Patient's experience with pain influences the pain, anxiety and cardiovascular responses during extraction of tooth

La experiencia del paciente con el dolor influye en el dolor, la ansiedad y las respuestas cardiovasculares durante la extracción del diente

Haydar Munir Salih*, Senior Lecturer in Maxillofacial Surgery, Department of Dentistry, Al-Rafidain University College, Baghdad, Iraq. email: ghinah09@gmail.com
Marwan S.M. Al-Nimer, Professor of Pharmacology, College of Pharmacy, Hawler Medical University. e mail: alnimermarwan@ymail.com marrwan@pha.hmu.edu.krd. Researcher ID: 18036403100,
Nawres Bahaa Mohammed, lecturer, University of Al-Ameed College of dentistry, nawres_bahaa@yahoo.com
Received/Recibido: 12/28/2020 Accepted/Aceptado: 01/15/2021 Published/Publicado: 02/10/2021 DOI: http://doi.org/10.5281/zenodo.5111001

Abstract

Background: Pain and anxiety are common symptom in dental practice, and they involved in the alteration of the hemodynamic responses. Aim: This study aimed to demonstrate the role of a patient's experience with pain in the hemodynamic responses that observed in the practice of tooth extraction. Materials and Methods: This observational cohort study was carried in the Clinics of Dentistry at the Department of Dentistry in the Al-Rafidain University College in Baghdad-Iraq through 2019. A total number of 70 patients (48 males and 22 females) aged 15-66 years were included in this study. The authors assessed the severity of the pain by using visual analogue scale (VAS), the anxiety by using Corah's Dental Anxiety Scale-Revised and the hemodynamic responses, including heart rate, blood pressure, arterial stiffness, and myocardial work stress before and after teeth extraction. Results: females expressed pain, anxiety and changes in the hemodynamic responses more than males. The VAS score is significantly and inversely correlated with age (r= -0.314, p=0.008). Anxiety is significantly correlated with heart rate (r=0.244, p=0.042) and myocardial work stress (r=0.232, p=0.05). The VAS score was significantly less in patients who previously experienced pain due to the concomitant illnesses while the mean ±SD of the hemodynamic responses were significantly higher than the corresponding values of patients without pain experience. Conclusion: there are many factors influencing the level of anxiety and pain, and patients with previous history of pain due to other diseases are at risk of activation of hemodynamic responses.

Keywords: Tooth extraction; Pain, Anxiety; Hemodynamic responses; Pain experience.

Resumen

Antecedentes: el dolor y la ansiedad son síntomas habituales en la práctica odontológica, e intervienen en la alteración de las respuestas hemodinámicas. Objetivo: Este estudio tuvo como objetivo demostrar el papel de la experiencia de un paciente con el dolor en las respuestas hemodinámicas que observa en la práctica de la extracción dentaria. Materiales y métodos: Este estudio de cohorte observacional se llevó a cabo en las Clínicas de Odontología del Departamento de Odontología del Colegio Universitario Al-Rafidain en Bagdad-Irak hasta 2019. Un total de 70 pacientes (48 hombres y 22 mujeres) de entre 15 y 15 años. En este estudio se incluyeron 66 años. Los autores evaluaron la gravedad del dolor mediante el uso de una escala analógica visual (EVA), la ansiedad mediante el uso de la Escala de ansiedad dental revisada de Corah y las respuestas hemodinámicas, incluida la frecuencia cardíaca, la presión arterial, la rigidez arterial y el estrés del trabajo del miocardio antes y después de la extracción de los dientes. Resultados: las mujeres expresaron más dolor, ansiedad y cambios en las respuestas hemodinámicas que los hombres. La puntuación EVA se correlaciona de forma significativa e inversa con la edad (r= -0,314, p=0,008). La ansiedad se correlaciona significativamente con la frecuencia cardíaca (r=0,244, p=0,042) y el estrés laboral del miocardio (r=0,232, p=0,05). La puntuación EVA fue significativamente más baja en pacientes que previamente experimentaron dolor debido a enfermedades concomitantes, mientras que la media ± DE de las respuestas hemodinámicas fue significativamente más alta que los valores correspondientes de pacientes sin experiencia de dolor. Conclusión: son muchos los factores que influyen en el nivel de ansiedad y dolor, y los pacientes con antecedentes previos de dolor por otras enfermedades tienen riesgo de activación de respuestas hemodinámicas.

Palabras Clave: extracción de dientes; Dolor, ansiedad; Res-puestas hemodinámicas; Experiencia de dolor.

Introduction

Lidocaine is the most common anesthetic agent used to block the inferior alveolar nerve, and prevent the pain that associated the tooth extraction. Some authors believed to use other substances to potentiate the effect of lignocaine e.g. mannitol[1]. It has been found that injection of lignocaine by computer-controlled device is a satisfactory method to reduce the pain and cardiac response during tooth extraction in children[2]. In addition to the pain, the patient under the tooth extraction complained from anxiety. Anxiety is common among young-age patients and a higher Corah's Dental Anxiety scale score was observed before administration of lignocaine[3]. In children aged 6-9 subjected to different dental procedures, including assessment of caries, topical fluoride application, endodontic treatment and tooth extraction, anxiety significantly observed at the moment of these procedures[4]. Jeddy et al (2018) conducted a survey study on the 300 patients aged >18 years and found that anxiety is more common among females and professional patients compared with the males (65.2% versus 34.8%) and (66.9% versus 33.1%), respectively.[5] Moreover, the frequency of the dental visit also directly impacts the anxiety[5]. Anxiety is associated with the cardiovascular response, including increased heart rate and labile blood pressure, during anesthesia[3]. Gadve et al (2019) observed that the blood pressure increased during ostectomy/tooth sectioning while the heart rate increased after tooth extraction[6]. Heart rate variability is a good marker for assessing the stress during the dental extraction, and dental experience is directly correlated with the patient's anxiety[7]. Pain during the surgical procedure of extraction causes anxiety and both of them may impact an adverse effect on the cardiovascular response. The aim of this study is to demonstrate the hemodynamic response before and after dental extraction and to relate these responses to the pain and anxiety. Moreover, this study also investigates the effect of patient's experience with pain on the cardiovascular response.

Materials and methods

The Scientific, Ethical Committee at the Al-Rafidain University College approved this study. The study conducted according to the guidelines of the Helsinki Declaration, and any device or medical intervention should be harmless and the patient if free to withdraw from the study at any time. Each patient signed a consent form prior to include in the study. This study was done in the Clinics of Dentistry in the Department of Dentistry in the Al-Rafidain University College in Baghdad-Iraq through 2019. Consultants of Prosthodontics referred the patients for tooth extraction. All the patients had a previous dentist visit for tooth extraction with a duration ranged between 2 months and 10 years. Schematic diagram-1 showed the frequency distribution of extracting teeth in respect to its position.

Patients with hypertension and diabetes were under control before tooth extraction. Patients with a history of previous ischemic heart disease, cardiac arrhythmias, and heart failure were excluded from the study. The authors assessed the severity of the pain by using visual analogue scale (0-10). Scores for no pain: 0-2, mild pain: 3-4, moderate pain: 5-6, severe pain: 7-8, and worst pain: 9-10. Anxiety was assessed by using Corah's Dental Anxiety Scale-Revised which composed from 4 multiple choice stem questions, and each one consisted of 5 options. Score for mild anxiety: <9, moderate anxiety: 9-12, high anxiety: 13-14, and severe anxiety (phobia): 15-20). Heart rate and blood pressure were measured at sitting position after a few minutes rest, and the mean of three readings is considered. The following hemodynamic responses were determined:

Pulse pressure (mmHg) = systolic blood pressure minus diastolic blood pressure

Pulse pressure index as a marker of arterial stiffness =

$$\frac{pulse\ pressure}{systolic\ blood\ pressure}$$

Mean arterial blood pressure (mmHg) = diastolic blood pressure + (⅓ pulse pressure).

Myocardial work stress =

$$\frac{Heart\ rate \times systolic\ blood\ pressure}{100}$$

Scores of hemodynamic response: Low: 100-149.9, Low intermediate: 150-199.9, Intermediate: 200-249.9, High intermediate: 250-299.9, High: ≥ 300

The authors examined and interviewed each patient before extracting tooth and after tooth extraction. The authors recorded the characteristic features of the patients,

including history of concomitant diseases. Concomitant diseases were sub-grouped to those presented with pain and frequently treated with pain killers, antidepressants and mood stabilizing agents. This group is considered as patient's experience pain, which included patients with a history of migraine, tension headache, fibromyalgia, chronic fatigue syndrome, myofacial syndrome, restless leg, chronic neck and back pain. Second group included patients with systemic chronic diseases, including controlled hypertension, diabetes mellitus, stable previous ischemic heart disease, thyroid gland disorders and epilepsy. None of the patients used pain killers at least 24 hours before extraction. The dentist planned his surgical procedure to extract only one tooth.

A total number of 70 patients (48 males and 22 females) aged 15-66 years were included in this study. The results are presented as number, percentage, median, interquartile range and mean ± SD. The data were analysed using two-tailed paired t-test taking, and a simple Pearson's correlation test. The P-value of ≤ 0.05 is considered significant. The statistical analysis and the illustration of the figure were done by using the Excel 2007 software.

Results

Table 1 shows the characteristics of the participants enrolled in this study. A female to male ratio was 1:2.18 with a non-significant (p=0.115) lower age. 27.1% of the participants were current smokers and 20% of the participants were ex-smokers. A wide pattern of co-morbidities was observed. 27.1% of patients had a history of hypertension, diabetes mellitus, ischemic heart disease and thyroid gland disorders (Table 1). 36 out of 70 (51.4%) participants had a history of neuro-fibro-muscular pains including migraine, tension headache, fibromyalgia, chronic fatigue syndrome, myofacial syndrome, chronic neck and back pain (Table 1).

Different therapeutic modalities were used by participants at the time of enrollment in this study. The median values of VAS for pain and DAS-R among females were higher than the corresponding values among males which accounted 6.0 and 1.47 folds. Hemodynamic determinants were within normal levels, and females showed a higher hemodynamic response, represented by rate pressure product than males, which accounted an increment of 3.2% (Table 2). The frequency distribution of patients, according to the score of the pain is: no pain: 43, mild: 14, moderate: 9, severe: 2, and worst: 2, and the frequency distribution of complaining anxiety are: mild: 36, moderate: 21, high: 4, and severe: 9.

Clinical assessment of each participant, before the procedure of tooth extraction was done, showed that there were non-significant correlations between the visual analogue score for pain with the DAS-R or any of hemodynamic determinants (Table 3). Significant positive correlations between the DAS-R with the heart rate and myocardial stress (Table 3) were observed. Figure 1 shows that there is a significant inverse correlation between the VAS for pain with the age (r=-0.314, p=0.008), while a non-significant correlation (r=+0.049, p=0.687) between DAS-R with age observed.

Table 4 shows that the procedure of tooth extraction does not produce a non-significant increment in the hemodynamic determinants, while the pressure pulse index, as a determinant of arterial stiffness was decreased to 99 % of the pre-extraction value.

Table 5 shows that patients with pain co-morbidities have significantly higher baseline data of hemodynamic determinants including, systolic, diastolic, pulse pressure, mean arterial blood pressure, and myocardium stress and a significantly low VAS. After the dental extraction, the participants with pain co-morbidities still have significantly higher systolic, pulse pressure, mean arterial blood pressure and myocardial stress.

Tabla 1: Frequency distribution of extracted tooth according to its position

Upper left	**4**	**Central incisor**	**1**	**Upper right**
	2	Lateral incisor	0	
	6	Canine	0	
	8	First premolar	5	
	1	Second premolar	3	
	4	First molar	2	
	1	Second molar	0	
	4	Third molar	1	
Lower left	3	Third molar	3	Lower right
	0	Second molar	3	
	1	First molar	3	
	3	Second premolar	4	
	0	First premolar	4	
	1	Canine	0	
	2	Lateral incisor	0	
	0	Central incisor	1	

Table 2: Clinical assessments of patients before extraction

Variables	Females (n=22)	Males (n=48)	Total (n=70
Visual analogue score	3.0 (0.25-4.0)	0.5 (0-3.0)	1.5 (0-4.0)
Dental Anxiety Scale-revised score	11.0 (7.0-13.75)	7.5 (5.0-11.0)	8.0 (5.0-12.0)
Heart rate (beat/min)	80.5 (75.75-91.5)	80.0 (70.0-90.0)	80.0 (70.25-90.0)
Systolic blood pressure (mmHg)	120.0 (115.5-139.5)	127.5 (120.0-140.5)	122.0 (119.0-140.0)
Diastolic blood pressure (mmHg)	74.0 (70.0-80.0)	76.0 (70.0-83.25)	75.5 (70.0-81.75)
Pulse pressure (mmHg)	49.5 (41.5-59.0)	51.0 (42.75-60.0)	50.0 (42.25-60.0)
Pulse pressure index	0.411 (0.359-0.435)	0.393 (0.369-0.441)	0.403 (0.365-0.438)
Mean arterial blood pressure (mmHg)	90.65 (85.65-97.64)	93.3 (87.23-101.98)	92.65 (86.65-99.98)
Rate pressure product (myocardial work stress)	105.9 (86.43-118.4)	102.7 (95.2-114.3)	103.0 (93.2-115.2)

Table 3: Correlation between VAS and DAS with the hemodynamic responses

Variables	Visual analogue scale (score)	Dental Anxiety Scale-Revised (score)
Visual analogue scale (score)		
Dental Anxiety Scale-Revised (score)	0.035 (0.775)	
Heart rate (beat/min)	0.158 (0.192)	0.244 (0.042)
Systolic blood pressure (mmHg)	-0.187 (0.122)	0.035 (0.776)
Diastolic blood pressure (mmHg)	-0.158 (0.191)	0.119 (0.326)
Pulse pressure (mmHg)	-0.128 (0.291)	-0.41 (0.736)
Pulse pressure index	-0.043 (0.722)	-0.060 (0.620)
Mean arterial blood pressure (mmHg)	-0.189 (0.116)	0.087 (0.472)
Rate pressure product (beat/min.mmHg)	0.006 (0.981)	0.232 (0.050)

Figure 1: Correlation between age (independent) and the VAS score (r= -0.314, p=0.008) and the DAS-R score (r= +0.049, p=0.687). VAS: visual analogue scale for pain, DAS-R: Dental Anxiety Scale-Revised)

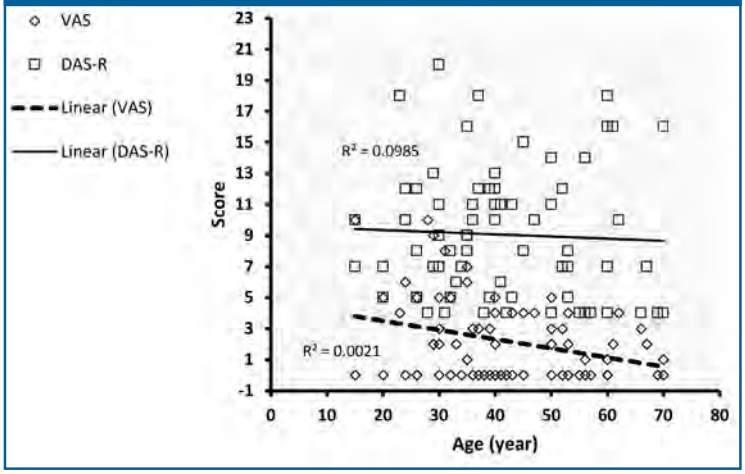

Table 4: Effect of tooth extraction on the hemodynamic responses

Hemodynamic parameters	Before extraction	After extraction	p-value
Heart rate (beat/min)	81.7±13.1	83.0±12.4	0.294
Systolic blood pressure (mmHg)	128.4±17.8	129.0±19.5	0.739
Diastolic blood pressure (mmHg)	76.4±9.9	76.8±11.8	0.799
Pulse pressure (mmHg)	52.0±13.7	52.2±19.2	0.915
Pulse pressure index	0.400±0.068	0.396±0.100	0.788
Mean arterial blood pressure (mmHg)	93.7±11.4	94.2±11.7	0.719
Rate pressure Product (beat/min.mmHg)	104.5±20.5	106.6±19.6	0.322

Table 5: effects of dental extract procedure on the VAS for pain, DAS-R, and hemodynamic determinants and response according to co-morbidities of pain.

Determinants	Before			After		
	History with pain (n=34)	No-history of pain (n=36)	p-value	History with pain (n=34)	No-history of pain (n=36)	p-value
Visual analogue score	1.53±2.14	2.89±2.92	0.028			
DAS-R	9.38±4.45	8.75±4.13	0.541			
Heart rate	81.3±13.1	82.1±13.3	0.763	82.8±11.4	83.1±13.4	0.916
Systolic blood pressure	135.1±15.8	122.0±17.4	0.002	135.0±18.4	123.3±19.0	0.011
Diastolic blood pressure	79.6±8.5	73.4±10.3	0.007	77.9±11.1	75.7±12.4	0.423
Pulse pressure	55.5±12.6	48.6±14.0	0.035	57.1±18.0	47.6±19.4	0.038
Pulse pressure index	0.407±0.059	0394±0.077	0.419	0.417±0.092	0.378±0.106	0.109
Mean arterial blood pressure	98.1±9.8	89.6±11.3	0.001	96.9±11.1	91.5±11.8	0.052
Rate pressure product (myocardium work stress)	109.5±21.2	99.8±18.9	0.048	111.4±18.6	102.±19.7	0.044

The results are expressed as mean ± SD. P-value was calculated using two-tailed student's t-paired test. VAS: visual analogue scale score for pain, DAS-R: dental anxiety scale-revised score.

Discussion

The results of this study show there is more than one factor which influences the expression of pain, anxiety and cardiovascular responses that associated tooth extraction. These factors are the sex, age, and experience of pain due to the concomitant illnesses which usually present with pain. Females are more likely to express pain and anxiety during her visit to the dental clinics. This observation is in agreement with the other studies.[8] The median score of VAS in males is 0.5 and in the females is 3.0 indicating the patients experience mild pain and this score is in agreement with other studies.[9] The median value of the anxiety tooth extraction is 8.0 which is less than a corresponding anxiety score that reported by Cui et al (2019)[10] which accounted a mean ± SD of 10.21± 3.29, and females reported a higher anxiety score as our observations. We observed that males responded to the dental extraction by higher values of cardiovascular indices than females. This observation is contradictory to the results to other studies which found a significantly high blood pressure due to the pain and anxiety was observed in females aged 6-12 years old[11]. The reason behind this contradictory is related to the design of the study.

Pain is not the cause of the cardiovascular responses as there are non-significant correlations between the score of VAS and the hemodynamic changes while anxiety is responsible for increasing heart rate and myocardial work stress (Table 3). This observation confirmed other studies that showed anxiety is responsible for dysfunction of the autonomic nervous system during the dental surgical procedure represented by variability in the heart rate[12]. Dental anxiety score correlated positively with the myocardial work stress, which is in the range of low stress (100-159.9). There is evidence that anxiety per se is a cause of non-cardiac chest pain[13]. Therefore, it is necessary to alleviate the anxiety during dental surgical procedure in order to prevent the myocardial work stress which may lead to the myocardial ischemia. A significant inverse correlation between the age and the VAS score is observed in this study. This observation is in agreement with others who reported a higher rate of VAS-score in dental pediatrics[14], and patients over 18 years old have a low level of anxiety and pain[15]. Pain tolerance is an important factor that determines the level of anxiety and pain during dental extraction[10]. We observed that patients who experience pain due to the extra-dental causes can tolerate the pain and they have a level of anxiety and pain. Moreover, the hemodynamic responses are significantly higher in patients who tolerated the pain which indicates that there are other reasons that involved in activation of the autonomic sympathetic nervous system during dental extraction. This observation is in agreement with Le study[7] which found that there is no relationship between the anxiety level and the heart rate variability. Moreover, patients with chronic disorders e.g. diabetes, thyroid gland dysfunction are more likely to have dysfunction of autonomic nervous system, therefore, we expected a blunted hemodynamic response to the fear stress of dental extraction.

Conclusions

There are many factors influencing the level of anxiety and pain and patients with previous history of pain due to other diseases are at risk of activation of hemodynamic responses.

References

1. Pathak PK, Singh AK, Agrawal S, Singh D, Mali DK, Kumar U. Role of 0.5 M mannitol as an adjuvant with lidocaine with or without epinephrine for inferior alveolar nerve block: A randomized control trial. J Clin Exp Dent 2019; 11:e500-e550.
2. Patini R, Staderini E, Cantiani M, Camodeca A, Guglielmi F, Gallenzi P. Dental anaesthesia for children - effects of a computer-controlled delivery system on pain and heart rate: a randomised clinical trial. Br J Oral Maxillofac Surg 2018; 56:744-749.
3. Sharma A, Pant R, Priyadarshi S, Agarwal N, Tripathi S, Chaudhary M. Cardiovascular changes due to dental anxiety during local anesthesia injection for extraction. J Maxillofac Oral Surg 2019; 18:80-88.
4. Pezzini Soares J, Cardoso M, Bolan M. Demystifying behaviour and dental anxiety in schoolchildren during endodontic treatment for primary teeth-controlled clinical trial. Int J Paediatr Dent 2019; 29:249-256.
5. Jeddy N, Nithya S, Radhika T, Jeddy N. Dental anxiety and influencing factors: A cross-sectional questionnaire-based survey. Indian J Dent Res 2018; 29:10-15
6. Gadve VR, Shenoi R, Vats V, Shrivastava A. Evaluation of anxiety, pain, and hemodynamic changes during surgical removal of lower third molar under local anesthesia. Ann Maxillofac Surg 2018; 8:247-253.
7. Le SH, Tonami K, Umemori S, Nguyen LT, Ngo LT, Mataki S. The potential of heart rate variability for exploring dental anxiety in mandibular third molar surgery. Int J Oral Maxillofac Surg 2018; 47:809-815.
8. Laskin DM, Carrico CK. What do patients fear most about having oral surgery? Quintessence Int 2019; 50:204-207.

9. Zhang SY, Dong H. Investigation of teeth defect and repair status of elderly people in ading district, Shanghai. Shanghai Kou Qiang Yi Xue 2018; 27: 522-552

10. Cui QY, Chen SY, Fu S, Zhang CB, Li M. Survey and analysis of tooth extraction anxiety of dental patients. Hua Xi Kou Qiang Yi Xue Za Zhi 2018; 36:314-318.

11. Hegde N, Hegde SK, Bhat SS, Anbuselvan GJ, Bhandari DPK, Radhakrishnan S Evaluation of the effect of extraction and restorative procedures on blood pressure and pulse rate due to anxiety in 6- to 12-year-old children: An In Vivo Study. J Pharm Bioallied Sci 2019; 11(Suppl 2):S429-S433.

12. Yamashita K, Kibe T, Ohno S, Kohjitani A, Sugimura M. The Effects of music listening during extraction of the impacted mandibular third molar on the autonomic nervous system and psychological state. J Oral Maxillofac Surg. 2019; 77:1153.e1-1153.e8

13. Heppell JL, Denis I, Turcotte S, Fleet RP, Dionne CE, Foldes-Busque G.

Incidence of panic disorder in patients with non-cardiac chest pain and panic attacks. J Health Psychol 2019; Jun 28:1359105319859062.

14. Veneva E, Cholakova R, Raycheva R, Belcheva A. Efficacy of vibrotactile device DentalVibe in reducing injection pain and anxiety during local anaesthesia in paediatric dental patients: a study protocol for a randomised controlled clinical trial. BMJ Open 2019; 9:e029460

15. Piano RP, Vieira WA, Sousa-Silva J, Paranhos LR, Rigo L. Evaluation of anxiety levels and their characteristics in dental care: Cross-sectional study. Indian J Dent Res 2019; 30:300-304.