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Evaluating the Severity of the Delirium Risk among Patients Undergoing Orthopedic Surgery: A Cross-Sectional Study

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ABSTRACT

Delirium is a prominent neurological diagnosis frequently observed among patients who have had orthopedic surgery. Assessing the risk factors for developing delirium is one approach to elucidating its pathogenesis and providing efficient prevention strategies. Therefore, this study was conducted to investigate the severity of the risk of developing delirium among individuals undergoing orthopedic surgery. This study was a cross-sectional descriptive analysis of 109 orthopedic surgery patients in the male and female surgery departments of Imam Jafar Sadiq hospital in Aligudarz city in 2022. The study included demographic and clinical information questionnaires, and Mini Mental State Examination and Abbreviated Mental Test tools administered 24 hours before the surgery. The sampling approach used was sequential non-probability. The data were analyzed using descriptive statistics and SPSS v26 software. The evaluation of 109 patients revealed that 57 (52.3%) were male and 52 (47.7%) were female. The calculated mean age of the patients was 68.46±10.77 years. The study included 41 patients (37.6%) diagnosed with hypertension, 26 patients (23.9%) with diabetes, and 19 patients (17.4%) with cardiovascular disorders. A total of 29 patients, accounting for 26.6%, had a documented record of smoking and drug addiction. Regarding cognitive disorders, 19 patients (17.4%) were within the moderate range, whereas 90 patients (82.6%) fell within the mild to normal range. The findings of this study suggest a somewhat elevated level of risk factors for delirium in patients undergoing orthopedic surgery. So, identifying risk factors, explaining pathophysiological mechanisms, and encouraging patients to adjust their lifestyle and habits to prevent POD is very important. Therefore, it is crucial to identify these risk factors, elucidate the underlying pathophysiological mechanisms, and motivate patients to modify their lifestyle and habitual behaviors in order to prevent the development of postoperative delirium.

Keywords: Delirium; Orthopedic Surgery; Risk Factors

Introduction

Surgery in the orthopedics field is frequently accompanied by complications and challenges for the patients [1]. Being prevalent among hospitalized orthopedic surgery patients, the occurrence of delirium can significantly affect the clinical outcomes of these patients [2]. Delirium is an acute and variable alteration in the patient's mental state, characterized by a decline in consciousness and impaired attention [3]. Several modifiable and non-modifiable risk factors, such as age, gender, underlying cognitive disorders, body mass index, diabetes, cardiovascular disorders, hypertension, type of surgery, smoking, drug abuse/addiction, and electrolyte disorders, may contribute to the development of postoperative delirium (POD) prior to, during, and following surgery [4-7].

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Based on the studied population, it is estimated that the prevalence of delirium among hospitalized patients ranges from 11% to 42% [8]. Abate et al. conducted a comprehensive systematic review which revealed that surgical patients who had undergone non-cardiac surgery, including orthopedic surgery, had a higher incidence of developing delirium after the operation. Furthermore, the mortality rate for patients with POD was shown to be about six times greater [9].

It is highly recommended that healthcare providers prioritize POD due to its substantial correlation with long-term brain damage in the initial days following surgery. Additionally, other consequences such as cognitive deterioration at 3 to 12 months post-surgery, extended hospital stays, increased healthcare expenses, higher rates of readmission, inability to return to or resume work, and increased mortality have also been reported among patients suffering from POD. When POD develops, it is usually underdiagnosed and subsequently exacerbates the complications for the patients [6, 10, 11].

Timely diagnosis of delirium following surgery is crucial in the management of these patients since a delay in treatment is linked to a substantial rise in fatality rates [12]. Although several theories have been proposed to explain the underlying mechanisms leading to delirium, there is no successful approach to preventing or treating POD. A comprehensive evaluation of the factors that increase the risk of developing delirium may assist with enhancing the relevant preventive measures [13]. Quantifying the risk levels associated with the pathogenesis of POD prior to surgery is one of the methodologies that, in turn, offers effective preventative strategies [4]. Given the scarcity of research on the development, prevention, and treatment of POD in Iran, the high prevalence, and the many risk factors of this condition and its consequences among orthopedic surgery patients, this study was undertaken to assess the severity of the delirium risk among orthopedic surgery candidates.

Materials and Methods

The objective of this cross-sectional descriptive study was to assess the prevalence of the relevant risk factors for the development of delirium among patients who underwent orthopedic surgeries such as internal bone fixation, joint replacement, and muscles, tendons, and ligaments repair at Imam Jafar Sadiq hospital in the city of Aligudarz, Lorestan province, Iran.

The sequential non-probability sampling method was implemented between between November 2022 and April 2023. The study population consisted of all orthopedic trauma patients aged 55 or above who were scheduled for surgery. Patients with orthopedic traumas of the upper or lower extremities, pelvis, and solitary spine fractures demanding surgery, a Mini Mental State Examination (MMSE) score between 18 and 30, and an Abbreviated Mental Test (AMTS) score between 4 and 10 were eligible for inclusion. Further, the exclusion criteria encompassed the patients' incapacity to communicate verbally and their unwillingness to participate in the study. Out of 154 examined patients, 109 were eligible to participate in the study. The researcher administered demographic and clinical information questionnaires inquiring about age, sex, body mass index, cognitive state, comorbidities, history of smoking and drug abuse, as well as MMSE and AMTS, to each participant 24 hours prior to surgery. These questionnaires were filled out based on electronic documentation and patient interviews. Therefore, the assessment tool for patients, in terms of investigating the risk factors of developing delirium, included demographic and clinical information questionnaires along with MMSE and AMTS tools to evaluate the cognitive status of the patients. Adhering to ethical principles, if delirium occurred, a required report was submitted to the head of the department for conducting the treatment process.

MMSE has been widely employed as a suitable tool for diagnosing and screening dementia. It contains 20 questions with a total score of 30 points. In the population of healthy people, the

result of this test is in the range of 18 to 30; according to the pertinent resources, a score of less than 25 indicates the possibility of cognitive impairment. In the study of Seyedian et al., the validity and reliability of the Persian version of the MMSE have been investigated, and in determining the internal reliability of this questionnaire, the Cronbach's alpha coefficient for the entire test has been obtained as 0.81. Furthermore, this test exhibits a sensitivity of 90% and a specificity of 93.5%, with commendable validity and reliability [14]. AMTS is an alternate tool for assessing cognitive performance that, in contrast to comparable tests (e.g., MMSE), is less affected by the participant's level of education. The AMTS is a concise, rapidly assessing 10-item test that may be completed within only 3 minutes. AMTS evaluates orientation, capacity for concentration/attention, and short-term and long-term memory. Each accurate response is awarded one point, and a lower aggregate score indicates a higher degree of cognitive impairment. The AMTS scoring system consists of three levels: 0-3 for severe cognitive impairment, 4-6 for mild cognitive impairment, and seven or higher for normal cognitive state [15]. A review of the literature reveals that Cronbach's alpha coefficient of 0.76 was applied in the study by Bakhtiari et al. to determine the internal consistency of this tool [16]. Furthermore, according to Forooghian et al., the reliability of the questions in this test among elderly Iranian people was established using Cronbach's alpha, which ranged from 0.88 to 0.91 [17].

The data collected were analyzed using descriptive statistics. The study design was reviewed at Lorestan University of Medical Sciences and received approval with the ethics ID IR.LUMS.REC.1401.175.

Results

The results indicated that of the 109 participants, 52.3% were male, and 47.7%were female. A mean age of 68.46±10.77 years was observed among the patients. The overall mean body mass index was found to be 26.02±5.20. The majority of patients were in the mild to normal range in terms of cognitive disorders and had no history of smoking and drug abuse (Table 1). In addition, the patients had an assessment of comorbidities based on self-report, details of which can be seen in Table 2.).

Table 1. Frequency distribution of clinical variables in the patients under study

Variable	Clinical Variables	Frequency Distribution (%)
Cognitive state	MMSE within the range of 18-24	2(1.8)
	MMSE within the range of 25-30	58(53.2)
	AMTS within the range of 4-6	17(15.6)
	AMTS within the range of 7-10	32(29.4)
History of smoking and drug abuse	Yes	29 (26.6)
	No	80(73.4)

Table 2. Frequency distribution of comorbidities in the patients under study

Comorbidities	Yes	No
	Frequency Distribution (%)	Frequency Distribution (%)
Diabetes	26(23.9)	83(76.1)
Hyperlipidemia	9(8.3)	100(91.7)
Hypertension	41(37.6)	68(62.4)
Hepatic disorders	2(1.8)	107(98.2)
Renal disorders	4(3.7)	105(96.3)
Cardiovascular diseases	19(17.4)	90(82.6)
Respiratory diseases	6 (5.15)	103(94.5)
Central nervous system disorders	5 (4.6)	104(95.4)
Neurological disorders	2(1.8)	107(98.2)
Esophageal disorders	7(6.4)	102(93.6)
Diseases affecting the urinary system	4(3.7)	105(96.3)
Other medical conditions	6 (5.5)	103(94.5)

Discussion

The results of this study indicate that about 50% of the patients under investigation were male, while the other 50% were female. Multiple studies have documented the susceptibility of both women and men to delirium. As an illustration, the study conducted by Karimi et al. revealed that women had a higher susceptibility to delirium compared to males. Nonetheless, this disparity was likely attributed to the study's substantial number of female participants [18]. The study conducted by Wang and colleagues showed that being male is a significant risk factor for the development of POD among patients after having heart surgery. Moreover, the prevalence of hyperactive delirium was found to be greater among male. Male patients under the age of 60 have been shown to be particularly more susceptible to POD. Hence, it is imperative to accord greater focus to such male patients in order to mitigate the incidence of POD [19]. In the same vein, Sun et al., in their study on orthopedic patients, concluded that POD was more common in male patients [20].

The current research revealed that the mean age of the patients as candidates for orthopedic surgery fell under the category of elderlies and the age group of seniors. It is implied that older patients are more prone to delirium due to the link between aging and their impaired physiological compensatory ability to cope with surgical physical stress, changes in the alterations of central neurotransmitters, and reduced sensitivity of different blood pressure regulation mechanisms [21, 22].

Prior investigations demonstrated a 2% rise in the occurrence of POD with each additional year of patient age, highlighting age as a significant contributory risk factor for delirium [4, 23]. Nevertheless, Steve believes age is not a standalone risk factor for developing POD. The lack of significance of age in the multivariate analysis of his study may be attributed to the fact that the investigation was executed among individuals aged 75 years and above [21]. In fact, among older individuals affected by osteoporosis and a relatively high occurrence of cognitive problems and hence falls from the bed, it is advisable to be vigilant about the increased likelihood of delirium following orthopedic surgery and to contemplate preventative actions.

Our study also showed that the patients' overall mean body mass index fell into the overweight category. Liang et al.'s research found an average BMI of 26.5±4.3 among elderly individuals who had undergone orthopedic surgery [24].

Higher levels of BMI are closely associated with adverse effects such as hypertension, hyperlipidemia, and insulin resistance, which are believed to contribute to cognitive dysfunction in various ways. On the other hand, the study conducted by Deng et al. demonstrated that BMI serves as a protective element against POD. This discovery provides evidence for the "obesity paradox," which posits that a higher BMI might lower the likelihood of POD. Nevertheless, the study by Chen et al. revealed that individuals diagnosed with POD exhibited a greater mean BMI, which may be attributable to its impact on the cognitive function of the patients [26]. Therefore, it is recommended that orthopedic surgery patients with BMI values deviating from the normal range (i.e., higher or lower than the normal range) should be given special attention to prevent and treat delirium.

Our findings indicated that most orthopedic surgery candidates exhibited mild to normal cognitive impairments. Meanwhile, it should be mentioned that patients with severe cognitive impairments have been excluded from this research. In a study conducted by Koskderelioglu et al., it was shown that positive and negative delirium were 20.45±4.18 and 24.61±3.97, respectively. They also demonstrated that the overall prevalence of cognitive impairment prior to the surgery was 10%, and cognitive impairment was significantly correlated with postoperative delirium [27]. Furthermore, the study conducted by Shi et al. revealed that patients with POD exhibited more severe cognitive impairment as measured by the CMMSE scale (18±5 vs. 24±5) [28]. In Segernäs et al.'s study,

24.3% of the population fell below the MMSE range of 27 or lower, indicating an impaired cognitive state [29]. Hence, it is advisable to provide particular focus on the prevention and treatment of delirium to orthopedic surgery patients with underlying cognitive disorders.

More than 25% of the examined patients came up with a documented record of both smoking and drug abuse. Previous research has shown this percentage ranging from 9% to 46% [26, 27, 30]. Previously published studies, such as the ones conducted by Karimi et al., Kim et al., and Chen et al., have documented a correlation between smoking history and the incidence of delirium in patients undergoing orthopedic surgery [18, 26, 30].

Furthermore, a substantial proportion of orthopedic surgery candidate patients were suffering from pre-existing medical conditions and underlying diseases. Referring again to the study by Koskderelioglu et al. revealed that 90% of patients who had displayed delirium were also suffering from one or more types of comorbidities. Overall, 50% of patients had been diagnosed with hypertension, 30% with coronary artery disease, and 20% with diabetes in the study above [27]. Previous investigations have also documented that the prevalence of hypertension among patients with similar conditions was ranging from 27% to 68% [26, 30].

In general, modifications in sample size, inclusion criteria, and other variables might result in variations in the reported burden of risk factors. In Kim et al.'s study, 17.9% of elderly orthopedic surgery patients were reported to have diabetes, 67.8% to have hypertension, and 4.2% to have congestive heart failure [30]. Cardiac failure and multiple medical comorbidities have been identified as significant risk factors for the development of POD among elderly patients undergoing orthopedic surgery [31]. Therefore, it is recommended to prioritize the prevention and treatment of delirium among patients who have a history of smoking, drug abuse, and underlying diseases in order to prevent and treat the consequences of delirium

Limitations

One of the inherent limitations of this study is the lack of inclusion of patients with severe cognitive disorders as well as subjects with head, face, chest trauma, and spinal cord injury, which diminishes the generalizability applicability of the results.

Conclusion

Considering the significant prevalence of risk factors that contribute to the development of delirium following orthopedic surgeries, particularly among the population of elderly patients, as well as its high incidence and complications such as prolonged hospital stays, higher expenses, increased mortality, etc., it is crucial to identify these risk factors, elucidate their underlying pathophysiological mechanisms and encourage the patients to modify their lifestyle and habits in order to prevent POD.

Conflict of Interests

Authors declare that they do not have any conflict interests.

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