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Relationship between Intraoperative Vasopressor Requirement and Postoperative Complications after Major Abdominal Surgery.

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Abstract

Introduction: Major abdominal surgery is associated with significant perioperative haemodynamic disturbances, with intraoperative hypotension potentially contributing to impaired organ perfusion and postoperative morbidity. Vasopressor requirement may reflect intraoperative physiological instability and may be associated with adverse postoperative outcomes. ***Materials and Methods:*** A prospective observational study was conducted at a tertiary care hospital from January 2025 to December 2025. Fifty adult patients undergoing major abdominal surgery under general anaesthesia were included. Demographic, clinical, operative, and intraoperative haemodynamic parameters were recorded, including mean arterial pressure (MAP), duration of MAP <65 mmHg, blood loss, fluid administration, and vasopressor requirement. Patients were categorized according to intraoperative vasopressor use and followed until hospital discharge for postoperative complications and length of ICU and hospital stay. Statistical analysis was performed using SPSS version 26.0, with $p<0.05$ considered statistically significant. ***Results:*** Among 50 patients, 22 (44.0%) required intraoperative vasopressors, with norepinephrine being the most commonly used agent (81.8%). Patients requiring vasopressors had lower mean MAP (66.9 ± 7.5 vs. 74.6 ± 6.8 mmHg; $p<0.001$) and longer duration of MAP <65 mmHg (24.7 ± 18.6 vs. 8.4 ± 7.2 minutes; $p<0.001$). Postoperative complications occurred in 54.5% of patients requiring vasopressors compared with 14.3% without vasopressor support ($p=0.002$). Acute kidney injury occurred in 22.7% versus 3.6% ($p=0.036$). Hospital and ICU stays were also longer in the vasopressor group (11.3 ± 5.1 vs. 7.1 ± 2.4 days and 3.4 ± 2.1 vs. 1.2 ± 0.7 days, respectively; $p<0.001$). Increasing duration of vasopressor exposure was associated with a progressive increase in postoperative complications ($p<0.001$). ***Conclusion:*** Intraoperative vasopressor requirement was associated with increased postoperative complications, particularly acute kidney injury, and longer ICU and hospital stays. Increasing duration of vasopressor exposure was accompanied by a progressive increase in postoperative complications, emphasizing the importance of vigilant intraoperative haemodynamic monitoring and postoperative surveillance.

Keywords: Intraoperative hypotension; Vasopressors; Major abdominal surgery; Postoperative complications; Haemodynamic instability.

INTRODUCTION

Major abdominal surgery is associated with substantial physiological stress and may result in significant perioperative haemodynamic disturbances [1]. Anaesthesia, blood loss, fluid shifts, surgical manipulation, and inflammatory responses can contribute to hypotension during surgery [2]. Intraoperative hypotension, particularly when prolonged or severe, may compromise perfusion of vital organs and has been associated with adverse postoperative outcomes, including acute kidney injury, myocardial injury, pulmonary complications, prolonged hospitalisation, and increased morbidity [3,4]. Vasopressors are frequently administered during major surgery to maintain adequate arterial pressure when hypotension occurs despite appropriate fluid management [5]. Norepinephrine is commonly used because of its predominant vasoconstrictive effect and ability to restore vascular tone and maintain mean arterial pressure. However, the requirement for vasopressor support may also serve as a marker of greater intraoperative physiological instability, blood loss, or impaired cardiovascular reserve [6]. Therefore, patients requiring vasopressors may represent a population at increased risk of postoperative complications.

The relationship between vasopressor administration and postoperative outcomes is complex [7]. Vasopressor use may be a direct contributor to altered tissue perfusion when administered inappropriately or at high doses, but it may also simply reflect the severity of intraoperative hypotension and underlying surgical illness [8]. Factors such as the duration and

severity of hypotension, duration of vasopressor exposure, blood loss, operative duration, comorbidities, and emergency surgical status may influence postoperative outcomes [9]. Identifying the relationship between intraoperative vasopressor requirement and subsequent complications may therefore help in early risk stratification and postoperative surveillance [10]. Despite the clinical importance of maintaining adequate intraoperative haemodynamics, data from routine major abdominal surgical populations remain limited, particularly regarding the association between the requirement and duration of vasopressor support and postoperative complications. Evaluating this relationship may provide useful information for perioperative risk assessment and postoperative management. Therefore, the present study aimed to evaluate the relationship between intraoperative vasopressor requirement and postoperative complications among patients undergoing major abdominal surgery, and to assess whether the duration of vasopressor exposure was associated with postoperative outcomes.

MATERIALS AND METHODS

This prospective observational study was conducted at a tertiary care hospital from January 2025 to December 2025. A total of 50 adult patients undergoing major abdominal surgery under general anaesthesia were included. Patients aged ≥18 years scheduled for elective or emergency major abdominal surgery were eligible for participation. Patients who underwent minor abdominal procedures, those receiving preoperative vasopressor support, and patients with incomplete intraoperative or postoperative records were excluded from the study. Written informed consent was obtained from all participants before enrolment, and the study was conducted after approval from the Institutional Ethics Committee.

Preoperatively, demographic and clinical characteristics including age, sex, body mass index, American Society of Anesthesiologists (ASA) physical status, relevant comorbidities, type of surgery, and elective or emergency status were recorded. All patients underwent standard preoperative evaluation and received anaesthesia according to institutional protocols. Intraoperatively, standard monitoring including electrocardiography, non-invasive or invasive blood pressure, pulse oximetry, and end-tidal carbon dioxide monitoring was performed. Haemodynamic parameters were recorded throughout the procedure, with particular attention to episodes of mean arterial pressure (MAP) <65 mmHg. The duration of hypotension, estimated blood loss, intravenous fluid administration, duration of surgery, and requirement for intraoperative vasopressor support were documented. The primary exposure variable was the requirement for intraoperative vasopressor support. Patients were categorized into two groups according to whether vasopressors were required during surgery. The type of vasopressor, dose, duration of administration, and indication for initiation were recorded. Norepinephrine was used as the principal vasopressor according to institutional practice, with other agents administered when clinically indicated. Postoperatively, patients were followed until hospital discharge for the occurrence of complications including acute kidney injury, pulmonary complications, surgical-site infection, cardiovascular complications, postoperative ileus, delirium, unplanned ICU admission, need for prolonged mechanical ventilation, re-exploration, and in-hospital mortality. Length of ICU stay and total hospital stay were also documented.

Data were entered into Microsoft Excel and analysed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequency and percentage. The association between intraoperative vasopressor requirement and postoperative complications was assessed using the Chi-square test or Fisher's exact test, as appropriate. Continuous variables between groups were compared using the independent-samples t-test for normally distributed data. The relationship between duration of vasopressor exposure and postoperative complications was additionally assessed for trend. A p-value <0.05 was considered statistically significant.

RESULTS

The study included 50 patients undergoing major abdominal surgery. The mean age was 48.72 ± 13.64 years, with the majority belonging to the 40–59-year age group (46.0%). Males constituted 62.0% of the study population. Most patients had a BMI of 18.5–24.9 kg/m² (42.0%), followed by 25.0–29.9 kg/m² (36.0%). ASA physical status II was most frequent (50.0%), followed by ASA III (30.0%). (Table 1)

Table 1. Baseline Demographic Characteristics of the Study Participants

Variable	Number (N=50)	Percentage
Age (years)		
18–39	14	28.0%
40–59	23	46.0%
≥60	13	26.0%
Mean age ± SD (years)	**48.72 ± 13.64**	
Sex		
Male	31	62.0%
Female	19	38.0%

BMI (kg/m²)		
<18.5	3	6.0%
18.5–24.9	21	42.0%
25.0–29.9	18	36.0%
≥30	8	16.0%
ASA physical status		
I	10	20.0%
II	25	50.0%
III	15	30.0%

Gastrointestinal procedures were the most common type of surgery (36.0%), followed by hepatobiliary (24.0%) and colorectal procedures (20.0%). Most surgeries lasted 2–4 hours (54.0%), while 22.0% lasted more than 4 hours. Elective procedures accounted for 78.0% of cases and emergency procedures for 22.0%. Intraoperative blood loss was <500 mL in 58.0% of patients, and the mean duration of surgery was 3.18 ± 1.24 hours. (Table 2)

Table 2. Clinical and Operative Characteristics of the Study Participants

Variable	Number (N=50)	Percentage
Type of surgery		
Gastrointestinal surgery	18	36.0%
Hepatobiliary surgery	12	24.0%
Colorectal surgery	10	20.0%
Urological surgery	6	12.0%
Other major abdominal surgery	4	8.0%
Duration of surgery		
≤2 hours	12	24.0%
2–4 hours	27	54.0%
>4 hours	11	22.0%
Emergency surgery	11	22.0%
Elective surgery	39	78.0%
General anaesthesia	50	100.0%
Intraoperative blood loss		
<500 mL	29	58.0%
500–1000 mL	14	28.0%
>1000 mL	7	14.0%
Mean duration of surgery ± SD (hours)	**3.18 ± 1.24**	

Intraoperative vasopressor support was required in 22 (44.0%) patients, while 28 (56.0%) did not require vasopressors. Among those receiving vasopressors, norepinephrine was the most commonly used agent (81.8%). Vasopressor administration lasted 30–60 minutes in 40.9% of patients, with a mean duration of 52.6 ± 31.4 minutes. (Table 3)

Table 3. Intraoperative Vasopressor Requirement among Study Participants

Vasopressor requirement	Number (N=50)	Percentage
No vasopressor required	28	56.0%
Vasopressor required	22	44.0%
Type of vasopressor among patients requiring vasopressor (n=22)		
Norepinephrine	18	81.8%
Phenylephrine	3	13.6%
Vasopressin	1	4.5%
Duration of vasopressor use among exposed patients		
<30 minutes	7	31.8%
30–60 minutes	9	40.9%
>60 minutes	6	27.3%
Mean duration of vasopressor use ± SD (minutes)	**52.6 ± 31.4**	

Patients requiring vasopressor support had a lower mean intraoperative MAP than those who did not require vasopressors (66.9 ± 7.5 vs. 74.6 ± 6.8 mmHg; p<0.001). MAP <65 mmHg was observed in 68.2% of patients requiring vasopressors compared with 17.9% without vasopressor support (p<0.001). Vasopressor-requiring patients also had greater blood loss and longer operative duration. (Table 4)

Table 4. Intraoperative Hemodynamic Characteristics According to Vasopressor Requirement

Parameter	No vasopressor (n=28)	Vasopressor required (n=22)	p-value
Mean MAP (mmHg)	74.6 ± 6.8	66.9 ± 7.5	<0.001
MAP <65 mmHg, n (%)	5 (17.9%)	15 (68.2%)	<0.001
Duration of MAP <65 mmHg (minutes)	8.4 ± 7.2	24.7 ± 18.6	<0.001
Mean intraoperative heart rate (beats/min)	78.5 ± 10.2	84.3 ± 12.1	0.072
Estimated blood loss (mL)	386 ± 214	642 ± 351	0.002
Duration of surgery (hours)	2.78 ± 0.86	3.69 ± 1.42	0.006
Intraoperative fluid administration (mL)	2650 ± 840	3190 ± 1050	0.049

Overall, 16 (32.0%) patients developed at least one postoperative complication. Acute kidney injury and postoperative ileus each occurred in 10.0% of patients, while pulmonary complications and unplanned ICU admission occurred in 10.0% each. Surgical-site infection and cardiovascular complications were observed in 8.0% each, and in-hospital mortality occurred in 4.0% of patients. (Table 5)

Table 5. Incidence of Postoperative Complications

Postoperative complication	Number (N=50)	Percentage
Any postoperative complication	16	32.0%
Acute kidney injury	6	12.0%
Pulmonary complications	5	10.0%
Surgical-site infection	4	8.0%
Cardiovascular complications	4	8.0%
Postoperative ileus	5	10.0%
Delirium	3	6.0%
Unplanned ICU admission	5	10.0%
Re-exploration	2	4.0%
In-hospital mortality	2	4.0%

Postoperative complications occurred in 12 (54.5%) patients who required intraoperative vasopressors compared with 4 (14.3%) patients who did not require vasopressors. This association was statistically significant (χ^2=9.18, p=0.002), indicating a higher proportion of postoperative complications among patients receiving intraoperative vasopressor support. (Table 6)

Table 6. Association Between Intraoperative Vasopressor Requirement and Postoperative Complications

Intraoperative vasopressor requirement	Postoperative complication Present, n (%)	Postoperative complication Absent, n (%)	Chi-square	p-value
No vasopressor (n=28)	4 (14.3%)	24 (85.7%)	9.18	0.002
Vasopressor required (n=22)	12 (54.5%)	10 (45.5%)		
Total (N=50)	**16 (32.0%)**	**34 (68.0%)**		

Acute kidney injury occurred in 22.7% of patients requiring vasopressors compared with 3.6% of those without vasopressor exposure (p=0.036). Delirium was also more frequent in the vasopressor group (13.6% vs. 0.0%; p=0.044). Other complications, including pulmonary complications, surgical-site infection, cardiovascular complications, ileus, unplanned ICU admission, re-exploration, and mortality, were numerically more frequent among patients requiring vasopressors, although the differences were not statistically significant. (Table 7)

Table 7. Individual Postoperative Complications According to Intraoperative Vasopressor Requirement

Postoperative complication	No vasopressor (n=28), n (%)	Vasopressor required (n=22), n (%)	Chi-square	p-value
Acute kidney injury	1 (3.6%)	5 (22.7%)	4.42	0.036
Pulmonary complications	1 (3.6%)	4 (18.2%)	3.07	0.080
Surgical-site infection	1 (3.6%)	3 (13.6%)	1.89	0.169
Cardiovascular complications	1 (3.6%)	3 (13.6%)	1.89	0.169
Postoperative ileus	1 (3.6%)	4 (18.2%)	3.07	0.080
Delirium	0 (0.0%)	3 (13.6%)	4.06	0.044
Unplanned ICU admission	1 (3.6%)	4 (18.2%)	3.07	0.080
Re-exploration	0 (0.0%)	2 (9.1%)	2.67	0.102
In-hospital mortality	0 (0.0%)	2 (9.1%)	2.67	0.102

Patients requiring intraoperative vasopressors had a longer mean hospital stay than those without vasopressor exposure (11.3 ± 5.1 vs. 7.1 ± 2.4 days; p<0.001). Mean ICU stay was also longer among vasopressor-exposed patients (3.4 ± 2.1 vs. 1.2 ± 0.7 days; p<0.001). Unplanned ICU admission and prolonged mechanical ventilation were more frequent in the vasopressor group, while in-hospital mortality occurred only among patients who received vasopressors. (Table 8)

Table 8. Postoperative Outcomes According to Intraoperative Vasopressor Requirement

Outcome	No vasopressor (n=28)	Vasopressor required (n=22)	p-value
Length of hospital stay (days), mean ± SD	7.1 ± 2.4	11.3 ± 5.1	<0.001
ICU stay (days), mean ± SD	1.2 ± 0.7	3.4 ± 2.1	<0.001
Unplanned ICU admission, n (%)	1 (3.6%)	4 (18.2%)	0.080
Mechanical ventilation >24 h, n (%)	1 (3.6%)	4 (18.2%)	0.080
In-hospital mortality, n (%)	0 (0.0%)	2 (9.1%)	0.102

A progressive increase in postoperative complications was observed with increasing duration of vasopressor exposure. Complications occurred in 28.6% of patients receiving vasopressors for <30 minutes, 44.4% of those receiving them for 30–60 minutes, and 100.0% of those with exposure >60 minutes, compared with 14.3% among patients who did not require vasopressors. The trend was statistically significant (p<0.001). (Table 9)

Table 9. Association Between Duration of Intraoperative Vasopressor Requirement and Postoperative Complications

Vasopressor exposure	Postoperative complication, n (%)	No complication, n (%)	p-value
No vasopressor (n=28)	4 (14.3%)	24 (85.7%)	
<30 min (n=7)	2 (28.6%)	5 (71.4%)	
30–60 min (n=9)	4 (44.4%)	5 (55.6%)	
>60 min (n=6)	6 (100.0%)	0 (0.0%)	**<0.001**

DISCUSSION

In the present study, intraoperative vasopressor support was required in 44.0% of patients undergoing major abdominal surgery, and patients requiring vasopressors demonstrated greater intraoperative haemodynamic instability, including a lower mean MAP and a greater duration of MAP <65 mmHg. These findings are consistent with the established relationship between intraoperative hypotension and adverse postoperative outcomes. Sun et al., in a cohort of 5,127 patients undergoing noncardiac surgery, demonstrated a graded association between prolonged hypotension and postoperative acute kidney injury (AKI), particularly with MAP <60 and <55 mmHg [11]. Similarly, a systematic review found that MAP <65 mmHg for more than 5 minutes was the most frequently reported threshold associated with postoperative AKI, with greater severity and duration of hypotension generally associated with increasing risk [12].

A major finding of the present study was the significantly higher incidence of postoperative complications among patients who received intraoperative vasopressors, with complications occurring in 54.5% of the vasopressor group compared with 14.3% of the non-vasopressor group. AKI was particularly more frequent among patients requiring vasopressors. These findings are in agreement with the large retrospective analysis by Sun et al., in which intraoperative hypotension was independently associated with postoperative AKI [11]. More recently, a retrospective cohort study involving 38,338 noncardiac surgical patients found that both the area under MAP 65 mmHg and cumulative intraoperative norepinephrine dose were independently associated with postoperative AKI, supporting the importance of considering both hypotension and vasopressor exposure when evaluating postoperative renal risk [13].

The present study also demonstrated a progressive increase in postoperative complications with increasing duration of vasopressor exposure. Complications were observed in 28.6% of patients exposed for <30 minutes, 44.4% of those exposed for 30–60 minutes, and 100.0% of those exposed for >60 minutes. This pattern is consistent with evidence suggesting that the duration and severity of intraoperative haemodynamic disturbance are important determinants of postoperative risk. A multicentre cohort study reported that greater cumulative exposure to MAP below 65 mmHg was independently associated with AKI, while a meta-analysis of 14 cohort studies found that intraoperative hypotension was associated with increased risks of AKI, major adverse cardiac events, and 30-day mortality [14,15]. However, vasopressor requirement should not necessarily be interpreted as a direct cause of complications, because patients requiring vasopressors may have greater blood loss, longer operations, more severe hypotension, or greater underlying physiological instability.

The longer postoperative hospital and ICU stays observed among patients requiring vasopressors in the present study are also consistent with previous evidence linking perioperative haemodynamic disturbances with increased postoperative resource utilization. A systematic review and meta-analysis of 26 studies involving 5,561 patients undergoing major abdominal surgery found that perioperative vasoactive-drug strategies were associated with fewer postoperative complications and a reduction in hospital length of stay, although the authors highlighted heterogeneity and limitations in

the available evidence [16]. Importantly, a recent randomized trial in high-risk patients undergoing major abdominal surgery found that early norepinephrine administration reduced intraoperative hypotension and the overall incidence of postoperative complications compared with an ephedrine-based strategy [17]. Taken together, these findings indicate that the clinical significance of vasopressor therapy depends on the underlying haemodynamic context, and that appropriately used vasopressors to prevent or promptly treat hypotension may have a different relationship with outcomes than vasopressor requirement occurring in the setting of prolonged hypotension and major physiological stress.

CONCLUSION

In patients undergoing major abdominal surgery, intraoperative vasopressor requirement was associated with a higher incidence of postoperative complications, particularly acute kidney injury, as well as longer ICU and hospital stays. Increasing duration of vasopressor exposure was accompanied by a progressive increase in postoperative complications. These findings highlight the importance of careful intraoperative haemodynamic monitoring, prompt recognition and management of hypotension, and close postoperative surveillance of patients requiring vasopressor support.

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