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POST-EXTRACTION HEMORRHAGE: ASSESSING HYPERTENSION AS A RISK FACTOR IN DENTAL EXTRACTIONS

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ABSTRACT

Background: Tooth extraction, a frequently performed dental procedure, typically culminates in hemostasis within several hours post-operatively. Hypertensive individuals exhibit a propensity for protracted bleeding following surgical interventions. This investigation seeks to assess prolonged bleeding after dental extraction in hypertensive patients. The study aims to determine whether elevated blood pressure is the sole etiological factor in prolonged bleeding or if other confounding variables are implicated.
Method: This prospective cohort study was conducted at Wates Public Hospital, Yogyakarta, Indonesia, from October 2024 to February 2025. Consecutive sampling was used in this study. All research subjects were patients at the Oral and Maxillofacial Surgery Clinic of the RSUD Wates who underwent closed-method extraction using local anesthesia. Patients were separated into two groups, normal and hypertension. Seventy-four patients have been involved in this research, based on inclusive and exclusive criteria. Confounding factors which could influence blood pressure were controlled statistically.
Outcome: Findings indicate that increased mean arterial pressure may extend bleeding time after extraction ($p < .001$).
Conclusion: Elevated mean arterial pressure may prolong bleeding following tooth extraction. Furthermore, several confounding factors, including patients' pharmacotherapy, localized inflammation resulting from periodontal disease in hypertensive individuals, and adverse patient behaviors after extraction, should be taken into consideration.

INTRODUCTION

Tooth extraction is a common dental procedure that, under normal conditions, results in hemostasis within a few hours post-operation (Yerragudi et al., 2023). According to WHO Surveillance, Monitoring and Reporting in 2023, Indonesia had higher prevalence of hypertension (>40%) rather than global population (<35%) among 30-79 years old. However, in hypertensive patients, prolonged bleeding following tooth extraction is a significant concern due to impaired clot formation and altered vascular responses. Hypertension affects the coagulation system by influencing platelet function, endothelial integrity, and fibrinolysis, thereby increasing the risk of post-extraction hemorrhage (Chu et al., 2021). Additionally, many hypertensive patients are prescribed antihypertensive medications, such as calcium channel blockers, beta-blockers, or anticoagulants, which can further compromise hemostasis and delay wound healing (Rodrigues et al., 2020).

Uncontrolled or poorly managed hypertension exacerbates bleeding by exerting excessive pressure on the vascular system, reducing the effectiveness of clot stabilization (Li et al., 2022). Moreover, stress and anxiety during dental procedures can trigger acute blood pressure spikes, worsening the risk of postoperative hemorrhage. Studies suggest that local hemostatic measures, including pressure application, hemostatic agents, and careful selection of anesthesia, can effectively reduce bleeding episodes in hypertensive individuals undergoing dental extractions (Liu et al., 2019).

Understanding the correlation between hypertension and prolonged post-extraction bleeding is essential for ensuring patient safety and optimal treatment outcomes. Clinicians must conduct a thorough preoperative assessment, monitor blood pressure levels, and implement appropriate hemostatic strategies to mitigate the risk of excessive bleeding in hypertensive patients undergoing tooth extraction. This investigation aims to evaluate the potential correlation between prolonged post-extraction hemorrhage and hypertension, as compared to normotensive individuals, given the absence of existing implicit studies on the relationship between hypertension and bleeding time.

RESEARCH METHODS

This prospective cohort study was conducted at the Wates Public Hospital, Yogyakarta, Indonesia, from October 2024 to February 2025. Seventy-four patients have been involved in this research, based on inclusive and exclusive criteria. If there are any unexpected conditions such as hypertensive crisis, hospitalization due to bleeding, open method extraction, periodontal inflammation, and performing socket suture and / or using local hemostatic agent such as spongostan, after extraction as a bleeding management, would be added as confounder factors and recorded in this research.

Ethical Guidelines

All research protocols and methodologies were reviewed and approved by the ethics committee of Wates Public Hospital. All procedures were performed under the supervision of Wates Public Hospital and in compliance with the relevant laws and institutional guidelines. This research had ethical clearance with approval number KEPK/032/RS/X/2024. This study also followed the clinical research guidelines established by the CIOMS (2016) and the Indonesian Ministry of Health (2021). Written informed consent was obtained from all patients who agreed to participate in the study.

Sample Size Calculation

The difference in means with given power and significance, the required per-group sample size can be estimated by the two-sample t-test formula:

$$N = (z_{1-\alpha/2} + z_{1-\beta})^2 \left(\frac{\sigma}{\delta}\right)^2 \rightarrow two - sided\ test$$

Where:

σ = standard deviation of the outcome in each group (assumed equal).

Δ = expected difference in means between groups (hypertensive – normal).

Z1−α/2 = Z-value for the two-tailed α (for 0.05, Z0.975≈1.96Z; {0.975} ≈ 1.96Z; 0.975≈1.96).

Z1−β = Z-value for power (for 80% power, Z0.80≈0.84Z; {0.80} ≈ 0.84Z; 0.80≈0.84).

Factor 2 in the numerator accounts for two groups of equal size.

n ≈ 37.16 per group. We plan to ensure adequate power (since sample size must be whole people), giving 37 subjects in each group.

Thirty-seven participants in the normotensive group and the hypertensive group (≈74 total), the study would have ~80% power at the 5% significance level to detect a difference of ~5 units in bleeding time between hypertensive and normal patients. This is the minimum sample size per group required under the given assumptions.

Patients

Consecutive sampling was used in this study. All research subjects were patients at the Oral and Maxillofacial Surgery Clinic of the RSUD Wates who underwent closed-method extraction using local anesthesia. Patients were separated into two groups, normal and hypertension. Their tooth diagnosis differed from retained dental roots; necrosis of pulp; and chronic periodontitis with luxation. Patients who were used as research subjects were required to meet the following inclusion criteria: age range of 21-80 years; they had normal blood pressure for normotensive group (90/60 mmHg to 140/90 mmHg. For hypertension group, they had to have history of hypertension and came as outpatient clinic with a systolic blood pressure range above 140 mmHg and below 180 mmHg, or diastolic blood pressure range above 90 mmHg and below 110 mmHg; willingness to become a research subject by signing an informed consent; and MAP $65 < X < 130$.

Patients were declared unable to become research subjects if: they had a history of allergy to local anesthetic ingredients; they had a history of other systemic diseases such as blood disorders, diabetes mellitus, a history of acute cardiovascular or cerebrovascular diseases such as stroke or heart attack less than 6 months ago; they were taking anticoagulant or antiplatelet drugs so as to bias the results of the study; they were pregnant; they were contraindicated for extraction with conventional methods (closed method extraction); MAP < 65 or > 130; patients received major surgery within the last 6 months; using anticoagulant and / or antiplatelets drugs. There were 2 patients who dropped out in the normotensive group because they had open method extraction.

Blood Pressure Measurement

The dental nurse measured the patient's blood pressure using a digital sphygmomanometer three consecutive times above the dental unit before tooth extraction under local anesthesia. The measurement results were averaged and recorded in the table. The research subjects were hypertensive patients with a mean systolic blood pressure of 140–180 mmHg and diastolic blood pressure of 90–110 mmHg (Stage 2 Hypertension, AHA Criteria). Patients with mean systolic blood pressure below 140 mmHg and diastolic blood pressure below 90 mmHg were categorized as normotensive patients.

Tooth Extraction

Tooth extraction was performed under local anesthesia with pure lidocaine. The maximum dose that can be administered to patients is only 2 ampoules (each containing 2ml lidocaine). If the patient still felt pain after being administered the maximum dose of local anesthesia, the tooth extraction procedure was postponed, and the patient's participation in the study was cancelled. Close method extraction was used for tooth extractions and were limited to extracting one tooth at a time.

Bleeding Time Measurement

A sterilized gauze tampon was immediately placed in the post-extraction socket, and the patient was instructed to bite the gauze tampon firmly for 5 minutes, while also being told to swallow saliva continuously. The researcher removed the gauze on the surface of the socket while looking for blood seepage from the socket. If blood was still oozing out of the socket, the patient was instructed to bite the gauze tampon again for another 5 minutes. If there was no blood seeping out of the socket, bleeding time was recorded. The procedure was repeated until four times (total 20 minutes) after biting the gauze tampon. If bleeding continued after 20 minutes of biting the gauze tampon, bleeding control management was performed by suturing the socket area while inserting local hemostatic materials such as gelatin sponge.

Data Analysis

All parameters recorded in the research table were subjected to descriptive statistical tests to assess their mean and standard deviation between male and female groups. The researcher conducted a normality test using Shapiro-Wilk and a homogeneity test using Levene's Test on systolic and diastolic blood pressure, mean arterial pressure, and bleeding time. The relationship between systolic, diastolic, mean arterial pressure, and bleeding time between groups was tested using an independent t-test (parametric) or the Mann-Whitney test (non-parametric). Correlation tests using linear regression to find relationships between blood pressure and prolonged bleeding after extraction. Differences were considered significant for $p < 0.05$. All data were analyzed using JASP 0.19 software.

RESEARCH FINDINGS

Blood pressure

This study categorized participants into two groups based on blood pressure: hypertensive and normotensive, each comprising 37 individuals. The hypertensive group showed higher mean values for systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) compared to the normotensive group (Table 1 & Figure 1). Data from both groups demonstrated normal distribution and homogeneity, as confirmed by non-significant results ($p > 0.05$) from the Shapiro-Wilk and Levene's tests (Table 2). An independent t-test (Table 3) revealed statistically significant differences in systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) between the hypertensive and normotensive groups ($p < 0.05$).

Table 1. Descriptive statistics for systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) between normotensive group (1) and hypertensive group (2)

Descriptive Statistics ▼

	SBP		DBP		MAP	
	1	2	1	2	1	2
Valid	37	37	37	37	37	37
Missing	0	0	0	0	0	0
Mean	153.595	119.189	92.892	74.757	113.108	89.595
Std. Deviation	6.103	7.593	5.552	6.898	4.465	5.525
Coefficient of variation	0.040	0.064	0.060	0.092	0.039	0.062
Shapiro-Wilk	0.953	0.960	0.947	0.975	0.984	0.956
P-value of Shapiro-Wilk	0.120	0.200	0.077	0.550	0.860	0.145
Minimum	143.000	103.000	82.000	62.000	104.000	79.000
Maximum	170.000	135.000	105.000	88.000	122.000	100.000

Table 2. Normality test and homogeneity test for systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) with p<0.05

Test of Normality (Shapiro-Wilk)

Residuals	W	p
SBP	0.968	0.055
DBP	0.975	0.159
MAP	0.982	0.382

Test of Equality of Variances (Levene's) ▼

	F	df_1	df_2	p
SBP	2.664	1	72	0.107
DBP	1.618	1	72	0.207
MAP	2.276	1	72	0.136

Table 3. Independent Sample T-Test for systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) with p<0.05

Independent Samples T-Test

	t	df	p
SBP	21.482	72	< .001
DBP	12.458	72	< .001
MAP	20.135	72	< .001

Note. Student's t-test.

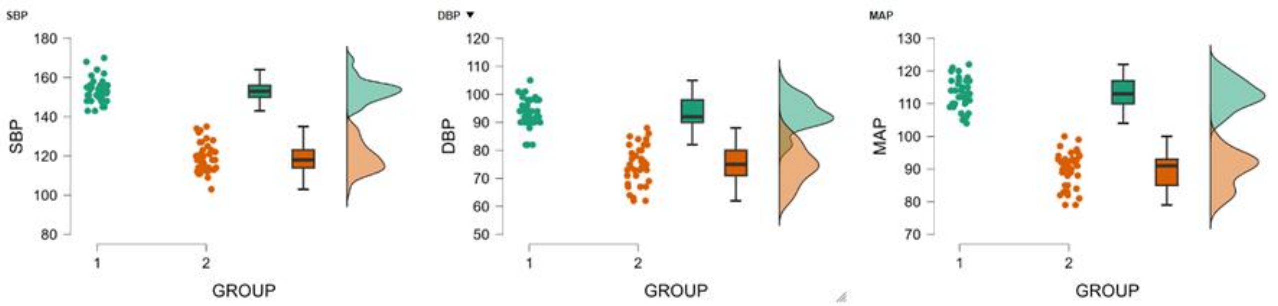

Figure 1. Rain Cloud plots with density for systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) between normotensive group (1) and the hypertensive group (2)

Bleeding Time

The bleeding time assay was conducted to ascertain the disparity between hypertensive and normotensive cohorts. Statistical analysis was performed utilizing the Mann-Whitney U Test, necessitated by the non-normal and heterogeneous data distribution. (Table 4 & 5). A statistically significant difference was observed between the two groups (p < 0.001). This indicates that bleeding time in the hypertensive group was significantly longer compared to the normotensive group (Figure 2).

Table 4. Normality test and homogeneity test for bleeding time with p<0.05

Test of Normality (Shapiro-Wilk)

Residuals	W	p
BT	0.801	< .001

Note. Significant results suggest a deviation from normality.

Test of Equality of Variances (Levene's)

	F	df_1	df_2	p
BT	47.402	1	72	< .001

Table 5. Mann-Whitney U Test for bleeding time between hypertensive and normotensive group with p<0.05

Independent Samples T-Test ▼

	U	df	p
BT	1308.000		< .001

Note. Mann-Whitney U test.

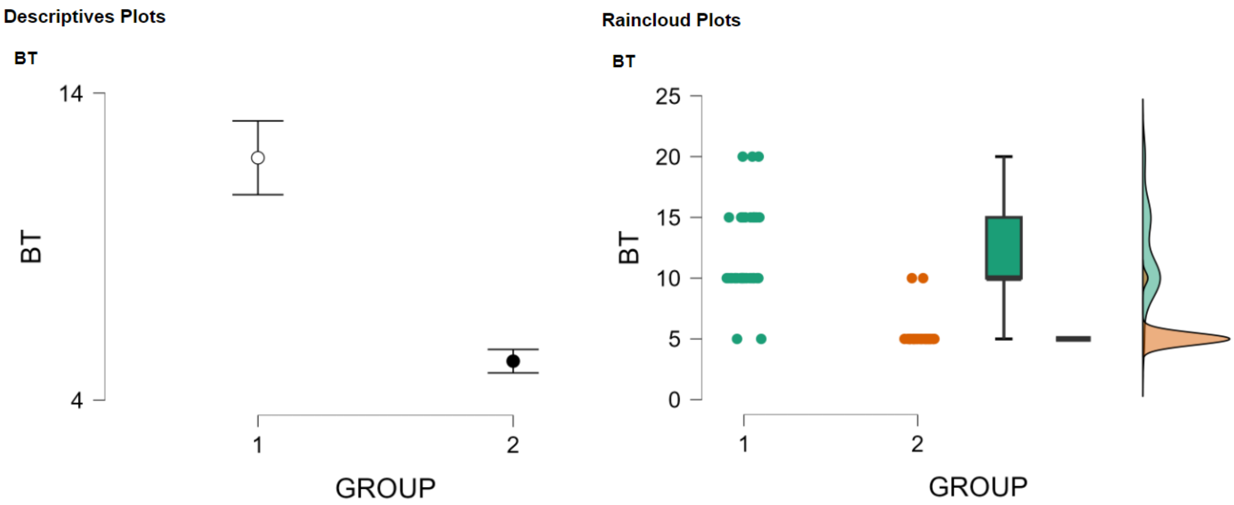

Figure 2. Descriptive plot (left) and raincloud plot (right) of bleeding time between hypertensive (2) and normotensive group (1).

A linear regression analysis was conducted to determine the correlation between bleeding time (BT) and mean arterial pressure (MAP). This unstandardized coefficient means that for every 1 unit increase in MAP, the dependent variable increases by 0.016 units. The result is highly significant ($p < 0.05$), meaning the relationship between MAP and the dependent variable is unlikely due to chance. The effect size is moderate (Beta = 0.251), meaning that MAP has a meaningful impact. Since the standard error is small, the estimate is precise and reliable (Tabel 6). Marginal effects analysis of Mean Arterial Pressure (MAP) on Bleeding Time (BT) revealed a positive trend, indicating an increase in bleeding time with rising mean arterial pressure (Figure 3).

Table 6. Linear regression for Mean Arterial Pressure (MAP) and Bleeding Time (BT) to find relationships between hypertension and prolonged bleeding time.

Model Summary - BT

					Durbin-Watson		
Model	R	R^2	Adjusted R^2	RMSE	Autocorrelation	Statistic	p
M_1	0.938	0.880	0.878	3.341	0.512	0.965	< .001

Note. M_1 includes MAP

Coefficients ▼

Model		Unstandardized	Standard Error	Standardized	t	p
M_1	MAP	0.088	0.004	0.265	23.107	< .001

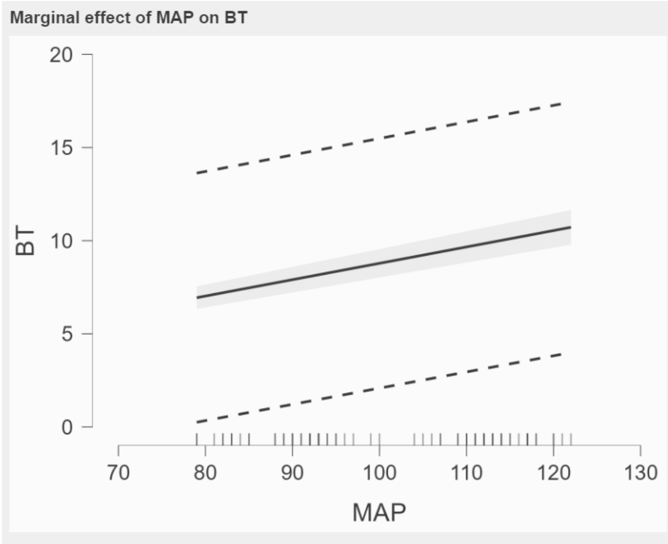

Figure 3. Marginal effect (prediction) of bleeding time elevation based on mean arterial pressure (MAP)

DISCUSSION

Post-extraction hemorrhage (PEH) is a well-documented and commonly observed complication in dental practice, characterized by bleeding persisting after dental extraction. The prevalence of post-extraction hemorrhage has been reported to range from 0% to 26%. If post-extraction hemorrhage is not appropriately managed, potential sequelae may range from soft tissue hematomas to significant blood loss. Local etiologies of bleeding include soft tissue inflammation and osseous hemorrhage. Huang et al. (2021) determined that inadequate oral hygiene may result in periodontal disease and extend the duration of bleeding following dental extraction in individuals with hypertension. Systemic etiologies encompass platelet dysfunction, coagulation abnormalities, and excessive fibrinolysis, which may be inherited or acquired (Kumbargere et al., 2018).

Chronic hypertension induces alterations within the cardiovascular system, potentially rendering patients more susceptible to hemorrhage during and following dental extractions. The elevation of blood pressure itself may intensify bleeding by augmenting hydrostatic pressure within blood vessels, thereby resulting in an increased rate and duration of oozing from the extraction site. Clinical observations indicate that patients with hypertension exhibit a propensity for substantial intraoperative bleeding, partially attributable to the impairment of stable clot formation by elevated arterial pressure, which may also dislodge newly formed clots from the extraction socket (Southerland et al., 2016; Liu et al., 2022).

Stress and pain can further worsen this issue: pain or anxiety in the dental chair may trigger acute blood pressure spikes in hypertensive individuals, compounding the bleeding risk (Pan et al., 2015). This creates a delicate balance during extractions: clinicians must achieve hemostasis while avoiding provoking a hypertensive episode. In essence, high blood pressure creates a hemodynamic environment that makes it harder for normal clotting to stop post-extraction hemorrhage, explaining why uncontrolled hypertension is a known risk factor for bleeding complications (Liu et al., 2022; Ashorobi et al., 2024)

This research revealed a significant increase in bleeding time in the hypertensive group compared to the normotensive group. Although some literature stated that patients with systolic blood pressure below 160 mmHg and diastolic blood pressure lower than 90 mmHg would be safe to have invasive treatment. This research may be attributed to the frequent association of hypertension with endothelial dysfunction and vascular alterations. While hypertension is generally known to promote thrombosis over time, it can acutely lead to hemorrhagic incidents, such as epistaxis and prolonged wound bleeding, owing to the vulnerability of small vessels under elevated pressure. Chronic hypertension induces alterations in the cardiovascular system, potentially predisposes patients to hemorrhage during and after dental extractions. Elevated blood pressure can independently intensify bleeding by augmenting hydrostatic pressure within blood vessels, thereby resulting in more rapid and protracted seepage from the extraction site. Clinically, hypertensive individuals are recognized as exhibiting a propensity for excessive intraoperative bleeding, partially attributed to the fact that elevated arterial pressure may impede the development of a stable clot and even dislodge nascent clots from the socket (Southerland et al., 2016; Ashrobi et al, 2024). If post-extraction bleeding is not controlled, the consequences can range from minor issues (like soft tissue hematomas) to severe blood loss requiring intervention (Kumbargere et al., 2018).

Subjects in the hypertensive group were prescribed antihypertensive medication. This may act as a confounding factor for their prolonged bleeding following extraction. Antihypertensive medications encompass various classifications (e.g., ACE inhibitors, angiotensin receptor blockers, beta-blockers, calcium channel blockers, diuretics, vasodilators) and primarily function to reduce blood pressure through vascular or renal mechanisms. Although most standard antihypertensive agents do not directly serve as anticoagulants or platelet inhibitors, they can exert indirect impacts on bleeding and oral tissues that are of clinical significance. For example, certain ACE inhibitors have been correlated with adverse oral effects such as neutropenia and gingival bleeding. Direct vasodilators, such as hydralazine, and specific alpha-adrenergic blockers may induce gingival bleeding or enlargement as an adverse reaction. Calcium channel blockers are recognized to elicit gingival hyperplasia (overgrowth) in 20–75% of patients, and this hypertrophic gingival tissue is prone to bleeding with instrumentation. Such medication-induced alterations in the gingiva can extend bleeding time during extractions due to tissue friability (Southerland et al., 2016; Valtellini & Ouanounou, 2023).

CONCLUSION

Prolonged post-extraction bleeding may be attributed to elevated mean arterial pressure. Additional contributing factors include patient pharmacotherapy, localized inflammation resulting from periodontal disease in hypertensive patients, and non-compliant post-extraction behaviors. This research offers guidelines for dentists to establish standard mean arterial pressure thresholds (lower than 100) prior to tooth extraction to mitigate the risk of prolonged bleeding (less than 10 minutes).

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