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Changes in Blood Pressure and Pulse Rate in Patients Following the Injection of Lidocaine with 2% Adrenaline in A Mandibular Nerve Block

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ABSTRACT

Local anaesthetic like lidocaine are commonly used in dental and maxillofacial procedures, but their systemic vasoconstrictive effects can cause physiological changes, especially in cardiovascular parameters. **Objectives:** To evaluate the blood pressure and pulse rate alterations in patients after administering a mandibular nerve block using 2% lidocaine with adrenaline. **Methods:** Three hundred patients aged 14-60 who came for extraction were selected through non-probability consecutive sampling. Clinical examinations were performed, and diastolic, systolic blood pressure, and pulse rate were recorded with an automatic digital blood pressure monitor in four stages (before local anesthesia (5 minutes' rest), before local anesthesia (sitting at chair), after local anesthesia (immediate) and after local anesthesia (10 minutes)). **Results:** A study of 300 mandibular nerve block patients found that male patients (69.3%) and female patients (30.7%) had a mean age of 32.95 ± 11.19 years. Blood pressure, pulse rate, and oxygen saturation significantly varied in all four stages. In the first stage, most patients had normal blood pressure (120/80 mmHg), while in stages 2-4, most had stage 1 blood pressure (139/89 mmHg). In stages 3 and 4, patients had stage 2 blood pressure (140/90 mmHg), and in stage 4, 1.3% experienced hypertensive crisis. In stages 1-4, most patients had normal pulse rate, followed by tachycardia and bradycardia. **Conclusions:** The study found significant differences in blood pressure and pulse rate among patients after administration of a mandibular nerve block using 2% lidocaine with adrenaline.

INTRODUCTION

Local anesthesia is a safe, effective, and economical method of reversibly blocking nerves at the application site without causing unconsciousness [1]. Anesthetic drugs block sodium ion entry via certain channels in neuronal membranes, preventing a nerve impulse from being sent [2]. Because the inferior alveolar nerve is a significant branch of the trigeminal nerve and passes through the jaw via the mandibular foramen, it is very important in dental treatment. With an onset time of 10 minutes, this approach was claimed to have a 72% success rate. An inferior alveolar nerve block is the kind of dental anesthetic that is most often used by professionals to induce anesthesia in the posterior mandibular teeth and the soft tissues that surround them. Even in the case of a skilled physician, block failure may still happen due to anatomical, pathological, and psychological factors [3]. Today, a variety

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of anesthetics with a strong safety and effectiveness record are available in dentistry to provide a comfortable procedure [4]. The fundamental molecular structure of this family of medications is composed of a positively charged amino terminus, an intermediate ester/amide chain, and a lipophilic aromatic ring. The potency, start time, and duration of action of anesthetic drugs are often taken into consideration while selecting them. However, dental practitioners should also take into account the substance's distribution, metabolism, excretion, and potential for toxicity [5]. Nowadays, the inferior alveolar nerve block is often treated using commercially accessible cartridges that include lidocaine and epinephrine [6]. A lipid-rich nerve and the interstitial tissues are easily penetrated by lidocaine, an amide-type anesthetic. Its duration of action is mild, and its start time is brief (3-5 minutes). Epinephrine is a well-known vasoconstrictor that is often used with lidocaine to lessen the likelihood of potential systemic toxicity [7]. To avoid difficulties and accomplish the desired aims, it is crucial to understand the pharmacokinetics and potential side effects of anesthetic medicines. It is fortunate that the symptoms of toxicity are only temporary and may be quickly reversed because of the short half-life of the substances [8]. When epinephrine is used with lidocaine, it may have unfavorable side effects, including hypertension, hypotension, chest discomfort, arrhythmias, tachycardia, and even cardiac arrest. However, there is a dose-dependent relationship between these cardiovascular adverse effects and the amount of anesthetic drugs in the blood. [9, 10].

This search aims to explore the effect of an injection of 2% lidocaine combined with epinephrine at a ratio of 1:80000 on cardiac parameters in people without systemic illnesses. Inconsistent findings and a lack of context-specific data, particularly in patients without underlying systemic conditions in our population, highlight a significant gap in the literature. This study shows the importance for dental professionals to assess the pharmacokinetics and pharmacodynamics of anesthetics, considering their diversity, potential side effects, and individual patient variability.

METHODS

This prospective cohort study with a non-probability consecutive sampling technique was performed at the Oral and Maxillofacial Surgery Department after the approval of the ethical committee (LUMHS/REC-127) of Liaquat University of Medical and Health Sciences from 1-8-2021 to 31-7-2022. Patients in the age range of 14-60 years of either gender, who reported for the extraction of mandibular 1st molar tooth, were included in the research. Patients suffering from high blood pressure, diabetes mellitus, cardiovascular disease, thyroid disease, pregnancy, or any known systemic illness, as well as those on medications affecting cardiovascular parameters or with a history of allergy to local anesthetics, were excluded from the study. Written informed consent was taken from all the participants before the procedure. The sample size was calculated using the power package method in R for a paired t-test, with a significance level of 0.05 and a power of 80%. Based on the mean systolic blood pressure before injection (110.64 ± 4.14 mmHg) and after 60 minutes of injection (108.04 ± 3.24 mmHg), the estimated effect size yielded a minimum required sample size of 40 participants. However, we have included all available 300 cases in the study to enhance the robustness and generalizability of the findings [11]. Based on the American Society of Anesthesiologists Physical Status categorization Class, records of patients were reviewed to make sure none of them had any potential systemic diseases [12]. The measurement of cardiac indices was done in each instance while the patient was sitting upright and using the right hand. To determine the pulse rate, systolic blood pressure (SBP), and diastolic blood pressure (DBP) in four distinct periods, an automated digital blood pressure monitor (HD-430M, Modigag) was utilized. First Stage (Stage 1) was before taking the subject's blood pressure and pulse rate during the first stage (Stage 1), they were instructed to relax for a minimum of five minutes. Second Stage (Stage 2) involved, before the local anaesthetic was injected, a second measurement was taken while the patient was sitting in the chair, and a dental syringe was prepared. Third Stage (Stage 3) involved, after that, each patient was given a typical inferior alveolar nerve block using a single cartridge of 2% lidocaine and 1:80000 epinephrine (Medicaine, manufactured in Korea). The final set of measurements was taken after the injection was correctly done and the dental syringe was removed. To avoid intravascular injection of the anesthetic solution, appropriate aspiration was carried out in each instance, and great care was taken to provide a painless injection. In Fourth Stage (Stage 4), ten minutes after the local anesthetic was administered, the last set of measurements was taken. To reduce the amount of variation in the results, a single operator performed all injections and measurements. After an inferior alveolar nerve block, each individual had dental operations depending on what was deemed required. Statistical analyses were performed using SPSS 22. All continuous variables were represented by means and standard deviations. The cardiac indicators were compared between the stages using a chi-square test/fisher exact test. Statistical significance was defined as a p-value of less than 0.05.

RESULTS

The majority of the participants were male, 208 (69.3%), while female patients constituted 92 (30.7%). The mean age of the participants was 32.95 ± 11.19 years (Table 1).

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Table 1: Age and Gender Distribution of the Participants Undergoing Mandibular Nerve Block (n=300)

Parameters	Variables	n (%)
Gender	Male	208 (69.3%)
	Female	92 (30.7%)
Age (Years)	Mean ± SD	32.95 (11.19%)

The distribution of patients' blood pressure across the four stages is presented. A statistically significant difference in blood pressure was observed across the stages p<0.001). Normal blood pressure (120/80 mmHg) was most commonly observed at Stage 1 (S1) in 158 patients (52.7%), which declined progressively in the subsequent stages. Elevated blood pressure (140/90 mmHg) was most prevalent in Stage 3 (S3), affecting 48 patients (16.0%), and remained high in Stage 4 (S4) (47 patients, 15.7%). Severe hypertension (180/120 mmHg) was only recorded in Stage 4 (S4) in 4 patients (1.3%), while no such cases were observed in the earlier stages (Table 2).

Table 2: Distribution of Blood Pressure of the Patients According to Four Stages of the Study (n=300)

BP (mmHg)	S1 (%)	S2 (%)	S3 (%)	S4 (%)	p-value
120/80	158 (52.7%)	29 (9.7%)	41 (13.7%)	35 (11.7%)	<0.001
129/80	74 (24.7%)	94 (31.3%)	77 (25.7%)	86 (28.7%)	
139/89	55 (18.3%)	152 (50.7%)	134 (44.6%)	128 (42.6%)	
140/90	13 (4.3%)	25 (8.3%)	48 (16.0%)	47 (15.7%)	
180/120	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (1.3%)	

*Fisher's exact test

The distribution of patients' pulse rates across the four stages is presented in Table 3. A statistically significant difference in pulse rate was observed across the stages (p=0.003). Normal pulse rate (60–100 beats/min) was most frequently observed in Stage 1 (S1) in 216 patients (72.0%), which declined during Stage 2 (S2) (194 patients, 64.6%) and Stage 4 (S4) (196 patients, 65.4%). Tachycardia (>100 beats/min) increased from 63 (21.0%) in Stage 1 to 92 (30.7%) in Stage 2, with the highest prevalence in Stage 4 (32.3%, n=97). Bradycardia (<60 beats/min) was least common, with a gradual decline from 21 (7.0%) in Stage 1 to 7 (2.3%) in Stage 4 (Table 3).

Table 3: Patient's Pulse Rate Distribution According to Four Stages of Study (n=300)

Pulse Rate (beats /min)	S1 (%)	S2 (%)	S3 (%)	S4 (%)	p-value
60-100	216 (72.0%)	194 (64.6%)	209 (69.7%)	196 (65.4%)	0.003
>100	63 (21.0%)	92 (30.7%)	83 (27.6%)	97 (32.3%)	
<60	21 (7.0%)	14 (4.7%)	8 (2.7%)	7 (2.3%)	

*Chi-square test

DISCUSSION

Vasoconstrictive medications, which extend the duration and enhance clinical effectiveness of local anesthesia, are widely accessible and may be used with a variety of local anesthetic agents. Adrenaline and lidocaine are most often used in different concentrations. Adrenaline-like medicines may produce a variety of cardiovascular problems, most of which are transient. However, in cases of pharmacologically induced ventricular arrhythmia, Ischemic myocardial necrosis, or cerebrovascular episodes, lasting harm or even death may result [13-16]. In this research, individuals who reported for the extraction of 1st molar teeth underwent mandibular nerve block, were male 208 (69.3%) and 92 (30.7%) were female, with a mean age of 32.95 ± 11.19 (14-60) years. A similar study by Gadve *et al.*, reported the higher female patients 56.7% and 43.3% were male patients with a higher mean age of 37 years [10]. Deo *et al.*, reported the higher male patients 60% and lower female patients 40% with a mean age of 24.93 years [17]. Most of the young patients were suffering from different tooth problems and underwent mandibular nerve block. in this study, blood pressure (p<0.001) and pulse rate (p=0.003) were significantly different in all four stages (before local anesthesia (5 minutes' rest), before local anesthesia (sitting at chair), after local anesthesia (immediate) and after local anesthesia (10 minutes)). A study by Gadve *et al.*, also reported the significant changes in blood pressure and observed maximum blood pressure at the time of surgery. Four minutes after the local anesthetic injection, the heart rate reached its peak, and it fell to its lowest point once the tooth extraction was finished. throughout the course of the investigation, notable variations were seen in oxygen saturation, heart rate, and blood pressure [12]. Another study by Chowdhury *et al.*, reported the difference in blood pressure preoperatively, whereas a significant increase in blood pressure intraoperatively and postoperatively [18]. Another study by Brkovic *et al.*, reported a significantly decreased pulse rate 10 min after surgery [19]. All similar study findings show the effect of lidocaine with 2% adrenaline on cardiac indices such as increased blood pressure, tachycardia, bradycardia and hypoxemia during different stages, especially after injecting 2% lidocaine with epinephrine. according to research by Aliabadi *et al.*, none of the patients had any signs of arterial hypertension, and both SBP and DBP were within the normal range at all phases (less than 130 and 80 mmHg, respectively). There were no indications of bradycardia or tachycardia, even though the pulse rate increased significantly at stages 2, 3, and 4 in comparison to stage 1 (p<0.05) [20].

CONCLUSIONS

Following the administration of lidocaine and adrenaline at a concentration of 2% in mandibular nerve block, the researchers concluded that the patients' blood pressure and pulse rate were substantially different following each of the four phases of the procedure. Elevated blood pressure, stage 1 blood pressure, stage 2 blood pressure, tachycardia, bradycardia, low oxygen saturation and hypoxemia significantly increased from stage 1 to stage 4,

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especially after injecting 2% lidocaine with epinephrine. These findings show the importance of careful monitoring of hemodynamic parameters during dental procedures, especially in at-risk patients with underlying cardiovascular conditions.

Authors Contribution

Conceptualization: M, SS
Methodology: M, FH
Formal analysis: SKP, AH
Writing review and editing: MIS, MO

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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