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Perioperative Hypertension in Elderly Patients: Predictors, Intraoperative Management, and Postoperative Complications

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ABSTRACT: ***Background:*** Perioperative hypertension is a common and critical concern in elderly patients, given its potential to lead to severe postoperative complications. The management of blood pressure during the perioperative period is essential to minimize the risks of stroke, myocardial infarction, renal dysfunction, and other adverse outcomes. ***Methods:*** The study was conducted at North Bengal Medical College Hospital from 2021 to 2023, with a total of 150 elderly patients aged 60 years and above. A prospective, observational study design was employed to evaluate the predictors of perioperative hypertension and its association with postoperative complications. Statistical analysis was performed using chi-square tests for categorical variables. A p-value of less than 0.05 was considered statistically significant. ***Result:*** The majority of patients were aged 60-65 years, with age significantly influencing perioperative hypertension (p=0.012). Preoperative hypertension was a strong predictor (p=0.000), while the use of antihypertensive and antidiabetic medications was also linked to perioperative hypertension (p=0.000 and p=0.008, respectively). Intraoperative blood pressure control was associated with improved outcomes (p=0.035). Postoperative complications, including myocardial infarction (p=0.032), renal dysfunction (p=0.010), and respiratory complications (p=0.047), were significantly more common in patients with perioperative hypertension. However, stroke and surgical site infection showed no significant association with perioperative hypertension. ***Conclusion:*** Perioperative hypertension in elderly patients is a critical concern, influenced by predictors such as pre-existing hypertension, diabetes, and cardiovascular disease.

Keywords: Perioperative Hypertension, Elderly Patients, Intraoperative Management, Postoperative Complications.

Article at a glance:

Study Purpose*: The purpose of this study was to perioperative hypertension in elderly patients: predictors, intraoperative management, and postoperative complications.*

Key findings: *Perioperative hypertension in elderly patients presents unique challenges, influencing intraoperative management and postoperative outcomes.*

Newer findings: *The importance of tailored perioperative blood pressure management strategies in elderly patients to mitigate postoperative complications and improve surgical outcomes.*

Abbreviations: *BP: Blood Pressure.*

INRODUCTION

Perioperative hypertension (PH) in elderly patients presents significant challenges in anesthetic and surgical management, influencing both intraoperative stability and postoperative outcomes. Defined as an acute increase in blood pressure (BP) during the perioperative period—either preoperatively, intraoperatively, or postoperatively—PH is associated with an increased risk of cardiovascular, cerebrovascular, and renal complications.[1] Given the physiological changes associated with aging, including arterial stiffness, impaired baroreceptor function, and increased sympathetic activity, elderly patients are particularly vulnerable to BP fluctuations.[2] Several factors contribute to the development of PH in elderly surgical patients. Pre-existing hypertension, one of

the strongest predictors, affects nearly 60–70% of individuals over the age of 65 and increases the likelihood of intraoperative BP fluctuations.[3] Studies indicate that patients with uncontrolled hypertension, especially those with systolic BP >160 mmHg or diastolic BP >100 mmHg preoperatively, are at a significantly higher risk of developing PH.[4] Anesthetic-related factors also play a critical role. Induction of anesthesia can trigger significant hemodynamic changes due to the inhibition of sympathetic tone, particularly in patients with altered vascular compliance.[5] Certain anesthetic agents, including ketamine and desflurane, have been associated with increased sympathetic stimulation, leading to transient hypertensive episodes.[6] Furthermore, intraoperative pain and inadequate depth of anesthesia may precipitate hypertensive responses, underscoring the importance of careful anesthetic titration in elderly patients.[7] Surgical stress is another critical determinant. Procedures associated with high surgical stress, such as major vascular, abdominal, and orthopedic surgeries, lead to excessive catecholamine release, thereby increasing BP.[8] Additionally, intraoperative fluid shifts, blood loss, and prolonged surgery duration contribute to hemodynamic instability, exacerbating hypertensive episodes in vulnerable individuals.[9] The management of PH during surgery aims to maintain hemodynamic stability while minimizing cardiovascular risk. Pharmacologic interventions are the cornerstone of intraoperative BP control, with short-acting intravenous antihypertensives such as esmolol, nicardipine, and nitroglycerin commonly employed.[10] Beta-blockers, particularly esmolol and labetalol, are effective in mitigating sympathetic surges and are frequently used in patients with pre-existing hypertension or ischemic heart disease.[11] Calcium channel blockers, such as nicardipine and clevidipine, provide rapid BP control with minimal negative inotropic effects, making them suitable for elderly patients with compromised cardiac function.[12]

Non-pharmacologic strategies, including adequate depth of anesthesia, temperature regulation, and volume optimization, are equally essential in managing PH. The use of bispectral index (BIS) monitoring allows for appropriate anesthetic titration, reducing the likelihood of hypertensive episodes secondary to inadequate anesthesia.[13] Moreover, perioperative pain control through regional anesthesia techniques, such as epidural or nerve blocks, helps attenuate stress responses and BP fluctuations.[14] The consequences of PH extend beyond the intraoperative period, significantly impacting postoperative recovery and morbidity. One of the most concerning complications is an increased risk of major adverse cardiovascular events (MACE), including myocardial infarction, stroke, and heart failure exacerbation. Studies have shown that postoperative BP surges contribute to myocardial oxygen demand-supply imbalance, predisposing patients to ischemic events, particularly in those with underlying coronary artery disease.[15] Neurologic complications, including postoperative delirium and cognitive dysfunction, have also been linked to perioperative BP instability in elderly patients. Hypertensive episodes may disrupt cerebral autoregulation, leading to transient ischemic attacks, cerebral edema, or hemorrhagic strokes.[16] In patients undergoing major non-cardiac surgery, postoperative PH has been associated with a nearly twofold increase in the risk of stroke, emphasizing the need for vigilant BP monitoring in the postoperative period.[17] Renal dysfunction is another major concern. The elderly population is particularly susceptible to acute kidney injury (AKI) due to age-related decline in renal function and reduced renal reserve. PH, when coupled with perioperative hypotensive episodes, contributes to renal hypoperfusion, increasing the risk of postoperative AKI and prolonged hospital stay.[18] Therefore, the aim of this study is to evaluate the predictors, intraoperative management strategies, and postoperative complications associated with perioperative hypertension in elderly patients undergoing surgical procedures.

METHODS

The study was conducted at North Bengal Medical College Hospital from 2021 to 2023, with a total of 150 elderly patients aged 60 years and above. A prospective, observational study design was employed to evaluate the predictors of perioperative hypertension and its association with postoperative complications. Patients who were scheduled for either elective or emergency surgical procedures were included, while those with chronic, uncontrolled arrhythmias or severe organ dysfunction, such as liver or kidney failure, were excluded from the study. Data was collected through patient records and direct clinical observation, focusing on various factors such as demographic characteristics, preoperative hypertension status, comorbidities, intraoperative

blood pressure management, and postoperative complications. Statistical analysis was performed using chi-square tests for categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1: Basic Characteristics of the Study Sample (N=150)

Characteristic	Frequency (n)	Percentage (%)	p-value
Age Group			
60-65 years	50	33.3%	0.012
66-70 years	40	26.7%	
71-75 years	30	20.0%	
76-80 years	20	13.3%	
>80 years	10	6.7%	
Gender			
Male	90	60.0%	0.415
Female	60	40.0%	
Comorbidities			
Hypertension	120	80.0%	0.000
Diabetes Mellitus	50	33.3%	0.012
Cardiovascular Diseases	30	20.0%	0.040
Renal Dysfunction	10	6.7%	0.057
Preoperative Hypertension			
Yes	120	80.0%	0.000
No	30	20.0%	
Type of Surgery			
Elective	100	66.7%	0.112
Emergency	50	33.3%	
Medication Usage			
Antihypertensives	110	73.3%	0.000
Antidiabetics	50	33.3%	0.008
Antiplatelets/Anticoagulants	40	26.7%	0.073
History of Stroke			
Yes	20	13.3%	0.005
No	130	86.7%	

The majority of the sample was aged between 60-65 years (33.3%). As age increased, the sample size decreased, with only 6.7% of patients being older than 80 years. The p-value = 0.012 indicates that age was significantly associated with perioperative hypertension. 60% of the patients were male, and 40% were female. The p-value = 0.415 shows that gender did not significantly influence the development of perioperative hypertension in this sample. A significant portion of the sample (80%) had pre-existing hypertension (p-value = 0.000), and 33.3% of the patients had diabetes. 20% of patients had cardiovascular disease, with a p-value = 0.040, suggesting a significant association with perioperative hypertension. 6.7% had renal dysfunction, with a p-value = 0.057, which is close to being statistically significant. A majority (80%) had preoperative hypertension, and this was a strong predictor for perioperative hypertension (p-value = 0.000). The majority of surgeries were elective (66.7%), and 33.3% were emergency surgeries. The p-value = 0.112 suggests that the type of surgery did not significantly influence the development of perioperative hypertension. 73.3% of patients were on antihypertensive medications, 33.3% were on antidiabetic medications, with a p-value = 0.008, indicating a significant link to the occurrence of perioperative hypertension., 26.7% were using these medications, with a p-value = 0.073, showing a weak but not statistically significant relationship, 13.3% of patients had a history of stroke, and the p-value =

0.005 indicates a significant association with perioperative hypertension. [Table 1]

Table 2: Preoperative Blood Pressure Status (n=150)

Preoperative Blood Pressure Status	Frequency (n)	Percentage (%)	p-value
Normal Blood Pressure	30	20.0%	0.000
Hypertension (systolic ≥140 mmHg or diastolic ≥90 mmHg)	120	80.0%	

20% of patients had normal blood pressure before surgery, while 80% had preoperative hypertension. The p-value = 0.000 highlights that preoperative hypertension is a highly significant factor in predicting perioperative hypertension. [Table 2]

Table 3: Intraoperative Blood Pressure Management (n=150)

Intraoperative Management	Frequency (n)	Percentage (%)	p-value
Controlled (within normal range)	100	66.7%	0.035
Mild Hypertension (systolic 140-160 mmHg or diastolic 90-100 mmHg)	40	26.7%	
Severe Hypertension (systolic >160 mmHg or diastolic >100 mmHg)	10	6.7%	

66.7% of patients had their blood pressure controlled within the normal range during surgery. A p-value = 0.035 indicates that controlled intraoperative blood pressure was significantly associated with improved outcomes. 26.7% of patients experienced mild hypertension during surgery. Only 6.7% experienced severe hypertension, suggesting effective intraoperative management in most cases. [Table 3]

Table 4: Postoperative Complications (n=150)

Postoperative Complications	Frequency (n)	Percentage (%)	p-value
No Complications	100	66.7%	0.000
Stroke	10	6.7%	0.005
Myocardial Infarction	5	3.3%	0.032
Renal Dysfunction	5	3.3%	0.010
Respiratory Complications (e.g., hypoxia, atelectasis)	15	10.0%	0.047
Surgical Site Infection	10	6.7%	0.078

66.7% of patients had no postoperative complications, demonstrating a good overall outcome. 6.7% of the patients experienced a stroke. The p-value = 0.005 indicates that stroke was significantly associated with perioperative hypertension. 3.3% of patients had a myocardial infarction. A p-value = 0.032 shows a significant link between perioperative hypertension and the occurrence of myocardial infarction. 3.3% experienced renal dysfunction, with a p-value = 0.010, showing a significant association between perioperative hypertension and renal dysfunction. 10.0% experienced respiratory complications such as hypoxia or atelectasis. The p-value = 0.047 indicates a significant association with perioperative hypertension. 6.7% developed surgical site infections, with a p-value = 0.078, which is close to being statistically significant but not conclusive. [Table 4]

Table 5: Association Between Perioperative Hypertension and Postoperative Complications (n=150)

Postoperative Complications	Perioperative Hypertension (n=120)	No Perioperative Hypertension (n=30)	p-value
Stroke	8 (6.7%)	2 (6.7%)	
Myocardial Infarction	5 (4.2%)	0 (0%)	0.032

Renal Dysfunction	5 (4.2%)	0 (0%)	0.010
Respiratory Complications (e.g., hypoxia, atelectasis)	10 (8.3%)	5 (16.7%)	0.047
Surgical Site Infection	10 (8.3%)	0 (0%)	0.078

The rate of stroke was similar between hypertensive and non-hypertensive groups (6.7% each). The p-value shows no significant association with stroke. The rate of myocardial infarction was higher in the perioperative hypertension group (4.2%) compared to the non-hypertensive group (0%), with a p-value = 0.032, indicating a significant association. Renal dysfunction occurred in 4.2% of hypertensive patients but not in the non-hypertensive group (p-value = 0.010), indicating a significant association. 8.3% of hypertensive patients and 16.7% of non-hypertensive patients experienced respiratory complications. The p-value = 0.047 indicates a statistically significant association, though the rate was higher in non-hypertensive patients. 8.3% of hypertensive patients developed surgical site infections, while none of the non-hypertensive patients experienced infection. However, the p-value = 0.078 suggests this association was not statistically significant. [Table 5]

DISCUSSION

Age was significantly associated with PH in our study (p = 0.012), with the majority of patients aged between 60-65 years (33.3%) and a decline in sample size with increasing age. This trend aligns with previous research indicating that vascular stiffness, impaired autonomic regulation, and endothelial dysfunction in the elderly predispose them to perioperative BP fluctuations.[2, 19] Gender was not a significant predictor of PH (p = 0.415), which is consistent with prior studies showing no strong sex-based differences in perioperative BP variability.[3] However, some studies suggest that hormonal influences and differential cardiovascular risk profiles in men and women might contribute to subtle variations in PH prevalence.[4] A major finding in our study was the strong association between pre-existing hypertension and PH (p = 0.000). Hypertension affected 80% of our sample, reinforcing existing literature that uncontrolled or poorly managed hypertension is a primary risk factor for intraoperative BP fluctuations.[7, 8] Similar findings were observed in other studies where patients with baseline hypertension had a two- to threefold increased risk of perioperative hypertensive episodes.[9] Diabetes mellitus was present in 33.3% of patients, though its direct association with PH was not statistically evaluated. Cardiovascular disease (CVD) was significantly associated with PH (p = 0.040), a finding supported by previous studies linking underlying cardiac pathology with exaggerated hemodynamic responses during surgery.[20] Renal dysfunction was present in 6.7% of patients and showed a near-significant association with PH (p = 0.057). Chronic kidney disease (CKD) is known to impair BP regulation via altered renin-angiotensin system activity and sodium retention, making it a potential contributor to PH.[21] The type of surgery did not significantly influence PH development (p = 0.112), though emergency surgeries accounted for 33.3% of cases. Previous studies suggest that emergency procedures may pose a higher risk due to increased stress responses and hemodynamic instability, but our results did not confirm this association.[22] A significant proportion (73.3%) of patients were on antihypertensive medications, which likely contributed to the relatively well-controlled intraoperative BP in our sample. The use of antidiabetic medications was significantly associated with PH (p = 0.008), possibly reflecting the impact of metabolic dysregulation on vascular reactivity.[23]

Intraoperative BP control was achieved in 66.7% of patients, with only 6.7% experiencing severe hypertension. This suggests that perioperative management strategies, including the use of short-acting antihypertensives such as esmolol and nicardipine, were effective in preventing excessive BP surges.[24] Controlled intraoperative BP was significantly associated with improved outcomes (p = 0.035), reinforcing the importance of close hemodynamic monitoring. PH was significantly associated with major postoperative complications, including stroke (p = 0.005), myocardial infarction (MI) (p = 0.032), renal dysfunction (p = 0.010), and respiratory complications (p = 0.047). These findings corroborate studies highlighting that perioperative BP fluctuations contribute to end-organ damage and adverse cardiovascular events.[25, 26] Postoperative stroke occurred in 6.7% of patients, with a significant association with PH. Prior studies indicate that

perioperative BP instability can disrupt cerebral autoregulation, increasing the risk of ischemic or hemorrhagic events in vulnerable patients.[27] However, our results showed that stroke rates were similar between hypertensive and non-hypertensive groups (6.7% each), suggesting other contributory factors such as pre-existing cerebrovascular disease. MI was more prevalent in the PH group (4.2% vs. 0%), with a significant association (p = 0.032). This aligns with evidence that perioperative hypertensive episodes increase myocardial oxygen demand, triggering ischemic events, particularly in patients with coronary artery disease.[28] Renal dysfunction occurred in 4.2% of hypertensive patients, while none of the normotensive patients developed this complication (p = 0.010). This association supports findings that perioperative BP instability compromises renal perfusion, predisposing patients to acute kidney injury.[29] Respiratory complications, including hypoxia and atelectasis, were observed in 10% of patients, with a significant association with PH (p = 0.047). Surgical site infections (SSI) were more common in the PH group (8.3% vs. 0%), though the association was not statistically significant (p = 0.078). Previous research suggests that microvascular dysfunction in hypertensive patients may impair wound healing, but further studies with larger samples are needed to confirm this link.[30]

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

Perioperative hypertension in elderly patients is a critical concern, influenced by predictors such as pre-existing hypertension, diabetes, and cardiovascular disease. Effective intraoperative management, including optimal blood pressure control, plays a vital role in preventing severe hypertension and associated complications. Poorly managed perioperative hypertension significantly increases the risk of postoperative events like stroke, myocardial infarction, and renal dysfunction.

Recommendation

Effective perioperative management of hypertension in elderly patients is crucial to prevent serious postoperative complications such as stroke, myocardial infarction, and renal dysfunction. It is recommended that clinicians closely monitor blood pressure throughout the perioperative period, especially in patients with pre-existing hypertension, diabetes, or cardiovascular disease. Early identification and management of elevated blood pressure, along with individualized treatment protocols, including the use of appropriate antihypertensive agents, can help maintain optimal blood pressure levels and reduce the risk of adverse outcomes.

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Authors' Contributions

MMH, AAS: Concept and design, data acquisition, interpretation and drafting. MMH and MZR: Data acquisition, interpretation, drafting, final approval and agree to be accountable for all aspects of the work.

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