BMC Anesthesiology

RESEARCH

Open Access

Postoperative delirium among elderly elective orthopedic patients in Addis Ababa Ethiopia: a multicentere longitudinal study

Y. A. Tekletsadik[2], S. A. Workineh[1], A. S. Gesso[1*] and H. S. Hirbo[1]

Abstract

Background Delirium is a neurocognitive disorder characterized by an acute and relatively rapid decline in cognition, disturbance of consciousness, reduced ability to focus, and shift of attention. It mainly affects elderly patients with an incidence of about 8–23% after an operation. It frequently occurs between 24-hrs and 5 days after surgery. It results in serious medical management problems. Hence, identifying the incidence and associated factors may help prevent and manage its sequel in the elderly.

Objective Assessment of the incidence and associated factors of postoperative delirium(POD) among elderly elective orthopedic surgical patients in Addis Ababa public hospitals, Ethiopia, 2024.

Methods A multi-centered longitudinal study was conducted on 220 elderly (age ≥ 65 years) patients in four selected public hospitals of the study area from February 2024 to May 2024, and a systematic sampling technique was used to select the study units. Data was collected through chart review and interviews of patients, and postoperative delirium was assessed using the confusion assessment method (CAM). Both bivariable and multivariable logistic regression models were used for statistical analysis. The strength of association was determined with an adjusted odds ratio (AOR) with a 95% confidence interval(CI) at a p-value of < 0.05.

Results A total of 220 patients were studied, and the incidence of POD among elderly elective orthopedic surgical patients was 33.7%. Age 65–75(AOR = 0.47, 95%CI (0.226–0.97)), Induction using ketamine (AOR = 1.32, 95%CI(1.109–3.87), $p = 0.003$)), perioperative opioid use (AOR = 2.20, 95%CI(1.073 4.5313)), intraoperative anticholinergic use(AOR = 2.24,95%CI(1.831–4.235)), recent hospitalization history (AOR = 2.24,95%CI(1.202–4.206)), and transfusion (AOR = 2.83,95%CI(1.295–6.193)) were significantly associated with POD ($p < 0.05$).

Conclusion and recommendations The incidence of POD in the study area was high (33.7%); advanced age, hospitalization history, Anesthesia induction by Ketamine, perioperative anticholinergic uses, opioid use, and blood transfusion use were associated factors for postoperative delirium. We recommend giving due attention to elderly patients with advanced age, history of hospitalization, perioperative Ketamie use, perioperative anticholinergic uses, opioid use, and blood transfusion use undergoing elderly elective orthopedic surgery.

Keywords Orthopedic surgery, Postoperative delirium, Elderly, Associated factors

*Correspondence:
A. S. Gesso
seifuashenafi@gmail.com

[1]Addis Ababa University College of Health Sciences, Addis Ababa, Ethiopia
[2]Wachemo University College of Health and Medical Sciences, Hosanna, Ethiopia

Introduction

Delirium is the most common neurocognitive disorder and potentially preventable clinical syndrome among persons who are 65 years of age or older. It is characterized by a disturbance in attention, level of consciousness, cognitive function (memory, orientation, speech, and thinking), change in circadian rhythm, emotional disturbance, and psychomotor disturbances. In which symptoms and severity are acute in onset and may fluctuate throughout the day, it is associated with acute medical or surgical illness, and most of the time it occurs in hospitalized older patients [1].

Post-operative delirium(POD) appears in patients who have undergone surgical procedures and received anesthesia, usually peaking between one and three days after surgery. It differs from emergence delirium, which occurs after 5–15 min of awakening from general anesthesia and resolves quickly within hours [2].

The pathophysiology of delirium is not fully elucidated, and the leading theories for its pathogenesis focus on the disturbance of neurotransmission, specifically in the production, release, or inactivation of neurotransmitters that regulate cognitive function including GABA, glutamate, acetylcholine, serotonin, norepinephrine, and dopamine [1, and 3].

Cholinergic insufficiency and excess dopamine are the primary causes of postoperative delirium. Another mechanism is associated with Cytokines such as interleukin-1,interleukin-2, interleukin-6, tumor necrosis factor α (TNF-α), and interferon, which also contribute to the occurrence of delirium by making the blood-brain barrier more permeable and changing neurotransmission [4]. Chronic stress due to chronic illness or trauma stimulates the sympathetic nervous system and hypothalamic pituitary adrenocortical axis and raises cytokine levels, causing hypercortisolism, which can damage hippocampal serotonin receptors and may cause delirium [1, and 3].

Many risk factors are reported for the development of POD delirium. Many studies found that; age, over 65 years old, male sex, preoperative cognitive impairment, electrolyte imbalance, intraoperative blood loss, intraoperative hypoxemia, use of general anesthesia, surgical procedures longer than 3-hrs (mainly after orthopedic surgeries), intraoperative hypercapnia, hypotension, use of opioids, presence of postoperative sleep disorders, anemia(HCT < 30), multiple comorbidities, depression or anxiety disorders, dehydration, hyponatremia, anticholinergic drugs, alcohol consumption, postoperative pain, trauma, terminal illness, HIV infection, treatment with multiple psychotropic drugs, functional dependence, immobility, visual and hearing impairment were among risk factors for POD [5, and 6].

Predisposing factors for post operative delirium could also be dementia, cognitive impairment, history of delirium, functional impairment including vision and/or hearing impairment, comorbidity/severity of illness, depression, history of transient ischemia/stroke, alcohol abuse, and advanced age, while the precipitating factors include multiple medications uses, use of bladder catheter, Physiologic like elevated BUN/creatinine ratio, abnormal serum albumin, sodium, glucose, or potassium levels, metabolic acidosis, infection, Iatrogenic event, surgical procedures like aortic aneurysm, thoracic, neurosurgery, emergency admission, or coma [7, and 8].

A number of trials have shown that there is no clear evidence that atypical anti-psychotics are more effective than typical anti psychotics (Haloperidol), but they appear to have fewer extra-pyramidal adverse effects [9]. Delirium is more common and severe in elderly. It has a prevalence rate of about 1% in general population, while it has a prevalence rate of about 15% or more in elderly depending on population, risk factors or other predisposing factors. Postoperative delirium has an incidence range from 4 to 53.3% after hip fracture surgery [10]. The incidence of postoperative delirium among elderly Asians was 17%, while it was 23% in Europeans and Americans [11].

Even when detected early and managed appropriately, delirium can lead to significant mortality and morbidity in frail, elderly surgical patients [12]. As such, it may progress to permanent post-operative cognitive dysfunction, if not prevented or left untreated.

Delirium is preventable in 30–40 percent of the case, and this holds substantial public health relevance as a target for intervention to prevent the associated burden of downstream complications and costs. Accordingly, delirium has been increasingly used as an indicator of health-care quality for elderly people [13].

Prevention of delirium is the most effective way to reduce its occurrence and sequel. Since delirium has a range of causes, multi-component approaches are the most effective and clinically applicable methods including; early mobilization, preventing sleep deprivation, fluid and electrolyte balance, pain control, reducing the usage of psychoactive drugs, and avoiding surgical and anesthesia-related postoperative complications can be applied. In addition, all delirium patients benefit from supportive care that aims to reduce triggers for delirium as well as pharmacologic treatment with strong antipsychotic medications, anticholinesterase, and benzodiazepines have some benefit. Haloperidol used to be the most common drug, but currently, health professionals are using newer anti-psychotic medications like risperidone, olanzapine, and quetiapine [9, and 14].

The number of elderly population is increasing as healthcare quality improves, and globally, it's estimated that 50% of older individuals have had at least one surgical procedure, associated with this postoperative

cognitive dysfunction is one of the most frequent complications after surgical procedure in this population group. This is generally underrated in the medical community. The number of comorbidities and the ASA score were significant risk factors for postoperative cognitive dysfunction. Elderly patients often demand a higher level of care and higher health care costs because most of the time this group of people has preoperative comorbidities which can be associated with a decline in cognitive and physiological functions and these factors can affect perioperative outcomes and increased risk of postoperative delirium [14, and 15].

The scientific evidences suggest that post operative delirium(POD) has many risk factors as predisposing and precipitating factors. The management of POD also requires a multidisciplinary interventions to overcome all the possibles factors. As such, prevention of POD delirium is more sound than managing it. The evidences available are from developed nations, different populations and many of these evidences were from cross-sectional study designs. Therefore, the current study was performed longitudinally where we followed each study participant for three days after surgery with the aim of assessing the incidence of postoperative delirium and its associated factors in resource limited settings. This can help health care providers to mitigate its occurrence by applying preventive measures or by treating it promptly once it happened.

Methods and materials

A multicentere prospective longitudinal study was conducted in randomly selected four Addis Ababa Public Hospitals, Ethiopia from February 1st to May 31st, 2024. The study was performed under the Declaration of Helsinki Ethical Principles for Medical Research involving human subjects protocol. Ethical clearance was obtained from Addis Ababa University's, college of health sciences institutional review board (with an IRB protocol number of-Anes/12/2023/2024) before the start of the study. An official support letter was written to each study hospital and permission for data collection was sought from the responsible authorities. The participants were ensured that the data were fully anonymous as the data collectors coded each participant and the results were discussed in aggregates. Verbal informed consent for participation in the study was obtained from each study participant before the start of the interview. The methodology in this study followed the STROCSS 2019 -statements included for the Strengthening the Reporting of Cross-sectional Study in Surgery [16]. Research registry at https://www.researchregistry.com/browse-the-registry#home/ registered this study with UIN: researchregistry10509.

Source and study population

All elderly patients aged 65 years and above who underwent elective orthopedic surgery in the study area public hospitals were source population, while all elderly patients aged 65 and above who underwent elective orthopedic surgery in selected study area public hospitals fulfilling inclusion criteria during the study period were the study population, and randomly selected participants were the study units.

Eligibility criteria

All elderly patients who underwent elective orthopedic surgeries in the study area selected public hospitals and agreed to participate in the study during the study period were the inclusion requirement, while participants with preoperative known cognitive impairment (dementia), with known psychiatric illness and long-term usage of psychotropic medications, who were transferred to an intensive care unit (ICU) after surgery, with day case surgery, ASA classification greater than three, and patients with delirium before surgery were excluded from the study.

Sample size determination and sampling technique

Sample size determination

The sample size was calculated using single population proportion. It was calculated using the assumptions of a 50% attribution rate as there is no prior study done in the study area, a 95% confidence interval, and a 5% margin of error. The total sample size calculated was 220 participants including 10% non-response rate contingency. The situational analysis revealed that the total number of elderly patients who undergo orthopedic surgery within three months was 418. As such, proportional allocation was performed to determine a number of study participants to be selected from each study hospital according to their respective case flow (Fig. 1).

Sampling procedure

Four hospitals were selected from twelve public hospitals in the capital city by a lottery method and elderly elective orthopedic patients were allocated proportionally by their total elderly surgical patients over the last year situational analysis. Each study participant was selected using a systematic random sampling technique using skip intervals. The skip interval (K) of 2 was obtained, so that every other participant was studied after the first (random start) participant was determined by a lottery method.

Variables of the study

Postoperative delirium was the dependent variable, while socio-demography-related factors like; age, sex, weight, height, BMI, educational level, laboratory-related factors;

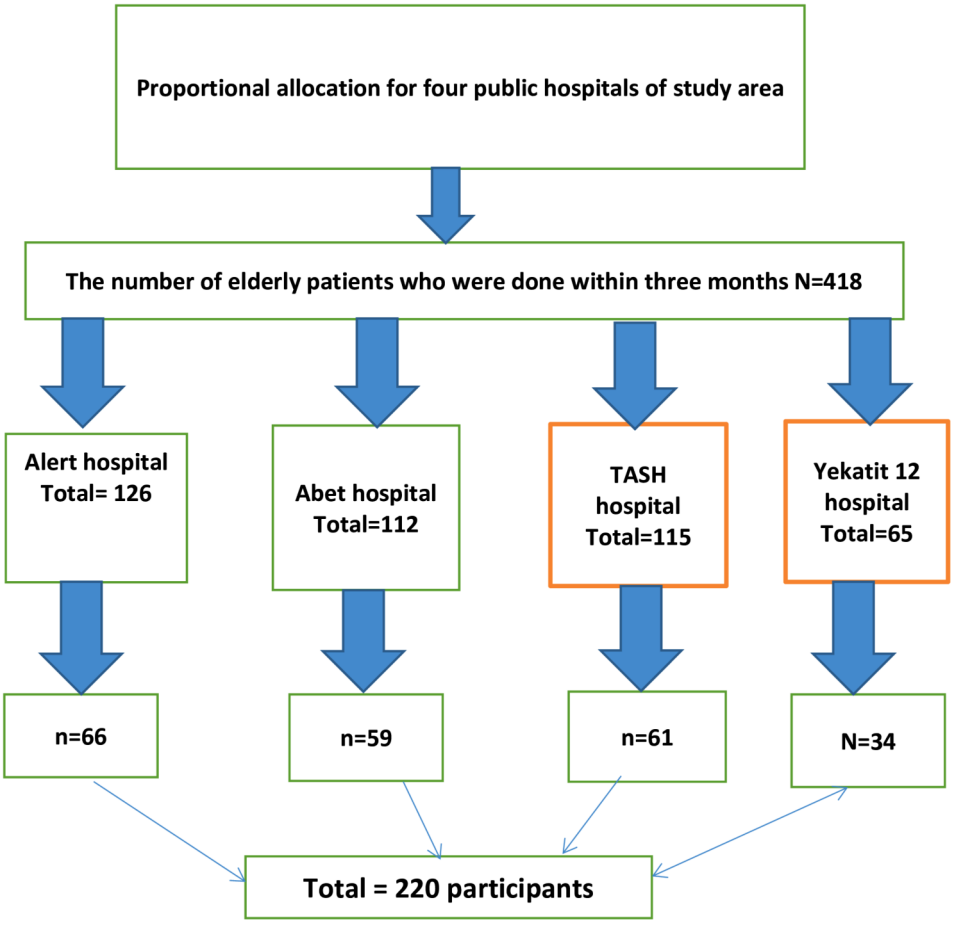

Fig. 1 Proportional allocation of study participants for each study hospital during study period ($n=220$)

like electrolyte levels, creatinine level, Anesthesia-related factors, ASA classification, type of anesthesia, perioperative opioid use, perioperative benzodiazepines use and anticholinergic use, Surgery-related factors; like duration of surgery, type of surgery, blood transfusion, Patient and behavioral-related factors; including preoperative smoking, alcohol drinking, chronic medical comorbidity, and previous hospitalization were the independent variables.

Operational definitions

Postoperative delirium Is a form of delirium that manifests in patients who have undergone surgical procedures and received anesthesia. It usually occurs within 5 days after surgery, especially during the first 24–48 h postoperatively [17, and 18].

Elderly According to the WHO definition; the Elderly are individuals aged 65 and above. Then old age is classified as young old (65 to 75). The time frame at which functional deficits start to show up is the age 75–85 years. Age 85 and above is considered as advanced old age and time that needs special care and support [19].

The Confusion assessment method (CAM) Was derived from the Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition, used to assess delirium. It is composed of four key features: (1) acute change in mental status with a fluctuating course (2) inattention, (3) disorganized thinking, and 4, altered level of consciousness; the diagnosis of delirium requires the presence of both of the first two features as well as either of the last two features or all of the four features [20, and 21].

Data collection protocols and procedures

After ethical approval was granted and an official letter was written to the respective hospitals, permission to collect data in each study hospital was sought. A day before surgery all study participants gave their verbal informed consent for the study; Patients were assessed preoperatively for the presence of delirium by using the confusion assessment method (CAM) score [20, and 21]. Postoperatively, after surgery the assigned trained nurse collected data by using a structured interviewer administered questionnaire to collect the pre-operative demographic data including (age, gender, height, weight, educational level, living arrangement, lifestyle habits, alcohol drinking and

tobacco smoking), past medical history, medication history, history of obstructive sleep apnea, previous history of hospitalization and data on other characteristics, including laboratory test results, diagnosis, and the type of surgery, duration of surgery, type of anesthesia, ASA classification, perioperative blood transfusion, intraoperative incidence and complications, intraoperative vital signs, intraoperative anticholinergic use, opioid use and anxiolytic use were collected from each patient charts in orthopedics ward after orthopedic surgery, then delirium was assessed by following each study participant from 24-hours after end of surgery to the consecutive three days using the Confusion Assessment Method (CAM) by trained nurses. Supervisors and principal investigators regularly checked for data collection procedures as well as data collection tools for completeness and clarity during data collection period. Data were collected as planned and there was no loss to follow-up or outliers at data collection.

Data quality assurance

Before data collection started, a pretest was done on 5% of the sample size (11 patient charts) in a public hospital other than the study site. The training was offered to data collectors and supervisors regarding ethical issues, general approaches, and strategies to minimize information bias. A principal investigator cross-checked each questionnaire for completeness, accuracy, and consistency.

Table 1 Socio-demographic and behavioral characteristics of the study participants at study area during study period ($n=220$)

Variable	Category	Frequency (*n*)	Percentage (%)
Gender	Male	113	51.4
	Female	107	48.6
Age	65–75	93	42.3
	75–85	59	26.8
	> 85	68	30.9
BMI(body mass index)	underweight	32	15.4
	Normal weight	130	59.1
	Overweight	45	20.5
	Obese	11	5
Educational status	Uneducated	129	58.6
	Can read and write	62	28.2
	Elementary school	20	9.1
	Secondary school	7	3.2
	College and above	2	0.9
Cigarette smoking	Yes	7	3.2
	No	213	96.8
Alcohol drinking	Yes	32	14.5
	No	188	85.5

Data processing and analysis

The data was coded and then entered into Epi-data version 4.6. Then the data was exported to the statistical package for social science (SPSS) software version 27.0 for cleaning and analysis. The chi-square test was done to determine the relationship between the incidence of postoperative delirium and potential associated factors. Both bivariable and multivariable logistic regression analysis was conducted to identify factors associated with postoperative delirium. In the bivariable logistic regression, variables with a p-value of <0.2 were taken into the multivariable analysis(survival analysis). In the final model, an adjusted odds ratio(AOR) with a 95% confidence interval(CI) was used to state the strength of the association. The p-value of <0.05 was taken as a cutoff to declare statistical significance. The results were presented using frequencies, percentages, figures, and tables.

To check the model fitness of multinomial logistic regression for our data using goodness of fit table Chi-square (Pearson and deviance) model test was used during the analysis.

Results

Socio-demographic characteristics of study participants

A total of 220 elderly orthopedic surgical patients were studied from February to May 2024 with 100% response rate. The majority were male 113(51.4%). Pertaining their age most of them were between 65 and 75 years old 93(42.3%), and more than half of the study participants 129(58.3%) were illiterates, while only 62(28.6%) can only read and write without formal education. The majority of them were non-smokers 213(96.8%) (Table 1).

Surgery and anesthesia related factors of study participants

The majority 193 (87.7%) of study participants were ASAII. Regarding co-morbid diseases about 92(41.1%) of the study participants had co-morbid diseases. The most common co-morbid disease was Diabetes mellitus 35(38%), about 20(21.7%) had hypertension, 16(17.4%) had respiratory disease, 6(6.5%) had cardiovascular disease, 5(5.4%) had cerebrovascular disease, and 10(10.9%) of participants had other comorbidities from these comorbidities; 5(2.3%) study participants had chronic kidney disease(CKD), 2(0.9%) participants had chronic liver disease (CLD), 7(3.2%) participants had retro viral infection, and about 86(39.9%) of the participants had a history of previous hospitalization. About the type of surgery and anesthesia, 70(31.8) participants underwent upper extremity surgery, 150(68.11%) underwent lower extremity surgery, 137(62.3%) of the participants received spinal anesthesia, 14(6.4%) received GA with face mask, 27(13.3%) of patients underwent surgery by peripheral nerve block, and 42(19.1%) received general anesthesia

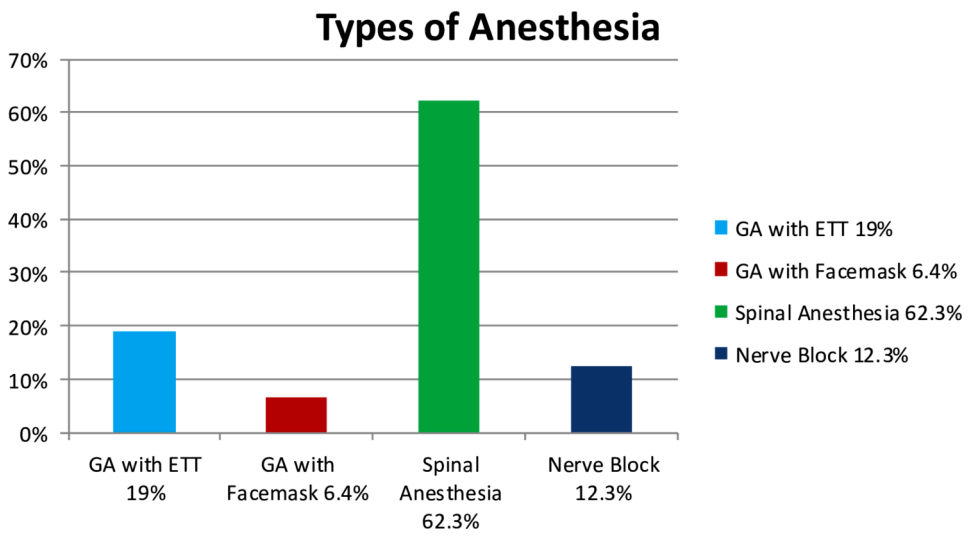

Fig. 2 Anesthesia techniques done for study participants at the study area during the study period ($n=220$)

Table 2 Surgery and anesthesia related risk factors of the study participants at the study area during the study period ($n=220$)

Variable	Category	Frequency (*n*)	Percentage (%)
ASA physical status	ASA II	193	87.7
	ASA III	27	12.3
Perioperative opioid use	Yes	150	68.2
	No	70	31.2
Anticholinergic use	Yes	74	33.6
	No	146	66.4
Duration of surgery	< 3 h	92	41.8
	≥ 3 h	128	58.2
Blood transfusion	Yes	39	17.7
	No	181	82.3
History of hospitalization	Yes	86	39.9
	No	134	60.1
Creatinine level	Low	23	10.4
	Normal	141	64.1
	High	56	25.5
Sodium level	Low	75	34.1
	Normal	91	41.4
	High	54	24.5
Potassium level	Low	30	13.6
	Normal	172	78.2
	High	18	18.2

Note: Creatinine level was taken as low if < 0.77 mg/dl, normal if between 0.77 mg/dl, and 1.21 mg/dl, High if > 1.21 mg/dl [22], Sodium level was taken as low if < 135mmol/l, normal if between 135, and 143.3mmol/l, and high if > 145mmol/l, and Potassium level was taken as low if < 3.5mmol/l, normal if between 3.5, and 5.3mmol/l, and high if > 5.5mmol/l [23]

with endotracheal intubation. From these 14(25%) of the patients were induced by ketamine, 26(46.4%) patients were induced by propofol, 15(26.8%) were induced with ketofol, and only one (1.8%) patient was induced with thiopentone (Fig. 2, and Table 2).

Incidence of postoperative delirium among participants

The incidence of postoperative delirium(POD) among elective orthopedic elderly surgical patients was 33.7% in the study area during the study period (Fig. 3).

Perioperative factors for postoperative delirium

The study analyzed perioperative variables including ASA classification, alcohol drinking habits, cigarette smoking habits, presence of co-morbid diseases, age, gender, educational status, opioid use, benzodiazepine use, anticholinergic use, Body Mass Index (BMI), duration of surgery, type of anesthesia, Anesthesia induction drugs, Anesthesia maintenance drugs, blood transfusion, history of hospitalization, sodium level, potassium level, and creatinine level on binary logistic regression. In this analysis model, age, perioperative blood transfusion, hospitalization history, cigarette smoking, preoperative sodium level, perioperative opioid use, perioperative benzodiazepine use, duration of surgery, and intraoperative anticholinergic use were associated with postoperative delirium with a p-value of < 0.2. The other variable with p-values more than 0.2 taken to the final model was the induction of anesthesia drugs, as it has a strong clinical association with post-operative delirium.

In a multinomial logistic regression, variables with a p-value < 0.2 as well as anesthesia induction agents were analyzed to determine independent associated factors for postoperative delirium and in this final analysis model; age, perioperative blood transfusion, previous history of hospitalization, intraoperative anticholinergic use, perioperative opioid use were strong (independent) associated factors for the incidence of postoperative delirium. Hence, patients whose age was from 65 to 75 years old had about 0.468 times less odds of developing postoperative delirium than patients whose age is greater than 85

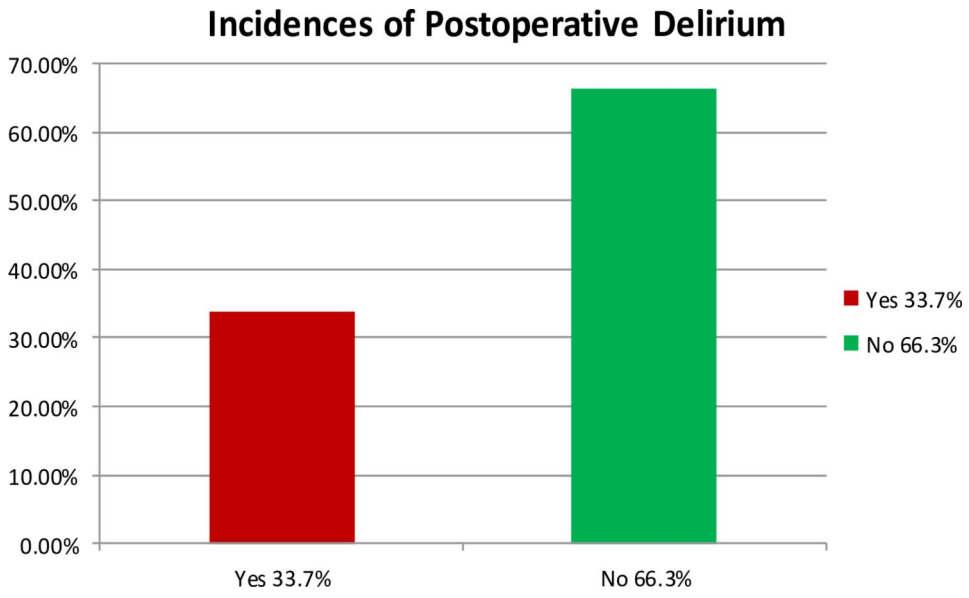

Fig. 3 The incidence of postoperative delirium among study participants at study area during study period ($n=220$)

years old (AOR=0.468, 95%CI(0.225–0.97),$p=0.041$)). Patients with a previous history of hospitalization had about 2.3 times higher odds of developing postoperative delirium than those who had no history of hospitalization (AOR=2.248, 95% CI(2.202–4.206), $p=0.011$)).

Elderly orthopedic patients who were induced by propofol have 0.14 times fewer odds for postoperative delirium than those induced by thiopental anesthesia induction (AOR=0.14 95%CI(0.12–2.546), $P=0.049$)), in addition Elderly orthopedic patients who were induced by Ketamine has 1.32 times higher odds of developing postoperative delirium than those induced by thiopental anesthesia induction (AOR=1.32, 95%CI(1.109–3.87), $p=0.003$)).

Those patients who were on opioid treatment perioperatively had about 2.2 times higher odds of having postoperative delirium than their counterparts (AOR=2.200, 95%CI(1.073–4.513),$p=0.031$)). About intraoperative anticholinergic use patients who used anticholinergic drugs intraoperatively had about 2.24 times higher odds of developing postoperative delirium than the patients who did not use anticholinergic drugs(AOR=2.238,95%CI(1.183–4.235), $P=0.013$)).

Concerning the blood transfusion, patients who had blood transfusion had 2.8 times higher odds of developing postoperative delirium than the patients who were not transfused (AOR=2.83,95CI% (1.295–6.193),$p=0.009$))(Table 3).

Discussion

This study found that the incidence of postoperative delirium among elderly orthopedic surgical patients was 33.7%. An increasing age(=0.041), history of previous hospitalization($p=0.011$), Anesthesia induction with ketamine ($p=0.003$) intraoperative anticholinergic use($p=0.013$), perioperative opioid use($p=0.031$), and perioperative blood transfusion ($p=0.009$)were independent associated factors for postoperative delirium.

The incidence of delirium in this study was comparable with a study conducted in Japan and the USA which reported the incidence of postoperative delirium as 28% and 27.7% respectively [24, and 25]. On the other hand, the finding of the current study on the incidence of POD is higher than previous studies from Taiwan, Turkey, and Canada which reported the incidence of POD as 9.1%, 15%, and 22.7% [26, 27, and 28] respectively. The discrepancy may be attributed to socioeconomic factors of study participants, population difference, or study design differences.

The finding of this study on the incidence of postoperative delirium (33.7%) was lower than a previous study done in Germany, which reported it as 45.8% [10,and 29]. This variation may be related to clinical setup or study population difference, as the previous study was done in a developed nation where the age of study participants is higher than the current study. The second attributing factor for the difference can be sample size variation, as the current study has a smaller sample size than those done previously. The other possible explanation may be a study design difference; as such, the current study design was a longitudinal study, while the previous studies conducted in Japan and Taiwan were prospective cohort and systemic review studies. The other possible explanation for the difference in the incidence of POD may be attributed to differences in the delirium assessment tools. The current study uses the confusion assessment method, while

Table 3 Perioperative factors associated with postoperative delirium among study participants during the study period ($n=220$)

Variables	Category	Postoperative delirium		COR(95%CI)	AOR(95%CI)	P-value
		Yes(n(%))	NO(n(%))			
Age	> 85	32(43.8)	36 (24.5)		1	
	75–85	16(21.9)	43(29.3)	0.988 (0.414–2.06)	0.94(0.428–2.076)	
	65–75	25(34.2)	68(46.3)	0.414(0.214–0.801)	0.468(0.23–0.97)	**0.041**
Hospitalization hx	No	35(47.9)	99(67.3)	1	1	
	Yes	38(52.1)	48(32.7)	2.239 (1.26–3.98)	2.248(1.20–4.20)	**0.011**
Cigarette smoking hx	No	69 (94.5)	144(98.0)	1	1	
	Yes	4(5.5)	3(2.0)	2.78(0.61–2.77)	2.5(1.01–5.43)	0.063
BDZs use hx	No	55 (75.30)	123(83.7)	1	1	
	Yes	18(24.70)	24 (16.3)	1.68(0.84–3.34)	1.46(1.39–2.88)	0.09
Induction agent	Thiopental	0(0.0)	1(2.3)	1	1	
	Ketofol	6 (46.25)	9(2.3)	0.26(0.19–3.2)	0.22(0.15–1.98)	0.061
	Propofol	6(46.25)	20 (46.55)	0.115(0.11–1.76)	0.14(0.12–2.55)	0.049
	Ketamine	1 (7.70)	13(30.30)	1.24(1.13–4.032)	1.32(1.11–3.87)	**0.003**
Duration of surgery	> 3 h	49 (67.1)	79 (53.70)	1	1	
	< 3 h	24 (32.90)	68 (46.30)	0.57(0.32–1.02)	0.65(0.31–1.40)	0.071
Opioid use hx	No	15(20)	55(37.4)	1	1	
	Yes	58(79.5)	92(62.6)	2.312(1.196–4.467)	2.2(1.073–4.513)	**0.031**
Anticholinergic	No	37(50.7)	109(74.1)	1	1	
	Yes	36(49.3)	38(25.9)	2.791(1.55–5.029)	2.238(1.183–4.24)	**0.013**
Transfusion hx	No	50(68.5)	131 (89.1)	1	1	
	Yes	23(31.5)	16(10.9)	3.766(1.84–7.71)	2.83(1.295–6.193)	**0.009**
Sodium level	High	20(27.40)	34 (23.10)	1	1	
	Normal	33(45.20)	58 (39.50)	1.025(0.23–4.32)	1.121(1.00-2.10)	0.081
	Low	20 (27.40)	55 (37.40)	1.765(1.34–2.17)	1.63(1.43–4.98)	0.063

Note: BZDs- Benzodiazepines, Hx = Recent history, **COR**- Crude odd ration, **AOR**- Adjusted odds ratio, p-values are derived from multinomial logistic regression

previous studies used the delirium observation screening (DOS) scale and 4AT- Assessment test for delirium and cognitive impairment.

The finding of the current study showed that the incidence of postoperative delirium in patients aged greater than 85 is higher than that of 65–75 years old ($p<0.05$). This is in line with studies done in China and Germany [17, and 30]. Advanced age is a strong risk factor for the incidence of postoperative delirium, as multiple comorbidities may increase the risk for postoperative delirium.

This study found that history of previous hospitalization was an independent associated factor for the incidence of postoperative delirium ($p<0.05$). This finding was in line with a study done in Germany [25] and another study conducted at Tianjin University in China [31].

This study found that anesthesia induction with ketamine was an independent risk factor for the development of postoperative delirium than induction by thiopental or propofol($p<0.05$). This is in line with a study conducted in the USA and Italy, which found that perioperative ketamine administration was associated with an increased incidence of postoperative delirium [32, and 33]. However, another study conducted in the USA found that perioperative ketamine administration has no impact on postoperative delirium [34]. Additional studies conducted in Switzerland, and France found that administration of ketamine reduces the incidence of postoperative delirium [31, and 35]. This variation may be associated with the difference in the patient's ASA status, liver, renal conditions, dose of the induction agent used, and drug interactions. The difference may also be attributed to the population difference or study design difference.

The result of this study found that intraoperative anticholinergic usage is an independent associated factor for the development of postoperative delirium($p<0.05$). This is similar to a study done in the USA [32]. However, another study conducted in the Netherlands found that there was no association between the incidence of postoperative delirium and anticholinergic usage [36]. This disparity may be attributed to study design or sample size differences. Another possible explanation for the observed difference could be associated with the type and dose of anticholinergic medications used, the ASA status of the patients or drug interaction.

In this study, perioperative opioid usage is significantly associated with the incidence of postoperative delirium($p<0.05$). This is similar to the study done in Boston [34], but another study conducted in Netherlands found that there was no significant association between opioid use and the incidence of postoperative

delirium [36]. The reason for this variation may be due to the difference in sample size, study population, and living conditions of the study participants, due to doses and types of opioids, liver and renal problems, and drug interactions.

This study found that perioperative blood transfusion is a significant associated factor for the development of postoperative delirium in elderly patients who underwent orthopedic surgeries($p<0.05$). This is in line with a study done in the USA at the University of Maryland in Baltimore [37], and two other Chinese studies [38, and 39], Another similar study conducted in Korea found no association between perioperative blood transfusion and postoperative delirium [40]. The main reason for this difference may be the difference in the number of units of blood transfused and the different blood components being transfused, or duration of intraoperative hypotension.

Strengths and limitations of the study

The study's strength is that the data collectors were trained professional nurses to ensure the accuracy of the collected data. The study was conducted in multi-center study areas. The study assessed possible preoperative, and intraoperative variables, which means it was more holistic in nature. The other strength of the study was that it considered an anesthesia induction agent taken to the survival analysis, even though it was not indicated in the binary logistic regression. This was done as clinically important variables can be considered for survival analysis even if they are not statistically significant. The main limitation of the current study was the relatively small sample size, and short study period due to time constraints.

Implications and relevance

The current research findings can be used to improve elderly orthopedic patients health care quality by identifying the independent associated factors to postoperative delirium. As, such health care providers will apply possible preventive measures for POD or treat it promptly if once happened. It may also help as an evidence for the incidence of postoperative delirium in elderly orthopedic surgical patients and their associated factors in the study region, where we have limited evidences. It offers researchers an insight, particularly for future study.

Conclusion and recommendation

In this study area, the incidence of postoperative delirium among elderly elective orthopedic surgical patients was high (33.7%). Advanced age, history of recent hospitalization, type of anesthesia induction agents, perioperative anticholinergic uses, perioperative opioid usage, and perioperative blood transfusion were independently associated factors for postoperative delirium. We recommend special attention to elderly patients with a recent history of hospitalization, advanced age, induced with ketamine anesthesia, perioperative anticholinergic uses, perioperative opioid uses, and perioperative blood transfusion. We recommend reducing ketamine-based anesthesia induction, anticholinergic medication, and opioid-based pain treatment as important. We also recommend that future researchers do ongoing research on the long-term impact of postoperative delirium on elderly patients' mortality and morbidity variables.

Abbreviations

AAU	Addis Ababa University
AOR	Adjusted Odds Ratio
CAM	Confusion assessment method
COR	Crude odds ratio
CI	Confidence interval
POD	Postoperative delirium
SPSS	Statistical Package for social sciences

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12871-024-02729-w.

Supplementary Material 1

Acknowledgements

We would like to express our gratitude to each study hospitals for allowing us to collect data. We are also grateful to the study participants, data collectors, and colleagues who helped a lot with this research work.

Author contributions

Tekletsadik (YA): Contributed to the source, data collection, design, analysis, and drafting of the research manuscript. Workineh (SA): contributed to the source, design, analysis, interpretation, and drafting of the research manuscript. Gesso(AS): contributed to the inception, design, analysis, interpretation, and drafting of the research manuscript. Hirbo(HS): contributed to the design, analysis, and drafting of the research manuscript. All authors read and approved the manuscript for publication.

Funding

Addis Ababa University college of health sciences funded this research project.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 19 July 2024 / Accepted: 16 September 2024
Published online: 28 September 2024

References

1. Maeker E, Maeker-Poquet B. Delirium in the elderly. NPG Neurol - Psychiatr - Geriatr. 2021;21(122):68–94.

2. Sun J, Zhang Q, Lin B, He M, Pang Y, Liang Q et al. Association between Postoperative Long-Term Heart Rate Variability and Postoperative Delirium in Elderly patients undergoing orthopedic surgery: a prospective cohort study. 2021;13(May):1–10.
3. Wan M, Chase JM. RE: Delirium in older adults. B C Med J. 2017;59(6):296.
4. Ganna Androsova R, Krause. 1 Georg Winterer, and Reinhard Schneider: Biomarkers of postoperative delirium and cognitive dysfunction… Front Aging Neurosci. 2015; 7:112. Published online 2015 Jun 9. https://doi.org/10.3389/fnagi.2015.00112).
5. NA; Delirium in Older Persons. Surv Anesthesiol. 2006;50(6):290–1.
6. Song K-J, Ko J-H, Kwon T-Y, Choi B-W. Etiology and related factors of postoperative delirium in orthopedic surgery. Clin Orthop Surg. 2019;11(3):297. https://doi.org/10.4055/cios.2019.11.3.297].
7. Sharon K, Inouye MD, Rudi MPH, Westendorp GJ, PhD MD, Saczynski JS. Ph.D: Delirium in elderly people. Lancet. 2014;383(9920):911–22. https://doi.org/10.1016/S0140-6736(13)60688-1).
8. Research. Xin Zhao. Lei Gao. Ying Wang.Juan Wang:incidence and associated factors of delirium after orthopedic surgery in elderly patients: a systematic review and meta–analysis. Aging Clin Experimental. 2020. https://doi.org/10.1007/s40520-020-01674-1].
9. Caplan G. Managing delirium in older patients. Aust Prescr. 2011;34(1):16–8.
10. Angela JB, Ritchie CW, Blizard R, Lai R. Peter Raven:the incidence of delirium associated with orthopedic surgery: a meta-analytic review. Int Psychogeriatr. 2007;19(2):197–214. https://doi.org/10.1017/S104161020600425X.
11. Wu YJ, Pang QJ, Liu JT, Cao S, Hu YM. Iincidence of postoperative delirium after hip surgery in elderly patients: a meta-analysis]. Zhongguo Gu Shang. 2015;28(12):1156–61. Chinese. PMID: 26911129.
12. Suzanne Wass PJ, Webster. Nair:Delirium in the Elderly: a review. Oman Med J. 2008;23(3):150–7.
13. Inouye SK. RGJ Westendorp, & JS Saczynski: Delirium in elderly people, The lancet, 2014•thelancet.com.
14. Mengistu MB, Andemeske YM, Emhatsion A, Wrieta H, Gebreyesus N. Incidence and risk factors of post-operative delirium in Elderly patients who underwent spinal anesthesia in Orotta, Halibet and Sembel hospitals: A Cross Sectional Study in Eritrea. J Surg Anesth Res. 2021;2021(2):1–8.
15. Farhan AB, Rehatta NM, Setiawati Y, Pudjirahardjo WJ. Risk factor analysis of post-operating cognitive dysfunction in Elderly patients. Int J Innov Sci Res Technol. 2021;6(8):679–84.
16. Agha R, Abdall-Razak A, Crossley E, Dowlut N, Iosifidis C, Mathew G, for the STROCSS Group. The STROCSS 2019 Guideline: strengthening the reporting of Cohort studies in surgery. Int J Surg. 2019;72:156–16526.
17. Guo Y, Jia P, Zhang J, Wang X, Jiang H, Jiang W. Prevalence and risk factors of postoperative delirium in elderly hip fracture patients. 2016.
18. Wang Cguang, Qin Y, fei, Wan X, Song L, cheng, Li Z jun, Li H. Incidence and risk factors of postoperative delirium in the elderly patients with hip fracture. 2018;1–7.
19. Boozer AL. Old age and aging. Encycl Anc Hist. 2019;(October):1–2.
20. Curtis R, Dyck V, Capezuti E, Fulmer TT. The Confusion Assessment Method (CAM) The Confusion Assessment Method Instrument: 2012;59(13).
21. Qiyun Shi1,Laura Warren, Saposnik G, Joy C, MacDermid. Confusion assessment method: a systematic review and meta-analysis of diagnostic accuracy, dove press journal. Neuropychiatric Dis Treat, 2013.
22. Marry Ralston: creatinine level, journal of clinical pathology. 1995, 8, pp-160.
23. Milud Ahmed Salem, Abdounasser Albasher Omar and Fathe Abdullah Ahmed: References for Potassium, Sodium and Chloride among Libyan People, International Journal of Diabetes & Metabolic Disorders. 2020, Vol. 5, issue 3, pp-98.
24. Saravana-Bawan B, Warkentin LM, Rucker D, Carr F, Churchill TA, Khadaroo RG. Incidence and predictors of postoperative delirium in the older acute care surgery population: a prospective study. Can J Surg. 2019;62(1):33–8.
25. Bai J, Liang Y, Zhang P, Liang X, He J, Wang J et al. Association between postoperative delirium and mortality in elderly patients undergoing hip fractures surgery: a meta-analysis. 2020;317–26.
26. Hirsch J, DePalma G, Tsai TT, Sands LP, Leung JM. Impact of intraoperative hypotension and blood pressure fluctuations on early postoperative delirium after non-cardiac surgery. Br J Anaesth. 2015;115(3):418–26.
27. Liang Ckuang, Chu C, liang, Chou M, yueh, Lin Y te, Lu T, Hsu C, jen et al. Interrelationship of Postoperative Delirium and Cognitive Impairment and Their Impact on the Functional Status in Older Patients Undergoing Orthopaedic Surgery: A Prospective Cohort Study. 2014;9(11):5–12.
28. Flink BJ, Rivelli SK, Cox EA, White WD, Falcone G, Vail TP, et al. Obstructive sleep apnea and incidence of postoperative delirium after elective knee replacement in the nondemented elderly. Anesthesiology. 2012;116(4):788–96.
29. Slor CJ, Jonghe ĀJFM, De, Vreeswijk ĀR, Groot E, Ploeg TVD, Van Gool WA et al. Undergoing Hip Surg. 2011;1313–9.
30. Kimura A, Shiraishi Y, Sawamura H, Sugawara R, Inoue H, Takeshita K. Predictors of postoperative delirium in older patients undergoing elective spine surgery. Spine Surg Relat Res. 2023;7(1):13–8.
31. Li T, Dong T, Cui Y, Meng X, Dai Z. Effect of regional anesthesia on the postoperative delirium: a systematic review and meta-analysis of randomized controlled trials. Front Surg. 2022;9(July):1–14.
32. Fellous S, Dubost B, Cambriel A, Bonnet Mpierre. Perioperative ketamine administration to prevent delirium and neurocognitive disorders after surgery: a systematic review and meta-analysis. 2023;(March).
33. Sica R, Wilson JM, Kim EJ, Culley DJ, Meints SM, Schreiber KL. The relationship of Postoperative Pain and Opioid Consumption to Postoperative Delirium after spine surgery. J Pain Res. 2023;16:287–94.
34. Elsamadicy AA, Charalambous LT, Sergesketter AR, Drysdale N, Adil SM, Freedman IG et al. Intraoperative ketamine may increase risk of postoperative delirium after complex spinal fusion for adult deformity correction. 2019;5(1):79–87.
35. Wittwer ED, Cerhan JH, Schroeder DR, Schaff HV, Mauermann WJ. Impact of ketamine versus propofol for anesthetic induction on cognitive dysfunction, Delirium, and Acute kidney Injury following cardiac surgery in Elderly. High Risk Patients. 2023.
36. Riegger H, Hollinger A, Seifert B, Toft K, Blum A, Zehnder T et al. Baden Prevention and reduction of incidence of postoperative delirium trial (PRIDe): a phase IV multicenter, blind clinical trial of ketamine versus haloperidol for prevention of postoperative delirium. 2018;1–12.
37. Raphael J, Hensley NB, Chow J, Parr KG, Mcneil JS, Porter SB et al. Red Blood Cell Transfusion and Postoperative Delirium in Hip Fracture Surgery Patients: A Retrospective Observational Cohort Study. 2021;2021.
38. Liu Ymei, Huang H, Gao J, Zhou J, Chu Hchen. Hemoglobin concentration and post-operative delirium in Elderly patients undergoing femoral Neck fracture surgery. 2022;8(January):1–8.
39. Scholz AFM, Oldroyd C, Mccarthy K, Quinn T, Hewitt J. Systematic review and meta-analysis of risk factors for postoperative delirium among older patients undergoing gastrointestinal surgery,br. J Surg. 2016;103(2):e21–8. https://doi.org/10.1002/bjs.10062. Epub 2015 Dec 16.
40. Kwon Ysuk, Kim Jho, Lee J. jun, Seo E min. Relationship between Perioperative Blood transfusion and postoperative delirium in patients undergoing spinal Fusion surgery. Clin Data Wareh Anal. 2022;1–15.

Publisher's note