Impact of anesthesia type on transfusion-related parameters and postoperative outcome in patients undergoing elective partial hip arthroplasty

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Original Article

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ABSTRACT

Objective: This study was designed to evaluate impact of anesthesia on transfusion-related parameters and postoperative recovery outcome in patients undergoing elective partial hip arthroplasty.

Design: Retrospective study

Setting: Antalya Training and Research Hospital, Orthopedics and Traumatology Clinic

Subjects: A total of 256 patients undergoing elective partial hip arthroplasty were included in this retrospective study.

Intervention: Non-interventional

Main outcome measures: Type and duration of anesthesia, American Society of Anesthesiologists (ASA) physical status, transfusion-related parameters, vasopressor or perioperative erythrocyte transfusion, blood loss, hemoglobin levels, postoperative transfer unit, length of hospital stay (LOS, day) and 30-day survivorship status were analyzed with respect to anesthesia type, separately for patients in ASA I-II and ASA III-IV categories.

Results: For patients in ASA III-IV category, general anesthesia was associated with older patient age ($p<0.001$) and higher amount of perioperative erythrocyte transfusion ($p<0.05$) than spinal anesthesia. For patients in ASA III-IV category general anesthesia, as compared with spinal and combined spinal-epidural anesthesia, was associated with higher intraoperative blood loss ($p<0.001$ and $p<0.01$, respectively), higher likelihood of perioperative erythrocyte transfusion ($p<0.001$ and $p<0.01$, respectively) and higher likelihood of postoperative ICU stay ($p<0.001$ and $p<0.01$, respectively) . No significant impact of anesthesia type was noted on LOS and 30-day mortality, regardless of ASA class.

Conclusion: In conclusion, our findings revealed no significant impact of anesthesia type on LOS or 30-day mortality in partial hip arthroplasty patients, whereas lesser transfusion need and lesser likelihood of postoperative ICU utilization with use of neuraxial vs. general anesthesia in ASA III-IV class patients.

KEYWORDS: Hip replacement; Neuraxial anesthesia; General anesthesia; ASA classification; Mortality

INTRODUCTION

The anesthesia practice for orthopedic surgery continues to be in progress with consideration of choice of anesthesia amongst the important factors for delivering cost-effective and excellent health care[1]. Thus, in parallel with a growing increase in the number of arthroplasties performed in orthopedics practice, optimizing the anesthesia type has become one of the important aspects of hip arthroplasty surgery due to its potential to enable higher patient satisfaction and reduction in morbidity and mortality rates[2].

Improved recovery and complications outcomes have been reported in the total hip or knee arthroplasty patients with use of modern neuraxial spinal anesthesia versus general anesthesia in terms of lower rates of blood loss, transfusion need, intensive care unit (ICU) utilization and cardiopulmonary and infectious complications along with shorter length of hospital stay (LOS) and improved 30-day morbidity and mortality[3-8]. Hence, neuraxial spinal anesthesia has become one of the key metrics for a hospital to become a center of excellence in joint arthroplasty[9,10].

However, there are also studies that reported no significant difference between general anesthesia and spinal neuraxial anesthesia in terms of postoperative outcomes in total hip arthroplasty or hip fracture repair patients[2,11,12]. Besides, use of regional anesthesia for total joint arthroplasty is considered to remain under-utilized with continuation of general anesthesia to be the main choice, particularly in centers performing a high volume of elective joint arthroplasties[1,3,10,13].

Indeed, compared to several studies on other risk factors (i.e. older age, male gender, bilateral joint surgery, diabetes, kidney disease, metastatic cancer, and cardiopulmonary or cerebrovascular comorbidities) type of anesthesia have been less extensively studied in relation to risk for morbidity and mortality after total joint arthroplasty[1,10].

Alongside the inconsistent findings of published studies on potential benefits of general vs. neuraxial anesthesia on the postoperative outcome in hip arthroplasty surgery[2-8], scarcity of available data on outcomes of contemporary general anesthesia practices has also been emphasized[10-14].

This study was therefore designed to evaluate the impact of anesthesia type on transfusion-related parameters and postoperative recovery outcome (ICU utility, LOS, 30-day mortality) among elective partial hip arthroplasty patients in relation to American Society of Anesthesiologists (ASA) physical status classification.

MATERIAL AND METHODS

Study population

A total of 256 patients (mean±SD age: 61.6±16.2 years, 56.3% were females) who underwent elective partial hip arthroplasty in a tertiary care center between 2010 and 2017 were included in this retrospective study. Patients were divided into three groups based on type of primary anesthesia including spinal anesthesia (n=182), combined spinal and epidural anesthesia (n=34) and general anesthesia (n=40).

The study was conducted in full accordance with local Good Clinical Practice (GCP) guideline and current legislations, while the permission was obtained from our institutional ethics committee for the use of patient data for publication purposes (Date of Approval/Protocol No: 2019/016).

Assessments

Data on patient demographics (age, gender), type and duration of anesthesia, ASA physical status classification, intraoperative time (min), transfusion-related parameters [need for crystalloids and colloid fluids (mL) or vasopressor agent and blood loss (mL), perioperative erythrocyte transfusion need, preoperative and postoperative levels for hemoglobin (mg dL^{-1}) and creatinine (mg dL^{-1})], postoperative transfer unit (ward, intensive care unit-ICU), LOS (day) and postoperative 30-day survivorship status were recorded in each patient and analyzed with respect to the three anesthesia groups separately for patients in ASA I-II and ASA III-IV categories. Blood transfusion was not performed unless there was worsening in hemodynamic parameters (Hb < 7 gdL^{-1}), while intravenous colloid replacement was based on 1:1 blood/colloid ratio. Since there were three different types of anesthesia, duration of anesthesia and operation time were evaluated equally.

Anesthesia

In the operating room, monitoring with electrocardiography (ECG), peripheral oxygen saturation (SpO_2), non-invasive blood pressure monitorization (NIBP) and invasive blood pressure monitorization in patients with high cardiovascular risk were performed.

In spinal anesthesia group, after recording basal parameters and preloading with 15 mL kg^{-1} crystalloid solution, 3-3.5 ml % 0.5 hyperbaric bupivacaine (intrathecal, L4 – L5 intervertebral space) was administered in the sitting position. Patients with sensory blockade (T10 level) were evaluated.

In combined spinal and epidural anesthesia group, after recording basal parameters and preloading with 15 mL kg^{-1} crystalloid solution 3 ml % 0.5 hyperbaric bupivacaine (intrathecal, L4 – L5 intervertebral space) was administered in the sitting position and epidural catheter was placed.

Postoperatively, pain management was based on intravenous (in spinal and general anesthesia groups) or epidural (in combined spinal epidural aneshtesia group) patient-controlled anesthesia (PCA) via tramadol administration. Patients with sensory blockade (T10 level) were evaluated.

In the general anesthesia group, after 2% intravenous lidocaine (1mg kg^{-1}) administration to reduce pain due to propofol, general anesthesia was induced via propofol (3mg kg^{-1}), fentanyl (1µg kg^{-1}) and rocuronium (0.6 mg kg^{-1}). For maintenance of anesthesia %50 air-oxygen, remifentanil (0.5µg $kg^{-1}min^{-1}$) infusion and desflurane inhalation (1 MAC) was performed, while end-tidal CO_2 ($EtCO_2$) was monitored with capnography when the bispectral index (BIS) was in the range of 40-60. The procedures were performed by the same operation team in all patients.

Statistical analysis

Statistical analysis was made using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY). Pearson Chi-Square Test (Monte Carlo) and Fisher Freeman Halton (Monte Carlo) with post Hoc Benjamini-Hochberg correction were used to analyze categorical variables, while One Way ANOVA (Robust Statistic: Brown-Forsythe) with post Hoc Tukey HSD, Kruskal Wallis test (Monte Carlo) with post Hoc Dunn's test, Mann Whitney U test (Monte Carlo) and General Linear Model Repeated ANOVA (Wilks' Lambda) were used for analysis of numerical variables. Wilcoxon Signed Ranks Test (Monte Carlo) test was used for two repeated measurements. Propensity-matched analysis was used to determine the perioperative risk factors that might affect the study and to regroup the pairings. The pairing was done in pairs with the least number of reference groups. When analyzed according to the new groups obtained from the Propensity score, the first analysis results of our study did not change according to the results of the first analysis and the first analysis results are shown to reduce the number of samples. Data were expressed as “mean±standard deviation (SD)” median (minimum-maximum) and percent (%) where appropriate. $p<0.05$ was considered statistically significant.

Power Analysis Results

Similarly, since the reference study was not available in the literature, our study was planned as post power. Power and Sample Size Calculated with G * Power 3.1.9.2. All patients we were interested in the hospital database were included in the study. Asa (III + IV) and the number of groups (n1 = 11, n2 = 23, n3 = 35) total

N = 69 obtained with the available data obtained from the results of the analysis of the effect size values intraoperative bleeding (ml) for 0.862 and perioperative erythrocyte transfusion. The post power value calculated for the need (unit) for 0.482 was calculated as 99.99 and 94.82%, respectively, and according to this result, the number of samples was found to be sufficient.

RESULTS

Patient demographics, clinical and operative characteristics (n=256)

Mean patient age was 61.6 years (range, 25 to 98) and females composed 56.3% of the study population. Spinal, general and combined spinal-epidural anesthesia was applied in 71.1%, 15.6% and 13.3% of patients, respectively. Most of patients (73.0%) were in ASA I-II category. Intraoperative need for colloid or vasopressor agent (ephedrine) and perioperative need for erythrocyte transfusion was noted in 33.6%, 24.6 and 32.0% of patients, respectively. Postoperative, majority of patients were transferred to a general ward (87.1%) and median LOS was 12 days. Postoperative 1-month survival rate was 94.1% [Table 1].

Study parameters with respect to anesthesia type in patients with ASA I-II and ASA III-IV categories

For patients in ASA I-II category, spinal anesthesia was associated with significantly shorter intraoperative time as compared with general and combined spinal-epidural anesthesia (median (min-max) 100 (60-200) vs. 140 (90-210) and 130 (80-200) min, $p<0.001$ for each), lesser amount of intraoperative crystalloids as compared with combined spinal-epidural anesthesia (1873 (1000-4000) vs. 2214 (1000-3500) mL, $p<0.05$) [Table 2].

No significant difference was noted between anesthesia types in patients with ASA I-II category in terms of other study parameters including patient demographics, intraoperative blood loss, colloid or vasopressor need, perioperative erythrocyte transfusion need, creatinine levels, postoperative transfer unit, LOS and postoperative 1-month survival rate. Hemoglobin levels significantly decreased postoperatively in each anesthesia group ($p<0.001$ for each) with no significant difference between groups in terms of preoperative and postoperative levels [Table 2].

For patients in ASA III-IV category, general anesthesia was associated with older patient age (mean±SD 81.43±8.90 vs. 67.80±16.88 years, $p<0.001$) and higher amount of perioperative erythrocyte transfusion (median(min-max) 3 (1-4) vs. 2 (1-3) units, $p<0.05$) than spinal anesthesia. For patients in ASA III-IV category general anesthesia as compared with spinal and combined spinal-epidural anesthesia was associated with higher amount of intraoperative blood loss (median (min-max) 500 (150-600) vs. 300 (200-800) and 300 (200-800) mL, $p<0.001$ and $p<0.01$, respectively), higher likelihood of perioperative erythrocyte transfusion (82.6% vs. 31.4% and 45.5%, $p<0.001$ and $p<0.01$, respectively) and higher likelihood of postoperative ICU stay (78.3% vs. 17.1% and 36.4%, $p<0.001$ and $p<0.01$, respectively) [Table 2].

Hemoglobin levels were significantly decreased postoperatively in each anesthesia group ($p<0.001$ for each), while both preoperative and postoperative levels were significantly lower in patients who received general anesthesia than those received spinal anesthesia ($p<0.05$ for each) [Table 2].

No significant difference was noted between anesthesia types in patients with ASA III-IV category in terms of other study parameters including gender, intraoperative time, colloid, crystalloid, vasopressor need, creatinine levels, LOS and postoperative 1-month survival rate [Table 2].

DISCUSSION

Our findings in a retrospective cohort of patients undergoing elective partial hip arthroplasty surgery have revealed that older patients in the ASA III-IV class undergo general anesthesia, higher amount of perioperative erythrocyte transfusion and lower hemoglobin levels than spinal anesthesia, whereas higher amount of intraoperative blood loss and higher likelihood of perioperative erythrocyte transfusion and postoperative ICU utilization as compared with both spinal and combined spinal-epidural anesthesia. Anesthesia type had no significant impact on transfusion-related parameters in ASA I-II class patients, while it also had no significant impact on LOS or 30-day mortality in partial hip arthroplasty patients regardless of their ASA physical status.

Past studies in total hip arthroplasty patients revealed that neuraxial anesthesia as compared to general anesthesia was associated with a significant reduction in blood loss[7], lesser risk of deep surgical site infection[4,15] and shorter LOS[4,6,7,16] alongside reduction in the rates of cardiopulmonary complications[3,5,6,8], ICU utilization[6] and 30-day mortality[4,5,7].

Although our findings support the less favorable outcome of general anesthesia as compared with neuraxial anesthesia in partial hip arthroplasty patients, this was valid only for ASA III-IV class patients and particularly for transfusion-related parameters[17] (low hemoglobin levels, higher intraoperative blood loss, increased erythrocyte transfusion need) along with ICU utilization. Notably, regardless of the ASA class, no significant impact of anesthesia type was noted on LOS or 30-day mortality in our cohort of partial hip arthroplasty patients.

Similarly, in a past study among bilateral total hip arthroplasty patients, authors reported higher rate of perioperative transfusion in the general anesthesia group as compared with the neuraxial anesthesia group, whereas no significant difference was noted between anesthesia groups in terms of postoperative outcomes including LOS, 30-day postoperative pulmonary complications, sepsis and surgical site infection[2]. Two large database studies among bilateral hip or knee arthroplasty patients also reported that apart from a decrease in transfusion need, neuraxial anesthesia had no superiority over general anesthesia in terms of complication rates, LOS and postoperative ICU utilization[2,11]. In a large scale observational study of elderly patients with hip fracture, use of regional anesthesia was also reported not to be associated with better outcome than general anesthesia in surgical repair in terms of morbidity and mortality[2].

In the present cohort, general anesthesia is associated with older patients, increased intraoperative blood loss and perioperative erythrocyte transfusion need and higher likelihood of postoperative ICU utilization as compared with spinal neuraxial anesthesia in ASA III-IV patients but not in ASA I-II class patients. This seems notable given that older patients with poorer ASA classification are considered to have a higher incidence of perioperative complications[1,18]. Neuraxial anesthesia has also been reported to be a favorable anesthesia in the presence of multiple comorbidities, particularly for elderly patients with significant cardiopulmonary comorbidities[6,16].

Importantly, identification of hemodynamic disadvantages of general anesthesia only in ASA III-IV class patients in our cohort seems to emphasize consideration of ASA physical status classification in anesthesia-based risk stratification of patients undergoing hip arthroplasty for better allocation of resources and improved patient care and experiences.

However, it should also be noted that in a study with total arthroplasty (54.9% ASA I-II, 44.9% ASA III-IV) and total knee arthroplasty (50.6% ASA I-II, 49.7% ASA III-IV) patients, implementation of a modern rapid-recovery general anesthesia protocol was reported to be associated with excellent outcomes with early mobilization and limited complications or adverse events[10]. In addition, while the anesthesia type was addressed among unilateral partial arthroplasty patients in the current study, unilateral arthroplasties as compared with bilateral arthroplasties are known to be associated with lower rates of complications and erythrocyte transfusion, while higher postoperative hemoglobin levels and higher improvement in postoperative pain scores[19,20].

Nonetheless, association of spinal and combined spinal-epidural anesthesia with improved transfusion-related parameters (lesser blood loss and transfusion need) in our ASA III-IV class patients is important given the correlated immunological interplay between blood transfusion and infection with higher rate of infection in patients who required more blood transfusion reported in several studies[21-23]. In fact, use of epidural anesthesia alone was reported to be associated not only with reduction of intra- and postoperative blood loss[24,25] but also with faster postoperative red blood cell recovery in patients undergoing total hip arthroplasty when compared to use of general anesthesia with or without epidural anesthesia[25]. Improved hemodynamics with neuraxial anesthesia in hip arthroplasty patients seems also important in terms of its additional putative advantages reported for homeostasis, cardiopulmonary, metabolic and immune functions as well as for better postoperative outcome in patients after major orthopedic surgery[24-27].

Certain limitations to this study should be considered. Firstly, due to retrospective single center design of the present study, establishing the temporality between cause and effect as well as generalizing our findings to overall arthroplasty surgical population seems not possible. Second, lack of data on co-morbid conditions, postoperative cardiopulmonary complications and surgical site infection rates is another limitation which otherwise would extend the knowledge achieved in the current study. Nevertheless, despite these certain limitations, providing data on transfusion-related and postoperative recovery outcome under different types of anesthesia in unilateral partial hip arthroplasty patients in relation to different ASA subgroups, our findings represent a valuable contribution to the literature.

CONCLUSION

Our findings revealed no significant impact of anesthesia type on LOS or 30-day mortality in partial hip arthroplasty patients, whereas improved transfusion-related and lesser likelihood of postoperative ICU utilization with use of neuraxial vs. general anesthesia in ASA III-IV class patients. This emphasizes the variable impact of anesthesia type on transfusion-related parameters in partial hip arthroplasty patients depending on the ASA class, implicating the need to consider ASA physical status in risk stratification and consequent resource allocation in this type of surgery. Larger scale prospective randomized controlled trials are needed to address the impact of anesthesia type on outcomes in relation to patient demographics, clinical

status, reason and type of specific surgery in hip arthroplasty patients to identify the optimal anesthesia procedure with potential benefits on perioperative morbidity and mortality in this surgical population.

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Compliance with Ethical Standards

For this type of studies, formal consent is not required. This study was conducted in compliance with the ethical principles stated in the “Declaration of Helsinki”. The permission to conduct the study was obtained from the Ethics Committee of Antalya Training and Research Hospital to use patient data for publication purposes.

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Author contribution:

OG: Author of the article

ST: Article of the organizer

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Table 1: Patient demographics, transfusion-related and postoperative outcome (n=256)

Patient demographics characteristics	Characteristic definition	Values
Age (year),	mean±SD	61.6±16.2
	median(min-max)	62 (25- 98)
Gender, n(%)	Female	144(56.3)
	Male	112(43.8)
Type of anesthesia, n(%)	Spinal	182(71.1)
	General	40(15.6)
	Combined spinal-epidural	34(13.3)
ASA category, n(%)	I-II	187(73.0)
	III-IV	69(27.0)
Duration of anesthesia (min), median (min-max)		110 (60-270)
Intraoperative time (min), median (min-max)		110 (60-270)
Intraoperative blood loss (ml), median(min-max)		300 (150-950)
Intraoperative crystalloid need (mL), median(min-max)		2000 (1000- 4000)
Intraoperative colloid need	mL, median(min-max)	500 (500-1500)
	Yes, n(%)	86(33.6)
Perioperative erythrocyte transfusion need	Units, median (min-max)	2 (1-5)
	Yes, n(%)	82(32.0)
Intraoperative vasopressor need	mg, median(min-max)	15 (5- 100)
	Yes, n(%)	63(24.6)
Hemoglobin (mg/dL), mean±SD	preoperative	12.19±1.51
	postoperative	9.44±1.19
	change (postop-preop)	-2.75±1.06
Creatinine (mg/dL), mean±SD	preoperative	1.00±0.55
	postoperative	1.00±0.66
	change (postop-preop)	0.01±0.38
Postoperative transfer unit, n(%)	ward	223(87.1)
	ICU	33(12.9)
Length of hospital stay (day), median (min-max)		12 (3-27)
30-day survivorship status, n(%)	Survivor	241(94.1)
	Non-survivor	15(5.9)

SD – Standard deviation; ASA – American Society of Anesthesiologists ; ICU – Intensive Care Unit

Table 2: Study parameters with respect to anesthesia type in patients with ASA I-II and ASA III-IV categories

Patient demographics, clinical and operative characteristics		Patients in ASA I-II Category				Patients in ASA III-IV Category			
		Spinal (n=147)	General (n=17)	Combined S-E (n=23)	p value	Spinal (n=35)	General (n=23)	Combined S-E (n=11)	p value
Gender, n(%)	Female	85 (57.8)	7 (41.2)	13 (56.5)	0.450[1]	17 (48.6)	15 (65.2)	7 (63.6)	0.430[1]
	Male	62 (42.2)	10 (58.8)	10 (43.5)		18 (51.4)	8 (34.8)	4 (36.4)	
Age (year), mean±SD.		57.94±14.21	54.24±12.56	53.09±12.51	0.162[2]	67.80±16.88	81.43±8.90**	77.91±15.14	**0.002[2]**
Intraoperative time (min), median (min-max)		100 (60-200)	140 (90-210)***	130 (80-200)***	**<0.001[3]**	100 (60-270)	120 (90-140)	120 (80-180)	0.105[3]
Intraoperative blood loss (ml), median(min-max)		300 (150-950)	350 (150-600)	300 (150-800)	0.871[3]	300 (200-800)qq	500 (150-600)	300 (200-800)q	**<0.001[3]**
Intraoperative crystalloid need (mL), median(min-max)		1873 (1000-4000)	2128 (1000-3500)	2214 (1000-3500)*	**0.007[3]**	2000 (1000-3000)	2000 (1000-3000)	2000 (1000-3000)	0.914[3]
Intraoperative colloid need	mL, median(min-max)	500 (500-1500)	500 (500-1000)	500 (500-1000)	0.940[3]	500 (500-1000)	500 (500-1000)	500 (500-1000)	0.755[3]
	No, n(%)	106 (72.1)	11 (64.7)	18 (78.3)	0.644[1]	22 (62.9)	7 (30.4)	6 (54.5)	0.051[5]
	Yes, n(%)	41 (27.9)	6 (35.3)	5 (21.7)		13 (37.1)	16 (69.6)	5 (45.5)	
Perioperative erythrocyte transfusion need	Units, median (min-max)	2 (1-5)	-	2 (1-3)	0.541[4]	2 (1-3)	3 (1-4)*	2 (2-4)	**0.037[3]**
	No, n(%)	108 (73.5)	14 (82.4)	18 (78.3)	0.755[5]	24 (68.6)	4 (17.4)	6 (54.5)	**0.003[1]**
	Yes, n(%)	39 (26.5)	3 (17.6)	5 (21.7)		11 (31.4)qq	19 (82.6)	5 (45.5)q	
Intraoperative vasopressor need, n(%)	No	116 (78.9)	14 (82.4)	19 (82.6)	0.854[1]	24 (68.6)	12 (52.2)	8 (72.7)	0.371[5]
	Yes	31 (21.1)	3 (17.6)	4 (17.4)		11 (31.4)	11 (47.8)	3 (27.3)	
Hemoglobin (mg/dL), mean±SD	preoperative	12.34±1.54	12.34±1.49	12.57±1.34	0.777[2]	12.10±1.46	11.20±1.41*	11.58±1.18	**0.046[2]**
	postoperative	9.60±1.17	9.42±1.29	9.50±0.94	0.780[2]	9.41±1.25	8.56±1.13*	9.16±1.10	**0.028[2]**
	change (postop-preop)	-2.74±0.97	-2.92±1.08	-3.06±1.07	0.359[2]	-2.69±1.29	-2.64±1.37	-2.42±0.61	0.774[2]
	p value (change)[6]	**<0.001**	**<0.001**	**<0.001**		**<0.001**	**<0.001**	**<0.001**	
Creatinine (mg/dL), mean±SD	preoperative	0.89 (0.51-4.29)	0.9 (0.78-2.3)	0.86 (0.71-2.4)	0.725[3]	0.95 (0.62-2.94)	0.98 (0.78-7)	0.92 (0.61-1.21)	0.325[3]
	postoperative	0.86 (0.61-2.46)	0.89 (0.73-1.76)	0.91 (0.68-4.79)	0.162[3]	0.91 (0.76-2.87)	0.89 (0.81-7.75)	0.86 (0.57-0.96)	0.374[3]
	change (postop-preop)	0 (-1.83-0.44)	-0.07 (-0.54-0.14)	0.04 (-0.42-2.39)	0.308[3]	-0.04 (-0.43-0.64)	-0.09 (-1.11-3.97)	-0.04 (-0.4-0.15)	0.926[3]
	p value (change)[7]	0.646	0.153	0.567		0.318	0.811	0.267	
Postoperative transfer unit, n(%)	ward	144 (98.0)	15 (88.2)	23 (100.0)	0.104[5]	29 (82.9)	5 (21.7)	7 (63.6)	**<0.001[5]**
	ICU	3 (2.0)	2 (11.8)	0 (0.0)		6 (17.1)qq	18 (78.3)	4 (36.4)q	

Length of hospital stay (day), median (min-max)		12 (3-27)	12 (4-23)	13 (6-23)	0.294[3]	11 (5-18)	9 (4-16)	11.5 (5-20)	0.083[3]
30-day survivorship status, n(%)	Survivor	144 (98.0)	17 (100.0)	23 (100.0)	0.999[5]	30 (85.7)	17 (73.9)	10 (90.9)	0.466[5]
	Non-survivor	3 (2.0)	0 (0.0)	0 (0.0)		5 (14.3)	6 (26.1)	1 (9.1)	

S-E: spinal-epidural; SD: standard deviation, min: minimum, max: maximum. [1]Pearson Chi-Square Test(Monte Carlo), [2]OneWay ANOVA (Robust Statistic: Brown-Forsythe) with post Hoc Tukey HSD, [3]Kruskal Wallis Test (Monte Carlo) with post Hoc Dunn's test, [4]Mann Whitney U Test (Monte Carlo), [5]Fisher Freeman Halton (Monte Carlo) with post Hoc Benjamini-Hochberg correction, [6]General Linear Model Repeated ANOVA (Wilks' Lambda), [7]Wilcoxon Signed Ranks Test (Monte Carlo)

$^{*}p<0.05$, $^{**}p<0.01$ and $^{**}p<0.001$; compared to spinal anesthesia group; $^{q}p<0.01$ and $^{qq}p<0.001$; compared to general anesthesia group