Effect of Local Anaesthesia with and without Adrenaline on Blood Pressure, Pulse Rate and Oxygen Saturation - A Comparative Study

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ABSTRACT

Introduction: Most of the minor oral surgical procedures are performed under local anaesthesia (LA). Vasoconstrictor present in LA decreases the rapid absorption of LA, decreases systemic toxicity, increases duration of LA and provides local hemostasis which favor clinicians for better work performance. But it is also known to increase heart rate (HR) and blood pressure (BP).

Objective: To evaluate the effect of vasoconstrictor adrenaline 1:80,000 in 1.8 ml of 2% Lidocaine on systolic and diastolic blood pressure, pulse rate and oxygen saturation of normotensive patients.

Methods: A prospective randomized study was conducted on 70 patients who were divided randomly into 2 parallel groups according to the LA received. Group 1 (G1): lidocaine 2% without adrenaline and Group 2 (G2): lidocaine 2% with adrenaline 1:80,000. Blood pressure, pulse rate and oxygen saturation were measured before and 10 minutes after LA administration for each patient.

Results: Statistically significant rise in blood pressure and pulse rate was seen in group receiving LA with adrenaline (G2) 10 minutes after administration.

Conclusion: Though adrenaline amount in 1.8ml causes significant rise of parameters assessed under the study, the rise is not clinically relevant for a normotensive, medically fit patient.

Keywords: Epinephrine; lidocaine; local anaesthesia; vitals.

INTRODUCTION

Local anaesthesia (LA) is widely used for medical procedures including maxillofacial surgeries. In 1948, lidocaine was the first local amide anaesthetic to be marketed and since then has become the "gold standard"[1] against which other LAs are measured.[2-4]

Lidocaine in dentistry is used either as plain LA i.e. without vasoconstrictor or with vasoconstrictor. The commonly used vasoconstrictor is adrenaline. Its effects, systemic as well as local at the site of injection are well established. Adrenaline aids in less bleeding at the site of injection.[5] It diminishes systemic toxic effects of lidocaine by slowing its incorporation, thereby increasing depth and duration at the site of administration.[6,7]

However, also documented are side effects of adrenaline and potential dose-related cardio-vascular effects.[8]

Therefore, it is imperative that the effects of adrenaline with vasoconstrictor in comparison with plain LA be studied and interpreted to better understand its systemic and local effects.

The purpose of the present study was to compare the effects of 2% lidocaine without and with adrenaline 1:80,000 on systolic and diastolic blood pressure, pulse rate and oxygen saturation before and 10 minutes after LA administration.

METHODS

This prospective randomized study was carried out from June 2019 to March 2020 in the Department of Oral and Maxillofacial Surgery at Universal Colleges of Medical

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Sciences. Ethical clearance (UCMS/IRC/132/19) for the study was taken from Institutional Review Committee, Universal College of Medical Sciences, Bhairahawa, Nepal. At 5% level of significance and a beta value of 80%, sample size was determined to be 35 in each group using the formula[9]

$$n = 2 (Z\alpha + Z [1-\beta])^2 \times SD^2 / d^2$$

Where

n = sample size required in each group,

d= effect size

SD = standard deviation

Zα: This depends on level of significance, for 5% this is 1.96

Z(1-β): This depends on power, for 80% this is 0.84

Seventy patients who needed minor oral surgery were included in the study.

Inclusion criteria: Patients who were not diagnosed as hypertensive and whose blood pressure was <140/90 mm of Hg[10] were included in the study.

Exclusion criteria: Patients with known history of hypertension, cardiovascular disease, sickle cell anemia, congenital methaemoglobinemia, hyperthyroidism, pregnancy, breastfeeding, allergy to local anaesthetics, any contraindications to epinephrine, and if the extraction required more than 2 ml of local anaesthetic or the duration exceeded 30 minutes were excluded from the study.

Study aims and procedures were explained to the included patients before signing the written informed consent.

Patients were asked to pick a number and were allocated to one of the two groups (G1 or G2), known only to principal investigator. Each group contained 35 patients. Group 1 received 1.8 ml of lidocaine 2% without epinephrine (G1). Group 2 received 1.8 ml of lidocaine 2% with epinephrine 1:80,000 (G2). The surgeon who administered the LA and took measurements was not aware of the solution used beforehand to eliminate bias.

On the dental chair, a pulse oximeter (Rossmax Pulse Oximeter) was applied to the left index finger of the patient then heart rate and oxygen saturation were recorded. The blood pressure was determined by the auscultatory method with the use of a mercury manometer (Accu sure) and a diaphragm stethoscope (Rossmax) on the resting left arm. Aspiration was done followed by injection of 1.8 ml of local anaesthesia (Lox 2% plain or adrenaline 1:80,000, Neon Laboratories Limited, Mumbai, India) selected according to the group. On positive aspiration, injection procedure was repeated. After ten minutes of anaesthesia, blood pressure, oxygen saturation, and heart rate were measured again. Data was entered in MS Excel sheet and analyzed using Statistical Package for Social Sciences (SPSS) software version 20 for Windows. For the statistical analysis, independent t-test was used between the two groups and paired t-test within group at the significant level of $P<0.05$.

RESULTS

Seventy patients including 24 males (34.3%) and 46 (65.7%) females were included in the present study. The age of the subjects ranged from 16 to 76 years. The mean age for all patients was 45.57 years. The patients were divided into two groups, each group included 35 patients. The mean age for groups-G1, and G2 was 47.2 and 43.94 years respectively.

The mean systolic and diastolic BP, oxygen saturation was reduced after injection of lidocaine without epinephrine. The differences were statistically insignificant. But pulse rate showed statistically significant rise throughout (Table 1). While comparing of mean time interval in G1, there were no significant difference in mean systolic, diastolic BP, Pulse rate and oxygen saturation (Table 2).

Table 1: Comparison of mean between two groups G1 and G2 at same time interval (T2).

Study Variable	G1 T2 (Mean±S.D.)	G2 T2 (Mean±S.D.)	T-test value	df	P value
SBP	115.14±14.43	128.86±11.04	-4.466	68	<0.001
DBP	71.54±8.62	78.8±8.1	-3.634	68	0.001
PR	83.2±11.21	83±11.6	0.073	68	0.942
SpO2	96.51±1.36	96.94±1.33	-1.335	68	0.186

SBP: systolic blood pressure. DBP: diastolic blood pressure.
PR: pulse rate. (SpO2): oxygen saturation.
T1- Before LA, T2- 10 minutes after LA
G1- LA without epinephrine, G2- LA with 1:80,000 epinephrine
df- degree of freedom
*independent t-test was used

Table 2: Comparison of Mean between two time interval for same group G1.

Study Variable	G1 T1 (Mean±S.D.)	G1 T2 (Mean±S.D.)	T-test value	df	P value
SBP	116.51±14.93	115.14±14.43	0.966	34	0.341
DBP	72.06±8.76	71.54±8.62	0.432	34	0.668
PR	80.8571±10.76	83.2±11.21	-2.659	34	0.012
SpO2	96.66±1.3708	96.51±1.36	0.695	34	0.492

SBP: systolic blood pressure. DBP: diastolic blood pressure.
PR: pulse rate. (SpO2): oxygen saturation.
T1- Before LA, T2- 10 minutes after LA
G1- LA without epinephrine, G2- LA with 1:80,000 epinephrine
df- degree of freedom
*paired t-test was used

Table 3: Comparison of mean between two time interval for same group G2.

Study Variable	G2 T1 (Mean±S.D.)	G2 T2 (Mean±S.D.)	T-test value	df	P value
SBP	121.43±11.003	128.86±11.04	-6.999	34	<0.001
DBP	75.37±8.93	78.8±8.1	-3.029	34	0.005
PR	79.49±11.22	83±11.6	-4.013	34	<0.001
SPO2	96.74±1.79	96.94±1.33	-1.045	34	0.303

SBP: systolic blood pressure. DBP: diastolic blood pressure.
PR: pulse rate. (SpO2): oxygen saturation.
T1- Before LA, T2- 10 minutes after LA
G1- LA without epinephrine, G2- LA with 1:80,000 epinephrine
df- degree of freedom
*paired t-test was used

Comparison of mean time interval in LA with adrenaline in G2 showed statistically highly significant difference in respect to systolic and diastolic BP and pulse rate (Table 3).

DISCUSSION

Local anaesthesia is a common component of minor surgical procedures not only in dentistry but in medical field as well. Lidocaine being the most common amide and adrenaline as the most widely combined vasoconstrictor are part and parcel of dentistry today. Lidocaine alone is a vasodilator but when combined with adrenaline, tends to balance its act and results in not much apparent change in hemodynamic parameters. This combination is known to enhance the depth and duration of anaesthesia, at the same time it decreases the systemic toxic effects of lidocaine.[11]

However, the use of vasoconstrictor has been documented to influence various cardiovascular parameters. There are two basic categories of adrenergic receptors, alpha adrenergic receptors and beta adrenergic receptors. Alpha adrenergic effects lead to peripheral vasoconstriction and beta adrenergic agonist causes increased rate and force of contraction of the heart and vasodilatation in muscles.[12] Epinephrine, the most commonly used vasoconstrictor in local anaesthetic solutions, has α as well as β adrenergic effects and can increase heart rate, stroke volume, and cardiac output.[13]

Our study showed reduction in blood pressure ten minutes after injecting lidocaine without epinephrine, which can be attributed to the inherent vasodilative property of lidocaine.[14,15]

There was statistically significant rise in blood pressure and pulse rate ten minutes after injecting with lidocaine with adrenaline 1:80,000 although the difference was not clinically considerable (mean rise in systolic BP was 7.43 mm Hg, in diastolic BP was 3.43mm Hg and in pulse rate was 3.51 beats/min).

Our study findings were in accordance with studies done by Meral et al.,[16] Silvestre et al.,[14] and Faraco et al.,[17] Ketabi, et al[18] all of which showed a small but not clinically important increase in hemodynamic parameters after injection of LA with epinephrine (BP, PR and Heart Rate).

In our study the administration of LA noted a fall in BP when compared to injection with adrenaline which is opposite of studies[19,20] concluding that rise in blood pressure following LA is probably due to stress and anxiety preceding dental operation.

Shakeel et al.[21] in 2019 studied the impact and changes associated with oxygen saturation in different adrenaline concentration 1:80000 and 1:200000 and found no statistically significant change which is in accordance with our findings.

From the above, it may be seen that the inclusion of epinephrine in dental local anaesthetic solutions does not raise the hemodynamic parameters clinically considerably, as the amounts used in dental injections (rarely more than 60 µg) is very little compared with the amount of epinephrine released endogenously during stress (280 µg/min.).[22]

This study population included medically fit and normotensive patients. Thus the results might not imply to hypertensive or patients with relevant medical and drug histories. As previous studies have reported that the maximum recommended dose of epinephrine in normotensive patients is 400 ug, while the maximum recommended dose of epinephrine for cardiac patients is 40 ug.[1]

CONCLUSION

We conclude that the rise in cardiac parameters after administration of 1.8 ml of 2% Lidocaine with adrenaline 1:80,000 is not associated with stress and fear during surgery. Still the rise is not known to cause harm in normotensive and medically fit patients. But, LA with epinephrine may be used under precaution in patients with cardiac histories. We are of the opinion that further researches to study effects of more amount of LA with various adrenaline concentrations on normotensive and cardiovascular parameters need to be conducted recruiting a higher number of subjects.

Conflict of interest: None.

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