Research Article

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The Relationship Between Dental Anxiety Level and Patients' Knowledge of the Procedure

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Abstract

Background and Aim: Patients avoid dental treatments due to fear and anxiety. Our aim is to determine the relationship between dental anxiety level and patients' knowledge of the procedure steps to be conducted, and to perceive the correlation between heart rate and dental anxiety.

Material and Methods: A random sample of patients were divided into two groups. The study group were shown a video describing the dental procedure, after filling the Modified Dental Anxiety Scale (MDAS) questionnaire. The heart rates of the study group were recorded four times with a pulse Oximeter; in the waiting area, while watching the video, on the dental chair and after the procedure. The control group had their heart rates recorded three times; without watching videos.

Results: Increased heart rate was detected while watching the video, and when seated on the dental chair, the study group showed a higher heart rate reading than the control group.

The study group showed a higher salivary cortisol level than the control.

Discussion: Salivary cortisol and heart rate can be reliable to confirm patient's anxiety level. A positive relation was found between MDAS and both heart rate and salivary cortisol. Our study revealed increased dental anxiety among patients receiving detailed information about the procedures.

Introduction

Three different terms have been used concerning dental apprehension in the literature:

Dental anxiety, fear and phobia of pain remain globally widespread and are considered major barriers to dental treatment^[1]. Generally fear is defined as an individual's response to a real threatening event or dangerous situation to protect his or her life^[2], while Specific phobia is an anxiety disorder classification that represents unreasonable or irrational fear related to a specific object or situation^[3].

Fear is considered to be aroused by a real, immediately present, specific stimulus (e.g. needles, drilling), whereas in the case of anxiety, the source of the threat is unclear, ambiguous, or not immediately present^[4, 5]. In 1998 Canakci noted that a patient with a high DAS (Dental Anxiety Score) would be more likely to present a high pain response than a patient with a lower DAS^[6]. People

with high DAS exhibit more pain after dental treatment^[7, 8].

A British study conducted in 2004, assessed the fear of dental pain among 1,800 students, and found that 17% reported dental fear, and 73% reported that oral health status affects quality of life^[9].

In 2009 W. Al-Omari and M. Al-Omari, concluded that the lack of adequate dental health education may result in a high level of dental anxiety among non-dental university students in Jordan^[10]. Another study in 2011, involving 1,600 Saudi students, revealed that 22% displayed a high degree of dental fear^[11]. In the same year, a different study was carried out in Pakistan, assessed discomfort with regard to dental treatment among 503 university students, and found that 21.6% of men and 24.0% of women reported negative sensations in relation to dental treatment^[12].

Anxiety related to dental treatment is a well-known phenomenon that has been reported to cause 6% of the general population to

avoid dental treatments^[13]. This avoidance of dental treatment, lead to poorer oral health and oral health-related quality of life^[14, 15].

Test of anxiety

The biological correlates of anxiety have not been widely examined, but the social examination using questionnaires is often used as a stress indicator. Stress related effects have been noted for hematological indices such as red blood counts, hemoglobin^[16], blood pressure, heart rate^[17], immunity in the form of natural killer cells activity^[18] and hormones such as cortisol^[19]. In addition, it appears that there is disparity between social examination (self-reported) and physiological stress that have not been correlated well enough in the literature. This demonstrates the importance of utilizing both social and physiological tests.

When the ANS (Autonomic Nervous System) gets activated, it releases epinephrine and nor epinephrine from the adrenal medulla^[20]. Upon activation of the hypothalamic-pituitary-adrenal axis, cortisol is secreted from the adrenal cortex to the saliva and all other body fluids^[21]. It was demonstrated in the past that salivary cortisol increases in response to stress and anxiety, and that it also presents an easy, noninvasive way of measuring stress^[22]. Cortisol levels were shown to be higher in patients undergoing wisdom teeth extractions and before emergency dental care^[23]. Similar to alpha amylase, cortisol has a definite circadian rhythm^[21].

In 2006, A.J. Van Wijk concluded that fear of pain for endodontic treatment can be decreased significantly by providing positive information about Endodontic treatment^[24]. A Saudi study found that oral health knowledge will enhance oral health by transforming knowledge into appropriate behaviors^[25]. In 2005, an Indian study concluded that the impact of dental fear on oral health related quality of life was significantly higher among non school going than school going children, due to low socioeconomic status and lack of awareness towards oral health and lack of dental visits^[26].

The major objective of this study is to determine the relationship between dental anxiety level and patients' knowledge of procedure steps to be conducted and to prove the correlation between salivary cortisol level, and heart rate with dental anxiety.

Material and Method

A random sample of eighty patients between the ages of 20 to 50 years old who attended Riyadh Colleges of Dentistry & Pharmacy's dental clinic, were divided in to two groups, a study and control group. The study group was shown a video describing the dental procedure steps, after filling the Modified Dental Anxiety Scale (MDAS) questionnaire. The study group participants' heart rates were recorded four times with a pulse Oximeter; in the waiting area, while watching the video, on the dental chair before receiving local anesthesia, and finally after the procedure. The control group did not watch the video and had their heart rates recorded three times: in the waiting area, on the dental chair and after the procedure. A saliva sample was collected utilizing the method of passive drooling. Participants were asked to allow the saliva to pool at the floor of the mouth first, before ejecting it. Sample collection was done over a maximum of 5 minutes; time and volume of the samples were recorded. All the samples were stored at 5 degrees Celsius until the saliva cortisol analysis was performed in the specialized laboratory. Any Patient with medical disorder, psy-

chological disorder, under any pain or anxiety medication, smokers, alcoholics, pregnant women and patients who refused to give informed consent were excluded from the study.

The Questionnaire

The instrument of study used in this research will be based on the Modified Dental Anxiety Scale (MDAS); which is a brief, self-complete questionnaire consisting of five questions each with a 5 category rating scale from 'not anxious' to 'extremely anxious'. It is the most well-known adult questionnaire designed to assess dental anxiety^[27]. The original English version of the MDAS questionnaire was translated by experienced bilingual professional who was fluent in English (and for whom Arabic was her native language) translated the questionnaire from English to Arabic. The Arabic version of the MDAS had excellent internal consistency and reliability (Alpha coefficients > 0.90). The scale was uni-dimensional, and the percentage of patients with dental anxiety was 48.3%^[15].

Physiological Test

Pulse Oximeter

The Pulse Oximeter is a non-invasive method for monitoring a person's oxygen saturation and heart rate. Its most common (transmissive) application mode, a sensor device is placed on a thin part of the patient's body, usually a fingertip. The device passes two wavelengths of light through the body part to a photo detector. It measures the changing absorbance at each of the wavelengths, allowing it to determine the absorbance due to the pulsing arterial blood alone, excluding venous blood, skin, bone, muscle, fat, and nail polish (in most cases)^[28].

Salivary Cortisol

A saliva sample was collected at the same time range for both groups utilizing the method of passive drooling, using 2-mL cryovials. Participants were asked to allow the saliva to pool at the floor of the mouth first, before ejecting it into the cryovials through a short piece of straw. Samples collections were done over a maximum of 5 minutes; time and volume of the samples were recorded. The samples then were sent to the lab for salivary cortisol measurement. Suggested in this study and the test were performed and interpreted following instruction out lined in kit (Human Cortisol ELISA Kit) MyBioSource, USA.

Principle of the test

The kit uses a double-antibody sandwich enzyme-linked immunosorbent Assay (ELISA) to assay the level of Human Cortisol (CORTISOL) in saliva. Human Substance Cortisol (CORTISOL) of saliva were positively correlated assay procedure:

1. Standard dilution: this test kit will supply one original Standard reagent and dilution occurs according to the instruction.
2. The quantity of the plates depends on the quantities of to-be-tested saliva and the standards.
3. Inject saliva: Blank well: don't add saliva and CORTISOL – antibody labeled with biotin, Streptavidin-HRP, only Chromogen solution A and B, and stop solution are allowed; other operations are the same.

Standard wells: add standard 50µl, Streptavidin-HRP 50µl (since the standard already has combined biotin antibody, it is not neces-

sary to add the antibody); to be test wells: add saliva 40µl, and then add both CORTISOL -antibody 10µl and Streptavidin-HRP 50µl. Then seal the sealing membrane, and gently shaking, incubated 60 minutes at 37C⁰.

4.Confection: dilute 30 times the 30×washing concentrate with distilled water as standby.

5. Washing: remove the membrane carefully, and drain the liquid, shake away the remaining water.

6. Add chromogen solution A 50µl, then chromogen solution B 50µl to each well. Gently mixed, incubate for 10 min at 37 C⁰ away from light.

7. Stop: Add Stop Solution 50µl into each well to stop the reaction (the blue changes into yellow immediately).

8. Final measurement: take blank well as zero, measure the optical density (OD) under 450 nm wavelength which should be carried out within 15min after adding.

9. According to standards' concentration and the corresponding OD values, calculate out the standard curve linear regression equation, and then apply the OD values of the saliva on the regression equation to calculate the corresponding saliva's concentration.

Statistical Analysis

All the data were statistically analyzed with the IBM-SPSS ver.21 data processing software (IBM corp. Armonk, NY, USA). One-way ANOVA test were used to compare control & study group salivary cortisol levels & heart rate differences in all stages. Cramer's Contingency Coefficient test was used to compare MDAS score in both groups. While Pearson correlations were used to correlate between salivary cortisol levels & heart rate on the dental chair, and Spearman Rank Correlation were used to correlate between MDAS, heart rate & salivary cortisol levels.

Results

The result obtained showed that from the 80 volunteers who participated in the research, 51 (63.75%) were female, and 29 (36.25%) were male. The mean age was 31.35 for both groups (Fig.1, 2). (Fig.1, 2) also shows the education level of our participants. All of them followed this study's inclusion criteria. Both groups had a normal heart rate value in the waiting area. An increase in the heart rate reading was found in the study group while watching the video. Both groups showed a noteworthy higher HR on the dental chair (P=0.36). While there was no significant difference in the HR after the procedure (P=0.771).

Fig.1: Show's Female and male level of education for control group

Fig.2: Show's Female and male level of education for Study group

This study investigated the difference in cortisol level between the control and study group; and found out that the mean value for salivary cortisol level in the study group was higher than the control group, even though it was statistically not significant (P value=.163) (**Table.1**).

Table.1: Salivary cortisol levels for control and study groups.

Salivary Cortisol Level							
Patient group							
Type	N	Mean	Std. Deviation	Variance	Minimum	Maximum	Range
Control	40	6.3487	2.55175	6.511	1.13	10.70	9.57
Study	40	7.6306	5.12983	26.315	.50	19.92	19.42
Total	80	6.9897	4.07695	16.622	.50	19.92	19.42

Prior to dental treatment; in the waiting area; both control and study groups showed normal heart rate readings (< 90Beats/Minute). While watching the video, the study group showed an increased heart rate. When seated on the dental chair, both groups displayed increased heart rate readings, however when compared with the waiting area readings, the study group showed higher readings than the control group (**Table 2**)(**Fig.3**).

Table 2: Patients heart rates during stages of treatment for both groups.

Heart Rate:

Patient groups during stages	N	Mean	Std. Deviation	Variance	Minimum	Maximum	Range
Heart Rate Waiting Area Control	40	83.3250	13.82378	191.097	56.00	113.00	57.00
Heart Rate Waiting Area Study	40	85.9750	11.19406	125.307	61.00	104.00	43.00
Heart Rate Dental Chair Control	40	82.8500	15.82363	250.387	57.00	122.00	65.00
Heart Rate Dental Chair Study	40	89.2000	13.95634	194.779	64.00	124.00	60.00
Heart rate After Procedure Control	40	80.3250	12.72669	161.969	58.00	111.00	53.00
Heart rate After Procedure Study	40	85.1750	12.80202	163.892	56.00	110.00	54.00
Heart Rate Study in Waiting	40	85.9750	11.19406	125.307	61.00	104.00	43.00
Heart Rate Study while watching video	40	87.3750	9.92714	98.548	64.00	110.00	46.00
Total	320	85.0250	12.92852	167.147	56.00	124.00	68.00

Fig.3: Shows heart rate values in both groups through different stages.

From the sample we have in this study, we can say that all salivary cortisol level measurements for both groups were normally distributed, also there were no significant statistical differences between the groups means (± 6.34). However, the study group had a higher salivary cortisol level than the control, this difference is considered unimportant statistically (**Fig.4**).

Fig.4: Salivary cortisol levels in study and control groups

There is no relation between heart rate readings and salivary cortisol levels within each group; moreover, p_{Control} and p_{Study} are estimated to be 0.000 and they are equivalent (**Table 3**). There is

no statistically significant relationship between the groups' salivary cortisol (control and study) and questionnaire result

Table 3: Heart rate and salivary cortisol levels relation in both groups.

Heart rate and salivary cortisol levels

	Heart Rate on Dental Chair for Study	Cortisol level for Study	Heart Rate on Dental Chair for Control	Cortisol level for Control
N	40	40	40	40
Minimum	64.00	.50	57.00	1.13
Maximum	124.00	19.92	122.00	10.70
Range	60.00	19.42	65.00	9.57

The MDAS questionnaire was evenly distributed for both groups, they were asked to answer the questions blindly (without knowing which group they belonged to). As seen in the Bar chart (**Fig.5**)

both "Control" and "study" carry the same proportion when it comes to the Questionnaire results: p Slightly anxious = 62.5%, π other anxious level for each category = 9.375%.

Fig.5: Questionnaire results proportions in both groups

There is no statistically significant correlation relationship between the salivary cortisol levels and questionnaire results for both groups (control & study). Both "Control" and "Study" have a value of $p = 0.00$ with salivary cortisol levels (**Table 4, 5**). Further-

more, there is no statistically significant correlation relationship between HR in the waiting area and the questionnaire results for both groups (control & study). Both "Control" and "Study" have a value of $p = 0.00$ with HR in the waiting area (**Table 6, 7**).

Table 4: Salivary cortisol levels and questionnaire results for control group.

Salivary cortisol levels and questionnaire results

			Questionnaire Result	Salivary Cortisol Level
Spearman's rho	Questionnaire Result	Correlation	1.000	.081
		Coefficient		
		Sig. (2-tailed)	.	.618
		N	40	40
	Salivary Cortisol Level	Correlation	.081	1.000
		Coefficient		
		Sig. (2-tailed)	.618	.
		N	40	40

Table 5: Salivary cortisol levels and questionnaire results for study group.

Salivary cortisol levels and questionnaire

			Questionnaire Result	Salivary Cortisol Level
Spearman's rho	Questionnaire Result	Correlation	1.000	.175
		Coefficient		
		Sig. (2-tailed)	.	.279
		N	40	40
	Salivary Cortisol Level	Correlation	.175	1.000
		Coefficient		
		Sig. (2-tailed)	.279	.
		N	40	40

Table 6: Heart rate in the waiting area and the questionnaire results in control group.

Heart rate in the waiting area and the questionnaire

			Questionnaire Result	Heart Rate in the Waiting area
Spearman's rho	Questionnaire Result	Correlation	1.000	-.021
		Coefficient		
		Sig. (2-tailed)		
		N		
	Heart Rate in the Waiting area	Correlation	-.021	1.000
		Coefficient		
		Sig. (2-tailed)		
		N		

Table 7: Heart rate in the waiting area and the questionnaire results for study group

Heart rate in the waiting area and the questionnaire results

			Questionnaire Result	Heart Rate in the Waiting area
Spearman's rho	Questionnaire Result	Correlation	1.000	-.104
		Coefficient		
		Sig. (2-tailed)		
		N		
	Heart Rate in the Waiting area	Correlation	-.104	1.000
		Coefficient		
		Sig. (2-tailed)		
		N		

Discussion

Emotional stresses increase the activity of the HPA (hypothalamic-pituitary-adrenal axis), which results in an enhanced secretion of adrenocortical hormones, and salivary cortisol is a reliable measure for assessment of its activity [29]. In stressful situations, the sympathetic nervous system is responsible for the release of epinephrine and norepinephrine, which causes the acceleration of heart rate[30]. In this study the mean value for cortisol level in the study group was higher than the control group, even though it was statistically not significant (P value= .163) that might be due to a small sample size. Noriyasu Takai et al. participants also showed an increase in cortisol level when shown a stressful video.[22]

The lowest HR reading was recorded at the end of the procedure; although the study group showed a lower reading than the control group. A similar study was done in 2014 by S.C.Panie et al. also found that the lowest heart rate recorded was after procedure, while the highest was during implant placement [31]. Another study by J.C.Goylart et al. contradicted our findings, stating that the heart rate did not change during the dental treatment in relation to the anxiety level presented by the patients [32]. That might be because of different methodology in their study they used the "Dental Anxiety Scale", aneroid sphygmomanometer and a professional cardiologic stethoscope to measure the heart rate and blood pressure, while in our study we used MDAS and pulse oximeter to measure the heart.

Salivary cortisol levels and questionnaire results are compared for both "Control" and "Study" groups and showed no statistically significant correlation, although a positive relation was present between both of them. In a disagreement with our result K.Kanegane et al. stated that there was a tendency for negative association between salivary cortisol and MDAS score[33]. That might be due to different saliva collection method, they asked their subjects to hold a soft cotton roll in the mouth until it was saturated with saliva then it was transferred to a plastic tube. Moreover, there is no statistically significant correlation between heart rate in the waiting area and questionnaire results for both groups.

Conclusion

Salivary cortisol level and heart rate can be reliable methods to confirm patient's anxiety level. A positive relation found between anxiety scale and both heart rate and salivary cortisol, even though the correlation between them is not detected. Our study revealed increasing of dental anxiety among patients receiving detailed information about the producers' steps prior to their treatment.

Recommendation:

Further investigation with larger sample size is needed in the future to determine the correlation between the heart rate and salivary cortisol level.

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