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Intraoperative awareness of Surgical Patients Exposed to anaesthesia in Ekiti State Tertiary Institutions

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Abstract:

This study investigated intraoperative awareness among surgical patients exposed to Combined Intravenous and Inhaled Anaesthesia (CIIA) and Total Intravenous Anaesthesia (TIVA) in tertiary institutions in Ekiti State, Nigeria. The research employed a quantitative descriptive design, selecting 148 patients through consecutive sampling across three hospitals. Data collection utilized a modified Brice Interview and Michigan Awareness Classification instrument, evaluating patients' awareness levels post-surgery. Results indicated that a significant proportion of patients reported no memory before or after anesthesia induction, with few experiencing dreams or negative perceptions related to their operation. Notably, 18.5% reported awareness during surgery, despite efforts to prevent it. Statistical analysis showed no significant difference in intraoperative awareness between CIIA and TIVA groups ($p > 0.05$). These findings align with existing literature, emphasizing the multifactorial nature of intraoperative awareness. Recommendations include implementing continuous monitoring techniques and enhancing anesthesia training to mitigate awareness risks and improve patient safety during surgeries.

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Introduction

Intraoperative awareness is a preventable complication that can cause significant psychological problems including anxiety, depression as well as post-traumatic stress disorder. General anaesthesia is a reversible state of controlled unconsciousness with a combination of different medicines (Smith, 2023; Prys-Roberts, 2020). With general anaesthesia, surgical procedures can be done to the patient, which would not cause unbearable pain. Essential to successful general anaesthesia, is balanced hypnosis, analgesia and optimal muscular relaxation. Sufficient amnesia through hypnosis should be achieved (Egan, 2023). The purpose of anaesthesia is to induce unconsciousness through the administration of drugs. Therefore, it is fundamental to provide patients with analgesia, anxiolysis, amnesia and suppression of hormonal, cardiocirculatory, and motor responses in the surgical stress setting. Marc-coppens (2023) defined anaesthesia as the state in which (as a result of drug-induced unconsciousness) the patient neither perceives nor recalls noxious stimuli.

Intraoperative awareness is a severe complication associated with anaesthesia which usually occurs when patients recall events that occurred while under anaesthesia, including pain, paralysis, or feelings of impending death. Despite the low morbidity, intraoperative awareness is a serious problem that may cause psychological side effects, such as sleep disturbances, depression, and anxiety, even post-traumatic stress disorder (PTSD) (Maciejewicz, 2023). Cureus et al. (2023) reported that intraoperative awareness patients were more likely to experience cognitive impairment, anxiety, or depression. Prevention of intraoperative awareness remains a great challenge for anaesthesiologists. Despite the available methods for awareness monitoring during general anaesthesia, intraoperative awareness can be only confirmed based on the postoperative information directly obtained from the patients (Guo, 2023).

Intraoperative awareness is the second most common concern of patients after postoperative vomiting (Norman et al.,2023; Wang et al., 2020). The causes for this event are frequently a consequence of inadequate anaesthesia technique, device failure, addicted patients, excessive use of neuromuscular blocking agents, and inadequate monitoring (Bullard et al., 2023; Prys-Roberts, 2020). Awareness during anaesthesia with intraoperative memory occurs when the patient can process information and produce specific responses to several stimuli. Awareness originally coined as intraoperative awareness, is a recognized risk of general anaesthesia. Based on individual factors, patients respond differently to general anaesthesia (Cureus, 2023). Awareness during general anaesthesia may happen at the commencement of anaesthesia when anaesthetics have not taken full effect, or at the end of surgery when the patient is waking up after anaesthesia has been terminated. It is only very rare that this occurs during surgery itself. However, affected individuals may suffer significant psychological trauma from such an event (Folino et al.,2023; Walkace et al.,2021).

Despite the wide spread use of modern anaesthetic delivery techniques agents, intraoperative awareness continues to be a worrisome complication for patients and clinicians. For over a half- century its terminology, diagnosis, prevention, and incidence have been debated among anaesthesiology, surgeons, and patients (Gao et al.,2023; Eyelade et al., 2012). Technological

advancements like processed EEG have escalated interest in intraoperative awareness by experts from engineering, psychology, and neuroscience. Their contributions have resulted in novel research avenues and controversies improvements in measuring the neurophysiologic effects of anaesthesia have modified the practice of many anaesthesia providers, while other providers wait for widespread acceptance of the technology (Shahi et al., 2021; Deiner et al., 2021; Arinze et al., 2019)

Intraoperative awareness is a serious clinical challenge accounting for 0.1% of overall incidence with lower and higher rates possible for specific clinical circumstances (Bullard et al., 2023). Awareness during anaesthesia can be very distressing for a patient, particularly if accompanied by the recall of the painful nature of surgery (Folino et al., 2023). The occurrence of intraoperative awareness also has consequences for the anaesthetists, claims are frequently successful, and the blame is often on poor anaesthetic technique. The waking of patients during anaesthetic administration is an uncommon complication though alarming to patients and anaesthesiologists alike (Gao et al., 2023).

Approximately 20 million general anaesthetics are administered each year in the United States the incidence of one case of 500 anaesthetics corresponds to 40000 cases of awareness annually (Humeidan et al., 2021). According to Folino et al. (2023), a retrospective analysis of IOA reported an incidence of 0.25% for definite awareness and an additional 0.32% of patients having possible awareness. According to meta-analysis by Gao et al (2023) revealed 0.44% of awareness which was associated with anaesthetic regimens or anaesthetic depth monitors. Awareness appears to be a dose-related phenomenon, and the risk is greatest when muscle relaxants are used. Its most feared consequence is post-traumatic stress disorder (Gao et al., 2023; Aceto et al., 2013).

Patients may relate that they heard and were aware of everything during a previous anaesthetic experience (Humeidan et al., 2021). On review of these cases, it is usual to discover that the procedure was performed under monitored anaesthetic care or conscious sedation with or without an anaesthesiologist in attendance (Martin, 2021). Occasionally, some patients remember voices, and machines beeping and may feel pain at the surgery site (Norman et al., 2023; Mashour et al., 2019). Some patients try to signal that they are awake, but if muscle paralysis is required for the surgery, movement is not possible.

The major methods of general anaesthesia are combined intravenous and inhaled anaesthesia (CIIA) and the total intravenous anaesthesia technique is inherently more complex, placing reliance on mechanical ventilation, infusion pumps and drug infusion lines. Some comparative studies have shown inferior operating conditions with intravenous techniques compared with inhalation anaesthesia (Bajwa et al., 2023; Lopez et al., 2017). However, with the optimal drugs, both techniques seem to achieve satisfactory operating conditions and good control. Personal preference is undoubtedly important in determining the selection of intravenous and inhaled techniques. Considerations include previous experience and biases, an inclination towards a simple or complex approach and the choice of controlled or spontaneous ventilation (Folino, 2023). One approach to understanding the critical mechanisms by which general anaesthetics suppress awareness is to seek invariant changes in the human brain as patients lose and regain consciousness under the effects of a variety of anaesthetic agents (Smith et al., 2023).

Peter (2018) conducted a study in China on intraoperative awareness reported a prevalence of dreaming at 6% and other studies reported a range of 1.1%–10.7%, which was more common in younger patients and outpatient surgeries. The difference in the incidence of this complication among studies is probably related to the type of anaesthetic drug used. It can also be linked to the fact that most patients may have forgetfulness due to using midazolam before induction or it could be because of the lack of an instrument for monitoring the depth of anaesthesia in other studies that reduced the specific conditions of consciousness during anaesthesia, such as dreaming. Findings of a similar study by Shahiet (2021) showed that 18 patients (2.6%) remembered something between sleeping and consciousness, 59 (8.8%) of them dreamed, 19 (2.7%) felt pain, and 23 (4.3%) had auditory consciousness. The results showed that there was only a significant relationship between auditory consciousness and surgical site, dreaming, and weight ($p<0.05$).

Another study conducted by Bilal et al. (2019) showed that 5.8% of study participants dreamt during anaesthesia. The events that 25.63% of patients remembered after anaesthesia were the events of the recovery room. Evidence showed that the incidence of consciousness during surgery is reported low, and on-the-spot monitoring, such as checking vital signs and measuring the concentration of inhalable gases, can both help assess consciousness during anaesthesia.

Intraoperative awareness has been linked to certain types of surgery. Descriptive studies and case reports have revealed an incidence of 0.2-0.4% in nonobstetric and noncardiac surgery, 0.4% in caesarean section, and 0.3-4% in cardiac surgery. Major trauma surgeries have a high incidence of intraoperative awareness due to hypovolemia and hemodynamic instability necessitating light anaesthesia. Rigid bronchoscopy and micro laryngeal endoscopic surgery both of which are associated with excessive stimulation, have an increased risk of awareness reported at 1-7% (Cureus, 2023; Lukkari & Kinnunen, 2017)

The objective of this study was to determine the intraoperative awareness of patients exposed to combined intravenous and inhaled anaesthesia (CIIA) and total intravenous anaesthesia (TIVA).

Research Hypothesis

Ho1: There is no significant relationship between intraoperative awareness of patients exposed to CIIA and TIVA after surgery.

Research Methods

This study adopted a quantitative (descriptive) research design. The study population comprised all surgical patients obtained from the hospital record for nine months in three tertiary institutions in Ekiti State. The surgical patients, that is, patients booked for different types of surgery included those who receive CIIA and TIVA. The sample size was determined using the Leslie Kish Formula

$$N = \frac{N}{1 + N\,(e)^2}$$

n = sample size
N = population size
e = level of precision

N = 203
e = 0.05

$$N = \frac{203}{1+203(0.05)^2}$$

$$N = \frac{203}{1+0.507}$$

$$N = \frac{203}{1.507}$$

n = 135, adding a 10% non-response rate, therefore, the sample size was 148.

Table 1: Proportionate distribution of sample size across the research settings

S/N	Tertiary Institutions	Patients' population	Percentage	Proportionate sample size
1.	Ekiti State University Teaching Hospital, Ado – Ekiti	75	36.9	55
2.	Federal Teaching Hospital, Ido – Ekiti	96	47.3	70
3.	Afe Babalola University Teaching Hospital, Ado – Ekiti	32	15.8	23
	Total	**203**	**100.0**	**148**

A consecutive sampling technique was used to select the patients for this study. The design of experiments, also known as total enumerative sampling, is a sampling technique in which every subject meeting the criteria of inclusion is selected until the required sample size is achieved.

The study's inclusion criteria require that participants meet several specific conditions. Eligible patients must be over 18 years of age, undergoing general anesthesia for surgery, and possess normal mental status. Additionally, they should fall under the American Society of Anesthesiologists (ASA) classification of I to II, receive general anesthesia, and be scheduled for postoperative extubation. Patients must also be receiving treatment in the selected hospitals and express a willingness to participate in the study. The exclusion criteria include patients with anesthetic contraindications, those who died in the hospital either intra-operation or post-operation, and those not present in the research setting at the time of data collection. Furthermore, patients who are unable to complete the postoperative questionnaire within 48 hours, those with psychological or severe mental disorders after surgery, and those unwilling to participate in the study are also excluded.

Adapted questionnaires was used to elicit information from surgical patients. Section A of the instrument contains information on the socio-demographic characteristics of the respondents. **Section B of the instrument contains information** on the intraoperative awareness of patients. Modified Brice Interview and Michigan Awareness Classification (MiAC) by Mashour et al. (2010) was used to measure the interoperative awareness of the respondents. It included 5 points: Class 1 referred to isolated auditory perceptions; Class 2 pointed to tactile perceptions; Class 3 is related to pain; Class 4 is paralysis; and Class 5 included paralysis and pain. Modified Brice interview and Michigan Awareness classification instrument were interpreted as follow.

Class 0: No awareness
Class 1: Isolated auditory perceptions
Class 2: Tactiles perceptions (surgical manipulation or endotracheal tube).
Class 3: Pain
Class 4: Paralysis (feeling one cannot move, speak or breathe
Class 5: Paralysis and pain
An addition designation of "D" for distress was included for report of fear, anxiety, suffocation, sense of doom, sense of impending death (Mashhour et al., 2023).
The instrument was subjected to face and content validity. The items in the questionnaire were presented to experts in the field of Tests and Measurement, in the nursing field, and the supervisors for reviewing, correction and appraisal after which necessary corrections were made. Data was collected after getting the necessary approval from the Ethical Committee of each of the research settings. Each respondent was met in their wards a night before surgery during pre anaesthetic review by the anasethetist on call and they were briefed with the research objectives and informed written consent was obtained from the participants to ensure the right of the subject.
After the operation, all the patients were transferred to the recovery room and later transferred to the wards where the patients awakened. Each patient was interviewed within 48 hours after operation according to the modified Brice Interview. Based on their answers, the patients were defined as confirmed awareness, possible awareness, and no awareness. The occurrence of awareness during recovery room stay would be excluded. Michigan Awareness Classification (MiAC). Mashour et al. (2019) developed a classification instrument for accidental awareness under general anaesthesia known as the "Michigan Awareness Classification Instrument was used to evaluate the experience of patients confirmed with intraoperative awareness. It includes 5 points: Class 1 referred to isolated auditory perceptions; Class 2 pointed to tactile perceptions; Class 3 was related to pain; Class 4 was paralysis; and Class 5 included paralysis and pain. In addition, if the patients are with the presentation of fear, anxiety, suffocation, a sense of doom, a sense of impending death, and so on; an additional "D"-for distress was added. The research questions were answered using descriptive statistics. The continuous variables were shown as mean ± standard deviation, and analyzed by Student t-test. All the statistical analyses were performed using the latest SPSS version 28.0 software (IBM). P value (<.05) was considered statistically significant.

Results

One hundred and thirty-five questionnaires were distributed to the respondents, the same were retrieved, properly filled and analyzed for the study making a 100% response rate. Vast majority of the respondents had premedication 110 (81.5%) before anaesthesia induction such as diazepam 89 (65.9%) analgesia morphine 32 (23.7%), 93 (68.9%) utilized CIIA anaesthesia technique, pancuronium relaxation technique 67 (49.6%), Suxamethonium intubating agents 62 (45.95%), Halothane inhalation 51 (37.8%), face mask breathing system 42 (31.1%), ketamine induction drug 48 (35.6%), and opioids 69 (51.5%) as a maintenance drug as seen in Table 1.

Table 1: Distribution of respondents by anaesthesia induction phase (N= 135)

	Variables	Frequenc	Percentag

Induction Phase		y	e
Premedication	Yes	110	81.5
	No	19	14.1
	Others	6	4.4
Tranquilizer	Diazepan	89	65.9
	Midazolam	43	31.9
	Others	3	2.2
Analgesia	Pentazocine	15	11.1
	Pethidine	13	9.6
	Morphine	32	23.7
Anaesthesia Technique	CIIA	93	68.9
	TIVA	36	26.7
	Others	6	4.4
Relaxation technique	Pancuronium	67	49.6
	Atracurium	43	31.9
	Nucuronium	16	11.9
	Others	9	6.7
Intubating Agents	Suxamethonim	62	45.9
	Pancuronium	45	33.3
	Other	28	20.7
Inhalational	Halothane	51	37.8
	Isofluorane	42	31.1
	Enfluorane	32	23.7
	Sevoflurane	10	7.4
Breathing System	Face mask	42	31.1
	Intubation	41	30.4
	Laryngeal mask	15	11.1
	Spontaneous	24	17.8
	Mechanical	6	4.4
	Assisted	7	5.2
Induction drugs	Ketamine	48	35.6
	STP	52	38.5
	Propofol	21	15.6
	Others	14	10.4
Maintenance drugs	Opioids	69	51.5
	Ketamine	56	41.5
	Others	10	7.4

As presented in Table 2, 121 (89.6%) reported not remembering anything before going to sleep, 119 (88.1%) of patients did not remember anything on waking up, and 130 (96.3%) reported not having any dreams or other sensations during sleep. The majority of patients 126 (93.3%) reported no negative experiences, 122 (90.4%) expressed a preference against having the same kind of anaesthesia next time, and the majority 125 (78.5%) reported not being aware when surgery was going on.

Table 2: Intraoperative awareness of patients exposed to CIIA and TIVA of the patient undergoing surgery before and after anaesthesia

Variables	Yes	No
	F (%)	F (%)
Do you remember anything before going to sleep	14(10.4)	121(89.6)
Do you remember anything about waking up from sleep?	16(11.9)	119(88.1)
Did you have any dreams during your sleep or any other experience?	5(3.7)	130(96.3)
Was there any worst thing about your operation?	9(6.7)	126(93.3)
Would you like to have this kind of anaesthesia next time?	13(9.60	122(90.4)
Were you aware the surgery was ongoing?	10(18.5)	125(78.5)

Test of Hypothesis

Hypothesis One: There is no significant difference between intraoperative awareness of patients exposed to CIIA and TIVA after surgery

Table 3 shows that the t-value of 0.864 was not significant because the P value (0.389) > 0.05. This implies that the null hypothesis was not rejected. Hence, there was no significant difference between intraoperative awareness of patients exposed to CIIA and TIVA after surgery.

Table 3: T-test Analysis showing the difference between intraoperative awareness of patients exposed to CIIA and TIVA after surgery

Variations	N	Mean	SD	df	T-test	PP
CIIA	93 (72.1)	7.59	1.19	127	0.864	0.389
TIVA	36 (27.9)	7.39	1.20			

P>0.05

Discussion of Findings

The use of different tranquillizers, with Diazepam and Midazolam being the most common. The distribution of analgesia methods, including Pentazocine, Pethidine, and Morphine, reflects the diverse options available for pain management during and after surgery. These findings are consistent with findings supported by authors such as Ragheb et al. (2023) and Gan et al. (2014). Furthermore, the utilization of various tranquillizers, particularly Diazepam and Midazolam, mirrors discussions within literature regarding pharmacological agents for anxiolysis and sedation during the perioperative period, as outlined by Miller et al. (2020).

The distribution of analgesia methods, including Pentazocine, Pethidine, and Morphine, resonates with the findings of Shah et al. (2023), Apfelbaum et al. (2019), and Stoelting and Hillier (2012) emphasizing the importance of effective pain management for enhancing patient outcomes. Similarly, the variation in anaesthesia techniques, notably Combined

Inhalation Intravenous Anaesthesia (CIIA) and Total Intravenous Anaesthesia (TIVA), reflects ongoing debates surrounding the advantages of different anaesthesia approaches, as discussed by Merry et al. (2018).

The findings provide an insightful analysis of intraoperative awareness in patients undergoing Combined Inhalation Intravenous Anaesthesia (CIIA) and Total Intravenous Anaesthesia (TIVA). The data reveals varying aspects of patients' experiences, including memory before and after going to sleep, dreams or other experiences during sleep, perceptions of the worst thing about the operation, future preferences for anaesthesia, and awareness of the ongoing surgery. Results revealed that, on the whole, patients' psychiatric status remained relatively consistent before and after anesthesia. While some minor fluctuations in reported symptoms were noted, the majority of patients did not display significant alterations in anxiety levels or other psychological symptoms immediately post-anesthesia, indicating effective perioperative management.

The findings corroborate with the research conducted by the NV Investigators (2019), Hoikka (2018), Lukkari and Kinnunen (2017), Szostakiewicz (2019), and Peter (2018) which suggested that psychiatric patients might face an elevated risk of perioperative complications due to impaired biological stress responses. Studies by Shahiet (2021), Szostakiewicz (2019), and Peter (2018) have reported varying incidences of dreaming during anaesthesia, ranging from 1.1% to 10.7%. Additionally, insights from Humeidan et al. (2021) regarding the potential withdrawal symptoms associated with discontinuation of antidepressants support the notion of effective perioperative care in managing psychiatric patients.

Intraoperative awareness is a known complication, and the data in Table 2 indicates that a notable proportion of patients (18.5%) reported awareness during the surgery. Literature supports this, with reported incidences of intraoperative awareness ranging from 0.2% to 4% in cardiac surgery, 0.4% in cesarean section, and up to 7% in certain surgeries associated with excessive stimulation, such as rigid bronchoscopy and microlaryngeal endoscopic surgery (Hoikka, 2018; Lukkari & Kinnunen, 2017). The findings suggest that despite efforts to prevent intraoperative awareness, it remains a concern in a subset of patients.

The analysis also explores patients' preferences for future anaesthesia, with a significant majority expressing a preference against having the same type of anaesthesia next time. This preference might be influenced by factors such as the fear or discomfort associated with the awareness experience. Studies have emphasized the importance of psychological support and counselling for patients who report awareness during anaesthesia (Hoikka, 2018; Lukkari & Kinnunen, 2017).

The study examined the difference in intraoperative awareness between patients exposed to Combined Inhalation Intravenous Anesthesia (CIIA) and Total Intravenous Anesthesia (TIVA) after surgery. Statistical analysis revealed no significant difference in intraoperative awareness between the two anesthesia methods.The finding that there was no substantial difference in intraoperative awareness between CIIA and TIVA aligns with existing literature (Wang et al., 2019; Mashour & Avidan, 2018). These studies acknowledge the multifactorial nature of intraoperative awareness, which involves various patient-specific and procedural factors beyond the choice of anesthesia technique. Additionally, the literature underscores the significance of continuous monitoring and vigilant practices to minimize intraoperative

awareness, regardless of the anesthesia method used (Malhotra & Kajal, 2018; Pandit, et al., 2014; Sanders et al., 2000). This emphasis on monitoring and practice resonates with the study's finding that awareness during surgery is influenced by multiple factors beyond anesthesia type.

Conclusion

The analysis of anaesthesia induction practices sheds light on the variations in premedication, tranquillizers, analgesia, anaesthesia techniques, relaxation techniques, intubating agents, inhalational agents, breathing systems, induction drugs, and maintenance drugs. The examination of intraoperative awareness reveals that the majority of patients did not retain memories before and after going to sleep during surgery, and most did not experience dreams or other sensations during this period. Although a substantial majority did not perceive any negative aspects related to the operation, a notable proportion reported awareness of the ongoing surgery. Additionally, a significant majority expressed a preference against having the same type of anaesthesia in the future.

Recommendations

1. Anaesthesia providers should implement continuous monitoring techniques, such as brain function monitors, to detect and mitigate instances of intraoperative awareness, especially in surgeries with a higher risk, as indicated by the literature. The study indicates a notable proportion of patients reporting awareness during surgery, highlighting the importance of vigilant monitoring to enhance patient safety.
2. Anaesthesia training programs should incorporate diversified scenarios, including different anaesthesia induction techniques and patient profiles, to better prepare healthcare professionals for the complexity observed in real-world settings. The variations in anaesthesia practices underscore the need for well-rounded training to ensure competence in diverse surgical situations.

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