

Article

Hemodynamic changes following injection of local anesthesia with vasoconstrictor agent in controlled hypertensive patients

Noor Alhuda Majid Muhsin, Saif Saadedeen Abdulrazaq*

Department of Oral and Maxillofacial Surgery, College of Dentistry, University of Baghdad, Iraq.

*Correspondence: noormajid9595@gmail.com

Abstract

Local anesthesia is considered the most commonly used in dentistry. Vasoconstrictors are added to its composition to maximize its advantages. However, it is considered a tourniquet and acts on beta 1 and 2 receptors. This causes augmentation of heart rate and blood pressure. This study aimed to evaluate the safety of vasoconstrictors during simple tooth extraction in controlled hypertensive patients by monitoring the changes in blood pressure, heart rate and oxygen saturation. A prospective clinical study was carried out in a control group (normotensive patients n=60) and study group (hypertensive patients) (n=60). The following hemodynamic parameters (blood pressure [diastolic and systolic], heart rate and oxygen saturation) were monitored at four different time points (before infiltration of local anesthesia (R1), after 3 minutes of local anesthesia (R2), immediately after extraction (R3) and 25 minutes after local anesthesia infiltration (R4). One carpule of local anesthesia for each patient was provided in the form of lidocaine 2% with adrenaline as vasoconstrictor 1/100,000; (3) Results: Mean heart rate increased from one to four beats per minute in all groups, but the increment was lesser in hypertensive group. The increase of systolic blood pressure in hypertensive patients during (R2, R3 and R4) was significantly lower than in the normotensive group ($p<0.001$). The diastolic blood pressure reading fell in the hypertensive group more than in the normotensive group during (R2, R3 and R4). No changes in oxygen saturation were recorded between both groups; (4) Conclusions: no adverse effects in well-controlled hypertensive patients were seen during simple tooth extraction. One carpule of local anesthesia with 1\100,000 adrenaline does not induce blood pressure augmentation in hypertension patients included in this study. The changes in heart rate were within the safe limits.

Keywords: local anesthesia, adrenaline, vasoconstrictors, hypertensive patients, hemodynamic changes.

Introduction

Lidocaine is considered the most local anesthetic drug and is widely used by dentists during dental procedures; it has a reversible block action on nerve conduction and inhibits the excitation in the myelinated and unmyelinated nerve fibers during pain transmission². First, vasoconstrictors like adrenaline are added to the composition of local anesthesia drugs by Heinrich Braun (1903), who deemed it a "chemical tourniquet"³. It modulates the adverse effect of plain lidocaine by prolonging its action and reducing its absorption by the tissue. Also, the tourniquet decreases the bleeding at the injection⁴. Adrenaline stimulates ($\alpha 1$) receptors. This causes narrowing in the blood vessels and reflects the vasodilation effect of

plain lidocaine. Adrenaline also reacts with the (β 1) receptor of the myocardial muscle and maximizes contraction strength. In higher concentrations, adrenaline reacts with (β 2) receptors and causes vasodilation in skeletal muscle and bronchodilator^{2,5}. Adrenaline was available in a concentration of 1:50,000, 1:80,000, 1:100,000 and 1:200,000⁶, the difference in concentrations of adrenaline does not change the depth of local anesthesia action (1 hour for pulpal and 3 to 5 hours for soft tissue), but it produces different levels of hemostasis². Dental procedures, i.e., extraction, injection of anesthesia or even the use of the handpieces, will produce anxiety and stress in the patient; these trigger the release of endogenous catecholamine from the adrenal gland and increase blood pressure and heart rate⁷. The patients with hypertension are suffering from the elevation of blood pressure above 130/80⁸. Blood pressure is the force pushing against the wall of arteries as it flows through them. There has been controversy regarding the use of vasoconstrictors when dealing with patients who have a history of cardiovascular problems^{9,10}; the present study focused on evaluating the safety and efficacy of 2% lidocaine local anesthetic with 1/100,000 vasoconstrictor in normotensive patients compared with controlled hypertensive patients.

Materials and Methods

This study is designed as a prospective clinical study for blood pressure, heart rate and oxygen saturation of controlled hypertensive and normotensive patients subjected to simple dental extraction. The purpose of the study was to explain to the patients that the signed consent of participants was obtained in all cases with their signatures. Before data collection, ethical approval was obtained from the ethical approval committee, College of Dentistry / University of Baghdad, to perform the protocol of this study. The study sample consisted of 120 patients who needed simple dental extraction of upper anterior teeth and premolars seen at the Department of Oral and Maxillofacial Surgery/College of Dentistry/University of Baghdad from December 2021 to May 2022. A prior clinical and medical history was compiled, and an internist for each patient conducted a clinical examination of general health. theCorah's anxiety scale was filled according to the patient's answers to evaluate his anxiety level; this scale was used since 1978¹¹. Calculate the B.M.I for each patient by measuring height and weight. The following inclusion criteria were established: Simple extraction of upper anterior and premolar teeth, controlled hypertensive patients with medication, and patients with anxiety score <12. Exclusion criteria included patients with high anxiety scores >12, harrowing extraction or extraction time exceeding 15 minutes, uncontrolled hypertensive patients, patients who used beta-blockers medication or adrenergic blockers, smokers or alcoholic patients and patients with breathing problems. The systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate (HR) were recorded just before the procedure as a basal reading by sphygmomanometer wrist electronic blood pressure monitor (OMRON® Company, Kyoto, Japan). The cuff of the device was Corroborate on the lift wrist and fixed on the level of the heart while sitting in the dental chair upright. This position was not changed during the procedure. The wrist diameter of the patients (14.8 cm-19 cm) coincides with the criteria of device manufacture. Oxygen saturation was recorded by Pulse oximeter (JUMPER, Germany), nail polish was removed if it was found, and the percentage of oxygen saturation was recorded by hanging the oximeter on the clean index finger of the left hand. No anxiolytic premedication was taken before the procedure. Extraction Protocol: the extractions in this research were done by the same surgeon who used a standardized method applied on both groups in a relaxed, comfortable atmosphere and performed under one cartilage (1.8 ml) of lidocaine 2% with adrenaline 1:100,000 (Zeyco. Mexico). Injecting the anesthetic slowly with an auto-aspirating syringe to ensure no direct injection of anesthesia solution into the

bloodstream. On the day of the extraction, the patients had a typical breakfast, and consumption of tea or coffee was to be avoided from the two hours before the procedure. In the hypertensive group, patients were instructed to take their usual medication and bring it to the clinic. Topical anesthesia was used at the needle insertion site for 2 minutes before injection to reduce the pain. The blood pressure, heart rate and oxygen saturation were recorded after 3 minutes of local anesthesia (R2), the extraction was done, and then immediately take the third reading (R3). Checked the socket after exodontia for any bone fragments or granulation tissues. After the extraction, patients were given suitable antibiotics and analgesics. The previous parameters were recorded after 25 minutes of local anesthesia (R4). The first reading (R1) is considered a basal reading to monitor the changes. The differences in both groups are calculated using SPSS version 22.0 statistical package for the social science (Chicago, Illinois, USA), percentage, mean and standard deviation as numerical variables, Independent two sample T-test as inferential statistics and 0.05 as the significance level.

Results

The present study included 120 patients, 60 in group A normotensive patients (23 males, 37 females) with an average age of 37.76 and average B.M.I 25.2, another 60 patients in group B controlled hypertensive patients (31 males, 29 females) with an average age of 52.78 and average B.M.I 26.7. Obese patients were excluded from the study; underweight patients were not found in both groups. Patients who were overweight in the hypertensive group were (75%) much higher than the normotensive group (52%). Corah's anxiety scale was 6.4 in the normotensive group and 6.1 in the hypertensive group. Heart rate was changed during the procedure, and there was a significant difference between both groups after extraction (0.027, $p < 0.05$) and after 25 minutes of local anesthesia (0.026 $p < 0.05$), illustrated in Table 1. The changes in systolic blood pressure are clarified in Table 2, which showed a highly significant difference ($p < 0.001$) just after the extraction when only 50% of hypertensive patients induced elevation in systolic blood pressure. At the same time, 82% induced the elevation in the normotensive group. Also, there were significant changes during R2 and R4 ($p < 0.005$). Table 3 clarifies the changes in diastolic blood pressure, which showed a significant fall during R2 and R3 ($p < 0.005$) in the hypertensive group. The changes in oxygen saturation were not significant in each group in all timelines, with no significant difference between groups A and B, as illustrated in Table 4

	time	group	Percentage of increase	Percentage of reduction	Not changes	Sd for the changes	P value
	R2	A	73%	22%	5%	6.44	0.132
		B	70%	25%	5%	6.181	0.132
	R3	A	68%	30%	2%	7.70	0.027
		B	62%	37%	2%	7.534	0.027
	R4	A	37%	57%	7%	5.524	0.026
		B	31%	85%	2%	4.446	0.026

Table 1. Changes in heart rate between groups A and B during R2, R3 and R4.

Time	group	Percentage of increase	Percentage of reduction	Not changes	Sd for the changes	P value
R2	A	73%	22%	5%	9.812	0.004
	B	48%	48%	3%	10.486	0.004
R3	A	82%	17%	2%	9.372	0.000
	B	50%	47%	3%	11.572	0.000
R4	A	35%	60%	5%	8.322	0.002
	B	20%	75%	5%	9.5198	0.002

Table 2. Changes in systolic blood pressure between groups A and B during R2, R3 and R4.

time	group	Percentage of increase	Percentage of reduction	Not changes	Sd for the changes	P value
R2	A	54%	38%	8%	6.023	0.004
	B	17%	78%	5%	5.590	0.004
R3	A	67%	27%	6%	5.663	0.002
	B	36%	62%	2%	8.609	0.002
R4	A	28%	67%	5%	6.705	0.401
	B	18%	77%	5%	6.282	0.401

Table 3. Changes in diastolic blood pressure between groups A and B during R2, R3 and R4.

time	group	Percentage of increase	Percentage of reduction	Not changes	Sd for the changes	P value
R2	A	17%	12%	72%	0.891	0.906
	B	18%	17%	65%	0.636	0.906
R3	A	20%	15%	65%	1.064	0.291
	B	15%	27%	58%	0.812	0.291
R4	A	17%	25%	58%	0.981	0.667
	B	17%	28%	55%	0.879	0.667

Table 4. Changes in oxygen saturation between groups A and B during R2, R3 and R4.

Discussion

The patients were selected to be non-smokers due to the effect of smoking on the mean arterial pressure and heart rate¹². Also, it may cause a risk for comorbidities and lung impairment¹³. BMI was measured for each patient and excluded obese participants (patients with BMI>29.9 kg/m² were considered obese¹⁴). The heavy weight of the patients diminishes the lung function and impairs its expansion¹⁵. 75% of the hypertensive group were overweight. This agrees with Mehata et al.¹⁶, who clarified that the risk of hypertension disease increases in patients with high weight. All patients that participated in this study had low anxiety levels <12, which was evaluated by Norman Corah's Dental scale due to the effect of anxiety on hemodynamic parameters¹⁷. In this study, 52% of the patients take angiotensin II receptor blockers, 25% take Calcium-channel blockers, and 23% take a combination of two drugs. We excluded the patients who take beta blockers as antihypertensive medication to eliminate their interaction with vasoconstrictor¹⁸. The measurements of the parameters were performed after 3 minutes when adrenaline produced its maximum action¹⁹. Swap the tissue with topical anesthesia before infiltrating the needle in the maxillary vestibule to reduce the pain²⁰. The present study showed increased heart rate after 3 minutes of local anesthesia and after the extraction procedure in both groups. This is due to external adrenalin from the local anesthesia and internal adrenaline from the anxiety of needle injection and extraction procedures. Abu-Mostafa et al.²¹ found the same results when two cartridges of articaine 4% with epinephrine 1:100,000 in normotensive patients. Chaudhry et al.²² found a slight reduction in heart rate after a local anesthetic drug containing 2% lidocaine with 1:100,000 adrenaline in hypertensive patients. This study differed from our present study by using two carpels of local anesthesia. After 25 minutes, both groups showed a reduced heart rate compared with the first reading. This was due to the absorption of adrenaline and the relaxation period, making parasympathetic activity more domain. The augmentation of heart rate was significantly higher in normotensive patients than hypertensive patients during R3 and R4 ($P<0.05$). We suggest this result due to higher anxiety levels in normotensive patients and the drug interaction of antihypertensive medication, which produced bradycardia in hypertensive group²³. In systolic blood pressure, the elevation was higher in the normotensive group than in the controlled hypertensive group. This is due to the effect of antihypertensive medication on systolic blood pressure²⁴. There was highly significant elevation in a normotensive group during R3; Gadve et al.²⁵ and Kumar et al.²⁶ found a significant increase in systolic blood pressure after extraction when used 2%lidocaine with adrenaline 1:200,000 and 2% lidocaine with adrenaline 1:80,000 respectively. The present study disagrees with the results of Abu-Mostafa et al.²¹ when they found the increase only after 3 minutes of local anesthesia injection. However, they used two cartridges of articaine 4% with adrenaline 1:100,000. The diastolic blood pressure showed a significant difference during R2 and R3 ($P<0.005$) when a higher percentage of normotensive patients induced elevation. Kumar et al.²⁶ found a slight increase in diastolic blood pressure after anesthesia injection and tooth extraction, but it was not significant when used 2%lidocaine with adrenaline 1:80,0000. The hypertensive group reduces diastolic blood pressure, which agrees with Chaudhry et al. 22 results. Also, Kyosaka et al.²⁷ used adrenalines in 1:80,000 concentration and found a reduction in diastolic blood pressure in older adults. The oxygen saturation results showed no significant difference between both groups in all situations ($p>0.05$). This agrees with the results of Laragnoit et al. 28. However, Abu-Mostafa et al.²¹ found a decrease in oxygen saturation after 3 minutes of local anesthesia injection, and a further decrease occurred after extraction. This study differs from the presented study by the type of local anesthesia: artecaine 4%.

Conclusions

No adverse effect in well-controlled hypertensive patients was seen during local anesthesia injection and simple extraction. There was no augmentation in hemodynamic parameters in hypertensive groups when one carpule of local anesthesia with adrenaline 1:100,000. Patients with hypertension showed a significant reduction in blood pressure (systolic and diastolic blood pressure) during the procedure compared with normotensive patients. The heart rate slightly increased in hypertensive patients during the procedure but without adverse effects.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Institutional Review Board (or Ethics Committee) of the College of Dentistry at the University of Baghdad (no 396121).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Bahar, E., & Yoon, H. Lidocaine: a local anesthetic, its adverse effects and management. *Medicina* **2021**, 57(8), 782.
2. Malamed, S. F. Handbook of local anesthesia-e-book. 7th ed Elsevier Health Sciences **2019**.
3. Millar, E., Henderson, A., & Waddell, A. Is it safe to inject local anesthetic with adrenaline into the pinna and external nose?. *Emergency Nurse* **2021**, 29(3).
4. Cummings, D. R., Yamashita, D. D. R., & McAndrews, J. P. Complications of local anesthesia used in oral and maxillofacial surgery. *Oral and Maxillofacial Surgery Clinics* **2011**, 23(3), 369-377.
5. Ferneini, E. M., Goupil, M. T., McNulty, M. A., & Niekrash, C. E. (Eds.). *Applied Head and Neck Anatomy for the Facial Cosmetic Surgeon*. Springer International Publishing, **2021**.
6. Kaushik, M., & Moturi, K. Local Anaesthesia and inferior alveolar nerve block-a never ending saga. *Jour of Pharmacol & Clin Res JPCR* **2018**, 5(1), 1.
7. Sharma, A., Pant, R., Priyadarshi, S., Agarwal, N., Tripathi, S., & Chaudhary, M. Cardiovascular changes due to dental anxiety during local anesthesia injection for extraction. *Journal of maxillofacial and oral surgery* **2019**, 18(1), 80-87.
8. Carey, R. M., Whelton, P. K., & 2017 ACC/AHA Hypertension Guideline Writing Committee*. Prevention, detection, evaluation, and management of high blood pressure in adults: synopsis of the 2017 American College of Cardiology/American Heart Association Hypertension Guideline. *Annals of Internal Medicine* **2018**, 168(5), 351-358.
9. Patil PM, Patil SP. Is clonidine an adequate alternative to epinephrine as a vasoconstrictor in patients with hypertension? *J Oral Maxillofac Surg*. **2012**, 70(2):257–262.
10. Guimaraes CC, Lopes Motta RH, Bergamaschi CC. Local anesthetics combined with vasoconstrictors in patients with cardiovascular disease undergoing dental procedures: a systematic review and meta-analysis protocol. *BMJ Open*. **2017**, 7(11) e01461.
11. Dantas, M. V. M., Nesso, B., Mituuti, D. S., & Gabrielli, M. A. C. Assessment of patient's anxiety and expectation associated with hemodynamic changes during surgical procedure under local anesthesia. *Revista de Odontologia da UNESP* **2017**, 46, 299-306.
12. Dimitriadis K, Narkiewicz K, Leontsinis I, Konstantinidis D, Mihos C, Andrikou I, Thomopoulos C, Tousoulis D, Tsioufis K. Acute Effects of Electronic and Tobacco Cigarette Smoking on Sympathetic

- Nerve Activity and Blood Pressure in Humans. *International Journal of Environmental Research and Public Health* **2022**,19(6):3237.
13. Sprio, A. E., Ciprandi, G., Riccardi, E., Giannoccaro, F., Carriero, V., Bertolini, F., & Ricciardolo, F. L. The influence of smoking on asthma in the real-life. *Respiratory Medicine* **2020**, 170, 106066.
 14. 12 Nam, G. E., & Park, H. S. Perspective on diagnostic criteria for obesity and abdominal obesity in Korean adults. *Journal of Obesity & Metabolic Syndrome* **2018**, 27(3), 134.
 15. Tan, M., He, F. J., & MacGregor, G. A. Obesity and covid-19: the role of the food industry. *Bmj* **2020**, 369,m2237.
 16. Mehata, S., Shrestha, N., Mehta, R., Vaidya, A., Rawal, L. B., Bhattarai, N., & Mishra, S. R. Prevalence, awareness, treatment and control of hypertension in Nepal: data from nationally representative population-based cross-sectional study. *Journal of hypertension* **2018**, 36(8), 1680-1688.
 17. Gadve, V. R., Shenoi, R., Vats, V., & Shrivastava, A. Evaluation of Anxiety, Pain, and Hemodynamic Changes during Surgical Removal of Lower Third Molar under Local Anesthesia. *Annals of maxillofacial surgery* **2018**, 8(2), 247–253.
 18. Maiden, N. M., Rajkapoor, B., Muthusamy, S., Ramanathan, S., Thangadurai, S. A., & Sughir, A. A. A Review on Pharmacokinetic and Pharmacodynamic Drug Interactions of Adrenergic β -blockers with Clinically Relevant Drugs-An Overview. *Current drug metabolism* **2021**, 22(9), 672-682.
 19. Silvestre, F. J., Verdú, M. J., Sanchís, J. M., Grau, D., & Peñarrocha, M. Effects of vasoconstrictors in dentistry upon systolic and diastolic arterial pressure. *Medicina oral: organo oficial de la Sociedad Espanola de Medicina Oral y de la Academia Iberoamericana de Patologia y Medicina Bucal* **2001**, 6(1), 57-63.
 20. Tirupathi, S., & Rajasekhar, S. Topical Anesthesia in Pediatric Dentistry: An Update. *Dent* **2022**, 15(2), 240-245
 21. Abu-Mostafa, N., Al-Showaikhat, F., Al-Shubbar, F., Al-Zawad, K., & Al-Zawad, F. Hemodynamic changes following injection of local anesthetics with different concentrations of epinephrine during simple tooth extraction: A prospective randomized clinical trial. *Journal of clinical and experimental dentistry* **2015**, 7(4), e471–e476.
 22. Chaudhry, S., Iqbal, H. A., Izhar, F., Mirza, K. M., Khan, N. F., Yasmeen, R., & Khan, A. A. Effect on blood pressure and pulse rate after administration of epinephrine containing dental local anesthetic in hypertensive patients. *JPM-A-Journal of the Pakistan Medical Association* **2011**, 61(11), 1088.
 23. Opie, L. H. Drug interactions of antihypertensive agents: SA Hypertension Society Supplement. *South African Family Practice* **2012**, 54(2), 23-25.
 24. Naci, H., Salcher-Konrad, M., Dias, S., Blum, M. R., Sahoo, S. A., Nunan, D., & Ioannidis, J. P. How does exercise treatment compare with antihypertensive medications? A network meta-analysis of 391 randomized controlled trials assessing exercise and medication effects on systolic blood pressure. *British journal of sports medicine* **2019**, 53(14), 859-869.
 25. Gadve, V. R., Shenoi, R., Vats, V., & Shrivastava, A. Evaluation of anxiety, pain, and hemodynamic changes during surgical removal of lower third molar under local anesthesia. *Annals of maxillofacial surgery* **2018**, 8(2), 247.
 26. Kumar, V., Saba, R., Shah, K., & Kumar, S. A clinical study to assess the hemodynamic changes occurs during dental extractions. *European Journal of Molecular & Clinical Medicine (EJMCM)* **2020**, 7(07).
 27. Kyosaka, Y., Owatari, T., Inokoshi, M., Kubota, K., Inoue, M., & Minakuchi, S. Cardiovascular comparison of 2 types of local anesthesia with vasoconstrictor in older adults: a crossover study. *Anesthesia progress* **2019**, 66(3), 133-140.
 28. Laragnoit, A. B., Neves, R. S., Neves, I. L. I., & Vieira, J. E. Locoregional anesthesia for dental treatment in cardiac patients: a comparative study of 2% plain lidocaine and 2% lidocaine with epinephrine (1: 100,000). *Clinics* **2009**, 64, 177-182.

Received: May 15, 2023/ Accepted: June 10, 2023 / Published: June 15, 2023

Citation: Muhsin, N.A.M.; Abdulrazaq, S.S. Hemodynamic changes following injection of local anesthesia with vasoconstrictor agent in controlled hypertensive patients. *Revis Bionatura* 2023;8 (3) 38.

<http://dx.doi.org/10.21931/RB/CSS/2023.08.03.38>