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Management and monitoring of anesthesia during the perioperative period in a Tertiary Hospital in Bangladesh

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Abstract

Background: Anesthesia management is crucial for ensuring patient safety and optimal surgical outcomes during the perioperative period. In Bangladesh, the challenges faced in managing and monitoring anesthesia in tertiary care hospitals necessitate a comprehensive evaluation of current practices. This study aims to assess the anesthetic management protocols and monitoring strategies employed in a tertiary hospital in Bangladesh.

Methods: This observational study was conducted in Islami Bank Medical College Hospital, Rajshahi, Bangladesh from July to December 2023. Data were collected from patients undergoing various surgical procedures requiring anesthesia. The anesthetic techniques used, intraoperative monitoring parameters, and any complications encountered were recorded. The study included a review of anesthesia charts, patient records, and interviews with anesthesia providers. Statistical analysis was performed to identify trends and correlations.

Results: A total of 200 patients were included in the study. The most commonly used anesthetic technique was general anesthesia (65%), followed by regional anesthesia (30%) and local anesthesia (5%). Intraoperative monitoring parameters included heart rate, blood pressure, oxygen saturation, and end-tidal carbon dioxide levels, which were consistently documented in 95% of cases. Complications occurred in 10% of patients, primarily involving respiratory issues and cardiovascular instability. Proper adherence to monitoring protocols significantly reduced the incidence of complications.

Conclusion: Effective management and monitoring of anesthesia during the perioperative period are vital for patient safety in a tertiary hospital setting. The study highlights the importance of standardized protocols and continuous monitoring to minimize complications. Recommendations for improving anesthetic practices include regular training for anesthesia providers and enhancing monitoring infrastructure to ensure optimal patient care.

Keywords: Perioperative monitoring; Intraoperative complications; Postoperative recovery; Anesthesia outcome

1. Introduction

Anesthesia monitoring has been the focus of extensive research and development. The Association of Anesthetists of Great Britain and Ireland (AAGBI) and the American Society of Anesthesiologists (ASA) have established minimum mandatory monitors, including electrocardiography (ECG), noninvasive blood pressure (NIBP), end-tidal CO_2, pulse oximetry, and temperature. These are widely recognized and are now essential components of anesthesia practice [1]. Some patients may require additional invasive monitoring, such as vascular or intracranial pressure (ICP), cardiac

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output (CO), or biochemical parameters. Over the past two decades, an increase in medical litigation and a growing emphasis on patient safety, alongside technological advancements, have heightened the need for enhanced monitoring. Newer perioperative monitoring techniques include depth of anesthesia (DOA) monitoring, goal-directed fluid therapy (GDFT), transesophageal echocardiography (TOE), neurological monitoring, improved alarm systems, and advancements in perioperative pain assessment. However, whether reliance on these newer technologies has actually improved patient outcomes remains a topic of ongoing debate [2].

Anesthesia is administered to millions of patients globally each year, but its direct contribution to perioperative morbidity and mortality is still debated.[3-5] However, it is generally recognized that advancements in anesthetic and surgical methods, along with improved perioperative care, have helped lower mortality rates, especially in developed countries.[6-7] Cardiac complications, such as myocardial infarction, heart failure, myocardial ischemia, and arrhythmias, are the primary causes of death during and immediately after anesthesia.[8-10] As a result, research has concentrated on reducing these incidents and improving cardiovascular monitoring during the perioperative period.[11–14] Furthermore, respiratory issues and moderate hypothermia during surgery are also linked to considerable patient morbidity.[15,16] On the other hand, complications directly related to anesthesia, such as hypoxia, unrecognized esophageal intubation, or the inability to ventilate, are relatively rare.[5,7] These complications are often attributed to technical errors or inadequate monitoring of equipment.[7,17] While the specific anesthesia technique may not significantly impact outcomes,[18] other elements—such as physiological monitoring, staff expertise, and innovations in perioperative management (like perioperative β-blockade, maintaining normothermia, and controlling sympathetic responses)—appear to play a greater role in reducing mortality.[6,19–21] The focus of this review is to provide a summary of the latest standards and recommendations for monitoring and medical management during anesthesia. The key to patient safety during anesthesia is the presence of a well-trained and experienced anesthetist. [7,22] Familiarity with the patient and all relevant technical devices is crucial. Regular observation of both the patient and the monitoring devices is essential to ensure safety. It is unacceptable to have monitoring equipment available but not in use, or to have an anesthetist who lacks experience with the specific monitoring system, procedure, or the patient's condition. Routine checks, including assessing the patient's mucosal color, chest movement, pupil size, and response to pain stimuli, are vital. Additionally, monitoring blood loss and urine output is often necessary, and a stethoscope should always be readily available.

The role of an anesthetist, with their specialized skill and vigilance, is a testament to this ideal, emphasizing the need for constant attention to ensure patient well-being. Effective anesthesia management is vital for safeguarding patient safety and achieving successful surgical outcomes throughout the perioperative period. In Bangladesh, the complexities involved in anesthesia management and monitoring in tertiary care hospitals highlight the need for a thorough review of existing practices. This study seeks to evaluate the anesthesia management protocols and monitoring techniques utilized in a tertiary hospital in Bangladesh.

2. Material and methods

This cross-sectional study was conducted to assess the management and monitoring of anesthesia during the perioperative period at Islami Bank Medical College Hospital, Rajshahi, Bangladesh, over a six-month period from July to December 2023. The study aimed to evaluate the anesthesia techniques, monitoring protocols, and related outcomes in both elective and emergency surgeries. The hospital serves a wide range of patients undergoing various surgical procedures and offers advanced healthcare services. A total of 200 patients, selected through convenience sampling, were included in the study. These patients were scheduled for elective or emergency surgeries and required anesthesia. The sample size was chosen to ensure a comprehensive evaluation of the anesthetic management and monitoring practices in use. Data collection was carried out through a structured questionnaire and a review of medical records. The information gathered included demographic details (age, gender, comorbidities), type of surgery (elective or emergency), anesthesia technique (general, regional, or local), and monitoring parameters during anesthesia (heart rate, blood pressure, oxygen saturation, temperature, and end-tidal CO_2). Additionally, complications during the perioperative period (cardiac, respiratory, or other) and postoperative recovery outcomes were recorded. The anesthesia and surgical teams collected real-time data on the anesthetic techniques, monitoring equipment, and intraoperative conditions of the patients. Ethical approval was obtained from the hospital's Ethical Review Board, and informed consent was secured from all participants. Patient confidentiality was strictly maintained throughout the study. Data analysis was performed using descriptive statistics. Categorical variables, such as the type of anesthesia, monitoring methods, and complications, were summarized using frequencies and percentages. Continuous variables, including age and intraoperative monitoring data, were presented as means with standard deviations. All analyses were conducted using SPSS software (version 25.0).

3. Results

The records of all 200 patients, including 120 men and 80 women, who received anesthesia at day cases service in a hospital. Of these, 55% were ASA physical status I, 30% were ASA physical status II, and 15% were found in status III. Safety outcomes were primarily based on the incidence of complications, while efficacy was evaluated using recovery metrics and patient-reported outcomes, such as satisfaction scores.

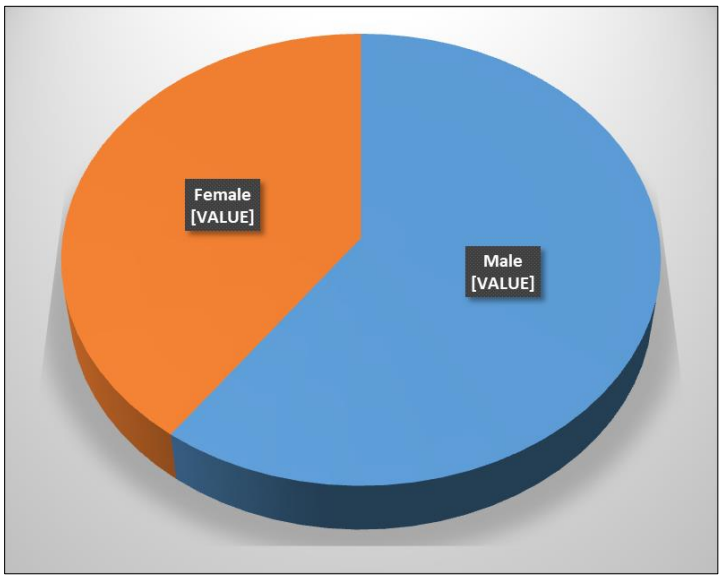

Figure 1 Gender distribution of the study subjects (n=200)

In this sutdy total 200 patients, of which 60% were male (120 patients) and 40% were female (80 patients). This distribution shows a higher proportion of male participants in the study.

Table 1 Demographic Characteristics of Patients (n=200)

Demographic Variable	Frequency (n)	Percentage (%)
Age (years)		
< 20	40	20%
21-40	90	45%
41-60	50	25%
> 60	20	10%
Gender		
Male	120	60%
Female	80	40%
ASA Physical Status		
ASA I	110	55%
ASA II	60	30%
ASA III	30	15%

The demographic distribution shows that the majority of patients (45%) were between 21-40 years of age, followed by 25% aged 41-60, and 20% younger than 20 years. The smallest group consisted of patients over 60, making up 10% of the total sample. In terms of gender, 60% of the patients were male, and 40% were female, indicating a higher

proportion of male participants. Additionally, more than half of the patients (55%) were classified as ASA I, while 30% were ASA II, and 15% were ASA III.

Table 2 Types of Anesthesia Administered (n=200)

Type of Anesthesia	Frequency (n)	Percentage (%)
General Anesthesia (GA)	130	65%
Regional Anesthesia (RA)	50	25%
Local Anesthesia (LA)	20	10%

General anesthesia (GA) was the most commonly used technique, applied to 65% of patients. Regional anesthesia (RA) was used in 25% of cases, while local anesthesia (LA) was administered in 10% of cases.

Table 3 Monitoring Techniques Used During Anesthesia (n=200)

Monitoring Technique	Frequency (n)	Percentage (%)
ECG	200	100%
Pulse Oximetry	200	100%
Blood Pressure (Non-invasive)	200	100%
Capnography	150	75%
Invasive Blood Pressure	50	25%
Heart Rate	200	100%
Blood Pressure	200	100%
Oxygen Saturation	200	100%
End-tidal CO2	150	75%
Temperature Monitoring	180	90%

Standard monitoring techniques were universally applied, with 100% of patients monitored using ECG, pulse oximetry, non-invasive blood pressure, heart rate, and oxygen saturation. Capnography was used in 75% of cases, and temperature monitoring in 90%, while invasive blood pressure monitoring was required for 25% of patients.

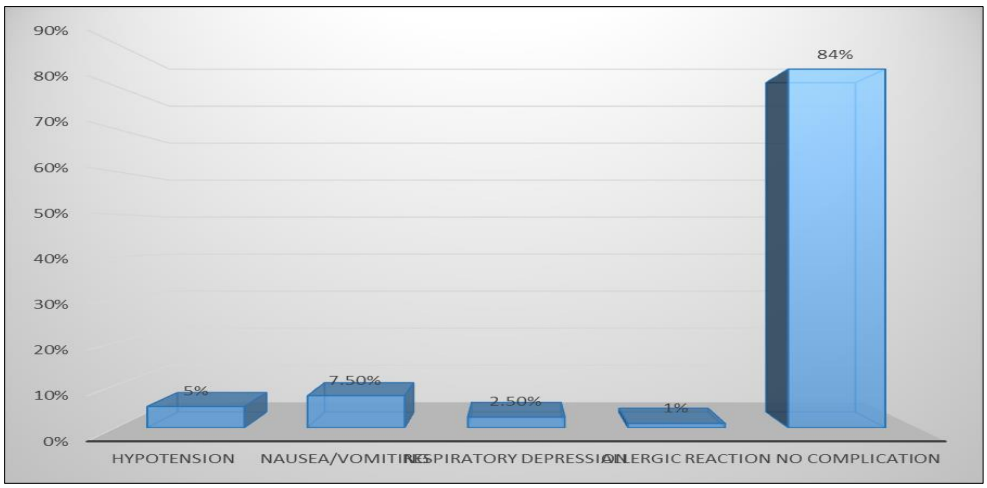

Figure 2 Complications Encountered During Anesthesia (N=200)

This figure shows that anesthesia management in this setting was largely safe and effective, with the majority of patients (84%) having no complications. Among the complications, nausea/vomiting was the most frequent, followed by hypotension, respiratory depression, and allergic reactions, which were rare occurrences.

Table 4 Monitoring Parameters During Anesthesia (N=200)

Monitoring Parameter	Frequency (n)	Percentage (%)
Heart Rate	200	100%
Blood Pressure	200	100%
Oxygen Saturation	200	100%
End-tidal CO2	150	75%

Every patient in the study had heart rate, blood pressure, and oxygen saturation continuously monitored during anesthesia. End-tidal CO_2 was monitored in 75% of patients, indicating that respiratory monitoring was crucial for most cases, though it may not have been necessary for all, depending on the type of anesthesia or surgery.

Table 5 Postoperative Recovery Outcomes (N=200)

Outcome	Frequency (n)	Percentage (%)
Discharged Same Day	150	75%
Overnight Stay	40	20%
Complications Requiring Extended Care	10	5%

The majority of patients (75%) were discharged on the same day of surgery, while 20% required an overnight stay for observation or recovery. Only 5% of patients experienced complications that necessitated extended care.

All procedures were conducted in a hospital setting, within a dedicated procedure room fully equipped with standard American Society of Anesthesiologists (ASA) monitors. These included noninvasive blood pressure monitoring, electrocardiography (ECG), capnography, temperature measurement, and pulse oximetry. An anesthesia machine with a ventilator and a resuscitation cart with a defibrillator were also readily available. Each procedure was attended by a multidisciplinary team, consisting of an anesthesiologist, surgeon, surgical technician, scrub technician, and circulating nurse. Postoperative care was provided in a dedicated post-anesthesia care unit (PACU), staffed by a specialized nurse who monitored patients using ASA-standard equipment until discharge. Additionally, a staff member certified in advanced cardiac life support (ACLS) remained on-site until the last patient had been discharged. Patients were also given a contact number for the anesthesiologist in case of post-discharge complications.

For monitored anesthesia care (MAC), patients were brought to the operating theater (OT), where ASA-standard monitors were applied, and supplemental oxygen was administered via a nasal cannula with sidestream capnography. Sedation was managed with a combination of midazolam, fentanyl, and propofol boluses, followed by a continuous infusion of propofol. Surgeons administered local anesthesia using a 50:50 mixture of 1% lidocaine and 0.5% bupivacaine.

For patients receiving general anesthesia (GA), propofol was administered after premedication with intravenous (IV) midazolam and/or fentanyl. The airway was secured using either a tracheal tube or a laryngeal mask airway (LMA), and total intravenous anesthesia (TIVA) was maintained with propofol infusions, adjusted based on heart rate, blood pressure, and patient movement. None of the patients receiving GA reported any intraoperative awareness.

Regional anesthesia was administered following the placement of an IV cannula and application of ASA-standard monitors. Sedation was provided using IV midazolam (1-4 mg), and the block site was prepared in a sterile manner. Axillary blocks were performed using a transarterial technique with a 23-gauge needle. Other nerve blocks utilized a Stimuplex 21-gauge or 22-gauge insulated needle in conjunction with a peripheral nerve stimulator, ensuring adequate responses to stimulation at less than 0.40 mA. Some regional blocks, including three femoral blocks and one interscalene

block, were administered before GA to provide postoperative analgesia. In the data analysis, cases where regional anesthesia was attempted or administered prior to GA were categorized as general anesthesia cases.

4. Discussion

The gender distribution in this study, as shown in **Figure I,** reveals that 60% of the participants were male (120 patients) and 40% were female (80 patients). This disparity indicates a higher proportion of male patients undergoing surgery at the hospital, which may reflect general trends in healthcare access, the types of surgeries conducted, or cultural factors influencing healthcare utilization among genders in Bangladesh.

The demographic characteristics presented in **Table 1** show that the majority of patients (45%) were between the ages of 21-40 years, followed by 25% in the 41-60 age group, 20% under the age of 20, and 10% over 60 years. This distribution indicates that a significant proportion of patients undergoing surgery are relatively young adults, with a smaller but important proportion of elderly patients who may require special consideration due to higher perioperative risks. Additionally, the American Society of Anesthesiologists (ASA) physical status classification system reveals that 55% of the patients were classified as ASA I, indicating a generally healthy population. However, 30% were ASA II (mild systemic disease) and 15% ASA III (severe systemic disease), indicating a notable proportion of patients with comorbid conditions, which can affect anesthesia management and postoperative outcomes. Recently, there has been a move toward performing more invasive procedures in hospital settings.[23-26] Commonly highlight the safe completion of cosmetic, general surgery, urologic, and ENT (ear, nose, and throat) procedures, using both monitored anesthesia care (MAC) and general anesthesia. These studies confirm that these types of anesthesia can be safely applied in such surgeries. Additionally, there is no reason why regional anesthesia cannot also be safely used in these environments.

This study shows the types of anesthesia administered. General anesthesia (GA) was the most common, used in 65% of cases. Regional anesthesia (RA) was used in 25% of patients, while local anesthesia (LA) was used in only 10% of cases. This high reliance on general anesthesia aligns with the nature of the surgeries being performed, which may require more comprehensive anesthesia coverage. However, the use of regional and local anesthesia in a quarter of cases suggests an effort to minimize the risks associated with GA, particularly in patients with comorbidities or those undergoing less invasive procedures.

General anesthesia involves the administration of a combination of intravenous or inhalation drugs to induce unconsciousness in the patient. It has been associated with a lower incidence of cerebrovascular accidents and shorter anesthesia duration compared to regional anesthesia [27]. On the other hand, regional anesthesia involves injecting a local anesthetic into the epidural or subarachnoid space of the lumbar spine. This technique has been linked to significantly lower early mortality rates and a reduction in complications such as deep vein thrombosis, acute postoperative confusion, myocardial infarction, pneumonia, fatal pulmonary embolism, and postoperative hypoxia [28]. Another similar study found that the majority of RA patients (96%) received continuous spinal anesthesia.[29]

Monitoring is a critical component of patient safety during anesthesia, and demonstrates that universal monitoring of essential parameters such as ECG, pulse oximetry, blood pressure, heart rate, and oxygen saturation was implemented for all patients. This adherence to basic monitoring standards is commendable and necessary for minimizing complications. More advanced monitoring, such as capnography and invasive blood pressure measurement, was used in 75% and 25% of patients, respectively. Capnography, which measures end-tidal CO_2, is especially important for patients under general anesthesia, as it provides real-time feedback on ventilation and helps prevent hypoventilation or hypercapnia. The fact that only 25% of patients required invasive blood pressure monitoring suggests that the majority of surgeries were lower-risk, but the use of this technique in critically ill or high-risk patients underscores its importance in complex cases. Temperature monitoring, employed in 90% of cases, is crucial in preventing perioperative hypothermia, a known cause of increased morbidity. The absence of temperature monitoring in 10% of cases may be an area for improvement, as perioperative hypothermia can contribute to a range of complications, including surgical site infections and impaired wound healing.

Other study shows that the latest advanced anesthesia workstations, such as those from Dräger, offer a new level of efficiency and safety, allowing anesthesiologists to concentrate more on patient care. These workstations come with key features like automatic self-checks, open architecture, and adaptable monitoring systems. They provide continuous monitoring of critical parameters, including exhaled CO_2, oxygen levels, anesthetic gases, pulmonary functions, and various ventilation settings. However, continuous monitoring of all these parameters may not be necessary for every case and should be determined based on availability and the specific patient population. While these features are now integral to modern anesthesia workstations, no clinical trials have been conducted to compare patient outcomes with or without their use.[30] **This study** indicates that complications occurred in a small proportion of patients. Cardiac

and respiratory events are always of concern during anesthesia, but the availability of detailed information on specific complications encountered, and their frequency, would provide more insight into the risk profile of the patient population. The presence of monitoring equipment, as shown, may have helped mitigate the impact of these complications. Some studies have found no link between age and the quality of recovery [31-32]. However, other research has suggested that there is a correlation between age and recovery outcomes [33-34].

In our study postoperative recovery outcomes show that 75% of patients were discharged on the same day of surgery, indicating successful management and monitoring of anesthesia with minimal complications. Meanwhile, 20% of patients required an overnight stay, and 5% experienced complications that required extended care. These figures highlight the effectiveness of anesthesia and surgical protocols in ensuring quick recovery for most patients, but also emphasize the need for careful monitoring of higher-risk patients to prevent complications that could necessitate longer hospital stays.

5. Conclusion

The results of this study underscore the effective use of anesthesia management and monitoring in a tertiary hospital in Bangladesh. The adherence to standard monitoring protocols, particularly for critical parameters such as heart rate, blood pressure, and oxygen saturation, demonstrates a commitment to patient safety. The reliance on general anesthesia for the majority of patients reflects the types of surgeries being performed, while the use of regional and local anesthesia in a significant minority of cases suggests an effort to optimize anesthesia management in lower-risk or less invasive surgeries. Nonetheless, there is room for improvement, particularly in ensuring 100% compliance with temperature monitoring and enhancing the use of advanced monitoring techniques like capnography. The small proportion of complications requiring extended care highlights the need for ongoing vigilance and optimization of perioperative management to further reduce risks, particularly for older or high-risk patients.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declared that they have no conflict of interest.

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Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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