during the luxation stage. During the administration of the anesthetic injection, 36.6% of the participants exhibited muscle contractions.

A paired-samples t-test was conducted to compare the pulse rate at different stages of tooth extraction. There was a significant difference in the pulse rate at luxation (M=84.57, SD=13.94) than the pulse rate (M=80.22, SD=10.51) preoperatively; t (36) =-3.055, p=0.004 was observed. Similarly, there was a significantly higher pulse rate at luxation (M=84.57, SD=13.94) than the pulse rate (M=78.78, SD=15.10) during the administration of local anesthetic; t (36) =-4.006, p=0.000 was observed. Further, pulse rate was significantly higher at luxation (M=85.41, SD=14.38) than during the forceps extraction (M=70.03, SD=38.14); t(31)=2.435, p=0.021.

Pulse rate showed significant difference between luxation (M=84.57, SD=13.94) and post-operatively (M=79.70, SD=10.74); t(36)=3.994, p=0.000, as shown in Table 2. Hence, it can be observed that the mean pulse rate was significantly higher at luxation than any other phase of extraction.

Systolic blood pressure was significantly higher during the administration of anesthetic than the preoperatively, during luxation than pre-operative, forceps extraction than pre-operative, forceps extraction than during anesthesia, luxation than post-operative and forceps extraction than post-operatively. Hence it can be observed that systolic blood pressure was significantly raised during the stage of forceps extraction than any other stage [Table 3].

There was significant difference in the mean diastolic blood pressure at forceps extraction (M=80.70 SD=10.58) and at the post-operative (M=36.64, SD=0.36) stage of extraction; t(29)=22.869, p=0.000. However, the paired t-test did not show any significant differences between any other stages of tooth extraction, as shown in Table 4.

Table 5 displays paired samples statistics for the body temperature at different stages of tooth extraction. The highest body temperature was found during the administration of the

Table 1: Characteristics of the study participants.

Variables		n	%
'Gender	Male	37	86.0%
	Female	6	14.0%
Diagnosis	Non-restorable	38	88.4%
	Remaining root	2	4.7%
	Pericoronitis	1	2.3%
	No opposing	2	4.7%
Previous extraction	Yes	27	62.8%
	No	16	37.2%
Epinephrine	Yes	31	73.8%
	No	11	26.2%
Age (Mean ± SD) years		27.98 ± 9.70	
Duration of procedure (Mean ± SD) minutes		15.98 ± 7.93	

Table 2: Paired samples statistics for pulse rate at different stages during extraction.

Pairwise comparison	Pulse rate	Mean	N	SD	SEM	t	df	*p**
Pair 1	Pre-operative	80.28	43	9.85	1.50	-0.976	42	0.335
	During anesthesia	82.67	43	18.70	2.85			
Pair 2	Pre-operative	80.22	37	10.51	1.73	-3.055	36	0.004
	Luxation	84.57	37	13.94	2.29			
Pair 3	Pre-operative	80.11	38	10.48	1.70	0.973	37	0.337
	Forceps extraction	74.37	38	36.65	5.95			
Pair 4	Pre-operative	80.28	43	9.85	1.50	-1.028	42	0.310
	Post-operative	81.86	43	12.28	1.87			
Pair 5	During anesthesia	78.78	37	15.10	2.48	-4.006	36	0.000
	Luxation	84.57	37	13.94	2.29			
Pair 6	During anesthesia	84.10	38	19.18	3.11	2.014	37	0.051
	Forceps extraction	74.36	38	36.65	5.94			
Pair 7	During anesthesia	82.67	43	18.70	2.85	0.473	42	0.639
	Post-operative	81.86	43	12.28	1.87			
Pair 8	Luxation	85.41	32	14.38	2.54	2.435	31	0.021
	Forceps extraction	70.03	32	38.14	6.74			
Pair 9	Luxation	84.57	37	13.94	2.29	3.994	36	0.000
	Post-operative	79.70	37	10.74	1.77			
Pair 10	Forceps extraction	74.37	38	36.65	5.95	-1.433	37	0.160
	Post-operative	82.21	38	12.93	2.10			

Table 3: Paired samples statistics for systolic blood pressure at different stages during extraction.

Pairwise comparisons	Systolic BP	Mean	N	SD	SEM	t	df	*p**
Pair 1	Pre-operative	122.49	43	12.63	1.93	-2.67	42	0.011
	During anesthesia	127.16	43	14.60	2.23			
Pair 2	Pre-operative	123.86	37	13.10	2.15	-3.75	36	0.001
	Luxation	131.65	37	16.05	2.64			
Pair 3	Pre-operative	122.65	31	10.98	1.97	-3.54	30	0.001
	Forceps extraction	131.42	31	16.73	3.00			
Pair 4	Pre-operative	122.49	43	12.63	1.93	-1.32	42	0.194
	Post-operative	124.47	43	14.37	2.19			
Pair 5	During anesthesia	128.46	37	15.31	2.52	-1.65	36	0.107
	Luxation	131.65	37	16.05	2.64			
Pair 6	During anesthesia	126.39	31	14.66	2.63	-2.28	30	0.030
	Forceps extraction	131.42	31	16.73	3.00			
Pair 7	During anesthesia	127.16	43	14.60	2.23	1.32	42	0.195
	Post-operative	124.47	43	14.37	2.19			
Pair 8	Luxation	128.76	25	16.19	3.24	-1.39	24	0.178
	Forceps extraction	131.72	25	18.62	3.72			
Pair 9	Luxation	131.65	37	16.05	2.64	2.85	36	0.007
	Post-operative	125.84	37	14.96	2.46			
Pair 10	Forceps extraction	131.42	31	16.73	3.00	3.91	30	0.000
	Post-operative	123.32	31	12.34	2.22			

Table 4: Paired samples statistics for diastolic blood pressure at different stages during extraction.

Pairwise comparisons	Diastolic BP	Mean	N	SD	SEM	t	df	*p**
Pair 1	Pre-operative	78.47	43	11.14	1.70	-0.720	42	0.476
	During anesthesia	79.53	43	9.97	1.52			
Pair 2	Pre-operative	79.97	37	11.14	1.83	-1.170	36	0.250
	Luxation	82.22	37	9.61	1.58			
Pair 3	Pre-operative	77.68	31	10.26	1.84	-1.903	30	0.067
	Forceps extraction	80.65	31	10.41	1.87			
Pair 4	Pre-operative	78.47	43	11.14	1.70	-0.983	42	0.331
	Post-operative	80.16	43	9.84	1.50			
Pair 5	During anesthesia	80.38	37	10.50	1.73	-1.390	36	0.173
	Luxation	82.22	37	9.61	1.58			
Pair 6	During anesthesia	78.29	31	10.97	1.97	-1.677	30	0.104
	Forceps extraction	80.65	31	10.41	1.87			
Pair 7	During anesthesia	79.53	43	9.97	1.52	-0.378	42	0.708
	Post-operative	80.16	43	9.84	1.50			
Pair 8	Luxation	81.00	25	10.43	2.09	-0.195	24	0.847
	Forceps extraction	81.24	25	11.24	2.25			
Pair 9	Luxation	82.22	37	9.61	1.58	1.452	36	0.155
	Post-operative	79.43	37	10.39	1.71			
Pair 10	Forceps extraction	80.70	30	10.58	1.93	22.869	29	0.000
	Post-operative	36.64	30	0.36	0.07			

Table 5: Paired samples statistics for temperature at different stages during extraction.

Pairwise comparisons	Temperature	Mean	N	SD	SEM	t	df	*p**
Pair 1	Pre-operative	36.71	39.00	0.30	0.05	-0.761	38	0.451
	During anesthesia	36.74	39.00	0.36	0.06			
Pair 2	Pre-operative	36.72	33.00	0.32	0.06	0.674	32	0.505
	Luxation	36.67	33.00	0.26	0.05			
Pair 3	Pre-operative	36.66	30.00	0.30	0.05	0.107	29	0.916
	Forceps extraction	36.66	30.00	0.33	0.06			
Pair 4	Pre-operative	36.71	39.00	0.30	0.05	0.000	38	1.000
	Post-operative	36.71	39.00	0.36	0.06			
Pair 5	During anesthesia	36.80	33.00	0.33	0.06	2.040	32	0.050
	Luxation	36.67	33.00	0.26	0.05			
Pair 6	During anesthesia	36.68	30.00	0.36	0.07	0.396	29	0.695
	Forceps extraction	36.66	30.00	0.33	0.06			

Pair 7	During anesthesia	36.74	39.00	0.36	0.06	0.612	38	0.544
	Post-operative	36.71	39.00	0.36	0.06			
Pair 8	Luxation	36.69	24.00	0.27	0.05	-0.200	23	0.843
	Forceps extraction	36.70	24.00	0.32	0.07			
Pair 9	Luxation	36.67	33.00	0.26	0.05	-1.766	32	0.087
	Post-operative	36.79	33.00	0.31	0.05			
Pair 10	Forceps extraction	36.66	30.00	0.33	0.06	0.244	29	0.809
	Post-operative	36.64	30.00	0.36	0.07			

Table 6: Past experience of tooth extraction and vital signs.

Variables		N	Mean	SD	SE	95% CI		F	p-value
						LB	UB		
Diastolic BP Preoperative	Good [a]	17	84.71	10.13	2.46	79.50	89.91	6.524	0.004
	Bad [a]	10	71.00	8.99	2.84	64.57	77.43		
	First experience	16	76.50	10.19	2.55	71.07	81.93		
	Total	43	78.47	11.14	1.70	75.04	81.89		
Pulse rate During anesthesia	Good	17	77.24	18.53	4.49	67.71	86.76	3.848	0.030
	Bad	10	76.50	11.30	3.57	68.42	84.58		
	First experience	16	92.31	19.46	4.87	81.94	102.68		
	Total	43	82.67	18.70	2.85	76.92	88.43		
Pulse rate during forceps extraction	Good	15	72.27	39.50	10.20	50.39	94.14	5.480	0.009
	Bad	9	47.56	41.48	13.83	15.67	79.44		
	First experience	14	93.86	13.15	3.51	86.27	101.45		
	Total	38	74.37	36.65	5.95	62.32	86.42		
Systolic BP during forceps extraction	Good [a]	12	124.33	13.55	3.91	115.72	132.94	6.633	0.004
	Bad [a,b]	5	151.80	15.69	7.02	132.32	171.28		
	First experience [b]	14	130.21	14.39	3.85	121.91	138.52		
	Total	31	131.42	16.73	3.00	125.28	137.56		

local anesthetic injection. However, no significant differences were observed during pairwise comparisons with regards to body temperature.

A one-way between subject's ANOVA was conducted to compare the effect of various vital signs in different groups with the past extraction experiences (Good, bad, and first experience). Diastolic blood pressure preoperatively [F=6.524, p=0.004], pulse rate during the anesthesia [F=3.848, p=0.030], and forceps extraction [F=5.480, p=0.009], and Systolic BP during forceps extraction [F=6.633, p=0.004] were found to differ significantly among subjects with past extraction experience. Further, post hoc analysis indicated a significant difference in the mean diastolic BP Preoperative between the good and bad past extraction groups. Similarly, mean systolic BP during forceps extraction was found to be significantly higher among the group having bad extraction experience compared to the good past extraction experience as well those undergoing first-time extractions [Table 6].

Discussion

The present study was conducted to assess stress levels among patients undergoing dental extractions in a dental institution in the Kingdom of Saudi Arabia. There are very few studies that have evaluated stress among patients undergoing dental extractions. The findings of the present study can pave the way for better patient care during dental extractions.

One of the crucial response systems of the body to stress, anxiety, phobia, fear, and pain is the somatic changes that one can observe in the body. However, this response mechanism is fraught with inherent limitation with this system being very subjective. The activation of the hypothalamic-pituitary-adrenal (HPA) axis is central to the body's response to stress.

The initial reaction of the body to stress during dental treatment procedures, including extraction, is an initial increase in blood pressure and heart rate. This is followed by a reduction in these parameters, which is due to the activation of the sympathetic nervous system in the body. One of the most common complications of dental extractions is vasovagal syncope. It is, therefore, imperative to monitor these clinical parameters to prevent vasovagal syncope and to enhance patient management during dental extractions.

The present study employed a specific Monitoring Devices (OMRON® M6 COMFORT & Geratherm® Infra-Red Non-Contact Thermometer) to collect vital signs data such as heart rate, blood pressure, and body temperature. This device was clinically validated by the Association of a medical instrument (AAMI), the European Society of Hypertension (ESH), and The British Hypertension Society (BHS). It facilitated the use of objective parameters to measure the stress response of the patients during dental extractions.

The results of the present study indicate that the mean pulse rate was highest during luxation. This is in contrast with the findings reported by Paramaesvaran and Kingon among patients undergoing extraction. The increase in the mean pulse rate might be due to the physical forces exerted during the luxation of the tooth. Although the patient is administered, local

anesthesia might still be able to perceive the forces generated during luxation. The patient might perceive this as a difficult phase, which might lead to an increased pulse rate. Similarly, systolic blood pressure was significantly raised during the stage of forceps extraction than any other stage. This finding is in disagreement with those observed by Paramaesvaran and Kingon. [22] The appreciation of the shearing forces of the forceps by the patients during extraction might lead to increased systolic BP in the patients.

It was also observed that temperature increase was noted only during the administration of LA and not in any other stages of the procedure. In a similar study conducted by Moorthi and Kumar [23] It was observed that pre-operative pain was significantly more than post-operative pain among patients undergoing extractions. The initial stress response might lead to the observed increase in the temperature. Once the body adapts to the crisis, the temperature increase might not be evident.

The clinical parameters employed in the present study can be routinely implemented in clinical practice by a majority of general dental practitioners. Numerous investigators have reported the use of salivary cortisol for measuring stress during dental treatment procedures, including exodontias. [24-26] Practical issues and logistical considerations have to be looked into for implementing these measures.

The present study has to be viewed in light of its limitations. The present study employed blood pressure and pulse rate as indicators of the stress response. The inclusion of respiratory rate, oxygen saturation, cortisol levels might shed more light on the topic. The findings from one dental institution cannot be generalized, and further studies are needed to confirm the results of the present study.

Conclusion

Blood pressure was significantly higher during the step of forceps extraction than any other stage, including the luxation step. The pulse rate was considerably higher at luxation than during the forceps extraction. Blood pressure during forceps extraction was found to be significantly higher among the group having a bad extraction experience compared to the excellent and first time experience. Straight Elevator was found to be the most instruments related to stress elevation in all dental extraction procedures.

Exodontia and the use of local anesthesia can lead to a stress response mechanism is a majority of patients. It is the primary responsibility of the dental health care professionals to reduce the patient's stress, anxiety and fear during the dental treatment procedures. It is, therefore, imperative that the practitioners should keep themselves abreast of stress management techniques for appropriate patient care. Strict clinical protocols should be adhered to during these treatment procedures. Extraction of teeth should be performed by following these protocols to minimize trauma and the resulting stress and anxiety among patients.

Clinical parameters such as heart rate, blood pressure, and pulse rate are easy to monitor and can provide vital clues related to stress response among patients undergoing extractions. General dental practitioners should implement these simple but effective measures to monitor stress levels during extractions. All possible measures to alleviate stress among dental patients should be implemented for enhanced patient care.

Competing Interests

The authors declare that they have no competing interests.

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