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Original Article

Hemodynamic changes in exodontia patients using 4% articaine with 1: 100,000 epinephrine and 2% lidocaine with 1:200,000 epinephrine

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Abstract. This study was conducted to evaluate and compare the hemodynamic changes associated with intraoral injection of 4% articaine with 1: 100,000 epinephrine and 2% lidocaine with 1:200,000 epinephrine in patients undergoing dental extraction. A prospective observational study was carried out in patients undergoing tooth extraction. Local anesthesia was administered using 4% articaine with 1:100,000 epinephrine to one group (A), while other group (B) received 2% lidocaine with 1:200,000 epinephrine. The parameters that were monitored at four different points of time (in waiting room, immediately after local anesthesia injection, during tooth extraction, and 15 minutes after tooth extraction) included systolic and diastolic blood pressures, pulse rate and oxygen saturation. No statistically significant differences were observed in systolic blood pressure, diastolic blood pressure and pulse rate at any evaluation time between both groups. However, measurement of oxygen saturation showed statistically significant differences at the time of local anesthesia administration and 15 minutes after tooth extraction, with group B showing higher values ($P < 0.05$). Administration of 2% lidocaine with 1:200,000 epinephrine and 4% articaine with 1:100000 epinephrine was safe during tooth extraction procedure with no statistically difference in hemodynamic status between the two groups. Only oxygen saturation showed statistically significant difference at the time of local anesthesia administration and 15 minutes after tooth extraction in group B.

Keywords: Exodontia, vital signs, local anesthesia, articaine, lidocaine

Introduction

Local anesthesia causes loss of painful sensation from a localized area of body without inducing a loss of consciousness, by reversibly blocking nerve conduction. Tooth extraction is one of the most feared dental procedures by patients. Use of safe and efficient local anesthetic agent and local anesthesia technique has evolved with time making the procedure more patient friendly.

Various local anesthetic agents are used to attain local anesthesia such as lidocaine, bupivacaine and mepivacaine. Use of lidocaine has been a gold standard for pain control in dentistry. It is an amide local anesthetic first prepared in 1943 by Nils Lofgren, and was subsequently approved for clinical use by 1948 [1]. Articaine is an intermediate duration local anesthetic which was first introduced in 1976 in Germany and Switzerland, 1983 in Canada and in 2000 in United States. Use of articaine has become more popular in the recent past. It possesses the ability to diffuse through hard and soft tissues more reliably than lidocaine, thus providing more profound anesthesia [2].

Hemodynamic changes during tooth extraction can be attributed to both stresses during the procedure and presence of the vasoconstrictor, epinephrine in the local anesthetic solution. Epinephrine is added to the local anesthesia to slow the systemic absorption of local anesthetic thus prolonging the action and intensity of the block. Also, the use of vasoconstrictor increases safety by lowering the required anesthetic dose. Monitoring hemodynamic changes during extraction allows the dentist to immediately identify situations of increased risk, establish an early diagnosis, prevent possible complications and operate with increased safety. The present study evaluates the hemodynamic changes associated with 4% articaine with 1:100,000 epinephrine, a relatively new anesthetic agent and compares it with 2% lidocaine with 1:200,000 epinephrine.

Materials and Methods

The present study was undertaken at exodontia clinics of Department of Oral and Maxillofacial Surgery, School

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TABLE 1
DATA MEASURING THE HAEMODYNAMIC VALUES AND STATISTICAL ANALYSIS USING UNPAIRED T TEST FOR EQUALITY OF MEANS OF PARAMETERS IN GROUP A AND GROUP B

Parameters	Time	Group	No.	Mean	SD	*t* statistic	P value
Systolic Blood Pressure	In waiting room	A	25	125.28	7.591	-0.087	0.931
		B	25	125.48	8.559		
	At time of local anaesthetic injection	A	25	120.72	7.808	-1.424	0.161
		B	25	124.32	9.945		
	During tooth extraction	A	25	122.88	7.44	-0.7	0.487
		B	25	124.56	9.408		
	15 mins after tooth extraction	A	25	122	8.145	-1.148	0.257
		B	25	124.72	8.6		
Diastolic Blood Pressure	In waiting room	A	25	81.04	6.113	-1.775	0.082
		B	25	84.28	6.779		
	At time of local anaesthetic injection	A	25	80.8	7.979	-1.358	0.181
		B	25	84.16	9.45		
	During tooth extraction	A	25	80.72	7.231	-1.257	0.215
		B	25	83.52	8.471		
	15 mins after tooth extraction	A	25	79.68	9.141	-1.642	0.108
		B	25	83.44	6.893		
Pulse Rate	In waiting room	A	25	79	11.993	-0.325	0.746
		B	25	80	9.613		
	At time of local anaesthetic injection	A	25	80.8	14.79	0.02	0.984
		B	25	80.72	12.857		
	During tooth extraction	A	25	79.16	13.594	0.093	0.926
		B	25	78.84	10.459		
	15 mins after tooth extraction	A	25	79.6	13.766	0.416	0.68
		B	25	78.2	9.704		
Oxygen Sturation	In waiting room	A	25	97.88	1.269	-0.323	0.748
		B	25	98	1.354		
	At time of local anaesthetic injection	A	25	97.64	1.35	-2.022	0.049
		B	25	98.44	1.446		
	During tooth extraction	A	25	97.92	1.115	-0.853	0.398
		B	25	98.24	1.508		
	15 mins after tooth extraction	A	25	97.36	1.35	-2.647	0.011
		B	25	98.44	1.53		

of Dental Sciences, Karad, India after due approval of the institutional ethical committee. Both male and female patients reporting to the department for routine dental extraction and willing to participate in the study were included. Hypertensive patients and patients with known cardiovascular disorders were excluded from the study. Patients were randomly divided into two groups: Group A included patients undergoing tooth extraction using local anesthetic injection of 4% articaine with 1:100,000 epinephrine. Group B included patients undergoing tooth extraction under local anesthetic injection of 2% lidocaine with 1:200,000 epinephrine.

Dental extractions were carried out in a relaxed atmosphere, with no anxiolytic premedication. On the day of the extraction the patients were asked to have a light breakfast. The indications for dental extraction were caries, periodontitis and combined caries and periodontitis. The patients were monitored for diastolic blood pressure (DBP) and systolic blood pressure (SBP), pulse rate and oxygen saturation (SpO_2). Blood pressure (BP) was measured with sphygmomanometer (Diamond, India). The cuff was placed on the right arm with the patient sitting in the dental chair and BP recorded. Oxygen saturation was measured using pulse oxymeter (Skanray Healthcare PVT. LTD, India®), applied to left index finger, that was made clean and free of nail varnish. These hemodynamic parameters were recorded in the waiting room before the injection (T1), immediately after local anesthetic injection (T2),

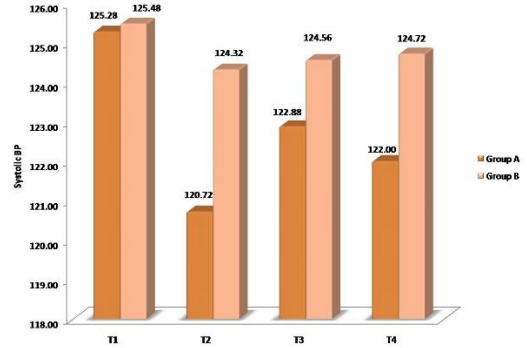

Figure 1. Mean systolic blood pressure (in mm Hg) in patients under 4% articaine with 1: 100,000 epinephrine and 2% lidocaine with 1:200,000 epinephrine at 4 different evaluation times; in waiting room (T1), At time of local anesthetic injection (T2), During tooth extraction (T3) and 15 minutes after tooth extraction (T4). Bars demonstrate mean in each group.

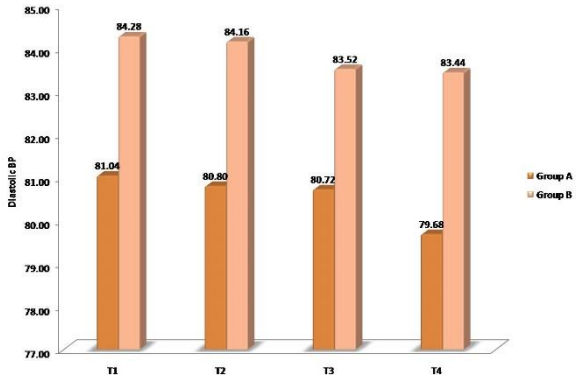

Figure 2. Mean diastolic blood pressure (in mm Hg) in patients under 4% articaine with 1: 100,000 epinephrine and 2% lidocaine with 1:200,000 epinephrine.

during tooth extraction (T3), and 15 minutes after tooth extraction (T4). Regional local anesthesia was provided using 4% articaine with 1:100,000 epinephrine (Group A) and 2% lidocaine with 1:200,000 epinephrine (Group B). Aspiration in two planes was done and then the solution was deposited slowly, to confirm that the anesthetic solution was not directly injected into the bloodstream. A maximum of 3 ml solution was injected.

The data collected was subjected to statistical analysis. All the values were analyzed for mean, standard deviation, errors and range. Unpaired T test, ANOVA and Tukey's multiple comparison post hoc *test* were used for evaluation of statistical significance between the two groups.

Results

These patients were studied for hemodynamic changes after the administration of local anesthesia at various points of time. Group A included 25 patients in age range of 20-84 (mean 56.24), with 15 males and 10 females. Group B included 25 patients in age range of 25-75 (mean 51.20), with 15 males and 10 females.

Measurement of hemodynamic parameters showed no hypertensive peaks in the measurement of SBP and DBP at

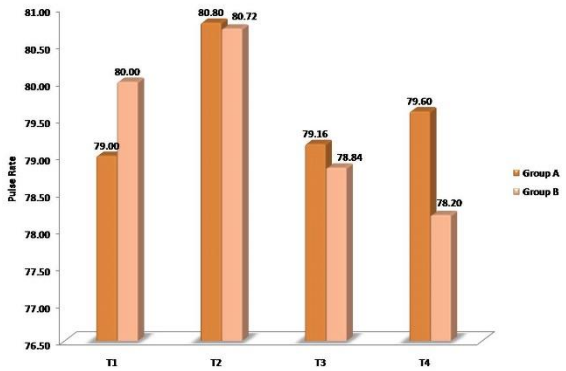

Figure 3. Mean pulse rate in patients under 4% articaine with 1: 100,000 epinephrine and 2% lidocaine with 1:200,000 epinephrine.

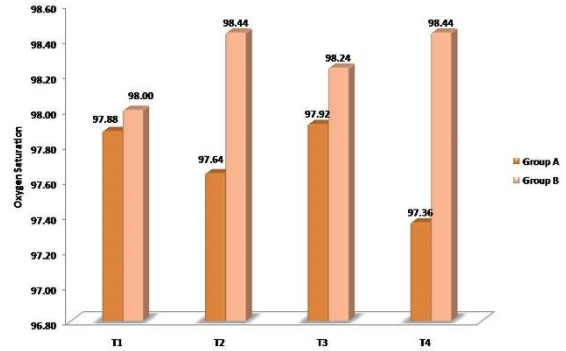

Figure 4. Mean oxygen saturation in patients under 4% articaine with 1: 100,000 epinephrine and 2% lidocaine with 1:200,000 epinephrine.

TABLE 2
REPEATED MEASURE ANOVA TEST FOR GROUP A

Parameters	F	P value
Systolic blood pressure	10.627	<0.0001
Diastolic blood pressure	1.076	0.3649
Pulse rate	61.053	0.2384
Oxygen saturation	2.143	0.1023

TABLE 3
TUKEY'S POST HOC TEST FOR SYSTOLIC BLOOD PRESSURE

Time 1	Time 2	Mean Difference	P value
In waiting room	At time of local anaesthetic injection	7.729	<0.001
	During tooth extraction	4.068	<0.05
	15 mins after tooth extraction	5.559	<0.01

TABLE 4
REPEATED MEASURE ANOVA FOR GROUP B

Parameters	F	P value
Systolic blood pressure	0.5699	0.6366
Diastolic blood pressure	0.7106	0.7106
Pulse rate	0.0973	0.0973
Oxygen saturation	0.2274	0.2274

any evaluation time. The type of local anesthetic slightly affected diastolic and systolic BP during different measurement periods. However, this variation did not achieve statistical significance ($P > 0.05$; Figs. 1 and 2, Table 1). In both groups, pulse rate varied slightly during different measurement periods, however, this variation did not achieve statistical significance ($P > 0.05$; Fig. 3, Table 1). Measurement of oxygen saturation showed statistically significant differences at time of local anesthesia administration and 15 minutes after tooth extraction, with group B showing higher values ($P < 0.05$; Fig. 4, Table 1).

Repeated Measure ANOVA test was done to study the equality of means of four parameters for group A and group B. As with any ANOVA, a repeated measure ANOVA, tests the equality of means. However, a repeated measure ANOVA is used when all members of a random sample are measured under a number of different conditions. As the sample is exposed to each condition in turn, the measurement of the dependent variable is repeated. For group A, it revealed that, there was significant difference for systolic blood pressure (Table 2). Tukey's multiple comparison post hoc test was used to find out in which measurement period, difference was there. Results showed that Systolic BP at T2, T3, & T4 was higher, than at T1 (Table 3). There was no significant difference for diastolic blood pressures, pulse rate and oxygen saturation. For Group B, it revealed that, there was no significant difference for SBP, DBP, pulse rate, and oxygen saturation (Table 4). Alternatively all these four parameters passed the test of equality of means.

Discussion

Given the number of local anesthetic agents available in market, it has becomes necessary to investigate the efficacy of these drugs in order to develop a favorable clinical practice. Properties of these anesthetic drugs vary depending on their molecular structure. Increased diffusiblity of articaine is attributed to its liposolubility and greater plasma protein binding, which can be due to the thiophenic ring and an additional ester ring when compared to traditionally used lidocaine. This property of articaine has led to its increased popularity in past few years.

Monitoring hemodynamic changes while administering local anesthesia, is essential so as to ensure safety of the patient. This will provide a continuous evaluation of patient's condition on the chair so that in case of emergency, immediate action can be taken. These fluctuations apart from the vasoconstrictor's effect can also be attributed to other patient related factors like gender, age, anxiety level, systemic condition.

No significant adverse reactions have been previously reported during the usage of these local anesthetics. Although, certain adverse events associated with the use of articaine with epinephrine were reported such as edema of lips, headache, soreness, trismus, paraesthesia, swelling [3, 4]. Some researchers have also indicated a higher risk of neurosensory disturbance with the use of 4% articaine than with other drugs in use (mainly in mandibular block anesthesia) [5-9].

Morais et al. [10] in 2012 conducted a study to analyze hemodynamic changes following the administration of either 2% lidocaine or 4% articaine (both with epinephrine 1:100,000) in the surgical removal of lower third molars. The results showed no hypertensive peak in systolic blood pressure, diastolic blood pressure and mean blood pressure. A study by Perusse R et al. [11] suggested that hemodynamic changes can also depend on the dose of injected vasoconstrictor. Therefore, variations should be expected if injected technique is not performed carefully and in case the solution gets accidentally injected into a blood vessel [12]. According to Silvestre FJ et al. [13], no significant hemodynamic changes were observed in well controlled hypertensive patients that can be attributed to the presence of vasoconstrictor in the local anesthesia. A study conducted by Aurelia AM et al. [14] on the hemodynamic changes during the surgical removal of lower 3rd molars showed that the fluctuations can also be related to anxiety which was found to be higher in females but these changes were not statistically significant. Also, no significant changes were observed with the parameters considered- systolic BP, diastolic BP, oxygen saturation.

In this study, group A (articaine) and group B (lidocaine) patients did not show statistically significant changes in blood pressure and pulse rate at various point of time during tooth extraction. While for oxygen saturation, there was significant difference between Group A and group B at time of local anesthetic injection and 15 minutes after tooth extraction. No hypertensive peak was observed in the measurement of systolic and diastolic at any evaluation time. Moreover, the type of local anesthetic slightly affected diastolic or systolic blood pressure during different measurement periods. However, this variation did not achieve statistical significance. In both groups, pulse rate varied slightly during different measurement periods, however, this variation did not achieve statistical significance.

According to some authors, oral surgical procedures are very likely to induce patient stress, resulting in the release of endogenous catecholamines, hence giving rise to small hemodynamic fluctuations rather than epinephrine associated with local anaesthesia [15-17]. But, a study conducted by Meilleret al. [18] on blood pressure fluctuations during oral surgical procedures in hypertensive patients, showed no such correlation between patient stress and the changes associated in hemodynamic variables. Some authors[19-22] have also stated that the amount of epinephrine that is used in local anesthetic formulation exerts a cumulative effect with plasma catecholamine levels but this phenomenon would not be sufficient to induce any major hemodynamic changes in

young and healthy individuals. However, risk of complications increases due to this mechanism in patients suffering from cardiovascular disease. This necessitates systemic monitoring of such patients [23-26].

Conclusion

Administration of 2% lidocaine with 1:200,000 epinephrine and 4% articaine with 1:100,000 epinephrine was safe during tooth extraction procedure with no statistically difference in haemodynamic status between the two groups. Only oxygen saturation at time of local anesthesia administration and 15 minutes after tooth extraction was higher in group B. with statistically significant difference.

Conflict of Interest

The authors declare no conflicts of interest.

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