

## Anesthesia-related Complications in General Surgery: Strategies for Prevention and Management

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DOI: <https://doi.org/10.36347/sjams.2024.v12i09.012>

| Received: 13.08.2024 | Accepted: 19.09.2024 | Published: 22.09.2024

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### Abstract

### Original Research Article

**Background:** Anesthesia-related complications in general surgery remain a significant concern despite advances in anesthetic techniques. These complications can lead to increased morbidity and mortality if not effectively managed. This study aimed to evaluate the incidence, prevention, and management of anesthesia-related complications in a tertiary care hospital in Bangladesh. **Methods:** A prospective observational study was conducted on 60 patients who underwent general surgery at the Department of Anesthesia, Analgesia, and Intensive Care Medicine, BSMMU, Dhaka, from 2022 to 2023. Demographic data, anesthesia-related complications, preventive measures, and management strategies were recorded and analyzed. **Results:** Cardiovascular complications were the most common, with hypotension in 11.7% and arrhythmias in 6.7% of patients. Respiratory complications, including hypoxemia and bronchospasm, occurred in 13.3% and 5% of cases, respectively. Neurological complications, such as postoperative delirium, were observed in 10% of patients. Preventive strategies, including fluid preloading, bronchodilators, and antiemetic prophylaxis, were effective in reducing the incidence of complications. All cases of hypotension, hypoxemia, postoperative nausea and vomiting (PONV), and arrhythmias were successfully managed with standard interventions, achieving a 100% success rate. **Conclusion:** This study demonstrates that anesthesia-related complications can be effectively managed through vigilant perioperative care and established management protocols. Cardiovascular and respiratory complications were the most common, and prompt interventions such as fluid resuscitation, oxygen therapy, and pharmacological treatment ensured favorable outcomes. Future studies with larger sample sizes and multicenter settings are recommended to further validate these findings and optimize anesthesia practices in diverse healthcare environments.

**Key words:** Anesthesia, general surgery, complications, prevention, perioperative care.

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## INTRODUCTION

Anesthesia-related complications are a significant concern in modern surgical practice, particularly in general surgery where patients may have diverse comorbidities and varying degrees of surgical complexity [1]. Despite advances in anesthesia techniques and monitoring, the perioperative period remains risky and can lead to morbidity and mortality if not managed properly [2]. Preventing, recognizing, and treating anesthesia-related complications is essential for improving patient outcomes and reducing perioperative risks [3].

Anesthesia involves administering drugs to induce reversible unconsciousness, muscle relaxation, and analgesia [4]. However these drugs can have profound physiological impacts, affecting the cardiovascular, respiratory, and neurological systems [5]. In general surgery patients are exposed to either general or regional anesthesia depending on the type and duration of the procedure [6]. The risks associated with anesthesia are influenced by patient-specific factors such as age and comorbidities, surgical complexity, and the type of anesthetic agents used [7]. Therefore effective strategies to prevent and manage these complications are essential for ensuring patient safety.

**Citation:** Mahmud-Un-Nabi, A.H.M Mostak Anwar, Taj Uddin Ahmed, Md. Sumsuzzaman, Ismot Ara, Monowara Begum. Anesthesia-related Complications in General Surgery: Strategies for Prevention and Management. Sch J App Med Sci, 2024 Sep 12(9): 1187-1192.

Complications during anesthesia arise from a combination of patient-specific, surgical, and anesthesia-related factors [8]. Cardiovascular, respiratory, and neurological complications are the most common and can occur during any stage of anesthesia, from induction and maintenance to recovery [9]. Cardiovascular complications, such as hypotension, arrhythmias, and myocardial ischemia, are frequent during anesthesia [10]. These issues are often due to the hemodynamic effects of anesthetic drugs, blood loss, or preexisting cardiovascular conditions [11]. Hypotension commonly caused by vasodilatory effects of anesthesia, blood loss, or dehydration, can lead to inadequate organ perfusion, resulting in renal failure or myocardial infarction if not managed properly [12]. Arrhythmias often triggered by electrolyte imbalances or hypoxia, require immediate pharmacological intervention to prevent further complications [13].

Respiratory complications including hypoxemia, aspiration, bronchospasm, and airway obstruction, are also significant concerns, particularly in patients with underlying respiratory conditions or those undergoing lengthy surgeries [14]. Hypoxemia or low blood oxygen levels, is one of the most common respiratory issues during anesthesia and can result from inadequate ventilation or airway obstruction. Aspiration of gastric contents can lead to severe respiratory distress and pneumonia, underscoring the importance of effective airway management during anesthesia [15]. Bronchospasm, a sudden narrowing of the airways, can be life-threatening, especially in patients with asthma or allergic reactions.

Neurological complications, though less frequent, pose serious risks. Postoperative delirium, an acute state of confusion, is more common in elderly patients and those with cognitive impairments [16]. This condition can be triggered by anesthesia, pain, or surgical stress and can significantly affect patient recovery [17,18]. Nerve injuries often caused by improper patient positioning or regional anesthesia techniques, also require timely management to avoid long-term disability.

Postoperative care in the Post-Anesthesia Care Unit (PACU) is critical, as many anesthesia-related complications, such as respiratory depression or cardiovascular instability, can manifest during recovery [19]. Vigilant monitoring and prompt intervention in this phase ensure a smooth transition from anesthesia to full consciousness and recovery [20].

In Bangladesh, the rising number of complex surgeries and the prevalence of comorbid conditions like hypertension, diabetes, and respiratory diseases highlight the need for improved management of anesthesia-related complications. In resource-limited settings, implementing standardized protocols and cost-effective preventive measures is crucial for enhancing surgical outcomes.

This study evaluated the incidence of anesthesia-related complications in general surgery patients at a tertiary care hospital in Bangladesh, focusing on identifying common complications, preventive measures, and management effectiveness. These findings aimed to improve perioperative care and patient safety in similar settings.

## METHODOLOGY & MATERIALS

This prospective observational study was conducted at the Department of Anaesthesia, Analgesia, and Intensive Care Medicine, BSMMU, Dhaka, Bangladesh, over a 1-year period from 2022 to 2023. A total of 60 patients undergoing general surgical procedures were included based on specific criteria: adults aged 18 years and above, ASA classification I-III, and undergoing elective or emergency surgery under general or regional anesthesia. Patients with ASA classification IV or above, a history of malignant hyperthermia, or significant cognitive impairments were excluded. Data collection involved structured observation checklists and patient records, documenting demographic details, preoperative assessments, intraoperative parameters, and postoperative complications. Anesthesia was standardized according to departmental protocols, including the use of induction agents like propofol or etomidate, maintenance with inhalational or intravenous agents, and continuous monitoring of vital signs. Postoperatively, patients were monitored in the Post-Anesthesia Care Unit (PACU) for complications such as hypotension, hypoxemia, and PONV. Preventive measures and management strategies were recorded, and data analysis was performed using SPSS version 25.0, with descriptive statistics and significance tests applied to evaluate the incidence and outcomes of anesthesia-related complications. Ethical approval was obtained from the Institutional Ethics Committee, and informed consent was secured from all participants.

## RESULTS

**Table 1: Demographic Characteristics of the Study Population (N = 60)**

Variable	Number of Patients	Percentage (%)
<b>Age (years)</b>		
- 18-30	12	20.0
- 31-50	26	43.3
- 51-70	15	25.0
- 71+	7	11.7

<b>Gender</b>		
- Male	38	63.3
- Female	22	36.7
<b>ASA Classification</b>		
- I (Healthy)	14	23.3
- II (Mild systemic disease)	28	46.7
- III (Severe systemic disease)	18	30.0

Table 1 provides a summary of the key demographic variables for the patients involved in the study. The age distribution of the study population reveals that the majority of patients (43.3%) were between 31-50 years old, followed by 25% aged 51-70 years, 20% aged 18-30 years, and 11.7% aged 71 years or older. In terms of gender, 63.3% of the participants were male (38 patients), while 36.7% were female (22

patients), indicating a higher proportion of male patients in the study. The American Society of Anesthesiologists (ASA) classification, which assesses the physical status and preoperative health of patients, shows that the largest group (46.7%) had mild systemic disease (ASA II), 30% had severe systemic disease (ASA III), and 23.3% were classified as healthy (ASA I).

**Table 2: Incidence of Anesthesia-related Complications (N = 60)**

<b>Complication</b>	<b>Number of Cases</b>	<b>Percentage (%)</b>
<b>Cardiovascular Complications</b>		
- Hypotension	7	11.7
- Hypertension	6	10.0
- Arrhythmias	4	6.7
- Myocardial Ischemia	2	3.3
<b>Respiratory Complications</b>		
- Hypoxemia	8	13.3
- Bronchospasm	3	5.0
- Aspiration	2	3.3
<b>Neurological Complications</b>		
- Postoperative Delirium	6	10.0
- Nerve Injury	2	3.3
Allergic Reactions	2	3.3
PONV (Postoperative Nausea and Vomiting)	10	16.7
Malignant Hyperthermia	0	0

Table 2 illustrates the occurrence of various complications among the study population during or after anesthesia. The cardiovascular complications recorded include hypotension, which occurred in 11.7% of patients, followed by hypertension in 10%, arrhythmias in 6.7%, and myocardial ischemia in 3.3%. These data suggest that cardiovascular issues were relatively common, with hypotension being the most frequent complication. Respiratory complications were also observed, with hypoxemia affecting 13.3% of patients, making it the most common respiratory issue. Bronchospasm was reported in 5% of cases, and aspiration occurred in 3.3% of patients, indicating the

importance of vigilant respiratory monitoring. Neurological complications included postoperative delirium in 10% of patients, and nerve injury occurred in 3.3%. These complications, though less frequent, can have significant long-term impacts on recovery and quality of life. Other complications included allergic reactions, seen in 3.3% of patients, and postoperative nausea and vomiting (PONV), which was the most frequent complication overall, affecting 16.7% of the study population. Notably, there were no cases of malignant hyperthermia, a rare but life-threatening condition.

**Table 3: Preventive Measures and Their Effectiveness (N = 60)**

<b>Complication</b>	<b>Preventive Strategy</b>	<b>Number of Cases</b>	<b>Percentage (%)</b>
Hypotension	Fluid preloading, vasopressors	7	11.7
Hypoxemia	Oxygen therapy, mechanical ventilation	8	13.3
PONV	Antiemetic prophylaxis	10	16.7
Arrhythmias	Electrolyte correction, beta-blockers	4	6.7
Bronchospasm	Bronchodilators, preoperative asthma control	3	5.0

Table 3 highlights the use of preventive strategies to manage anesthesia-related complications. Despite implementing measures like fluid preloading and vasopressors, 11.7% of patients experienced hypotension. Oxygen therapy and mechanical ventilation helped reduce hypoxemia, but it still affected 13.3%. PONV prophylaxis with antiemetics was given, yet

16.7% of patients had postoperative nausea and vomiting. Arrhythmias occurred in 6.7% of cases despite electrolyte correction and beta-blockers. Bronchodilators and preoperative asthma control reduced bronchospasm to 5%. Overall, these measures reduced complications but were not completely preventive.

**Table 4: Management of Anesthesia-related Complications**

Complication	Management Strategy	Number of Successfully Managed Cases	Percentage (%)
Hypotension	Fluid resuscitation, vasopressors	7/7	100
Hypoxemia	Mechanical ventilation, supplemental oxygen	8/8	100
Postoperative Delirium	Sedation, reorientation strategies	6/6	100
PONV	Additional antiemetics	10/10	100
Arrhythmias	Pharmacological intervention	4/4	100

Table 4 demonstrates the successful management of all reported anesthesia-related complications in the study population. For hypotension, fluid resuscitation and vasopressors were 100% effective, managing all 7 cases. Similarly, hypoxemia was successfully treated in 8 patients using mechanical ventilation and supplemental oxygen. Postoperative delirium was managed with sedation and reorientation strategies, achieving a 100% success rate in all 6 cases. For PONV (postoperative nausea and vomiting), the use of additional antiemetics resolved symptoms in all 10 affected patients. Finally, arrhythmias were effectively treated using pharmacological interventions, with all 4 cases being successfully managed. Overall, the table shows that the management strategies employed were highly effective, with a 100% success rate for all listed complications.

## DISCUSSION

The management and prevention of anesthesia-related complications in general surgery have long been a subject of critical importance in anesthesiology. In this study, all recorded complications were successfully managed, reflecting the effectiveness of standardized protocols and vigilant perioperative care. These findings align with previous studies, although there are notable differences in complication incidence rates and management strategies across various populations.

Cardiovascular complications such as hypotension, hypertension, and arrhythmias are among the most frequent issues in anesthesia practice. In our study, hypotension occurred in 11.7% of patients, managed effectively using fluid resuscitation and vasopressors. This is comparable to findings by Meng *et al.*, where hypotension affected 12% of patients undergoing general anesthesia, primarily attributed to the vasodilatory effects of anesthetic agents and blood loss during surgery. Their study also noted that aggressive fluid management and the use of vasopressors such as ephedrine and phenylephrine were effective in restoring

blood pressure in most cases, with a similar success rate of 100% [16].

Arrhythmias, another common cardiovascular complication, affected 6.7% of our study population. Pharmacological interventions such as beta-blockers and antiarrhythmic agents successfully managed all cases. Similarly, Kheterpal *et al.*, reported a 7% incidence of perioperative arrhythmias in patients undergoing major surgery, emphasizing the role of electrolyte imbalances, hypoxia, and anesthetic agents in triggering arrhythmias [18]. Their study highlighted the importance of preoperative electrolyte correction and intraoperative monitoring, both of which contributed to the successful management of arrhythmias. They reported an 85% success rate with pharmacological management, slightly lower than the 100% success rate observed in our study, possibly due to differences in patient comorbidities or the complexity of surgeries performed.

The incidence of hypoxemia in our study was 13.3%, and all cases were successfully managed with mechanical ventilation and supplemental oxygen. Dabbagh *et al.*, reported a similar incidence of hypoxemia (14%) in their study on respiratory complications in anesthesia [15]. Their findings stressed the importance of early detection and prompt intervention through oxygen supplementation and ventilatory support, especially in high-risk patients such as those with preexisting respiratory conditions. While their success rate in managing hypoxemia was also high (97%), the small percentage of patients who did not respond well to initial interventions required prolonged mechanical ventilation postoperatively, a situation not encountered in our study.

Postoperative nausea and vomiting (PONV) remains one of the most common complications following anesthesia, affecting 16.7% of patients in our study. All cases were successfully managed with the administration of additional antiemetics. According to Martin *et al.*, the incidence of PONV varies widely

between 10% and 30%, depending on risk factors such as patient history, type of surgery, and anesthetic agents used [20]. Their research indicated that multimodal antiemetic prophylaxis, including the use of serotonin antagonists and corticosteroids, reduced the incidence of PONV by over 70%, with a management success rate similar to ours. However, they noted that a small percentage of patients, particularly those with a history of motion sickness or prior PONV, required repeated doses of antiemetics or different classes of drugs to achieve full symptom relief. In our study, a single additional dose of antiemetics was sufficient to manage all cases, likely due to the routine use of prophylactic antiemetics in high-risk patients.

Postoperative delirium, a common neurological complication, occurred in 10% of our patients. All cases were managed successfully with sedation and reorientation strategies. O'Neill *et al.*, reported a similar incidence of 9% in their study on postoperative delirium in older adults, with higher rates seen in elderly patients and those with preexisting cognitive impairment [19]. Their findings supported the use of non-pharmacological interventions, such as reorientation techniques and environmental modification, to manage delirium. They also recommended the judicious use of sedatives, particularly in elderly patients, to minimize the risk of prolonged cognitive dysfunction. While their study reported a slightly lower management success rate (95%), this could be attributed to the older population they studied, where underlying cognitive decline complicates the resolution of delirium.

Interestingly, we observed no cases of malignant hyperthermia, a rare but potentially fatal complication associated with certain anesthetic agents. This is consistent with the findings of Rosenberg *et al.*, who noted that while malignant hyperthermia remains a serious risk, its incidence is very low, occurring in approximately 1 in 100,000 anesthetic administrations [21]. They emphasized the importance of preoperative screening for risk factors, such as a family history of malignant hyperthermia, and the availability of dantrolene, a specific treatment for the condition. The absence of malignant hyperthermia in our study may be due to effective preoperative screening and the use of safe anesthetic agents.

Bronchospasm was reported in 5% of patients, all of whom were managed with bronchodilators and preoperative control of asthma or other respiratory conditions. This aligns with findings from Shankar *et al.*, who reported a 4.5% incidence of bronchospasm in a similar patient population [10]. Their study underscored the importance of preoperative optimization of patients with reactive airway diseases, as well as the use of bronchodilators during the perioperative period to prevent and manage bronchospasm. Like in our study, all cases in their research were successfully managed with

these interventions, further supporting the effectiveness of this approach.

Overall, our study demonstrates the effectiveness of current management strategies for anesthesia-related complications in general surgery. The high success rates observed are consistent with those reported in other studies, indicating that well-established protocols and vigilant perioperative care significantly reduce the morbidity associated with anesthesia.

### Limitations of the study

This study has several limitations that must be acknowledged. First, the relatively small sample size may limit the generalizability of the findings to broader populations. Larger studies would provide more robust data on the incidence and management of anesthesia-related complications. Additionally, this study was conducted in a single tertiary care hospital in Bangladesh, which may not fully represent the diversity of practices and outcomes in other healthcare settings. Another limitation is the short duration of follow-up, which primarily focused on perioperative complications, potentially overlooking long-term effects of anesthesia.

### Recommendations

Future research should focus on multicenter studies with larger sample sizes to enhance the generalizability of the findings and provide a more comprehensive understanding of anesthesia-related complications. There is also a need for longer-term follow-up studies to assess the impact of anesthesia on patient recovery and postoperative outcomes over extended periods. Additionally, incorporating newer monitoring technologies, such as depth of anesthesia monitors and advanced hemodynamic monitoring, could further improve early detection and management of complications.

## CONCLUSION

This study demonstrates that the effective management of anesthesia-related complications in general surgery is achievable with vigilant perioperative care and established protocols. Cardiovascular and respiratory complications were the most common, with hypotension, hypoxemia, and postoperative nausea and vomiting being successfully managed using standard interventions. The high success rates observed in managing these complications underscore the importance of early detection and prompt intervention. Despite these positive outcomes, there remains a need for ongoing efforts to reduce the incidence of complications through improved preoperative assessment, intraoperative monitoring, and postoperative care. Expanding research to include larger populations and diverse settings will provide further insights into optimizing patient safety in anesthesia practice.

**Acknowledgment**

I would like to express my sincere gratitude for the invaluable support and cooperation provided by the staff, participants, and my co-authors/colleagues who contributed to this study.

**Financial support and sponsorship:** No funding sources.

**Conflicts of interest;** There are no conflicts of interest.

**Ethical approval:** The study was approved by the Institutional Ethics Committee.

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