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Occurrence and Associated Factors of Delirium in Elderly Orthopedic Patients: A Prospective Observational Study

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Abstract

Background: Delirium is a common neuropsychiatric disorder in elderly patients, characterized by an acute decline in cognitive function. It is associated with increased complications and mortality. Identifying factors associated with its occurrence is crucial for guiding clinical management.

Objectives: To determine the incidence of delirium during hospitalization in the orthopedic department and identify unadjusted factors associated with the occurrence of delirium in elderly patients.

Methods: Patients aged 60 years or older admitted to the orthopedic department, HRH Princess Maha Chakri Sirindhorn Medical Center between August 2024 and February 2025 were included. Data were collected using structured forms and categorized into delirium and nondelirium groups based on the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* criteria. Statistical analyses included chi-square test, Fisher exact test for categorical variables, and independent *t* test for continuous variables. A *P* value < .05 was considered statistically significant.

Results: A total of 150 patients were enrolled, of whom 13 developed delirium, resulting in cumulative incidence of 8.67%. Unadjusted factors significantly associated with delirium included advanced age (*P* < .001), particularly in patients aged over 80 (*P* < .001), and electrolyte imbalances, specifically hyponatremia (*P* = .003) and hypokalemia (*P* = .020).

Conclusions: Delirium occurs in a notable proportion of elderly orthopedic patients, showing unadjusted associations with advanced age and electrolyte imbalances. Due to the lack of multivariable adjustment, these findings should be interpreted cautiously to guide early clinical screening and vigilant monitoring.

Keywords: Delirium, Elderly, Incidence, Risk factors, Orthopedic surgery

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Citation: Thavongul S, Wanthong N, Viphavaphanich N, et al. Occurrence and associated factors of delirium in elderly orthopedic patients: a prospective observational study. *Res Med J*. 20XX;XX(X):e281125. doi:10.33165/rmj.2028.e281125

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Received: 23 March 2026
Revised: 12 September 2026
Accepted: 20 September 2026
Published Online: 4 November 2026

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Introduction

Delirium is an acute neuropsychiatric disorder characterized by a sudden disturbance in brain function, resulting in confusion, disorientation (in time, place, or person), mood lability, perceptual disturbances such as hallucinations or misinterpretations, and sometimes inappropriate behavior.[1] The prevalence of delirium can be as high as 56%

among hospitalized patients, and it occurs particularly frequently in the elderly population, with reported rates ranging from 20% to 79% in older inpatients.[2]

This condition has been associated with prolonged hospital stays, complications, and increased mortality.[2] One of the most common clinical settings in which delirium occurs among the elderly is the orthopedic ward, where the incidence has been reported to reach up to 19.7%.[3] According to a 2023 systematic review and meta-analysis by Igwe et al[4] investigating the incidence of postoperative delirium in older adults, the overall pooled incidence in orthopedic surgery is alarmingly high at 20% (95% CI, 17%-24%). This substantial statistical evidence underlines that older orthopedic patients are exceptionally vulnerable to developing delirium. Clinically, this condition has been directly linked to a downward trajectory in functional recovery by significantly impairing mobility and delaying rehabilitation outcomes among elderly patients. Furthermore, patients admitted for orthopedic conditions often experience significant pain and frequently undergo procedures or surgeries that require the use of analgesic and antimicrobial agents.[5] Many of these medications have been reported in previous studies as being associated with an increased risk of delirium due to their pharmacologic properties which influence the central nervous system. These include:1) anticholinergic agents such as orphenadrine, which increase central anticholinergic activity;[6] 2) gabapentinoids, which act as inhibitory neurotransmitters and possess sedative and hypnotic effects;[7] 3) opioids (eg, tramadol, morphine), which may suppress presynaptic acetylcholine release;[8] and 4) fluoroquinolones, which have GABA-antagonistic effects and may disrupt inhibitory neurotransmission in the central nervous system.[7] Crucially, in the study site, older orthopedic patients routinely receive these identical classes of medications as part of their standard pain management and perioperative care. Given their high exposure to these high-risk drugs, these patients face an even greater susceptibility to developing delirium. Therefore, the investigators recognized the vital need to incorporate these specific pharmacological factors into the evaluation. Apart from pharmacologic causes, several other factors have been associated with delirium, including sex, age, cognitive impairment, physical function, comorbidities, traumatic injuries,[5] surgical procedures,[9] infections,[10] and electrolyte disturbances. In particular hyponatremia and hypokalemia have been recognized as significant risk factors in previous studies.[11]

Given the substantial impact of delirium on clinical outcomes and the remarkably high risk observed globally in older orthopedic patients, localized data are urgently required. While international literature highlights this risk, the meta-analysis by Igwe et al[4] in 2023 does not account for data from the Thai population. Furthermore, existing local research remains limited; for instance, the prospective cohort study by Kaveenuntachai et al[12] in 2025 focused exclusively on internal medicine wards of a large urban hospital in Bangkok, reporting a 20.80% delirium incidence, and did not involve orthopedic patients. Because there is currently a critical lack of research specifically investigating delirium within orthopedic settings in Thailand, this study was conducted.

Therefore, the aims of present study were to: 1) determine the incidence of delirium, and 2) identify factors associated with its occurrence among elderly inpatients admitted to the orthopedic department at HRH Princess Maha Chakri Sirindhorn Medical Center. The findings of this multidisciplinary investigation will provide valuable evidence for the development of preventive strategies aiming at reducing the risk of delirium among elderly orthopedic inpatients in the future.

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Methods

Study Design, Setting, and Participants

A prospective observational design was conducted between August 2024 and February 2025 at HRH Princess Maha Chakri Sirindhorn Medical Center, Thailand. The research aimed to investigate the incidence and associated factors of delirium among elderly patients admitted to the orthopedic department.

The study population comprised elderly patients aged 60 years or older without preexisting major neurocognitive or neurological disorders who were admitted to the inpatient orthopedic ward during the study period. Consequently, the target study population was strictly defined as elderly individuals without known baseline neurological disorders. Voluntary participation with written informed consent was provided by the patient or a legal representative.

Patients were excluded if they met any of the following conditions: 1) being diagnosed with delirium by a psychiatrist prior to admission to the orthopedic ward; 2) foreign patients or those unable to communicate in Thai (reading, writing, or comprehension understand); 3) being diagnosed with neurological disorders (eg, dementia, Parkinson disease, or stroke). These conditions were documented as underlying diseases and were intentionally excluded to establish a homogeneous study population of elderly patients without known baseline neurological disorders; 4) patients who were intubated or admitted to the intensive care unit (ICU) at the time of inclusion; and 5) patients with chronic alcohol use, or those with drug dependence who had abruptly discontinued substance use.

The sample size was determined based on a time-bound sampling approach over a 7-month study period. All eligible elderly patients (aged ≥ 60 years) admitted to the orthopedic ward during this timeframe were consecutively screened for inclusion. During the study period, a total of 441 patients were admitted to the ward, among whom 158 elderly patients were screened for eligibility. Of these, 8 patients were excluded due to baseline neurological disorders (7 with prior stroke and 1 with Parkinson disease with dementia). No patients were excluded due to prior delirium, communication barriers, ICU admission/intubation, or substance dependence. Ultimately, all 150 eligible patients provided written informed consent and were included in the final analysis.

Data Collection

A structured data collection form was used and managed through a collaborative multidisciplinary approach. All personnel involved in data collection and clinical assessments were members of the research team.

Patient demographic and clinical data included sex, age, chief complaints, comorbidities, surgical history, and current medications. General demographic and clinical data were collected by the ward nurses, while medication histories and current medications were thoroughly evaluated and recorded by a clinical pharmacist. Additionally, clinical characteristics regarding the treatment phase were categorized by the scope of surgical procedures: 1) major operations, defined as procedures requiring general or neuraxial anesthesia (spinal or epidural) performed in a major operating theater with a duration exceeding 60 minutes; and 2) minor operations, defined as procedures requiring only short-acting local anesthesia, or none at all, performed in a minor theater or standard operating room. Electrolyte imbalances were defined based on standard laboratory reference thresholds at the institution: hyponatremia was defined as serum sodium < 135 mEq/L, hypokalemia as serum potassium < 3.5 mEq/L,

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hypocalcemia as serum calcium < 8.5 mg/dL, and hypomagnesemia as serum magnesium < 1.7 mg/dL.

Delirium assessment was conducted using a 2-step evaluation process. First, ward nurses performed an initial screening using the 4-Item Assessment Test (4AT).[13] Patients suspected of having delirium based on a 4AT score of 4 or higher were subsequently referred to a psychiatrist for a definitive clinical diagnosis using an assessment form adapted from the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (*DSM-5*), which was conducted within 24 hours of notification. To account for the fluctuating nature of delirium, patients with a confirmed diagnosis underwent daily clinical reassessments by the psychiatrist until the delirium completely resolved during their inpatient stay.[14]

Outcome Measurement

The primary outcome was the cumulative incidence of delirium, which was calculated as the percentage of patients who developed new-onset delirium during their stay in the orthopedic department. The following formula was utilized: cumulative incidence (%) = (number of new delirium cases/total number of patients at risk at baseline) × 100.

Furthermore, for the patients who developed delirium, the duration from the time of admission to the orthopedic ward until the definitive clinical diagnosis of delirium confirmed by the physician was precisely recorded to determine the onset of delirium.

Statistical Analysis

Descriptive statistics were used to summarize patient characteristics. Eligible participants were prospectively enrolled and monitored throughout hospitalization. Data were categorized into delirium and nondelirium groups for comparative analysis. Continuous variables were expressed as mean (SD) and assessed for normality using the Kolmogorov-Smirnov test. Between-group comparisons for continuous data were performed using the independent *t* test alongside the nonparametric Mann-Whitney *U* test to ensure robustness given the unequal group sample sizes. Mean differences, 95% CI, and Hedges *g* effect sizes (specifically adjusted for small and unequal sample sizes) were reported. Categorical variables were expressed as frequencies and percentages and compared using the chi-square test, or Fisher exact test when expected cell counts were less than 5 due to small sample sizes. All statistical analyses were 2-tailed, and a *P* value < .05 was considered statistically significant. All analyses were performed using Stata, version 14 (StataCorp).

Results

A total of 150 elderly patients met the inclusion criteria and were enrolled in the study. Among them, 13 patients developed delirium, representing a cumulative incidence of 8.67% (13/150), whereas 137 patients (91.33%) did not. All 13 delirium cases (100%) were classified as hyperactive delirium, characterized by agitation, restlessness, and emotional instability. The mean (SD) time from admission to the orthopedic ward to delirium onset was 6.15 (2.04) days (range 2-27 days).

Patient characteristics and unadjusted associated factors with delirium were determined (Table 1). Comparison of clinical factors between patients with and without delirium showed that age was significantly associated with the occurrence of delirium (*P* = .002).

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Another factor that differed significantly between groups was the presence of electrolyte abnormalities, particularly hyponatremia (P = .003) and hypokalemia (P = .020), were significantly associated with delirium occurrence.

The mean (SD) age of all participants was 70.55 (7.94) years. The age distribution met the assumption of normality both in the nondelirium (P = .126) and delirium (P = .877) groups based on the Kolmogorov-Smirnov test. Patients in the delirium group were significantly older compared to the nondelirium group (mean [SD], 78.23 [7.54] and 69.82 [7.64] years, respectively; mean difference, 8.41 years; 95% CI, 4.03-12.78) . This age difference was statistically significant using both the independent t test (t[148] = -3.795, P < .001) and the nonparametric Mann-Whitney U test (U = 360.5, P < .001), demonstrating a large effect size (Hedges g = 1.10). When classified by age groups (60-70, 71-80, and > 80 years), the incidence of delirium differed significantly across categories (P < .001). Notably, patients older than 80 years accounted for the highest proportion within the delirium group.

The most common comorbidities were hypertension (58%) and dyslipidemia (46.7%). Regarding pain scores, severe pain (pain score 7-10) was reported by 2 patients (15.38%) in the delirium group and 24 patients (17.52%) in the nondelirium group.

Regarding orthopedic physical restraints and immobilization protocols implemented to safeguard surgical alignments, prevent implant dislodgement, and maintain mandatory bone and joint care (including the application of splints, braces, cast immobilization, and traction), a total of 118 patients (78.67%) underwent these safety measures at some point during hospitalization. Within the delirium group, 11 patients (84.62%) required restraints, which was statistically comparable to the proportion observed in the nondelirium group (107 patients [78.10%]). In terms of surgical procedures, a total of 117 patients (78%) underwent major operations, which was higher than those who underwent minor operations (22%). Within the delirium group, 10 patients (76.92%) underwent major operations, compared to 107 patients (78.10%) in the nondelirium group.

Due to electrolyte abnormalities, hyponatremia was significantly associated with the occurrence of delirium (P = .003). Specifically, hyponatremia was present in 38.46% of patients in the delirium group, compared with only 6.57% in the nondelirium group. Similarly, hypokalemia was also significantly associated with delirium (P = .020). Hypokalemia was observed in 15.38% of patients in the delirium group, whereas it was present in only 0.73% of the nondelirium group.

The comparison of medication exposure between groups was performed. Although no statistically significant differences were observed for any drug classes (P > .05), opioids and anticholinergic agents were used more frequently in the delirium group compared to the nondelirium group (69.23% vs 58.39%, P = .561 and 53.85% vs 42.34%, P = .560, respectively). Among patients who developed delirium, the most frequently prescribed anticholinergic agents were orphenadrine/paracetamol (3 patients [23.08%]) and cyproheptadine (2 patients [15.38%]). Regarding opioid use, tramadol (5 patients [38.46%]) and morphine (4 patients [30.77%]) were the most prevalent medications. Within the gabapentinoid group, gabapentin was used in 4 cases (30.77%), while pregabalin was used in 1 case (7.69%) (Table 2).

Furthermore, other medications administered to patients in the delirium group included tolperisone, clonazepam, chlorpheniramine, and lorazepam, each used in 1 case (7.69%). In terms of delirium management, quetiapine and haloperidol were the most commonly utilized antipsychotics, with 7 patients each (53.85%) receiving these medications. These were

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followed by risperidone and olanzapine, which were prescribed to 1 patient each (7.69%). The mean (SD) total duration of delirium-related care, encompassing both inpatient treatment and post-discharge follow-up, was 33.38 (32.08) days.

Table 1. Comparison of Baseline Characteristics Between Patients With and Without Delirium

Variable	No. (%)			*P* Value
	Total (N = 150)	Delirium (n = 13)	Nondelirium (n = 137)	
Age, y				
60-70	83 (55.33)	2 (15.38)	81 (59.12)	< .001
71-80	50 (33.33)	5 (38.46)	45 (32.85)	
> 80	17 (11.33)	6 (46.15)	11 (8.03)	
Sex				
Female	77 (51.33)	5 (38.46)	72 (52.55)	.395
Male	73 (48.67)	8 (61.54)	65 (47.45)	
Comorbidities*				
Hypertension	87 (58.00)	8 (61.54)	79 (57.66)	.803
Dyslipidemia	70 (46.67)	7 (53.85)	63 (45.99)	.587
Diabetes mellitus	48 (32.00)	4 (30.77)	44 (32.12)	> .999
Cardiovascular disease	22 (14.67)	4 (30.77)	18 (13.14)	.104
Chronic kidney disease	13 (8.67)	3 (23.08)	10 (7.30)	.088
Pain score (7-10)	26 (17.33)	2 (15.38)	24 (17.52)	> .999
Physical restraints	118 (78.67)	11 (84.62)	107 (78.10)	.732
Surgical procedures				
Major operation	117 (78.00)	10 (76.92)	107 (78.10)	> .999
Minor operation	33 (22.00)	3 (23.08)	30 (21.90)	
Electrolyte imbalance				
Hyponatremia	14 (9.33)	5 (38.46)	9 (6.57)	.003
Hypokalemia	3 (2.00)	2 (15.38)	1 (0.73)	.020
Hypocalcemia	0	0	0	NA
Hypomagnesemia	0	0	0	NA

Abbreviation: NA, not applicable.

* Each patient may have more than one comorbidity.

Table 2. Comparison of Medication Use Between Delirium and Nondelirium Groups

Drug Class	No. (%)			*P* Value
	Total (N = 150)	Delirium (n = 13)	Nondelirium (n = 137)	
Opioids	89 (59.33)	9 (69.23)	80 (58.39)	.561
Anticholinergics	65 (43.33)	7 (53.85)	58 (42.34)	.560
Gabapentinoids	65 (43.33)	5 (38.46)	60 (43.80)	.777
Fluoroquinolones	5 (3.33)	0	5 (3.65)	> .999

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Discussion

This study demonstrated that the incidence of delirium among elderly patients admitted to the orthopedic ward was 8.67% of the study population. The incidence observed in this study was lower than that reported by Ngamkala et al[15] (12.85%) in a general medical ward in Thailand and considerably lower than rates reported internationally, where delirium occurs in 29%-64% of patients in general or geriatric medicine wards, 11%-68% in surgical wards, and 26%-82% in intensive care units.[16] In a study by Wang et al[11] focusing on elderly orthopedic postoperative patients aged ≥ 70 years, the incidence was 12.9%, which is slightly higher than that found in the present study. The relatively lower rate in this study setting may reflect improved awareness and early screening for delirium among healthcare personnel in the orthopedic ward, such as the use of the 4AT delirium screening tool and multidisciplinary prevention strategies. Specifically, these collaborative strategies involved systematic screening by ward nurses using the 4AT, thorough evaluation of high-risk medications by clinical pharmacists, and prompt psychiatric assessment within 24 hours for suspected cases to optimize early intervention and care. Additionally, this relatively lower incidence should be interpreted in light of the exclusion criteria, which omitted patients with preexisting neurological disorders (such as dementia, Parkinson disease, and stroke). Since these underlying diseases are potent predisposing factors for delirium, the selection of patients without known baseline neurological disorders likely accounts for the lower incidence observed in this study compared to broader, unselected clinical populations.

The mean (SD) onset of delirium in this study was 6.15 (2.04) days after admission, comparable to the findings of Wang et al[11] who reported an average onset of 2.8 days (range 7-16 days) postoperatively. This similarity suggests that delirium typically occurs within the first week of hospitalization or following major orthopedic surgery, indicating the importance of early vigilance during this period.

Delirium is a multifactorial condition resulting from an interaction between a patient's baseline vulnerability (predisposing factors) and acute stressors (precipitating factors). In this study, univariable comparisons identified 3 exploratory, unadjusted factors associated with the occurrence of delirium: advancing age and electrolyte imbalances, specifically hyponatremia and hypokalemia

Age was strongly associated with delirium occurrence, particularly among patients aged ≥ 80 years, who represented the highest proportion of cases (46.15% of the delirium group). Advanced age is linked to physiological and neurological changes that reduce the brain's resilience to stressors. Furthermore, elderly patients often present with multiple comorbidities and altered pharmacokinetics, increasing their vulnerability to metabolic disturbances and medication side effects.[5, 17] In this study, patients who developed delirium had a mean (SD) age of 78.23 (7.54) years, with those aged ≥ 80 years representing the highest proportion of cases. Notably, within the delirium group, 7 patients (53.85%) were prescribed anticholinergic agents. The frequent use of these medications, known to cross the blood-brain barrier more easily in the aged brain, may have further exacerbated the risk of delirium in this highly vulnerable population. These findings are consistent with previous Thai and international studies reporting advanced age as one of the most significant independent predictors of delirium among surgical and hospitalized populations, likely due to a combination of physiological brain changes and increased sensitivity to medication side effects.[6, 15]

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In this study, electrolyte abnormalities, particularly hyponatremia and hypokalemia, were significantly associated with the occurrence of delirium, whereas no patients in either group exhibited calcium or magnesium imbalances. For the purposes of this analysis, these disturbances were defined using categorical thresholds: < 135 mEq/L for hyponatremia and < 3.5 mEq/L for hypokalemia**,** < 8.5 mg/dL for hypocalcemia, and < 1.7 mg/dL for hypomagnesemia. The finding on hyponatremia aligns with Wang et al[11] who reported that hyponatremia (< 135 mmol/L) increased the odds of delirium (odds ratio [OR], 3.05; 95% CI, 1.70-5.47). The same study also found that hypocalcemia (< 2.25 mmol/L) was associated with an increased likelihood of developing delirium (OR, 1.986; 95% CI, 1.217-3.241). The authors explained that hyponatremia is an important contributing factor to delirium, as this association has been well supported by previous evidence.[11] The pathophysiological explanation for hyponatremia-induced delirium is that decreased serum sodium levels create an osmotic gradient across the blood-brain barrier, leading to a shift of water from the intravascular space into brain cells, particularly astrocytes. This results in cerebral cellular swelling (cytotoxic edema) and subsequently increased intracranial pressure. These changes disrupt neuronal function and alter neurotransmitter metabolism, ultimately manifesting as neurological symptoms, including impaired mental status and delirium.[18] However, clinical evidence remains limited and less consistent compared with hyponatremia, suggesting that the association may exist but is not yet strongly established. Regarding hypokalemia, this study found a significant association with delirium occurrence, which is supported by theoretical neurophysiological mechanisms involving impaired membrane potential and neurotransmitter dysregulation.[19] According to Maldonado et al,[20] hypokalemia is identified as a significant precipitating factor for delirium within the framework of the "systems integration failure hypothesis". This hypothesis posits that physiological stress, including electrolyte imbalances like hypokalemia, disrupts neuronal ion pumps, altering intra- and extracellular electrolyte concentrations which then impact neurotransmitter function and neural network communication, ultimately leading to the symptoms of delirium. Wang et al[11] reported that hypokalemia (< 3.5 mmol/L) was nearly associated with an increased risk of developing delirium (OR, 2.123; 95% CI, 0.926-4.865); however, this association did not reach statistical significance.

Due to the small sample size and low exposure rates for specific high-risk drug classes, the analysis remains descriptive. Nevertheless, a comparison of medication usage patterns revealed that opioids and anticholinergic agents were more frequently administered to patients in the delirium group than to those in the nondelirium group, serving as an exploratory observation. Opioid medications can precipitate excited delirium through mechanisms involving alterations in dopaminergic and cholinergic regulation. Specifically, opioid exposure increases dopaminergic neuronal activity while concurrently reducing cholinergic activity within the frontostriatal regions of the brain. Elevated dopamine levels stimulate the D2 receptor family, leading to inhibition of acetylcholine synthesis. In addition, dysregulation of D2 receptor subtypes has been associated with the development of hallucinations, stereotypic behaviors, and disturbances in thought processes.[21] Evidence from a meta-analysis demonstrated that opioid use was not significantly associated with the development of delirium (OR, 1.50; 95% CI, 0.91-2.49). This lack of association may be attributed to substantial heterogeneity among the included studies. Nevertheless, findings from individual drugs have shown that opioids can induce delirium, particularly at higher dosages, suggesting a potential dose-dependent effect.[22]

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Drugs with anticholinergic properties reduce cholinergic neurotransmission, which can impair memory, alertness, and attention, and has been associated with an increased risk of delirium.[6, 23] Several observational studies and meta-analyses have consistently shown that a higher anticholinergic burden is associated with an increased incidence of delirium among elderly populations across diverse clinical settings, including acute medical wards, postsurgical care, and nursing homes.[24, 25] Although the observed effect sizes are generally modest, these findings highlight the clinical importance of assessing and minimizing anticholinergic exposure in older adults to prevent delirium and its related adverse outcomes.[24-26]

In this study, quetiapine and haloperidol were the most commonly prescribed antipsychotics for managing delirium. This pharmacological selection directly aligns with the clinical finding that 100% of the detected delirium cases manifested as the hyperactive subtype, where prominent symptoms of severe agitation and conspicuous behavioral disruptions necessitated immediate medical control. Haloperidol was strategically reserved for these highly agitated hyperactive presentations due to its potent D2 receptor antagonism and minimal anticholinergic properties, while quetiapine was favored for more stable presentations due to its relatively low risk of extrapyramidal side effects.[27, 28] Notably, the mean (SD) total duration of delirium-related care, encompassing inpatient treatment through postdischarge follow-up, was 33.38 (32.08) days. This prolonged duration further underscores the impact of the established multidisciplinary approach, demonstrating that the collaborative team did not merely manage acute inpatient episodes but provided continuous, longitudinal tracking to ensure complete symptom resolution in the outpatient setting.

Several limitations of this study should be acknowledged. First, this study utilized a single-center design conducted within a single university hospital, and the sample size was relatively small with a limited number of outcome events. Consequently, the statistical power was constrained, meaning that univariable comparisons identified only 3 exploratory, unadjusted factors associated with the occurrence of delirium rather than establishing definitive multivariate predictors, which may also limit the generalizability of this findings to broader populations.

Second, a significant selection bias may have been introduced through the strict exclusion criteria. This study population was restricted by design to individuals without preexisting major neurocognitive or neurological conditions, including dementia, stroke, and Parkinson disease. These criteria were intentionally applied to focus on elderly patients with intact baseline functions, allowing the investigation of exploratory risk factors independent of chronic brain pathology. However, these excluded populations represent the highest-risk groups for developing delirium, particularly delirium superimposed on dementia.[29, 30] Consequently, excluding these patients likely resulted in an underestimation of the true incidence of delirium, thereby limiting the external validity and generalizability of these findings to broader patient populations where comorbid neurological disorders are highly prevalent.

Third, while the 2-step protocol (nurse 4AT screening and psychiatrist *DSM-5* evaluation) ensured high diagnostic validity, finding 100% hyperactive delirium indicates an inherent detection bias. In routine orthopedic wards, agitated (hyperactive) patients are highly conspicuous, triggering prompt referral, whereas lethargic (hypoactive) patients are easily overlooked. Consequently, the true cumulative incidence of delirium, particularly the hypoactive subtype, may have been further underestimated in this study.

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Fourth, electrolyte disturbances were defined using binary categorical thresholds: hyponatremia as serum sodium < 135 mEq/L and hypokalemia as serum potassium < 3.5 mEq/L. A notable constraint is that the data did not reflect the actual continuous serum levels beyond these binary categories, obscuring how the specific degree of depletion correlates with the onset and severity of delirium.

Finally, because of the small sample size and low exposure rates for certain high-risk drug classes, the statistical power was insufficient to determine independent medication risks or evaluate dose-dependent effects. Therefore, the medication analysis remains strictly descriptive, allowing us only to observe and compare how medication usage patterns differed between the delirium and non-delirium groups.

To translate these findings into routine clinical practice, the implementation of standardized assessment tools is recommended with multiple time-point screenings using the 4AT tool particularly for ultra-elderly patients (aged ≥ 80 years). Routine care protocols should also prioritize proactive electrolyte surveillance and rapid replenishment of sodium and potassium, alongside collaborative clinical pharmacist reviews to minimize the anticholinergic burden.

For future research, larger-scale, multicenter prospective studies are strongly warranted to mitigate single-center biases and control for complex confounding factors. Furthermore, future efforts should focus on intervention-based approaches, such as evaluating the efficacy of targeted, multidisciplinary delirium prevention bundles tailored specifically for the orthopedic surgical environment.

Conclusions

This study found that the cumulative incidence of delirium among elderly orthopedic inpatients without preexisting major neurocognitive or neurological disorders was 8.67%. The unadjusted, exploratory factors associated with the occurrence of delirium were advanced age and electrolyte disturbances, specifically hyponatremia and hypokalemia. As delirium is a potentially preventable condition, early identification of high-risk patients, particularly those of advanced age or those presenting with electrolyte imbalances, is crucial for improving clinical outcomes. While preliminary, these exploratory findings support the importance of routine clinical vigilance, particularly attentive electrolyte monitoring, within the elderly orthopedic population. Additionally, although medication-related factors did not reach statistical significance in this study, cautious medication management remains a vital consideration based on broader clinical guidelines and existing literature to optimize patient safety. These observations underscore the value of further large-scale research to guide the future development of comprehensive, evidence-based preventive protocols and multidisciplinary strategies for this vulnerable group.

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Additional Information

Acknowledgments: The authors gratefully acknowledge all patients who participated in this study and the medical personnel of HRH Princess Maha Chakri Sirindhorn Medical Center for their cooperation and support during data collection.

Ethics Approval: This study was approved by the Human Research Ethics Committee of Srinakharinwirot University (SWUEC-673043) on 29 August 2024. All participants or their legal representatives provided written informed consent prior to their participation in the study.

Clinical Trial Consideration: This study does not report on a clinical trial.

Financial Support: This research was financially supported by the Faculty of Pharmacy, Srinakharinwirot University, fiscal year 2024 (Grant No. 555/2567, Siranan Klanbut).

Conflict of Interest: The authors declare no conflict of interest.

Declaration of AI Assistance: The authors used a generative AI tool (Gemini) in the preparation of this manuscript. The AI was utilized for language refinement, including grammar and clarity. All AI-generated content is based on real data and has been thoroughly reviewed and verified by the authors to ensure accuracy, validity, and integrity. The authors take full responsibility for the content presented.

Author Contributions:
Conceptualization: All authors
Formal Analysis: All authors
Funding Acquisition: Siranan Klanbut
Methodology: All authors
Visualization: All authors
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