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Comparison of the effects of general and regional anesthesia on mortality and hospital length of stay in geriatric hip fractures

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Abstract. – OBJECTIVE: In this study, we sought to compare the effects of general and regional anesthesia techniques on the length of hospital stay and morbidity-mortality in geriatric patients who have had hip fractures and underwent surgical treatment.

PATIENTS AND METHODS: A total of 331 patients who were 65 or older and had had surgical treatment for elective or urgent hip fractures were classified into two groups; regional and general anesthesia. Recorded variables were: age, sex, American Society of Anesthesiologists (ASA) score, comorbid disease, length of stay at the clinic, mortality, morbidity, intraoperative loss of blood, the necessity of blood transfusion, and type of fracture. These variables were compared in the control groups and evaluated retrospectively.

RESULTS: For the regional anesthesia group, length of stay in the clinic, loss of blood, and necessity of blood transfusion were significantly lower compared to the general anesthesia group ($p<0.05$). Additionally, we found general anesthesia mortality and morbidity rates were significantly higher than regional anesthesia ($p<0.05$). Finally, we determined that increased age and number of comorbid diseases increased the morbidity and mortality rates significantly ($p<0.05$).

CONCLUSIONS: This study evaluated regional anesthesia's advantages over general anesthesia when treating geriatric hip fractures. This includes reduced morbidity-mortality rates, bleeding, and shorter length of hospital stay.

Key Words:
Geriatric, Hip fractures, General anesthesia, Regional anesthesia, Mortality, Morbidity.

Introduction

Hip fractures affect 1.6 million geriatric patients worldwide. Due to the increasing elderly population, this rate is predicted to increase rapidly in the next 30 years[1]. Conditions such as systemic disease, loss of independent function, and cerebrovascular events in the geriatric patient population may cause increased exposure to environmental trauma, resulting in increased hip fracture rates. In addition, the decrease in bone mass in the elderly population is another possible cause of the increasing incidence of fracture development[2]. Regarding hip fractures, literature shows conflicting viewpoints regarding the significance of anesthesia techniques in treating these patients. Successful outcomes may include variables such as the patient's age, sex, operation time, surgery waiting time, length of hospital stay, systemic disease status, depression[3], muscle strength[4], and the anesthesia method used in the surgical operation. All of these factors may affect or be affected by mortality and morbidity[5]. Both general and regional anesthesia are associated with their own advantages and disadvantages. The contradictory data from the literature regarding the optimal technique warrants further investigation[5].

Although epidural anesthesia was first used over one hundred years ago, its significance and efficacy are still being studied today. The most important advantage of spinal and epidural anesthesia is that it can create a deep nerve block in most of the body by using a small amount of local anesthetic with a simple injection, thus reducing pain as well as

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opioid use[6]. There are many advantages of regional anesthesia, including minimal effects on the respiratory system, no need for muscle relaxants, no loss of reflexes, and reduced hospital costs[7]. Disadvantages of regional anesthesia include an undesirable spread of medication upon injection near the nerve, hypotension, and various other complications resulting from a sympathetic blockade[2].

General anesthesia is characterized by transient loss of consciousness and decreased reflex activity[8]. This condition occurs as a result of a descending nerve depression in the central nervous system (CNS). This starts at the cortical and psychic centers and descends to the basal ganglia, cerebellum, spinal cord, and medullary centers. The clinical triad of general anesthesia is loss of consciousness, suppression of reflexes, and muscle relaxation, all of which serve as important functions during surgery where the vital function may be thoroughly observed[9].

The literature presents mixed results on the positive postoperative outcomes of regional anesthesia compared to general anesthesia. Ahn et al[10], in 2018, found that regional anesthesia, in the setting of hip fracture in geriatric patients, reduces delirium, mortality, and risk of serious complications such as pulmonary embolism compared to general anesthesia. Recently, a large, multi-centered randomized trial[11] did not find any significant difference in mortality or delirium onset for hip surgery when utilizing spinal or general anesthesia. Finally, a systemic review by Chen et al[12], observed that the length of hospital stay, mortality, and readmission rates were lower in those receiving regional anesthesia than in general for geriatric hip fracture surgery. These varying results warrant further investigation.

It is still not fully understood how different anesthesia techniques may affect liver and kidney function. Propofol, one of the most commonly used medications for induction of general anesthesia, has been suggested as a potential cause of acute liver injury[13]. In addition, other studies may suggest that both IV and inhaled halogenated anesthetics may actually be protective against acute liver damage post-operatively. The effect of neuraxial anesthesia on kidney function is largely unknown. Spinal anesthesia has been shown to be generally safe in parturients with chronic kidney disease[14]. On the other hand, many types of agents used in general anesthesia are renal-protective and can improve kidney function. The only demonstrated agent to be nephrotoxic is methoxyflurane[15].

The choice of anesthesia method depends on several medical conditions, including the patient's age, comorbid characteristics, surgical method, and the risk of each anesthesia technique. When evaluating the risks of anesthesia type, conditions such as regional block, invasive monitoring, anesthetic agent toxicity, intraoperative and postoperative complications, and postoperative pain should be considered[16].

We primarily aimed to determine the relationship between general and regional anesthesia and to detect if one technique showed increased benefits regarding morbidity and mortality in patients 65 and older. Secondarily, we aimed to investigate and compare the length of hospital stay, amount of bleeding, and blood transfusion needs between general anesthesia and regional anesthesia for geriatric hip fracture surgery.

Patients And Methods

This retrospective study was submitted to the Necmettin Erbakan University Meram Faculty of Medicine Department of Orthopedics and Traumatology, Konya, Turkey, between 01/01/2010-01/03/2015 after receiving the approval of the Ethics Committee numbered 2015/196. The files of 769 patients who applied were scanned. All subjects provided written informed consent.

Anesthesia type was divided into two groups: general anesthesia and regional anesthesia. The group of patients who received general anesthesia was called the GA (General Anesthesia) group. The group of patients who underwent regional anesthesia, such as spinal, epidural, combined, sciatic, and lumbar plexus (psoas) block, was named RA (Regional Anesthesia). The seven and 30-day mortality rates of the groups divided into RA and GA were recorded separately. Mortality rates were calculated in the general and regional anesthesia groups according to the type of fracture and the surgery performed. We have included all ASA I, II, III, and IV patients in the study. Our exclusion criteria contained patients with all contraindications for general and regional anesthesia techniques.

Comparisons between groups were made by recording the fracture type, surgical methods applied, amount of bleeding, whether blood transfusion was performed, and length of hospital stay. The analysis was based on whether there was a difference between GA and RA.

Statistical Analysis

All study analyses were performed with the SPSS 20.0 package program Version 20.0. (IBM Corp., Armonk, NY, USA). Categorical variables were presented as frequency and percentage, and variables with numerical values were presented as mean and standard deviation. In order to determine the relationship between proportional scale variables, Pearson's or Spearman's Rho correlation analyses were performed for non-parametric cases. A $p<0.05$ value was considered statistically significant for the 5% margin of error in all analyses.

Results

Files of 769 geriatric patients older than 65 who applied to the Department of Orthopedics and Traumatology due to hip fracture were scanned, and 331 were included in the study. Four hundred thirty-eight patients were excluded from the study due to insufficient data, chronic renal failure, chronic liver disease, uncontrolled diabetes, decompensated heart failure, and bleeding diathesis. In the file scan of the 331 patients included in the study, demographic data, ASA scores, and comorbidities were recorded (Figure 1).

Demographic data, including gender and age values of the 331 patients included in the study, were evaluated. While there were 189 (57.1%) patients in the general anesthesia group, 110 (33.2%) of the 142 patients were Spinal, 29 (8.8%) Epidural, and 3 ($p<0.01\%$) psoas compartment block (PCB) in the regional anesthesia group (RA).

There were 93 (49.2%) male patients in the GA group and 67 (47%) male patients in the RA group. In females, 96 (50.8%) were in the GA group, and 75 (52.8%) were in the RA group. There was no statistical difference observed between the groups in terms of gender ($p>0.05$) (Table I).

The average age between the groups was 78.50±7.679 in the GA group and 78.75±8.048 in the RA group. In total, the average age was 78.60±7.828. There was no statistical difference in age values between the groups ($p>0.05$) (Table I). Comorbid diseases between groups are given in Table II.

ASA values and statistical evaluation of patients who received general and regional anesthesia were also measured. While the mean ASA was 2.63±0.683 in the GA group, it was 2.30±0.607 in the RA group. A statistically significant difference was observed ($p<0.001$). General anesthesia was used more often in patients with higher ASA scores.

The fracture type distribution between groups was also examined, but no significant difference was observed ($p>0.05$). When evaluated in terms of the type of surgery performed between the groups, Bipolar (partial prosthesis) was 79

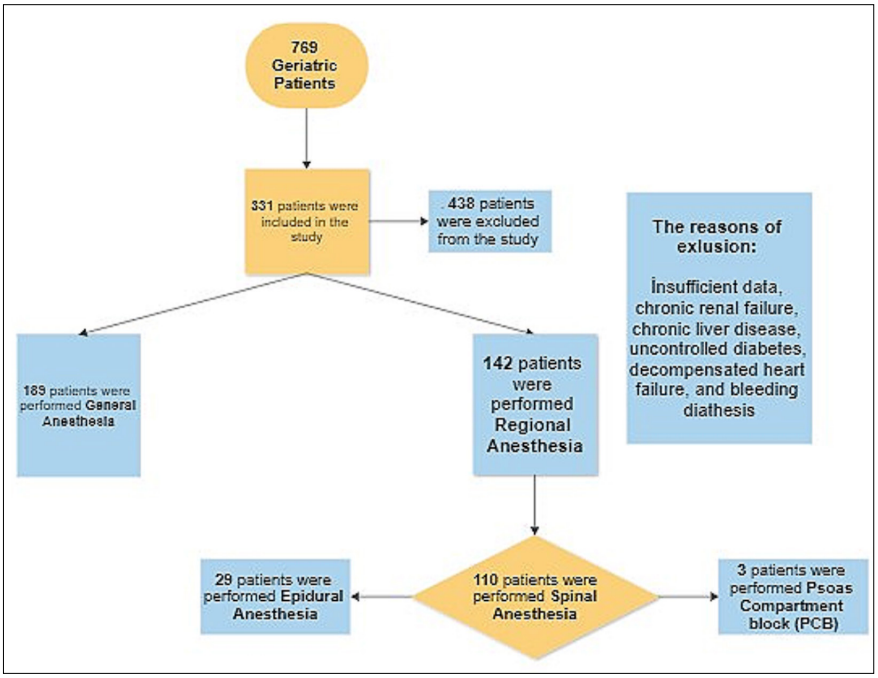

Figure 1. Flow Chart of the study. The number of patients are shown through the process.

Table I. Evaluation of demographic data.

	TGA N=189 (%)	RA N=142 (%)	Total (%)	p
Male	93 (49.2)	67 (47)	160 (48.3)	0.715
Female	96 (50.8)	75 (52.8)	171 (51.7)	
Age (years)	78.50±7.679	78.75±8.048	78.60±7.828	0.775
Group 1 (65-74 years)	53 (28)	45 (31.6)	98 (29.6)	
Group 2 (75-84 years)	94 (49)	64 (44.3)	158 (47.7)	
Group 3 (85 years and over)	42 (23)	33 (24.1)	75 (22.7)	
ASA I	12 (6.3)	11 (7.7)	23 (6.9)	0.00*
ASA II	55 (29.1)	77 (54.2)	132 (39.8)	
ASA III	112 (59.3)	54 (38.0)	166 (50.1)	
ASA IV	10 (5.3)	0 (0)	10 (3.2)	

*p<0.05 significant difference between groups. GA (General Anesthesia); RA (Regional Anesthesia).

Table II. Evaluation of comorbidities between groups (%).

	GA N=189 (%)	RA N=142 (%)
Hypertension	161 (60.1)	107 (39.9)
Diabetes	96 (50.8)	59 (41.5)
COPD (chronic obstructive pulmonary disease)	94 (57.0)	71 (43.0)
Coronary heart disease	111 (58.7)	56 (39.4)
Heart Failure	57 (30.2)	9 (6.3)
Atrial Fibrillation	25 (13.2)	13 (9.2)
Cerebrovascular event	28 (14.8)	8 (5.6)
Alzheimer Disease	30 (15.9)	19 (13.4)
Parkinson Disease	13 (6.9)	5 (3.5)
Rheumatologic disease	5 (2.6)	5 (3.5)
Malignancy	12 (6.3)	10 (7.0)

GA (General Anesthesia); RA (Regional Anesthesia).

(41.8%) in the GA group and 70 (49.3%) in the RA group. Again, a statistically significant difference was observed (p<0.05) (Table III).

Considering the 7-day mortality of the patients included in the study, 285 (86.1) were alive, and 46 (13.9) were deceased. Considering the mortality rates by gender, there were 132 (82.5) alive, 28 (17.5) decreased in the male gender, 153 (89.5) alive, and 18 (10.5) dead in the female gender. There were 15 (4.5) deaths on the 7th day and 31 (9.4) deaths on the 30th day (Table IV). Regarding the 7-day mortality between the groups, 15

Table III. The surgical distribution between groups (%).

Surgery	GA N=189 (%)	RA N=142 (%)	p
Total hip replacement	44 (23.3)	12 (8.5)	0.02*
Bipolar partial hip replacement	79 (41.8)	70 (49.3)	
Intramedullary Pin (IM Pin)	66 (34.9)	60 (42.3)	

*p<0.05 significant difference between groups. GA (General Anesthesia); RA (Regional Anesthesia).

Table IV. Intergroup values mortality for postoperative 7 days (%)

Mortality	GA N=189 (%)	RA N=142 (%)	p
Healthy	174 (92.1)	142 (100)	0.001*
Deceased	15 (7.9)	0	

*p<0.05 significant difference between groups. GA (General Anesthesia); RA (Regional Anesthesia).

(7.9%) died in the GA group, while there was no death in the RA group. A statistically significant difference was observed (p<0.001) (Table IV).

Regarding the 30-day mortality between the groups, 24 (12.7%) died in the GA group, while 7 (4.9%) died in the RA group. The survival rate was 87.3% in the GA group and 95.01% in the RA group. A statistically significant difference was observed (0.016) (Table V).

Blood transfusion volume was 427.78±420.528 ml in the GA group and 138.03±235,647 ml in the RA group. A statistically significant difference was observed (p<0.05) (Table VI). Regarding bleeding, there was an average of 574.60±410.196 ml of blood loss in the GA group and 202.46±148.315 ml in the RA group. A statistically significant difference was observed (p<0.05) (Table VI).

The length of hospital stay was an average of 11.93±5.94 days in the GA group and 9.00±6.03 days in the RA group. There was a statistically significant difference (p<0.001) (Table VII).

Discussion

In this study, we compared the effects of regional anesthesia with general anesthesia in geriatric patients who had been operated on for hip fractures. Variables such as length of stay in the hospital, the amount of bleeding, and the volume of blood transfused during surgery were significantly lower in the regional anesthesia group. Additionally, mortality and morbidity rates were significantly higher in the patient group given general anesthesia. It was observed that both mortality and morbidity rates were aligned with a higher ASA score. In addition, it was determined that increased age and the presence of additional comorbid diseases significantly increased the mortality and morbidity rates. As a result of our study, the most important determinants of mortality in geriatric patients who underwent hip surgery were the anesthesia method applied, age, ASA score, and length of hospital stay.

Nearly 90% of patients with hip fractures are older than 65. The frequent occurrence of hip fractures may be due to the rapidly increasing elderly population and the high exposure to orthopedic traumas. This situation makes hip fractures an important public health problem[17]. Importantly, the decrease in physiological adaptations in the elderly increases the risk of complications that may occur during and after the operation. Since hip fracture is common in elderly patients, increased morbidity and mortality can subsequently occur. Furthermore, hemodynamic instability becomes inevitable following anesthesia induction. The degree of this may depend on the cardiovascular system changes in the elderly[18].

Table V. Mortality values between groups for postoperative 30 days (%).

MORTALITY	GA N=189 (%)	RA N=142 (%)	p
Healthy	165 (87.3)	135 (95.01)	0.016*
Deceased	24 (12.7)	7 (4.9)	

*p<0.05 significant difference between groups. GA (General Anesthesia); RA (Regional Anesthesia).

Table VI. Blood transfusion and bleeding values between groups (mean±SD).

	GA N=189 (ort±sd)	RA N=142 (ort±sd)	p
Blood Transfusion	427.78±420.528	138.03±235.647	0.00*
Bleeding	574.60±410.196	202.46±148.315	0.00*
Minimum	516.86±347.00	179.65±110.648	
Maximum	634.12±470.248	227.53±188.166	

*p<0.05 significant difference between groups. GA (General Anesthesia); RA (Regional Anesthesia).

Table VII. Length of stay between groups (mean±sd).

	GA N=189 (ort±sd)	RA N=142 (ort±sd)	p
Hospital length of stay (days)	11.93±5.94	9.00±6.03	0.001*

*p<0.001 significant difference between groups. GA (General Anesthesia); RA (Regional Anesthesia).

Post-anesthesia morbidity and mortality risk are affected by many factors. Some examples are advanced age, cardiovascular disease, pulmonary disease, diabetes mellitus, and poor health. These may be associated with increased mortality during anesthesia, regardless of the type of anesthesia used[19].

In our study, patients older than 65 were included, and the mean age was 78.6 years. These results support that hip fracture occurs at advanced ages, and a statistically significant positive correlation was found between the ages of our patients and the length of hospital stay. The increased length of a hospital stay and increased age may be associated with the patient's underlying comorbid diseases. This may be due to the fact that they are more prone to complications that may develop in the postoperative period due to the fragility of their general condition.

Considering the surgery type, there were statistical differences between general and regional anesthesia, as seen in Table III. The basic reason for this difference was that anesthesiologists usually choose general anesthesia for total hip surgery to protect the patient from postoperative complications and shorten the length of hospital stay, like our anesthesia team[20]. Various studies[21,22] have shown that cardiovascular and pulmonary disease, DM, and other comorbid conditions increase mortality regardless of the type of anesthesia used[21]. When examining elderly patients for hip fractures, it has been shown that mortality rates were related to age, gender, and general health status[22]. In one study, it was determined that mortality increased significantly in patients with hip fractures who had two or more chronic diseases.

Donegan et al[23] showed that the ASA classification is a useful indicator of the patient's general medical condition and can strongly predict perioperative medical complications after hip fracture surgery. Hamlet et al[24] found a three-year mortality rate of 23% in patients with ASA I and II and 39% in patients with ASA III and IV in 168 retrospectively examined patients. Our study showed no mortality increase in the patient group with ASA I and II in both general and regional anesthesia. In contrast, the total mortality rate was 13.9% in the ASA III and IV patient groups.

Studies[25] have shown that the one-month mortality rate of hip fractures in the elderly population is 5-10%, and the one-year mortality rate is 20-30%.

Results from our study demonstrate a total mortality rate of 13.9%, a 7-day mortality rate of 4.5%, and a 30-day mortality rate of 9.4%.

Because hip fracture surgery requires early intervention in elderly patients, there is not enough time for adequate and extensive preoperative evaluation of these patients. Therefore, choosing the most appropriate anesthesia technique with limited time for pre-anesthesia preparation is important. Special consideration must be taken in patients with multiple comorbid conditions and other risk factors. Many studies have been conducted to determine the effects of surgery on the geriatric patient group, considering the pre-and postoperative care and the selected anesthesia technique's effects on length of hospital stay, mortality, and morbidity. Although discussions and research continue, no definite conclusion has been reached[5].

In our study, 7-day mortality was not observed in patients who underwent regional anesthesia, while the mortality rate was 7.9% in those who underwent general anesthesia. When we look at the 30-day mortality rates, it was 4.9% in the regional anesthesia group and 12.7% in the general anesthesia group. The regional anesthesia group's 7-day and 30-day mortality rates were significantly lower. We think that the reason for the different results in these studies may be due to the different ASA scores of the patients participating in the study.

It is known that general and regional anesthesia have different effects on bleeding and transfusion parameters. It is thought that there will be fewer hypertensive episodes due to the reduction of the stress response with regional anesthesia, and therefore, less bleeding will occur. Hypotension occurs with vasodilation due to sympathetic block, venous pooling, and decreased venous return to the heart. Accordingly, local blood flow in the surgical area decreases, and the amount of intraoperative blood loss decreases. It has been suggested that there is less bleeding in hip fracture surgeries using neuraxial anesthesia[26].

The length of stay in the hospital also increased with advanced age. With increasing age, the length of stay may be related to the patient's additional disease burden and sensitivity to postoperative complications. Kaufmann et al[27] state that applying neuraxial anesthesia in high-risk patients may reduce the possibility of being admitted to the postoperative intensive care unit for patients undergoing hip surgery.

In our study, the average stay in the service was 10.16 days for the general anesthesia group and 8.4 days for the patients who received regional anesthesia. Those who received regional anesthesia had a shorter length of hospital stay.

Limitations

There are limiting factors due to the retrospective nature of this study. First, the difference in the mean ASA score of patients between the groups is a possible confounding factor affecting the results investigated. However, many other parameters were considered for comparison purposes. Another consideration is that anesthetists and surgical teams with varying experience may affect results by choosing an anesthetic technique they prefer. Third, due to its retrospective nature, there is a lack of standards for the specific drugs used in anesthesia. Fourth, not knowing the characteristics of the preoperative patient, such as nutrition, mental state, and movement function, may further add confounding variables to this study.

Conclusions

In conclusion, it was observed that the RA group had a reduced duration of hospital stay, decreased mortality rate, and significantly decreased operative bleeding in surgically treated hip fractures compared with the GA group. This is especially true when considering differences in ASA scores. However, to determine the optimal type of anesthesia for hip fracture surgery in geriatric patients, further studies with prospective randomized groups are needed to confirm the optimal anesthesia technique in geriatric hip fractures.

Conflict of Interest

The authors declare that they have no conflict of interest.

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Ethics Approval

Ethics approval was obtained by the Health Sciences University Ankara, City Hospital Clinical Research Ethics Committee (Decision Number: E1-22-2852, Date: 09.21.2022).

Informed Consent

All subjects provided written informed consent.

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