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Analysis of the Analgesic Effect of Dexmedetomidine Combined with Ropivacaine Retractor Tube Block After Total Knee Arthroplasty

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Abstract: *Objective:* This paper aims to explore and analyze the analgesic effect of dexmedetomidine combined with ropivacaine retractor tube block after total knee arthroplasty. *Methods:* The study period was from January 2023 to July 2023. 50 patients admitted to our hospital after total knee arthroplasty were selected as the study subjects, and were divided into the study group (n = 25) and the control group (n = 25) according to double-blind method. The study group was given dexmedetomidine combined with ropivacaine and the control group was given ropivacaine. The analgesic effect and hemodynamic indexes were compared between the groups. *Results:* At 3 hours postoperatively, the analgesic effects of resting numeric rating scale (NRS) score and activity NRS score between the groups were compared, and the difference was not statistically significant ($P > 0.05$). At 12 hours and 24 hours postoperatively, the resting NRS score and activity NRS score of the study group were significantly better than those of the control group, and the difference was statistically significant ($P < 0.05$). Before treatment, hemodynamic indexes such as output per beat, cardiac output, cardiac index, and other hemodynamic indexes were compared between the groups, the difference was not statistically significant ($P > 0.05$). After treatment, hemodynamic indexes such as output per beat, cardiac output, cardiac index, and other hemodynamic indexes of the study group were significantly better than those of the control group, the difference was statistically significant ($P < 0.05$). *Conclusion:* Dexmedetomidine combined with ropivacaine retractor block has better analgesic effect after total knee arthroplasty, and it can be widely used and promoted in the clinic.

Keywords: Dexmedetomidine combined with ropivacaine; Retractor tube block; Total knee arthroplasty; Analgesic effect

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1. Introduction

Surgery is needed to treat knee diseases that are ineffective with conservative treatment, but the damaged knee joint cannot be recovered. For the knee joint to function normally, an artificial prosthesis is needed instead of the articular cartilage, i.e., knee arthroplasty, of which total knee arthroplasty is one type [1]. Total knee arthroplasty is

a large operation, which is very traumatic and can easily damage the nerves of the leg, and the patients' pain level after the operation is very severe, thus it is necessary to reduce the postoperative pain, which has a certain positive significance on the postoperative rehabilitation and patients' quality of life [2]. Ultrasound-guided retractor tube block has a certain inhibitory effect on postoperative pain, and the commonly used drug for this anesthesia method is ropivacaine, which can prolong the duration of the block, and its combined application with dexmedetomidine can strengthen the effect on postoperative pain [3]. This drug is a new type of adrenergic receptor agonist with an excellent sedative effect, which can effectively reduce postoperative pain [4]. The purpose of this paper is to study and analyze the analgesic effect of dexmedetomidine combined with ropivacaine retractor tube block after total knee arthroplasty.

2. Materials and methods

2.1. General information

The study period was from January 2023 to July 2023. 50 cases of post-total knee replacement patients admitted to our hospital were selected as the study subjects and grouped according to the double-blind method into study group (n = 25) and control group (n = 25). There were 11 male patients and 14 female patients in the study group, their ages were 55–75 years old, with a mean age of 65.98 ± 2.48 years. In the control group, there were 10 male patients and 15 female patients, with age range of 55–78 years and mean age of 66.05 ± 2.53 years. Comparing the general information of gender and age between the groups, the difference was not statistically significant ($P > 0.05$).

Inclusion criteria included total knee arthroplasty patients, and patients with informed consent.

Exclusion criteria were patients with blood system diseases, patients with autoimmune diseases, and patients with psychiatric diseases.

2.2. Methods

The control group was given ropivacaine: ropivacaine hydrochloride injection (Renfu Pharmaceuticals, 10ml, 100mg), 20mg was taken into the retractor tube.

The study group was given dexmedetomidine combined with ropivacaine:

(1) Dexmedetomidine hydrochloride injection (Renfu Pharmaceutical, 2ml, 200μg), 0.6μg/kg was taken into the retractor tube.

(2) Ropivacaine hydrochloride injection was used as above.

2.3. Observation indexes

The indexes below were observed in the two groups.

(1) Comparing the analgesic effect between groups, including resting numeric rating scale (NRS) score and active NRS score. NRS is the pain numerical scoring method, with 0–10 points.

(2) Comparing hemodynamic indexes between groups, including output per beat, cardiac output, and cardiac index.

2.4. Statistical analysis

SPSS21.0 statistical software was selected to process and analyze the data. Count data were expressed as the number of cases (n) and percentage (%), and the x^2 test was implemented, and the measurement data were expressed as the mean ± standard deviation (SD), and the t test was implemented, and the difference was regarded as statistically significant ($P < 0.05$).

3. Results

3.1. Comparison of analgesic effects

In 3 hours after operation, the analgesic effects of resting NRS score and activity NRS score were compared between the groups, the difference was not statistically significant ($P > 0.05$). In 12 hours and 24 hours after operation, the resting NRS score and activity NRS score of the study group were significantly better than those of the control group, the difference was statistically significant ($P < 0.05$), as shown in **Table 1**.

Table 1. Comparison of analgesic effects between groups (mean ± SD)

Group	Resting NRS score			Activity NRS score		
	3 hours after surgery	12 hours after surgery	24 hours after surgery	3 hours after surgery	12 hours after surgery	24 hours after surgery
Study group ($n = 25$)	0.72 ± 0.52	1.78 ± 0.67	1.54 ± 0.64	2.41 ± 0.72	2.68 ± 0.68	2.14 ± 0.61
Control group ($n = 25$)	0.73 ± 0.58	2.24 ± 0.72	2.58 ± 0.67	2.43 ± 0.75	3.75 ± 0.96	4.15 ± 0.74
t-value	0.0641	2.3385	5.6122	0.0961	4.5476	10.4795
P-value	0.9491	0.0236	0.0000	0.9238	0.0000	0.0000

3.2. Comparison of hemodynamic indexes

Before treatment, hemodynamic indexes such as output per beat, cardiac output, cardiac index, and other hemodynamic indexes were compared between the groups, and the difference was not statistically significant ($P > 0.05$). After treatment, hemodynamic indexes such as output per beat, cardiac output, cardiac index, and other hemodynamic indexes of the study group were significantly better than those of the control group, and the difference was statistically significant ($P < 0.05$). The results are presented in **Table 2**.

Table 2. Comparison of hemodynamic indices between groups (mean ± SD)

Group	Output per beat (ml)		Cardiac output (l/min)		Cardiac index (l/min·m)	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Study group ($n = 25$)	43.21 ± 3.25	62.58 ± 4.53	3.16 ± 0.25	5.87 ± 0.29	2.51 ± 0.16	5.68 ± 0.34
Control group ($n = 25$)	43.26 ± 3.28	53.87 ± 3.59	3.19 ± 0.27	4.35 ± 0.52	2.53 ± 0.19	3.75 ± 0.41
t-value	0.0541	7.5345	0.4076	12.7645	0.4025	18.1174
P-value	0.9570	0.0000	0.6853	0.0000	0.6890	0.0000

4. Discussion

The knee joint is the largest joint in the body and the most important weight-bearing joint, it is very prone to injury under the influence of external factors, and the incidence of knee arthropathy has continued to rise in recent years [5]. Knee joint diseases include meniscus injury, rheumatoid arthritis, osteoarthritis of the knee and other diseases, usually given conservative treatment first, and then surgical treatment if conservative treatment is ineffective, the surgical treatment modality is total knee arthroplasty [6]. Total knee arthroplasty is the placement of artificial prosthesis to replace the knee joint function, the surgery involves removing the damaged knee joint, thus it is very damaging with a certain impact on the bones and tissues. Moreover, the patient's postoperative pain is very intense and intolerable, it not only affects the patient's life and sleep, but it is also not conducive to postoperative rehabilitation [7]. Therefore, it is necessary to take pain relief measures for patients in advance to reduce the postoperative pain. Ultrasound-guided retractor tube block is a kind of sedative and analgesic measure, which can effectively reduce the postoperative pain level of patients [8]. Ropivacaine is a commonly used analgesic drug in surgery belonging to the class of local anesthetics, which is widely used in the fields of local tissue anesthesia, epidural anesthesia, and postoperative analgesia [9]. The drug can block the mobility of sodium ions, preventing

them from flowing into the nerve cells to conduct impulses, thus resulting in a reversible block. The drug has a dual effect, including anesthetic and analgesic effects, a large dose of the drug can be used to exert the effect of anesthesia, while a small dose of the drug is usually used for analgesia [10]. During the analgesic application of ropivacaine in postoperative patients, the dosage of the drug is repeatedly increased in order to reduce pain, at this time, the sympathetic excitability is very strong, and it has a certain effect on the hemodynamics of patients [11]. Based on the application of ropivacaine, dexmedetomidine is added to strengthen the effect of sedation and analgesia, and improve the pain relief of patients [12]. Dexmedetomidine, a sedative drug for intubation and ventilator use, is an α2-adrenergic receptor agonist which can be absorbed in a short period of time after injection, peaks at about 60 minutes, and is metabolized and eliminated through urine [13]. The drug is well tolerated and generally does not cause adverse effects [14]. Dexmedetomidine inhibits sensory nerves and nerve signals, and also acts directly on monoaminergic neurons, reducing the release of catecholamine transmitters, decreasing the excitability of the sympathetic nervous system, and thus inhibiting the onset of the stress response [15]. Dexmedetomidine combined with ropivacaine can shorten the onset of block and prolong the recovery time of nerve conduction, and generally does not cause adverse reactions, and the safety of sedation is ideal.

The results of the experiment are as follows. 3 hours after the operation, the analgesic effects of resting NRS score and activity NRS score were compared between the groups, the difference was not statistically significant ($P > 0.05$). 12 hours and 24 hours after the operation, the resting NRS score and activity NRS score of the study group were significantly better than that of the control group, the difference was statistically significant ($P < 0.05$). Implementing the block in the retractor muscle canal can comprehensively block the nociceptive nerve conduction around the knee joint, and can exert a good sedative effect. These two drugs will not affect the quadriceps muscle, dexmedetomidine can reduce the absorption of ropivacaine, reduce the addition of the analgesic drug, make up for the limitations of ropivacaine. Before treatment, hemodynamic indexes such as output per beat, cardiac output, cardiac index, and other hemodynamic indexes were compared between the groups, the difference was not statistically significant ($P > 0.05$). After treatment, hemodynamic indexes such as output per beat, cardiac output, cardiac index, and other hemodynamic indexes of the study group were significantly better than those of the control group, the difference was statistically significant ($P < 0.05$). The retractor tube block is performed under ultrasound guidance, the operation process is more precise, and multiple nerves can be blocked. Dexmedetomidine can reduce the release of norepinephrine, cut off the conduction of pain signals, and stabilize the hemodynamics of patients.

In conclusion, the analgesic effect of dexmedetomidine combined with ropivacaine retractor tube block after total knee arthroplasty is ideal, the pain level of the patient is significantly reduced, and the hemodynamic indexes are not greatly affected, thus this anesthesia protocol has certain clinical application value.

Disclosure statement

The author declares no conflict of interest.

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