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A retrospective study of the effects of anesthesia methods on post-operative delirium in geriatric patients having orthopedic surgery: Anesthesia methods on post-operative delirium

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Ethics Committee Approval
This study was performed by the ethical permission obtained from Malatya Turgut Özal University, Faculty of Medicine Ethics Committee (Permission No: 2022/177). All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

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No conflict of interest was declared by the authors.

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Abstract

Background/Aim: Post-operative delirium, which usually develops in geriatric patients, also causes an increase in mortality and morbidity for various reasons, such as difficulty in compliance with treatment. Estimating the effects of the anesthesia method on delirium contributes to the prevention of possible complications. In this study, effects due to use of different anesthesia methods on the post-operative delirium development in geriatric patients who underwent orthopedic surgery were investigated.

Methods: In our retrospective cohort study, scanning of the patient files was performed for 276 patients who were older than 65 years and who had undergone surgery for lower extremity fractures in Malatya education and research hospital, orthopedics department between May 1, 2022 and October 15, 2022. Demographic data, comorbid conditions, anesthesia type, lengths of surgery, and level of delirium development were recorded for each scanned patient.

Results: In our study, 201 patients were included. The mean age of the patients was 74.1 (7.3) (min–max: 65–98); 133 (66.2%) were female, and 68 (33.8%) were male. It was noticed that patients who had undergone regional anesthesia developed a significantly smaller rate of delirium development (8.1%) compared to those who had received general anesthesia (20.6%; P=0.012). Ages (P<0.001), lengths of surgery (P<0.001), and lengths of hospitalization stays (P<0.001) were significantly higher in patients with delirium compared to those without.

Conclusion: Based on the data obtained in this study, it was concluded that to reduce the risk of delirium development after orthopedic surgery, regional rather than general anesthesia should be selected, and the time of hospitalization stay should be minimized.

Keywords: post-operation, geriatric, spinal anesthesia, general anesthesia, delirium

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Introduction

The rate of living longer in the older population is increasing due to developments in health sciences, improvements in life standards and hygiene, and vaccination and sanitation programs in developed and developing countries; however, in parallel with that increase is a corresponding increase in the rate of developing chronic health problems. The number of people older than 65 years worldwide has increased three times in recent years [1], and the rate in Turkey is reported to be 8.8% [2]. As the geriatric population increases, the number of patients needing healthcare is also increasing. One important occurrence within the geriatric population is the higher risk of fall-related injuries with a corresponding increase in the risk of lower extremity fractures. The risk of falls in geriatric patients also increases with changes in lifestyle in that these people more likely to stay alone rather than in care centers since the nuclear family style is much more preferred at present. In such cases, the geriatric patients may face increased risk of serious surgery-related complications, including prolonged recoveries and various chronic conditions.

Hip fractures are among the most feared orthopedic conditions in geriatric patients. Low-energy hip fractures in people over 60 are seen more often than other types of fractures; thus, the related morbidity and mortality risk is also higher. This issue also creates social and emotional problems for the elderly population. It was reported that after application of post-fracture interventions in elderly patients who also present a very fragile emotional status, the possibility of increasing delirium symptoms in 60% of the patients is present [3]. Delirium can be defined as an acute onset and fluctuating course of this clinical syndrome with mental disorders characterized by deteriorations in consciousness, memory, orientation, thought, perception, and behavior [4]. Delirium can most often be seen in elderly patients and may cause fluid–electrolyte disorders, cognitive dysfunction, and an increase in the risk of infections and medication-related side effects. The American Society of Anesthesiologists (ASA) scoring system is used to assess pre-operative physical condition and reduce the risk of delirium development and surgery-related complications [5]. This score is based on a six-degree scoring system and is a useful scale, especially for the choice of anesthesia and monitoring methods for such patients.

In this study, we aimed to investigate the development of delirium in geriatric patients who undergo orthopedic surgery in addition to the risk factors involved in this process.

Materials and methods

This study was performed after ethical permission was obtained from Malatya Turgut Özal University, Faculty of Medicine Ethics Committee (Permission No: 2022/177). The files of 276 patients who were over 65 years and had undergone surgery due to lower extremity fractures in Malatya Education and Research Hospital between May 1, 2022 and October 15, 2022 were scanned. The study was started in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) and Helsinki Declaration. The minimum sample size of the study was calculated as 200 patients with an alpha error of 0.05 and a beta error of 0.8 (with reference to similar studies). Considering possible reasons for exclusion, the study was initiated with 276 patients. However, 75 patients were excluded from the study due to reasons, such as the transition from regional anesthesia to general anesthesia and others, and 201 patients were finally included in the study. Pre-anesthesia anamnesis and mini-mental test were administered to all patients, and it was confirmed that they did not present signs of delirium. Patients with psychiatric and neurological diseases, such as Alzheimer's disease, psychosis, cognitive and conscious state alterations, cerebrovascular diseases, and pre-existing cognitive diseases in addition to kidney and liver diseases, decompensated heart failure, addiction to alcohol and drugs, post-operative hospitalization in the intensive care unit, ASA scores of 4 and higher, and narcotic analgesics received during the post-operative period, all of which may have affected the study results were excluded; hence, a total of 201 patients were included in the study.

During the post-operative period, cognitive changes that did not exist prior to surgery, attention, perception, and orientation disorders, and disturbances in sleep balance were defined as delirium. Mini-mental tests was applied to the patients at 24 and 72 h.

Patients were divided into two groups: (1) patients who had received general anesthesia (GA group) and (2) regional anesthesia (spinal, spinal and epidural combined, epidural, and neuromuscular neural blockage) constituted the RA group.

Information regarding sex, age, comorbidities, ASA scores, whether delirium developed 24 and/or 72 h after surgery, and any administration of pre-operative drugs for patients included in the study were recorded. Total lengths of operation, pre-operative sedation use, hospitalization times, mortality rates, and parameters, such as urea, creatinine, aspartate aminotransferase (AST), and alanine aminotransferase (ALT) values at 24 and 72 h were also noted. Patients who had delirium diagnosis based on consultation with the Neurology and Psychiatry Departments at post-operative day 7 were recorded.

Statistical analysis

Statistical analyses of the data were performed using the SPSS (Statistical Package for Social Sciences; SPSS Inc., Chicago, IL) package program version 22.0 for Windows. While categorical variables were shown as percentages and n values, numerical data were given as the mean standard deviation (SD). The chi-squared test was used for nonparametric variables (Pearson chi-squared). Normal distribution of data was tested using the Kolmogorov–Smirnov test. Mann–Whitney U-test was used for comparison of the groups. *P*-value <0.05 was considered statistically significant.

Results

A total of 201 patients with a mean age of 74.1 (7.3) (min–max: 65–98) with 133 (66.2%) females and 68 (33.8%) males were included in the study. Of these patients, 27.5% had hypertension (HT), 54.2% had diabetes mellitus (DM), 47.8% had congestive heart failure (CHF), 31.8% had ischemic heart disease (IHD), and 16.4% had cancer. ASA scores of the patients were 10.9% ASA 1, 34.8% ASA 2, and 54.2% ASA 3. It was recorded that 13.4% of the patients did not use any prescribed medication, 19.9% used only one medicine, 7% used two medicines, and 59.7% used more than two medications per day

regularly. During the surgeries that these patients underwent, 49.3% received regional anesthesia, while 50.7% underwent general anesthesia. Sedation was administered to 44.3% of the patients. Delirium was noted in 29 out of the total 201(14.4%) patients. Mortality was seen in 6% (Table 1). The rate of patients receiving sedation was significantly higher in patients who had regional anesthesia (66.7%) compared to that of had general anesthesia (22.5%; $P<0.001$). Contrary to that finding, the rate of delirium development was significantly lower in patients who had regional anesthesia (8.1%) compared to general anesthesia (20.6%; $P=0.012$) as shown in Table 2. In patients who received regional anesthesia, creatinine levels both at 24 h ($P=0.006$) and 72 h ($P=0.11$) in addition to hospitalization time ($P=0.037$) were significantly lower than in those who received general anesthesia. ALT levels were significantly higher in patients who received regional anesthesia compared to those who received general anesthesia ($P=0.042$) as shown in Table 3.

Table 1: Demographic information of the patients (n=201) in the study.

		mean	SD
Age		74.1	7.3
		n	**%**
Sex	Woman	133	66.2
Comorbidity*	Hypertension	55	27.5
	DM	109	54.2
	CHF	96	47.8
	IHD	64	31.8
	Cancer	33	16.4
ASA score	1	22	10.9
	2	70	34.8
	3	109	54.2
Medication use	None	27	13.4
	1 per day	40	19.9
	2 per day	14	7.0
	> 2 per day	120	59.7
Anesthesia type	Regional anesthesia	99	49.3
	General anesthesia	102	50.7
Sedation		89	44.3
Delirium		29	14.4
Mortality		12	6.0

*There were cases with more than one comorbidity. SD: standard deviation, DM: diabetes mellitus, CHF: Congestive heart failure, IHD: Ischemic heart disease, ASA: American Society of Anesthesiologists

Table 2: Comparison of categorical parameters according to anesthesia type

		Regional anesthesia		General anesthesia		*P-value
		n	%	n	%	
Sex	Woman	63	63.6	70	68.6	0.455
Hypertension		32	32.7	23	22.5	0.110
DM		53	53.5	56	54.9	0.846
CHF		43	43.4	53	52.0	0.226
IHD		35	35.4	29	28.4	0.292
Cancer		20	20.2	13	12.7	0.154
ASA score	1	12	12.1	10	9.8	0.833
	2	35	35.4	35	34.3	
	3	52	52.5	57	55.9	
Medication use	none	15	15.2	12	11.8	0.057
	1 per day	12	12.1	28	27.5	
	2 per day	7	7.1	7	6.9	
	>2 per day	65	65.7	55	53.9	
Sedation		66	66.7	23	22.5	<0.001
Delirium		8	8.1	21	20.6	0.012
Mortality		5	5.1	7	6.9	0.588

*A chi-squared analysis was performed. DM: diabetes mellitus, CHF: Congestive heart failure, IHD: Ischemic heart disease, ASA: American Society for Anesthesiologists

Table 3: Comparison of the numerical parameters according to anesthesia type

		Regional anesthesia Mean (SD)	General anesthesia Mean (SD)	*P-value
Age (years)		73.4 (7.2)	74.7 (7.4)	0.148
Length of surgery (minutes)		114.8 (42.0)	106.7 (41.7)	0.095
Glucose mg/dl	at 24 h	152.1 (79.3)	151.9 (65.3)	0.565
Urea mg/dl		54.1 (39.6)	57.0 (69.9)	0.761
Creatinine mg/dl		1.2 (1.2)	1.6 (5.2)	0.006
AST u/l		50.5 (30.1)	56.0 (44.8)	0.294
ALT u/l		46.2 (41.4)	41.3 (31.4)	0.564
Glucose mg/dl	at 72 h	159.7 (90.4)	150.0 (79.1)	0.361
Urea mg/dl		57.6 (38.8)	56.8 (35.8)	0.715
Creatinine mg/dl		0.9 (0.3)	1.0 (0.5)	0.011
AST u/l		72.2 (96.2)	48.7 (28.5)	0.145
ALT u/l		59.1(82.4)	42.0 (35.2)	0.042
Hospitalization stay (days)		9.4 (4.0)	10.7 (4.6)	0.037

*A Mann–Whitney U analysis was performed. SD: standard deviation, AST: aspartate aminotransferase, ALT: alanine aminotransferase

The rate of delirium development in IHD patients (21.9%) was significantly higher than that of non-HD patients (10.0%; $P=0.04$). Delirium development was observed in all ASA score groups (I–III) in this study. Delirium occurred in 4.5% in ASA 1, 8.6% in ASA 2, and 20.2% in ASA 3 groups; the latter was significantly higher than in the other score groups ($P=0.037$). The rate of delirium development in patients who had received sedation (4.5%) was significantly lower than who did not receive sedation (22.3%; $P<0.001$). The mortality rate in patients with delirium (17.2%) was significantly higher than those who did not develop delirium (4.1%; $P=0.017$) as shown in Table 4. Ages ($P<0.001$), lengths of surgery ($P<0.001$), and lengths of hospitalization stays ($P<0.001$) in patients who had delirium were significantly higher than those who did not develop delirium. AST levels at 72 h in patients who had delirium were significantly lower than that of who did not have delirium ($P=0.007$) as shown in Table 5.

Table 4: Comparison of categorical parameters according to the presence of delirium.

		Delirium		Non-delirium		*P-value
		n	%	n	%	
Sex	Woman	19	14.3	114	85.7	0.939
Hypertension		7	12.7	48	87.3	0.661
DM		17	15.6	92	84.4	0.608
CHF		15	15.6	81	84.4	0.644
IHD		14	21.9	50	78.1	0.04
Cancer		6	18.2	27	81.8	0.587
ASA score	1	1	4.5	21	95.5	0.037
	2	6	8.6	64	91.4	
	3	22	20.2	87	79.8	
Medication use	None	2	7.4	25	92.6	0.547
	1 per day	7	17.5	33	82.5	
	2 per day	3	21.4	11	78.6	
	> 2 per day	17	14.2	103	85.8	
Sedation		4	4.5	85	95.5	< 0.001
Mortality		5	17.2	7	4.1	0.017

*A chi-squared analysis was performed. DM: diabetes mellitus, CHF: Congestive heart failure, IHD: Ischemic heart disease

Table 5: Comparison of the numeric parameters according to the presence or absence of delirium.

		Delirium Mean (SD)	Non-delirium Mean (SD)	*P-value
Age (years)		82.1 (6.1)	72.7 (6.6)	<0.001
Length of operation (minutes)		170.2 (43.9)	100.7 (32.2)	<0.001
Glucose mg/dl	at 24 hours	136.1 (35.6)	154.7 (76.6)	0.665
Urea mg/dl		51.1 (27.4)	56.3 (60.5)	0.796
Creatinine mg/dl		1.1(0.4)	1.5 (4.1)	0.194
AST u/l		70.9 (74.8)	50.3 (27.2)	0.408
ALT u/l		58.3 (51.9)	41.2 (33.0)	0.068
Glucose mg/dl	at 72 hours	165.0 (63.1)	153.1 (88.0)	0.070
Urea mg/dl		62.2 (40.4)	56.3 (36.7)	0.364
Creatinine mg/dl		1.1(0.4)	1.0 (0.4)	0.158
AST u/l		39.7 (24.8)	63.8 (75.9)	0.007
ALT u/l		32.4 (18.4)	53.5 (67.8)	0.070
Hospitalization time (days)		19.1 (2.8)	8.5 (2.1)	<0.001

*A Mann–Whitney U analysis was performed. SD: standard deviation, AST: aspartate aminotransferase, ALT: alanine aminotransferase

Discussion

As people age, the risks of orthopedic diseases and conditions increase making it difficult for people to maintain coordination; hence fall-related injuries and fractures significantly increase. It has been estimated that almost half of the people over 65 will need surgical intervention at some point during the rest of their lives [6]. It has been assumed that the life quality after surgical intervention decreases significantly with the development of post-operative complications, including delirium, in addition to complications related to the primary reason for surgery.

It has been reported that presence of comorbidities leads to an increase in the risk of complications during the post-operative period [7]. In our study, HT in 27.5%, DM in 54.2%, CHF in 47.8%, IHD in 31.8%, and cancer in 16.4% of the

patients were recorded. It was noted that in patients with IHD, the risk of delirium development was significantly higher than in those without. It has been suggested that ASA scoring may be helpful in facilitating a decrease in the rate of mortality after surgery. It is evident that patients with high ASA scores such as III/IV show high mortality rates [8]. In addition, studies reporting that the type of anesthesia also affects the rates of morbidity and mortality are available as regional anesthesia causes less mortality compared to general anesthesia [9]. Similarly, Gunturk et al. [10] reported a 3.4% mortality rate in patients with regional anesthesia compared to 8.8% in those receiving general anesthesia. In another study in which in-hospital mortality rates were compared between patients who underwent regional anesthesia, general anesthesia, and intra-surgery change from general to regional anesthesia (Cv), it was reported that the mortality rate between general and regional anesthesia was 1.38, while it was 2.23 between Cv and regional anesthesia [11]. However, studies reporting no significant differences between the effects of general and regional anesthesia on mortality in addition to cardiovascular complications are available in which the unadjusted rates were compared in patients who underwent hip fracture surgery in adults [12]. In our study, although the mortality rate in patients with regional anesthesia (5.1%) was lower than that of with general anesthesia (6.9%), the difference between the two groups was not significant. However, the mortality rate was found to be closely related to the presence of delirium complications. Mortality rate was 17.2% in patients with delirium complications, while it was 4.1% in without delirium, and this difference was statistically significant. ASA scores were also found to be effective in the presence of delirium complications since patients with ASA3 score were found to have higher rates of delirium complications compared to ASA1 and ASA2 patients.

Lengths of surgery in addition to lengths of hospitalization stays were determined to be related to the presence of delirium in this study. Delirium was suggested to be associated with increased days of mechanical ventilation, intensive care unit lengths of stay, and increased lengths of hospital stay [13]. In addition, delirium may also result to a longer stay in hospital [14]. Delirium was also reported to be related to the patients' functional decline [15]. Increased lengths of hospital stay, especially in geriatric patients, may cause an increase in the risk of new complications, including development of infections; hence, lengthy stays are not preferred. The results clearly indicate that shorter hospital stays should be implemented to reduce the risk of post-operative delirium complications. Delirium is more commonly seen in patients who have pre-cognitive dysfunctional conditions, comorbidities, and intensive care unit care [16]. Since such conditions may significantly affect the results of a study, they were excluded in the present study.

Hip fracture is quite common, especially among elderly women [17,18]. In our retrospective study, a high incidence of hip fracture was similarly noted in women (66.2%) compared to men (33.8%). Increased rate of osteoporosis especially after menopause in women makes this group of patients more vulnerable for hip fractures [19]. In a study, 40% delirium was reported to develop in patients after hip fracture surgery [20]. A 14.4% rate of delirium development was observed in our study, which seems quite low compared to the previous study. Considering the multifactorial reasons for the development of delirium, it is quite difficult to make comparisons between the two studies.

In this study, delirium was detected in 8.1% of the patients who had received regional anesthesia, while the rate was 20.6% for general anesthesia. Similarly, higher delirium rates were reported by others for patients receiving general anesthesia [21]. Multiple drug use and presence of chronic diseases were suggested to be some factors in post-operative development of delirium [22]. However, Atay et al. [17] reported no relationship between multi drug use and post-operative delirium development. Similarly, we did not observe any association between the presence of chronic diseases and multi drug use with post-operative delirium development. It may be more appropriate to scan larger patient groups to allow a clear conclusion to be drawn on the effects of drug use and presence of chronic diseases for development of post-operative delirium.

Sedation use was detected in 66.7% of the patients who had regional anesthesia, while it was only 22.5% in patients receiving general anesthesia. In addition, delirium development in patients who had received regional anesthesia was significantly lower than that of general anesthesia; hence, a reverse association between sedation use and delirium development was noted. It could be suggested that to reduce the risk of delirium development, regional anesthesia should be chosen, especially in geriatric patients.

Limitations

Our study was a single-center study and included only geriatric patients who underwent surgery for the lower extremities. The absence of upper extremity surgery, pediatric patients, and young patient groups caused the number of study patients to be low; therefore, our study data and results from data analyses are more limited.

Conclusions

In conclusion, as a result, when we evaluated the data in our study, delirium appears to develop more frequently in geriatric patients who receive general anesthesia. We concluded that regional anesthesia may be more beneficial than general anesthesia in terms of producing a reduction in the development of delirium.

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