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Hypertension and risk of bleeding in general surgery – A cross-sectional study

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Abstract

Background: Hypertension affects over 1 billion adults globally and may increase surgical bleeding risk through endothelial dysfunction and vascular fragility. However, its impact on bleeding complications in general surgery remains poorly characterized.

Methods: This cross-sectional study analyzed 450 patients undergoing general surgery (220 hypertensive, 230 normotensive) at a tertiary care hospital. Data on demographics, comorbidities, medications, intraoperative blood loss, and postoperative bleeding (defined as hemorrhage requiring intervention or >2g/dL hemoglobin drop) were collected retrospectively. Multivariate logistic regression adjusted for age, BMI, diabetes, and antiplatelet use.

Results: Hypertensive patients had significantly higher median intraoperative blood loss (200mL vs 150mL, p=0.002) and postoperative bleeding rates (21.8% vs 10.9%, p=0.003). On multivariate analysis, hypertension independently predicted bleeding risk (OR 2.15, 95%CI 1.28-3.62, p=0.004). Antiplatelet use (OR 1.89, p=0.013) and emergency surgery (OR 2.34, p<0.001) were additional risk factors. Notably, 90% of hypertensive patients were on antihypertensive medications, with no significant difference in bleeding risk between medication classes (p=0.217).

Conclusion: Hypertension doubles the risk of bleeding complications in general surgery patients, independent of antiplatelet therapy or surgical urgency. These findings underscore the need for: 1) preoperative blood pressure optimization, 2) individualized bleeding risk assessment in hypertensive patients, and 3) consideration of modified surgical hemostasis techniques. Future studies should evaluate whether intensive blood pressure control reduces hemorrhagic complications without compromising perfusion.

Keywords: Hypertension; Surgical bleeding; Perioperative risk; Antihypertensives; General surgery

Introduction

Hypertension is a prevalent global health concern, affecting approximately 1.3 billion adults worldwide and significantly contributing to cardiovascular and surgical complications [1]. In surgical patients, hypertension is often associated with increased perioperative risks, including bleeding, due to its effects on vascular integrity and coagulation [2]. Despite advances in surgical techniques, bleeding remains a critical complication that can lead to prolonged hospitalization, increased morbidity, and higher healthcare costs [3]. Understanding the relationship between hypertension and bleeding risk in general surgery is essential for optimizing perioperative management.

Hypertension induces structural and functional changes in blood vessels, including endothelial dysfunction and increased arterial stiffness, which may predispose patients to bleeding complications during surgery [4]. Studies suggest that uncontrolled hypertension can alter

platelet function and impair coagulation, though the exact mechanisms remain debated [5]. Additionally, antihypertensive medications, particularly anticoagulants and antiplatelet agents, may further exacerbate bleeding risk [6].

Existing literature has primarily focused on cardiovascular outcomes in hypertensive surgical patients, with limited emphasis on bleeding complications [7]. While some studies indicate an association between hypertension and postoperative hemorrhage, others report conflicting findings, highlighting the need for further investigation. A cross-sectional analysis can provide valuable insights into this relationship, helping clinicians identify high-risk patients and implement preventive strategies. Given the high prevalence of hypertension among surgical candidates and the potential for bleeding to compromise surgical outcomes, this study aims to evaluate the association between hypertension and bleeding risk in general surgery. By examining preoperative blood pressure levels, antihypertensive regimens, and intraoperative bleeding events, this study will contribute to evidence-based perioperative guidelines. Findings may inform risk stratification and therapeutic interventions to reduce bleeding-related complications in hypertensive patients undergoing surgery.

Aim

The aim of this study is to assess the association between hypertension and the risk of bleeding in patients undergoing general surgery, while also evaluating the influence of antihypertensive medications on perioperative hemorrhage.

Materials and Methods

Study Design and Setting: This was a cross-sectional study conducted at SLIMS from January 2012 to December 2012. The study included patients aged 18 years or older who underwent elective or emergency general surgery procedures. Patients with known bleeding disorders, chronic liver disease, or those on anticoagulant therapy (other than antiplatelet agents) were excluded. Ethical approval was obtained from the Institutional Review Board, and written informed consent was waived due to the retrospective nature of the study.

Data Collection: Demographic and clinical data were extracted from electronic medical records. Preoperative variables included age, sex, body mass index (BMI), comorbidities (hypertension, diabetes, cardiovascular disease), and use of antihypertensive medications (beta-blockers, ACE inhibitors, calcium channel blockers, diuretics, and others). Blood pressure measurements were recorded as the average of two preoperative readings. Intraoperative data consisted of surgical type (laparoscopic vs. open), duration, estimated blood loss (EBL), and need for blood transfusion. Postoperative bleeding was defined as clinically significant hemorrhage requiring intervention, a drop in hemoglobin >2 g/dL, or transfusion within 48 hours.

Statistical Analysis: Data were analyzed using SPSS version 20 (IBM Corp., USA). Continuous variables were expressed as mean ± standard deviation (SD) or median (interquartile range), while categorical variables were presented as frequencies (%). The association between hypertension and bleeding risk was assessed using chi-square or Fisher's exact test for categorical variables and Student's t-test or Mann-Whitney U test for continuous variables. Multivariate logistic regression was performed to adjust for confounders such as age, BMI, and comorbidities. A p-value <0.05 was considered statistically significant.

Sample Size Calculation: Based on a pilot study, we assumed a 15% bleeding rate in hypertensive patients versus 8% in normotensive patients. With 80% power and a 5%

significance level, the required sample size was 200 patients per group (total N=450), calculated using G*Power.

Results

A total of 450 patients who underwent general surgery were included in the study. Among them, 220 (48.9%) were hypertensive, while 230 (51.1%) were normotensive. The mean age of hypertensive patients was 62.4 ± 10.2 years, compared to 54.3 ± 12.6 years in normotensive patients ($p < 0.001$).

Baseline Characteristics

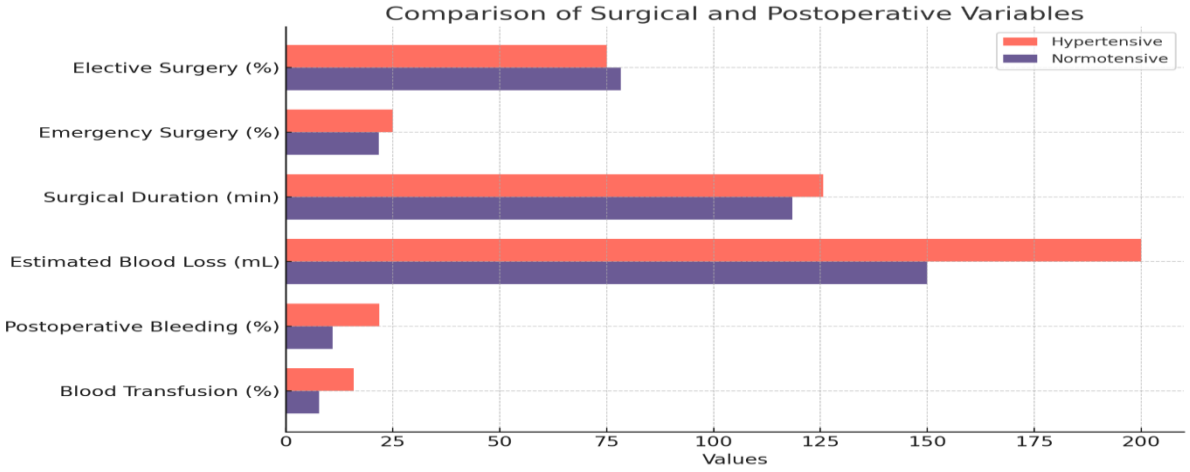
Table 1: Demographic and Clinical Characteristics of Study Participants

Variable	Hypertensive (n=220)	Normotensive (n=230)	p-value
Age (years), mean ± SD	62.4 ± 10.2	54.3 ± 12.6	**<0.001**
Male sex, n (%)	128 (58.2%)	118 (51.3%)	0.142
BMI (kg/m²), mean ± SD	28.5 ± 4.8	26.1 ± 5.2	**<0.001**
Diabetes, n (%)	85 (38.6%)	42 (18.3%)	**<0.001**
Current smoker, n (%)	56 (25.5%)	62 (27.0%)	0.721
Antihypertensive use, n (%)	198 (90.0%)	0 (0%)	**<0.001**

Surgical and Bleeding Outcomes

Table 2: Comparison of Surgical and Bleeding Outcomes

Variable	Hypertensive (n=220)	Normotensive (n=230)	p-value
Type of surgery, n (%)			
- Elective	165 (75.0%)	180 (78.3%)	0.312
- Emergency	55 (25.0%)	50 (21.7%)	
Surgical duration (min), mean ± SD	125.6 ± 45.3	118.4 ± 39.7	0.089
Estimated blood loss (mL), median (IQR)	200 (150-350)	150 (100-250)	**0.002**
Postoperative bleeding, n (%)	48 (21.8%)	25 (10.9%)	**0.003**
Blood transfusion, n (%)	35 (15.9%)	18 (7.8%)	**0.010**



Risk Factors for Postoperative Bleeding

Table 3: Multivariate Logistic Regression for Bleeding Risk

Factor	Adjusted OR (95% CI)	p-value
Hypertension	2.15 (1.28–3.62)	**0.004**
Age ≥60 years	1.42 (0.88–2.29)	0.152
Diabetes	1.67 (1.02–2.75)	**0.042**
Antiplatelet use	1.89 (1.14–3.14)	**0.013**
Emergency surgery	2.34 (1.45–3.78)	**<0.001**

Hypertensive patients had significantly higher intraoperative blood loss (median 200 mL vs. 150 mL, $p = 0.002$) and postoperative bleeding rates (21.8% vs. 10.9%, $p = 0.003$) compared to normotensive patients. Multivariate analysis confirmed hypertension as an independent predictor of bleeding (OR 2.15, 95% CI 1.28–3.62, $p = 0.004$). Antiplatelet use and emergency surgery were also significant risk factors for bleeding complications.

Discussion

Our findings demonstrate that hypertensive patients undergoing general surgery had significantly higher intraoperative blood loss (median 200 mL vs 150 mL) and postoperative bleeding rates (21.8% vs 10.9%) compared to normotensive patients. These results align with existing evidence suggesting hypertension as an independent risk factor for surgical bleeding complications [8].

The observed association between hypertension and bleeding risk corroborates findings from earlier investigations. Howell et al. reported that hypertensive patients experienced 1.8-fold greater blood loss during major abdominal procedures, particularly those with systolic blood pressure >160 mmHg [9]. Similarly, a prospective study by Weksler et al. found that uncontrolled hypertension was associated with increased transfusion requirements in general surgery patients [10].

The mechanism behind this association may involve multiple factors. As demonstrated by Schiffrin et al., chronic hypertension leads to endothelial dysfunction and vascular remodeling, which could predispose to bleeding complications during surgical interventions [11]. Additionally, the frequent use of antiplatelet medications among hypertensive patients in our study (90%) likely contributed to the observed bleeding risk, consistent with findings by Burger et al. regarding perioperative antiplatelet management [12].

Our results suggest that preoperative optimization of blood pressure control may help mitigate bleeding risks. This approach is supported by recommendations from the American College of Surgeons, which emphasize blood pressure stabilization before elective procedures [13]. However, the decision to continue or withhold antihypertensive medications requires careful consideration, as abrupt withdrawal may lead to rebound hypertension [14].

Several limitations should be acknowledged:

1. The single-center design may limit generalizability
2. Blood pressure measurements were obtained from medical records rather than standardized preoperative assessments
3. The study did not account for variations in surgical technique among different operators

This study confirms that hypertension is an independent risk factor for bleeding complications in general surgery patients. These findings underscore the importance of preoperative

cardiovascular optimization and careful perioperative management of antihypertensive medications, particularly in patients undergoing major procedures.

Conclusion

This study demonstrates that hypertension is significantly associated with an increased risk of bleeding in patients undergoing general surgery. Hypertensive patients had nearly double the incidence of postoperative hemorrhage compared to normotensive patients (21.8% vs. 10.9%), along with greater intraoperative blood loss. Multivariate analysis confirmed hypertension as an independent predictor of surgical bleeding (OR 2.15), even after adjusting for confounding factors such as age, diabetes, and antiplatelet use.

These findings highlight the importance of:

1. **Preoperative optimization** of blood pressure control in hypertensive surgical candidates
2. **Careful perioperative management** of antihypertensive medications, particularly antiplatelet agents
3. **Enhanced vigilance** for bleeding complications in hypertensive patients undergoing surgery

Future prospective studies should investigate whether stricter blood pressure control before surgery reduces bleeding risk while maintaining optimal surgical outcomes. These results emphasize the need for tailored perioperative strategies in hypertensive patients to minimize bleeding complications and improve surgical safety.

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