

Holter ECG assessment of the effects of three different local anesthetic solutions on cardiovascular system in the sedated dental patients with coronary artery disease

Üç farklı lokal anestezi solüsyonunun koroner arter hastalığı olan sedatize edilmiş dental hastalarda kardiyovasküler sisteme olan etkilerinin EKG Holter cihazı ile değerlendirilmesi

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ABSTRACT

Objective: The purpose of the study is to compare the effects of lidocaine alone, epinephrine-combined lidocaine and prilocaine with octapressin on the cardiovascular system during minor oral surgery of sedated cardiac dental patients under local anesthesia.

Methods: Connected to a Holter electrocardiogram (ECG) monitor for a total of 5 hours starting 1 hour before the procedure, twenty patients with high risk of coronary artery disease were included in the prospective cohort study. All the patients had three operations at 3 different appointments with at least one-week intervals and each operation was performed under local anesthesia achieved by 3.6 mL of 3% prilocaine with octapressin, 3.6 mL of 2% lidocaine with 1:80.000 epinephrine and 3.6 mL of 2% lidocaine without a vasoconstrictor. Data of the Holter ECG device assessed at the end of every hour and evaluated statistically. Repeated measures ANOVA, Friedman test, and Wilcoxon signed ranks test were used to perform statistical analysis.

Results: Heart-rate showed significant differences between lidocaine with epinephrine and pure lidocaine in an hour following the injection ($p<0.05$ for all). Cardiac rhythm showed significant differences between prilocaine with octapressin and pure lidocaine at the second hour after its administration ($p<0.05$ for all). There were no significant differences between 3 local anesthetics in terms of ST segment deviation.

Conclusion: In minor oral operation on the sedated patients with cardiac disease, the use of 3.6 mL or a less amount of local anesthetic injection containing epinephrine appears to be a predictable and safe method. (*Anadolu Kardiyol Derg 2013; 13: 480-5*)

Key words: Minor dental operations, local anesthetics, cardiac diseases, Holter monitoring

ÖZET

Amaç: Bu çalışmanın amacı, sedatize edilmiş dental kardiyak hastaların, saf lidokain, epinefrin+lidokain ve oktapressin+prilokain ile yapılan minör oral cerrahi girişimleri sırasında, lokal anesteziğin kardiyak sistem üzerindeki etkilerini karşılaştırmaktır.

Yöntemler: İşlem başlamadan 1 saat önce ve toplam 5 saat süreyle EKG Holter cihazına bağlanan yüksek riskli koroner arter hastalığı olan 20 hasta çalışmaya alınmıştır. Tüm vakalar en az birer haftalık aralıklarla üç farklı tarihte üçer ameliyat geçirmiştir ve her ameliyat, %3'lük oktapressinli prilokainden 3,6 mL, %2'lik 1:80.000'lik epinefrinli lidokainden 3,6 mL ve vazokonstriktör içermeyen %2'lik lidokainden 3,6 mL ile sağlanan lokal anestezi ile yapılmıştır. Holter EKG cihazı verileri her saat sonunda değerlendirilip, istatistiksel olarak incelenmiştir.

Bulgular: Kalp atım hızı, enjeksiyondan 1 saat sonra epinefrinli lidokain ve saf lidokain arasında anlamlı farklılıklar göstermiştir. Kalp ritmi enjeksiyon sonrası 2. saatin içinde oktapressinli prilokain ile saf lidokain arasında anlamlı farklılıklar göstermiştir. ST segment deviasyonu açısından üç lokal anestezi arasında anlamlı farklılık bulunmamıştır.

Sonuç: Kalp hastalığı olan sedatize hastalarda, minör oral cerrahide 3,6 mL ya da daha az epinefrin içeren lokal anestezi solüsyon kullanımı, güvenli ve sonuçları tahmin edilebilir bir yöntem izlenimi vermektedir. (*Anadolu Kardiyol Derg 2013; 13: 480-5*)

Anahtar kelimeler: Minör dental operasyonlar, lokal anestezi solüsyonlar, kalp hastalıkları, Holter EKG cihazı



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Accepted Date/Kabul Tarihi: 19.12.2012 **Available Online Date/Çevrimiçi Yayın Tarihi:** 27.05.2013

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doi:10.5152/akd.2013.146

Introduction

Coronary artery disease and hypertension are the most common chronic systemic disease in adults and its prevalence tends to increase with age. As the number of these patients increases, it is expected to encounter more of these patients in minor oral surgery. Premedication (local anesthesia and sedation) is an important concern in these patients as the anesthetic solution may cause serious complications (1).

Administration of a vasoconstrictor in combination with a local anesthetic has evolved as a method to decrease systemic toxicity, increase the duration of anesthesia and provide hemostasis during surgery (2). Lidocaine with epinephrine is commonly used throughout the world. However, epinephrine-containing anesthetics in patients with cardiovascular disease may lead to dangerous side effects such as arrhythmias, unstable angina, increase in blood pressure, cardiac output and stroke volume and even myocardial infarction. Octapressin, a vasoconstrictor agent, does not cause significant alterations in heart rate, but its vasoconstrictor action is lower than epinephrine (3-6).

Dental anxiety is a phenomenon prevalent in dental surgery, which has a complex etiology involving many factors. Previous traumatic dental experiences, painful dental treatment processes, fainting during injection of local anesthetic and erroneous extraction are some of these factors. Pain and stress during dental procedures are responsible for release of endogenous catecholamines likely to activate hemodynamic disturbances, including increases in blood pressure, heart rate and the frequency of arrhythmias (7). Importance of monitoring such patients for ischemic changes has been recognized (8-10). To avoid any adverse cardiovascular effects, especially in high risk patients, some authors have recommended the use of octapressin-containing local anesthetics or epinephrine-free local anesthetics after premedication of diazepam (11). In the dental patients with cardiovascular disease, both beta-blocking and non-potassium sparing diuretic drugs can exacerbate unwanted effects of epinephrine in dental local anesthetics and dose reduction of epinephrine is wise (12). Nevertheless, local anesthetics without epinephrine have some disadvantages such as hemorrhage and less deep analgesia of shorter duration (13, 14).

Coronary artery disease (CAD) constitutes the majority of cardiac diseases. Heart rate, pause, missed beats, isolated and ectopic beats, extrasystoles and ST segment deviations are some parameters that are measured by an electrocardiographic (ECG) Holter device during oral surgery under local anesthesia. Especially ST segment deviation is a reliable marker of important events in the myocardium which may cause myocardial damage (12, 13, 15, 17).

On the other hand, vasoconstrictor dose used in dentistry are very low (16). According to Malamed et al. (2), intramuscular or intravenous dose of epinephrine (1:100.000 or 1:10.000 concentrations) used in the treatment of anaphylaxis or cardiac arrest is 0.5 to 1 mg whereas an anesthetic cartridge with epinephrine contains only 0.018 mg. Therefore, at this dose, epinephrine offers

many advantages and few disadvantages and is only contraindicated, in oral surgery, in very specific cases (2-16).

Some authors hypothesize that increased heart rate and alterations in blood pressure in dental procedures owing to endogenous catecholamine release from the adrenal medulla result from emotional stress, anxiety and pain but not from a pharmacologic process (15-19). However, other authors consider that cardiovascular response to dental treatment under local anesthesia may be further influenced by the anesthetic used (20-23).

The unique study compares electrocardiographic changes in a sedated cardiac patient exposed to oral operation under local anesthesia with lidocaine alone, epinephrine-combined lidocaine and prilocaine with octapressin in the same patient. The study also compares the cardiovascular effects of local anesthetics with and without vasoconstrictors in sedated cardiac dental patients in one-hour periods of time.

Methods

Study design

A prospective cohort study.

Study population

A total of twenty patients (37-71 years of age) in both sexes with the indication of at least 3 similar oral operations were included in this prospective cohort study. All the cases were at high risk (CAD or CAD risk equivalents) according to the National Cholesterol Education Programme, Adult Treatment Panel III (NCEP ATP 3) guidelines (which means that their 10-year risk of major cardiovascular event is > 20%) (24). According to European Society of Cardiology (ESC) guidelines for perioperative cardiac management in non-cardiac surgery, dental procedures are included in low-risk (<1 %) category. CAD covered history of myocardial infarction, unstable angina, stable angina, coronary artery procedures (angioplasty or bypass surgery), or evidence of clinically significant myocardial ischemia. CAD risk equivalents included clinical manifestations of non-coronary forms of atherosclerotic disease (peripheral arterial disease, abdominal aortic aneurysm, and carotid artery disease 'transient ischemic attacks or stroke of carotid origin or >50% obstruction of a carotid artery'), diabetes, and 2+ risk factors with 10-year risk for hard CAD >20%.

Patient selection criteria: Patients with acute myocardial infarction (occurring <6 months), imminent indication of cardiac surgery or angioplasty, severe hypertension (SP>180 mmHg and/or DP>110 mmHg) and uncontrolled diabetes mellitus were excluded. In addition, patients with acute symptoms for whom oral minor operation was found to be unfeasible at the time of the scheduled procedure were excluded.

The patients were fully informed of the purposes of the study and the procedures involved and written consent was obtained. The Ethics Committee of the university approved the study protocol.

Study protocol

We planned and conducted three dental intervention of equivalent difficulty on the cases each.

Dental operations

Oral operations of comparable difficulty included dental extractions, soft tissue interventions and surgical extraction of impacted third molars or supernumerary teeth using 3.6 mL local anesthetic in every case. Each operation was performed on three different days with at least one-week intervals. Aspiration was performed before the administration of the local anesthetic solution and the application of various nerve blocks with different solutions were successful in all the patients who underwent local anesthesia with 3.6 mL of two percent lidocaine with 1:80.000 epinephrine (Jetokain^R, Adeka), 3.6 mL of two percent lidocaine without a vasoconstrictor (Jetokain Simplex^R, Adeka) and 3.6 mL of three percent prilocaine with 0.03 IU (international units)/mL octa-pressin (Citanest Octapressin^R, Astra Zeneca). We planned that it was sufficient for us to use 2 cartridges local anesthetics with each being 1.8 mL.

Prior to the dental intervention, an ECG was recorded and the patients showed no abnormal findings, having their blood drawn for routine biochemical tests (Plasma glucose, total cholesterol, high-density lipoprotein, low-density lipoprotein and triglyceride levels).

Holter monitoring

Holter ECG device which uses Syne View Holter ECG Analysis Software (MinHR/24h, Syne Flash, France) was employed to record and compare the ECG changes during the operations.

The pre-operative period took an hour after a Holter ECG device was installed to obtain electrocardiographic records (Fig. 1). After 30 minutes it was connected to the case, 5 mg diazepam was given to the patients intramuscularly and the blood pressure values measured in 30 minute-intervals. Intramuscular sedation was administered in the preoperative period of an hour since ECG changes were to be assessed as the resting process and what could be changed and how following the injection should be observed. The operative period which is supposed to take 2 hours does not imply the surgical period but the process in which significant ECG variations could be expected including dental intervention. It was started with the injection of the local anesthetic solution. At the end of the third hour, another two-hour period was used to assess the

Table 1. The patients data and number of dental operations

Gender	Number of patients	Number of dental operations
Male	17	51
Female	3	9
Total	20	60

postoperative period (Fig. 2). Entire Holter ECG monitoring time took 1 preoperative, 2 operative and 2 postoperative hours with a total of 5 hours.

Holter ECG device Syneflash Card MinHR/24h revealed findings composed of an hour intervals of the heart-rate, pause, missed beats, supraventricular extrasystoles (isolated and couplet), ventricular extrasystoles (isolated and couplet), total extrasystoles and ST segment deviations each.

Statistical analysis

SPSS for Windows (SPSS Inc, Chicago, IL, USA) was used to perform statistical calculations and 0.05 level set for significance. ANOVA for repeated measurements was used for comparing heart rate the three local anesthetics for. Friedman test and non-parametric multiple comparison test were conducted to compare number of arrhythmic events between groups of local anesthetics and different periods for the ECG changes.

Results

Overall, 20 adult cases, 17 men and 3 women (from 37 to 71 with mean age of 59.6) with high risk according to the NCEP ATP 3 guidelines and low risk according to ESC guidelines were included in the study (Table 1). All minor oral operations (Total 60 operations) were well tolerated by all sedated cardiac dental patients. Among patients,

Time hh:mm	Analysed Time (mn)	Total no.of QRS	Heart Rate (bpm)			Pause	Missed Beat	Supraventricular ES			Ventricular ES		
			Average	Min	Max			Isolated	Couplet	Run	Isolated	Couplet	Run
09:48	59	4056	68	57	91	0	0	1	0	0	7	3	0
10:48	59	3825	63	54	81	0	0	1	0	0	5	0	0
11:48	59	3848	64	55	85	0	0	4	0	0	9	1	1
12:48	59	3714	61	52	72	0	0	1	0	0	2	0	0
13:48	51	3497	67	57	93	0	0	1	0	0	21	6	3
14:48	0	0	0	0	0	0	0	0	0	0	0	0	0
15:48	0	0	0	0	0	0	0	0	0	0	0	0	0
16:48	0	0	0	0	0	0	0	0	0	0	0	0	0
17:48	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 1. An example of Holter electrocardiogram device reports (Syneflash Card MinHR/24h)

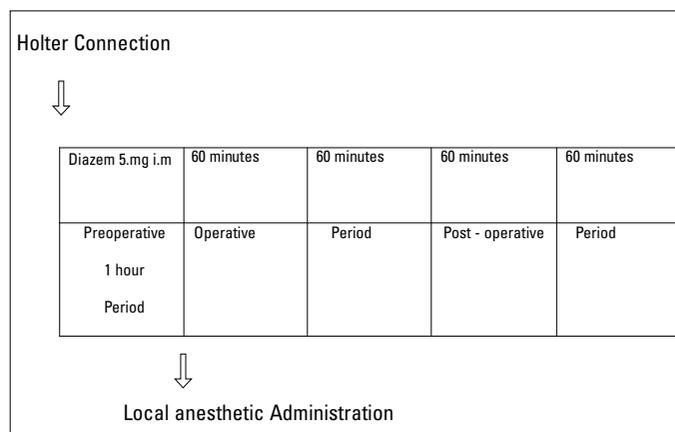


Figure 2. Holter application and periods

Table 2. Differences for heart rate between the local anesthetics at ECG Holter monitoring times

Local Anesthetics	Prilocaine with octa.		Lidocaine		Lidocaine with epi.		*F *p
	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	
Preop. Period	77.7	12.8682	76.15	10.5195	78.2	11.7545	F=12.096 p<0.0001
Operative 1.hr	72.9	10.0205	71.8	10.8511	75.9	9.9255	
Operative 2.hr	72.9	11.021	72.15	13.8916	72.95	12.072	
Postop 1.hr	69.15	10.4744	71.35	14.0348	72.65	10.7374	
Postop 2. hr	72.2	9.9979	75.3	14.3384	74.1	9.6567	
*F *p			F[2;57]=0.158		p=0.855		
ANOVA test							
ECG - electrocardiogram, epi. - epinephrine, octa. - octapressin							

Table 3. Differences for the mean numbers of total extrasystoles

	Mean Rank	
Total ventricular events opr. 2. hr. pure lidocaine	1.58	The differences between pure lidocaine with lidocaine + epinephrine were significant. (p<0.05)
Total ventricular events opr. 2. hr. lidocaine with epi.	2.10	
Total ventricular events opr. 2. hr. prilocaine with octa.	2.33	The differences between pure lidocaine with prilocaine + octapressin were significant. (p<0.05)
N	20	
Chi-Square	6.077	
Df	2	
p	.048	
Friedman test		
Df - degrees of freedom, epi. - epinephrine, octa. - octapressin, opr. 2. hr - operative 2 nd hour		

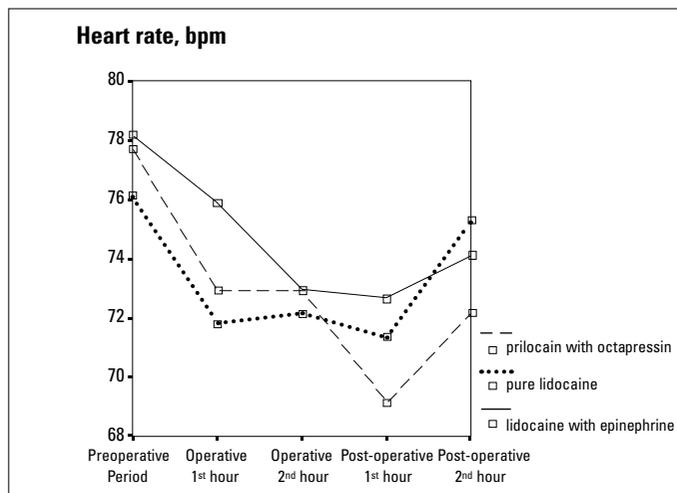


Figure 3. The graph showing heart rate changes with the local anesthetics use

10 had history of percutaneous transluminal angioplasty/stent placement interventions, 6 had coronary artery bypass surgery, 2 were treated with antiarrhythmic drugs and 2 suffered from hypertension with coronary artery disease previously. Blood pressure values measured in 30 minutes intervals showed no significant changes.

In view of heart rate variables, there was a significant difference (p<0.05) between 3.6 mL of lidocaine with 1:80.000 epinephrine and 3.6 mL of 2% lidocaine without a vasoconstrictor at the first hour following the injection (lidocaine with epinephrine 75.9, pure lidocaine 71.8) which did not create any cardiac risks with all the other differences being insignificant (Table 2, Fig. 3).

There was a significant difference for the mean numbers of total extrasystoles and isolated ectopic beats between local anesthetics over monitoring times. The differences between pure lidocaine with lidocaine+epinephrine and prilocaine with octapressin were significant (Table 3, 4).

There were no significant differences between 3.6 mL of 3% prilocaine with octapressin, 3.6 mL of 2% lidocaine with 1:80.000 epinephrine and 3.6 mL of 2% lidocaine without a vasoconstrictor for ST segment deviation variable (Table 5).

Discussion

The present study compared the electrocardiographic effects of lidocaine, lidocaine with epinephrine and prilocaine with octapressin in the same high risk sedated cardiac patient

Table 4. Differences for the mean numbers of isolated ectopic beats

	Mean Rank	
Isolated ectopic beats Opr. 2. hr. Pure Lidocaine	1.55	
Isolated ectopic beats Opr. 2 hr. Lidocaine with epi.	2.13	The differences between pure lidocaine with lidocaine + epinephrine were significant. (p<0.05)
Isolated ectopic beats Opr. 2. hr. Prilocaine with octa.	2.33	The differences between pure lidocaine with prilocaine + octapressin were significant. (p<0.05)
N	20	
Chi-Square	6.816	
Df	2	
p	.033	
Friedman test		

epi. – epinephrine, octa.- octapressin, opr.2.hr – operative 2nd hour

Table 5. Differences for ST segment deviation variable

Local anesthetics	N	ST Segment deviations	%
Lidocaine with epinefrin	20	13	65
Pure lidocaine	20	8	40
Prilocaine with octapressin	20	10	50
Chi square= 2.91		p>0.05	

according to the National Cholesterol Education Programme, Adult Treatment Panel III (NCEP ATP 3) guidelines and low risk according to European Society of Cardiology (ESC) guidelines during oral surgery under local anesthesia.

The findings showed that there were significant differences in heart-rate after the administration of 3.6 mL of 2% lidocaine with 1:80.000 epinephrine and 3.6 mL of 2% lidocaine without a vasoconstrictor in sedated cardiac patients in the first hour following the injection during the oral surgery. Normal heart-rate ranges between 60-100 bpm. Increased heart rate of 75.9 bpm was caused by combination of epinephrine with lidocaine, which is therefore not significant in terms of cardiac risk. Greenwood and Meechan (8), and Middlehurst, Coulthard et al. (25) and Bispo et al. (26) emphasized that the use of sedation in patients with cardiac disease might be valuable for reducing the effects of stress and eliminating the need for general anesthesia. Heart rate was significantly higher with the injection of epinephrine-containing lidocaine than pure lidocaine although the use of 5 mL i.m diazepam for premedication agent in the pre-operative period. Niwa et al. (27, 28), showed that infiltration anesthesia for dental use with 3.6 mL of lidocaine with 1:80.000 epinephrine could be carried out safely on the patients who have exercise capacity of more than 4 metabolic equivalents. Brkovic et al. (29) found no significant differences in the patients' hemodynamic response with lidocaine with epinephrine concerning the use of local anesthetic injection for single tooth extraction. Our results showed similarity to those by Perusse et al. (17, 20), who reported that the use of epinephrine-containing local anesthetics in dental patients with coronary

atherosclerosis could show significant hemodynamic changes and lead to life threatening complications. Malamed (1) recommended the use of epinephrine and other vasoconstrictors in such patients if the vasoconstrictor was administered slowly in small amounts after negative aspiration has been ensured.

As shown in table 3 and 4, we found a significant difference in terms of the mean numbers of total extra systoles and isolated ectopic beats between pure lidocaine with lidocaine + epinephrine and prilocaine with octapressin were significant in the second hour following the injection. 3.6 mL of 3% prilocaine with octapressin effected total extrasystoles and isolated ectopic beats more than 3.6 mL of 2% lidocaine without a vasoconstrictor. Also 3.6 mL of 2% lidocaine with 1:80.000 epinephrine effected total extrasystoles and isolated ectopic beats more than 3.6 mL of 2% lidocaine without a vasoconstrictor. Our clinical results about extra systoles and ectopic beats on sedated cardiac dental patients are similar to those by Blinder's (21) who found significant electrocardiographic changes two hours after the administration of the local anesthetic. Furthermore, Meechan et al. (14) showed a significant tachycardia 10 minutes after injection of 4.4 mL lidocaine with 1:80.000 epinephrine in cardiac transplant patients.

The present study found no significant differences between 3.6 mL of 3% prilocaine with octapressin, 3.6 mL of 2% lidocaine with 1:80.000 epinephrine and 3.6 mL of 2% lidocaine without a vasoconstrictor for ST segment deviation while Meechan et al. (14) experienced a significant tachycardia 10 minutes after the injection of 4.4 mL of lidocaine with 1:80.000 epinephrine in cardiac transplant patients. Blinder et al. (21, 22) reported that when the local anesthetic contained a vasopressor, there was a greater incidence of tachycardia only with less arrhythmia or ST depression.

Conclusion

In conclusion, our evidence appears consistent with the opinion of the authors that administration of 3.6 mL of 2% lidocaine with 1:80.000 epinephrine or a less amount could be rec-

ommended safely during oral surgery in high risk cardiac patients sedated with diazepam.

Conflict of interest: None declared.

Peer-review: External peer-review.

Authorship contributions: Concept - M.Z., Ü.T., M.C.A., İ.S.; Design - M.Z., İ.S.; Supervision - M.Z., Ü.T.; Resource - M.Z., Ü.T., İ.S.; Material - M.Z.; Data collection&/or Processing - M.Z., Ü.T.; Analysis &/or interpretation - M.Z., M.C.A.; Literature search - M.Z.; Writing - M.Z., İ.S.; Critical review - M.Z., Ü.T., İ.S.

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