

Changes in Blood Pressure and Pulse Rate of Patients without Systemic Diseases Following the Injection of 2% Lidocaine Plus Epinephrine 1:80000 in an Inferior Alveolar Nerve Block - A Prospective Study

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Abstract

Introduction: An inferior alveolar nerve block is dental anesthesia produced by the local injection of lidocaine plus epinephrine; however, its administration could cause cardiovascular side effects. We aimed to assess the changes in blood pressure and pulse rate following the injection of 2% lidocaine with epinephrine 1:80000 for an inferior alveolar nerve block. **Materials and Methods:** Seventy-one patients without any systemic disease were enrolled in this study. Systolic blood pressure (SBP), diastolic blood pressure (DBP), and pulse rate were measured using an automatic digital blood pressure monitor in four stages as follows: at the rest time (Stage 1), prior to injection (Stage 2), immediately after injection (Stage 3), and 10 min after the administration of anesthetic agents (Stage 4). All injections and measurements were carried out by a single operator to minimize the variability. **Results:** SBP and DBP in all stages were within the normal range (lower than 130 and 80 mmHg, respectively), and none of the patients showed evidence of arterial hypertension. Although the pulse rate increased significantly at Stages 2, 3, and 4 compared with Stage 1 ($P < 0.05$), no evidence of bradycardia or tachycardia was seen. **Discussion:** Local anesthesia with 2% lidocaine plus epinephrine 1:80000 for an inferior alveolar nerve block would be safe for patients without any systemic diseases.

Keywords: Arterial hypertension, epinephrine, inferior alveolar nerve block, lidocaine, pulse rate

INTRODUCTION

Local anesthesia is a safe, efficient, and cost-effective procedure of reversible block of nerves at the site of application without loss of consciousness.^[1,2] Anesthetic agents interrupt the conduction of a nerve impulse by inhibiting the sodium ion influx through the specific channels within neuronal membranes.^[3-5] Inferior alveolar nerve has a critical role in dental practice because it is a major branch of the trigeminal nerve that runs through the mandible via the mandibular foramen. An inferior alveolar nerve block is the most common type of dental anesthesia administered by practitioners to induce numbness in the posterior mandibular teeth and adjacent soft tissues. However, block failure occurs sometimes because of anatomical, pathological, and psychological characteristics even when performed by an experienced clinician.^[6-8]

At present, various anesthetic agents with an impressive history of efficacy and safety are available in dentistry to make the treatment a pleasant experience.^[1] This class of drugs possess a basic chemical structure consisting of a lipophilic aromatic ring, an intermediate ester/amide chain, and a positively chargeable amino terminus. The choice of anesthetic agents is generally based on their potency, time to onset, and length of action. However, its absorption, distribution, metabolism,

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and excretion, as well as the possibility of toxicity, should also be considered by dental professionals.^[2,9]

Currently, the commercially available cartridges containing lidocaine in combination with epinephrine is routinely prescribed for the inferior alveolar nerve block.^[8,10] Lidocaine is an amide-type anesthetic agent with the ability to readily diffuse through the interstitial tissues and lipid-rich nerves. It has a short onset time (2–5 min) and a moderate length of action. Lidocaine is frequently utilized in a form that contains epinephrine, which is a common vasoconstrictor that is usually added to decrease the possibility of systemic toxicity.^[2,9,11-13] Knowledge of the pharmacokinetic and possible adverse effect of anesthetic drugs is essential to prevent complications and achieve the intended goals; however, because of its short half-life, the toxicity symptoms are provisional and rapidly reversible.^[1,8,10] The addition of epinephrine to lidocaine might express undesirable adverse effects such as an increase in blood pressure, hypotension, chest pain, arrhythmias, tachycardia, and even cardiac arrest. However, such cardiovascular side effects are related to the concentration of anesthetic agents in circulation in a dose-dependent manner.^[14-19] Therefore, the current study aims to examine whether the injection of 2% lidocaine with epinephrine 1:80000 for an inferior alveolar nerve block would change the cardiac indices such as blood pressure and pulse rate in patients without systemic diseases.

MATERIALS AND METHODS

Patients

Seventy-one patients from those who visited the Department of Dentistry at a dental hospital, affiliated to Shiraz University of Medical Sciences, Shiraz, Iran, participated in this study. These patients presented for extraction of teeth, endodontic treatment, or tooth restoration. Before any assessment, the patient's record was evaluated to ensure that none of them suffered from any possible systemic disease according to the American Society of Anaesthesiologists Physical Status classification Class 1. The subjects who had any systemic illness such as cardiovascular disease, uncontrolled hypertension, diabetes, and liver disorders were excluded. The research protocol was approved by the Local Ethics Committee of Shiraz University of Medical Sciences, Shiraz, Iran. All participants signed the written informed consent in accordance with the declaration of Helsinki and its later amendment.

Study design

After meeting the inclusion criteria, each subject was made aware of the aims and purposes of the research with an exact explanation of the procedures. In all cases, the right hand in a similar upright-seated position was used for the assessment of cardiac indices. The systolic blood pressure (SBP), diastolic blood pressure (DBP), and pulse rate were measured in four stages using an automatic digital blood pressure monitor (HD-430M, Eikon, Taiwan). At the first stage (Stage 1), each subject was asked to take a rest for at least 5 min before measuring the blood pressure and pulse

rate. A second measurement was performed prior to injection of the local anesthetic when the patient was seated on the chair and observing the preparation of a dental syringe (Stage 2). Afterward, the standard inferior alveolar nerve block was produced for each case using one cartridge of 2% lidocaine with epinephrine 1:80000 (perisonocaine-E, Daropaksh, Iran). When injection was performed properly and the dental syringe was removed, the third set of measurements was carried out (Stage 3). In all cases, proper aspiration was performed to prevent intravascular injection of the anesthetic solution, and utmost care was taken to inject as painlessly as possible. The last set of measurements were obtained 10 min after the administration of local anesthetic agents (Stage 4). All the injections and measurements were carried out by a single operator to minimize the variability of the outcome. Following an inferior alveolar nerve block, dental procedures were performed for each subject based on the necessary treatment.

Statistical analysis

Statistical analyses were carried out using SPSS software (IBM SPSS Statistics for Windows, Version 18.0, Armonk, NY: IBM Corp. Released 2009). All values were expressed as means and standard deviations. Comparison of the cardiac indices between the stages was performed by a repeated measure ANOVA and the Bonferroni correction test. A $P < 0.05$ was considered to be statistically significant.

RESULTS

Overall, 71 patients including 37 male (52.1%) and 34 female (47.9%) in the age range of 14–68 years were eligible for the statistical analysis. The levels of SBP, DBP, and pulse rate are presented in Table 1.

Our results indicated that SBP and DBP in all time points

Table 1: The mean systolic blood pressure, diastolic blood pressure, and pulse rate following an inferior alveolar nerve block

Variables	SBP (mm Hg)	DPB (mm Hg)	Pulse rate
Stage 1			
Male	122.97	79.97	71.38
Female	116.85	74.62	72.18
Total	120.04	77.41	71.76
Stage 2			
Male	124.41	80.24	76.05
Female	118.59	76.38	78.35
Total	121.62	78.39	77.15
Stage 3			
Male	124.59	81.30	74.73
Female	119.35	76.44	77.38
Total	122.08	78.97	76.00
Stage 4			
Male	123.30	79.73	77.95
Female	117.03	74.32	80.88
Total	120.30	77.14	79.35

SBP=Systolic blood pressure; DBP=Diastolic blood pressure

were within the normal range (lower than 130 and 80 mmHg, respectively), and none of the patients showed any evidence of arterial hypertension. Although the mean levels of SBP was elevated at Stages 2, 3, and 4 in comparison to Stage 1, the differences were not statistically significant ($P > 0.05$). In addition, DBP was also similar and exhibited no significant difference between the stages ($P > 0.05$). The blood pressure values between both genders were also similar ($P > 0.05$).

As expected, the mean pulse rate differed significantly between the study stages. Compared to Stage 1, the pulse rate increased significantly at Stages 2, 3, and 4 by a mean difference of 5.39, 4.24, and 7.59, respectively ($P < 0.05$). However, the pulse rate was within normal range and not >81 or <71 beats/min. Therefore, no evidence of bradycardia (lower than 60 beats/min) or tachycardia (higher than 100 beats/min) was noticed in this research. Although at all stages, the pulse rate in male gender was lower than that observed in females, the mean difference between the stages was statistically significant only in the female group ($P < 0.05$). Variations in cardiac indices are shown in Figure 1.

DISCUSSION

The diversity of anesthetics and associated side effects, as well as the inherent characteristics of each patient, provides a rationale for dental professionals to assess both the pharmacokinetics and pharmacodynamics of these agents.^[1,8,10] Currently, several vasoconstrictors in various concentrations are available to improve the efficacy of anesthetic agents. Epinephrine is the most commonly used vasoconstrictors in dentistry; however, its usage is not in full agreement because of a number of cardiovascular disturbances, especially in high-risk patients.^[9,13,20] Consequently, some researchers have recommended the use of epinephrine-free anesthetics in clinical dental practice.^[21-23] However, the addition of a vasoconstrictor might have greater benefits, such as the reduction in plasma concentration of anesthetic agents, minimizing the amount of anesthetic required for a nerve block, bleeding reduction during oral surgical procedures, and improving the duration and quality of anesthesia.^[2,9] To date, several studies have investigated the changes in arterial blood pressure and pulse rate during the injection of lidocaine plus epinephrine in dental practice; however, their significance was limited due to small sample size, different time of measurement, and differences

in the dose of anesthetic agents or vasoconstrictor. Therefore, the current study designed to assess the alterations in cardiac indices following an inferior alveolar nerve block with a mixture of lidocaine plus epinephrine in patients without systemic diseases.

Our findings revealed the absence of significant change in SBP and DBP between the stages or following the administration of the anesthetic agent, which is comparable to a group of healthy subjects who had been admitted for an inferior alveolar nerve block with one cartridge of 2% lidocaine with 1:80000 epinephrine.^[10] However, in contrast to our finding, Managutti *et al.*,^[20] and Khalighi Sigaroodi *et al.*^[18] demonstrated the significant elevations in SBP and DBP after injection of the same doses of lidocaine-epinephrine. In addition, the mean SBP and DBP in the male group were slightly higher than that females; however, the differences were not significant. These observations are in agreement to those reported by Shaban *et al.*,^[15] however, Haghghat *et al.*^[10] reported a significantly higher DBP in male gender at the beginning of injection, probably due to fear of injection or pain prohibition and feeling expression.

In the current study, the injection of one cartridge of 2% lidocaine with epinephrine 1:80000 was associated with physiological responses, resulted in a significant rise in pulse rate. In line to our findings, Managutti *et al.*^[20] and Shaban *et al.*^[15] also showed significant rise in the pulse rate of patients without any systemic illness following the administration of one or two cartridges of 2% lidocaine with 1:80000 epinephrine for extractions of mandibular bilateral teeth or maxillofacial surgeries, respectively. The pulse rate increase without elevation of SBP or DBP might be due to the stress induced by injection or pain, which leads to the secretion of endogenous catecholamines, resulted in hemodynamic changes.^[18,24,25] On the other hand, some investigators had believed that this compound did not significantly change the blood pressure and pulse rate, with vasoconstrictor dose-dependent or dose-independent.^[24-28]

Gadve *et al.* showed maximum heart rate was 4 min after the administration of 2% lignocaine with vasoconstrictor (adrenaline 1:200000) for inferior alveolar nerve block.^[29]

This study demonstrates some limitations such as no prior sample size estimation; however, we used as many cases

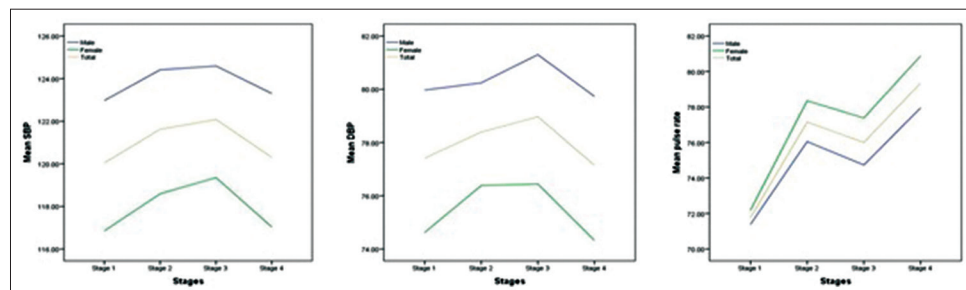


Figure 1: Comparison of the changes in mean systolic blood pressure, diastolic blood pressure, and pulse rate between the stages

as possible. Although no side effect was reported in the present study, the results should be interpreted with some caution. Further studies with larger sample size and more time-points are warranted to assess the efficacy and safety of lidocaine-containing epinephrine for an inferior alveolar nerve block.

CONCLUSION

Adaptation of local anesthetics containing a vasoconstrictor to the patient's characteristics should be considered before each injection. Local anesthesia with 2% lidocaine plus epinephrine 1:80000 for an inferior alveolar nerve block would be safe for patients without any systemic diseases, but it is not the case for all patients and might be problematic in those with cardiovascular diseases, which needs to be evaluated in future studies.

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Conflicts of interest

There are no conflicts of interest.

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