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The effect of the selected anaesthesia method on mortality, the charlson comorbidity index, and complications in geriatric patients abstract

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Abstract

Our study aimed to investigate how anaesthesia methods affect the chances of dying, needing intensive care after surgery, having complications, and scores on a health scale called the Charlson Comorbidity Index in the growing number of older people. In our study were 299 patients. We recorded their demographic data, American Society of Anaesthesiology score, need for transfusions, operation time, Charlson Comorbidity Index scores, need for intensive care after surgery, postoperative complications, such as respiratory problems, low blood pressure, nausea and vomiting, the number of days they stayed in the hospital and death rates. In our study, 195 patients (65.2%) were women. The average age was 73.9±7 years. No difference was found between the groups in terms of demographic data or Charlson Comorbidity Index scores. The patients who received spinal anaesthesia had shorter operation times and more hypotension. Overall, the factors affecting mortality were the American Society of Anaesthesiology score, cerebrovascular disease, cancer, embolisms, the need for postoperative intensive care, age, Charlson Comorbidity Index score, length of hospital stay, neutrophil, lymphocyte and albumin levels and operation duration. The data we obtained showed that mortality rates for patients receiving spinal or general anaesthesia were similar. However, the patients who received spinal anaesthesia needed less intensive care after surgery, had fewer complications, and had shorter hospital stays. Good care before and during surgery, careful monitoring after surgery, and proper pain relief can lower death rates and complications and reduce time in the hospital.

Keywords: Geriatric patients, general anaesthesia, spinal anaesthesia, mortality

Introduction

Nowadays, particularly in advanced countries, we are seeing a significant drop in birth rates. This trend is driven by several factors: the use of birth control, economic worries and a preference for smaller families in socioeconomically developed countries like Germany. In addition, policies in countries such as China (However, this ban has now been lifted) encourage having fewer children, contributing to a decrease in the young population and an increase in the elderly population. According to Turkish Statistical Institute data, the proportion of the population over the age of 65 in Turkey increased by 22.5% from 2015 to 2020, from 8.2% to 9.5%1. By 2030, this rate is expected to increase to 12.9% [1]. This increase in the elderly population is also reflected in anaesthesia because patients over the age of 65 are more likely to undergo surgery.

Currently, especially with the widespread use of ultrasonography, regional anaesthesia is becoming increasingly popular. However, general and spinal anaesthesia still play a significant role in practice. In geriatric patients, while there is a growing preference for regional techniques due to the presence of comorbid diseases, general anaesthesia is also significantly used due to factors such as the type and duration of the operation and the use of anticoagulants.

With ageing, numerous physiological changes occur. Neuronal degeneration, neuron loss, and decreased levels of neurotransmitters, such as dopamine and serotonin, as well as changes in the blood–brain barrier, lead to functional declines in cognitive and muscular systems [2,3]. Similarly, decreased

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production of elastin and collagen affects arterial-venous vessels and the heart itself, contributing to systolic hypertension, a decrease in cardiac output, heart failure, and a reduction in brain perfusion pressure [3]. The reduction in elastin also causes a decrease in alveolar capacity and functional tidal volume. Additionally, degenerative changes in pneumocytes lead to reduced gas exchange. Declining liver and kidney functions can impact the elimination of drugs, leading to various pharmacodynamic and pharmacokinetic effects [4,5]. These and other unmentioned physiological reasons can increase the risk of complications and mortality in both general and regional anaesthesia.

Our study aimed to investigate the relationships between anaesthesia methods and mortality, postoperative intensive care need (PICN), complications, and Charlson Comorbidity Index (CCI) scores in an increasingly ageing geriatric population.

Material and Methods

Our research was conducted as a retrospective cohort study. It involved patients aged 65 and older who had undergone surgery for a range of reasons. This study was initiated after receiving approval from the Malatya Turgut Özal University Clinical Research Ethics Committee (date:01.11.2022; no:2022/176) and was conducted in accordance with the principles of the Declaration of Helsinki. The entire study took place at Malatya Training and Research Hospital during the period from 01.01.2022 to 30.06.2022 Patients who were admitted for emergency surgery, those who were converted from spinal to general anaesthesia, patients operated on from the intensive care unit and patients and/or their legal guardians who did not give consent for the study were excluded. Written informed consent with wet signatures was obtained from all patients and their relatives. The minimum sample size for the study was calculated to be 280 patients, considering an alpha error of 0.05 and a beta error of 0.8.

The patients were divided into two groups: those who received general anaesthesia and those who received spinal anaesthesia. Through the hospital's automated system and patient records, we collected data on age, gender, comorbidities, American Society of Anaesthesiology (ASA) score, laboratory data, CCI scores, need for transfusions, operation time, PICN, postoperative complications, such as respiratory distress, hypotension, nausea and vomiting, duration of hospital stay and mortality rates.

Statistical Analysis

Data entry and analysis were conducted using IBM SPSS Statistics 21.0 software IBM Corp., Armonk, NY, USA). Age, total hospital stay duration, operation time, and laboratory data are presented as means±standard deviations, while CCI data are given as median s(min–max). Other data are expressed in percentages. The Shapiro–Wilk test was applied to assess normal distribution. The Mann–Whitney U test was used to analyse age, the hospital stay duration and the laboratory data. For the analysis of the categorical variables, the Pearson chi-square test was employed. After determining the factors affecting mortality, a binomial regression model was constructed to understand these factors. The likelihood of significant factors was calculated using beta exp. A P-value of<.05 was considered statistically significant.

Result

In our study, we included 299 patients aged over 65, consisting of 195 women (65.2%) and 104 men (34.8%). The average age of these patients was 73.9±7 years. Among them, 149 patients received general anaesthesia, while spinal anaesthesia was administered to 150 patients. In terms of surgeries, 12% (36) had had neurosurgery, 14.4% (43) had undergone general surgery, 63.5% (190) had undergone orthopaedic procedures and 10% (30) had had urological operations. We found no significant differences in age, gender, ASA classification, additional illnesses, or CCI scores between the patients receiving spinal or general anaesthesia (Table 1). Comparing the preoperative tests, it was observed that the patients who had received general anaesthesia showed significantly higher lymphocyte counts (Table 2). In the perioperative assessment, we found that the group that had received spinal anaesthesia had shorter operation times, but there was no significant difference in perioperative transfusion needs between the groups. In the postoperative phase, the general anaesthesia group showed significantly higher rates of nausea and vomiting, intensive care requirements and longer hospital stays. More instances of hypotension were observed in the spinal anaesthesia group (Table 3). No significant differences were found in postoperative respiratory difficulties, embolism or mortality rates. when they compare the data's associations with mortality, the ASA score, cerebrovascular disease, cancer, PICN, embolism, age, CCI score, length of hospital stay, neutrophil, lymphocyte and albumin levels and operation duration were significant (Table 4).

The binomial regression results showed that the model we used for this analysis was statistically significant (omnibusX2(3)=112.901, P<.001 Hosmer and Lemeshow=P>.05). This means that the factors we studied had a meaningful impact on patient outcomes. Our study's independent variables explained 70.2% of the differences in the factors affecting whether patients survived or not. Specifically, we found that age, the CCI score, a low lymphocyte level and longer operation duration played a significant role in mortality in the groups. Old (over 65 ages) people had a higher chance of passing away (52.3%) compared to younger ones (47.7%). In the same way, people with higher CCI scores had a higher risk of death (65.1%) compared to those with lower scores (34.9%). In addition, individuals with fewer lymphocytes faced a greater risk of mortality (77.4%) compared to those with more (22.6%). Moreover, patients who had undergone longer surgeries had a higher risk of mortality (52.7%) than those with shorter surgeries (47.3%) (table 5). When we used our model to group patients, it correctly separated those who left the hospital (98.9%) from those who experienced death (73.1%). Overall, the model performed exceptionally well, with an accuracy rate of 96.7%. In short, we have strong confidence in our model's accuracy.

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Table 1. Distribution of preoperative clinical characteristics of the patients included in the study by anaesthesia type

Variables	Type of Anesthesia		Total n= 299	P value
	General n=149	Spinal n= 150		
Age (mean±SD)	74.1 ± 7.1	73.7 ± 7.0	73.9 ± 7.0	0.624
Gender (%)				
Female	100 (67.1)	95 (63.3)	195 (65.2)	0.493
ASA (%)				
ASA I	14 (9.4)	13 (8.7)	27 (9.0)	
ASA II	62 (41.6)	53 (35.3)	115 (38.5)	0.680
ASA III	66 (44.3)	76 (50.7)	142 (47.5)	
ASA IV	7 (4.7)	8 (5.3)	15 (5.0)	
HT (%)	58 (38.9)	55 (36.7)	113 (37.8)	0.687
DM (%)	54 (36.2)	40 (26.7)	94 (31.4)	0.075
İHD (%)	61 (40.3)	51 (34.2)	112 (37.2)	0.250
Asthma (%)	25 (16.8)	27 (18.0)	52 (17.4)	0.781
COPD (%)	35 (23.5)	55 (36.7)	90 (30.1)	**0.013***
CVH (%)	23 (15.4)	22 (14.7)	45 (15.1)	0.852
Malignancy	13 (8.7)	18 (12.0)	31 (10.4)	0.650
CCI	3.8 ± 2.9	3.6 ± 2.4	3.7 ± 2.7	0.893
Type Of Operation (%)				
Neurosurgery	19 (12.8)	17 (11.3)	36 (12.0)	
General	20 (13.4)	23 (15.3)	43 (14.4)	
Orthopaedics	96 (64.4)	94 (62.7)	190 (63.5)	
Urology	14 (9.4)	16 (10.7)	30 (10.0)	

ASA: American society of anaesthesiologists classification, HT: Hypertension, DM: Diabetes mellitus, IHD: Ischemic heart disease, COPD: Chronic obstructive pulmonary disease, CVH: Cerebrovascular disease, CCI: Charlson comorbidity index, Values are given as several cases (%) or mean±standard deviation (mean±SD,) *: P<0.05 was considered significant

Table 2. Distribution of preoperative examination values of the patients included in the study by anaesthesia type

Variables	Type of Anaesthesia		Total	P value
	General	Spinal		
Hemoglobin (g/dL)	12.9 ± 2.0	12.9 ± 2.0	12.9 ± 2.0	0.536
Hematocrit (%)	38.8 ± 5.9	38.5 ± 5.9	38.6 ± 5.9	0.856
Neutrophil (10^3/µL)	5.0 ± 2.4	5.1 ± 2.2	5.0 ± 2.3	0.324
Lymphoside(10^3/µL)	2.6 ± 1.2	2.0 ± 0.9	2.3 ± 1.1	**<0.001***
Urea (mg/dL)	59.6 ± 36.2	60.5 ± 31.7	60.0 ± 34.0	0.645
Creatinine (mg/dL)	2.3 ± 10.7	3.0 ± 13.2	2.6 ± 12.0	0.321
Albumin (g/dL)	3.1 ± 0.6	3.3 ± 2.3	3.2 ± 1.7	0.551

Values are given as mean±standard deviation. *: P<0.05 was considered significant

Table 3. Distribution of the perioperative and postoperative clinical characteristics of the patients included in the study by anaesthesia type

Variables	Type of Anaesthesia		Total	P value
	General	Spinal		
PERIOPERATIVE				
Operation time (mean±SD).	63.1 ± 15.6	57.3 ± 10.9	60.2 ± 13.7	**0.003***
Blood transfusion (%)	118 (79.2) 31 (20.8)	112 (74.7) 38 (25.3)	230 (76.9) 69 (23.1)	0.353
POSTOPERATIVE				
Need Intensive Care (%)	59 (39.6)	34 (22.7)	93 (31.1)	**0.002***
Respiratory Difficulty (%)	22 (14.8)	22 (14.7)	44 (14.7)	0.981
Emboli (%)	7 (4.7)	5 (3.3)	12 (4.0)	0.548
Nausea-Vomiting (%)	44 (29.5)	13 (8.7)	57 (19.1)	**<0.001***
Hypotension	21 (14.1)	44 (29.3)	64 (21.7)	**0.001***
Mortality (%)				
Charge **Ex**	135 (90.6) 14 (9.4)	138 (92.0) 12 (8.0)	273 (91.3) 26 (8.7)	0.668
Hospital Day of Accommodation (mean±SD)	8.4 ± 2.7	8.0 ± 2.7	8.2 ± 2.7	0.035*

Values are given as several cases (%) or mean±standard deviation (me±SD) *: P<.05 was considered significant

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Table 4. Comparison of the effects of preoperative. peroperative and postoperative factors on mortality

Variables	Discharged n=273	Exitus n=26	Total N=299	P value
Gender (n)				
Female	176	19	195	.379[a]
Asa (n)				
Asa I	27	0	27	
Asa II	110	5	115	**<0.001[a]***
Asa III	130	12	142	
Asa IV	6	9	15	
Type of anaesthesia (n)				
Genel	135	14	149	0.668 [a]
Spinal	138	12	150	
HT (n)	101	12	113	0.357 [a]
DM (n)	87	7	94	
IHD (n)	100	11	111	
Asthma (n)	45	7	52	0.180[a]
COPD (n)	80	10	90	0.331[a]
CVH (n)	34	11	45	**<0.001 [a]***
Malignancy (n)	25	6	31	
PICN (n)	71	22	93	**<0.001[a]***
Perioperative Transfusion (n)	62	7	69	0.626 [a]*
Respiratory Distress (n)	38	6	44	
Emboli (n)	9	3	12	
Nausea-Vomiting (n)	53	4	57	
Hypotension (n)	58	7	65	
Age (year).	72 (65-97)	82 (65-98)	73 (65-98)	**<0.001[b]***
CCI	3 (0-11)	9 (1-12)	3 (0-12)	**<0.001[b]***
Day of Hospitalization (day)	8 (3-15)	11 (8-16)	8 (3-16)	**<0.001[b]***
Hemoglobin (g/dL)	13.1 (7-18.1)	12.6 (9.7-18.3)	13 ± 2	0.240[b]
Hematocrit (%)	38.7 ± 5.7	37.7 ± 7.1	38.9 (21-57.4)	0.407[c]
Neutrophil (103/µL)	4.37 (1.5-15.3)	5.25 (2.3-22.3)	4.44 (1.5-22.3)	**0.045[b]***
Lymphocyte(103/µL)	2.18 (0.28-8.9)	1.48 (0.28-3.62)	2.18 (0.28-8.9)	**0.003[b]***
Urea (mg/dL)	52.4 (1.16-337)	58 (26-129)	53 (1.16-33)	0.155[b]*
Creatinine (mg/dL)	0.93 (0.46-98)	0.85 (0.56-1.49)	0.92 (0.46-98)	0.451[b]
Albumin (g/dL)	3.2 (1.04-4.4)	2.85 (1.8-3.8)	3.2 (1.04-4.4)	**0.013[b]***
Operation Time (minute)	59 (30-110)	75 (45-90)	60 (30-110)	**< 0.001[b]***

PICN: Postop intensive care need, ASA: American society of anaesthesiologists classification, HT: Hypertension, DM: Diabetes mellitus, İHD: İschemic heart disease, COPD: Chronic obstructive pulmonary disease, CVH: Cerebrovascular disease, CCI: Charlson comorbidity index. Values are given as number of patients, mean±standard deviation, and median (min-max). *: P<0.05 was considered significant

Table 5. Binomial regression analysis to determine the factors that cause patients to die

Variables	B	Sh	Wald	Sd	P	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Age	0.093	0.045	4.293	1.000	**0.038***	1.097	1.005	1.197
Asa	-0.418	0.607	0.474	1.000	0.491	0.658	0.200	2.163
CVH	1.330	0.885	2.261	1.000	0.133	3.781	0.668	21.402
Malignancy	-0.466	1.062	0.192	1.000	0.661	0.628	0.078	5.029
CCI	0.625	0.204	9.417	1.000	**0.002***	1.867	1.253	2.783
Day of Hospitalization	0.196	0.128	2.323	1.000	0.127	1.216	0.946	1.564
Neutrophil	0.276	0.173	2.552	1.000	0.110	1.318	0.939	1.848
Lymphocyte	-1.234	0.464	7.058	1.000	**0.008***	0.291	0.117	0.724
Emboli	1.731	1.239	1.951	1.000	0.162	5.644	0.498	64.002
Albumin	-0.941	0.812	1.345	1.000	0.246	0.390	0.079	1.915
Operation time	0.109	0.030	13.392	1.000	**0.000***	1.115	1.052	1.182
Constant	-17.536	5.003	12.284	1.000	**0.000***			

Nagelkerke R2=0.715 Omnibus Chi-Square=114.848 Sd=3 P <.001 Hosmer and Lemshow= P>0.05 *: P<0.05 was considered significant

Discussion

Today, especially in developed countries, the elderly population is increasing. This has led to many challenges in anaesthesia practice for older people. The reasons for this include less active lifestyles, a higher incidence of additional health problems and orthogeriatric issues like hip fractures. In our study, we looked at the relationship between the anaesthesia method used (general and spinal) and mortality for patients aged 65 and older undergoing surgery for various reasons. We found no difference in mortality between spinal and general anaesthesia. In our analysis, we found factors that increased mortality, regardless of the anaesthesia method used. These factors included the ASA score, heart problems, cancer, PICN, embolism, age, CCI score, length of hospital stay, neutrophil, lymphocyte and albumin levels and surgery duration.

In geriatric patients, factors such as ageing, reduced reserve capacities of organs such as the brain, heart, lungs, liver and kidneys, comorbid conditions and the need for surgeries play a crucial role in determining the choice of anaesthesia method. As in our study, in this age group, orthopaedic surgeries, especially for hip fractures due to osteoporosis, alongside neurodegenerative conditions and muscle weakness, are quite common. Regional anaesthesia is more prominent in such cases. However, for surgeries such as abdominal procedures and brain surgery, general anaesthesia takes the forefront.

In our study, the patients who underwent general anaesthesia experienced more postoperative complications, longer hospital stays and a higher need for intensive care. Chen and colleagues' 2019 meta-analysis of hip fracture patients linked general anaesthesia to increased mortality [6]. Luger et al.'s meta-analysis involving geriatric patients undergoing non-cardiac surgeries found lower mortality and fewer postoperative complications with regional anaesthesia and less hypotension with general anaesthesia [7]. Rodkey and colleagues' retrospective study of 23,649 patients showed similar mortality rates between general and spinal anaesthesia, but spinal anaesthesia had advantages in terms of fewer complications and earlier discharge [8]. Lin and colleagues reported general anaesthesia as a higher risk factor for mortality compared to epidural anaesthesia in surgeries for adenosarcoma [9]. Postoperative delirium, though not covered in our study, has been associated with sedation levels accompanying general or spinal anaesthesia. Sieber and their team's 2018 study on 200 hip fracture surgery patients found a lower risk of delirium with spinal anaesthesia, especially in patients with a lower CCI score and lower sedation doses. İn surgeries involving nerve blocks in geriatric patients [10]. İt is crucial to consider the potential for increased local anaesthesia toxicity due to factors such as reduced elimination rate and muscle loss [11].

In general anaesthesia, several factors contribute to higher mortality and complication rates compared to regional anaesthesia. These factors include reduced pulmonary capacity, anaesthesia reducing cerebral perfusion, the superior analgesic effect of spinal or epidural anaesthesia, prolonged recovery due to reduced elimination and increased cardiac sensitivity to inhalation and induction anaesthetics for reasons such as ischaemia or heart failure, among others. Spinal anaesthesia tends to lead to more hypotension, exacerbated by age-related reductions in total body fluid relative to weight and increased susceptibility to dehydration in geriatric patients with kidney and cardiac issues [12]. Adequate fluid replacement and preoperative care, as well as the use of opioids to adjust bupivacaine dosage, can reduce the risk of hypotension and subsequent hypoperfusion [13,14]. In particular, pulmonary complications and cardiac instability contribute to increased postoperative intensive care requirements, leading to extended hospital stays. Regional anaesthesia, especially epidural anaesthesia, provides more effective postoperative analgesia. Sufficient analgesia reduces the incidence of stress-related delirium, contributes to early mobilization and decreases complications such as embolism and other cardiovascular issues, thus promoting rehabilitation [15]. Consequently, it also shortens the length of hospital stays.

When examining the factors that affected mortality regardless of the anaesthesia method, our study found that the ASA score, cerebrovascular disease, cancer, PICN, embolism, age, the CCI score, length of stay, neutrophil, lymphocyte and albumin levels and operation duration were significant. As age increases, the geriatric population has higher ASA scores due to decreases in organ capacity and comorbid conditions. In our study, 157 patients (52.5%) had an ASA score of 3–4. A high ASA score is directly proportional to mortality [16]. Güntürk and colleagues reported higher mortality in the ASA 3–4 patient group in their studies comparing general anaesthesia to spinal anaesthesia [17]. However, in our study, there was no difference in mortality between the general and spinal anaesthesia methods in the ASA groups.

The CCI, widely used since 1987 for predicting mortality, is a simple index encompassing age and comorbid conditions. It assigns +1 to the CCI for each decade after the age of 50. Numerous studies have shown that higher CCI scores are associated with increased mortality and postoperative complications [18,19]. Tikici and colleagues, in their research on patients undergoing emergency colorectal surgery, found that a high CCI score was linked to mortality but concluded that the ASA scoring system was more effective in predicting mortality [20]. A 2018 meta-analysis indicated that ASA and CCI scores independently influenced mortality, but it also highlighted that general and spinal anaesthesia methods had similar mortality rates, with a higher risk of complications in general anaesthesia (such as pneumonia, kidney disease, myocardial infarction, etc [21]. In our study, there was no significant difference in mortality between the general and spinal anaesthesia methods concerning the CCI scores. However, regardless of the anaesthesia method, patients with high CCI scores had significantly higher complication rates.

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Limitations

Our study was a single-centre study, which means that the limited number of patients restricts the generalizability of the findings. Another limitation is the absence of cognitive data, such as delirium, in our study, preventing the identification of postoperative neurodegenerative changes.

Conclusion

In our study, we found the data we obtained showed similar mortality rates between the patients who received spinal anaesthesia and those who received general anaesthesia. However, the need for postoperative intensive care, complications and length of hospital stay were lower in the spinal anaesthesia group. We believe that thorough perioperative assessment and care, close postoperative monitoring and adequate analgesia will reduce both mortality and complications, while also shortening the length of hospital stays.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
The study received ethical approval from the Malatya Turgut Özal University Clinical Research Ethics Committee dated 01.11.2022 and numbered 2022/176.

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