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Effect of inhalation anesthesia combined with nerve block on improving postoperative cognitive function in elderly orthopedic patients.

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Abstract

Postoperative Cognitive Dysfunction (POCD) is a common complication of central nervous system in postoperative anesthesia. The paper was to study the effect of two anesthesia methods on POCD in elderly orthopedic patients. Sixty-five elderly orthopedic patients underwent elective single knee arthroplasty were randomly divided into two groups. Inhalation anesthesia combined with nerve block was performed in observation group, and inhalation anesthesia was performed in control group. Mean Arterial Pressure (MAP), Mini Mental State Examination (MMSE) score, postoperative pain score (Visual Analogue Scale (VAS)) and adverse reactions at different time points after anesthesia were evaluated in POCD of elderly orthopedic patients. The MAP of T1, T2, T4 in observation group was significantly lower than control group, while MAP of T3 in observation group was significantly higher than control group (P<0.05). In the observation group, MMSE scores were significantly higher than those in control group at 6, 12 and 24 h after anesthesia (P<0.01). The incidence of POCD in the two groups was statistically significant (P<0.05). The incidence of adverse reactions such as dizziness, nausea and vomiting, respiratory depression and hypertension in observation group were significantly less than control group (P<0.05) within 24 h. The VAS score of observation group were significantly lower than control group (P<0.05) at 6, 12 and 24 h after surgery. In elderly patients with single knee arthroplasty, compared with simple inhalation general anesthesia, inhalation anesthesia combined with nerve block reduced the impact of physiological indexes in perioperative period. Furthermore, it indicated that inhalation anesthesia combined with nerve block improved POCD.

Keywords: Inhalation anesthesia, Nerve block, Elderly orthopedic patients, POCD.

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Introduction

It is well known that cognition is the most important component of advanced neural activity in human [1]. POCD is a common complication of central nervous system after surgical anesthesia [2]. It refers to abstract thinking ability, disorientation, memory, personality and other symptoms of impaired, and often occurs in 3~7 d after surgery. Numerous studies suggested that POCD was a reversible mental disorder syndrome associated with volatility of acute [3]. In addition, POCD has different degrees in different patients, thus affecting the quality of life of patients.

Although there are many studies on POCD, risk factors are still unknown in recent years. Accumulating evidence has demonstrated that POCD may be related to genetic factors, age, educational, complications, type and duration of surgery and anesthesia and perioperative anesthesia management [4]. In clinical reports, the incidence of POCD was 25.8% in patients who elder than 60 years old underwent non-cardiac surgery after 1 week, while the incidence was 9.9% after surgery 3 months [5].

The fact that aging and surgical trauma have been associated with the development of POCD [6]. With the aggravation of population aging in China, orthopedic trauma surgery for elderly patients is increasing. Due to the function decline of liver and kidney in elderly patients, the metabolism of narcotic drug was decreased. It has been shown that the retention time of narcotic drug prolonged may affect the depth of anesthesia in surgery and recovery time after surgery [7].

This study was to investigate effects of two anesthesia methods on the early cognitive function of elderly patients underwent single knee arthroplasty. Furthermore, the paper promoted understanding of POCD in elderly patients and provided effective reference for clinical prevention.

Materials and Methods

Materials

Sixty-five elderly orthopedic patients underwent elective single knee arthroplasty were randomly divided into two groups

between September 2015 and September 2016. Inhalation anesthesia combined with nerve block was performed in observation group, and inhalation anesthesia was performed in control group. There were 35 patients, 22 males and 13 females, average age was (72.3 ± 4.3) years in observation group. The control group of 30 patients, 19 males and 11 females, mean age was (72.9 ± 4.5) years. American Society of Anesthesiologists (ASA) physical status classes Ito III. Additionally, age, gender, ASA classification and other general information were comparable (P>0.05).

Inclusion criteria and exclusion criteria

Inclusion criteria: The age of patient older than 65 years, and BMI is 18-25 kg/m2. All patients were volunteered to participate in this study, and approved by the consent of the hospital ethics committee.

Exclusion criteria: Patients were non-first joint replacement surgery; hearing, vision and language barriers; combined with active liver disease, stroke sequelae; long-term alcoholism or taking tranquilizers, antidepressant drugs; unwilling to cooperate with the data.

Anesthesia method

The observation group was given inhalation anesthesia combined with nerve block. Nerve block: the drug was 0.375% ropivacaine, and ultrasound combined neurostimulator femoral nerve and sciatic nerve block. First, patients with supine position, the femoral nerve block anesthesia, injection dose of 15~25 ml. Then the lateral position of the sciatic nerve block was injection dose of 15~20 ml. The sensory nerve block was examined by acupuncture. If the skin pain disappeared in the acupuncture block, the anesthesia induction could be further performed. Anesthesia induction: intravenous injection remifentanil 3~5 μg/kg, propofol 1.0~1.5 mg/kg. Continued inhalation at a concentration of 2%, the oxygen flow 1-2 L/ min. Ventilation frequency at 10 to 15 times per minute. Continuous anesthesia: Continuous infusion of propofol with 4.0 to 8.0 $mg.kg^{-1}.h^{-1}$ and remifentanil 0.05 to 0.15 $\mu g.kg^{-1}.min^{-1}$. And injected with a dose of 0.10-0.15 mg/kg of atracurium cis-benzenesulfonate intermittently. The heart rate of the sphygmomanometer was controlled within 20% of the basal value. At the same time, we adjusted the amount of remifentanil and propofol.

The induction of anesthesia in control group was similar to observation group. Anesthesia continued: The heart rate of the sphygmomanometer was controlled within 20% of the basal value. The dose of remifentanil was changed according to the heart rate of the sphygmomanometer in patients. Two groups of patients were performed by the same group of surgeons.

Physiological indexes

MAP in different time points were measured in two groups of patients before and after anesthesia. It involved before anesthesia (T_0), intubation of laryngeal mask for 1 min (T1), the use of tourniquet for 60 min (T2), tourniquet release for 5 min (T3), removal of the laryngeal mask for 1 min (T4), after anesthesia for 6 h (T5). The cognitive function and pain status were evaluated at 6, 12, 24, and 72 h after anesthesia induction. Then adverse reactions of nausea, vomiting, itching, respiratory depression, hypertension and others were observed.

The criteria of cognitive function: MMSE include language expression, calculation, reading, writing, painting, reading comprehension and orientation, a maximum of 30 points. Mild cognitive impairment: MMSE score of 24 to 27 points; moderate cognitive impairment: MMSE score of 18 to 24 points; severe cognitive impairment: 0 to 18 points. MMSE score lower than 3 points before induction anesthesia were diagnosed as POCD.

Postoperative pain criteria: VAS pain score to evaluate the degree of postoperative pain, 0 point to painless; 3 points for mild pain; 4 to 6 into pain, still tolerable. 7 to 10 is divided into severe pain, a strong sense of pain, affecting daily life and work.

Statistical analysis

Data were processed by SPSS11.0 software. The measurement data were analysed using mean ± SD (Standard Deviation), and two independent samples of the group data were used the Student's test. The Dunnett method was used to compare the differences of the data at each time. Then count data were analysed by χ^2 test, P<0.05 for the difference was statistically significant.

Results

The MAP value of two groups in different time points

There was no significant difference in MAP between T0 and T5 (P>0.05) in two groups. The MAP of T1, T2, and T4 in observation group was significantly lower than in control group (P<0.05). However, the MAP of T3 in observation group was markedly higher than in control group (P<0.05). Results showed that the range of MAP in observation group was lower than control group in different time points in surgery. It indicated that inhaled anesthesia combined with nerve block was more stable in physiological environment, as shown in Table 1.

The MMSE score of two groups in perioperative

As shown in Table 2, MMSE scores of two groups were not statistically significant (P>0.05) before induction of anesthesia. The MMSE scores of observation group were significantly higher than control group at 6, 12 and 24 h after anesthesia (P<0.01). In the present study, 3 cases of POCD were found in observation group, the incidence was 8.6%. However, there are 8 cases of POCD were found in control group, and the

incidence was 26.7%. These results showed that the incidence of POCD in two groups were statistically significant (P<0.05).

Table 1. *The MAP value of two groups in different time points ($\bar{x} \pm s$).*

Group	MAP (mmHg)					
	T0	T1	T2	T3	T4	T5
Observation group	84.3 ± 9.3	80.3 ± 9.5	76.5 ± 7.6	70.3 ± 8.3	86.2 ± 6.5	82.2 ± 5.9
Control group	83.0 ± 7.6	91.3 ± 8.5	79.3 ± 11.0	65.5 ± 8.8	90.1 ± 7.3	81.7 ± 6.5
P	0. 5219	0	0.0001	0	0.0015	0.6542

Table 2. *The MMSE score of two groups in perioperative pain.*

Group	Before anesthesia	MMSE score				Incidence of POCD
		After anesthesia 6 h	After anesthesia 12 h	After anesthesia 24 h	After anesthesia 72 h	
Observation group	28.6 ± 1.4	27.1 ± 1.5	27.8 ± 1.1	27.4 ± 13	26.1 ± 1.0	3 (8.6%)
Control group	28.1 ± 1.7	28.9 ± 2.0	26.0 ± 0.9	25.9 ± .1.1	25.7 ± 1.2	8 (26.7%)
P	0.456	0	0.0001	0.0432	0.3541	0.0014

The VAS score and adverse reactions in postoperative pain

As shown in Table 3, the VAS score of observation group was significantly less than control group at 6, 12 and 24 h after surgery (P<0.05).

The incidence of adverse reactions such as dizziness, nausea, vomiting, respiratory depression and hypertension in observation group was markedly lower than control group (P<0.05) within 24 h after surgery. It suggested that adverse reactions and security were better in the method of inhalation anesthesia combined with nerve block, as shown in Table 4.

Table 3. *The VAS score in postoperative pain.*

Group	Postoperative 6 h	Postoperative 12 h	Postoperative 24 h (Rest/ Exercise)	Postoperative 72 h (Rest/ Exercise)
Observation group	3.4 ± 0.3	2.6 ± 0.5	2.0 ± 0.5/2.9 ± 1.1	1.3 ± 0.2/1.9 ± 0.8
Control group	4.6 ± 0.8	3.2 ± 0.6	2.3 ± 0.6/4.9 ± 1.3	1.5 ± 0.5/2.1 ± 0.9
p	0.0031	0.0064	0.0473/0.0002	0.0654/0.0761

Table 4. *Adverse reactions in postoperative within 24 h (n (%)).*

Group	Dizziness	Nausea	Vomiting	Respiratory depression	Hypertension
Observation group	1 (2.9)	1 (2.9)	0 (0.0)	2 (5.7)	3 (8.6)
Control group	4 (13.3)	5 (16.7)	3 (10.0)	6 (20.0)	7 (23.3)
p	0.0021	0	0	0.0001	0

Discussion

It suggested that the occurrence of POCD at any age, but more common in the elderly population, the pathogenesis is unclear [8]. Some scholars believed that poor of language fluency, vocabulary memory, spatial orientation and other aspects in preoperative were more prone to short-term POCD [9,10]. Moller et al. showed that the incidence of POCD was closely related to age, and elderly patients had a high incidence of POCD [11]. The incidence of POCD in the elderly above 65 years old is 2-10 times higher than young. While patients above 75 years old, the incidence of POCD is about 3 times higher than 65-75 years old patients.

There are many risk factors for the development of POCD, such as genetic, age, educational, underlying diseases, surgery, anesthesia, perioperative anesthesia management and other factors [12]. Among risk factors, the main factors were type of

surgery and anesthesia. It has been demonstrated that the lumbar plexus block nerve and sciatic nerve block were small impact in systemic circulation [13]. Thus, it suits for systemic disease, especially for a variety of underlying diseases in elderly patients. Two methods of anesthesia did not affect the mortality in postoperative patients [14].

In recent years, among the anesthesia of knee and hip, the proportion of nerve block increased year by year [15]. On the other hand, clinical study showed that nerve block reduced the incidence of venous thrombosis of the lower extremities [16]. This study focused on the role of inhalation anesthesia combined with nerve block on improving POCD in elderly orthopedic patients.

In the present study, our results showed that the MAP of T1, T2, T4 in observation group were significantly lower than control group. Consistently, the VAS score of observation group was significantly lower than control group at 6, 12 and 24 h after surgery. It indicated that hemodynamics was stable in observation group, and stress response of anesthetic and surgical trauma in patients was small. The MMSE score of observation group was significantly higher than control group at 6, 12 and 24 after anesthesia ($P<0.01$). There were 3 cases POCD in observation group, and the incidence was 8.6%. While in control group 8 cases POCD were found, the incidence was 26.7%. Based on our study, the incidence of POCD in two groups had statistically significant ($P<0.05$). Thus, we hypothesized that the size of neurons was reduced in brain of elderly patients. With the reduction of Dopamine, ACH, 5-HT and other neurotransmitter, the activity of catechol methyltransferase and monoamine oxidase were relatively enhanced [17,18]. In addition, the binding capacity of acetylcholine and nicotinic receptor subtypes were weakened gradually. These factors contributed to the reserve capacity of central nervous system were decreased in elderly patients. Therefore, stress response of surgical trauma and anesthesia lead to degenerative lesions caused by POCD.

It has been shown that the effect of cardiopulmonary bypass on brain was associated with POCD [19]. In this study, the MAP of T3 in observation group was significantly higher than control group. It may be related to accumulation of anesthetic drugs caused circulation inhibition and vasodilation. With age increased in elderly patients, the liver microsomal enzyme system was damaged. Furthermore, the decomposition and metabolic of drugs were reduced, and leading to prolonged half-life of drugs [20]. In addition, the proportion of body fat in elderly patients was increased. It resulting in extended half-life of lipophilic drugs, the prolonged cycle time of drug in body induced POCD [21].

The incidence of adverse reactions such as dizziness, nausea, vomiting, respiratory depression, and hypertension in observation group were significantly lower than in control group ($P<0.05$), which was similar to Biedler et al. [22]. This study showed that the incidence of adverse reactions in inhalation anesthesia combined with nerve block was low. Moreover, it is more suitable for the elderly patients.

In conclusion, the dose of drug is smaller in inhalation anesthesia combined with nerve block compared with the general inhalation anesthesia. The present study showed that inhalation anesthesia combined with nerve block has slightly effect in body, and has no significant adverse reactions and complications. Above all, it reduced the recovery time of anesthesia and decreased the morbidity of POCD.

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None

Conflicts of Interest

The authors declare no conflicts of interest.

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