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# Incidence and Risk Factors of Emergence Delirium after Anesthesia in Elderly Patients at a Postanesthesia Care Unit in Ethiopia: Prospective Observational Study

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**Introduction:** Emergence delirium is a common incidental trouble in elderly patients that may interfere with patient recovery and will challenge the attending staff. So, we aimed to determine the incidence and risk factors of emergence delirium after anesthesia in elderly patients at the University of Gondar Comprehensive Specialized Hospital (UOGCSH), Post Anesthesia Care Unit (PACU).

**Methods:** A prospective observational study was conducted from February 20 to May 20, 2020 among elective and emergency procedures in patients aged 60 years and over at UOGCSH, PACU. Data were analyzed by SPSS version 20. The association between outcome variables and independent variables was determined by binary logistic regression analysis. The strength of association of variables was determined by calculating crude and adjusted odds ratio with 95% CI. A *P*-value of <0.05 was used to determine the significance of the variable.

**Results:** A total of 172 patients were included with a 97.7% response rate. The incidence of emergence delirium at PACU was 40.7% (95%CI: 32–48). Perioperative intravenous narcotic used (AOR: 5.1, 95%CI: 1.265–20.565), intraoperative excessive blood loss (AOR: 6.5, 95% CI: 2.47–17.02), and preoperative anxiety (AOR: 7, 95%CI: 1.757–28.549) were significantly associated with emergence delirium.

**Conclusion:** Perioperative intravenous narcotic, intraoperative blood loss, and preoperative anxiety were significantly associated with emergence delirium. Reassuring patients preoperatively, giving full information about anesthesia and adequate postoperative pain management may decrease the magnitude of emergence delirium.

**Keywords:** delirium, emergence delirium, incidence and associated factors, postanesthesia care

## Introduction

Delirium is an acute confusional state mainly outlined by fluctuating symptoms including, disturbance of consciousness, inattention, and disorganized thinking.[1,2] Delirium is manifested by decreased ability to maintain attention and impaired cognition.[3,4] It has been associated with neurological status degeneration and scarcity of neurotransmitters in the brain.[5] Emergence delirium usually lasted for 15 to 30 min soon after anesthesia in PACU.[6,7]

The incidence of delirium in critically ill patients was 50–80%, in elective major noncardiac surgical patients were up to 54%, in any elderly patients were 70%, and in elderly patients who underwent surgery were up to 47%. Although it may affect

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any age group, it was more prevalent in older patients after lengthy major surgeries.[1,2,8–11]

Emergence delirium is a serious and unsafe complication that leads to increased morbidity and mortality, increased length of hospital stay, and costs of patient care after surgery.[3,4,9–12] Each year emergence delirium complicates hospital stays for more than 2.3 million older people, involves more than 17.5 million inpatients, and accounts for more than $4–16 billion of Medicare expenditure. Substantial additional costs accrue after discharge from the hospital because of the increased need for institutionalization, rehabilitation, and home care.[3]

Studies have found that patients experiencing emergence delirium were often quite violent, with 86% of patients who were thrashing and kicking, while 14% of them were simply incoherent. This implies that emergence delirium can be quite dangerous to patients and caregivers. Due to the unsafe behavior of patients, there might be an unrecognized and delayed diagnosis of the disease, which affects the safety of the patients and may need more staff for patient management.[5,9,12] Common risks that often occur were the removal of urinary and indwelling catheters, damage to the surgical site, the removal of dressings, drainage tubes, and monitors, which makes assessing such patients quite difficult for PACU staff.[5]

According a study by Patel et al, there was no substantial evidence on emergence delirium to recommend a specific type of anesthetic technique, general or regional anesthesia, however, intraoperative monitoring to avoid swings in blood pressure was advocated.[13]

It is a common problem we face immediately after anesthesia as well as in PACU, especially anesthetists, nurses, interns, and residents are facing such delirium in elderly patients. As far as human resources are concerned, it increases the number of staff members to restrain an agitated patient. Staff must be present on-site at all times, and while nurses or other professionals are attending to delirium patients, other patients might be less closely watched, thereby increasing their anxiety. So, we aimed to determine the incidence and associated risk factors of emergence delirium after anesthesia in elderly patients at UOGCSH, PACU.

# Methodology

## Study Design, Study Setting, and Population

An institution-based, prospective observational study was conducted in UOGCSH, from February 20 to May 20, 2020, at PACU. This referral and teaching hospital is found at Gondar Town in Amhara Regional State, located 738 km away from Addis Ababa, Ethiopia. In this study we included both elective and emergency procedures in patients aged 60 years and over who underwent an operation in the study period. However, patients who had a known psychiatric disorder and intubated patients at PACU were excluded from the study.

## Operational Definitions

When the Richmond Agitation-Sedation Scale (RASS) ≥1 within the first one hour, it was considered as emergence delirium (Table 1).[7,12,14] State-Trait Anxiety Inventory (STAI) was calculated from a total score (range: 20–80); sum all the six scores and then multiply the total score by 20/6. A value greater than 44 was considered as presence of clinically significant anxiety. Score of 20: patients feel no anxiety at all. Score of 80: patients feel a high level of anxiety (Table 2).[15] The numerical rating scale was assigned from 0 to 10 to represent the severity of pain (Figure 1).[16] The participants were categorized as elderly if they were

**Table 1** Richmond Agitation-Sedation Scale (RASS)

| Score | Term | Description |
|---|---|---|
| +4 | Combative | Overtly combative, violent, immediate danger to staff |
| +3 | Very agitated | Pulls or remove tube(s) or catheter, aggressive |
| +2 | Agitated | Frequent nonpurposeful movement, fight ventilator |
| +1 | Restless | Anxious but movement not aggressive vigorous |
| 0 | Alert and calm | |
| −1 | Drowsy | Not fully alert, but has sustained awakening (eye-opening/eye contact) to voice (≥10 seconds) |
| −2 | Light sedation | Briefly awakens with eye contact to voice (≤10 seconds) |
| −3 | Moderate sedation | Movement or eye opening to voice (but not eye contact) |
| −4 | Deep sedation | No response to voice, movement or eye opening to physical stimulation |
| −5 | Unarousable | No response to voice or physical stimulation |

**Table 2** State-Trait Anxiety Inventory

| **Negative Items** | | | | |
|---|---|---|---|---|
| **Items** | **Not at All** | **Some What** | **Moderately** | **Very Much** |
| I feel tense | 1 | 2 | 3 | 4 |
| I feel upset | 1 | 2 | 3 | 4 |
| I feel worried | 1 | 2 | 3 | 4 |
| **Positive Items** | | | | |
| **Items** | **Not at All** | **Some What** | **Moderately** | **Very Much** |
| I feel calm | 4 | 3 | 2 | 1 |
| I feel relaxed | 4 | 3 | 2 | 1 |
| I feel content | 4 | 3 | 2 | 1 |

aged ≥60 years.[17,18] The abnormality of sodium and potassium was considered if the serum level was <130 or >150 mmol/L and <3 or >6 mmol/L respectively.[10] Intraoperative blood loss ≥400 mL was considered excessive blood loss.[19] Prolonged hospital admission was defined as a preoperative hospital stay of more than a week.

## Sample Size and Procedure

To determine the sample size, single population proportion formula was used. Since there was no previous study done similar with this topic, we took a proportion of 50% by assuming a 95%CI with a 5% margin of error, and finally, the sample size for the study was calculated as:

$$n = \frac{(z^{\propto}/2)2pq}{\varepsilon^2}$$

Where; n=the desired sample size; z=standard normal distribution usually set as 1.96 (corresponds to 95%CI); *p*=population proportion (50%, 0.5), q which is 1–0.5=0.5, and d=degree of accuracy desired (marginal error is 5%, 0.05); then the sample size was

$$n=\frac{(1.96)^2\times(.5\times.5)}{(0.05)^2} =384.16 \approx 385.$$

Among the total number of operations, the number of elderly patients having an operation in our hospital annually is below 10,000, correction factor formula was used to get the exact sample size. Here in UOGCSH, an average of 80–82 cases were done in a month therefore, by considering this 246 operations were performed on average.

$$nf = \frac{n}{1+n/N}$$

Where; nf=adjusted sample size, n=initial sample size. N=population size.

$nf = \frac{385}{1+385/246}$=151 with 10% nonresponse rate, nf=176

Where; nf=final adjusted sample size. Finally, data were collected based on convenient sampling technique until the desired sample size was achieved.

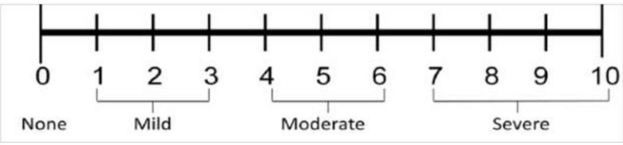


**Figure 1** Numerical rating scale (NRS).

## Data Collection Procedures and Quality Control

Before data collection, training was given to data collectors. The data collection procedures included chart review, interview, and direct observation of patient's RASS score in the first one hour at PACU. The questionnaire was primarily prepared in the English language and tools were translated to the Amharic language. The questionnaire includes sociodemographic variables, preoperative, intraoperative, and postoperative related risk factors. To ensure qualities of data, pretesting of the data collection tool was conducted on 18 patients or 10% of the study sample size. Data collectors were provided adequate information regarding the assessment tool of RASS. The data collectors were closely monitored by the principal investigator throughout the study period. The collected data were checked for completeness, accuracy, and clarity on the day of data collection before entering into the database by the principal investigator.

## Statistical Methods

The data were entered into Epi Info™ software version 7 and analyzed with SPSS version 20. Descriptive statistics were used to explain the study participants in relation to study variables and presented as median (interquartile range). Hosmer–Lemeshow test was used to assess the goodness of fit. The association between the outcome variable and independent variables was determined by binary logistic regression analysis. The strength of association of variables was determined by calculating COR and AOR with 95%CI. The minimum value of statistical significance $p<0.2$ for bivariable and 0.05 for multivariable binary logistic regression. Finally, data were presented with numbers, frequencies, tables, charts, and figures accordingly.

## Ethical Consideration

This study was approved by the Institutional Review Board of the University of Gondar with SOM on May 12, 2019 and conducted in accordance with the Declaration of Helsinki. All participants of the study were informed about the study and written consent was taken. Every participant was allowed to discontinue if they did not want to take part in the study. They were assured that their treatment and other benefits they can gain from the hospital were not interrupted or compromised due to their withdrawal. Those patients who developed emergence delirium during the data collection period were treated by the assigned health professionals. Confidentiality was ensured by removing identifiers.

# Results

## Sociodemographic Characteristics

A total of 172 patients were included with a 97.7% response rate. Four patients were excluded from the analysis due to incomplete data. Regarding the age of the participants ≥75 years, 11 (57.9%) developed emergence delirium. Among elderly patients 93 (54.1%) were males and 79 (45.9%) were females. The majority of participants' BMI 138 (80.2%) were found between 18.5 −24.5 kg/m$^2$ (Table 3).

**Table 3** Sociodemographic Characteristics of the Study Participants, in UOGCSH, Northwest Ethiopia (n=172)

| Variables (n=172) | | Emergence Delirium, Frequency (%) | |
|---|---|---|---|
| | | Yes (n=70) | No (n=102) |
| **Overall** | **Frequency (%)** | **70 (40.7)** | **102 (59.3)** |
| Age (years) | | | |
| 60–64 | 85 (49.4) | 34 (40) | 51 (60) |
| 65–74 | 68 (39.5) | 25 (36.8) | 43 (63.2) |
| ≥75 | 19 (11.1) | 11 (57.9) | 8 (42.1) |
| Sex | | | |
| Male | 93 (54.1) | 41 (44.1) | 52 (55.9) |
| Female | 79 (45.9) | 29 (36.7) | 50 (63.3) |
| BMI (kg/m$^2$) | | | |
| ≤ 18 | 25 (14.5) | 12 (48) | 13 (52) |
| 18.5–24.5 | 138 (80.2) | 53 (38.6) | 85 (61.4) |
| ≥25 | 9 (5.3) | 5 (55.6) | 4 (44.4) |

**Notes:** n=frequency, %=percentage.
**Abbreviation:** BMI, body mass index.

## Preoperative Risk Factors

As the distribution of preoperative risk factors showed, the majority of patients lie on ASA I, 109 (63.4%), while ASA II and ASA III, are 54 (31.4%), 9 (5.2%), respectively. Those patients who had a history of substance abuse like chewing khat and consuming alcohol regularly were 62 (36%). Regarding urgency of surgery, 95 (55.2%) were elective and the rest 77 (44.8%) were emergency procedures (Table 4).

## Intraoperative and Postoperative Risk Factors

Among elderly patients who underwent an operation, general surgeries were mostly procedures relative to the other specialties, 77 (44.8%). From the available induction agents, 58 (33.7%) of patients were induced with ketamine. From the technique of anesthesia, GA/ETT was the most commonly used procedure, 131 (76.2%. For postoperative pain management, NSAID was the frequently given drug, 85 (49.4%) (Table 5).

## Incidence of Emergence Delirium in Elderly Patients

The incidence of emergence delirium in elderly patients at PACU was 70 (40.7%) (95%CI: 32–48). The first occurrences of emergence delirium were during the first one hour period. Out of this, (42.85%) patients were agitated and 32.86% restless (Figure 2).

## Time to Emergence Delirium Occurrence

The time to occurrence of emergence delirium at PACU was higher within the first 11–20 min with 31.4% as shown in Figure 3.

## Factors Associated with Emergence Delirium Among Elderly Patients at PACU

On the bivariable binary logistic regression, ASA physical status, premedication with benzodiazepine, comorbidity, history of substance abuse and consuming alcohol, induction agent, technique of anesthesia, maintenance agent, perioperative intravenous narcotic use, intraoperative excessive blood loss, postoperative pain, and preoperative anxiety were significant at $p$-value <0.2. However, perioperative intravenous narcotic used, excessive intraoperative blood loss, postoperative pain, and preoperative

**Table 4** A Cross-tabulation of the Preoperative Factors and Their Association with Emergence Delirium after Anesthesia in Elderly Patients at PACU in UOGCSH, Northwest Ethiopia (n=172)

| Variables (n=172) | | Emergence Delirium, Frequency (%) | |
|---|---|---|---|
| | | Yes (n=70) | No (n=102) |
| **Overall** | **Frequency (%)** | **70 (40.7)** | **102 (59.3)** |
| ASA physical status | | | |
| ASA I | 109 (63.4) | 29 (26.6) | 80 (73.4) |
| ASA II | 54 (31.4) | 33 (38.9) | 21 (61.1) |
| ASA III | 9 (5.2) | 8 (88.9) | 1 (11.1) |
| Premedication with benzodiazepine | | | |
| Yes | 14 (8.1) | 11 (78.6) | 3 (21.4) |
| No | 158 (91.9) | 59 (37.3) | 99 (62.7) |
| Duration of fasting time | | | |
| <360 min | 87 (50.6) | 38 (43.7) | 49 (56.3) |
| ≥360 min | 85 (49.4) | 32 (37.6) | 53 (62.4) |
| Comorbidity | | | |
| Yes | 57 (33.2) | 39 (68.4) | 18 (31.6) |
| No | 115 (66.8) | 31 (27) | 84 (73) |
| History of substance abuse and alcohol consuming | | | |
| Yes | 62 (36.1) | 36 (58.1) | 26 (41.9) |
| No | 110 (63.9) | 34 (30.9) | 76 (69.1) |
| Electrolyte abnormality | | | |
| Yes | 12 (6.9) | 8 (66.7) | 4 (33.3) |
| No | 160 (93.1) | 62 (38.8) | 98 (61.2) |
| Urgency of surgery | | | |
| Elective | 95 (55.2) | 41 (43.2) | 54 (56.8) |
| Emergency | 77 (44.8) | 29 (37.7) | 48 (62.3) |
| Previous hospital admission | | | |
| Yes | 31 (18) | 17 (54.8) | 14 (45.2) |
| No | 141 (82) | 53 (37.6) | 88 (62.4) |

**Notes:** n=frequency. %=percentage.
**Abbreviations:** PACU, postanesthesia care unit; ASA, American Society of Anesthesiologists.

anxiety were significantly associated with emergence delirium in multivariable binary logistic regression at which *p*-value was <0.05.

Elderly patients who had given intravenous narcotics were 5.1 times (AOR: 5.1, 95%CI: 1.265–20.565), more likely to develop emergence delirium than who were not given intravenous narcotics. Those patients having excessive intraoperative blood loss were 6.5 times (AOR: 6.5,

**Table 5** A Cross-tabulation of the Intraoperative and Postoperative Factors and Their Association with Emergence Delirium after Anesthesia at PACU in UOGCSH, Northwest Ethiopia (n=172)

| Variables (n=172) | | Emergence Delirium, Frequency (%) | |
|---|---|---|---|
| | | Yes (n=70) | No (n=102) |
| **Overall** | **Frequency (%)** | **70 (40.7)** | **102 (59.3)** |
| Type of surgery | | | |
| General surgery | 77 (44.8) | 30 (39) | 47 (61) |
| Urology | 16 (9.3) | 3 (18.8) | 13 (81.2) |
| Orthopedics | 26 (15.1) | 11 (42.3) | 15 (57.7) |
| Gynecology | 31 (18) | 12 (38.7) | 19 (61.3) |
| Neurosurgery | 13 (7.6) | 7 (53.8) | 6 (46.2) |
| Cardiothoracic | 4 (2.3) | 4 (100) | 0 (0) |
| ENT | 5 (2.9) | 3 (60) | 2 (40) |
| Induction agent | | | |
| Ketamine | 58 (33.7) | 31 (53.4) | 27 (46.6) |
| Thiopental | 22 (12.8) | 5 (22.7) | 17 (77.3) |
| Propofol | 14 (8.2) | 3 (21.4) | 11 (78.6) |
| Ketofol | 46 (26.7) | 29 (63) | 17 (37) |
| Anesthesia Type | | | |
| GA/ETT | 131 (76.2) | 65 (49.6) | 66 (50.4) |
| GA/LMA | 9 (5.2) | 3 (33.3) | 6 (66.7) |
| SA | 32 (18.6) | 2 (6.2) | 30 (93.8) |
| Maintenance agent | | | |
| Halothane | 88 (51.2) | 42 (6.2) | 46 (93.8) |
| Isoflurane | 52 (30.2) | 26 (50) | 26 (50) |
| Use of muscle relaxant | | | |
| Yes | 129 (75) | 66 (51.2) | 63 (48.8) |
| No | 43 (25) | 4 (9.3) | 39 (90.7) |
| Use of anticholinergic | | | |
| Yes | 59 (65.7) | 26 (44.1) | 33 (55.9) |
| No | 113 (34.3) | 44 (38.9) | 69 (61.1) |
| Duration of surgery | | | |
| <120 min | 56 (32.6) | 14 (25) | 42 (75) |
| ≥ 120 min | 116 (67.4) | 56 (48.3) | 60 (51.7) |
| IV narcotic used | | | |
| Yes | 109 (63.4) | 63 (57.8) | 46 (42.2) |
| No | 63 (36.6) | 7 (11.1) | 56 (88.9) |
| Excess blood loss | | | |
| Yes | 74 (43) | 51 (68.9) | 23 (31.1) |
| No | 98 (57) | 19 (19.4) | 79 (80.6) |
| Blood transfusion | | | |
| Yes | 14 (8.1) | 9 (64.3) | 5 (35.7) |
| No | 158 (91.9) | 61 (38.6) | 97 (61.4) |
| Bladder catheter | | | |
| Yes | 168 (97.7) | 69 (41.1) | 99 (58.9) |
| No | 4 (2.3) | 1 (25) | 3 (75) |

(*Continued*)

**Table 5** (Continued).

| Variables (n=172) | | Emergence Delirium, Frequency (%) | |
|---|---|---|---|
| | | Yes (n=70) | No (n=102) |
| **Overall** | **Frequency (%)** | **70 (40.7)** | **102 (59.3)** |
| NGT | | | |
| Yes | 20 (11.6) | 11 (55) | 9 (45) |
| No | 152 (88.4) | 59 (38.8) | 93 (61.2) |
| Postoperative pain management | | | |
| Opioid | 32 (18.6) | 11 (34.4) | 21 (65.6) |
| NSAID | 85 (49.4) | 31 (36.5) | 54 (63.5) |
| Infiltration | 9 (5.3) | 4 (44.4) | 5 (55.6) |
| Nerve block | 46 (26.7) | 24 (52.2) | 22 (47.8) |
| Postoperative pain | | | |
| None to mild | 47 (27.3) | 7 (14.9) | 40 (85.1) |
| Moderate to severe | 125 (72.7) | 63 (50.4) | 62 (49.6) |
| Preoperative anxiety | | | |
| Yes | 26 (15.1) | 22 (84.6) | 4 (15.4) |
| No | 146 (84.9) | 48 (32.9) | 98 (67.1) |

**Notes:** n=frequency. %=percentage.
**Abbreviations:** ENT, ear nose throat; NSAIDs, nonsteroidal anti-inflammatory drugs; NGT, nasogastric tube; GA, general anesthesia; LMA, laryngeal mask airway.

95%CI: 2.47–17.024), more likely to develop emergence delirium than having less intraoperative blood loss.

Participants who had moderate to severe pain at PACU were 3.9 times (AOR: 3.9, 95%CI: 1.134–13.596), more likely to develop emergence delirium when compared to those who had none to mild pain. Similarly, those elderly patients having preoperative anxiety were seven times (AOR: 7, 95%CI: 1.757–28.549), more likely to develop emergence delirium when compared to non-anxious patients (Table 6).

## Discussion

Emergence delirium is a confusional state that occurs during the recovery phase of anesthesia and is associated with increased patient morbidity and resource utilization. Incidence rates of emergence delirium in the PACU can occur in up to 80% of surgical procedures and have proven to be a problem in the ability of health-care providers to manage their patients appropriately.[5] In this study, we used RASS for assessment of emergence delirium, because it has good specificity and sensitivity for diagnosis in older patients.[14]

The study was conducted to find out the incidence and associated factors among elderly patients after anesthesia at PACU. The overall incidence of emergence delirium in elderly patients at PACU was reported 40.7% (95%CI: 32–48).

A prospective study carried out at Black Line Hospital, in Ethiopia, showed that the incidence of emergence delirium in the general surgical population was 31.7%. This is relatively low when compared with this study. The possible explanation of this discrepancy could be elderly patients were at more risk of developing emergence delirium than adult age groups.[7]

A study conducted in Canada showed that the incidence of emergence delirium in elderly patients was 41.6%, this is approximately in line with our finding.[21] However, another prospective observational study found that the incidence of emergence delirium was 23%. Our finding is relatively higher than the above study. The possible explanation for the high incidence of emergence delirium in our study might be due to inadequate preoperative optimization and reassurance of the patient, inadequate postoperative pain management, and could be due to clinical set-up differences.[22]

Another prospective study found that the incidence of emergence delirium varies from 10% to 46% in the general surgical population. It occurred in approximately 7.8% of elderly patients with benign prostatic hyperplasia who underwent TURP. The possible explanation might be due to the use of continuous bladder irrigation after transurethral resection of the prostate and irritation from catheters were often a distressing risk factor for emergence delirium.[23]

A study conducted in the USA, in elderly patients that underwent major surgery, showed that the incidence of emergence delirium varies between 5.1% and 52.5%. Certain procedures such as hip fracture and aortic surgery had higher risk of postoperative delirium. The possible

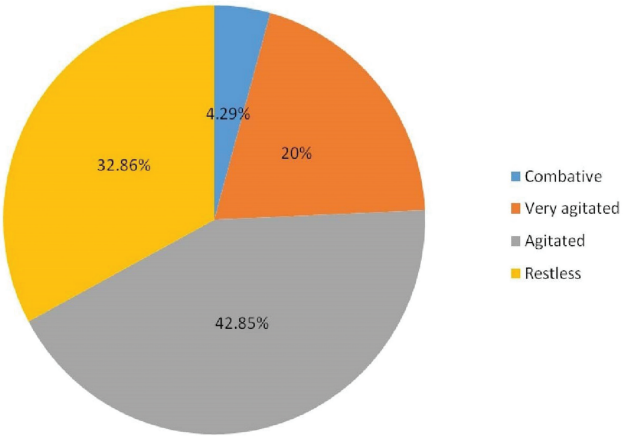


**Figure 2** Percentage and degree of delirium in elderly patients after anesthesia at postanesthesia care unit in University of Gondar Comprehensive Specialized Hospital Northwest Ethiopia 2020 (n=70).

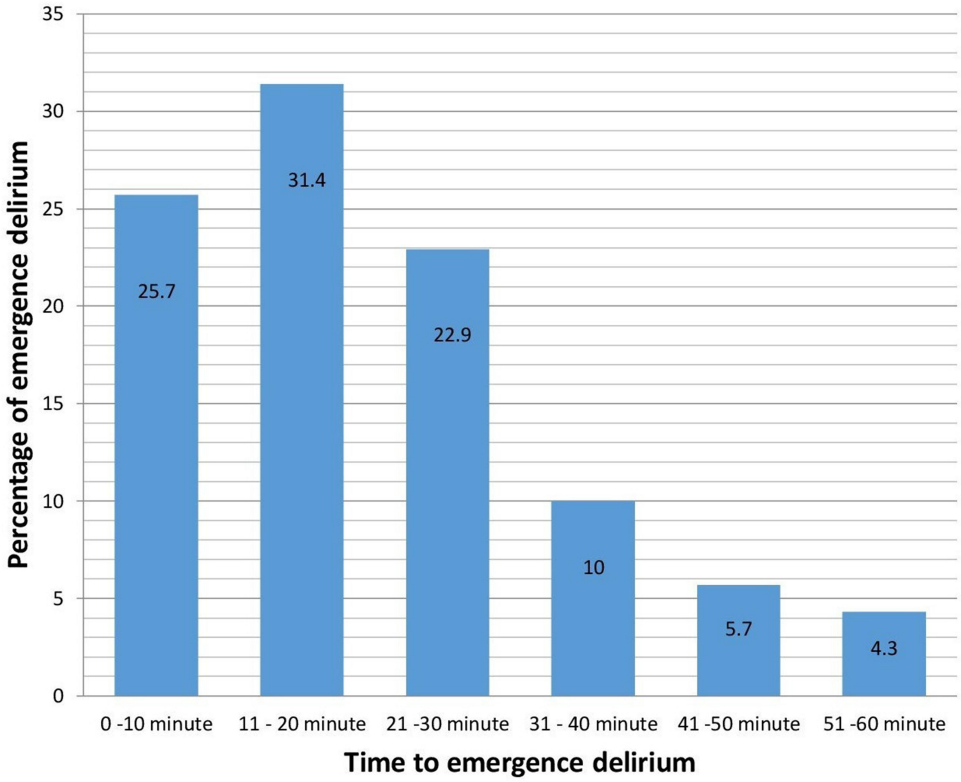


**Figure 3** Bar graph presentation of percentage and time to emergence delirium occurrence in elderly patients after anesthesia at postanesthesia care unit in University of Gondar Comprehensive Specialized Hospital, Northwest Ethiopia 2020 (n=70).

reason could be due to major surgery, high intraoperative bleeding, and prolonged duration of surgery.[24]

Another study conducted in China showed that patients who developed postoperative delirium in elderly patients were significantly associated with the risk of developing delirium with an incidence of 36.8% of surgical patients suffering from emergence delirium.[9]

In this study, perioperative intravenous narcotics used were 5.1 times (AOR: 5.1, 95%CI: 1.265–20.565), more likely to develop emergence delirium than those who have not taken intravenous narcotics. This finding is supported by other studies in which opioids increase the risk of adverse outcomes such as delirium, but whether this risk differs between the various opioids remains controversial. It has been shown that patients with narcotics were 5.2 times more likely to develop emergence delirium than those patients who have not taken narcotics.[25–27] The possible explanation for risk of emergence delirium differs among the various opioids as a result of their specific pharmacokinetic and pharmacodynamic properties. Rudolph et al proved that opioid pain medication is needed after surgery with standardized age-adjusted protocols to minimize emergence delirium.[28]

In this study, participants having excessive intraoperative blood loss were 6.5 times (AOR: 6.5, 95%CI: 2.47–17.02), more likely to develop emergence delirium than those who have less intraoperative bleeding. Other studies agreed that intraoperative excessive bleeding was a high risk factor for postoperative emergence delirium. The possible explanation might be that intraoperative excessive blood loss may result in a drop of cerebral blood flow and hypotension which invoked emergence delirium. Intraoperative hypotension could be deliberate or due to bleeding from the procedure with reduction of mean arterial blood pressure[20] and above.[13,19,29] Another prospective study agreed that intraoperative excessive bleeding was 1.6 times significantly associated with postoperative emergence delirium.[30,31]

In this study, those patients having postoperative moderate to severe pain were 3.9 times (AOR: 3.9, 95%CI: 1.134–13.596), more likely to develop emergence delirium when compared with those patients having none to mild pain. This finding was in agreement with a study conducted in California which stated that emergence delirium was more likely when the pain numeric rating scale was greater than or equal to five. In their study, those elderly

**Table 6** Bivariable and Multivariable Binary Logistic Regression with Emergence Delirium in Elderly Patients at PACU in UOGCSH, Northwest Ethiopia (n=172)

| Variables (n= 172) | | Emergence Delirium, Frequency (%) | | Odds Ratio | |
|---|---|---|---|---|---|
| | | Yes (n=70) | No (n=102) | | |
| Overall | | 70 (40.7) | 102 (59.3) | | |
| | | | | Crude (95%CI) | Adjusted (95%CI) |
| ASA status | ASA I<br>ASA II<br>ASA III | 29 (26.6)<br>33 (38.9)<br>8 (88.9) | 80 (73.4)<br>21 (61.1)<br>1 (11.1) | 1*<br>4.34 (2.168–8.66)<br>22 (2.644–184.195) | 1<br>3.67 (0.88–15.235)<br>7.42 (0.49–112.6) |
| Benzodiazepine | Yes<br>No | 11 (78.6)<br>59 (37.3) | 3 (21.4)<br>99 (62.7) | 6.15 (1.649–22.95)*<br>1 | 3.97 (0.694–22.739)<br>1 |
| Comorbidity | Yes<br>No | 39 (68.4)<br>31 (27) | 18 (31.6)<br>84 (73) | 5.87 (2.93–11.75)*<br>1 | 0.80 (0.185–3.456)<br>1 |
| Substance abuse | Yes<br>No | 36 (58.1)<br>34 (30.9) | 26 (41.9)<br>76 (69.1) | 3.09 (1.621–5.9)*<br>1 | 0.91 (0.340–2.478)<br>1 |
| Technique of anesthesia | GA/ETT<br>GA/LMA<br>SA | 65 (49.6)<br>3 (33.3)<br>2 (6.2) | 66 (50.4)<br>6 (66.7)<br>30 (93.8) | 14.77 (3.39–64.36)<br>7.5 (1.023–54.996)<br>1* | 0.77(0.124–4.868)<br>0.23 (0.22–2.596)<br>1 |
| Induction agent | Ketamine<br>Thiopental<br>Propofol<br>Ketofol | 31 (53.4)<br>5 (22.7<br>3 (21.4)<br>29 (63) | 27 (46.6)<br>17 (77.3)<br>11 (78.6)<br>17 (37) | 0.67 (0.305–1.483)<br>0.17 (0.054–0.552)<br>0.16 (0.039–0.655)<br>1– | 2.48 (0.116–53.1)<br>0.45 (0.015–13.416)<br>0.84 (0.036–19.72)<br>1 |
| Maintenance agent | Halothane<br>Isoflurane | 42 (6.2)<br>26 (50) | 46 (93.8)<br>26 (50) | 0.91 (0.460,1.813)*<br>– | 1.43 (0.49–,4.139)<br>1 |
| IV narcotics use | Yes<br>No | 63 (57.8)<br>7 (11.1) | 46 (42.2)<br>56 (88.9) | 10.95 (4.577–26.2*)<br>1 | 5.10 (1.265–20.565)**<br>1 |
| Excess blood loss | Yes<br>No | 51 (68.9)<br>19 (19.4) | 23 (31.1)<br>79 (80.6) | 9.22 (4.568–18.60*)<br>1 | 6.48 (2.47–17.024)**<br>1 |
| Postoperative pain | None to mild<br>Moderate to severe | 7 (14.9)<br>63 (50.4) | 40 (85.1)<br>62 (49.6) | 1<br>5.80 (2.4,13.946)* | 1<br>3.92 (1.134–13.596)** |
| Preoperative anxiety | Yes<br>No | 22 (84.6)<br>48 (32.9) | 4 (15.4)<br>98 (67.1) | 11.23 (3.66,34.4)*<br>1 | 7.07 (1.757–28.549)**<br>1 |

**Notes:** *Significant in bivariable logistic regression (*p*-value <0.2).SA=spinal anesthesia. **Significant in multivariable logistic regression (p-value <0.05).
**Abbreviations:** GA, general anesthesia; LMA, laryngeal mask airway; ETT, endotracheal tube; AOR, adjusted odds ratio; SA, spinal anesthesia.

patients who managed their pain with opioids were more likely to develop emergence delirium than those managed with nonopioids.[26–28] Another study conducted in South Korea dictated that emergence delirium was 3.6 times more likely to develop when the pain numerical rating scale was ≥6.[32]

In our study, elderly patients who had preoperative anxiety were seven times (AOR: 7, 95%CI: 1.757–28.549), more likely to develop emergence delirium than those who were not anxious in the preoperative period.[15] This result was in line with a prospective observational study done by Wada et al, who stated that preoperative anxious patients were 4.37 times more likely to develop emergence delirium than nonanxious patients.[33]

## Strength and Limitation of the Study

To the best of our knowledge, this is one of the few studies to investigate the incidence and associated factors of emergence delirium in elderly patients at PACU. This finding

will primarily to primarily reassure the patient and to decrease the magnitude of the problem. Finally, the limitations of this study were that we did not include patients with preexisting dementia and cognitive impairments, some of the associated variables had wider a confidence interval due to the smaller sample size. We did not study duration of delirium and took the first occurrences of emergence delirium. Different surgical procedures, both elective and emergency cases may affect the result of the study.

## Conclusion

In this study, emergence delirium has been identified as a significant problem and presented as a challenge in the recovery process for patients and PACU providers. The incidence of emergence delirium after anesthesia in elderly patients was 40.7% (95%CI: 32–48). This study showed that intravenous narcotic use, excessive intraoperative blood loss, postoperative pain, and preoperative anxiety were significantly associated with emergence delirium. Preoperative reassuring of the patient and adequate postoperative nonopioid pain management may decrease the magnitude of the problem. Finally we recommend research for further study using large sample size with longitudinal follow-up study.

## Abbreviations

ASA, American Society of Anesthesiologist; AOR, adjusted odds ratio; COR, crude odds ratio; ETT, endotracheal tube; ICU, intensive care unit; LMA, laryngeal mask airway; PACU, postanesthesia care unit; RASS, Richmond Agitation-Sedation Scale; SPSS, Statistical Package for Social Science; STAI, State-Trait Anxiety Inventory; UOGCSH, University of Gondar Comprehensive Specialized Hospital.

## Data Sharing Statement

Data are available with Muleta Teshome Assefa, teshomemuleta94@gmail.com, upon reasonable request.

## Ethics Approval

This study was approved by the Institutional Review Board of the University of Gondar with SOM on May 12, 2019 and conducted in accordance with the Declaration of Helsinki. All participants of the study were informed about the study and they gave their written consent to be included in the study.

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## Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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The authors report no conflicts of interest in this work.

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