

Two types of anesthesia and Hemodynamic changes in Patients over 60 years of age who need artificial femoral head replacement: a retrospective cohort study

WeiQi Ke

The First Affiliated Hospital of Shantou University Medical College

Yuting WANG

The First Affiliated Hospital of Shantou University Medical College

Xukeng GUO (✉ 396273835@qq.com)

The First Affiliated Hospital of Shantou University Medical College

Ronghua HUANG

The First Affiliated Hospital of Shantou University Medical College

Xiangdong ZHANG

The First Affiliated Hospital of Shantou University Medical College

Weikai WANG

The First Affiliated Hospital of Shantou University Medical College

Xuan JI

The First Affiliated Hospital of Shantou University Medical College

Shaohui ZHUANG

The First Affiliated Hospital of Shantou University Medical College

Research Article

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Abstract

Background:Artificial femoral head replacement is one of the most effective methods for treatment of severe diseases of femoral joint in the elderly. The ideal anesthetic effect is one of the key elements for the success of the operation because it brings fast recovery. However, the multiple comorbidities of the elder patients make them too weak to tolerate the hemodynamic changes after anesthesia.

Objective:To compare the post-anesthetic hemodynamic changes between combined lumbar plexus and sciatic nerve block(CLPSB) and combined spinal and epidural anesthesia(CSEA) in elderly patients undergoing unilateral artificial femoral head replacement.

Methods:We reviewed records of the patients who aged over 60 years old (age 62-103 years) and received unilateral artificial femoral head replacement. 477 patients were included and divided into CLPSB group (n=90) and CSEA group (n=387). The primary outcome was comparison of the hemodynamic changes after anesthesia, including the SBP, diastolic blood pressure DBP, MAP and (HR). The second outcome was the comparison of the vasopressor used during the surgery.

Results:We established three models to compare the two anesthesia methods on hemodynamic changes.All three models exhibit that changes of MAP (Δ MAP) after CSEA were higher than that after CLPSB($\beta= 6.88$, 95% CI: 4.33 - 9.42, $P < 0.0001$), with significant difference, which indicated that CSEA causes higher fluctuation of MAP. Concurrently, the use of vasopressors increased by 137% (OR=2.37, 95%CI: 1.24-4.53, $P=0.0091$) in the CSEA group, which is statistically significant. However, the changes of HR (Δ HR) between the CLPSB and CSEA was not significant($\beta= 0.50$, 95% CI: 1.62 - 2.62, $P = 0.6427$).

Conclusions:Both CLPSB and CSEA are ideal anesthesia methods for patients receiving femoral head replacement, though CLPSB is more suitable for elderly patients with advanced hemodynamic stability.

Introduction

Artificial femoral head replacement refers to the human femoral head necrosis caused by a variety of factors, the use of artificial femoral head instead of femoral head function of the operation. Elderly people are more prone to femoral head lesions due to calcium loss and decreased body function. With the aggravation of population aging, the number of elderly patients receiving artificial femoral head replacement is also increasing gradually. Since artificial femoral head replacement is a large surgical operation, patients need to be operated under anesthesia, and elderly patients often have a variety of chronic underlying diseases, and the risk of anesthesia is significantly increased compared with the younger group.[1]

Combined spinal-epidural anesthesia (CSEA) is characterized with rapid onset, full muscle relaxation, longer duration of anesthesia effect, and it is convenient for postoperative analgesia.However, for elderly patients, the anesthesiologists face greater challenges because of compulsive position of the patients

and leading to greater failure rate comparing with combined lumbar plexus-sciatic nerve blockage (CLPSB). What's more, it disturbs the stability of the circulatory system.

Combined lumbar plexus-sciatic nerve block (CLPSB) is an effective anesthesia method for unilateral lower limb surgery,[2] which has little effect on the general physiological state of the patients. Also, it is an optional option when patients are taking antiplatelet and/or anticoagulant drugs.

In this study, we evaluated the role of CSEA and CLPSB in hemodynamics during artificial femoral head replacement in elderly patients.[3]

Participants And Methods

2.1 Study Design

In this study, conducted a retrospective cohort study, with the relationship between the two types of anesthesia and hemodynamics. Target independent variables are two modes of anesthesia and dependent variables are hemodynamic changes (including $\Delta\text{MAP}=\text{post-MAP}-\text{pre-MAP}$, $\Delta\text{HR}=\text{post-HR}-\text{pre-HR}$, as well as the application of intraoperative vasopressors)

2.2 Study population

The data of participants of Chinese patients with newly-diagnosed patients requiring artificial femoral head replacement were non-selectively and consecutively collected from Department of Anesthesiology, The First Affiliated Hospital of Shantou University Medical College, Shantou, Guangdong Province city, China. Our data did not include identifiable participants data for the purpose of safeguarding patient privacy. Data were compiled from Hospital electronic medical record system. Participants informed consent is not required in this study because of the nature of retrospective cohort study. The study protocol was approved by the Medical Ethics Committee of the First Affiliated Hospital of Shantou University Medical College. The data are anonymous, and the requirement for informed consent was therefore waived. Written informed consents were waived by the Medical Ethics Committee of the First Affiliated Hospital of Shantou University Medical College, because our study didn't involve privacy and treatment of patients.

We reviewed the surgical records of 530 ASA grade I-III elderly patients who underwent unilateral artificial femoral head replacement in our hospital from January 2015 to December 2020. We excluded 4 patients younger than 60 years old, 39 patients who chose endotracheal intubation general anesthesia, and 10 patients who switched to epidural anesthesia only after CSEA puncture failure. A total of 477 patients aged 62 to 103 years (male: female = 122:355) were included and divided into CSEA group (n=387) and CLPSB group (n=90) according to different anesthesia methods. The patient selection process is shown in Fig. 1.

2.3 Variables

We recorded the two types of anesthesia as categorical variables. The procedure is described as follows: We were divided into two groups according to the two types of anesthesia.

According to published guidelines and studies, we obtain the final result variables (Δ MAP, Δ HR as continuous variables and Vasopressor as classification variables). The detailed procedure for measuring hemodynamic changes was described as follows: baseline mean arterial pressure was subtracted from the mean arterial pressure measured 10 minutes after occlusion, and baseline heart rate was subtracted from the heart rate measured 10 minutes after occlusion.

In this study, we included the following covariables, which can be summarized as follows :(1) Demographic data; (2) Variables that can affect hemodynamic changes reported in previous literature; (3) According to our clinical experience. Therefore, the following variables were used to construct a fully adjusted model :(1) continuous variables: age, baseline systolic blood pressure, baseline diastolic blood pressure, and baseline heart rate (obtained at baseline); (2) Classification variables: gender, hypertension, diabetes, heart disease, lung disease, central nervous system disease.

2.4 Methods

Premedication was not performed for any of patient. After arrival in the operating room, noninvasive blood pressure, electrocardiogram (ECG) and oxygen saturation (SpO₂) were performed. Before anesthesia, intravenous access was established through 18G intravenous cannula in the upper arm and Ringer solution 10ml/kg was administered as prehydration. Oxygen, at the rate of 5L/min was delivered through a facial mask as well.

For CSEA group, the patient was placed in the lateral recumbent position and epidural space puncture was performed in L2-3 or L3-4 with needle-through-needle technique. Tuohy 18-gauge needle was infiltrated into epidural space at the point 1-1.5cm lateral to the midline with saline resistant loss technique. And then pencil point spinal needle 26-gauge passed through Touhy needle and reached to subarachnoid space. Isobaric 0.5% ropivacaine 15mg was administered intrathecally after observing free leakage of cerebrospinal fluid. After all, spinal needle was withdrew and epidural catheter 20-gauge was placed cephalically 4cm in the epidural space, and 0.5% ropivacaine solution was injected 3-4ml if necessary. The patient was then placed in supine position.

For CLPSB group, combined lumbar plexus-sciatic nerve blockage was performed guiding by nerve stimulator (Stimuplex HNS 12 nerve stimulator, Stimuplex D B. Braum nerve-stimulator-guided needle). Psoas compartment block technique was used in lumbar plexus nerve blockage.[4, 5] The patient was placed in lateral decubitus position with his neck, back and hips flexed, and posterior iliac spine was identified. The nerve-stimulator-guided needle was inserted vertically at the intersection point of the posterior iliac spine and the line 4cm lateral and parallel to the midline along the intercrystal line. The nerve stimulator delivered a current of 1.0mA at a frequency of 1MHz at the very beginning, and once appropriate movement was induced, the current was progressively decreased at 0.4mA, and 10ml 1.5% chloroprocaine and 20ml 0.4% ropivacaine were administered when ipsilateral contraction of the

quadriceps muscle was still induced, indicating that the tip of the needle is close to the lumbar plexus. Next, the patients' positions were not changed, and sciatic nerve blockage was performed as follows: the greater trochanter and posterior iliac spine were identified and 4cm caudally on the midperpendicular line of this two landmarks was marked as the puncture point. The nerve-stimulator-guided needle was inserted vertically at this point and the nerve stimulator delivered a current of 1.0mA at a frequency of 1MHz, and the stimulation current was reduced to 0.2-0.4mA until dorsiflexion motion on foot became visible. Following negative aspiration with the injector, 10ml 1.5% chloroprocaine and 20ml 0.4% ropivacaine were administered.[6]

The patient's non-invasive blood pressure and heart rate were recorded at baseline and 10 minutes after anesthesia. The application of intraoperative vasopressors was also recorded.[7, 8]

All methods were performed in accordance with the relevant guidelines and regulations.

3.Statistical analysis

We expressed continuous variables with normal distribution as mean \pm standard deviation. Categorical variables were expressed in frequency or as a percentage. We used χ^2 (categorical variables), Student T test (normal distribution), or Mann-Whitney U test (skewed distribution) to test for differences among different anesthesia groups. The data analysis process of this study was based on three criteria: (1) what is the relationship between anesthesia and hemodynamics (Δ MAP, Δ HR, vasopressor); (2) which factors modify or interfere with the relationship between anesthesia and hemodynamics; and (3) adjust the interference factors or After the stratified analysis, what is the true relationship between anesthesia and hemodynamics? Therefore, data analysis can be summarized in three steps. Step 1: Univariate and multivariate linear regression were employed. We constructed three models: crude model, no covariates were adjusted; model 1, only adjusted for sociodemographic data(age and gender); model 2, model 1+other covariates presented in table 1.[9] Step 2: The subgroup analyses were performed using stratified linear regression models. For continuous variable, we first converted it to a categorical variable according to the clinical cut point or tertile, and then performed an interaction test. Tests for effect modification for those of subgroup indicators were followed by the likelihood ratio test. [10]To ensure the robustness of data analysis, we did a sensitivity analysis. All the analyses were performed with the statistical software packages R (<http://www.R-project.org>, The R Foundation) and EmpowerStats (<http://www.empowerstats.com>, X&Y Solutions, Inc, Boston, MA). P values less than 0.05 (two-sided) were considered statistically significant.[11]

Results

4.1 Baseline characteristics of selected participants

A total of 477 participants were selected for the final data analysis after screening by inclusion and exclusion criteria (see Figure 1 for a flow chart). We showed baseline characteristics of these selected participants in table 1 according to two types of anesthesia. In general, the average age of the 477

selected participants was 80.17 ± 7.671 years old and about 0.25577% of them were male. No statistically significant differences were detected in age, gender, no complications, hypertension, diabetes, heart disease, central nervous system disease among different anesthesia groups ($P > 0.05$). There were statistical differences in pulmonary diseases among different anesthesia groups ($P < 0.05$).

In Table 2, we show baseline and post-block hemodynamic values for these selected participants, as well as differences in mean arterial pressure and heart rate between the two groups, and the use of vasoactive drugs. There were no significant differences in baseline systolic blood pressure, baseline diastolic blood pressure, baseline mean arterial blood pressure and baseline heart rate between the two groups ($P > 0.05$). The systolic blood pressure after block, diastolic blood pressure after block, mean arterial pressure after block and heart rate after block in the CSEA group were all lower than those in the CLPSB group, and the difference was statistically significant ($P < 0.05$). The difference between baseline mean arterial pressure and post-block mean arterial pressure was statistically significant between the two groups ($P < 0.05$), and the CSEA group was significantly lower than the CLPSB group. There was no statistical difference between baseline heart rate and post-block heart rate between the two groups ($P > 0.05$). The proportion of vasoactive drugs used in the CSEA group was higher than that in the CLPSB group, and the difference was statistically significant ($P < 0.05$).

4.2 Univariate analysis

We listed the results of univariate analyses in Table 3. By univariate linear regression. First of all, we found that age, gender, diabetes, heart disease, lung disease, central nervous system disease were not associated with Δ MAP and Δ HR ($P > 0.05$); univariate analysis showed that hypertension were positively correlated with Δ MAP and Δ HR ($P < 0.05$). [12] Then, we found that age, gender, diabetes, hypertension, lung disease, central nervous system disease were not associated with vasopressor ($P > 0.05$); univariate analysis showed that heart disease were positively correlated with vasopressor ($P < 0.05$).

4.3 Results of unadjusted and adjusted linear regression

In this study, we constructed three models to analyze the independent effects of two types of anesthesia on Δ MAP, Δ HR, vasopressor (univariate and multivariate linear regression). The effect sizes (β and OR, β for Δ MAP and Δ HR, OR for vasopressor) and 95% confidence intervals were listed in Table 4-6. In the unadjusted model (crude model), the effect size of 6.80 mmHg for Δ MAP in unadjusted model means that mean arterial pressure change was higher in CSEA group than in CLPSB group (6.80, 95% CI (4.27, 9.34)), the difference was statistically significant ($P < 0.05$). In the minimum-adjusted model (model 1), mean arterial pressure change was higher in CSEA group than in CLPSB group (7.02, 95% CI (4.47, 9.56)), the difference was statistically significant ($P < 0.05$). In the fully-adjusted model (model 2) (adjusted all covariates presented in table 1), mean arterial pressure change was higher in CSEA group than in CLPSB group (6.88, 95% CI (4.33, 9.42)), the difference was statistically significant ($P < 0.05$). In the unadjusted model (crude model), the effect size of 0.71 bpm for Δ HR in unadjusted model means that heart rate change was higher in CSEA group than in CLPSB group (0.71, 95% CI (-1.39, 2.81)), the difference

was not statistically significant ($P > 0.05$). In the minimum-adjusted model (model 1), heart rate change was higher in CSEA group than in CLPSB group (0.59, 95% CI (-1.51, 2.70)), the difference was not statistically significant ($P > 0.05$). In the fully-adjusted model (model 2) (adjusted all covariates presented in table 1), heart rate change was higher in CSEA group than in CLPSB group (0.50, 95% CI (-1.62, 2.62)), the difference was not statistically significant ($P > 0.05$). In the unadjusted model (crude model), the effect size of 2.29 for vasopressor in unadjusted model means that use of vasopressor was higher in CSEA group than in CLPSB group 129% (2.29, 95% CI (1.22, 4.30)), the difference was statistically significant ($P < 0.05$). In the minimum-adjusted model (model 1), use of vasopressor was higher in CSEA group than in CLPSB group 141% (2.41, 95% CI (1.28, 4.54)), the difference was statistically significant ($P < 0.05$). In the fully-adjusted model (model 2) (adjusted all covariates presented in table 1), use of vasopressor was higher in CSEA group than in CLPSB group 137% (2.37, 95% CI (1.24, 4.53)), the difference was statistically significant ($P < 0.05$).

4.4 Subgroup analysis

We used age, gender, no complications, hypertension, diabetes, heart disease, lung diseases, central diseases as the stratification variables to observe the trend of effect sizes in these variables (Figure 2-4). No significant heterogeneity was found in all subgroups ($P > 0.05$). Found that central disease patients who applied probability increase use of vasopressor (OR 6.44, 95% CI (1.46, 28.47), $P = 0.0662$). Other results of the subgroup analysis were consistent with the preliminary results.

Discussion

The present study was a retrospective cohort study comparing the hemodynamic effects of combined lumbar plexus-sciatic nerve block with combined lumbar epidural anesthesia in elderly patients undergoing artificial femoral head replacement. [13]

The earliest recorded attempts at hip replacement were performed in Germany by Themistocles Gluck in 1891. [14] And an American surgeon, Dr. Austin T. Moore carried out the first metallic hip replacement surgery on September 28, 1940 at Columbia Hospital in Columbia, South Carolina. [15] Most of the patients suffered from hip fracture and receiving femoral head arthroplasty are elderly patients. And multi-systemic diseases, such as hypertension, diabetes mellitus, coronary artery diseases, cerebral infarction, and chronic obstructive pulmonary diseases, often exist as well. They bring great risks to the patients and big changes to the anesthesiologists. [16, 17] So, it is a big task for us to choose a most suitable anesthetic technique for the patients.

General anesthesia with endotracheal intubation can be the choice for artificial femoral head replacement surgery. Better airway management is the dominant advantage compared to nerve blockage and combined spinal-epidural anesthesia techniques. However, instability in hemodynamics during endotracheal intubation and extubation has been criticized. What's worse, post-operative atelectasis may worsen cardiopulmonary conditions and prolong the length of hospital stay. [18] At the same time, the

application of general anesthesia and the occurrence of intraoperative hypotension increase the incidence of postoperative delirium in elderly patients.[19-22]

Combined spinal-epidural anesthesia technique is another choice for hip replacement surgery. It is characterized with rapid onset, reliable anesthesia effect for operation and it is convenient for postoperative analgesia. And it can reduced the incidence of post-operative atelectasis, pulmonary infection and deep venous thrombosis comparing with general anesthesia with endotracheal intubation. On the other hand, CSEA technique is not suitable for patients who are receiving anti-coagulative medications. Compulsive position and osteo-proliferation would lead to greater failure rate as well. R. J. Wood et al. concluded similarly that intraoperative hypotension is a common complication during surgical anesthesia for hip fractures in elderly patients.[23] Vengamamba Tummala et al. demonstrated that CSEA is a safe, effective, and reliable technique with stable hemodynamics in high-risk elderly patients undergoing perhip surgery.[24] However, our results showed that CSEA significantly reduced blood pressure in patients undergoing artificial femoral head replacement. The decrease value was 17.20 ± 11.37 mmHg. We analyzed these studies that were inconsistent with our results, and we speculated that the reasons for the different results might be caused by the following factors: (1) the study population was different. (2) The number of study cases was small.

Combined lumbar plexus-sciatic nerve blockage technique can be the alternative choice for femoral head arthroplasty in elderly patients. It can provide full anesthesia blockage in unilateral lower limb. And it has less influence on cardiovascular system and respiratory system. It is more suitable for elderly patients and especially those suffering from cardiac dysfunction and pulmonary dysfunction. Similar to us, Marcel A. de Leeuw, MD et al. found that peripheral nerve block did not cause clinically significant hemodynamic changes.[25] Leonardo Teixeira Domingues Duarte has similar results to ours, and has also shown that the addition of sciatic nerve block to lumbar plexus block promotes complete blockade of the injurious nerve innervation of the hip, but the dose of local anesthetic is also significantly increased.[26]

In our study, the probability of intraoperative application of vasoactive drugs in the CSEA group was higher than that in the CLPSB group. CSEA technique causes hypotension through peripheral vasodilation due to sympathetic efferent block. [27] CLPSB technique has less effect on hemodynamics and is more suitable for elderly patients. Mehmet Aksoy et al. 's study reached a similar conclusion.[28]

In our study, combined lumbar plexus-sciatic nerve blockage and combined spinal-epidural anesthesia are both suitable for elderly patients receiving artificial femoral head replacement. Combined lumbar plexus-sciatic nerve blockage anesthesia method has an advantage in hemodynamic stability, and it has less influence on physical status. Combined spinal-epidural anesthesia method has more reliable clinical effects and faster onset of action. However, it may cause cardiovascular disturbance and affect respiratory system due to high block level.[29] Guang Han et al. studied that sitting CSEA was more stable than lying CSEA in terms of hemodynamics.[30] C. Olofsson et al. suggested that a low dose of high-density bupivacaine (7.5 mg) in combination with sufentanil (5 mg) could provide reliable lumbar

anesthesia for the repair of hip fractures in elderly patients with fewer hypotensive events and no need for vasopressant support.[31]

The limitations of this study include: (1) in this study, we research object is mainly over 60 patients with femoral head replacement is required, the results do not apply to patients younger than 60 years of age, and other patients (2) the surgical procedure of this study is the single center of regional level, so the results do not necessarily apply to other region or ethnic group. Combined with the above two points, the universality and extrapolation of the research have some deficiencies. (3) we are not listed in the study of the operation of the hemodynamic situation, because we know that in the operation because different surgery, surgeons in surgical bleeding, operation time, auxiliary opioid analgesia, etc, there will be a lot of confounding factors, block after the longer results is unreliable, so we have no intraoperative and postoperative data list. In future studies, we will design prospective studies to explore intraoperative and postoperative hemodynamic changes through randomization and blind methods.

From what has been discussed above,we should choose a most suitable anesthesia approach according to the patient conditions.

Declarations

-Ethics approval and consent to participate

The experimental protocol was established, according to the ethical guidelines of the Helsinki Declaration and was approved by the Medical Ethics Committee of the First Affiliated Hospital of Shantou University Medical College.Written informed consents were waived by the Medical Ethics Committee of the First Affiliated Hospital of Shantou University Medical College, because our study didn't involve privacy and treatment of patients.

-Consent for publication

Not applicable

-Availability of data and materials

The datasets generated during and analysed during the current study are not publicly available due to our data is still undergoing other analysis, we cannot share it at present, but are available from the corresponding author on reasonable request.

-Competing interests

The authors declare that they have no competing interests.

-Funding

Not applicable

-Authors' contributions

Weiqi Ke was responsible for the overall implementation of the study and paper writing, Xuan Ji was responsible for the data analysis, Xiangdong Zhang, and Xuan Ji were responsible for the data collection, and Weiqi Ke was responsible for the overall guidance. All authors reviewed the manuscript.

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32. Two Types of Anesthesia and Hemodynamic Changes in Patients Over 60 Years of Age Who Need Artificial Femoral Head Replacement: A Retrospective Cohort Study.

Tables

Table 1. Baseline Characteristics of participants (N =477)

Anesthesia	Total	CLPSB	CSEA	P-value
N	477	90	387	
Age—Mean ± SD	80.170 ± 7.671	81.689 ± 7.643	79.817 ± 7.644	0.037
Gender, n (%)				0.588
Female	355 (74.423%)	69 (76.667%)	286 (73.902%)	
Male	122 (25.577%)	21 (23.333%)	101 (26.098%)	
ASA, n (%)				0.006
I	227 (47.589%)	31 (34.444%)	196 (50.646%)	
II	250 (52.411%)	59 (65.556%)	191 (49.354%)	
No complications, n (%)	60 (12.579%)	9 (10.000%)	51 (13.178%)	0.413
Hypertension, n (%)	334 (70.021%)	58 (64.444%)	276 (71.318%)	0.2
Diabetes, n (%)	140 (29.350%)	26 (28.889%)	114 (29.457%)	0.915
Heart diseases, n (%)	91 (19.078%)	17 (18.889%)	74 (19.121%)	0.96
Lung diseases, n (%)	90 (18.868%)	28 (31.111%)	62 (16.021%)	<0.001
Central diseases, n (%)	148 (31.027%)	31 (34.444%)	117 (30.233%)	0.437

Abbreviations:CLPSB,combined lumbar plexus-sciatic nerve blockage.CSEA,combined spinal-epidural anesthesia

Table 2. Comparison of hemodynamics before and after block between the two groups,the application of Vasopressor between the two groups (N =477)

Anesthesia	Total	CLPSB	CSEA	P-value
N	477	90	387	
Baseline.SBP...mmHg., Mean ± SD	152.45 ± 22.03	148.81 ± 19.33	153.29 ± 22.55	0.082
Baseline.DBP...mmHg., Mean ± SD	81.24 ± 11.77	81.21 ± 10.59	81.25 ± 12.04	0.98
Baseline.MAP...mmHg., Mean ± SD	104.98 ± 13.40	103.74 ± 12.08	105.26 ± 13.69	0.334
Baseline.HR..bpm, Mean ± SD	87.60 ± 15.13	89.63 ± 14.85	87.12 ± 15.17	0.157
Post-block.SBP...mmHg., Mean ± SD	129.14 ± 18.90	133.09 ± 17.46	128.23 ± 19.12	0.028
Post-block.DBP...mmHg., Mean ± SD	69.02 ± 11.58	73.48 ± 10.43	67.98 ± 11.60	<0.001
Post-block.MAP...mmHg., Mean ± SD	89.06 ± 12.54	93.35 ± 11.45	88.06 ± 12.59	<0.001
Post-block.HR..bpm, Mean ± SD	80.00 ± 13.95	82.61 ± 13.56	79.40 ± 13.99	0.049
ΔMAP...mmHg., Mean ± SD	15.92 ± 11.36	10.40 ± 9.62	17.20 ± 11.37	<0.001
ΔHR..bpm, Mean ± SD	7.60 ± 9.15	7.02 ± 8.36	7.73 ± 9.33	0.51
Vasopressor, n (%)				0.008
	No 356 (74.63%)	77 (85.56%)	279 (72.09%)	
	Yes 121 (25.37%)	13 (14.44%)	108 (27.91%)	

Abbreviations:CLPSB,combined lumbar plexus-sciatic nerve blockage.CSEA,combined spinal-epidural anesthesia.ΔMAP=post-MAP-pre-MAP.ΔHR=post-HR-pre-HR.

Table 3 Univariate analysis for ΔMAP,ΔHR,vasopressor

	Statistics	Δ MAP(mmHg) β (95%CI) <i>P</i> -value			Δ HR(bpm) β (95%CI) <i>P</i> -value			Vasopressor value	OR	(95%CI)	<i>P</i> -value
		CLPSB	CSEA	Total	CLPSB	CSEA	Total				
Age group											
<75	117 (24.53%)	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
>=75, <85	217 (45.49%)	1.16 (-4.51, 6.83)	2.04 (-0.74, 4.83)	1.91 (-0.58, 4.40)	2.58 (-2.33, 7.49)	-1.86 (-4.14, 0.43)	-1.19 (-3.26, 0.88)	1.00 (0.18, 5.58)	1.23 (0.70, 2.15)	1.20 (0.71, 2.04)	
>=85	143 (29.98%)	0.6887	0.1504	0.1340	0.3066	0.1122	0.2602	1.0000	0.4737	0.5008	
		1.98 (-4.04, 7.99)	2.43 (-0.61, 5.47)	2.38 (-0.32, 5.09)	2.00 (-3.21, 7.21)	-1.09 (-3.59, 1.40)	-0.71 (-2.95, 1.54)	1.30 (0.22, 7.64)	1.33 (0.72, 2.43)	1.33 (0.75, 2.36)	
		0.5209	0.1179	0.0851	0.4539	0.3910	0.5385	0.7716	0.3606	0.3268	
Gender											
Female	355 (74.42%)	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Male	122 (25.58%)	-0.23 (-4.95, 4.50)	-0.82 (-3.40, 1.76)	-0.71 (-2.99, 1.56)	0.28 (-3.83, 4.39)	-1.60 (-3.72, 0.51)	-1.27 (-3.15, 0.61)	0.98 (0.24, 3.96)	1.45 (0.89, 2.37)	1.39 (0.88, 2.20)	
		0.9252	0.5339	0.5388	0.8934	0.1382	0.1875	0.9811	0.1347	0.1620	
Hypertension	334 (70.02%)	5.12 (1.09, 9.16)	3.53 (1.05, 6.01)	3.86 (1.72, 6.00)	1.20 (-2.42, 4.82)	3.32 (1.29, 5.35)	2.88 (1.10, 4.66)	0.59 (0.18, 1.95)	0.69 (0.43, 1.12)	0.68 (0.44, 1.06)	
		0.0147	0.0056	0.0005	0.5183	0.0015	0.0016	0.3915	0.1323	0.0861	
Diabetes	140 (29.35%)	-1.40 (-5.80, 2.99)	1.58 (-0.90, 4.06)	1.02 (-1.16, 3.20)	-1.82 (-5.63, 2.00)	0.87 (-1.17, 2.91)	0.37 (-1.44, 2.17)	0.40 (0.08, 1.95)	0.79 (0.48, 1.29)	0.73 (0.46, 1.17)	
		0.5330	0.2124	0.3578	0.3533	0.4040	0.6902	0.2582	0.3436	0.1959	
Heart diseases	91 (19.08%)	-1.07 (-6.17, 4.03)	-2.69 (-5.56, 0.18)	-2.38 (-4.90, 0.14)	-0.03 (-4.47, 4.41)	-0.82 (-3.18, 1.55)	-0.67 (-2.76, 1.42)	3.39 (0.95, 12.13)	1.77 (1.04, 3.02)	1.95 (1.19, 3.19)	
		0.6822	0.0674	0.0643	0.9904	0.4987	0.5310	0.0610	0.0356	0.0083	
Lung diseases	90 (18.87%)	-2.30 (-6.59, 1.99)	0.18 (-2.91, 3.28)	-0.49 (-3.06, 2.08)	0.18 (-3.58, 3.93)	0.15 (-2.39, 2.69)	0.16 (-1.97, 2.28)	0.98 (0.27, 3.50)	0.88 (0.47, 1.63)	0.90 (0.52, 1.57)	
		0.2954	0.9069	0.7098	0.9273	0.9077	0.8851	0.9770	0.6875	0.7073	
Central diseases	148 (31.03%)	-1.36 (-5.55, 2.84)	1.00 (-1.46, 3.47)	0.53 (-1.62, 2.68)	-2.74 (-6.35, 0.87)	-0.20 (-2.23, 1.83)	-0.71 (-2.48, 1.07)	0.30 (0.06, 1.45)	1.22 (0.76, 1.97)	1.05 (0.67, 1.64)	
		0.5271	0.4255	0.6270	0.1405	0.8474	0.4371	0.1352	0.4090	0.8413	

Abbreviations:CLPSB,combined lumbar plexus-sciatic nerve blockage.CSEA,combined spinal-epidural anesthesia. Δ MAP=post-MAP-pre-MAP. Δ HR=post-HR-pre-HR.CI,confidence interval. OR,odds ratio.

Table 4 Relationship between Two types of anesthesia and Δ MAP

Outcome	Δ MAP(mmHg) β (95%CI) <i>P</i> -value		
	Crude Model	Model I	Model II
CLPSB	Reference	Reference	Reference
CSEA	6.80 (4.27, 9.34) <0.0001	7.02 (4.47, 9.56) <0.0001	6.88 (4.33, 9.42) <0.0001

Table 5 Relationship between Two types of anesthesia and Δ HR

Outcome	Δ HR(bpm) β (95%CI) <i>P</i> -value		
	Crude Model	Model \square	Model \square
CLPSB	Reference	Reference	Reference
CSEA	0.71 (-1.39, 2.81)	0.5101 0.59 (-1.51, 2.70) 0.5801	0.50 (-1.62, 2.62) 0.6427

Table 6 Relationship between Two types of anesthesia and vasopressor

Outcome	Vasopressor OR (95%CI) <i>P</i> -value		
	Crude Model	Model \square	Model \square
CLPSB	Reference	Reference	Reference
CSEA	2.29 (1.22, 4.30) 0.0096	2.41 (1.28, 4.54) 0.0067	2.37 (1.24, 4.53) 0.0091

Abbreviations: CI, confidence interval.

Model \square adjusted for age and gender.

Model \square adjusted for age, gender, hypertension, diabetes, heart diseases, lung diseases, Central diseases.

Figures

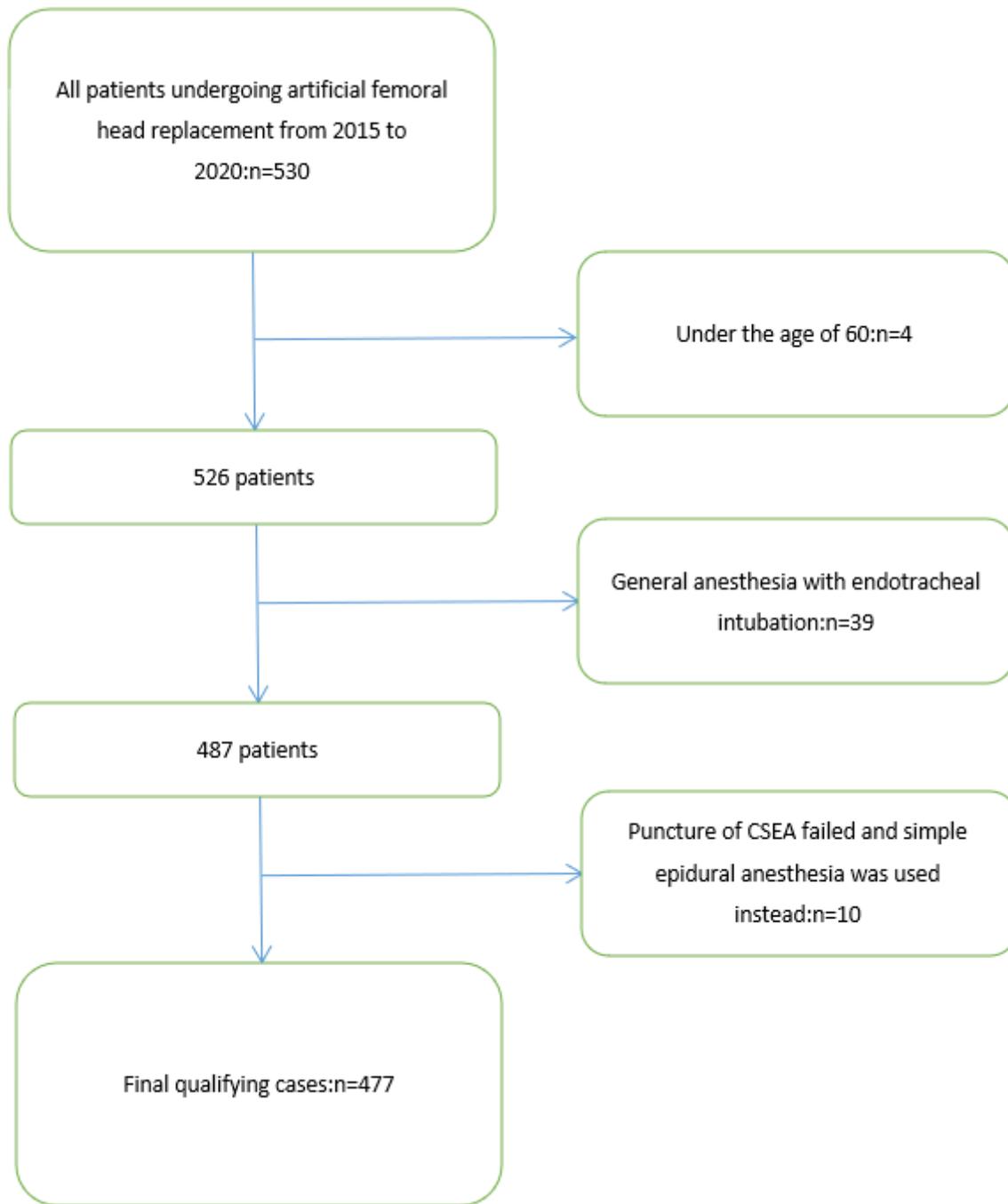


Figure 1

Flowchart of patient selection

Figure 2

Effect size of two types of anesthesia on Δ MAP in prespecified and exploratory subgroups in Each Subgroup

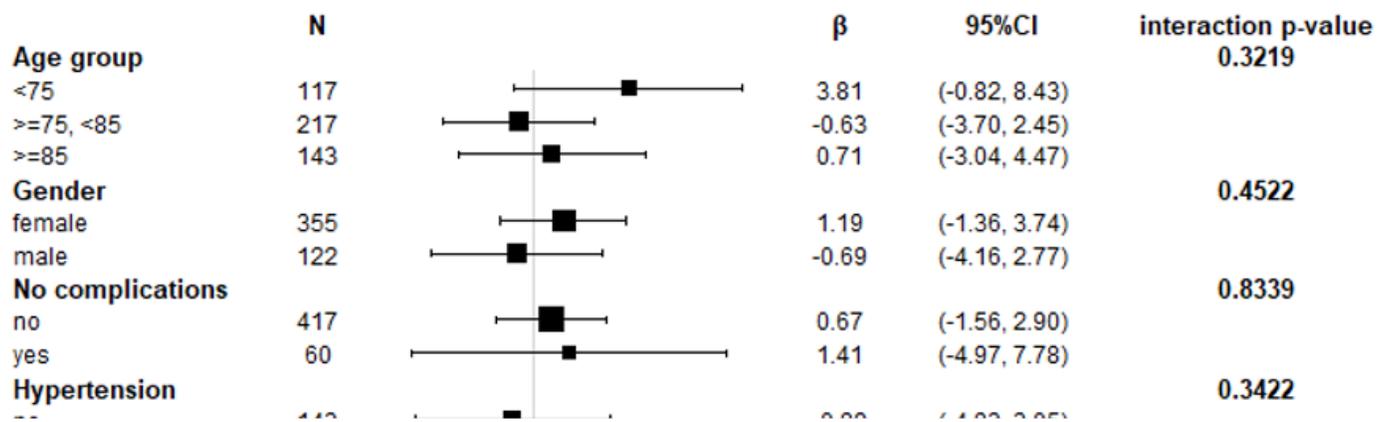


Figure 3

Effect size of two types of anesthesia on Δ HR in prespecified and exploratory subgroups in Each Subgroup

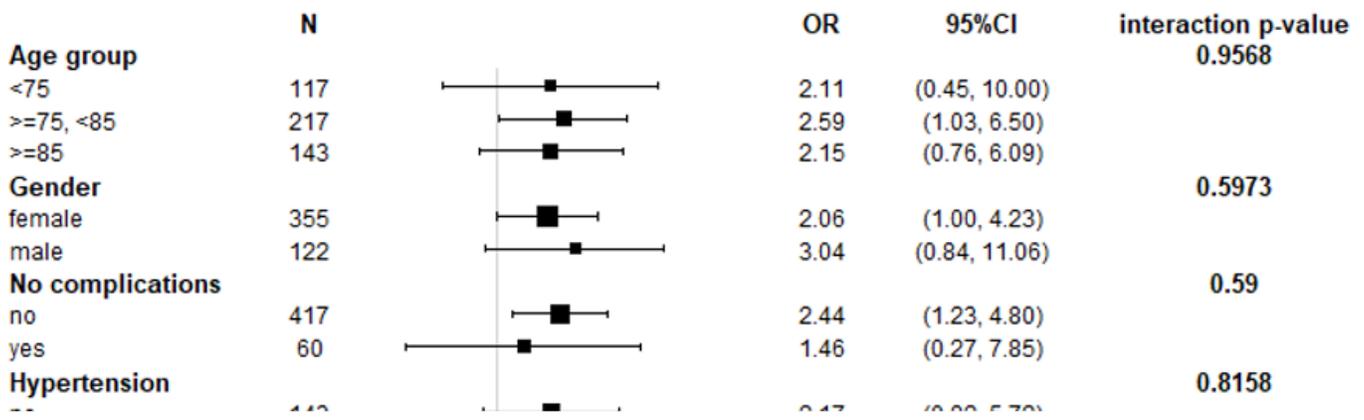


Figure 4

Effect size of two types of anesthesia on vasopressor in prespecified and exploratory subgroups in Each Subgroup