ORIGINAL ARTICLE

The effect of adrenaline concentration in lidocaine on prehypertension patients during tooth extraction: an observational analysis

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ABSTRACT

Introduction: Prehypertension refers to a systolic value 120–139 mmHg or diastolic value 80–90 mmHg. Studies have shown that the prevalence of prehypertension is over 30% among young adults. The extraction procedure was performed using lidocaine and adrenaline as anesthetics. The purpose of this study was to analyze the effect of adrenaline concentration in lidocaine on prehypertension patients during tooth extraction. **Methods:** This is a prospective analytical observational study with a pre–post measurement design. This study was conducted on 36 prehypertensive patients who were divided into 3 groups. Blood pressure was measured before and less than 5 minutes after administration of lidocaine 2% local anesthesia with either 1:80,000, 1:100,000 or 1:160,000 adrenaline, using a calibrated digital tensimeter (TensiOne 1A). Data were analyzed using paired *t*-tests. **Results:** Homogeneity test: systole before 0,033, systole after 0,329, diastole before 0,174, diastole after 0,274. Anova test: systole before 0,685, systole after 0,837, diastole before 0,03, diastole after 0,058. Post hoc results showed there were statistically significant differences in diastolic blood pressure in the 1:100.00 and 1:160.000 group before diastole. Before performing the one-way ANOVA and paired t-test, the data were assessed for normality using the Shapiro–Wilk test, which indicated a normal distribution ($p > 0.05$). Statistical analysis was then conducted using paired t-tests and one-way ANOVA, followed by post hoc testing. **Conclusion:** The administration of 2% lidocaine with adrenaline concentrations of 1:80,000, 1:100,000, and 1:160,000 did not produce meaningful changes in blood pressure in prehypertensive patients undergoing closed-method dental extraction

KEYWORDS

lidocaine, prehypertension, blood pressure, closed method extraction

INTRODUCTION

According to the Seventh Report of the Joint National Committee (JNC VII), prehypertension is a newly defined blood pressure category, characterized by a systolic pressure between 120–139 mmHg and a diastolic pressure between 80–90 mmHg.[1,2,3] The individual risk factor for developing prehypertension stands at 64%.[4,5,6] Moreover, individuals with prehypertension are 1.65 times more likely to develop hypertension compared to those with normal blood pressure.[7] Several studies have also reported that prehypertension is 30% more common among young adults. It is recognized as an initial stage that can lead to hypertension and is associated with an increased risk of cardiovascular disease. Therefore, prehypertension warrants greater attention and emphasizes the need for lifestyle modifications.[8]

Tooth extraction is a dental procedure to completely remove a tooth from its socket in the jawbone. This procedure involves extracting a tooth from its socket (alveolus) using instruments such as forceps and elevators. There are two main techniques used: the closed (simple) method and the open (surgical) method. Feelings of anxiety and fear related to pain are common both before and after the procedure.[9,10] However, such discomfort can be effectively managed through the use of local anesthesia.[11] Local anesthesia is considered the safest and most effective approach for minimizing pain during dental procedures. It works by blocking peripheral nerves, thereby reducing sensation and discomfort throughout the treatment.[12,13]

Lidocaine, an amide-type anesthetic, is the most widely used local anesthetic in dental practice, particularly in tooth extraction procedures.[14] It is common practice to combine lidocaine with a vasoconstrictor to counteract its natural vasodilating effects. Adrenaline (epinephrine) is the vasoconstrictor most frequently added, as it enhances the duration of anesthesia, accelerates the onset of action, reduces systemic toxicity, lowers the plasma peak concentration, and promotes hemostasis during procedures.[15,16] However, when lidocaine is combined with adrenaline, it can cause an increase in heart rate and cardiac contractility, effects that may occur even at low or high doses. The most commonly used concentration ratios of adrenaline in dentistry are 1:80,000, 1:100,000, and 1:200,000.[17,18] For healthy individuals, the maximum recommended dose of adrenaline in local anesthesia is 0.2 mg, which is approximately equivalent to 10 cartridges of 1:100,000 solution.[19]

Higher levels of adrenaline in the bloodstream can place extra strain on the heart, leading to an increase in blood pressure.[20,21] Similarly, Mustapa et al.[22] reported that normotensive patients experienced elevated blood pressure after receiving lidocaine 2% with 1:80,000 adrenaline.

However, results vary depending on the patient's condition. Siddiqui et al.[19], for example, found that in hypertensive patients, administering lidocaine 2% with 1:100,000 adrenaline led to a temporary rise in both systolic and diastolic blood pressure, followed by a gradual decrease after a few minutes. In contrast, Fabio G.[23] observed only a drop in systolic pressure in prehypertensive patients after anesthesia. Another study by Karanam et al.[24] found that using lidocaine 2% with 1:200,000 adrenaline in hypertensive patients still resulted in increased blood pressure.

Research conducted by Ahyar et al.[25] showed a change in patients' blood pressure after an injection of lidocaine with adrenaline 1:80,000, from 116.04/71.67 to 125.31/76.67. Similarly, research conducted by Amirhossein et al.26 showed results from normal to prehypertension, namely from 111.10/77.71 to 123.16/81.35. According to the results of the studies conducted by Ahyar et al. and Amirhossein et al., patients with normal blood pressure after receiving an injection of lidocaine with adrenaline 1:80,000 can become prehypertensive.

Based on these studies, it is possible that prehypertensive patients after receiving an injection of lidocaine with adrenaline 1:80,000 can become stage I or II hypertensive. Therefore, further research is needed to determine changes in blood pressure in prehypertensive patients following lidocaine injection with adrenaline at ratios of 1:80,000, 1:100,000, and 1:160,000. The purpose of this study was to analyze the effect of adrenaline concentration in lidocaine on prehypertension patients during tooth extraction.

METHODS

This study used a pre-post analytical research design with a cross-sectional approach, and the sampling technique employed was simple random sampling. The population of this study included all patients who underwent tooth extraction using the close method with local anesthesia of 2% lidocaine with adrenalin 1: 80.000, 1:100,000 and 1:160,000 at RSGM Nala Husada Surabaya.

The sample consisted of a subset of pre-hypertensive patients who received tooth extraction using the close method with local anesthesia of 2% lidocaine with adrenalin 1: 80.000, 1:100,000 and 1:160,000 at the same institution. The sample size was calculated using the Slovin formula based on an average population of 36 patients, divided into three groups receiving 2% lidocaine at ratios of 1:80,000, 1:100,000, and 1:160,000.

The inclusion criteria for this study were as follows: Based on previous studies, patients aged 18–55 years scheduled for close-method extraction using 2% lidocaine 1:80.000, 1:100,000 and 1:160,000 as local anesthesia; Male or female patients; Immunocompetent patients (no abnormalities in the immune system); Patients classified as pre-hypertensive (systolic blood pressure 120–139 mmHg and diastolic blood pressure 80–89 mmHg); Patients without systemic disease or psychiatric disorders; Patients willing to participate in the study and who had signed informed consent at RSGM Nala Husada Surabaya. Exclusion criteria were met if the patient was uncooperative and could not be included as a study subject.

The instruments and materials required for this study included a calibrated Omron HEM 7130 digital sphygmomanometer, 3 cc anesthetic syringes, forceps set, diagnostic set, stationery, informed consent forms, 2% lidocaine with adrenalin 1:80.000, 1:100,000 and 1:160,000. The procedure of this study involved preparing diluted local anesthetic solutions by mixing Pehacaine 1:80,000 with lidocaine to achieve concentrations of 1:80.000, 1:100,000 and 1:160,000., using standard dilution formulas. Blood pressure was measured before anesthetic administration and again 2–5 minutes after administering the local anesthesia, as the onset duration is less than five minutes.

Blood pressure measurements were performed using an Omron HEM 7130 digital sphygmomanometer. A properly sized cuff was placed on the upper arm, with the lower edge positioned 2–4 cm above the antecubital fossa. The device was then activated to inflate the cuff and record blood pressure. The systolic and diastolic values were automatically measured and displayed on the LCD screen.

Data were tabulated and statistically tested using one-way ANOVA for both systolic and diastolic pre-post data, and paired t-tests were used for each group. Data analysis used SPSS 27 tools (IBM, United States) with a significance level of 0.05.

RESULTS

Before conducting the one-way ANOVA and paired t-test, the research data were tested for normality using the Shapiro-Wilk test. This study showed that the data were normally distributed ($p>0.05$) in Table 1.

Table 1. Normality test

Group	Systole		Diastole	
	Before	After	Before	After
1:80.000	0.306	0.078	0.979	0.064
1:100.000	0.481	0.326	0.751	0.534
1:160.000	0.446	0.197	0.586	0.869

Table 2. Statistical test results using paired t test and one way ANOVA followed by post hoc test

Group	n	Systole				p-value*	Diastole				p-value*
		Before		After			Before		After		
		Mean	SD	Mean	SD		Mean	SD	rerata	SD	
1:80.000	12	130,7	9,27	126,4	18,12	0,503	82,0[ab]	6,16	77,6	9,75	0,138
1:100.000	12	128,2	6,10	127,5	13,24	0,858	78,0[a]	6,78	78,6	8,75	0,871
1:160.000	12	128,6	4,19	130,0	9,95	0,652	85,2[b]	3,65	81,5	5,91	0,055
p-value**		0,685		0,837			0,03***		0,558		

Note: *Paired t-test; ** One Way Anova; ***Post hoc test

The paired t-test results found no significant difference before and after local anesthetic injection with all lidocaine-adrenaline ratios, including 1:80,000, 1:100,000, and 1:160,000 (Table 2). This occurred in both systolic and diastolic blood pressure. This indicates that administering adrenaline at the highest ratio did not affect blood pressure in pre-hypertension patients.

The next statistical test was conducted using a one-way ANOVA. The one-way ANOVA showed no difference in systolic data before and after local anesthetic injection with all lidocaine-adrenaline ratios, nor in diastolic data after local anesthetic injection with all lidocaine-adrenaline ratios (1:80,000 and 1:100,000). However, a difference in diastolic data occurred in the sample with the 1:160,000 ratio. This indicates that patients given a lidocaine-adrenaline injection at a ratio of 1:160,000 had higher diastolic blood pressure than patients given other ratios. However, this did not alter the results, which showed no significant difference of before and after in patients given a lidocaine-adrenaline injection at a ratio of 1:160,000.

DISCUSSION

Before conducting further statistical analyses, the distribution of the data was first evaluated using the Shapiro–Wilk test to determine whether it met the assumption of normality. Assessing normality is an essential step when applying parametric statistical tests, such as the one-way ANOVA and paired t-test, because these methods require the data to be normally distributed. The results showed a p-value greater than 0.05, indicating that the data were normally distributed, as presented in Table 1.

Therefore, the assumption of normality was satisfied, and parametric tests were considered appropriate for analyzing differences within and between the study groups. Table 2 demonstrates differences in the mean diastolic blood pressure values among the groups prior to the administration of 2% lidocaine with adrenaline at concentrations of 1:80,000, 1:100,000, and 1:160,000; however, these values remained within the prehypertensive range. Following the administration of 2% lidocaine with adrenaline at concentrations of 1:80,000, 1:100,000, and 1:160,000, no statistically significant changes in blood pressure were observed.

These findings are consistent with those of a prospective study that evaluated blood pressure changes after the administration of 2% lidocaine with epinephrine (1:80,000) during an inferior alveolar nerve block. The study reported that both systolic and diastolic blood pressure remained within normal limits, and no signs of hypertension were detected following the administration of the local anesthetic.[27] The results of this study showed that the paired t-test analysis revealed no significant differences in blood pressure before and after the administration of local anesthetic containing lidocaine with adrenaline at ratios of 1:80,000, 1:100,000, and 1:160,000. This finding was observed in both systolic and diastolic blood pressure (Table 2). These results suggest that the use of lidocaine combined with adrenaline, even at the highest concentration evaluated in this study, did not produce significant hemodynamic changes in patients with prehypertension. Therefore, the administration of local anesthesia with adrenaline in controlled concentrations may be considered relatively safe for patients with prehypertensive conditions when used within recommended clinical limits.

Further analysis using one-way ANOVA also showed no significant differences in systolic blood pressure either before or after injection across all lidocaine–adrenaline ratios. Similarly, no significant differences were observed in diastolic blood pressure following injections with ratios of 1:80,000 and 1:100,000. Although a variation in diastolic blood pressure was observed in the group receiving the 1:160,000 ratio, where the values appeared slightly higher compared to the other groups, the comparison between pre- and post-injection measurements remained statistically non-significant.

These findings indicate that the addition of adrenaline to lidocaine at commonly used concentrations does not significantly influence blood pressure in prehypertensive patients. The absence of clinically significant changes may be related to the small amount of adrenaline administered during dental anesthesia. Additionally, the vasoconstrictive properties of adrenaline help prolong anesthesia, reduce systemic absorption, and minimize intraoperative bleeding, which may outweigh potential cardiovascular effects when used appropriately.

The absence of significant changes in systolic blood pressure may be attributed to the low dose of adrenaline used. Although adrenaline can increase heart rate and myocardial contractility via β1-adrenergic receptors—potentially elevating systolic pressure the vasodilatory effect of lidocaine appears to counterbalance this response.[28] Adrenaline can increase heart rate and myocardial contractility via β_1-adrenergic receptors—potentially elevating systolic pressure; the vasodilatory effect of lidocaine appears to counterbalance this response. Adrenaline (epinephrine) exerts its effects through both α- and β-adrenergic receptors.

Stimulation of β_1 receptors in the heart produces positive chronotropic and inotropic effects, increasing heart rate, myocardial contractility, cardiac output, and potentially systolic blood pressure. Activation of α_1 receptors in vascular smooth muscle induces vasoconstriction, particularly in cutaneous and mucosal tissues, thereby reducing bleeding and limiting systemic absorption of local anesthetics. In contrast, lidocaine alone promotes peripheral vasodilation through direct smooth muscle relaxation, which may enhance systemic uptake and shorten anesthetic duration. Therefore, combining adrenaline with lidocaine prolongs anesthesia and reduces systemic toxicity by counteracting lidocaine-induced vasodilation. [29]

Similarly, no significant change was observed in diastolic blood pressure. At low doses, adrenaline has a limited vasoconstrictive effect on peripheral blood vessels, which means it does not significantly alter systemic diastolic pressure. The vasoconstriction that does occur is primarily localized to the injection site, where it serves to prolong the anesthetic effect and minimize bleeding.[31] These localized actions—mainly affecting small blood vessels in the submucosal tissue—are typically insufficient to cause systemic changes in blood pressure.[32]

In some patients, a decrease in blood pressure was observed following the administration of lidocaine 2% local anesthesia with adrenaline concentrations of 1:100,000 and 1:160,000. This effect may be attributed to the predominance of β2-adrenergic receptor activation by low doses of adrenaline. Since β2 receptors are more abundant than α-adrenergic receptors in the vasculature, their activation leads to vasodilation, which in turn can result in a reduction in blood pressure.[32,33]

Furthermore, the lidocaine used in this study—at concentrations of 2% combined with adrenaline at 1:80.000, 1:100,000 and 1:160,000 is known to have inherent vasodilatory properties. This effect is thought to occur through the inhibition of sodium (Na^+) channels in the vascular smooth muscle cell membranes. By reducing intracellular Na^+ levels, which are essential for depolarization and muscle contraction, lidocaine impairs vascular smooth muscle tone, leading to relaxation and vasodilation.[34] This mechanism likely contributes to the observed decrease in blood pressure in certain individuals.

This study has several limitations. First, the sample size did not reach the minimum number recommended according to the Slovin formula for population-based sampling, which may have influenced the statistical power and the ability to detect significant differences between groups. Second, some research samples showed relatively wide variations in systolic and diastolic blood pressure values, although they remained within the same classification of prehypertension. Future studies should consider using a larger sample size and selecting participants with more homogeneous baseline blood pressure values to improve the robustness and reliability of the statistical analysis

CONCLUSION

In this study, prehypertensive patients did not experience noticeable changes in blood pressure before and after receiving 2% lidocaine with epinephrine at concentrations of 1:80,000, 1:100,000, or 1:160,000 during closed tooth extraction. Overall, these results suggest that the use of these epinephrine concentrations remains stable from a cardiovascular standpoint and can be safely applied in prehypertensive patients undergoing minor oral surgical procedures.

The clinical implications of this study indicate that local anesthesia using 2% lidocaine with 1:80,000 epinephrine is most effective in prehypertensive patients, as it does not cause statistically significant changes in blood pressure after administration. Lidocaine 2% with epinephrine 1:80,000 has the ability to induce vasoconstriction due to the epinephrine effect contained in the anesthetic, thereby reducing bleeding. In addition, the higher adrenaline content of 1:80,000 compared to lidocaine with adrenaline 1:110,000 and 1:160,000 has another advantage, namely a faster onset of anesthetic action, allowing the operator to immediately perform tooth extraction. Another advantage is a longer duration of action, giving the operator sufficient time to perform tooth extraction in difficult cases.

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REFERENCES

1. Slade LJ, Wilson M, Mistry HD, Bone JN, Bello NA, Blackman M, et al. The 2017 American College of Cardiology and American Heart Association blood pressure categories in the second half of pregnancy: a systematic review of their association with adverse pregnancy outcomes. Am J Obstet Gynecol. 2023;229(2):101–117. https://doi.org/10.1016/j.ajog.2023.01.013
2. Nayak AP, Wanjari AK, Prasad G, Kumar S. Prevalence of prehypertension and risk factors among resident doctors. Eur J Cardiovasc Med. 2024;14(2):189–193.
3. Bashir MA, Yahaya AI, Muhammad M, Yusuf AH. Prevalence of prehypertension in Nigeria: a systematic review and meta-analysis. Int J Epidemiol Health Sci. 2021;2(9):e20. https://doi.org/10.51757/IJEHS.2.9.2021.245213
4. US Preventive Services Task Force. Screening for hypertension in adults: updated evidence report and systematic review. JAMA. 2021;325(16):1657–1669. https://doi.org/10.1001/jama.2020.21669

5. Aldiab A, Shubair MM, Al-Zahrani JM, Al-Khaled K. Prevalence of hypertension and prehypertension and associated cardioembolic risk factors: a population-based cross-sectional study in Alkharj, Saudi Arabia. BMC Public Health. 2018;18:1327. https://doi.org/10.1186/s12889-018-6216-9
6. Huang X, Hu L, Long Z, Wang X, Wu J, Cai J. Hypertensive heart disease: mechanisms, diagnosis, and treatment. Rev Cardiovasc Med. 2024;25(3):93. https://doi.org/10.31083/j.rcm2503093
7. Widjaja FF, Santoso L, Barus NRV, Pradana GA. Prehypertension and hypertension among young Indonesian adults at a primary health care in a rural area. Med J Indones. 2023;32(1):39–45. https://doi.org/10.13181/mji.oa.226580
8. Jasmine M, Maulida D, Pradana DA, Nanjar II, Idya S. Risk factors of prehypertension and hypertension among young adults in several countries: a literature review. Trop Public Health J. 2022;2(1):1–12. https://doi.org/10.32734/trophico.v2i1.8655
9. Ma S, Chen X, Zhai Y, Sun X, Sheng J, Sun Y. Predictive risk factors for adverse events during tooth extraction among elderly patients with cardiovascular diseases. Ann Med. 2024;56(1):1–10. https://doi.org/10.1080/07853890.2024.2448274
10. Okechi U, Chukwuneke F, Sohal K, Anyikwa C, Mgbeokwere C. Tooth extraction in middle-aged and older adults: indications and medical conditions among patients in Nigeria. Fac Dent J. 2024;15(2):79–85. https://doi.org/10.1308/rcsfdj.2024.19
11. Martin E, Nimmo A, Lee A, Jennings E. Articaine in dentistry: an overview of the evidence and meta-analysis of randomized controlled trials comparing articaine with lidocaine. BDJ Open. 2021;7:27. https://doi.org/10.1038/s41405-021-00082-5
12. Guimarães CC, Lopes LC, Bergamaschi CC, Ramacciato JC, Silva MT, Araújo JO, et al. Local anaesthetics combined with vasoconstrictors in patients with cardiovascular disease undergoing dental procedures: systematic review and meta-analysis. BMJ Open. 2021;11(7):e044357. https://doi.org/10.1136/bmjopen-2020-044357
13. Gholami M, Banihashemrad A, Mohammadzadeh A, Ahrari F. Efficacy of 4% articaine versus 2% lidocaine in inducing palatal anesthesia for tooth extraction in different maxillary regions. J Oral Maxillofac Surg. 2021;79(8):1643–1649. https://doi.org/10.1016/j.joms.2021.02.019
14. Decloux D, Ouanounou A. Local anaesthesia in dentistry: a review. Int Dent J. 2021;71(2):87–95. https://doi.org/10.1111/idj.12625
15. Bahar E, Yoon H. Lidocaine: a local anesthetic, its adverse effects and management. Medicina (Kaunas). 2021;57(8):782. https://doi.org/10.3390/medicina57080782
16. Cherobin ACFP, Tavares GT. Safety of local anesthetics. An Bras Dermatol. 2020;95(1):82–90. https://doi.org/10.1016/j.abd.2019.09.025
17. Moodley D. Local anaesthetics in dentistry—Part 3: vasoconstrictors in local anaesthetics. S Afr Dent J. 2017;72(4):176–178.
18. Gajniak D, Mendrala K, König-Widuch G, Parzonka S, Gierek D, Krzych ŁJ. Effect of lidocaine on intraoperative blood pressure variability in vascular surgery. BMC Anesthesiol. 2024;24:170. https://doi.org/10.1186/s12871-024-02550-5
19. Siddiqui HK, Hussain A, Khan FNA, Shafi AM, Heyat U. Systemic effects of local anaesthesia in hypertensive patients. Pak Oral Dent J. 2017;37(4):538–542.
20. Motiejunaite J, Amar L, Vidal-Petiot E. Adrenergic receptors and cardiovascular effects of catecholamines. Ann Endocrinol (Paris). 2021;82(3–4):193–197. https://doi.org/10.1016/j.ando.2021.03.004
21. Hermanto E, Pranoto AE. Blood pressure differences due to lidocaine in hypertensive patients. In: Proc Int Conf Dent Technol Med Sci (ICDENTEMS 2024). Jakarta; 2026. p. 439–445. https://doi.org/10.1201/9781003647294-56
22. Chandrasekaran D, Chinnaswami R, Shanthi K, Sargunam AED, Kumar KS, Satheesh T. Efficacy of articaine, bupivacaine, and lignocaine for maxillary tooth extraction. J Pharm Bioallied Sci. 2021;13(Suppl 1):S721–S724. https://doi.org/10.4103/jpbs.JPBS_648_20
23. Guarracino F, Bertini P. Perioperative hypotension: causes and remedies. J Anesth Analg Crit Care. 2022;2:17. https://doi.org/10.1186/s44158-022-00045-8
24. Acharya N, Tamrakar ET, Tuladha L. Effects of lidocaine with adrenaline on blood pressure in hypertensive patients. J Lumbini Med Coll. 2021;9(1):1–6. https://doi.org/10.22502/jlmc.v9i1.415
25. Riza A, Siregar IB, Oes A, Tilagamalar. Differences in blood pressure before and after administration of local anesthetic among obese adult female patients. J Dentomaxillofac Sci. 2021;6(1):17–21. https://doi.org/10.15562/jdmfs.v6i1.830
26. Moaddabi A, Soltani P, Zamanzadeh M, Nosrati K, Mollamirzaei M, Cernera M, et al. Comparison of articaine and lidocaine on blood pressure after maxillary infiltration: a randomized clinical trial. Int J Dent. 2021;2021:8894160. https://doi.org/10.1155/2021/8894160
27. Aliabadi E, Divanpour V, Mardani M. Changes in blood pressure and pulse rate following lidocaine with epinephrine injection. Ann Maxillofac Surg. 2020;10(2):361–364. https://doi.org/10.4103/ams.ams_187_19
28. Brunton LL, Hilal-Dandan R, Knollmann BC, editors. Goodman & Gilman's: the pharmacological basis of therapeutics. 13th ed. New York: McGraw-Hill; 2017.
29. Rodrigues GA, Bronzato JD. Local anesthetics in dentistry: mechanism of action, characteristics, and clinical considerations. J Oral Maxillofac Anesth. 2025;4:8. https://doi.org/10.21037/joma-25-8
30. Shionoya Y, Nakamura E, Tsujimoto G, Koyata T, Yasuda A, Nakamura K, et al. Hemodynamic impact of epinephrine–antipsychotic interactions under general anesthesia. Anesth Prog. 2021;68(3):141–145. https://doi.org/10.2344/anpr-68-02-01
31. Wijaya MA, Hidayat M, Sitorus TD. Blood pressure changes during tooth extraction using epinephrine-containing local anesthesia. J Med Health. 2018;2(2):95–101. https://doi.org/10.28932/jmh.v2i2.1011
32. Lyng JW, White CC, Peterson TQ, Lako-Adamson H, Goodloe JM, Dailey MW, et al. Non-auto-injector epinephrine administration by basic life support providers: a literature review and consensus process. Prehosp Emerg Care. 2019;23(6):855–861. https://doi.org/10.1080/10903127.2019.1595235
33. Dalal R, Grujic D. Epinephrine. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2024. Available from: https://www.ncbi.nlm.nih.gov/books/NBK482160/
34. Adetunji A, Uche-Orji C, Ezebialu C, Adebayo PC, Sanusi F, Imo U, et al. Prevalence and risk factors of prehypertension and hypertension among clinical students. BMC Cardiovasc Disord. 2025;25:393. https://doi.org/10.1186/s12872-025-04852-z