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Haemodynamic changes in healthy normotensive patients during the surgical removal of lower third molars under local anaesthesia

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Abstract

Aim: To determine the haemodynamic changes in healthy normotensive patients during the surgical removal of lower third molars, and to evaluate whether these variations are attributable to patient anxiety and fear during the surgical procedure.

Methods: A prospective study was done on 60 healthy normotensive individuals,30 male and 30 female. All these patients required surgical removal of lower third molar. The surgery was performed using 2% lignocaine with 1:80000 epinephrine. The following parameters were monitored in each of the surgical interventions: systolic blood pressure, diastolic blood pressure, heart rate and oxygen saturation. Patient anxiety and fear was evaluated before the start of the procedure using Corah’s dental anxiety scale and fear using Kleinknecht’s fear scale. Degree of pain experienced was assessed using 10 point visual analogue scale.

Results: The mean age of males were 28 years and females were 25 years. The females showed higher levels of anxiety. The most anxious patients had the lowest blood pressure values and the highest heart rate values, although

the differences did not reach statistical significance. There were variations in the blood pressure and heart rate at different surgical interventions. The highest mean systolic and diastolic blood pressure values were observed at the time of ostectomy and tooth removal. The highest mean heart rate values were observed at the time of flap reflection and ostectomy. The oxygen saturation values showed no significant changes, however slight decrease was observed at the time of ostectomy. All these patients reported minimal to moderate pain during the procedure as measured on visual analogue scale. There were cardiovascular changes seen during the different intervention of the surgical procedure of third molar surgery. But these changes were within normal limits taking in to consideration the patient anxiety and fear for the procedure. Females showed higher level of fear and anxiety.

Conclusion: Every dental or surgical procedure is potentially stress inducing leading to increased release of catecholamines and increasing workload on cardiovascular system, hence minimizing patient anxiety and fear before the surgical procedure is essential for a safe clinical practice.

Keywords: Haemodynamic, Normotensive, Third molars, Local anaesthesia, Anxiety.

Introduction

It is imperative that professionals be alerted to the proper use of local anaesthetic and to the care needed when choosing and administering these local anaesthetic agents bearing in mind that the local anaesthetic currently available are marketed in different kinds of solutions with various concentrations of both anaesthetic salt and vasoconstrictors. The use of inappropriate volume or concentrations of anaesthetic solutions can produce systemic complications which are frequently serious.(1) The adrenaline is added to the anaesthetic solution to increase the potency and duration of anaesthesia but also has some undesirable cardiovascular effects when absorbed systemically. The anxiety and stress produced by pain during dental treatment also induce the secretion of endogenous catecholamines which likewise exert undesirable effects on the cardiovascular system.(1)

Lidocaine without and with a vasoconstrictor changes the heart rate and blood pressure differently. These hemodynamic changes are superposed by alterations caused by emotional stress and similar in all test series. The so called epinephrine collapse often seems to have its cause in an abrupt relative deficiency of epinephrine after stress. It is possible to significantly influence the cardiovascular system in connection with a local anaesthesia with the choice of vasoconstrictor.(2)The adrenaline present in the local anesthetic is a major source of adrenergic activation during minor oral surgery (3) and the measurement of systolic blood pressure, diastolic blood pressure and heart rate are appropriate monitoring methods for patients under the effects of local anesthetic, even healthy one. (4)

Monitoring during surgery is a global method of observation. Basic monitoring provides essential information for assessing the vital signs both circulatory and respiratory and it comprises the control of blood pressure, heart rate and rhythm.

Monitoring during oral surgery allows the surgeon to immediately identify situations of increased risk before the surgical procedure and establish an early diagnose and prevent possible complications and operate with increased safety. (1) In perioperative care, monitoring includes the following four essential features: observation and vigilance, instrumentation, interpretation of data, and initiation of corrective therapy when indicated. (5) This

study is aimed at monitoring patient vitals perioperatively and determines the haemodynamic changes in healthy patient during the surgical removal of lower third molars.

Aims & Objectives

To study haemodynamic changes during surgical removal of lower third molar under local anaesthesia and to establish:

1. Whether increased blood pressure occurring during surgical treatment is dependent on anaesthetic solution containing vasoconstrictor or it is attributable to anxiety or other factors inherent to the patient.
2. How the patient fear and stress associated with different moments of the surgical procedure can induce variations in the cardiovascular system.
3. Whether there is influence of patient gender and age on the degree of fear and anxiety and the variations in the hemodynamic variables.

Methods

A prospective study was done on 60 healthy normotensive individuals,30 male and 30 female. The mean age of males were 28 years and females were 25 years. All these patients required surgical removal of lower third molar. The surgery was performed using 2% lignocaine with 1:80000 epinephrine. The following parameters were monitored in each of the surgical interventions: systolic blood pressure, diastolic blood pressure, heart rate and oxygen saturation. The surgical interventions were: at the start of the procedure (baseline value), 4minutes after local anaesthetic injection, incision, flap reflection, ostectomy, tooth removal, suturing, at the end of procedure. Patient anxiety and fear was evaluated before the start of the procedure using Corah's dental anxiety scale (DAS) and fear using Kleinknecht's dental fear scale (DFS). Degree of pain experienced was assessed using 10 point visual analogue scale (VAS).

Results

The patient distribution by gender was deliberately balanced (30 males and 30 females),with a mean age of 28 years in males and 25 years in females. The difficulty of surgical extraction of third molar was assessed using the classification system of Pell and Gregory and winter and proved to be minimal to moderate in all cases. The maximum duration for surgical procedure measured from time of local anaesthesia to the end of suturing was not exceeding 45 minutes. All surgical removal of lower third molar was done under local anaesthetic solution containing lignocaine 2% and epinephrine 1:80000.

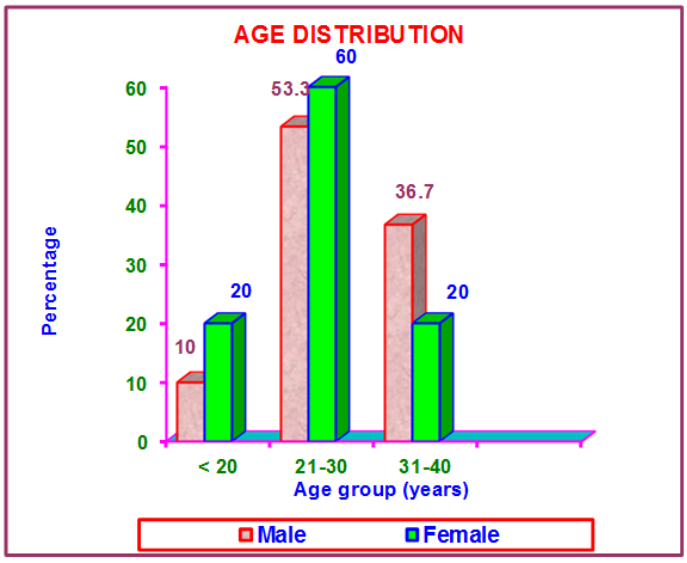


Fig. 1: showing age distribution among included patients of both genders.

Age ranging from 18 years to 40 years. According to age patients were divided in to three groups, maximum number of patients were in age group of 21-30 years. (fig. 1) Patients anxiety and fear were assessed before the start of the procedure. The mean degree of anxiety and fear was moderate, according to DAS and DFS. The females however showed higher level of anxiety and fear with significantly higher mean values for both when compared to males.

	Male (n=30) (Mean±SD)	Female (n=30) (Mean±SD)
DFS	3.13±1.008	4.13±0.860
DAS	5.80±1.627	9.70±1.968

Table 1: Dental anxiety scale (DAS) and Dental fear scale (DFS) in relation with sex.

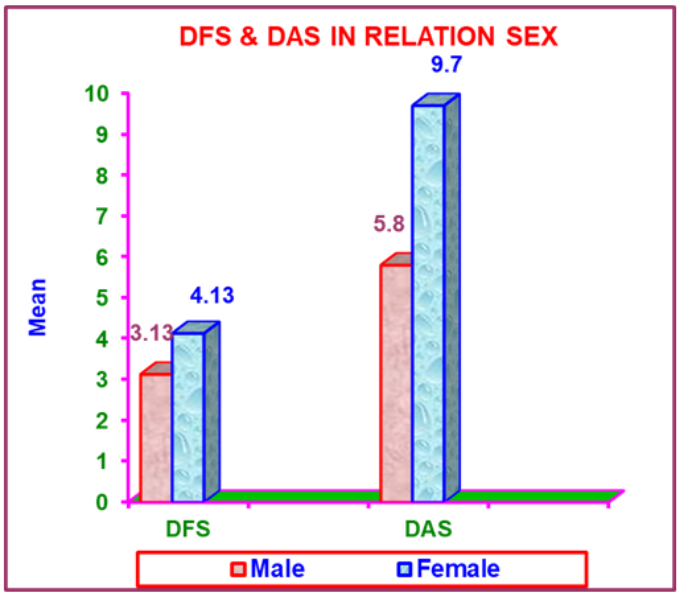


Fig. 2: Graph showing the mean value of anxiety and fear in males and females.

Females are having higher mean values for both anxiety and fear (fig.2). Haemodynamic change during surgical removal of third molar was assessed by evaluating the change in following parameters: systolic blood pressure, diastolic blood pressure, heart rate, and oxygen saturation. All these parameters were recorded at seven moments during the surgical procedure.

Analysis of the data for systolic blood pressure fluctuations indicated that there was no significant difference in male and female. Mean baseline value for male was more when compared to females. The SBP varied with surgical time ($p < 0.05$). The variation in SBP showed a similar pattern in both male and female, but with more accentuated values in males ($p<0.05$).

Interval	Male	Female	'p' value
Baseline	128.26±7.57	122.26±8.48	**0.0054**
4min after LA	128.73±7.47	126.06±7.13	0.1621
Incision	129.50±8.02	126.60±7.29	0.1482
Flap elevation	129.53±7.62	127.13±6.40	0.1917
Ostectomy	130.73±6.79	127.40±5.73	**0.0446**
Tooth removal	129.46±6.78	125.80±5.97	**0.0304**
Suturing	127.40±6.91	123.73±6.31	**0.0359**
End of procedure	126.90±6.62	122.46±6.98	**0.0142**

Table 2: Mean Systolic Blood Pressure (mm Hg) variations at different stages of procedure.

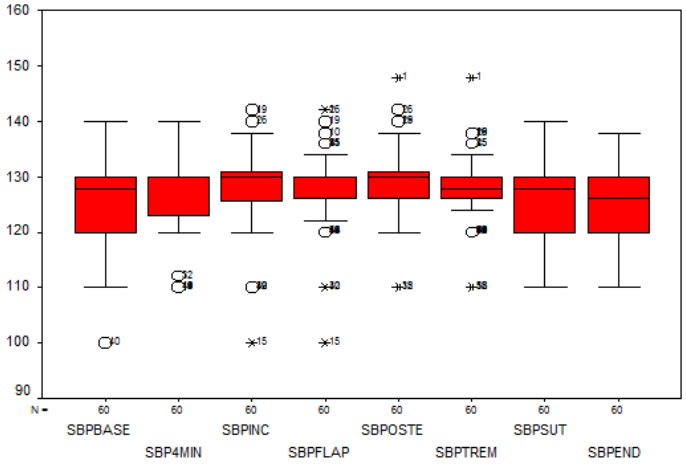


Fig. 3: Graph depicting the fluctuation of SBP with surgical time Highest fluctuation is observed at the time of ostectomy in most of the patients.

Pattern of SBP variation is same in both male and female however males have accentuated values. (Fig. 4) The mean DBP was 82 mmHg in males and 76mmhg in females. analysis of the data for DBP showed significant variation with surgical time ($p < 0.05$). the pattern of variation in DBP was similar in both males and females. No relationship was found between patient gender and variation. there was a significant rise of DBP during the ostectomy procedure.

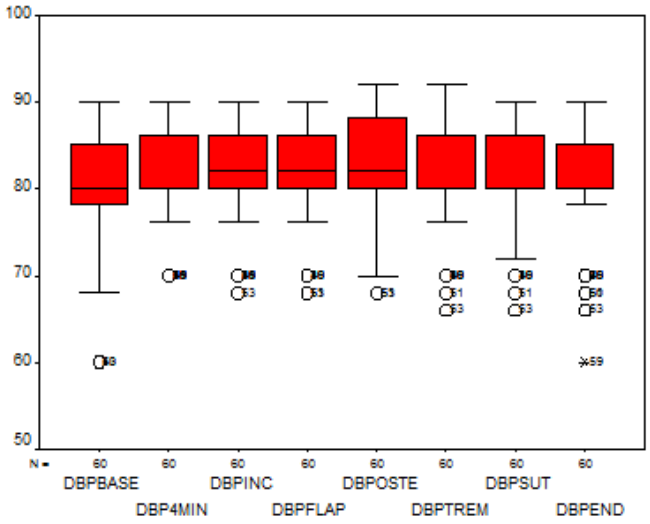


Fig. 4: Graph showing pattern of diastolic pressure variation at different stages.

Data analysis for heart rate showed females have higher mean value of heart rate than males but the difference was not significant ($p>0.05$). the heart rate varied with surgical time. There was no difference in pattern of variation in heart rate between male and females.

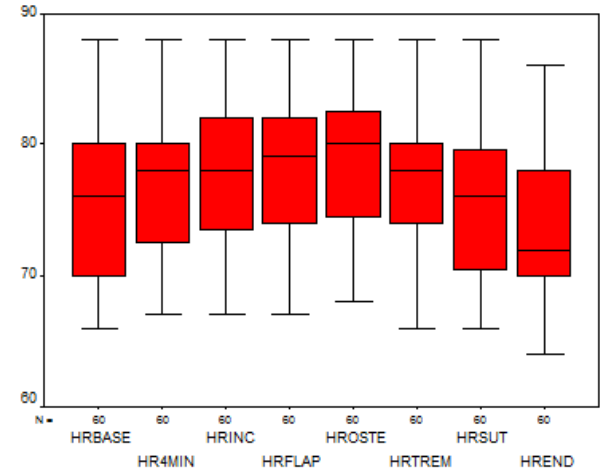
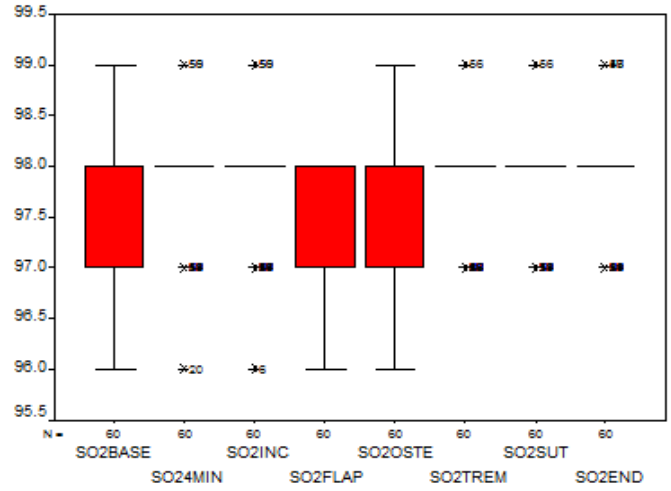


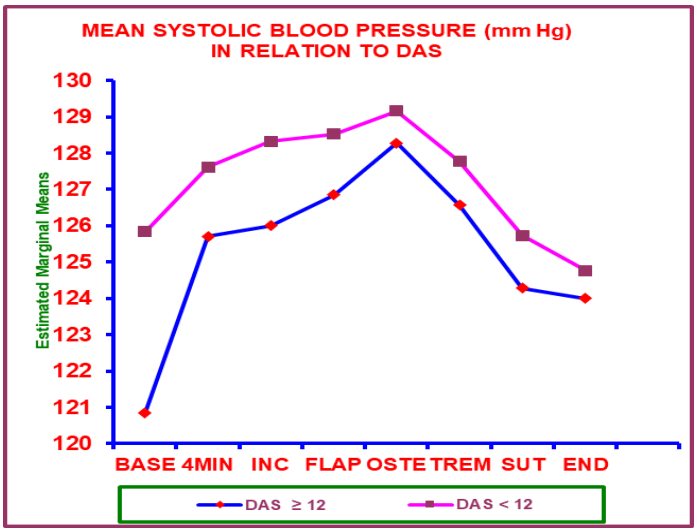
Fig. 5: Graph showing pattern of Heart rate variation at different stages.

The females showed higher mean value for oxygen saturation (98.86) than males (97.60), however the difference was not significant statistically. The saturation varied with surgical time but not significantly($p>.05$). the pattern of variation was similar in both male and females.

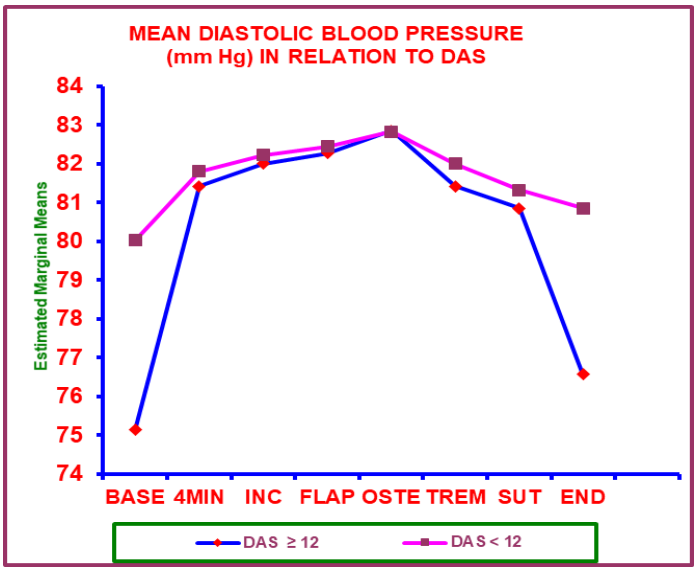


Graph 6: The graph shows variation of saturation with surgical time. There was not significant change in the oxygen saturation.

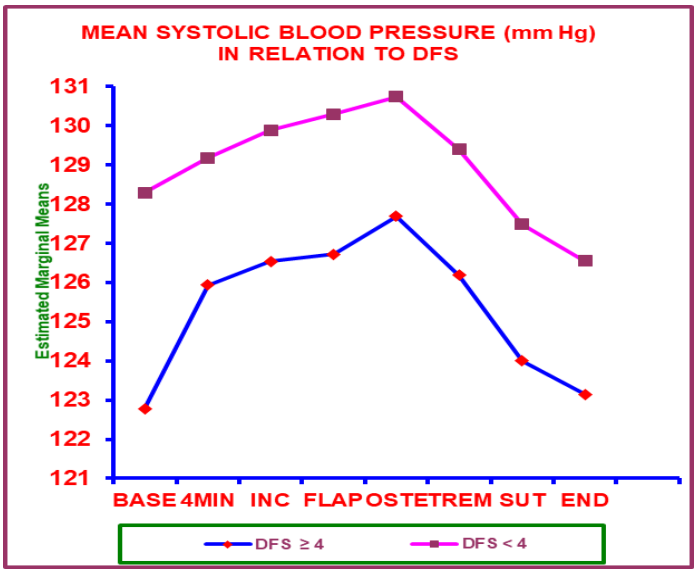
The females demonstrated more anxiety and fear than males. There was significant difference in the mean values of males and females. Correlating the mean of DAS and DFS with the haemodynamic parameters revealed no significant difference between patients with low and high anxiety. However the patient with high anxiety showed low BP and higher heart rate values although the difference was not significant statistically.DAS has maximum score of 20 and DFS has maximum score of 100(where score of 20=1).



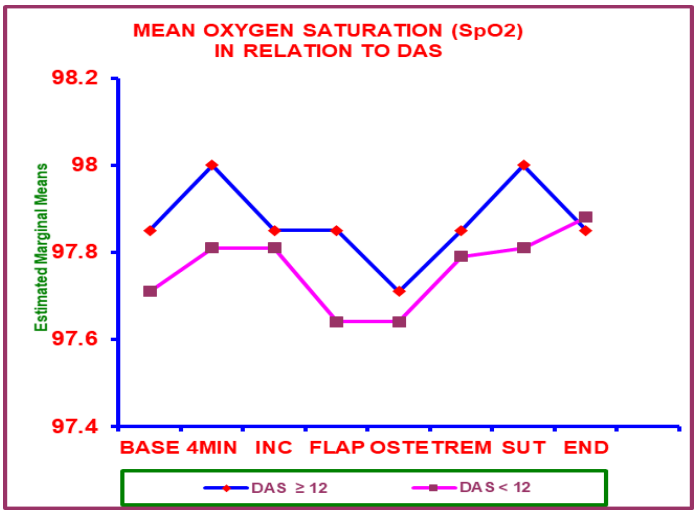
Graph 7



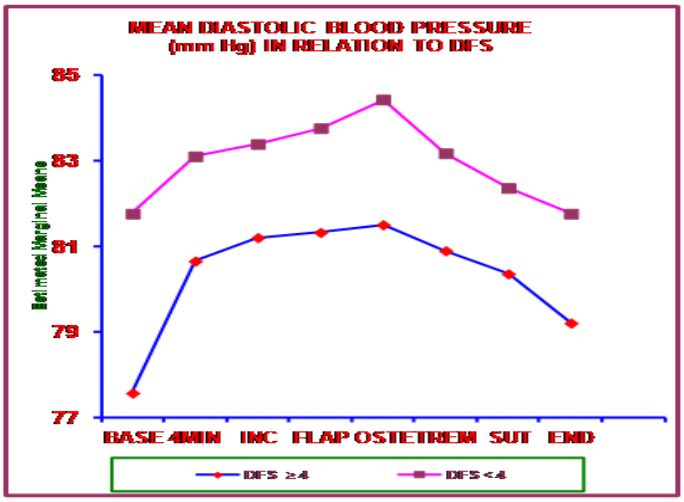
Graph 8



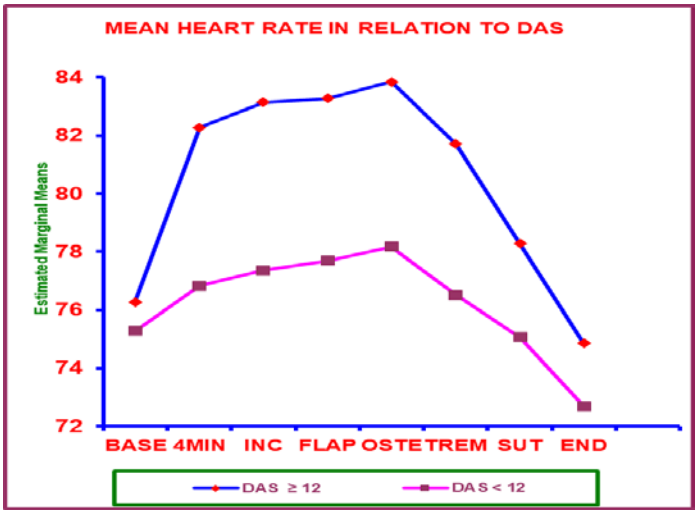
Graph 11



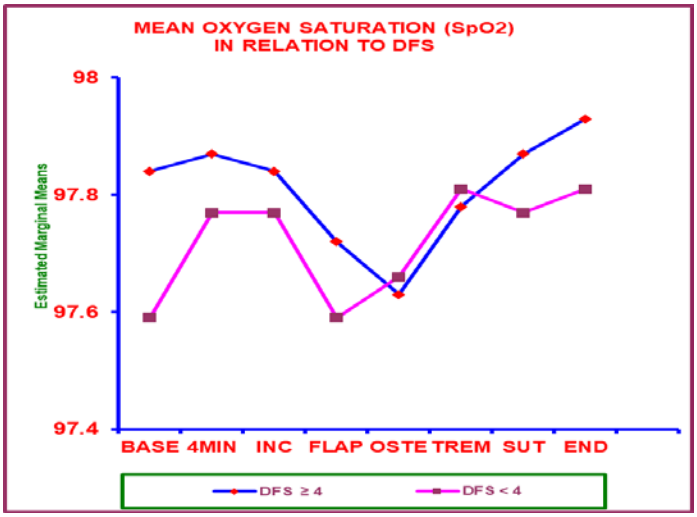
Graph 9



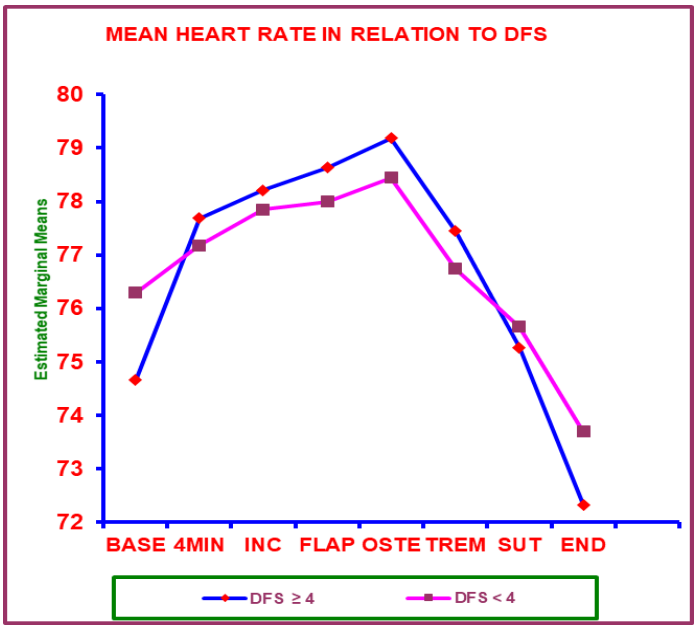
Graph 12



Graph 10



Graph 13



Graph 14

Discussion

Epinephrine is included in the anesthetic solution to delay systemic absorption, which increases the duration and profoundness of anesthesia. The preponderance of data in regard to epinephrine-containing local anesthetics shows that blood pressure and heart rate are minimally affected by the typically low doses and short-term use of the drug in dentistry.(6)

Epinephrine produces its effects by stimulating the alpha adrenergic receptors located in the walls of the arteriole. Epinephrine is also a beta adrenergic stimulator and may cause vasodilatation of arterioles in skeletal muscle due to the predominance of beta receptors in this tissue. Epinephrine's beta adrenergic responses, even at low systemic levels, include skeletal muscle vasodilatation plus increased heart rate and inotropy. The beta adrenergic effects predominate over the alpha because of the greater sensitivity of beta adrenergic receptors to epinephrine. In the amounts commonly used in dentistry, 0.02-0.2mg, there should be minimal effect on other organs or systems outside the arterioles in the immediate area of injection. Inadvertent intravascular administration, injections of increased volumes or concentrations, or injection into inflamed tissue may enhance the systemic uptake of vasoconstrictor (and local anesthetic) and produce toxic manifestations. (7)

According to Malamed, most instances of true epinephrine overdosage are of such short duration that little or no formal management is required, especially in the ASA I patient. (7) These symptoms are most often caused by intravascular administration of the anesthetic solution. Fortunately in this situation, the symptoms are of brief duration, as intravenous epinephrine has a half-life of one to three minutes. (8)

The exogenous epinephrine contained in anesthetic solution may actually help prevent the release of excessive endogenous epinephrine. Less-than-profound anesthesia has been associated with increased release of endogenous epinephrine. The benefits of the small doses of epinephrine used in dentistry, when administered properly, far outweigh the cardiovascular disadvantages. (6)

Kohler et al (9, 10), Tolas et al.(11), Goldstein et al. (12), Raymond and Dionne et al.(13) proved that intra-oral injections of epinephrine containing local anesthetics result in dose-dependently-increased circulating epinephrine levels that are associated with cardiovascular changes.(14)

Kohler et al showed that the increase in the venous plasma epinephrine concentration after injection of 20 and 80 mcg epinephrine by a factor from two to eight, respectively, led to an increased heart rate of 6% and 20% per min, compared with the basal values. Despite these changes in the plasma epinephrine concentrations, systolic blood pressure remained constant, but diastolic blood pressure dropped by 9%. (9)

Dionne et al., Clutter et al. and Goldstein et al. found cardiovascular responses to plasma epinephrine levels

easily obtained with minimal dosage of epinephrine from dental injections.(13)

Tolas et al., Chernow et al. and Cioffi et al. studied the hemodynamic response to local anesthetics containing epinephrine in dental patients, found minimal changes in heart rate associated with elevated plasma epinephrine levels. (11) Dionne et al. reported increases in heart rate and systolic blood pressure at epinephrine levels five times the baseline. (7) The main aim of this study was to evaluate haemodynamic change during the surgical removal of lower third molar using local anaesthetic with epinephrine. The study involved of 60 healthy and normotensive patients.

In our study both systolic and diastolic blood pressure increased slightly up to the moment of tooth removal, significant increase was seen at the time of ostectomy. The pattern of increase in blood pressure was similar in both male and female. After the peak values were reached there was decrease in the blood pressure till the end of the procedure. Our finding is similar to the findings of many authors and we concur with other investigators that the moment of dental avulsion is the most stressful phase of the surgical procedure. Numerous studies in young healthy patients with no known history of cardiovascular disease show that injection of local anesthetic with epinephrine is associated with an increased plasma epinephrine level but no corresponding significant hemodynamic effect.(1)

Several studies have attempted to measure plasma catecholamine levels after intraoral injections of local anesthetic solutions containing epinephrine, and correlate these levels with hemodynamic responses. Three studies found that after injections of 1.8 ml of 2% lidocaine with 1:100,000 epinephrine there was a two to three fold rise in plasma catecholamine levels over baseline levels without a significant hemodynamic response. These studies utilized young, healthy patients and a small dosage of epinephrine as 18 mcg. (7)

Nichols reported that the blood pressure measurements were always higher at the start of the surgical procedure than at the end of the procedure. (14) This could be explained by endogenous adrenaline release caused by the patient's anxiety or fear associated with visiting the dentist. (1) Psychogenic stress may also play a role in the release of endogenous catecholamines. In physiologic response to stimulation and stress, the increase in plasma epinephrine is accompanied by a comparable increase in plasma norepinephrine concentration. (7)

Changes in heart rate and blood pressure are affected by pain and certain individual factors such as age, gender, hypertension, previous experience with dental treatments, and psychological response. (1) In our study, males showed higher blood pressure values than females while the females had higher heart rate values. The anxiety and fear were higher in females when compared to males. Thus, we can concur that more anxious patients had lower blood pressure values and higher heart rate values. There was a significant difference between males and females in terms of anxiety level. The graph 2 and table 1 shows the mean values of anxiety and fear which was higher in females.

This observation is in agreement with other studies which have reported that the pain perception is lower in females than in males although males tend to suppress their anxiety more than the females. Michael et al showed that there is large gender-role related influences on men and women's expectations of the painfulness of common, potentially painful events. (15) Consistent with more global assessments of gender-related pain expectations, women are generally perceived as expecting events to be more painful than men do. (15)

We can concur that there is difference in the experience of pain between males and females. The attenuation of stress with anxiolytics or sedation can be used to reduce the cardiovascular response associated with patient anxiety. Although in these cases dentist mediated patient behavioural control appears to play a fundamental role. Conscious sedation administered intravenously in oral surgery can help maintain haemodynamic stability in both hypertensive and normotensive patients. (16)

The age range for the study was from 17 to 40 years, mean age for males was 28 years and for females was 25 years. The fact that the patients in our study were of younger age group will explain the lack of significant haemodynamic change in our study. The vast majority of studies that measure plasma epinephrine levels and hemodynamic responses to intraoral injections of local anesthetic with epinephrine, utilize healthy, young, ASA I patients and small amounts of vasoconstrictor.(7) Matsumura et al found that adult and middle aged patients exhibited larger blood pressure increments during oral surgery when compared to younger patients. (1)

In this study there was cardiovascular changes induced during the surgical removal of lower third molar but these changes were not very significant and were considered within normal limits, taking into consideration the stress and anxiety produced during surgery.

Conclusion

In this present study 'haemodynamic changes during surgical removal of lower third molar', we concur that cardiovascular changes are seen during the surgical procedure of lower third molar, but these changes are not significant enough to cause concern during and after the procedure. These cardiovascular changes can be considered within normal limits, taking into consideration the level of anxiety and fear in the patient. On an average females exhibited more anxiety and fear for the procedure and they showed more rise in heart rate during the procedure.

Minimizing patient anxiety with anxiolytics and adopting stress reduction protocols in highly anxious patients will help to reduce the cardiovascular responses associated with patient anxiety. Dentist mediated patient behavioural control also plays a fundamental role. We consider avoiding pain and minimizing patient anxiety essential to safe clinical practice.

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