

# Assessment of Incidence and Associated Risk Factors of Awareness with Recall Under General Anesthesia in Non-Cardiac and Non-Obstetric Patients in Tikur Anbessa Specialized Hospital, Addis Ababa From May 2021 to October 2021, Addis Ababa, Ethiopia

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## Abstract

### Introduction

General anesthesia involves administering drugs to induce hypnosis, amnesia, and stress suppression during surgery. Anesthesia awareness, an unintended event where patients recall experiences during anesthesia, can lead to long-term psychological effects.

### Objective

This study evaluated the incidence and risk factors associated with awareness under general anesthesia among non-cardiac and non-obstetric patients at Tikur Anbessa Specialized Hospital (TASH), Addis Ababa, Ethiopia, from May to October 2021.

### Methodology

A prospective cross-sectional study was conducted at TASH using the modified Brice questionnaire and Aldrete score to assess intra-operative awareness and wakefulness. Systematic random sampling was used to select patients assessed in the Post-Anesthesia Care Unit (PACU) and ward. Data were analyzed using SPSS version 25, and logistic regression was used to determine variable associations ( $p < 0.05$ ).

### Results

The study included 354 patients (response rate: 96.4%); 58.7% were male, and 41.5% were female, with a mean age of 39.3 years. The incidence of awareness with recall was 11.7%, while dreaming occurred in 9.1% of patients. Awareness was significantly associated with muscle relaxants (OR 2.793, 95% CI 1.872-1.948,  $p = 0.003$ ). Dreaming was more common in females.

### Conclusions

The incidence of awareness was higher than in many global studies, with consistent risk factors, particularly the use of muscle relaxants. Dreaming was more common among females.

### Recommendations

Anesthesia providers should monitor intra-operative awareness, manage muscle relaxant dosages, and maintain anesthesia equipment, including gas and depth monitors

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## 1. Introduction

### 1.1. Background

General anesthesia is the complex process of administering drugs to induce hypnosis, amnesia, and suppression of stress response to surgical stimuli and create a quiet surgical field. However, it is difficult to define the depth of anesthesia, especially in developing countries where invasive monitors are limited the main aim of anesthesia is to alleviate patients from stress/anxiety and pain, and maintain the physiologic state. However, depending on the intensity of surgical stimulation and different patient pathophysiology, there will be an imbalance between drug requirement and drug administration, which results in a variable depth of anesthesia. When a patient has been given less than the desired dose of a drug, the patient will develop intraoperative awareness the ability of memorizing or recalling events during a surgical procedure [1,2]. Awareness is one of the rare but potentially disastrous complications of surgery and anesthesia. It is characterized by explicit memorizing of events happening during anesthesia. Remembering of events of anesthesia and surgery are a common concern raised by most patients before undergoing anesthesia. Awareness was recognized since the nineteenth century when the first general anesthesia with ether was started for tooth extractions after Gilbert Abbot remembered all events without postoperative pain [3,4]. Patients with awareness may experience different adverse events including nightmares, sleepiness, insomnia, anxiety, and even post-traumatic stress disorders (PTSD) [5-8].

The awareness causes are not identified and it is multi-factorial. However, patient requirement for light anesthesia, increased anesthetic requirement, and machine malfunction or misuse resulting in an inadequate delivery of anesthesia, are among the commonest causes incriminated. It can also be classified according to their source like patient related, surgery-related related and anesthesia-related [9-11]. Sometimes, it is not uncommon for doctors and nurses to hear patients complaining about their experience to their close family and friends after surgery. The patient may feel pain, hear the sound of falling instruments, be unable to move extremities and feel anxiety during anesthesia. Intraoperative awareness is one of the perioperative adverse events that are neglected by anesthesia providers and surgeons during operations, particularly in low-resource settings. Though the magnitude of intraoperative awareness is low in the westerns, the incidence in the developing countries was higher and ranged from 1.07-13.3% [8,12-16]. In addition, no study deals on the impact of awareness, and the effects of anesthesia type on awareness, even on high-risk surgeries such as cesarean delivery and cardiac surgery.

The effect of perioperative awareness following anesthesia is a concerning issue for the patient and it may result in the development of post-operative insomnia, anxiety, nightmare post-traumatic stress disorder, and other chronic psychological sequelae [6,7]. Only one study in Ethiopia studies the magnitude and associated risk factors of awareness with recall [15]. Intra-

operative anesthesia awareness is almost neglected in low-income countries, particularly in Africa. There was no similar study done in Addis Ababa so this study aimed to answer the questions about the incidence of awareness with recall under general anesthesia (GA), and its associated risk factors. Even though the incidence and impact of awareness are high in low-income countries, particularly in Africa, low attention has been given by both anesthesia providers and surgeons. There were very few studies conducted so far. Therefore, the result of this study will fill the information gap on the magnitude of intra-operative awareness and associated risk factors. The result of this study will also help to improve patient care during the perioperative period and possible guideline development. It will also serve as a baseline reference for future studies in the study areas. Finally, recommendations will be given for respective stakeholders to act accordingly.

## 2. Methods

### 2.1. Study Area and Period

The study was conducted at Tikur Anbesa Specialized Hospital (TASH) in Addis Ababa, Ethiopia's capital. As one of the largest hospitals in the country, TASH provides a range of surgical services across various departments, including Neurosurgery, Cardio-Thoracic Surgery, Pediatric Surgery, Urological Surgery, ENT, Orthopedic Surgery, Gastrointestinal Tract Surgery, and Obstetrics and Gynecology. Anesthesia services are managed by the Department of Anesthesiology, Critical Care, and Pain Medicine. The study was conducted from May to October 2021. TASH was selected due to its high case volume, variety of surgical procedures, and extensive range of cases.

### 2.2. Study Design

An institutional-based prospective cross-sectional study.

### 2.3. Inclusion Criteria

All adult patients above 18 years of age with normal mental status who had undergone general anesthesia during the study period at TASH were included.

### 2.4. Exclusion Criteria

Patients not ex-intubated after surgery, patients undergoing conscious sedation, and patients who refused to participate were excluded.

### 2.5. Sample Size and Sampling Technique

A sample size of 354 was determined using a single population proportion formula with a systematic random sampling technique.

### 2.6. Data Collection

Data were collected using structured questionnaires on demographics, patient, anesthesia, and surgery-related variables. The Brice questionnaire, translated to Amharic, and the Aldrete score were used.

## 2.7. Variables

### 2.7.1. Dependent

Awareness with recall.

### 2.7.2. Independent

Patient-related factors (e.g., age, sex), surgery-related factors (e.g., type of surgery), anesthesia-related factors (e.g., drug use).

### 2.7.3. Data Quality Assurance

Structured questionnaires, pre-tests, training, and supervision ensured data quality.

### 2.7.4. Data Analysis

Data were entered into SPSS version 25, cleaned, and analyzed using logistic regression to determine associations (significance at  $p < 0.05$ ).

### 2.7.5. Ethical Considerations

Ethical clearance was obtained, and informed consent was taken from participants.

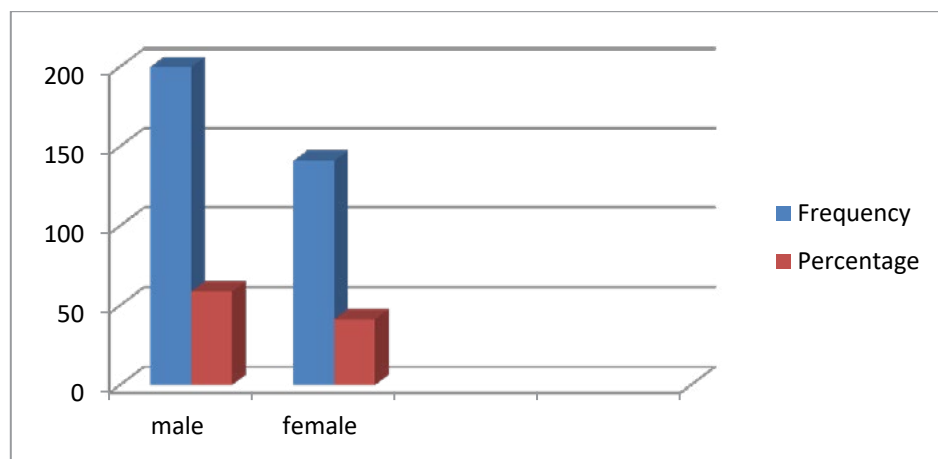
### 2.7.6. Dissemination of Results

Findings will be presented to the Department of Anesthesiology, with efforts made to publish in a scientific journal.

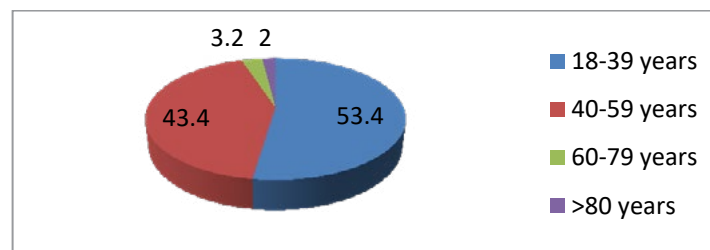
## 3. Results

### 3.1. Socio-Demographic Characteristics

The study population included 354 patients, who underwent surgery under general anesthesia during the study period from May to September 2021. Among these 13 patients were excluded due to incomplete data. Male 200 (58.7%) participants were greater than female 141 (41.3%). The minimum and maximum ages of the respondents were 19 and 89 with a mean of  $39.3 \pm 15.2$  (SD).



**Figure 1:** Sex Distribution of a Study Participant in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia, 2021



**Figure 2:** Age Distribution of a Study Participant in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia, 2021

### 3.2. Risk Factors

In this study majority of patients were ASA I 176 (51.6%), and the rest were ASA II 137 (40.2%), ASA III 20 (5.9%), and ASA IV 8 (2.3%). Among the respondents, 99 (29) were found to have a

chronic illness, 57 (16.7%) were taking alcohol, 16 (4.7) patients were smokers, 19 (5.6%) had a history of chronic pain and three patients had a history of awareness in previous surgeries.

Variables		Frequency	Percent
ASA status	ASA I	176	51.6
	ASA II	137	40.2
	ASA III	20	5.9
	ASA IV	8	2.3
Alcohol	Yes	57	16.7
	No	284	83.3
Smoking	Yes	16	4.7
	No	325	95.3
Chronic pain	Yes	19	5.6
	No	322	94.4
Medical illness	Yes	99	29
	No	242	71
Previous history of awareness	Yes	3	0.9
	No	339	99.1

**Table 1: Frequency and Percentage of Risk Factors in The Study Participants in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia, 2021(N=341)**

### 3.3. Anesthesia-Related Factors and Surgical Procedures

Both normal (218, 63.9%) and modified rapid sequence induction (RSI) (123, 36.1%) were used during intubation. Thiopental 176 (51.6%), propofol 143 (41.9%), ketamine 9 (2.6%), and ketofol 8 (2.3%) were used as induction of anesthesia. Volatile anesthetics (halothane 87.7%), and isoflurane 12.3%) were used as a maintenance of anesthesia and supplemented with opioids (morphine 71.8%, fentanyl 15.8%, and pethidine 10.9%). Of the patients, 16.1% were received premedication,

usually dexamethasone (3.2%), followed by diazepam (2.6%), metoclopramide (2.1%), and lidocaine (1.8). Muscle relaxants (78.3%) were used for both induction and maintenance in 276 (78.3%) of patients. Different adjuvant drugs, like lidocaine 25 (7.3%), dexamethasone 17 (5.0%), Mgso4 14 (4.1%), fentanyl 7 (2.1%), diazepam 5 (1.5%), and paracetamol 5 (1.5%), were used. Most of the respondents were elective 231 (67.7%) while the rest 110 (32.3%) were emergency.

Procedures	Elective		Emergence		Total
	Frequency	Percent	Frequency	Percent	
Neurosurgery	34	14.4	12	11.4	46
Thoracic surgery	33	14.0	4	3.8	37
ENT surgery	25	10.6			25
Endocrine surgery	10	4.2			10
Abdominal surgery	50	21.3	34	32.4	84
Gynecologic surgery	18	7.6	11	10.5	29
Urology surgery	29	12.3	4	3.8	33

Orthopedics surgery	23	9.7	17	16.2	40
Vascular surgery	14	5.9	16	15.2	30
Trauma surgery			7	6.7	7
<b>Total</b>	<b>236</b>	<b>100</b>	<b>105</b>	<b>100</b>	<b>341</b>

**Table 2: Frequency and Percentage of Surgical Procedures Performed in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia, 2021(N=341)**

### 3.4. Prevalence of Awareness

Among 341 respondents, 278 (81.5%) were assuming that the surgery was done under complete sleeping conditions; whereas 63 (18.5%) were not.

Variables	Frequency	Percent (%)
The last thing the patient remember		
Feeling mask on face	84	24.6
Being with family	74	21.7
Being in the pre-op area	57	16.7
Seeing the operating room	54	15.8
Burning or stinging in the IV line	27	7.9
Hearing voices	25	7.3
Smell of gas	16	4.7
The first thing you remember after waking up		
Hearing of voice	143	41.9
Nothing	47	13.8
Feeling breathing tube	42	12.3
Feeling mask on the face	32	9.4
Feeling pain	30	8.8
Being in the recovery room	19	5.6
Seeing the operating room	14	4.1
Being with family	14	4.1
<b>Total</b>	<b>341</b>	<b>100</b>

**Table 3: Frequency and Percentage of The Last Thing Patients Remember and The First Thing Remember After Waking Up Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia, 2021(N=341)**

Forty cases (11.7%) were identified with awareness and 33 (9.7%) patients reported dreaming. Among 40 cases who had awareness, 70% had auditory perception, 10% experienced anxiety/stress, 10 % felt pain, 5% sensed surgical events, and the remaining experienced unable to move or breathe and sensation of the breathing tube. Most patients claimed pain 141 (41.3%) and

anxiety 122 (35.8%) as their worst experience during operations. Among patients with dreaming, 8 patients experienced horrifying sounds and events while others reported being with family, going to the toilet, being bitten by ants, collecting crops from the farm area, being surrounded by old people, and 4 patients with unspecified dreams.

Events		Frequency	Percentage
Nothing		301	88.3
Hearing voices		28	8.2
Sensing surgical events		2	0.6
Unable to move or breath		1	0.3
Anxiety or stress		4	1.2
Feeling pain		4	1.2
Sensation of breathing tube		1	0.3
Dreaming	Yes	33	9.7
	No	308	90.3
Worst thing about the operation	Anxiety	122	35.8
	Pain	141	41.3
	Recovery process	21	6.15
	Unable to carry out usual activities	12	3.52
	Others	45	13.23

**Table 4: Frequency and Percentage of Intra-Operative Events Reported Among Patients Who Had Awareness with Recall Under General Anesthesia in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia, 2021(N=341)**

### 3.4. Factors Associated with Awareness

Binary logistic regression was performed to assess the association of each independent variable with the dependent variable and the factors that showed a p-value of 0.25 and less were added to multivariate regression model to detect the statistically significance variable. On binary logistic regression, factors such as ASA status, history of chronic pain, use of premedication, use of muscle relaxant, smoking history, and orthopedics surgery were entered to multivariate analysis. On multi-variant logistic regression only uses of muscle relaxants and history of chronic pain were

significantly associated. Other variables like age, sex, history of previous awareness, alcohol intake, smoking, premedication use, type of surgery, type of operation, use of inhalations, and opioids did not have a statistically significant association on this study. Awareness was associated with the use of muscle relaxant (OR2.793 (1.872-1.948), p-value 0.003). Patient with muscle relaxant were 2.8 times higher chance of developing awareness when compared to non-relaxed patients. Dreaming was associated with a female gender (OR 2.375, CI 1.038-5.433, and P value 0.036) in this study.

Variables	Frequency (%)	Bi-variant		Multivariate	
Age		Crude OR	P value	Adjusted OR	Pvalue
18-39	177(51.9)	0.510 (0.051-	0.568	1.447(0.177-11.83)	0.731
40-59	148 (43.4)	5,142)	0.957	1.212(0.145-10.09)	0.859
60-79	14(3.2)	0.939 (0.095-			
>80	2	9.332)			
Sex					
Male	200 (58.7)	0.974(0.442-	0.948	0.948(0.486-1.848)	0.875
Female	141(41.3)	2.149)			
ASA status					
ASA I	176(51.6)	5.421(0.62447.61	0.125	0.3(0.056-1.611)	0.160
ASA II	137(40.2)	7)	0.390	0.454(0.085-2.423)	0.333
ASA III	20(5.9)	2.391(0.327-	0.957	0.750(0.108-5.216)	0.771
ASA IV	8(2.3)	17.485)			
		0.941(0.107-			
		8.272)			
Alcohol					
Yes	57(16.7)	0.710(0.275-	0.479	1.286(0.559-2.957)	0.554
No	284(83.3)	1.833)			
Smoking					
Yes	16(4.7)	0.481(0.133-	0.265	2.676(0.819-8.738)	0.103
No	325(95.3)	1.745)			
chronic pain					
Yes	19(5.6)	0.349(0.098-	0.105	2.929(0.995-8.621)	0.042
No	322(94.4)	1.248)			
Premedication					
Yes	55(16.1)	0.673(0.260-	0.415	1.351(0.586-3.114)	0.480
No	286(83.9)	1.743)			
Difficult intubation					
Yes	2(0.6)	0.317(0.071-	0.131	2.359(0.621-8.964)	0.207
No	339(99.4)	1.407)			

Muscle relaxant					
Yes	267(78.3)	3.447(1.517-	0.003	2.793(1.872-1.948)	0.003
No	74(21.7)	7.831)			
Urgency of surgery	105(30.8)	1.680(0.645-	0.288	0.835(0.400-1.743)	0.835
Emergency	236(69.2)	4.375)			
Elective					
Type of operations	46(13.5)	0.356(0.037-	0.374	5.026(0.585-	0.141
Neurosurgery	37(10.9)	3.469)	0.485	43.179)	0.190
Thoracic	25(7.3)	0.438(0.043-	0.882	4.375(0.482-	0.479
ENT	10(2.9)	4.430)	0.587	39.727)	0.439
Endocrine	84(24.6)	0.818(0.059-	0.576	2.435(0.207-	0.307
Abdomen	29(8.5)	11.599)	0.685	28.584)	0.561
Gynecology	33(9.4)	0.433(0.021-	0.560	3.111(.176-54.967)	0.299
Urology	40(11.7)	8.892)	0.168	3.027(0.362-	0.094
Orthopedics	30(9.1)	0.533(0.059-	0.220	25.316)	0.145
Vascular	7(2.1)	4.816)		2.074(0.178-	
Trauma		0.587(0.045-		24.228)	
		7.677)		4.667(0.255-	
		0.391(0.017-		85.551)	
		9.169)		6.222(0.734-	
		0.208(0.022-		52.712)	
		1.936)		5.185(0.568-	
		0.234(0.023-		47.321)	
		2.384)			

**Table 5: Bi-Variant and Multi-Variable Logistic Regression Among Patients Who Develop Awareness with Recall Under General Anesthesia in Tikur Anbessa Specialized Hospital Addis Ababa, Ethiopia, 2021 (N=341)**

#### 4. Discussion

Awareness during surgery is a rare but potentially devastating event that occurs in the perioperative period. This study examines the incidence of awareness and its associated risk factors through an institutional-based cross-sectional approach. The study found that the incidence of awareness with recall under general anesthesia

was 11.7%. This rate is higher than that reported in most Western studies, which range from 0.0068% to 1% [17-21]. It also exceeds the rates observed in studies from Nigeria (4.6%), Brazil (2.5%), England (1.0%), India (0.78%), and Ethiopia (8.2% at Debre Tabor) [5,13,20,22]. However, it is lower than a study from Sudan, which reported an incidence of 13.3% [16]. The variation may



be due to factors such as the lack of anesthesia depth monitoring, absence of anesthetic gas monitors, anesthesia techniques used, and inappropriate drug dosages.

The incidence of awareness was assessed using the Modified Brice questionnaire, which revealed that 70% of respondents reported hearing voices, 10% experienced anxiety or stress, 10% felt pain, 5% recalled hearing events during surgery, and some patients reported sensations such as the inability to move or breathe, or feeling the breathing tube. These findings align with other studies, such as those from the US, which showed 48% of patients with auditory perceptions, 36% with anxiety, and 28% with pain, and from China, which reported similar experiences [13,20]. Another Brazilian study reported auditory memories (48%), sensations of not breathing (48%), and pain (28%) [8]. A study from Debre Tabor, Ethiopia, also found comparable results, with 4.9% hearing voices, 2.6% feeling pain, and 1.8% experiencing anxiety and stress [15]. These studies suggest no significant differences in the signs and symptoms of awareness. Multivariate logistic regression analysis showed a significant association between the use of muscle relaxants and awareness (OR 2.793, 95% CI 1.872-1.948,  $p = 0.003$ ). A meta-analysis by Nunes et al. found that 0.18% of patients receiving muscle relaxants developed awareness, highlighting the link between neuromuscular blocking agents and increased intra-operative awareness and implicit memory [10]. Additionally, a closed claims analysis by the American Society of Anesthesiologists identified muscle relaxants as a cause of awareness due to awake paralysis from labeling errors and incorrect drug administration in 18 out of 79 aware patients [21]. Silva and Squeff also demonstrated an association between awareness and the use of general anesthesia with muscle relaxants [8]. Hypnosis was achieved using volatile anesthetics or intravenous anesthesia, but factors such as low minimum alveolar concentration (MAC), lack of intravenous supplements, infrequent machine maintenance, and expired CO<sub>2</sub> absorbent could contribute to awareness.

While many studies consider ASA physical status an independent risk factor for awareness, this study did not find a significant association. This discrepancy may be due to the small sample size or the low number of patients with higher ASA status in this study. In contrast, other studies have shown a positive correlation between awareness and higher ASA status, such as a study from China indicating a link with ASA III and IV status [20,23]. Factors like the type of surgery, difficult intubation, and previous awareness history were not associated with awareness in this study, potentially due to the limited sample size. However, bi-variate and multivariate analysis showed that dreaming was significantly associated with female sex (OR 2.375, CI 1.038-5.433,  $p = 0.036$ ). The incidence of dreaming in this study (6%) aligns with a multi-center US study but is slightly higher than another study reporting 3.3% [13,24,25]. Conversely, the incidence here was lower than in another US study that reported a 22% incidence of dreaming [21].

## 5. Conclusion

According to this study, the incidence of intraoperative awareness

with recall under general anesthesia was 11.7%. Under the findings of this study, we conclude that the incidence of awareness with recall under general anesthesia is higher than in most global studies. However, the risk factors and symptoms of awareness were comparable with most literature. The use of muscle relaxants was identified as a risk factor in this study. When the incidence of dreaming was 9.3%, being female is a risk factor for dreaming.

## Strengths and Limitations of The Study

Having a comparable finding of this study with most studies across the globe was one of the strengths of this study. Patients were interviewed a minimum of two times and the response rate was also good. It will also serve as a baseline for further studies in the future. The limitation of this study includes being done in a single center; low sample size, absence of anesthesia depth monitors, and lack of gas analyzer.

## Recommendation

Awareness has a great impact on the patient's life and peri-operative satisfaction. So that the study has recommended the anesthesia provider give much emphasis on intra-operative awareness, be vigilant on the dosage of relaxants, hypnotics, and inhalational, prevention and pain management, follow the patient in the postoperative period, and check anesthesia equipment and machine every day for every patient. We also recommend to have anesthesia depth monitors and gases sensors to monitor inhalational anesthetics in the gases supply. Finally, the area also needs further multicenter studies to draw conclusion to the national level.

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