INTRAOPERATIVE CONSCIOUSNESS AND RECALL IN PATIENTS UNDERGOING GENERAL ANESTHESIA: A PROSPECTIVE OBSERVATIONAL ANALYSIS IN A TERTIARY CARE HOSPITAL.

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Abstract

Background: Intraoperative awareness under general anesthesia is a rare but distressing complication with potential long-term psychological consequences. Despite advancements in anesthetic techniques and monitoring, its occurrence remains a concern in clinical practice.

Aim: To determine the incidence of intraoperative awareness and recall, and to identify associated risk factors and outcomes among patients undergoing elective surgeries under general anesthesia.

Methods: This prospective observational study was conducted at a tertiary care center over 18 months from June 2025 to December 2026. A total of 2800 adult patients undergoing elective surgeries under general anesthesia were included. Standardized anesthesia protocols and monitoring were employed. Postoperative assessment of awareness was conducted using a structured interview based on the modified Brice questionnaire at multiple time points. Data were analyzed to determine incidence and associated risk factors.

Results: The incidence of intraoperative awareness was 0.57% (16/2800). Among these, 62.5% reported vague perceptions, while 37.5% experienced vivid recall. Auditory perceptions (56.25%) and sensations of paralysis (37.5%) were the most commonly reported experiences. Prolonged surgery duration (>4 hours) (OR 3.21, $p<0.05$) and use of neuromuscular blocking agents (OR 2.89, $p<0.01$) were significantly associated with increased risk of awareness.

Conclusion: Intraoperative awareness, though infrequent, remains clinically relevant. Identification of high-risk factors and implementation of vigilant anesthetic practices, along with routine postoperative assessment, are essential to minimize its occurrence and improve patient safety.

Keywords: Intraoperative awareness, General anesthesia, Recall, Bispectral Index, Neuromuscular blocking agents, Patient safety

Introduction:

Intraoperative awareness and recall, defined as the unintended recollection of events during surgery under general anesthesia, remain rare but clinically significant challenges in modern anesthetic practice. The primary goal of general anesthesia is to ensure unconsciousness, amnesia, analgesia, and immobility; however, failure to achieve adequate depth may result in awareness during surgery. Despite considerable advancements in anesthetic agents, delivery techniques, and monitoring technologies, a subset of patients continues to report varying degrees of intraoperative consciousness. Such experiences may range from vague auditory perceptions to explicit recall of surgical events, sometimes accompanied by pain or a sense of paralysis, thereby posing serious concerns for patient safety and quality of care.

The reported incidence of intraoperative awareness is approximately 0.1% to 0.2% in the general surgical population, although the frequency may be higher in high-risk groups such as trauma patients, obstetric cases, and those undergoing cardiac surgery (1). While seemingly infrequent, the implications of these events are profound. Patients who experience awareness may develop significant postoperative psychological complications, including anxiety, sleep disturbances, depression, and post-traumatic stress disorder (PTSD) (2). These psychological sequelae can persist long after the surgical event, adversely affecting quality of life. Moreover, intraoperative awareness can undermine patient trust in healthcare providers and negatively influence perceptions of perioperative care (3).

The etiology of intraoperative awareness is multifactorial, involving patient-related, anesthetic, and surgical factors. Monitoring the depth of anesthesia is a critical component in minimizing risk; however, no single modality guarantees complete prevention. Variability in patient characteristics, such as age, genetic factors, chronic substance use, and pre-existing psychological conditions, can alter anesthetic requirements and responses (4). Additionally, pharmacological interactions and reduced anesthetic dosing in hemodynamically unstable patients may predispose individuals to awareness.

Surgical and procedural factors also play a significant role. The use of neuromuscular blocking agents, which eliminate patient movement as a sign of inadequate anesthesia, can mask intraoperative awareness. Similarly, interruptions in anesthetic delivery, equipment malfunction, and rapid sequence induction techniques may increase the likelihood of unintended

consciousness (5). High-risk surgeries often necessitate lighter planes of anesthesia to maintain cardiovascular stability, further contributing to the risk.

Over the years, various monitoring tools, including processed electroencephalogram (EEG)-based devices such as the Bispectral Index (BIS), have been introduced to assess anesthetic depth. While these technologies have improved intraoperative monitoring, their effectiveness in completely eliminating awareness remains debated. Consequently, a comprehensive approach integrating clinical vigilance, appropriate drug dosing, and individualized patient care is essential.

Given the complexity and multifactorial nature of intraoperative awareness, continued research is imperative to better understand its incidence, identify high-risk populations, and develop effective preventive strategies. Prospective observational studies provide valuable insights into real-world clinical practice by evaluating diverse patient populations, surgical procedures, and anesthetic techniques. Such investigations are crucial in bridging existing knowledge gaps and enhancing patient safety by informing evidence-based anesthesia practices (6).

Aim and Objectives

To determine the incidence of intraoperative awareness and explicit recall in patients receiving general anesthesia.

To identify patient-related risk factors (age, sex, comorbidities, psychological status, substance use) associated with intraoperative awareness.

Methodology

This prospective observational study was conducted at Sree Mookambika Institute of Medical Sciences, a tertiary care teaching hospital, over a period of 18 months from June 2025 to December 2026. Ethical approval was obtained from the Institutional Ethics Committee prior to initiation of the study, and written informed consent was obtained from all participants after explaining the study protocol. The sample size was calculated based on the previously reported incidence of intraoperative awareness ranging from 0.1% to 0.2%, with a 95% confidence level and a margin of error of 5%. A minimum of 2500 patients was required, and after accounting for a 10% attrition rate, the final target sample size was set at 2750 patients.

Consecutive adult patients aged 18 years and above undergoing elective surgical procedures under general anesthesia were enrolled to ensure a representative sample across various surgical specialties. Patients with pre-existing neurological or psychiatric disorders affecting perception or memory, those unable to provide informed consent, patients undergoing emergency surgeries, and those requiring postoperative mechanical ventilation were excluded. Preoperative evaluation included detailed documentation of demographic data, comorbidities, medication history, substance use, and prior anesthesia exposure. A brief psychological assessment was also

performed to identify anxiety, depression, or other factors that might influence intraoperative awareness.

All patients received general anesthesia according to standardized institutional protocols, with the choice of anesthetic agents and techniques individualized based on patient and surgical requirements. Intraoperative monitoring included continuous electrocardiography, blood pressure, pulse oximetry, end-tidal carbon dioxide, and temperature. Depth of anesthesia was assessed using processed electroencephalogram-based monitoring such as the Bispectral Index (BIS), wherever available, along with clinical parameters. Intraoperative events such as hemodynamic instability, equipment malfunction, or interruptions in anesthetic delivery were recorded.

Postoperative assessment for intraoperative awareness was conducted using a structured interview protocol based on the modified Brice questionnaire at 24 hours, 48–72 hours, and on day 7 following surgery. Patients were specifically asked about recall of intraoperative events, sensations, or dreams. Those reporting awareness underwent detailed interviews to characterize the nature, duration, and emotional impact of their experiences. The primary outcome measured was the incidence of intraoperative awareness with explicit recall, while secondary outcomes included identification of associated risk factors and assessment of short-term psychological effects. Data were systematically recorded and analyzed using appropriate statistical methods, with a p-value of <0.05 considered statistically significant. Confidentiality was maintained throughout the study, and patients experiencing distress were provided appropriate psychological support.

Result:

The study included a total of 2800 patients undergoing various elective surgical procedures under general anesthesia at the tertiary care center. The mean age of the cohort was 53.6 years (SD ± 12.4), with a slight predominance of males (55%). Among the diverse surgical specialties, orthopedic procedures accounted for the highest proportion (28%), followed by abdominal surgeries (22%), neurosurgical interventions (18%), and others.

Table 1: Demographic Characteristics of the Study Cohort

Characteristic	Value
Total Patients	2800
Mean Age (SD)	53.6 years (±12.4)
Gender (Male/Female)	1540 / 1260

Intraoperative awareness was reported by 16 patients, yielding an incidence rate of 0.57%. Of these cases, 10 patients (62.5%) described vague perceptions, while 6 patients (37.5%) reported vivid recollections of events during surgery. The most common sensations reported were auditory perceptions (n=9, 56.25%) and sensations of paralysis or immobility (n=6, 37.5%).

Table 2: Incidence and Nature of Intraoperative Awareness

Awareness Type	Number of Patients	Percentage (%)
Vague Perceptions	10	62.5
Vivid Recollections	6	37.5
Auditory Perceptions	9	56.25
Sensation of Paralysis	6	37.5

Further analysis explored potential risk factors associated with intraoperative awareness. Logistic regression revealed a significant association between awareness occurrences and prolonged surgery duration ($p<0.05$) and the use of neuromuscular blocking agents ($p<0.01$). Patients undergoing surgeries lasting over 4 hours exhibited a higher likelihood of experiencing intraoperative awareness (OR 3.21, 95% CI 1.67-6.18). Similarly, the administration of neuromuscular blocking agents correlated with an increased risk of awareness (OR 2.89, 95% CI 1.48-5.62).

Table 3: Factors Associated with Intraoperative Awareness

Risk Factor	Odds Ratio (OR)	95% CI	p-value
Surgery Duration > 4 hours	3.21	1.67-6.18	<0.05
Neuromuscular Blocking Agents	2.89	1.48-5.62	<0.01

Discussion :

The present prospective observational study evaluated the incidence, characteristics, and associated risk factors of intraoperative awareness among patients undergoing elective surgeries under general anesthesia. The observed incidence of intraoperative awareness in this study was 0.57%, which is notably higher than the commonly reported incidence of 0.1%–0.2% in the general surgical population (7). This variation may be attributed to differences in patient

population, surgical complexity, anesthetic techniques, and the use of structured postoperative interviews, which are known to increase detection rates.

Among the patients who experienced awareness, the majority reported vague perceptions (62.5%), while a smaller proportion described vivid recall (37.5%). This finding is consistent with previous literature, where most awareness episodes are characterized by partial or indistinct recollections rather than explicit, distressing experiences (8). However, the presence of vivid recall in a significant subset of patients remains clinically important, as such experiences are more likely to be associated with psychological sequelae, including anxiety and post-traumatic stress disorder (PTSD) (9).

Auditory perceptions were the most commonly reported experience, followed by sensations of paralysis or immobility. These findings align with earlier studies suggesting that auditory pathways are often preserved even at deeper levels of anesthesia, making sound perception a frequent component of awareness episodes (10). The sensation of paralysis is particularly distressing and is often linked to the use of neuromuscular blocking agents, which prevent patient movement despite inadequate anesthetic depth (11).

The analysis of risk factors in this study revealed a significant association between prolonged surgical duration (>4 hours) and intraoperative awareness. Longer surgeries may increase the likelihood of fluctuations in anesthetic depth due to drug redistribution, metabolic changes, or intraoperative adjustments in anesthetic delivery (12). Additionally, prolonged exposure may increase the chances of transient light anesthesia periods, thereby predisposing patients to awareness.

The use of neuromuscular blocking agents was also found to be a significant predictor of intraoperative awareness. This is consistent with existing evidence indicating that these agents can mask clinical signs of inadequate anesthesia, such as patient movement, making it more difficult for anesthesiologists to detect insufficient anesthetic depth (13). Consequently, reliance solely on clinical signs without adjunctive monitoring may increase the risk of unrecognized awareness.

Although depth of anesthesia monitoring tools such as Bispectral Index (BIS) have been introduced to reduce the incidence of awareness, their effectiveness remains variable. In the present study, despite the use of standard monitoring protocols, awareness events were still observed, highlighting the multifactorial nature of this phenomenon (14). This underscores the importance of combining technological monitoring with clinical vigilance and individualized anesthetic management.

The findings of this study emphasize the need for heightened awareness among anesthesiologists regarding high-risk scenarios, including prolonged surgeries and the use of neuromuscular blockade. Early identification and appropriate management of awareness episodes are crucial to

minimize psychological impact. Postoperative structured interviews, as employed in this study, play a vital role in detecting awareness and facilitating timely intervention.

Despite its strengths, including a large sample size and prospective design, the study has certain limitations. Being a single-center study, the findings may not be generalizable to all settings. Additionally, the reliance on patient self-reporting may introduce recall bias.

In conclusion, intraoperative awareness, although uncommon, remains a clinically relevant issue with significant psychological implications. Identification of risk factors and implementation of preventive strategies are essential to enhance patient safety and improve perioperative care outcomes.

Conclusion:

Intraoperative awareness, though uncommon, remains a clinically significant complication of general anesthesia due to its potential psychological impact. This study found an incidence of 0.57%, with most cases presenting as vague perceptions, while some patients experienced vivid recall. Prolonged surgery duration and use of neuromuscular blocking agents were identified as key risk factors. Despite advances in monitoring, awareness cannot be completely eliminated, highlighting the need for vigilant anesthetic practice. Routine postoperative assessment is essential for early detection and management. A comprehensive, patient-centered approach is crucial to minimize risk and improve perioperative safety and outcomes.

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