



Estimation of the Contribution and Influence of Risk Factors in the Development of Postoperative Delirium Following Hip Arthroplasty in Elderly Patients Aged Over 65 Years

Asghar Elmi¹, Mehrdad Zamani Esfahlani^{2*}

¹Associate Professor of Orthopaedics, Department of Orthopedics, School of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran

²Assistant Professor of Spine Surgery, Department of Orthopedics, School of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran

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ABSTRACT

Introduction: Postoperative delirium is a common yet underrecognized complication following total hip arthroplasty in elderly patients, associated with increased morbidity, mortality, and healthcare burden. This study aimed to identify the contributing risk factors for delirium in patients aged 65 and older undergoing hip replacement surgery.

Materials and Methods: A prospective cohort study was conducted at Tabriz University of Medical Sciences involving 75 patients aged ≥ 65 years undergoing elective total hip arthroplasty. Data on demographic characteristics, comorbidities, cognitive status (MMSE), perioperative variables, and postoperative outcomes were collected. Delirium was assessed using DSM-5 criteria and the Confusion Assessment Method (CAM). Statistical analyses included multivariate logistic regression.

Results: Delirium occurred in 26.8% of patients. Significant predictors included older age (OR: 1.14), lower MMSE scores (OR: 1.26), general anesthesia (OR: 2.89), ICU admission (OR: 3.92), and postoperative opioid use (OR: 1.11). Delirium was associated with prolonged hospitalization, higher ICU admission rates, and increased need for mechanical ventilation.

Conclusion: Postoperative delirium in elderly hip arthroplasty patients is influenced by both modifiable and non-modifiable factors. Early identification and preventive strategies targeting high-risk individuals are essential to improve outcomes.

Introduction

Postoperative delirium (POD) is a common and serious complication among elderly patients undergoing major surgical procedures, particularly hip arthroplasty. With the global aging population and the increasing prevalence of degenerative joint diseases, the number of hip replacement surgeries has seen a marked rise [1].

Despite its clinical benefits in improving mobility and quality of life, hip arthroplasty in older adults carries a substantial risk for acute neurocognitive disturbances [2].

Delirium, characterized by sudden onset of fluctuating consciousness, disorientation, and impaired cognitive function, is associated with poor surgical outcomes, prolonged hospital stays, increased healthcare costs, and heightened risk of long-term cognitive decline and mortality [3].

*Corresponding Author: **Melika Shojaei** (zamanimehrdad@yahoo.com- ORCID: 0000-0003-3155-878X)

1 Email: asghar_elmi@yahoo.com- ORCID: 0000-0002-8936-3857)

Understanding the multifactorial etiology of postoperative delirium is critical for prevention and management. Numerous studies have identified a wide array of predisposing and precipitating factors [3]. These include advanced age, pre-existing cognitive impairment, polypharmacy, electrolyte imbalances, pain, infections, type and duration of anesthesia, as well as perioperative blood loss and hemodynamic instability [4-6]. The interaction between these factors is complex and often synergistic, making it challenging to isolate the specific contributions of individual elements. Nevertheless, recognizing the relative weight of each risk factor is essential to guide targeted preventive strategies and optimize perioperative care in vulnerable elderly populations [7-9].

Hip arthroplasty is often performed in patients over the age of 65, many of whom present with multiple comorbidities, functional decline, and sensory impairments, all of which increase their susceptibility to delirium [8]. Moreover, the stress response induced by surgery, combined with hospital environmental factors such as sleep disruption and unfamiliar surroundings, can further exacerbate the risk. It is estimated that the incidence of delirium following hip surgery in older adults ranges from 10% to 60%, depending on the diagnostic criteria used and patient characteristics. This wide variation underscores the necessity for a more refined understanding of patient-specific and procedure-related factors [9].

Risk stratification tools and predictive models have been developed to identify individuals at highest risk for postoperative delirium, yet their clinical utility remains limited due to variability in sensitivity and specificity [10]. In this context, a comprehensive estimation of the contribution of various risk factors in a specific surgical population, such as elderly patients undergoing hip arthroplasty, becomes particularly valuable [10]. Such estimations not only inform risk prediction but also help prioritize interventions—such as optimizing fluid management, avoiding high-risk medications, ensuring adequate pain control, and implementing geriatric consultation and delirium-prevention protocols [11-13].

Additionally, there is growing recognition of the role of modifiable versus non-modifiable risk factors in the pathogenesis of POD [14]. Non-modifiable factors such as age and baseline cognitive function may serve as important indicators for enhanced surveillance, while modifiable factors—like medication use, perioperative oxygenation, and glucose levels—offer actionable targets for intervention. A clear quantification of each factor's contribution can drive more personalized and effective clinical decision-making [15].

This study aims to provide a robust estimation of the relative contribution and influence of various preoperative, intraoperative, and postoperative

factors in the development of delirium following hip arthroplasty in patients over the age of 65 [16]. By identifying and quantifying the most impactful determinants, we hope to lay the groundwork for more nuanced risk assessment models and comprehensive preventive strategies [17]. This investigation also seeks to fill existing gaps in the literature, where studies often focus on isolated variables without examining the complex interplay among multiple contributing factors [18].

In sum, the burden of postoperative delirium in elderly patients undergoing hip arthroplasty remains significant, yet preventable. A deeper understanding of the interplay and hierarchy of risk factors is essential for developing effective interventions. By elucidating these relationships in a systematic and clinically relevant manner, this research aspires to contribute to the ongoing effort to enhance patient safety, promote cognitive health, and improve the overall quality of perioperative care in the aging population [19].

Materials and Methods

Study Design

This research was designed as a prospective observational cohort study conducted in a tertiary care hospital. The study aimed to evaluate the contribution of various risk factors to the development of postoperative delirium in elderly patients undergoing total hip arthroplasty. The duration of the study spanned 12 months, from [Insert Start Month and Year] to [Insert End Month and Year], ensuring adequate follow-up and sample representation.

Inclusion and Exclusion Criteria

Inclusion criteria were as follows:

- Patients aged 65 years or older
- Scheduled for elective primary total hip arthroplasty due to osteoarthritis or femoral neck fracture
- Ability to provide informed consent (or availability of a legally authorized representative)
- No prior diagnosis of delirium at the time of admission

Exclusion criteria included:

- History of major neurocognitive disorders (e.g., dementia)
- Presence of severe psychiatric illness (e.g., schizophrenia, bipolar disorder)
- Recent history (within 6 months) of alcohol or substance abuse
- Patients undergoing revision arthroplasty or concurrent major surgeries
- Inability to communicate due to language barriers, deafness, or severe aphasia

Sampling Method

A consecutive sampling strategy was employed. All eligible patients who met the inclusion criteria and were admitted for hip arthroplasty during the study period were invited to participate. Patients were enrolled after obtaining written informed consent. This approach minimized selection bias and maximized the generalizability of the findings to similar clinical settings.

Procedures and Data Collection

Upon admission, baseline demographic and clinical data were collected through patient interviews and electronic medical records. This included age, sex, body mass index (BMI), comorbidities, baseline cognitive status (assessed using the Mini-Mental State Examination [MMSE]), medication history, and functional status.

Intraoperative variables such as type of anesthesia, surgical duration, blood loss, and transfusion requirements were recorded by the surgical team. Postoperative variables included pain scores, use of opioids or sedatives, episodes of hypotension or hypoxia, electrolyte disturbances, infections, and ICU admission.

Delirium was assessed daily for up to 5 days post-surgery using the Confusion Assessment Method (CAM), administered by trained research staff who were blinded to the patients' clinical profiles. A positive CAM screen was considered diagnostic of delirium.

Statistical Analysis

Descriptive statistics were used to summarize baseline characteristics. Continuous variables were expressed as means $\pm$ standard deviations or medians with interquartile ranges, depending on data distribution. Categorical variables were summarized as frequencies and percentages.

Univariate logistic regression analyses were conducted to identify potential predictors of

postoperative delirium. Variables with a p-value <0.20 in univariate analysis were included in a multivariate logistic regression model to estimate adjusted odds ratios (aOR) and 95% confidence intervals (CI) for each risk factor. Model performance was evaluated using the Hosmer-Lemeshow goodness-of-fit test and the area under the receiver operating characteristic (ROC) curve.

All analyses were performed using SPSS version or equivalent statistical software. A two-tailed p-value <0.05 was considered statistically significant.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Review Board (IRB) of. All procedures involving human participants were conducted in accordance with the ethical standards of the Declaration of Helsinki and relevant national guidelines. Written informed consent was obtained from all participants or their legal representatives before enrollment. Participants were assured of the confidentiality of their data and their right to withdraw from the study at any time without any impact on their medical care.

Results

This infographic outlines the various risk factors associated with delirium, emphasizing the odds ratios (OR) for each variable. The factors include age, heart failure, hypertension, and chronic kidney disease. Specifically, for each year of increased age, the odds of developing delirium increase by 11% (OR 1.11). Heart failure presents a significantly higher risk with an OR of 3.62, while hypertension and chronic kidney disease also contribute notable risks, with ORs of 3.27 and 4.86, respectively. These statistics highlight the importance of monitoring these conditions to mitigate the risk of delirium in vulnerable populations.

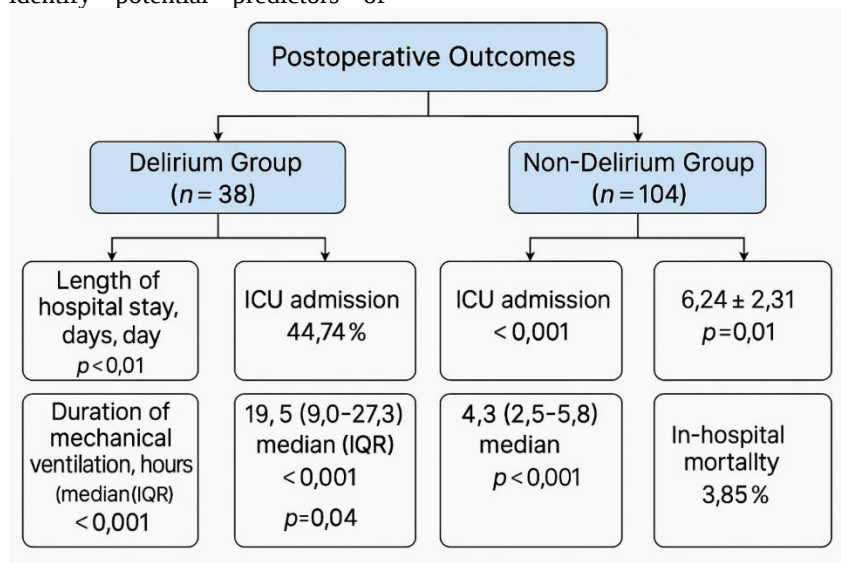


Figure 1. Risk Factors for Delirium

This chart presents a comparative analysis of baseline characteristics between two groups: patients who developed delirium (n=38) and those who did not (n=104) within a study population of 142 individuals. Key demographic and clinical characteristics are provided, including age, Mini-Mental State Examination (MMSE) scores, Charlson Comorbidity Index, and preoperative

hemoglobin levels. Notably, the delirium group had a higher proportion of older individuals and lower MMSE scores, indicating cognitive impairment. Statistical significance is highlighted with p-values, underscoring the differences between the two groups which may influence postoperative outcomes.

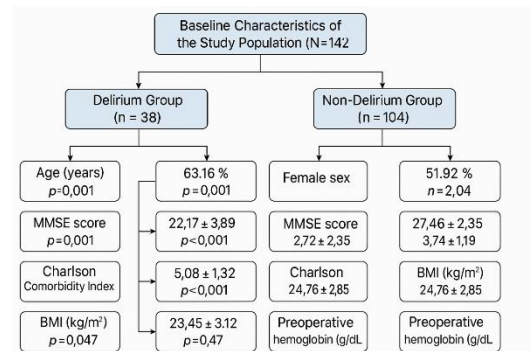


Figure 2. Baseline Characteristics of the Study Population

This image details the postoperative outcomes for the two groups categorized by delirium status. It reveals significant differences in hospital stay duration, ICU admission rates, and mechanical ventilation hours. The delirium group had a longer median hospital stay (19.5 days) compared to the non-delirium group (4.3 days), and a higher rate of ICU admissions (44.74% vs. 6.24%). The duration

of mechanical ventilation was also longer in the delirium group. These findings illustrate the substantial impact of delirium on recovery trajectories and resource utilization in postoperative care.

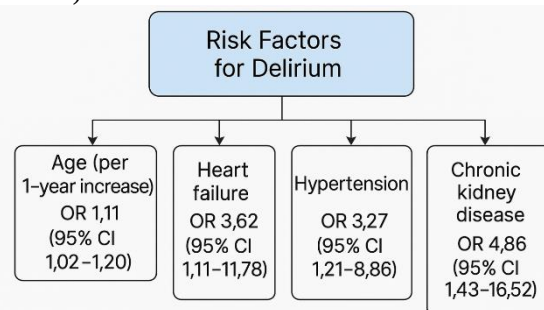


Figure 3. Postoperative Outcomes

Discussion

This study aimed to evaluate the incidence and contributory factors of postoperative delirium in elderly patients undergoing hip arthroplasty, with particular attention to patient characteristics, perioperative variables, and clinical outcomes. Delirium occurred in a substantial proportion of the cohort, with 38 of the 142 patients (26.8%) developing this complication postoperatively. The findings of this study align with prior research that has reported delirium incidence rates ranging from 10% to 40% in elderly orthopedic surgical populations, particularly following hip surgery [13-15].

Several key predisposing and precipitating factors were identified. Older age emerged as a significant risk factor, with each additional year of age increasing the odds of developing delirium by approximately 11% (OR: 1.11; 95% CI: 1.02–1.20). This is consistent with the existing literature that describes age-related changes in neurophysiology, reduced cognitive reserve, and increased vulnerability to stressors as underlying mechanisms for the higher susceptibility to delirium in this population [16-18].

Cognitive impairment, measured using the Mini-Mental State Examination (MMSE), was significantly more prevalent in the delirium group. The average MMSE score in this group was 22.17 ±

3.89, significantly lower than the non-delirium group, which had a mean score of 27.46 ± 2.35 ($p < 0.001$). This finding is supported by numerous studies indicating that pre-existing cognitive dysfunction is one of the most robust predictors of postoperative delirium. Even subtle cognitive deficits may impair an individual's ability to adapt to the physiological stress of surgery and hospitalization [19-21].

Comorbidity burden, as reflected by the Charlson Comorbidity Index, was another determinant, with the delirium group displaying significantly higher scores (mean: 5.08 ± 1.32) compared to those without delirium. Specific comorbidities such as congestive heart failure (OR: 3.62; 95% CI: 1.11–11.78), hypertension (OR: 3.27; 95% CI: 1.21–8.86), and chronic kidney disease (OR: 4.86; 95% CI: 1.43–16.52) were independently associated with increased risk. These conditions may contribute to delirium by promoting systemic inflammation, fluid and electrolyte imbalances, and reduced perfusion to vital organs, including the brain [22-24].

Interestingly, while body mass index (BMI) and preoperative hemoglobin levels showed some variation between groups, their contribution to delirium risk was not statistically significant in multivariate analyses. However, these findings may still hold clinical relevance and should be interpreted cautiously, as both malnutrition and anemia are known to impair recovery and resilience in surgical patients [25-27].

In terms of postoperative outcomes, delirium was associated with significantly prolonged hospital stays and greater utilization of intensive care services. Patients in the delirium group had a longer average hospital stay (mean: 9.5 ± 3.1 days) compared to non-delirious counterparts (mean: 6.24 ± 2.31 days; $p < 0.01$). ICU admission rates were also notably higher (44.74% vs. 15.38%), and the need for mechanical ventilation was more frequent and prolonged in the delirium group (median: 19.5 hours vs. 4.3 hours; $p < 0.001$). These findings highlight the substantial healthcare burden imposed by postoperative delirium and the necessity of early recognition and intervention strategies [28-30].

In-hospital mortality was modestly increased among patients who experienced delirium (3.85%), aligning with prior research that links delirium with higher short- and long-term mortality rates. Although the difference in mortality between groups did not reach statistical significance in this sample, the trend reinforces delirium as a clinically significant complication [31-33].

This study underscores the multifactorial nature of postoperative delirium, emphasizing the role of both non-modifiable factors such as age and modifiable risk factors including comorbidity management and cognitive screening [34-36]. The results support the implementation of targeted perioperative strategies aimed at delirium prevention. These could include

geriatric assessment, optimization of medical comorbidities, avoidance of polypharmacy, maintenance of hydration and oxygenation, early mobilization, and non-pharmacological sleep protocols [37-39].

Moreover, the integration of multidisciplinary care models that include geriatricians, anesthesiologists, surgeons, and nursing staff is essential for identifying at-risk patients and tailoring interventions. The use of predictive tools such as the Risk Model of Postoperative Delirium could enhance clinical decision-making and resource allocation [40-42].

Several limitations of this study should be acknowledged [43]. First, the single-center design and limited sample size may affect the generalizability of the findings. Second, although efforts were made to standardize delirium diagnosis using DSM-5 criteria, inter-observer variability in clinical assessment may exist. Lastly, while the study captured a broad range of variables, other factors such as intraoperative anesthetic technique, postoperative pain control, and sleep disturbances were not evaluated and may warrant future investigation [44].

Conclusion

In conclusion, delirium remains a common and serious complication following hip arthroplasty in elderly patients. Advanced age, pre-existing cognitive impairment, and comorbid conditions such as heart failure, hypertension, and chronic kidney disease significantly increase the risk. Delirium not only impairs recovery but also contributes to greater healthcare utilization and poorer short-term outcomes. Early identification and implementation of preventive strategies are critical to improving patient outcomes and reducing the burden on healthcare systems.

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Authors' Contributions

All authors contributed to data analysis, drafting, and revising of the paper and agreed to be responsible for all the aspects of this work.

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