DOI: https://doi.org/10.54393/pjhs.v5i06.1581

PAKISTAN JOURNAL OF HEALTH SCIENCES
https://thejas.com.pk/index.php/pjhs
ISSN (P): 2790-9352, (E): 2790-9344
Volume 5, Issue 6 (June 2024)

Original Article

Effects of Adrenaline Containing Local Anesthesia on Blood Pressure and Blood Glucose Levels Undergoing Tooth Extractions – A Comparative Study

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ARTICLE INFO

Keywords:
Exodontia, Local Anesthesia, Adrenaline, Tooth Extraction, Blood Glucose Levels, Blood Pressure

How to Cite:
Rehman, I. ur, Zeb, M., Anwar, M. A., Khalid, A., Tayyab, T. F., Siddique, K., & Kushef, H. (2024). Effects of Adrenaline Containing Local Anesthesia on Blood Pressure and Blood Glucose Levels Undergoing Tooth Extractions – A Comparative Study: Adrenaline Effects during Tooth Extraction. Pakistan Journal of Health Sciences, 5(06), 73–78. https://doi.org/10.54393/pjhs.v5i06.1581

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Received Date: 25th April, 2024
Acceptance Date: 12th June, 2024
Published Date: 30th June, 2024

ABSTRACT

Exodontia, the most common dental procedure for damaged or decayed teeth, often utilizes local anesthesia with vasoconstrictors like adrenaline. Although effective, adrenaline can impact blood glucose levels and hemodynamic parameters, particularly in hypertensive and diabetic patients. **Objectives:** To compare changes in blood pressure and blood glucose levels among healthy, hypertensive and diabetic patients undergoing tooth extraction with adrenaline-containing local anesthesia. **Methods:** A total of 177 participants were split equally into three groups: healthy, hypertensive and diabetic. Prior to and twenty minutes' post-injection, blood pressure, and blood glucose levels were measured while a local anesthetic containing 2% lignocaine HCL with 1: 100,000 adrenaline was administered. Sample paired t test and one-way ANOVA were employed in the analysis. **Results:** After the procedure, hypertensive patients experienced a significant decrease in random blood glucose levels (p=0.001). Similarly, systolic blood pressure exhibited a significant increase (p<0.001), while diastolic blood pressure significantly decreased (p=0.021), post-procedure. Diabetic patients showed a non-significant decrease in glucose levels (p=0.209) but a significant increase in both systolic (p<0.001) and diastolic blood pressure (p=0.002). Healthy patients experienced a significant increase in systolic blood pressure (p=0.015) but no significant changes in glucose levels (p=0.873) or diastolic pressure (p=0.301). **Conclusions:** Adrenaline in local anesthesia significantly increases systolic blood pressure in all patient groups, with pronounced effects in hypertensive and diabetic patients. Changes in blood glucose were significant only in hypertensive patients, while changes in diabetic patients were non-significant. These findings highlight the need for careful monitoring and personalized management strategies in dental procedures to minimize potential adverse effects and ensure patient safety.

INTRODUCTION

Exodontia is indeed the most common dental procedure performed when a tooth is damaged, infected, or decayed [1]. While it is considered a routine procedure, it can still be stressful and uncomfortable for many patients [2]. Local anesthesia is the primary method used in dentistry to minimize intraoperative pain and discomfort while performing dental procedures. It is typically administered with vasoconstrictors, which are considered safe and are commonly used in dental practices [3, 4]. The inclusion of vasoconstrictors provides several advantages, such as enhancing the local anesthetic effect, improving hemostasis, and reducing systemic toxicity [5]. However, it is documented that adrenaline, a common vasoconstrictor, can impact hemodynamic parameters and blood glucose levels. Specifically, adrenaline can increase heart rate and blood pressure through vasoconstriction and stimulate glycogenolysis and gluconeogenesis, while decreasing glucose utilization by tissue [6-10]. Given the high prevalence of hypertension and diabetes worldwide, these conditions are frequently encountered in patients visiting dental clinics [11, 12]. Therefore, it is crucial for dental professionals to

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understand how to effectively manage and treat patients with hypertension and diabetes during dental procedures. Controversy remains in the use of local anesthesia containing epinephrine in hypertensive patients due to its effect on beta 1, beta 2 and alpha receptors [13]. The systemic absorption of epinephrine can lead to unexpected cardiovascular effects, such as severe hypertension and ventricular arrhythmias, emphasizing the need for caution when using epinephrine in local anesthesia [12]. The observed increase in systolic and diastolic pressure is primarily dependent on the plasma clearance of exogenous epinephrine. Hypertensive emergencies during dental treatment can lead to life-threatening situations [7]. The increase in glucose levels after local anesthesia with adrenaline is due to adrenaline's vasoconstrictive effects, which reduce the systemic absorption of the anesthetic, leading to higher blood concentrations [8, 14]. Studies show that diabetic patients not on hypoglycemic medication experience significant blood glucose increase after receiving adrenaline-containing anesthesia for tooth extraction [15]. Stress and discomfort can significantly raise glucose concentrations, emphasizing the impact of stress on blood sugar levels. The relationship between stress levels and blood sugar levels in individuals with diabetes mellitus highlights a strong positive correlation, indicating that stress can complicate glycemic control in diabetic patients[16].

This study aimed to compare blood pressure (both systolic and diastolic) and blood glucose levels among healthy, hypertensive and diabetic patients pre and post tooth extraction with local anesthesia containing adrenaline as vasoconstrictor.

METHODS

The observational comparative study involved 177 participants, conducted at the Oral and Maxillofacial Department at the University College of Dentistry, The University of Lahore, following approval from the university's ethical committee on 14-03-2023 with reference number UCD/164 between June 2023 to September 2023. A purposive sampling technique was employed to select participants based on specific criteria. This non-probabilistic method was chosen to specifically include individuals who met the predefined inclusion and exclusion criteria, ensuring the sample's relevance and alignment with the study's objectives. The calculated sample size was 18 (6 in each group) with 95% confidence level, 80% power of test and by taking expected mean value of post-op blood sugar level for healthy and diabetic patients as 102.97 ± 14.7 and 202.47 ± 54.45 respectively [17]. Given the variability in individual responses to dental anesthesia and the importance of detecting even small differences in glycemic response, a larger sample size of 59 participants per group was chosen to increase the robustness and reliability of the findings. All participants had dental appointments between 9:00 AM to 11:00 AM at for extraction at the dental hospital. Medical history and written informed consent were obtained from all patients. The study consisted of three groups: Group A, comprising healthy patients; Group B, consisting of hypertensive patients who were managing their condition with medication and Group C, including diabetic patients who were managing diabetes through either oral hypoglycemic agents or insulin. All patients were priorly diagnosed by their respective physicians according to international guidelines for their respective conditions and treated accordingly. For blood pressure measurement, a sphygmomanometer and stethoscope were used, while for blood glucose concentration, an Accu-Chek instant glucometer (mg/dl), sterile lancets and a lancing device were used. The inclusion criteria for healthy patients are as follows: patients should not have any systemic disorders and should not be taking any medication for any other ailment. In the case of hypertensive patients, the study included those who were managing their condition with medication and dietary restrictions. Likewise, diabetic patients who were managing diabetes through dietary control and medication such as insulin or oral hypoglycemic agents were included in the study. The exclusion criteria comprise pediatric extractions, patients who received local anesthesia without adrenaline or required more than one cartridge of 1.8ml of local anesthesia, pregnant patients, surgical extractions and patients with uncontrolled diabetes and blood pressure without undergoing treatment. After explaining the procedure to the patient, the healthcare provider proceeded to assess the patient's blood pressure and random blood glucose level. Blood pressure was measured using a stethoscope and sphygmomanometer according to standard clinical practice. The cuff was placed snugly around the upper right arm and the pressure was gradually increased until it temporarily cut off blood flow. As the pressure was released, the demonstrator listened for the characteristic sounds using the stethoscope placed over the brachial artery. The systolic pressure was recorded at the onset of these sounds and the diastolic pressure was recorded when the sounds disappeared. For blood glucose measurement, the finger (from which blood was to be taken) of the patient was cleaned with sterile alcohol gauze. The blood drop was then obtained by pricking the sterile lancet over the finger and placing the strip on the glucometer, using an Accu-Chek glucometer. Subsequently, the blood pressure readings and blood glucose levels were documented on the patient's record form at the start of the procedure and 20 minutes after injecting one cartridge of the local anesthesia. All the above procedure was performed by a trained demonstrator. The extraction procedure was carried out by injecting local anesthetic 2% lignocaine HCL (1.8ml) cartridge with 1:100,000 adrenaline either as an Inferior Alveolar Nerve (IAN) block or as an infiltration depending on the tooth to be extracted. Teeth were extracted using atraumatic techniques. Blood pressure and plasma

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glucose levels were tested and recorded prior and 20 minutes after the injection. Data entry and analysis were done with SPSS version 25.0. Quantitative variables were presented with mean ± SD and qualitative variables with frequency and percentages. To compare random blood glucose, systolic and diastolic blood pressure before and after (local anesthesia with adrenaline) within study groups, a paired sample t-test was applied. The comparison of blood glucose levels, systolic and diastolic blood pressure between groups after the procedure was conducted using one-way ANOVA. A p-value equal to or less than 0.05 was considered statistically significant.

RESULTS

The study comprised 177 participants, divided into three groups: Healthy (n=59), Hypertensive (n=59) and Diabetic (n=59). The Healthy group had a mean age of 47.23 ± 15.15, spanning from 20 to 81 years. The mean age of participants in the Hypertensive group was 65.55 ± 4.05 years, ranging from 60 to 70 years. In the Diabetic group, the mean age was 54.67 ± 8.92 years, with an age range of 37 to 69 years. Gender distribution varied among the groups, with the majority being female in two groups as 66.1% in the Hypertensive group followed by 52.2% in the Diabetic Group. The demographic characteristics of the participants are summarized in table 1.

Table 1: Demographics of Study Participants

Variables	Healthy (N=59)	Hypertensive (N=59)	Diabetic (N=59)
Age	**Mean ± SD**		
	47.23 ± 15.15	65.55 ± 4.05	54.67 ± 8.92
	Min-Max		
	20-81	60-70	37-69
Gender	**Male N (%)**		
	35 (59.3%)	20 (33.9%)	28 (47.5%)
	Female N (%)		
	24 (40.7%)	39 (66.1%)	31 (52.5%)

Table 2 displayed the results of the paired sample t-test conducted to assess changes in random blood glucose levels and blood pressure among the three groups of patients 20 minutes' post-injection. Among hypertensive patients, a significant decrease was observed in random blood glucose levels (p=0.001), while systolic blood pressure significantly increased (p<0.001) and diastolic blood pressure significantly decreased (p=0.021) post-procedure. In diabetic patients, a non-significant decrease was noted in blood glucose levels post-procedure (p=0.209), while both systolic (p<0.001) and diastolic blood pressure (p=0.002) exhibited a significant increase. Conversely, among healthy individuals, no significant changes were observed in random blood glucose levels (p=0.873) or diastolic blood pressure (p=0.301) post-procedure compared to pre-procedure values. However, there was a significant increase in systolic blood pressure post-procedure compared to pre-procedure levels (p=0.015) as shown in table 2.

Table 2: Random Blood Glucose Level (BGL), Systolic (SBP) and Diastolic Blood Pressures (DBP) in Study Groups before and after Procedure

Groups	Variables	Pre and Post Treatment	Mean ± SD	Difference Pre and Post (Mean ± SD)	p-Value
Healthy	BGL (mg/dL)	Pre-Treatment	124.10 ± 31.94	0.71 ± 33.92	0.873
		Post-Treatment	123.38 ± 29.27		
	SBP (mmHg)	Pre-Treatment	124.57 ± 13.82	7.20 ± 22.10	0.015*
		Post-Treatment	131.77 ± 18.10		
	DBP (mmHg)	Pre-Treatment	79.10 ± 8.47	2.77 ± 13.03	0.107
		Post-Treatment	81.88 ± 9.44		
Hypertensive	BGL (mg/dL)	Pre-Treatment	121.37 ± 25.041	-7.76 ± 16.97	0.001*
		Post-Treatment	13.61 ± 29.23		
	SBP (mmHg)	Pre-Treatment	142.03 ±7.88	10.00 ± 7.54	<0.001*
		Post-Treatment	152.03 ± 8.10		
	DBP (mmHg)	Pre-Treatment	83.98 ± 9.08	-2.20 ± 7.14	0.021*
		Post-Treatment	81.77 ± 4.71		
Diabetic	BGL (mg/dL)	Pre-Treatment	183.62 ± 41.77	7.33 ± 44.40	0.209
		Post-Treatment	176.28 ± 50.92		
	SBP (mmHg)	Pre-Treatment	124.57 ± 18.011	16.77 ± 18.11	<0.001*
		Post-Treatment	41.35 ± 18.35		
	DBP (mmHg)	Pre-Treatment	76.52 ± 8.16	4.66 ± 10.98	0.002*
		Post-Treatment	81.18 ± 5.74		

*Significant p-value

Table 3 presents the results of the one-way ANOVA conducted to assess differences in random blood glucose levels and blood pressure among the study groups (Healthy Control, Hypertensive and Diabetic). A significant difference was observed between study groups for both random blood glucose levels (p<0.001) and systolic blood pressure (p<0.001). However, diastolic blood pressure did not show any significant difference between the study groups (p=0.842) as shown in table 3.

Table 3: Comparison of Random Blood Glucose Level (BGL), Systolic (SBP) and Diastolic Blood Pressure (DBP) between Study Groups after Procedure

Variables	Groups	Mean ± SD	Standard Error	p-Value
BGL (mg/dL)	Healthy	123.38 ± 29.27	3.81	<0.001*
	Hypertensive	113.61 ± 29.23	3.80	
	Diabetes	176.28 ± 50.92	6.63	
SBP (mmHg)	Healthy	131.77 ± 18.10	2.35	<0.001*
	Hypertensive	152.03 ± 8.10	1.05	
	Diabetes	141.35 ± 18.35	2.38	
DBP (mmHg)	Healthy	81.88 ± 9.44	1.22	0.842
	Hypertensive	81.77 ± 4.71	0.61	
	Diabetes	81.18 ± 5.74	0.74	

*Significant p-value

Table 4 illustrated that there was no significant difference in random blood glucose levels and systolic blood pressure among patients using oral diabetic medication and insulin pre and post-procedure, respectively. However, a significant difference was observed in diastolic blood pressure between oral and insulin user's pre and post-

DOI: https://doi.org/10.54393/pjhs.v5i06.1581

injection, respectively. This finding suggests a differential impact of oral medication and insulin on diastolic blood pressure in patients undergoing the procedure as shown in table 4.

Table 4: Comparison of Random Blood Glucose level (BGL), Systolic (SBP) and Diastolic Blood pressure (DBP) among Diabetic Patients in Relation to type of Medication.

Variables	Pre and Post Treatment	Oral Hypoglycemic N=41	Insulin N=18	p-Value
		(Mean ± SD)		
BGL (mg/dL)	Pre-Treatment	178.56 ± 29.72	195.17 ± 60.60	0.282
	Post-Treatment	174.37 ± 49.00	180.67 ± 56.30	0.666
SBP (mmHg)	Pre-Treatment	127.56 ± 17.43	117.78 ± 17.92	0.054
	Post-Treatment	146.22 ± 16.57	130.28 ± 17.78	0.002*
DBP (mmHg)	Pre-Treatment	78.90 ± 7.54	71.11 ± 6.98	<0.001*
	Post-Treatment	79.51 ± 5.22	85.00 ± 5.14	<0.001*

*Significant p-value

DISCUSSION

Previous studies have presented conflicting findings regarding the impact of local anesthesia containing adrenaline on blood glucose levels and blood pressure in patients undergoing dental treatment. In the present study, we evaluated changes in random blood glucose and diastolic and systolic values before and after tooth extraction in healthy, hypertensive and diabetic patients using local anesthesia with adrenaline as a vasoconstrictor, to assess the association between blood pressure and hyperglycemia. In healthy individuals, adrenaline-induced hyperglycemia triggers compensatory mechanisms that result in a slight increase in glucose levels. However, in uncontrolled diabetic patients, these mechanisms are altered, leading to a marked accentuation of hyperglycemia. This is due to changes in hepatic glucose output and insulin-stimulated glucose utilization [18]. Interestingly, in the present study, a statistically significant decrease in the mean random blood glucose level was observed in the hypertensive group 0.873(p=0.01), while healthy controls exhibited a non-significant difference in mean random blood glucose levels pre and post injection (p=0.873). Diabetic patients whether on oral hypoglycemic agents or insulin, also exhibited a statistically non-significant difference in mean random blood glucose levels (p=0.209), consistent with findings reported by Khawaja NA *et al.*, but contrary to results reported by Nair VS *et al.*, Kaur P et al., Saad TA, Ahmad T *et al.*, Bhoosreddy S *et al.*, where increases in values were observed in controlled diabetic patients [8, 15, 19-22]. These findings contribute to the understanding of the complex interplay between adrenaline, blood glucose levels and patient health status. Epidemiological studies have consistently shown that hypertension is more prevalent among diabetic mellitus patients compared to the general population [23]. Moreover, higher blood pressure levels are associated with an increased risk of hyperglycemia, even in individuals without diabetes [24]. Hyperinsulinemia, often seen in individuals with insulin resistance, can lead to impaired insulin vasodilatory responses in peripheral tissues. This, in turn, increases vasoconstrictor responses to certain vasopressors, contributing to elevated systolic blood pressure levels [25-26]. In our study, healthy group, there was a significant increase in systolic blood pressure (p<0.001), but no significant changes were observed in random blood glucose levels or diastolic blood pressure post-procedure compared to pre-procedural values (p=0.842, 0.107, respectively). However, diabetic patients showed a significant increase in systolic blood pressure, with mean values rising by 16.77 ± 18.11 (pre vs post, p=0.001), followed by the hypertensive group which had an increase of 10.00 ± 7.54 (pre vs post, p=0.001). These findings align with those reported by Ali FM *et al.*, but another study showed the systolic and diastolic blood pressure remained constant after local anesthetic with vasoconstrictor, regardless patient's hypertensive profile or anxiety levels [27, 28]. However, Guimaraes CC *et al.*, meta-analysis showed that there was a decrease in systolic blood pressure after local anesthesia with a vasoconstrictor [29]. A compensatory increase in systolic blood pressure within the normal range was observed in the healthy group (p=0.015). This finding aligns with a study by Moaddabi A *et al.*, which attributed the increase to adrenaline-induced vasoconstriction and the body's stress response releasing catecholamines. Additionally, the delayed absorption of the anesthetic from the injection site prolonged its effects, contributing to elevated blood pressure [30]. However, this result contrasts with a study by Ali FM *et al.*, who did not find any change in normotensive patients after injecting adrenaline-containing local anesthesia [27]. Regarding diastolic blood pressure, diabetic patients experienced a significant increase, with mean values rising by 4.66 ± 10.98 (pre vs post, p=0.002). These are similar to findings in literature which may be due to their altered cardiovascular physiology, heightened sympathetic response, individual variation, and interactions with diabetes medications [6, 18]. Conversely, in this study, hypertensive patients on medication showed a significant decrease in diastolic blood pressure, with mean values dropping by 2.20 ± 7.14 (pre vs post, p=0.021). This can be attributed to the dominant effects of antihypertensive medications, reduced vascular resistance, and a blunted sympathetic response. The interaction between these factors and the physiological response to adrenaline leads to a net decrease in diastolic pressure [13, 26]. In exploring the association between blood pressure, hyperglycemia and the use of adrenaline in local anesthesia, our study provides valuable insights into the physiological responses of patients during dental procedures. The observed changes in random blood glucose and blood pressure levels underscore the importance of considering individual patient characteristics and medical history when administering dental anesthesia. Moreover, our findings raise intriguing questions about the underlying

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mechanisms driving these responses, warranting further investigation. By deepening our understanding of these dynamics, we can enhance patient safety and optimize treatment outcomes in dental practice

CONCLUSIONS

Our study demonstrates that adrenaline-containing local anesthesia used during tooth extraction affects blood pressure and blood glucose levels, with notable variations among healthy, hypertensive and diabetic patients. Adrenaline was associated with a significant increase in systolic blood pressure in all groups, particularly in hypertensive and diabetic patients. However, changes in random blood glucose levels were only significant in the hypertensive group. These findings suggest that while adrenaline effectively prolongs anesthetic effects and improves hemostasis, its impact on hemodynamic and glycemic parameters necessitates careful monitoring. Therefore, dental practitioners should adopt personalized management strategies to minimize potential adverse effects and enhance patient safety.

Authors Contribution

Conceptualization: IUR, MZ
Methodology: IUR, MZ, TFT
Formal analysis: IUR, MAA, TFT, KS, HK
Writing, review and editing: MAA, AK, HK

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

Conflicts of Interest

The authors declare no conflict of interest.

Source of Funding

The authors received no financial support for the research, authorship and/or publication of this article.

REFERENCES

[1] Khaled AM and Neyaz AA. A Minimally Invasive Technique for the Retrieval of Fractured Root Tips. Cureus. 2023 Jun; 15(7): e41458. doi: 10.7759/cureus.41458.

[2] Herrera-Barraza V, Arroyo-Larrondo S, Fernández-Córdova M, Catricura-Cerna D, Garrido-Urrutia C, Ferrer-Valdivia N. Complications post simple exodontia: A systematic review. Dental and Medical Problems. 2022 Oct; 59(4): 593-601. doi: 10.17219/dmp/144596.

[3] Layosh NV. Analysis of the Clinical Effectiveness of Local Anesthesia in the Treatment of Acute forms of Caries and Pulpitis in Adolescents. Art of Medicine. 2023 Apr; 12: 37-43. doi: 10.21802/artm.2023.1.25.37.

[4] Ogle OE and Boyce R. Local Anesthesia: Agents and Techniques. Oral and Maxillofacial Surgery, Medicine, and Pathology for the Clinician. 2023 Jun: 261-73. doi: 10.1002/9781119362579.ch21.

[5] Saputra DR, Imansari IP, Elnisa AR, Amania HN. Penggunaan Vasokonstriktor dalam Anestesi Lokal Kedokteran Gigi pada Pasien Kompromis Medis: Telaah Pustaka. STOMATOGNATIC-Jurnal Kedokteran Gigi. 2023 Mar; 20(1): 56-62. doi: 10.19184/stoma.v20i1.38602.

[6] Yadav D, Bali H, Mishra R, Kandel L, Khanduri N, Tripathi S *et al.* Effect of Local Anaesthesia with and without Adrenaline on Blood Pressure, Pulse Rate and Oxygen Saturation-A Comparative Study. Journal of Nepalese Society of Periodontology and Oral Implantology. 2020 Jun; 4(1): 18-21. doi: 10.3126/jnspoi.v4i1.30899.

[7] Wakita R, Ito T, Fukayama H. Small doses of adrenaline contained in the local anaesthetic may result in prolonged increased cardiac function even after the vital signs return to normal. Advances in Oral and Maxillofacial Surgery. 2021 Jul; 3: 100104. doi: 10.1016/j.adoms.2021.100104.

[8] Nair VS, Anusuya N, Sankar K, Sathiyanathan D, Sane VD, Kanagasabapathy T. Effect of Local Anaesthesia with and without Adrenaline on Blood Glucose Concentration in Patients Undergoing Tooth Extractions-A Comparative Study. Annals of Maxillofacial Surgery. 2022 Jul; 12(2): 123-7. doi: 10.4103/ams.ams_136_22.

[9] Silva OB, Costa CF, Veloso FS, Kassar SB, Sampaio DL. Efeitos do uso de vasoconstritores no bloqueio de nervos digitais: revisão sistemática com metanálise. Revista do Colégio Brasileiro de Cirurgiões. 2020 Jan; 46(6): e20192269. doi: 10.1590/0100-6991e-20192269.

[10] Valtellini R and Ouanounou A. Management of the Hypertensive Dental Patient. Journal of the Canadian Dental Association. 2023; 89(2): 1-4.

[11] Al-Sebaei MO, Bamashmous M, Bassyoni L, Alsubaie R, Alnahdi DO. Pre-procedure Blood Sugar levels in Diabetic and high-risk patients visiting King Abdulaziz University Dental Hospital: the role of the dentist in diabetes screening. Diabetes, Metabolic Syndrome and Obesity. 2023 Dec; 1021-7. doi: 10.2147/DMSO.S405676.

[12] Altermatt FR and De la Cuadra-Fontaine JC. Using epinephrine in local infiltration analgesia (LIA): focusing on safety reasons. Acta Orthopaedica. 2023 Jun; 94: 287. doi: 10.2340/17453674.2023.13646.

[13] George A, Sharma M, Kumar P, Kulkarni S, Patil V, Plackal JJ. Cambios hemodinámicos durante la extracción en pacientes hipertensivos y normotensivos tras la inyección de anestésicos locales con y sin epinefrina: un estudio comparativo prospectivo. Revista Española de Cirugía Oral y Maxilofacial. 2022 Mar; 44(1): 9-15.

DOI: https://doi.org/10.54393/pjhs.v5i06.1581

[14] Byakodi S, Gurjar V, Soni S. Glucose Levels and Hemodynamic Changes in Patients submitted to Routine Dental Extraction under Local Anesthesia with and without Adrenaline. The Journal of Contemporary Dental Practice. 2017 Jan; 18(1): 57-9. doi: 10.5005/jp-journals-10024-1989.

[15] Khawaja NA, Khalil H, Parveen K, Alghamdi AM, Ra'ed AA, Sa'ad MA. An influence of adrenaline (1: 80,000) containing local anesthesia (2% Xylocaine) on glycemic level of patients undergoing tooth extraction in Riyadh. Saudi Pharmaceutical Journal. 2014 Dec; 22(6): 545-9. doi: 10.1016/j.jsps.2014.02.006.

[16] Mifsud S, Schembri EL, Gruppetta M. Stress-induced hyperglycaemia. British Journal of Hospital Medicine. 2018 Nov; 79(11): 634-9. doi: 10.12968/hmed.2018.79.11.634.

[17] Tily FE and Ajman ST. Glycemic effect of administration of epinephrine-containing local anaesthesia in patients undergoing dental extraction, a comparison between healthy and diabetic patients. International Dental Journal. 2007 Apr; 57(2): 77-83. doi: 10.1111/j.1875-595X.2007.tb00442.x.

[18] Jensen J, Ruge T, Lai YC, Svensson MK, Eriksson JW. Effects of adrenaline on whole-body glucose metabolism and insulin-mediated regulation of glycogen synthase and PKB phosphorylation in human skeletal muscle. Metabolism. 2011 Feb; 60(2): 215-26. doi: 10.1016/j.metabol.2009.12.028.

[19] Kaur P, Bahl R, Kaura S, Bansal S. Comparing hemodynamic and glycemic response to local anesthesia with epinephrine and without epinephrine in patients undergoing tooth extractions. National Journal of Maxillofacial Surgery. 2016 Jul; 7(2): 166-72. doi: 10.4103/0975-5950.201370.

[20] Saad TA. Evaluation of Healing Process and Blood Sugar Level Following Local Anesthetic Infiltration with and Without Vasoconstrictor for Extraction of Maxillary Teeth in Diabetic Patients: Double Blind Randomized Controlled Clinical Trial. The Egyptian Journal of Hospital Medicine. 2023 Apr; 91(1): 5439-44. doi: 10.21608/ejhm.2023.305757.

[21] Ahmad T, Jain S, Lone PA, Nabi S. To Assess the Changes in the Blood Glycemic Level among Diabetic Patients before and after Administration of Local Anesthesia Containing Adrenaline 1: 80,000 for Dental Extraction in OMFS Department MGSDC Sri Ganganagar. Journal of Research in Medical and Dental Science. 2019 Mar; 7(2): 98-102.

[22] Bhoosreddy S, Gondhalekar MR, Naphade MV, Gondhalekar RV, Bhoosreddy A, Naphade UM. Analysis of Local Anesthesia with Adrenaline in Diabetic Patients Undergoing Extractions. Journal of Pharmaceutical Negative Results. 2022 Nov; 13(9): 3240-3.

[23] Chowdhury YS, Moaddab A, Soni L, McFarlane SI. Diabetes and Hypertension. InDiabetes and Cardiovascular Disease 2023 Jun; 399-424. doi: 10.1007/978-3-031-13177-6_13.

[24] Naseri MW, Esmat HA, Bahee MD. Prevalence of hypertension in Type-2 diabetes mellitus. Annals of Medicine and Surgery. 2022 Jun; 78: 103758. doi: 10.1016/j.amsu.2022.103758.

[25] Seminario-Amez M, González-Navarro B, Ayuso-Montero R, Jané-Salas E, López-López J. Use of local anesthetics with a vasoconstrictor agent during dental treatment in hypertensive and coronary disease patients. A systematic review. Journal of Evidence Based Dental Practice. 2021 Jun; 21(2): 101569. doi: 10.1016/j.jebdp.2021.101569.

[26] Martyushev-Poklad AV, Yankevich DS, Petrova MV, Savitskaya NG. Hyperinsulinemia and age-related diseases: interrelations and approaches to treatment. Voprosy Pitaniia. 2022 May; 91(3): 21-31. doi: 10.33029/0042-8833-2022-91-3-21-31.

[27] Ali FM, Iryani GM, Bakri MM, Halawi S, Mashyakhi E, Darraj O. Evaluation of changes in Blood Pressure (BP) and Heart Rate (HR) among controlled Hypertensive and Normotensive Patients before and after receiving Dental Local Anesthesia (DLA) with Adrenaline: A Prospective Study. Biomedical and Pharmacology Journal. 2022 Jun; 15(2): 757-66. doi: 10.13005/bpj/2413.

[28] Silvestre FJ, Martinez-Herrera M, García-López B, Silvestre-Rangil J. Influence of anxiety and anesthetic vasoconstrictors upon hemodynamic parameters during dental procedures in controlled hypertensive and non-hypertensive patients. Journal of Clinical and Experimental Dentistry. 2021 Feb; 13(2): e156. doi: 10.4317/jced.57232.

[29] Guimaraes CC, Lopes LC, de Cássia Bergamaschi C, Ramacciato JC, Silva MT, de Oliveira Araújo J *et al.* Local anaesthetics combined with vasoconstrictors in patients with cardiovascular disease undergoing dental procedures: systematic review and meta-analysis. British Medical Journal Open. 2021 Jul; 11(7): e044357. doi: 10.1136/bmjopen-2020-044357.

[30] Moaddabi A, Soltani P, Zamanzadeh M, Nosrati K, Mollamirzaei M, Cernera M *et al.* Comparison of the Effects of Articaine and Lidocaine Anesthetics on Blood Pressure after Maxillary Infiltration Technique: A Triple-Blind Randomized Clinical Trial. International Journal of Dentistry. 2021 Aug; 2021(1): 8894160. doi: 10.1155/2021/8894160.