

Original Article

Efficacy and safety of ultrasound-guided fascia iliaca compartment block using dexmedetomidine combined with ropivacaine in aged patients undergoing hip replacement

Xiaojun Hua^{1*}, Yongchu Hu^{2*}, Dengliang Chen¹, Yirong Xiao¹, Liming Luo¹

¹Department of Anesthesiology, The 92 th Hospital of Chinese People's Liberation Army, Nanping, Fujian, China;

²Department of Anesthesiology, Shanghai Changzheng Hospital, The Second Military Medical University, Shanghai 200003, China. *Equal contributors and co-first authors.

Received August 20, 2017; Accepted August 29, 2017; Epub December 15, 2017; Published December 30, 2017

Abstract: Objective: To evaluate the efficacy and safety of ultrasound-guided fascia iliaca compartment block (FICB) using dexmedetomidine combined with ropivacaine in aged patients undergoing hip replacement. Methods: Ninety aged patients scheduled for hip replacement surgery with general anesthesia were included in our trial. Patients were randomly divided into three groups: general anesthesia group (group G, n=30), general anesthesia combined with ropivacaine group (group GR, n=30) and general anesthesia combined with ropivacaine + dexmedetomidine group (group GRD, n=30). 0.4% ropivacaine 35 mL in group GR and 0.4% ropivacaine mixed with 1 ug/kg dexmedetomidine 35 mL in group GRD were injected into fascia iliaca compartment before 25 min of the induction of anesthesia. The comparison of heart rate (HR) and mean arterial pressure (MAP) at the time of 5 min, 10 min, 30 min, 60 min and 90 min after block and extubation, consumption of opioids, mental condition after extubation, analgesic effect at the time of 8 h, 16 h and 24 h after surgery (VAS scores), the number of patients with additional analgesics after surgery and incidence of adverse effects were carried in all the patients. Results: Compared with group G and GR, the HR and MAP in group GRD were more stable. The consumption of opioids was less in group GRD than in group G and GR ($P=0.0026$ and $P=0.0369$). The VAS score of patients in group GRD were in the low level at the following time points (8 h, 16 h and 24 h) after operation and there were fewer patients with additional tramadol than the group G ($P=0.0003$) and the group GR ($P=0.0074$). The mental condition of patients in group GRD was steady with lower frequency of emergence agitation than the other two groups ($P=0.0004$ and $P=0.0021$). The incidence of nausea and vomiting and respiratory depression in group GRD was significantly lower than that in the group G ($P<0.01$) and group GR ($P<0.05$). Conclusions: Ultrasound-guided FICB using dexmedetomidine combined with ropivacaine applied in aged patients undergoing hip replacement offers satisfactory sedative and analgesic effects. So it may be a safe, effective and economical method for multimodal analgesia and deserves to be widely used in clinic.

Keywords: Ultrasound-guided, dexmedetomidine, ropivacaine, fascia iliaca compartment block, the aged, hip replacement

Introduction

Currently, hip replacement is an effective clinical treatment for the related osteoarticular diseases and has been a reliable technique after many years' clinical exploration [1, 2]. Whereas, the most patients who received hip replacement were in the elder stage and accompanied with many obstacles which were the degeneration of body functions, organ dysfunction and majority of complications. Thus, this was still a

great challenge to the patients' management and analgesia in the perioperative period [3, 4].

Lumbar plexus block was applied in hip surgery obtaining satisfactory analgesia effort. What's more, fascia iliaca compartment block (FICB), which could act on femoral nerve, lateral femoral cutaneous nerve and obturator nerve simultaneously, was one of the most often carried analgesia method with the doctors' and patients' unanimous recognition. When it

Ultrasound-guided fascia iliaca compartment block in aged patients

was operated in the old ways with many complications, such as inaccurate positioning, block defectively and injury of blood vessels and nerves, so the popularity of FICB in clinic was limited [5, 6]. In our trail, ultrasound-guided FICB, which is with the advantages of safe and convenient operation and significant effect, was applied in aged patients to replace the old ways avoiding majority of complications.

The conventional administration of FICB was ropivacaine with the concentration of 0.4%. Although it took much advantages relative to the general anesthesia, there were also many complications, such as high incidence of nausea and vomiting and postoperative restlessness etc., demanding prompt solution [7]. Dexmedetomidine, with certain analgesic effect, was commonly applied in clinical sedation, and routining vein administration has gained favourable clinical effects. However, this way for administration was often with many complications, for example hypotension and bradycardia etc., which was a great risk for the aged [8, 9]. So the combination of dexmedetomidine and ropivacaine which was applied in the elderly FICB maybe achieve desired result: improving the analgesic effect of each other, deepening the level of sedation and avoiding the obvious complications of medicines, and was thought to be safe and effective. However, the specific clinical trail results were unclear and need to be further identified [10, 11].

Therefore, the trail was carried to explore the efficacy and safety ultrasound-guided FICB using dexmedetomidine combined with ropivacaine in aged patients undergoing hip replacement, to provide a new mindset for clinical analgesia and detailed references for the future popularization of the method in clinic.

Methods and patients

Patients

The hospital ethics committee approval was obtained in this trail and informed consent forms were signed with the patients or relatives. For calculation of sample size, the visual analog scale (VAS) was used as the primary endpoint index. The difference of VAS score was estimated as 1.5 between groups and standard deviation was also 1.5 retrieving from the related literature [12]. Meanwhile, alpha

error was considered as 0.05 and power was 90% for this study. Finally, the sample size was calculated as twenty-four in every group. Just in case, such as lost to follow-up or patients' quit, additional six patients were included in every group. Patients, who were scheduled for hip replacement surgery with general anesthesia from September 2012 to September 2016 in our hospital, were included in our trail. The included patients must meet the following criteria: patients or family members volunteered to participate in this experiment, age from 60 to 75, American Society of Anesthesiologists (ASA) physical status I to II and without critical organ diseases (such as hypertension, coronary heart disease, diabetes and renal insufficiency etc.). Excluded criteria: local anesthetic anaphylaxis, existing infection in the site of puncture or surrounding area, cognitive impairment, condition deteriorated sharply and serious complications. Ninety patients were assigned to three groups (30 each) by the random number table: general anesthesia group (group G), general anesthesia combined with ropivacaine group (group GR) and general anesthesia combined with ropivacaine + dexmedetomidine group (group GRD).

Puncture method

The routine monitoring of electrocardiography (ECG), blood pressure (BP) and saturation of pulse oximetry (SpO₂) were carried when the patients entered the operating room. Then, intravenous access was obtained and arterial puncture was performed to monitor the arterial blood pressure in real time. FICB was implemented before 25 min of the induction of anesthesia. Patients were placed in supine position with drawing a line between the pubic tubercle and the anterior superior iliac spine. The line was divided into 3 equal parts and the junction of the middle and lateral thirds was identified. And the local anaesthesia was performed with 1 mL 2% lidocaine in this point. And then, the ultrasonic probe (HFL 38×/13-6MHz, SonoSite, America) was located in the inguinal region to obtain sharp ultrasonic image of femoral artery cross section. Afterwards, the echo area of fascia lata, fascia iliaca and iliopsoas were identified from the outer regions. Under the guidance of ultrasound, syringe needle arrived the acute location and 3-5 mL saline was injected. If the fluid diffused along the interval evidently,

Ultrasound-guided fascia iliaca compartment block in aged patients

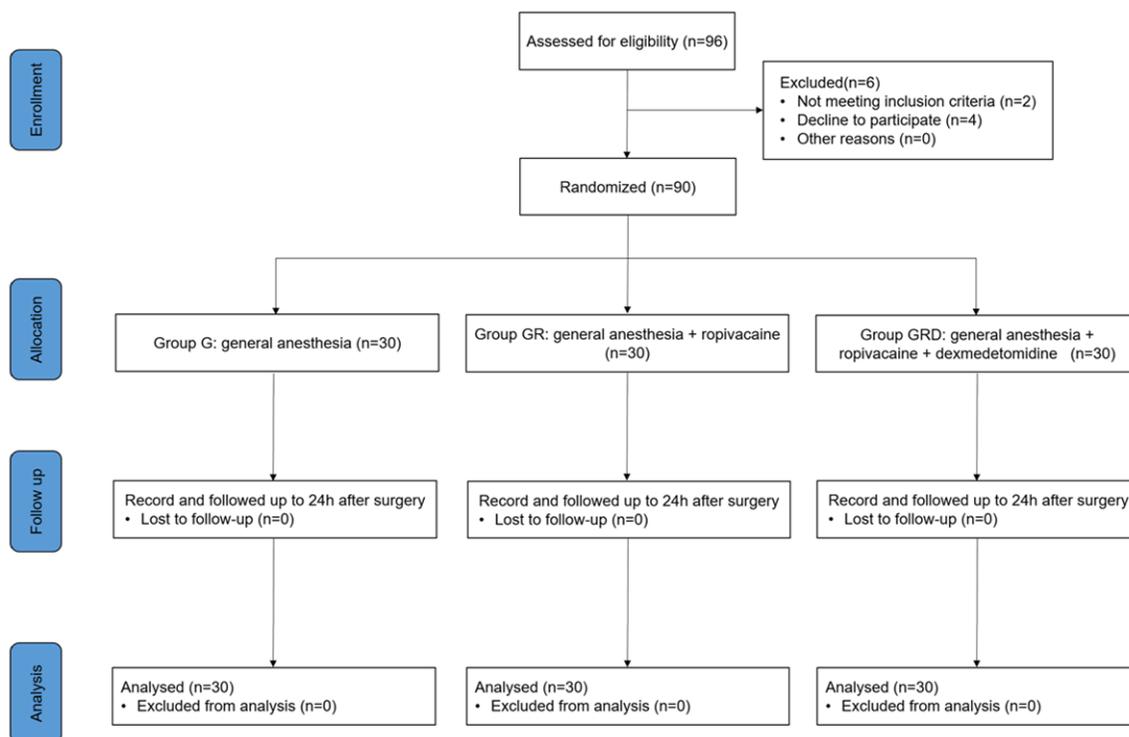


Figure 1. Flow chart of patients' recruitment.

it meant the puncture was successful. The patients in group GR were administrated with 35 mL 0.4% ropivacaine and the patients in group GRD were injected with the same volume of 0.4% ropivacaine mixed with 1 ug/kg dexmedetomidine. 25 min later, the induction of anaesthesia which included 0.03 mg/kg midazolam, 0.3 ug/kg sufentanil, 200 ug/kg etomidate and 0.6 mg/kg rocuronium bromide, was implemented in the three groups of patients. All the patients received intravenous patient controlled analgesia pump, including sufentanil (1 mL : 0.05 mg), azasetron (4 mL : 20 mg), dezocine (3 mL : 15 mg) and saline (92 mL). When the pain was too intense to endure, the patients were administrated intravenous tramadol 100 mg.

Assessment index

The cardiovascular indicators, including heart rate (HR) and mean arterial pressure (MAP), were observed and compared at the time of 5 min, 10 min, 30 min, 60 min and 90 min after block and extubation. Total consumption of opioids of every patient was recorded in the trail as an important indicator. The analgesic effect

was assessed using a visual analog scale (VAS, 0-10), which a 0 meant no pain and a 10 meant the worst pain imaginable, in the time of 8 h, 16 h and 24 h postoperatively [13, 14]. The abnormal mental state was also noted, such as emergence agitation (an extremely excited, inappropriate action in the period of anesthesia recovery) and somnolence etc. Meanwhile the number of patients with additional analgesics after surgery and incidence of adverse effects, including nausea and vomiting, respiratory depression (mainly manifested as slower respiratory rate and decreased tidal volume) and cardiovascular complications (including hypotension, bradycardia and tachycardia etc.), were also collected.

Statistical analysis

All the calculations were conducted using SPSS 19.0 software (IBM, NY, USA), and data charts were made using Prism 6.0 (GraphPad Software, Inc., San Diego, USA). All the measurement data were expressed as mean \pm standard deviation ($\bar{x} \pm SD$) and statistical analyses were performed using SNK test or one-way analysis of variance. All the enumeration data

Ultrasound-guided fascia iliaca compartment block in aged patients

Table 1. Demographic characteristics of patients in the three groups

Group	n	Sex (n)		Age (y)	BMI (kg/m ²)	ASA		Operation time (min)	Anesthesia time (min)
		Male	Female			I	II		
G	30	17	13	69.23±4.03	23.74±2.21	11	19	87.03±10.24	140.8±12.30
GR	30	18	12	68.67±4.40	22.64±2.35	9	21	89.00±12.51	143.9±11.21
GRD	30	18	12	69.30±4.45	22.80±2.23	13	17	87.53±10.69	144.4±13.99
Statistic		$\chi^2=0.09$		F=0.20	F=2.06	$\chi^2=1.15$		F=0.25	F=0.72
P		0.96		0.82	0.13	0.56		0.78	0.49

were expressed as percentage (%) and statistical analyses were performed with χ^2 test. A P value of <0.05 was considered to indicate a statistically significant difference.

Results

No statistically significant difference among the three groups about the patients' demographic data

Initially, Ninety-six patients were enrolled in our trial. Thereinto, two patients were excluded due to age above 75 and four patients refused to participate in this study. Finally, information of the remaining 90 patients in three groups (n=30) were analyzed (**Figure 1**), including fifty-three men and thirty-seven women.

There was no marked difference in the comparison of patients' baseline information, including sex (P=0.96), age (P=0.82), BMI (P=0.13), ASA (P=0.56), operation time (P=0.96) and anesthesia time (P=0.49) (**Table 1**).

The values of HR and MAP were more stable in group GRD

There were no significant difference in the three groups of HR and MAP at the initial stage, including 5 min and 10 min after block (P>0.05). At the beginning of the operation, which was 30 min after block, the two measures in the group G and group GR elevated significantly and the rose was more clearly in group G. Under the influence of favourable analgesia and sedation, the two indices in group GRD didn't rise markedly. During the operation, 60 min and 90 min after block, the value of HR and MAP in the former two groups was apparently higher than the group GRD. In the stimulus of the tubule, the cardiovascular indicators in group G and group GR increased drastically, but the related indices in group GRD were still in stable condition.

The detailed variation was shown in **Figures 2, 3**.

The consumption of analgesics was further decreased in group GRD

As is shown in **Table 2**, the application of ropivacaine in FICB decreased the intraoperative dosage of sufentanil significantly (P=0.0064). However, when dexmedetomidine was added in the blocking compound, the usage of sufentanil was further reduced compared with the simple ropivacaine (P=0.0369). The number of patients with twice additional tramadol in group GR was notably more than the other two groups (P=0.0321 and P=0.0149). Nevertheless, the number of patients with more than thrice additional tramadol in group GR and group GRD was evidently less than the group G (P=0.0062 and P=0.0002). In terms of total additional tramadol, there was no statistical difference between the group G and group GR (P=0.2373), but the number of additional tramadol was significantly less than the above two groups (P=0.0003 and P=0.0074).

Group GRD were assessed with the lower post-operative VAS pain scores

The VAS score in the 8 h after operation, it was lower in the group GR than the group G (P=0.0232) and distinctly lower in the group GRD than the group G (P=0.0089). But the difference between group GR and group GRD was unobvious (P=0.1203). In the 16 h postoperatively, the VAS scores in the three groups were all increased to a certain extent. Thereinto, there was no significant difference between the group G and group GR (P=0.0513), whereas the score in group GRD was evidently lower than the other two groups (P=0.0017 and P=0.0075). However, the scores in the three groups were all visibly decreased and there was no signifi-

Ultrasound-guided fascia iliaca compartment block in aged patients

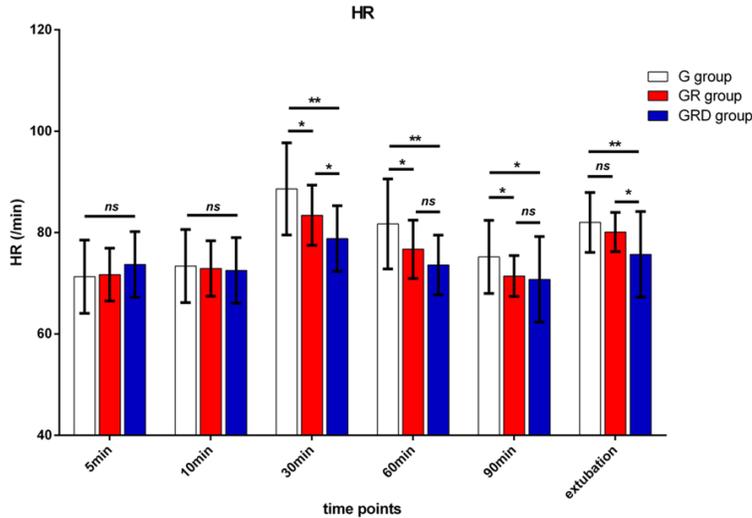


Figure 2. The comparison of HR in different time points. G group, general anesthesia group; GR group, general anesthesia combined with ropivacaine group; GRD group, general anesthesia combined with ropivacaine + dexmedetomidine group. ns, $P > 0.05$; * $P < 0.05$; ** $P < 0.01$.

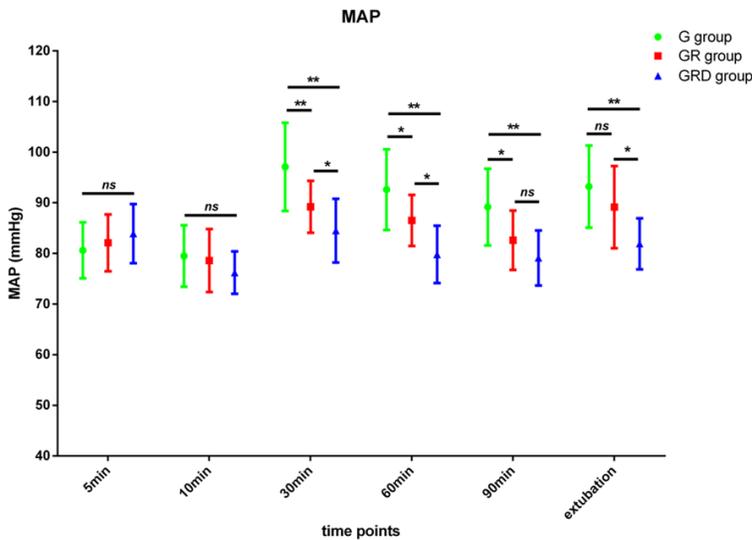


Figure 3. The comparison of MAP in different time points. G group, general anesthesia group; GR group, general anesthesia combined with ropivacaine group; GRD group, general anesthesia combined with ropivacaine + dexmedetomidine group. ns, $P > 0.05$; * $P < 0.05$; ** $P < 0.01$.

cant difference among the three groups ($P > 0.05$, **Table 3**).

The application of mixture ropivacaine and dexmedetomidine improved the patients' status in recovery and decreased the incidence of complications

In the period of recovery, the incidence of agitation in group GRD was apparently lower than

the group G ($P = 0.0004$) and group GR ($P = 0.0021$). As regards the complications, the occurrence rates of nausea, vomiting and respiratory depression were obviously higher in group G than in the group GRD ($P = 0.0025$), and the incidence in group GR was also higher than group GRD ($P = 0.0257$), but there was no evidently difference between the group G and group GR. Regarding to delirium (3/3/4) and cardiovascular complications (6/5/8), there was no statistical difference ($P > 0.05$, **Table 4**).

Discussion

With the gradual decline of the physical function, the incidence of osteoarthropathy in the elderly is constantly increased. As a safe and effective therapeutic method, hip replacement of the aged has been popular in clinical practice. However, due to the pain and other side effects of the operation, the intraoperative state and postoperative rehabilitation of the patients are greatly influenced [15, 16]. Concerning of this thorny problem, the safe and effective multimodal analgesia method has been explored in clinic. Pain after hip replacement is mainly controlled by the branch of the hip joint of the femoral nerve and nervus cutaneus femoris lateralis, which are both influenced by the FICB.

Then, FICB is deserved to be applied in the multimodal analgesia method [17].

There are many defects, such as inaccurate positioning, incomplete block and many complications etc., to perform FICB in the traditional model, causing further injury to the patients and losing the actual meaning of this operation [18]. In our study, the acute iliac fascial gap localization was carried with ultrasound-guided

Ultrasound-guided fascia iliaca compartment block in aged patients

Table 2. The consumption of analgesics and number of patients with additional tramadol

Group	n	Times with additional tramadol [n (%)]				
		Sufentanil (ug)	One time	Two times	Three times	Total
G	30	46.43±5.44	8 (26.7)	7 (23.3)	15 (50.0)	30 (100.0)
GR	30	40.00±5.07**	7 (23.3)	15 (50.0)*	5 (16.7)**	27 (90.0)
GRD	30	36.20±5.42**,#	10 (33.3)	6 (20.0)#	1 (3.3)**	17 (56.7)**,##
P		0.0064 ^①	1.0000 ^①	0.0321 ^①	0.0062 ^①	0.2373 ^①
		0.0026 ^②	0.7787 ^②	0.7540 ^②	0.0002 ^②	0.0003 ^②
		0.0369 ^③	0.5675 ^③	0.0149 ^③	0.1945 ^③	0.0074 ^③

Note: ^①group GR vs group G, *P<0.05, **P<0.01; ^②group GRD vs group G, **P<0.01; ^③group GRD vs group GR, #P<0.05, ##P<0.01.

Table 3. The VAS score in different postoperative time points

Group	n	8 h	16 h	24 h
G	30	1.80±0.89	5.30±1.44	2.50±1.04
GR	30	1.10±0.71*	4.50±1.53	2.30±0.92
GRD	30	0.80±0.76**	2.30±0.92**,#	2.20±0.89
P		0.0232 ^①	0.0513 ^①	0.4329 ^①
		0.0089 ^②	0.0017 ^②	0.2347 ^②
		0.1203 ^③	0.0075 ^③	0.6689 ^③

Note: ^①group GR vs group G, *P<0.05; ^②group GRD vs group G, **P<0.01; ^③group GRD vs group GR, ##P<0.01.

to reach simple, safe and convenient block and it effectively reduced the pain caused by the operation [19]. Previous studies have tried to inject the simple local anesthetics (ropivacaine) for analgesia receiving proper curative effect, but there were also many adverse effects, such as emergence agitation and unstable cardiovascular index etc [10, 20].

Dexmedetomidine, as a highly selective α_2 -adrenoreceptor agonist, has been widely used in clinical intravenous administration with the advantage of high security and significant sedation, and it's also gradually recommended as the adjuvant medication for single nerve block [21]. However, there is still no concrete conclusion about the specific adjuvant analgesic effect and the inhibitory effect on mental agitation of dexmedetomidine. The main thought of this trail was that dexmedetomidine would be absorbed into blood when it was injected into the iliac fascial gap mixed with local anesthetics. Then the α_2 epinephrine receptor on the back of the spinal cord would be activated to prevent the transmission of pain to the central nervous system, and it also could exert anal-

gesic effect through non-receptor dependent pathway to enhance the analgesic effect of ropivacaine. Moreover, dexmedetomidine also shown the central nervous sedation binding to the α_2 epinephrine receptor on the blue spot [22, 23].

In this trail, during the period from the onset of block to the beginning of the operation, there were

no significant difference among the three groups in the HR and MAP indicating that the simple FICB didn't affect the patient's cardiovascular indices. At 30 min after FICB, due to surgical stimulation, the cardiovascular indices elevated obviously in the group G and group GR, but the related parameters in the group GRD were still in a stable state because of the satisfactory analgesia and sedation. Under the continuous operation stimulation, the values of HR and MAP in the former two groups were evidently higher than the basic state of the body and the group GRD. In the stage of extubation, the intense cardiovascular response was shown in the group with the simple general anaesthesia and the response was restrictively relieved in the group GR. Nevertheless, the strong cardiovascular response was significantly alleviated in the group GRD. In the whole perioperative period, the cardiovascular indices of patients in group GRD tended to be a stable condition, which was an excellent protection measure.

Because of the intense pain in the operation, a large amount of sufentanil was consumed in group G to alleviate pain. When the general anaesthesia combined with local anaesthesia, the consumption of sufentanil was evidently decreased with favorable analgesic effect. Based on the above, when dexmedetomidine was added into the local anesthetics, the dosage of sufentanil was further reduced and it was also declined of the occurrence of complications from the application of opioids. With the gradual metabolism of anaesthetics, the problems of postoperative pain was urgent to be solved with analgesics. In the group G with incomplete analgesia, all the patients had the additional

Ultrasound-guided fascia iliaca compartment block in aged patients

Table 4. The state of recovery and incidence of complications [n (%)]

Group	n	Emergence agitation	Somnolence	Nausea and vomiting	Respiratory depression	Cardiovascular complications
G	30	15 (50.0)	3 (10.0)	11 (36.7)	14 (46.7)	6 (20.0)
GR	30	13 (43.3)	3 (10.0)	8 (26.7)	11 (36.7)	7 (23.3)
GRD	30	2 (6.7)**##	4 (13.3)	1 (3.3)**,#	3 (10.0)**#	6 (20.0)
P		0.7961 ^①	1.0000 ^①	0.4051 ^①	0.4321 ^①	0.7540 ^①
		0.0004 ^②	1.0000 ^②	0.0025 ^②	0.0034 ^②	1.0000 ^②
		0.0021 ^③	1.0000 ^③	0.0257 ^③	0.0303 ^③	0.7540 ^③

Note: ^①group GR vs ^②group G; group GRD vs group G, ** $P < 0.01$; ^③group GRD vs group GR, * $P < 0.05$, ## $P < 0.01$.

tramadol and the number of patients with additional analgesic more than three times was apparently more than the other groups. Post-operative tramadol supplemental rate in group GRD (56.7%) was much lower than that in the group G (100%) and group GR (90.0%). As is shown in **Table 3**, the postoperative VAS score in group GRD was overtly smaller than that in the other two groups. The above results showed that the combination of ropivacaine and dexmedetomidine applied in FICB could exhibit perfect analgesic effect and sustain a long time, which evidently decreased the consumption of analgesics in the perioperation.

During the awakening period of hip arthroplasty, patients would show the obvious emotional turmoil due to the strong pain stimulus, and even the obviously abnormal cardiovascular indices and hypoxia were observed in the patients with severe pain which was a terrific damage to the patients. In our study, there were many patients with the condition of emergence agitation in the group G and group GR, but the number of patients with the related complications was significantly decreased when dexmedetomidine was mixed into the local anesthetic. There were fewer patients in the group GRD than the other two groups concerning of the occurrence of nausea and vomiting, emergence agitation and respiratory depression caused by the use of opioids. But there was no statistical difference among the three groups in other complications, such as somnolence and cardiovascular anomalies etc.

In conclusion, ultrasound-guided FICB using dexmedetomidine combined with ropivacaine in aged patients undergoing hip replacement could maintain the patient's cardiovascular indices in the stable condition, decrease the

consumption of analgesics in the whole perioperation period and reduce the incidence of complications. So it may be a safe, effective and economical method for multimodal analgesia and deserves to be widely used in clinic.

Disclosure of conflict of interest

None.

Address correspondence to: Liming Luo, Department of Anesthesiology, The 92 th Hospital of Chinese People's Liberation Army, 99 North Binjiang Road, Nanping 353000, Fujian, China. Tel: +86-1896069-2118; Fax: +86-599-6987313; E-mail: llming92yy@163.com

References

- [1] Dargel J, Oppermann J, Bruggemann GP and Eysel P. Dislocation following total hip replacement. *Dtsch Arztebl Int* 2014; 111: 884-890.
- [2] Liu G, Guo T, Zhang Y, Liu N, Chen J, Chen J, Zhang J and Zhao J. Apoptotic pathways of macrophages within osteolytic interface membrane in periprosthetic osteolysis after total hip replacement. *Apmis* 2017; 125: 565-578.
- [3] Forster-Horvath C, Egloff C, Valderrabano V and Nowakowski AM. The painful primary hip replacement - review of the literature. *Swiss Med Wkly* 2014; 144: w13974.
- [4] Renner L, Drwal V and Boettner F. [Hip replacement in patients with neuromuscular disorders]. *Orthopade* 2015; 44: 546-554.
- [5] Dalens B, Vanneuville G and Tanguy A. Comparison of the fascia iliaca compartment block with the 3-in-1 block in children. *Anesth Analg* 1989; 69: 705-713.
- [6] Neubrand TL, Roswell K, Deakyne S, Kocher K and Wathen J. Fascia iliaca compartment nerve block versus systemic pain control for acute femur fractures in the pediatric emergency department. *Pediatr Emerg Care* 2014; 30: 469-473.
- [7] Groot L, Dijkman LM, Simons MP, Zwartsenburg MM and Rebel JR. Single fascia iliaca compartment block is safe and effective for emergency pain relief in Hip-fracture patients. *West J Emerg Med* 2015; 16: 1188-1193.
- [8] Devasya A and Sarpangala M. Dexmedetomidine: a review of a newer sedative in dentistry. *J Clin Pediatr Dent* 2015; 39: 401-409.

Ultrasound-guided fascia iliaca compartment block in aged patients

- [9] Keating GM. Dexmedetomidine: a review of its use for sedation in the intensive care setting. *Drugs* 2015; 75: 1119-1130.
- [10] Sun K, Jin M and Yang Q. Clinical effect of fascia iliaca compartment block with dexmedetomidine combined with ropivacaine for preventing emergence agitation in elderly patients after hip arthroplasty. *The Journal of Practical Medicine* 2016; 32: 3769-3771.
- [11] Zhang Q, Cheng F, Wan J and Yan F. Effects of dexmedetomidine combined with ropivacaine in fascia iliaca compartment block for postoperative analgesia after elderly patients femoral surgery. *J Med Theor & Prac* 2017; 30: 1264-1266.
- [12] Rahimzadeh P, Imani F, Sayarifard A, Sayarifard S and Faiz SH. Ultrasound-guided fascia iliaca compartment block in orthopedic fractures: bupivacaine 0.2% or 0.3%? *Med J Islam Repub Iran* 2016; 30: 433.
- [13] Wu J, Chen Y and Luo Y. Evaluation of the visual analog score (VAS) to assess acute mountain sickness (AMS) in a hypobaric chamber. *PLoS One* 2014; 9: e113376.
- [14] Hawker GA, Mian S, Kendzerska T and French M. Measures of adult pain: visual analog scale for pain (VAS Pain), numeric rating scale for pain (NRS Pain), McGill pain questionnaire (MPQ), Short-Form McGill pain questionnaire (SF-MPQ), chronic pain grade scale (CPGS), Short Form-36 bodily pain scale (SF-36 BPS), and measure of intermittent and constant osteoarthritis pain (ICOAP). *Arthritis Care Res (Hoboken)* 2011; 63 Suppl 11: S240-252.
- [15] Ilchmann T. Approaches for primary total hip replacement. *Hip Int* 2014; 24 Suppl 10: S2-6.
- [16] Nystad TW, Furnes O, Havelin LI, Skredderstuen AK, Lie SA and Fevang BT. Hip replacement surgery in patients with ankylosing spondylitis. *Ann Rheum Dis* 2014; 73: 1194-1197.
- [17] Fujihara Y, Fukunishi S, Nishio S, Miura J, Koyanagi S and Yoshiya S. Fascia iliaca compartment block: its efficacy in pain control for patients with proximal femoral fracture. *J Orthop Sci* 2013; 18: 793-797.
- [18] Gallardo J, Contreras-Dominguez V, Begazo H, Chavez J, Rodriguez R and Monardes A. [Efficacy of the fascia iliaca compartment block vs continuous epidural infusion for analgesia following total knee replacement surgery]. *Rev Esp Anesthesiol Reanim* 2011; 58: 493-498.
- [19] Foss NB, Kristensen BB, Bundgaard M, Bak M, Heiring C, Virkelyst C, Hougaard S and Kehlet H. Fascia iliaca compartment blockade for acute pain control in hip fracture patients: a randomized, placebo-controlled trial. *Anesthesiology* 2007; 106: 773-778.
- [20] Lei G, Wu W, Li P, Zhang L and Wu G. The efficacy of ultrasound-guided continuous iliaca fascia space block for postoperative analgesia in elderly patients undergoing total hip replacement. *PRACTICAL JOURNAL OF CLINICAL MEDICINE* 2016; 13: 114-117.
- [21] Gerresheim G and Schwemmer U. [Dexmedetomidine]. *Anaesthesist* 2013; 62: 661-674.
- [22] Kunisawa T, Ota M, Suzuki A, Takahata O and Iwasaki H. Combination of high-dose dexmedetomidine sedation and fascia iliaca compartment block for hip fracture surgery. *J Clin Anesth* 2010; 22: 196-200.
- [23] Pasin L, Greco T, Feltracco P, Vittorio A, Neto CN, Cabrini L, Landoni G, Finco G and Zangrillo A. Dexmedetomidine as a sedative agent in critically ill patients: a meta-analysis of randomized controlled trials. *PLoS One* 2013; 8: e82913.