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Effects of ultrasound-guided fascia iliaca compartment block combined with general anesthesia under tracheal intubation on the vital signs and quality of recovery of elderly patients receiving hip replacement

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Hip replacement surgery, though followed as an important treatment for femoral neck fractures, femoral head necrosis, osteoarthritis and rheumatoid arthritis, issues such as intraoperative mechanical ventilation and tracheal intubation for some critically ill patients, particularly the elderly, pose a great challenge to general anesthesia surgery. Not only it makes the surgery more difficult, but also affects the quality of life during the recovery period and relevant vital signs of patients. Ultrasound-guided fascia iliaca compartment block (FICB), as a postoperative analgesia mode in clinical practice, effectively relieves postoperative pain and also reduces cardiovascular adverse events and over-analgesia complications. Here, we explored the effects of FICB combined with general anesthesia under tracheal intubation on the vital signs and quality of recovery of elderly patients receiving hip replacement. A total of 75 elderly patients undergoing hip replacement were randomly divided into an observation group and a control group. All patients underwent general anesthesia under tracheal intubation and were given routine postoperative patient-controlled intravenous analgesia. One minute before skin cutting, at the time of incision suture and at 30 min after entering the anesthesia recovery room, blood oxygen saturation was higher in the observation group than that in the control group, while heart rate and mean arterial pressure were significantly lower in the observation group (P <0.05). The observation group had lower Visual Analogue Scale scores than the control group 2 h, 12 h, 24h and 48 h after recovery, and higher Ramsay sedation score 30 min, 2 h and 12 h after recovery (P <0.05). Ultrasound-guided FICB combined with general anesthesia under tracheal intubation can significantly ameliorate the vital signs and quality of recovery of elderly patients receiving hip replacement.

Key words: Analgesia, Fascia iliaca compartment block (FICB), Hip replacement

With the increasing aging of the population, hip replacement surgery has also been increasingly applied in clinic, which is an important treatment for femoral neck fractures, femoral head necrosis, osteoarthritis and rheumatoid arthritis[1-3]. These diseases frequently occur in the elderly, and general anesthesia is required during surgery, even intraoperative mechanical ventilation and tracheal intubation for some critically ill patients, posing a great challenge to general anesthesia surgery. Moreover, the elderly are often complicated with such diseases as coagulation dysfunction, cerebral infarction, diabetes, heart diseases and hypertension[4-6]. As a result, the surgery becomes more difficult, and the quality of life during the recovery period and relevant vital signs of patients are affected, which are all important influencing factors for the surgical effect and postoperative rehabilitation status of patients.

Ultrasound-guided fascia iliaca compartment block (FICB) is a commonly used postoperative analgesia mode in clinical practice, which can not only effectively relieve postoperative pain but also reduce cardiovascular adverse events and over-analgesia[7-9]. Ultrasound-guided FICB is also applied in elderly patients following hip replacement. In the present study, we have explored the effects of ultrasound-guided FICB combined with general anesthesia under tracheal intubation on the vital signs and quality of recovery of elderly patients undergoing hip replacement.

Materials and Methods

General data

This study has been approved by the ethics committee of our hospital. Seventy-five elderly patients undergoing hip replacement in our hospital from June 2018 to December 2019 were enrolled as subjects. The inclusion criteria were as follows: (i) patients aged above 60 years; (ii) those undergoing unilateral total hip replacement; (iii) those who signed the informed consent form; and (iv) those in American Society of Anesthesiologists (ASA) grade I-II.

The exclusion criteria were: (i) patients complicated with coagulation dysfunction or hematological system diseases; (ii) those complicated with dysfunction or serious diseases of important organs (such as heart, liver or kidney) or systems

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before operation; (iii) those unable to communicate with people normally due to psychosis or cognitive dysfunction; (iv) those with allergy or contraindication to relevant drugs or surgery; (v) those with a history of lumbar surgery or symptoms of nerve compression due to lumbar disc herniation; or (vi) those complicated with systemic infection or infection at the puncture site. The dropout criteria included: (i) patients who died postoperatively or failed surgery, or (ii) those with severe postoperative complications.

Eligible subjects were randomly divided into observation group (n=38) and control group (n=37), and their general data were collected. In the observation group, there were 22 males and 16 females aged 62-83 years, with an average of (71.4±7.7) years. The lesions were on the left side in 21 cases and on the right side in 17 cases. Femoral neck fractures, femoral head necrosis, osteoarthritis, rheumatoid arthritis and other diseases occurred in 19 cases, 8 cases, 2 cases, 6 cases and 3 cases, respectively. In terms of ASA grade, there were 7 cases in grade I and 31 cases in grade II. In control group, there were 24 males and 13 females aged 61-80 years, with an average of (69.7±8.2) years. The lesions were on the left side in 19 cases and on the right side in 18 cases. Femoral neck fractures, femoral head necrosis, osteoarthritis, rheumatoid arthritis and other diseases occurred in 15, 11, 3, 7 and 2 cases, respectively. In terms of ASA grade, there were 5 cases in grade I and 32 cases in grade II. The general data had no statistically significant differences and were comparable between the two groups (P >0.05). The selection, grouping and intervention of subjects were all in accordance with the *World Medical Association Declaration of Helsinki*.

Methods

All patients received relevant examinations after admission. They were given general anesthesia under tracheal intubation and routine postoperative patient-controlled intravenous analgesia. Anesthesia procedures were shown as follows: After routine preoperative fasting and confirming the stability of vital signs and indicators, the operation was performed. The vital signs, including blood oxygen saturation (SpO_2), heart rate (HR), pulse, respiration, and blood pressure, were continuously monitored after the patient entered the operating room. Then venous access was opened, through which dexmedetomidine (0.3 μg/kg) was pumped within 10 min, and remifentanil (1.0 μg/kg), propofol (1.0-2.0 mg/kg) and cisatracurium (0.2 mg/kg) were injected 20 min later for anesthesia induction, followed by general anesthesia under tracheal intubation with inhalation of 1.0% sevoflurane. Anesthesia was maintained with continuous pump infusion of sufentanil [0.05-0.2 μg/(kg·h)], continuous inhalation of 2-4% sevoflurane, and intermittent injection of cisatracurium (2 mg/time). The concentration of sevoflurane and the dosage of sufentanil should be controlled according to the patient's HR, blood pressure and bispectral index (BIS). Besides, postoperative analgesia was usually performed for two consecutive days with a mechanical ("foolproof") analgesia pump. The analgesic drug formula was 100 μg of sufentanil and 10 mg of tropisetron added to 100 mL of normal saline, with a maximum dose of 10 mL/h, a locking time of 15 min, a self-controlled rate of 1 mL each time, a background rate of 2 mL/h, and a loading dose of 4 mL. If the patient had mild pain and infusion at the background rate could maintain comfort, the analgesia pump could be withdrawn in advance before the drugs in the pump were used up. Additionally, ultrasound-guided FICB was conducted on the affected side after anesthesia in observation group[7,8], specifically as follows: The ultrasonic probe was placed parallel to the groin of the patient in a supine position. The iliac fascia, iliac muscle, sartorius muscle, tensor fasciae latae, femoral nerve and femoral artery were found under the guidance of ultrasound, and the optimal puncture site was determined. Then the iliac fascia was punctured with a 24 G puncture needle at an angle of 30° to the skin, and 2 mL of normal saline was injected after there was no blood return. If normal saline diffused well, 30 mL of 0.375% ropivacaine was injected, and its diffusion was observed. Tramadol was used for postoperative rescue analgesia among patients with a Visual analogue scale (VAS) score >4 points.

Observation indicators

(i) Anesthesia- and operation-related indicators, including recovery time (the time from anesthetic withdrawal to eye opening), operation time (min), extubation time (the time from anesthetic withdrawal to tracheal extubation), and hospitalization time (d), were compared between the two groups. (ii) Vital signs [SpO_2, HR, and mean arterial pressure (MAP)] were observed at 30 min after entering the anesthesia

recovery room, at the time of incision suture, at 1 min before skin cutting, and at the time of tracheal intubation. (iii) The incidence of adverse reactions (post-recovery respiratory depression, nausea, restlessness and vomiting) was observed. (iv) Analgesia satisfaction was recorded. (v) VAS and Ramsay sedation scores were evaluated before anesthesia and at 30 min, 2, 12, 24 and 48 h after recovery. The Ramsay sedation scoring criteria were as follows: 6 points: somnolence and no response to stimulus, 5 points: somnolence and slow response to shouting, 4 points: somnolence and quick response to shouting, 3 points: able to fall asleep and follow instructions, 2 points: with the ability of orientation, and able to keep calm and cooperate, and 1 point: anxious or agitated. A Ramsay sedation score of 5-6 points and 2-4 points indicated excessive sedation and satisfactory sedation, respectively. Besides, the VAS score ranged from 0 (no pain) to 10 points (severe pain).

Statistical analysis

SPSS 20.0 software was used for statistical analysis. The measurement data were subjected to the *t*-test or repeated measures analysis of variance and described by mean ± standard deviation ($\bar{x} \pm s$), and the LSD-*t* test was used for pairwise comparison. The count data were subjected to the χ^2 test or exact probability test and described by [n (%)]. The test level was α=0.05.

Results and Discussion

Operation- and anesthesia-related indicators and analgesia satisfaction

Compared with the control group, the hospitalization time, extubation time and recovery time were significantly shortened and the analgesia satisfaction was improved in the observation group (P <0.05) (Table 1).

Changes in intraoperative vital signs

Compared with those at the time of tracheal intubation, SpO_2 significantly declined, while HR and MAP significantly rose in both groups at the other three time points (P <0.05). At the time of incision suture, at 1 min before skin cutting and at 30 min after entering the anesthesia recovery room, SpO_2 was significantly higher in observation group than that in control group, while HR and MAP were significantly lower in observation group than those in control group (P <0.05) (Table 2).

Visual analogue scale (VAS) and Ramsay scores

The VAS score declined in both groups at 30 min, 2, 12, 24 and 48 h after recovery compared with that before anesthesia. The Ramsay sedation score was higher at 30 min, 2 h and 12 h after recovery than that

Table 1 — Operation- and anesthesia-related indicators and analgesia satisfaction ($\bar{x} \pm s$)

Group	n	OT (min)	HT (d)	ET (min)	RT (min)	Analgesia satisfaction [n (%)]
Observation	38	115.6±24.5	14.3±2.1	13.1±6.3	13.9±2.5	36 (94.7)
Control	37	120.7±30.8	16.5±2.6	19.2±9.8	16.3±3.2	32 (86.5)
t/χ^2		0.125	5.627	7.082	6.923	6.368
P		0.783	0.025	0.003	0.008	0.023

[OT, Operation time; HT, Hospitalization time; ET, Extubation time; and RT, Recovery time]

Table 2 — Changes in intraoperative vital signs ($\bar{x} \pm s$)

Group	n	Time point	SpO_2 (%)	HR (beats/min)	MAP (mmHg)
Observation	38	At tracheal intubation	98.35±0.92	77.30±7.87	96.41±9.74
		1 min before skin cutting	97.91±0.85*#	81.22±8.18*#	101.32±9.55*#
		At incision suture	97.74±0.93*#	85.75±8.81*#	104.57±11.34*#
		30 min after entering the recovery room	97.79±0.89*#	84.20±8.58*#	108.20±10.35*#
Control	37	At tracheal intubation	98.26±0.92	76.88±7.83	95.87±9.62
		1 min before skin cutting	97.48±0.95*	85.48±8.85*	106.28±10.17*
		At incision suture	97.07±0.96*	90.30±9.00*	118.71±10.68*
		30 min after entering the recovery room	97.33±0.90*	88.36±8.84*	115.42±12.50*
F			$F_{time\ point}$=6.569, $F_{between\ two\ groups}$=31.305, $F_{interaction}$=53.610	$F_{time\ point}$=18.732, $F_{between\ two\ groups}$=7.912, $F_{interaction}$ =120.467	$F_{time\ point}$=9.467, $F_{between\ two\ groups}$=13.262, $F_{interaction}$=35.342
P			$P_{time\ point}$=0.009, $P_{between\ two\ groups}$<0.001, $P_{interaction}$<0.001	$P_{time\ point}$<0.001, $P_{between\ two\ groups}$<0.001, $P_{interaction}$<0.001	$P_{time\ point}$ <0.001, $P_{between\ two\ groups}$<0.001, $P_{interaction}$ <0.001

[*P <0.05 *vs*. the same group at the time of tracheal intubation, #P <0.05 *vs*. control group at the same time point]

Table 3 — Visual analogue scale (VAS) scores ($\bar{x}$ ± s)

Group	n	Before anesthesia	Period after recovery				
			30	2 h	12 h	24 h	48 h
			VAS scores				
Observation	38	3.27±0.94	0.87±0.21*	1.23±0.30*#	1.74±0.27*#	1.86±0.35*#	1.46±0.42*#
Control	37	3.32±0.98	0.84±0.23*	1.39±0.32*	1.96±0.30*	2.01±0.29*	1.63±0.38*
F			$F_{time\ point}$=19.283, $F_{between\ two\ groups}$=127.364, $F_{interaction}$=256.97				
P			$P_{time\ point}$<0.001, $P_{between\ two\ groups}$<0.001, $P_{interaction}$<0.001				
			Ramsay sedation scores				
Observation	38	2.00±0.00	2.36±0.43*#	2.41±0.32*#	2.42±0.28*#	2.10±0.38	2.05±0.56
Control	37	2.00±0.00	2.10±0.35	1.86±0.68*	1.73±0.81*	2.14±0.63	2.08±0.74
F			$F_{time\ point}$ =15.897, $F_{between\ two\ groups}$ =28.253, $F_{interaction}$ =31.467				
P			$P_{time\ point}$ <0.001, $P_{between\ two\ groups}$ <0.001, $P_{interaction}$ <0.001				

[*P <0.05 *vs*. the same group at the time of tracheal intubation, #P <0.05 *vs*. control group at the same time point]

Table 4 — Incidence of adverse reactions [n (%)]

Group	n	Respiratory depression	Nausea/Vomiting	Rest-lessness	Others	Incidence rate of adverse reactions
Obser-vation	38	4 (10.5)	3 (7.9)	1 (2.6)	2 (5.3)	10 (26.3)
Control	37	3 (8.1)	3 (8.1)	2 (5.4)	1 (2.7)	9 (24.3)
χ^2						0.145
P						0.436

before anesthesia in observation group, whereas it was lower at 2 h and 12 h after recovery than that before anesthesia in control group (P <0.05). Observation group had lower VAS scores than control group at 2, 12, 24 and 48 h after recovery, and higher Ramsay sedation scores than control group at 30 min, 2 h and 12 h after recovery (P <0.05) (Table 3).

Incidence of post-recovery adverse reactions

There was no statistically significant difference in the incidence rate of postoperative adverse reactions between observation group and control group (26.3% *vs*. 24.3%) (χ^2=0.145, P=0.436) (Table 4).

Characterized by high requirements for anesthesia, complicated conditions, many postoperative complications, large blood loss and great surgical trauma, total hip replacement, one of the common clinical orthopedic operations, is the most effective and radical treatment for femoral neck fractures, femoral head necrosis, osteoarthritis and other serious diseases, with the best postoperative recovery. General anesthesia, usually dominated by intraspinal anesthesia, is required during hip replacement, but its clinical application is restricted by some factors, such as perioperative anticoagulation treatment, great hemodynamic fluctuations and sympathetic nerve block[10-12]. Therefore, it is of great significance to search for new methods to avoid these limiting factors or side effects while ensuring the anesthetic effect. Nerve block anesthesia is a commonly used anesthesia technique in clinical practice, which has been widely used in a variety of operations, and the effect of combined use is often better than that of a single method[13-15]. It has been shown that combined nerve block anesthesia also has a good effect in major orthopedic surgery, which can facilitate early postoperative rehabilitation and reduce the dosage of opioid analgesics, greatly relieving perioperative pain[16,17].

In bone joint operations, regional nerve block not only has an obvious analgesic effect but also can reduce stress reactions and enhance the anti-injury ability of the body. However, a large number of local anesthetics are needed to completely block lumbosacral nerves in total hip replacement, inducing many adverse reactions despite better analgesic and anesthetic effects, with more harms than benefits[18-20]. To improve anesthetic and analgesic effects, reduce adverse reactions and achieve targeted medication, the drug should be accurately delivered to the site to be blocked according to the surgical requirements. Ultrasound-guided FICB is an effective method for achieving this goal in hip replacement. Through accurately injecting local anesthetics into potential lacunae among the psoas major muscle, iliopsoas muscle and iliac fascia by means of ultrasonic detection, unnecessary use of local anesthetics can be greatly reduced, the drug diffusion status can be observed, and both analgesic and anesthetic effects can be significantly improved, fully meeting the surgical requirements.

This study demonstrated that ultrasound-guided FICB combined with general anesthesia under tracheal intubation can significantly ameliorate the vital signs and quality of recovery of elderly patients

undergoing hip replacement. To be specific, compared with those in control group, the hospitalization time, extubation time and recovery time were significantly shortened and the analgesia satisfaction was significantly improved in observation group (P <0.05). Compared with those at the time of tracheal intubation, SpO_2 significantly declined, while HR and MAP significantly rose in both groups at the other three time points (P <0.05). At the time of incision suture, at 1 min before skin cutting and at 30 min after entering the anesthesia recovery room, SpO_2 was significantly higher in observation group than that in control group, while HR and MAP were significantly lower in observation group than those in control group (P <0.05). The VAS score declined in both groups at 30 min, 2, 12, 24 and 48 h after recovery compared with that before anesthesia. The Ramsay sedation score was higher at 30 min, 2 h and 12 h after recovery than that before anesthesia in observation group, whereas it was lower at 2 h and 12 h after recovery than that before anesthesia in control group (P <0.05). Observation group had lower VAS scores than control group at 2, 12, 24 and 48 h after recovery, and higher Ramsay sedation scores than control group at 30 min, 2 h and 12 h after recovery (P <0.05). There was no statistically significant difference in the incidence rate of postoperative adverse reactions between observation group and control group (26.3% *vs*. 24.3%) (χ^2=0.145, P=0.436).

Conclusion

The above study on ultrasound-guided fascia iliaca compartment block (FICB) combined with general anesthesia under tracheal intubation can ameliorate operation- and anesthesia-related indicators has shown increased Ramsay sedation score and SpO_2, and reduced visual analogue scale (VAS) score, HR and MAP of elderly patients undergoing hip replacement, without any increase in the incidence of adverse reactions. Nevertheless, this study is limited. The sample size is small, and the findings are obtained from only one medical center.

Conflict of interest

Authors declare no competing interests.

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