

Research Article

Changes in glycemic level following injection of local anaesthesia with epinephrine in hypertensive patients

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Abstract: Background: Stress hormones or sympathetic activities induce hemodynamic changes and increase peripheral vasoconstriction, making more blood available in the body's vital organs. Hepatic cells will respond by increasing glucose release and gluconeogenesis. All these events inhibit glucose uptake by peripheral tissues and induce hyperglycemia. As such, more sugar becomes available in the blood. Injection of local anaesthesia and dental extraction are considered stressful procedures. Moreover, epinephrine added to the local anaesthesia, which is used as a vasoconstrictor, can produce hyperglycemia during dental procedures. This study aimed to evaluate changes in the glycemic level of patients with controlled hypertension and compare it with healthy adults undergoing simple tooth extraction under local anaesthesia with epinephrine 1:100,000. Methods: A prospective clinical study was conducted on 60 normotensive and 60 controlled hypertensive patients. Glycemic level was monitored at two different time points (before and 25 minutes after infiltration of local anaesthesia). Each patient was provided with one cartridge of anesthetic solution containing lignocaine 2% and epinephrine (1:100,000). Results: The glycemic level did not significantly change in the normotensive group ($p=0.372$) and significantly increased in the hypertensive group ($p=0.018$). The difference between the two groups was significant ($p=0.017$). Conclusion: Significant elevation in glycemic level was seen when dealing with controlled hypertensive patients. In patients with normal blood pressure, their glycemic level did not increase during simple extraction under one cartridge of local anaesthesia with a vasoconstrictor.

Keywords: local anaesthesia, epinephrine, vasoconstrictors, hypertensive patients, glycemic level.

Introduction

Dental extraction is a common procedure in dental clinics. It is a minor surgery and can be performed without pain under local anaesthesia. Plain local anesthetic solutions can affect receptors and cause dilation of blood vessels, leading to induced muscle relaxation. Epinephrine is usually added to plain local anaesthesia to optimize its properties and suppress the vasodilator action. Epinephrine offers indisputable advantages, such as aiding in hemostasis, increasing the depth of local anaesthesia, and reducing the dose of toxicity⁽¹⁾. Epinephrine is also considered a potent systemic glucagon stimulator^(2,3). Epinephrine acts on α_1 receptors of blood vessels, causing the narrowing of the vessels. By contrast, its action on β_1 receptors of cardiac muscles increases the strength of muscle contraction. A higher dose of epinephrine will react with β_2 receptors and cause dilation of vessels in skeletal muscles and airways^(4,5).

Anxiety associated with dental extraction stimulates sympathetic endogenous stress hormones. The blood flow increases through the vessels and vital organs, such as the pancreas, which is responsible for the production of glucagon by α -cells. This phenomenon increases the level of glucagon and inhibits the usage of insulin by peripheral tissues; as such, free sugar exists in the bloodstream. All of these events lead to

hyperglycemia ⁽⁶⁻⁹⁾. Insulin concentrations may decrease after injection of local anaesthesia; during surgery, insulin secretion fails to match the catabolism, thereby promoting hyperglycemia. Hyperglycemia may be caused partly by α -adrenergic inhibition of β -cell secretion. Another cause is the failure of the usual cellular response to insulin, and this process is called "insulin resistance," which occurs in the perioperative period ⁽¹⁰⁾.

Hypertension is considered a common cardiovascular disease. Controversy exists regarding the use of epinephrine or vasoconstrictors during dental procedures when dealing with patients with cardiovascular problems because epinephrine induces significant or nonsignificant cardiovascular changes ⁽¹¹⁾. The present study evaluates the changes in the glycemic level following simple dental extraction under local anaesthesia with a vasoconstrictor in healthy normotensive patients compared with controlled hypertensive patients.

Materials and Methods

Study design and sample grouping

The study was designed as a prospective clinical study. Two groups (patients with normal blood pressure and patients with controlled hypertension) were subjected to simple dental extraction under local anaesthesia with a vasoconstrictor agent. All the participants were carefully informed about the nature of the study and signed explicit consent forms. The total sample consisted of 120 patients seen at the Department of Oral and Maxillofacial Surgery/ College of Dentistry /University of Baghdad from November 2021 to May 2022. All of the patients underwent simple dental extraction of upper anterior teeth or premolars.

The following inclusion criteria were established, namely, controlled hypertensive patients with antihypertensive medication and simple extraction of upper teeth, including premolars and anterior teeth only. The exclusion criteria included difficult extraction or extraction time extending more than 15 minutes, uncontrolled hypertensive patients, or patients controlled by beta-blockers or adrenergic blockers.

Clinical and medical history was obtained, and an internist examined the general health of each participant (healthy patients were diagnosed to ensure they did not have high blood pressure). Body mass index (BMI) was calculated for each patient by dividing the weight in kilograms by the square of height in meters. The participants were classified as follows based on their BMI: underweight, $<18.5 \text{ kg/m}^2$; normal weight, 18.5 to $<25.0 \text{ kg/m}^2$; overweight, 25.0 to $<30.0 \text{ kg/m}^2$; and obese, $\geq 30.0 \text{ kg/m}^2$ ⁽¹²⁾.

Protocol for monitoring glycemic level

All patients had their normal breakfast on the day of the procedure. Glucose level was recorded before the procedure by the active blood glucose meter Accu-chek [Roche, Germany; Figure (1)A]. The thumb tip of the left hand was cleaned with alcohol and completely dried prior to taking a blood sample with a flat glucometer lancet [Figure (1)B]. The blood sample touched the red light and filled the green area of the test strip. After a few seconds, the result showed on the device screen.

The accuracy of the blood glucose meter was checked by taking a venous blood sample from 20 patients. Plasma was separated by centrifugation. The sample was processed with special chemicals and measured by a Stat Fax 4500 spectrophotometer. A drop of the sample was used to measure glucose level by Accu-chek. The results differed from 0% to 15%, which is considered acceptable based on the Food and Drug Administration guideline that glucose results should not have an error greater than 20% ⁽¹³⁾.



Figure 1: Measuring glucose level: A: Glycemic monitoring device, and B: blood sample

Extraction protocol

Topical anaesthesia was applied before the needle insertion for 2 minutes to reduce the pain. All the extractions were done with the standardized method applied to both groups by the same surgeon (the researcher). The procedure was completed in a relaxed, comfortable atmosphere under local anaesthesia of lignocaine 2% with epinephrine as a vasoconstrictor (1:100,000) (Zeyco, Mexico). One cartridge (1.8 ml) was used for each patient. The anesthetic solution was injected slowly and aspirated with an auto-aspirating syringe to ensure no direct penetration of the anaesthesia solution into the bloodstream.

In the hypertensive group, patients were instructed to take their usual dose of antihypertensive drugs on the day of the procedure. The patients were given written and verbal instructions after the procedure. The glucose level was recorded again after 25 minutes of local anaesthesia.

Statistical analysis

The reading (R) of the glucose level was obtained before the injection of local anaesthesia (R1) and 25 minutes after local anaesthesia (R2). Changes in each group were calculated. Statistical Package for the Social Sciences (SPSS version 22.0, Chicago, IL, USA) was used. Paired t-test was used to evaluate differences within each group, and independent t-test was used to compare changes between the two groups. The significance level was set at or lower than 0.05.

Results

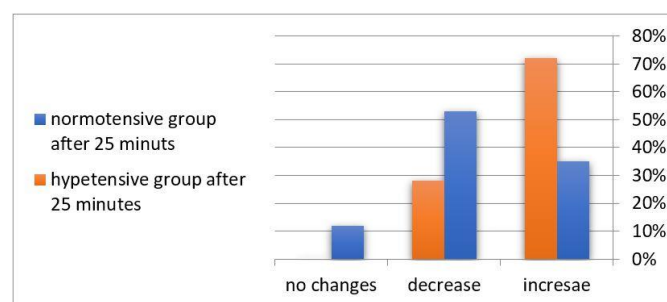
The control group included patients with normal blood pressure (23 males, 37 females) with a mean age of 39.13 years and a mean BMI of 25.29 kg/m² (ranging from 20.1 kg/m² to 29.9 kg/m²). The study group included controlled hypertensive patients (31 males, 29 females). with a mean age of 52.78 and a mean BMI of 26.74 kg/m² (19.9–29.8 kg/m²).

The glycemic level before the injection of local anaesthesia ranged from 85 mg/dl to 200 mg/dl in the normotensive group and between 76 and 289 mg/dl in the hypertensive group (Table 1). Fifteen percent of patients in the hypertensive group had diabetes mellitus and were taking hypoglycemic medications. After 25 minutes, 35% of patients in the normotensive group showed an increase in glucose level; the remaining 53% had reduced glucose level, and 12% had no changes (Figure 2). The statistical analyses showed no significant change in the normotensive group ($p = 0.372$). In the hypertensive group, 72% showed an increase in blood glucose level, while 28% showed a reduction [Figure (2)]. The two readings in this group ($p=0.018$) showed a significant change. A significant difference was detected between changes in the normotensive and hypertensive groups (before–after 25 min) ($p= 0.017$).

Table 1: Glucose level before and 25 minutes after injection of local anaesthesia

Glucose level	Patients	Mean	SD	SE
Before injection of LA	Normotensive patients	118.28	25.93	3.34
	Hypertensive patients	147.38	51.35	6.63
After 25 minutes of LA	Normotensive patients	116.65	26.69	3.44
	Hypertensive patients	152.76	51.38	6.63

SD= Standard Deviation; SE = Standard Error

**Figure 2:** Changes in glucose level between the two groups.

Discussion

In the hypertensive group, a high percentage of patients were overweight (75%), consistent with the findings of Mehata et al.⁽¹⁴⁾, who reported the relation of blood pressure with body weight and found that the hypertension risk was 1.38 times higher among the overweight and 1.67 times higher among the obese participants compared with those with normal weight. Thus, the risk of hypertension increases with high BMI. Moreover, patients with normal blood pressure have a lower mean age than hypertensive patients because the prevalence of hypertension increases with advancing age^(14, 15). We excluded patients who are taking beta blockers to eliminate their interaction with epinephrine in local anaesthesia⁽¹⁶⁾.

Glucose level was recorded before and 25 minutes after injection of local anaesthesia (LA). In the normotensive group, the first reading was between 85 and 200 mg/dl. After 25 minutes, the change was not significant. Similarly, Bortoluzzi et al.⁽¹⁷⁾ found no significant change in glucose level after dental treatment with administration of LA containing 1:100,000 epinephrine. The results of Nakamura et al.⁽¹⁸⁾ disagreed with those of the present study; in their study, the serum glucose level significantly increased and reached its peak after local anaesthesia infiltration in normotensive patients. The difference in the findings may be due to the difference in sample size.

In hypertensive patients, the first reading before LA injection was between 76 and 289 mg/dl. At 25 minutes after the injection of LA with 1:100,000 epinephrine and after completing the simple extraction, 72% of the patients had elevated glucose levels. This finding could be due to the effect of endogenous and exogenous epinephrine on stimulating hepatic glucose and reducing glucose utilization. Consistently, Haji et al.⁽¹⁹⁾ and Madan et al.⁽²⁰⁾ recorded a significant change in glucose level after administering LA 2% lignocaine hydrochloride and epinephrine 1:80,000. However, Santos-Paul et al.⁽²¹⁾ found a significant decrease in glucose levels in patients with cardiovascular problems and diabetes treated with lignocaine 2% and 1:100,000 epinephrine. The contradicting findings could be due to differences in the patient sample (all of them had diabetes and took hypoglycemic medication).

The most probable explanation for the decrease in glucose level is the stress that occurred during the procedure. Under stress, the muscles will utilize more energy and glucose from the blood, thereby decreasing the level of glucose ⁽²²⁾. A study performed by Suzuki et al. (2025) reports the importance of tooth extraction and other types of dental care in enhancing glycemic control over 3 years, specifically in individuals with obesity and baseline hyperglycemia ⁽²³⁾. Moreover, the half-life of hypoglycemic medication that was taken by the patients before the procedure might still be effective in controlling the glucose level and preventing it from rising. Khawaja et al. ⁽²⁴⁾ stated that patients with uncontrolled diabetes had a significant change in glucose level after LA with 1: 80,000 epinephrine. Ahmad et al. ⁽²⁵⁾ reported the same results.

Noor et al. in 2026 ⁽²⁶⁾ showed that LA containing epinephrine 1:80,000 was linked with a moderate short-term rise in random blood sugar levels in both healthy patients and patients with type II diabetes mellitus needing tooth extraction. Epinephrine-containing LA may be used carefully in controlled diabetic patients if the baseline glucose status is carefully assessed. Equally, this study suggests that well-controlled hypertensive patient who needs tooth extraction can tolerate LA with epinephrine 1:100,000 if the baseline blood pressure is assessed carefully and the patient complies with the medications prescribed by the physician.

Conclusions

Patients with controlled hypertension had a significant increase in glucose level after simple tooth extraction under one carpule of local anaesthesia with vasoconstrictor 1:100,000 compared with patients with normal blood pressure.

Conflict of interest:

No potential conflict of interest was reported by the authors in this study.

Author contributions:

All authors approved the final version of the manuscript.

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تغيرات نسبة السكر في الدم بعد حقن التخدير الموضعي مع الأدرينالين في المرضى الذين يعانون من ارتفاع ضغط الدم نور الهدى ماجد محسن سيف سعد الدين عبد الرزاق المستخلص:

الخلفية: هرمونات التوتر أو النشاط العصبي الودي يحفز تغيرات الدورة الدموية ويزيد من تضيق الأوعية المحيطية وذلك يجعل المزيد من الدم متاحا في أعضاء الجسم الحيوية، كما تستجيب الخلايا الكبدية عن طريق زيادة إطلاق الجلوكوز وتكوينه وبالتالي ارتفاع مستويات الجلوكوز بالإضافة إلى تثبيط امتصاص السكر بواسطة الأنسجة الطرفية، كل هذه الأحداث تحفز ارتفاع السكر مما يجعل المزيد من السكر في الدم. يعتبر حقن التخدير الموضعي وقلع الأسنان إجراء يسبب التوتر بالإضافة إلى الأدرينالين في محلول التخدير الموضعي المستخدم في تضيق الأوعية فمن المتوقع أن ينتج عنه ارتفاع السكر في الدم أثناء إجراءات علاج الأسنان. كان الغرض من هذه الدراسة هو تقييم التغير في مستوى نسبة السكر في الدم لدى البالغين الأصحاء ومقارنته مع مرضى ارتفاع ضغط الدم الذين يخضعون لخلع الأسنان البسيط تحت التخدير الموضعي الذي يحوي على الأبنفرين بنسبة 1: 100,000. المواد وطرق العمل: صممت الدراسة كدراسة سريرية مستقبلية على المجموعة المسيطر عليها وهم الذين لا يعانون من ارتفاع في ضغط الدم (60 مريضا) ومجموعة المراد الدراسة عليها وهم الذين يعانون من ارتفاع في ضغط الدم الخاضع للرقابة (60 مريضا) تمت مراقبة مستوى السكر في الدم في نقطتين زمنيتين مختلفتين (قبل حقن التخدير الموضعي وبعد 25 دقيقة من حقن التخدير الموضعي). تم توفير حقنه واحده من التخدير الموضعي لكل مريض في شكل لكتوكاينين 2٪ مع تركيز الأبنفرين 1/100,000. النتائج: كانت التغيرات غير معنوية للمرضى الأصحاء ذو ضغط دم طبيعي ($p=0.37$) بينما كانت التغيرات في مستوى نسبة السكر في الدم معنوية ($p=0.01$) لمجموعه المرضى الذين يعانون من ارتفاع في ضغط الدم. وعند المقارنة إحصائيا بين التغيرات في كلتا المجموعتين كانت الاختلافات معنوية ($p=0.01$) بين مجموعه المرضى الذين لا يعانون من ارتفاع في ضغط الدم ومجموعه الأخرى الذين لديهم ارتفاع مزمن في ضغط الدم. الاستنتاج: يوجد ارتفاع معنوي في مستوى نسبة السكر في الدم عند التعامل مع مرضى ارتفاع ضغط الدم الذين يتم التحكم فيهم جيدا مقارنة بالأصحاء الذين لا يعانون من ارتفاع في ضغط الدم حيث لم يلاحظ عليهم ارتفاع معنوي في نسبة السكر أثناء القلع البسيط تحت حقنه واحده من التخدير الموضعي مع مضيق للأوعية.