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Original Article

Dentistry Section

Evaluation of Anxiety Induced Cardiovascular Response in known Hypertensive Patients Undergoing Exodontia - A Prospective Study

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ABSTRACT

Introduction: Anxiety towards exodontic procedures is a common occurrence in dental practice. In hypertensive patients this anxiety induced stress may have an effect on cardiovascular system which may be clinically significant.

Aim: To evaluate the cardiovascular changes in hypertensive patients that may manifest following anxiety induced stress in patients undergoing exodontic procedures under local anaesthesia.

Materials and Methods: Eighty known hypertensive patients under medication reporting to Department of Oral and Maxillofacial surgery, Dayananda Sagar College of Dental Sciences Bangalore, Karnataka, India for extraction of teeth were taken up for the study. Anxiety was measured before local anaesthetic delivery using Amsterdam Pre-operative Anxiety and Information Scale (APAIS). Cardiovascular response data including blood pressure, heart rate, pulse rate, oxygen saturation and electrocardiographic changes were measured pre-operatively, immediately after local anaesthesia administration and Post-operatively at five, ten and fifteen minutes interval. Kruskal-Wallis test was used to compare continuous variables before and after the injection of local anaesthesia including heart rate, pulse rate, oxygen saturation, and blood pressure. Repeated-measures analysis of variance (ANOVA) was used to analyse the significance of changes in heart rate, pulse rate, blood pressure, and oxygen saturation over time between groups. Chi-square test was used to analyse the significance of electrocardiographic changes.

Results: The results revealed that the mean anxiety score before administration of local anaesthetic was 9.91(S.D ±2.9) with a range 4-20. Severe preoperative anxiety (<12) was associated with significantly increased heart rate, pulse rate, systolic blood pressure. At the pre-injection phase the mean values were systolic blood pressure (130.72±9.2), diastolic blood pressure (81.6±7.7), heart rate (72.7±11.9) and oxygen saturation (95.2±1.9). These values were increased immediately after local anaesthetic delivery and this relation was statistically significant for all parameters except oxygen saturation. Electrocardiographic abnormalities were found before and after injection of local anaesthetic (p>0.001). One patient showed right bundle branch block pattern.

Conclusion: Dental anxiety impacts the effects of delivery of local anaesthesia on blood pressure, heart rate, pulse rate and electrocardiograph and is significantly associated with the increase in systolic blood pressure, heart rate, pulse rate and changes in electrocardiograph. Thus, present study supported that increased anxiety in hypertensive patients who underwent extraction is associated with cardiovascular changes.

Keywords: Blood pressure, Electrocardiogram, Heart rate, Oxygen saturation

INTRODUCTION

The incidence of medically compromised patients receiving oral surgical procedures has increased tremendously for the past few decades because of better availability, affordability and awareness of medical care, thereby increasing the longevity.

Elevated blood pressure is one of the commonly encountered medical diseases in general population which might not exhibit any clinically discernible symptoms but can be easily detected on clinical examination and may have morbid complications if not diagnosed and treated early. Worldwide hypertension is estimated to cause 7.1 million premature deaths and 4.5% of the disease burden economically [1].

Dental surgeon plays a role in the recognition of patients with hypertension. Presently, there are considerable figure of subjects with undetected uncontrolled hypertension or high blood pressure who are seeking dental treatment. These patients are of potential risk for excessive bleeding during and after oral surgical procedures. They are also at high risk for significant complications such as stroke, heart disease, kidney disease and retinal disease [2].

Patients with high blood pressure receiving dental treatment are at a great risk for acute medical problems and hence, their blood pressure should be monitored during oral surgical procedures. Blood pressure is defined as the force exerted by the blood against any unit area of the vessel wall [3]. It has been demonstrated that both stress induced release of endogenous catecholamine and administration of local anaesthetic agents containing sympathomimetics can alter blood pressure [4].

Anxiety, fear and pain also play important and probably an underemphasized role in dental treatment. Although every procedure performed in dental office is capable of being viewed as frightening by the patient, anxiety related to injection of a local anaesthetic induces more fear [5]. The physiologic response is characterized by an increase in heart rate and blood pressure.

Use of epinephrine in local anaesthesia is to increase the depth and duration of anaesthesia and to reduce bleeding in the operative field and the absorption of the local anaesthetic in to the cardiovascular system, resulting in lower anaesthetic blood levels, thereby minimizing the risk of local anaesthetic toxicity

[6]. The administration of a vasoconstrictor in combination with local anaesthetics has been shown to be a source of exogenous catecholamine, which when combined with unmarked endogenous catecholamine induced from increased anxiety due to anticipation of the dental procedure, may cause unwanted side effects. Earlier study showed that the role of the catecholamine in local anaesthetic solutions and of endogenous catecholamine from the adrenal medulla released during stress remains to be established in the aetiology of cardiovascular reactions [5].

Use of epinephrine as an adjuvant to increase the effectiveness of the local anaesthetic when compared with the effect of epinephrine on cardiovascular system and the changes in haemodynamics, makes its use a controversial debate [6].

The present study hypothesized that anxiety has an additive effect on cardiovascular response to treatment with local anaesthetic solution during exodontia.

Thus, the purpose of this study was to evaluate cardiovascular changes in hypertensive patients that may manifest following anxiety induced stress in patients undergoing extraction under local anaesthesia.

MATERIALS AND METHODS

A cross sectional study was conducted among patients who visited the department of Oral and Maxillofacial Surgery in Dayananda Sagar College of Dental Sciences, Bangalore, Karnataka, India over a period of two years (2013-2015). Eighty known Hypertensive patients on medication both male and female aged between (40-60 years) to receive routine dental extraction under local anaesthesia were randomly selected. Sample size was calculated with 80% power and 5% alpha error using n- master software as eighty participants.

$n=(Z(1-\alpha)/^{2})^2\ p(1-p)/\ d^2$

$Z(1-\alpha)/^{2}$ - is standard normal variate at 5% type 1 error (i.e., 1.96)

p- expected proportion of patients based on census report of study institution.

d- absolute error or precision.

Ethical approval for the study was taken from Institutional Ethical Committee. A custom made case sheet was designed for the study to record the case history of the patients and a written informed consent was obtained from all patients enrolled in this study after explaining the procedure.

Patient Selection: Normal blood pressure is recorded as systolic pressure less than 140 mmHg and diastolic pressure of less than 90 mmHg. Patients who had been diagnosed as hypertensive with a baseline recording of blood pressure higher than 140/90 mmHg were selected for the study. Inclusion criteria included known hypertensive patients on medication and those aged between 40-60 years. Patients presenting with the following characteristics were excluded; patients with systemic disorders like cardiovascular disease, uncontrolled diabetes mellitus, cerebrovascular accidents, renal and hormonal disorders. Thus, the physical status of patients enrolled in this study met American Society of Anaesthesiologists Physical Status I or II.

All selected patients were asked to complete the questionnaire of APAIS (Amsterdam Anxiety and Information Scale) [7] which had been translated in to the local language. APAIS has six term questionnaire. First four term questionnaire represent the anxiety scale that is fear of anaesthesia and fear of surgical procedure each of which could be scored from 1 to 5. The anxiety scale score is the sum of these four questions with a score ranging from 4 to 20. The last two term questionnaire represents the need for information each of which scored from 1 to 5. The need for information scale is the sum of these two questions with a score ranging from 2 (no need for information) to 10 (high need for information).

The local anaesthesia injected was 1.8 mL of 2% lidocaine with 1:200000 epinephrine used by technique of nerve block and local infiltration. A 12 lead Electrocardiogram (ECG), a pulse oximeter and a sphygmomanometer were used to monitor the cardiac and haemodynamic changes before, after delivery of local anaesthesia. Abnormal electrocardiographic findings were recorded in an electrocardiograph paper and interpreted by a cardiologist who was unaware of the patient's clinical and demographic characteristics at the time of recordings. Heart rate, pulse rate, systolic and diastolic blood pressure, oxygen saturation and electrocardiographic changes were recorded pre-operatively, immediately after local anaesthetic administration and post-operatively at five, ten and fifteen minutes interval.

STATISTICAL ANALYSIS

Descriptive and inferential statistical analysis was conceded. Results on continuous measurements are presented on mean±S.D. and results on categorical measurements were presented in number (%). Significance is assessed at 5% level of significance.

Data were analysed using SPSS Software version 16.0. According to Shapiro-Wilks test the distribution was found to be non-normal. So, Kruskal-Wallis test was used to compare continuous variables before and after the injection of local anaesthesia, including heart rate, pulse rate, oxygen saturation, and blood pressure. Repeated-measures of analysis of variance (ANOVA) were used to analyse the significance of changes in heart rate over time between groups based on the assumption of sphericity.

Chi-square tests were used to analyse the significance of electrocardiographic changes.

RESULTS

Mean anxiety score was 9.91 ± 2.9 and mean information score was 4.47 ± 1.5 [Table/Fig-1]. In that 75.0% of patients having average information score were highly anxious and 6.2% having high information were severely anxious and there is a statistically significant association between anxiety and information score with a p-value of <0.001 [Table/Fig-2].

In the study population 20.0% of patients in the severe anxiety group had significant increase in Systolic Blood pressure (144. 9 ± 9.2), Heart rate (89.8 ± 5.52), Pulse rate (94.3 ± 9.76) than mild anxiety group after the local anaesthetic delivery and this difference was most significant with severe anxiety group with a p-value of < 0.001. There was an insignificant change in oxygen saturation [Table/Fig-3]. Similarly among the study population 20.0% of people in the severe anxiety group showed an abnormal electrocardiographic changes. Sinus tachycardia and QT interval prolonged in 100.0% of patients in the severe anxiety group [Table/

APAIS	MEAN	S.D
ANXIETY SCORE	9.91	2.932
INFORMATION SCORE	4.47	1.501

[Table/Fig-1]: Mean anxiety score and information score.

INFORMATION SCORE	ANXIETY SCORE			TOTAL	p-value[a]
	MILD	MODERATE	SEVERE		
LITTLE % within anxiety score	88.9%	40.5%	18.8%	52.5%	<0.001*
AVERAGE % within anxiety score	11.1%	56.8%	75.0%	45.0%	
HIGH % within anxiety score	0.0%	2.7%	6.2%	2.5%	

[Table/Fig-2]: Association of information score with anxiety score.
[a]Chi square tests

PARA-METERS	ANXIETY SCORE						p-value[b]
	MILD (4-8)		MODERATE (9-12)		SEVERE(> 12)		
	33.75%		46.25%		20.00%		
	MEAN	S.D	MEAN	S.D	MEAN	S.D	
SYSTOLIC B.P							
PRE-OP	130.72	9.235	135.6	9.366	142	10.556	0.005
INJECTION	134.72	8.364	139.2	9.038	144.93	9.254	0.005
5 min	135.28	7.85	139.66	10.852	144.53	8.991	0.014
10 min	133.92	7.968	138.4	10.888	143.4	8.5	0.01
15 min	134.24	7.986	137.54	10.869	142.93	9.736	0.013
DIASTOLIC B.P							
PRE-OP	81.68	7.782	83.03	8.803	82.4	10.259	0.381
INJECTION	84	8.124	85.43	7.92	83.73	9.192	0.282
5 min	83.76	7.401	84.17	7.052	83.6	9.046	0.579
10 min	83.84	6.829	83.89	7.21	83.07	9.647	0.666
15 min	82.88	7.876	86.6	7.126	83.07	9.13	0.411
HEART RATE							
PRE-OP	72.76	11.914	76.89	11.424	89.47	9.062	<0.001
INJECTION	77.72	12.641	80.26	10,831	89.87	5.527	0.005
5 min	77.36	1.202	79.77	1.0616	89.6	5.082	0.002
10 min	77	11.597	78.69	10.515	88.87	4.926	<0.001
15 min	76.2	12.373	78.94	11.672	86.6	6.288	0.02
PULSE RATE							
PRE-OP	72.88	10.627	76.69	11.802	90.73	11.997	<0.001
INJECTION	81.28	13.04	79.26	10.388	94.33	9.796	<0.001
5 min	81.32	11.894	80.26	11.239	91.13	8.518	0.008
10 min	80.12	11.534	80.57	9.856	91.53	7.745	0.003
15 min	78.32	11.194	81.17	9.766	91.73	7.769	0.001
OXYGEN SATURATION							
PRE-OP	95.2	1.915	94.89	1.568	94.47	2.386	0.609
INJECTION	95.48	1.475	95.57	1.577	95.13	2.134	0.939
5 min	95	1.915	94.66	3.646	94.33	2.637	0.81
10 min	94.8	2.062	94.74	1.633	94.4	2.444	0.919
15 min	94.56	2.122	94.8	1.952	93.93	2.789	0.68

[Table/Fig-3]: Average systolic B.P., diastolic B.P (mmhg), heart rate (beats/min), pulse rate, oxygen saturation (spo_2) of patients in different anxiety groups in the pre-opperiod, immediately after local anaesthesia administered and post operatively at 5, 10 and15 minutes interval.
[b]Kruskal-Wallis test
According to Chapiro wilks test the distribution was found to be non-normal. So Kruskal-Wallis test was used to compare continuous variables before and after the injection of local anaesthesia, including heart rate, pulse rate, oxygen saturation, and blood pressure. Repeated-measures analysis of variance (ANOVA) was used to analyse the significance of changes in heart rate over time between groups based on assumption of sphericity. Mean score of heart rate were significantly different over a period of time among anxiety groups (with p-value = 0.000.)

ECG CHANGES AT 15 MINUTES INTERVAL	ANXIETY SCORE			TOTAL	p-value[a]
	MILD	MODERATE	SEVERE		
NORMAL	37.5%	53.6%	8.9%	100.0%	<0.001*
EARLY REPOLARIZATION	0.0%	50.0%	50.0%	100.0%	
ISCHEMIC CHANGES	0.0%	0.0%	100.0%	100.0%	
SINUS BRADYCARDIA	100.0%	0.0%	0.0%	100.0%	
SINUS TACHYCARDIA	0.0%	0.0%	100.0%	100.0%	
RIGHT BUNDLE BRANCH BLOCK	0.0%	0.0%	100.0%	100.0%	
VENTRICULAR ECTOPIA AND ISCHEMIC CHANGES	0.0%	100.0%	0.0%	100.0%	
VENTRICULAR ECTOPIA AND QT-PROLONGED	100.0%	0.0%	0.0%	100.0%	
ISCHEMIA AND QT-PROLONGED	.0%	60.0%	40.0%	100.0%	
SINUS TACHYCARDIA AND QT-PROLONGED	0.0%	0.0%	100.0%	100.0%	

[Table/Fig-4]: Association of post-operative ECG at 15 minutes interval with different anxiety groups.
[a]Chi square tests

IMMEDIATELY AFTER LOCAL ANAESTHESIA	ANXIETY SCORE			TOTAL	p-value[a]
	MILD	MODERATE	SEVERE		
NORMAL	35.7%	53.6%	10.7%	100.0%	<0.001*
EARLY REPOLARIZATION	0.0%	50.0%	50.0%	100.0%	
SINUS BRADYCARDIA	100.0%	0.0%	0.0%	100.0%	
SINUS TACHYCARDIA	0.0%	0.0%	100.0%	100.0%	
QT-PROLONGED	50.0%	0.0%	50.0%	100.0%	
RIGHTBUNDLE BRANCH BLOCK	0.0%	0.0%	100.0%	100.0%	
VENTRICULAR ECTOPIA AND ISCHEMIC CHANGES	0.0%	100.0%	0.0%	100.0%	
ISCHEMIA AND QT-PROLONGED	0.0%	60.0%	40.0%	100.0%	

[Table/Fig-5]: Association of ECG taken immediately after local anaesthesia administered with different anxiety groups.
[a]Chi square tests
In this study ECG findings are considered as categorical data (nominal data). Thus Chi- Square test was used to assess the association of ECG changes at different anxiety groups.

Fig-4]. QT interval is a measure of the time between the start of Q wave and the end of the T wave in the heart electrical cycle. It represents the electrical depolarization and repolarisation of the ventricles [4]. One patient in the study population in the severe anxiety group showed right bundle branch block pattern [Table/Fig-5].

DISCUSSION

The anticipation of proposed dental treatment induces a physiologic stress response that manifests as changes in haemodynamic and cardiovascular reactions with increase in blood pressure due to corticoid release [8]. Numerous clinical studies have demonstrated that the past traumatic dental history and high anxiety results in an increase in heart rate and blood pressure [9].

A wide variety of measures are available to assess the levels of dental anxiety. Most of them exhibit adequate levels of internal consistency and correlate with other measures of the same construct. Choice of a particular measure will depend, in part, on the purpose for which the measure is intended and on the particular aspects of dental fear that are being assessed. Both anxiety and pain are multidimensional constructs and it is important to identify which dimensions are being assessed. Furthermore the use of standardized instruments provides the opportunity for comparison of data across groups, experimental manipulations and treatment approaches [10]. Thus the use of APAIS (Amsterdam Preoperative Anxiety and Information Scale) [7] in this study gives a valuable tool in assessing the pre-operative anxiety and information.

Anxiety or fear can have a pain-increasing effect owing to intentional bias toward the painful stimuli or pain-related sensation. Anxiety induced somatic changes may occur from activation of the hypothalamus-pituitary adrenal axis, the main result being an increased secretion of cortisol [5].

In the present study, patients with severe dental anxiety had a greater heart rate response to the administration of local anaesthetic. Anderson and Regan [11] as well as Lilienthal and Reynolds [12] reported that attempts to assess patient anxiety subjectively during preoperative sessions were not necessarily useful because patients who appeared calm or who claimed to be without anxiety during dental procedures may show signs of significant physiologic stress when monitored electronically [5]. Thus, the APAIS is an objective instrument to assess patients anxiety level.

The increase of heart rate and the alterations in blood pressure during the injection may have been partly due to endogenous epinephrine release as a result of emotional stress and not from the effect of local anaesthetic. Clinical studies on epinephrine containing solutions have consistently shown negligible influences on blood pressure in hypertensive patients. Anxiety and psychosocial stress has been linked to increases in blood pressure changes in hypertensive patients [13].

The cardiovascular reaction to a stressful situation is thought to be influenced by cardiac-vagal withdrawal and adrenergic activation, resulting in increased cardiac chonotropic and ionotropic influences as well as an increased total peripheral resistance. It is possible that cardiac and vascular reactivity reflects individual differences in sympathetic adrenal activation during a stressful situation [14]. In the present study a certain increase in systolic blood pressure and heart rate was noted during local anaesthetic delivery and at the moment of extraction. This could be more closely related to patient anxiety.

The present findings of increased systolic blood pressure and heart rate during the procedure was in correlation with the Liau et al., [5], but in contrary to earlier studies that reported a decrease in blood pressure and heart rate [15,16]. A thorough literature revealed many added risks that have been attributed to the use of epinephrine in hypertensive patients including acute hypertensive crisis, angina pectoris, myocardial infarction and cardiac arrhythmias [6,17-23].

Previous studies on Electrocardiographic changes during local anaesthesia delivery and oral surgical procedures found incidences of abnormal electrocardiograph changes in 15-37.5% of patients [5]. In the present study there were significant differences in the electrocardiographic changes between patients with different levels of anxiety after local anaesthetic injection. The most common abnormalities identified on electrocardiographic study were early repolarisation, sinus tachycardia, sinus bradycardia, ventricular ectopia, ischemic changes and prolonged QT interval. Right bundle branch block pattern was observed in one patient in the present study was in correlation with the study done by Sanadhya et al., were changes in the cardiac electrical activity was observed [8].

LIMITATION

The limitations of the study are small sample size and short duration. Clinical implications recommended are that identification of the patients prone for dental anxiety through pre-operative evaluation greatly helps in planning and managing these patients by counselling and following stress free protocol in the exodontia procedures. Hypertensive patients especially need to be evaluated and a proper protocol must be followed for these patients to reduce the anxiety. Instilling confidence greatly helps in preventing the unwanted haemodynamic changes during the exodontia procedures.

The present study supports the implications that the changes in cardiovascular effects following administration of local anaesthetic are influenced by anxiety and are significantly associated with increase in heart rate, alterations in blood pressure and changes in electrocardiograph. However, a prospective continuation of this study is planned on larger group of patients with wider spectrum of age groups that might give a conclusive evidence of the influence of anxiety related changes in the hypertensive patients undergoing exodontia.

CONCLUSION

From the observations and results obtained it is suggested that hypertensive subjects undergoing exodontic procedures experience increase in systolic blood pressure, heart rate, pulse rate as well as changes in electrocardiograph associated with the use of a local anaesthetic containing epinephrine. These increases occur more in patients who are highly anxious. Increase of heart rate and alterations in blood pressure during the injection in the present study may have been partly due to endogenous epinephrine release as a result of the emotional stress and not from the effect of local anaesthetic. Thus, anxiety has a significant and an additive effect on the cardiovascular changes in hypertensive patients. The use of stress reduction techniques and adequate analgesia may provide a patient with positive dental experience, which in turn may reduce the cardiovascular response. All patients with elevated blood pressure should be counselled and referred for medical workup.

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