Research Paper

The Effect of Brachial Plexus Block and Superficial Cervical Plexus Block Combined with General Anesthesia in Shoulder Arthroscopic Surgery

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To investigate the effect of brachial plexus block and superficial cervical plexus block combined with general anesthesia in shoulder arthroscopic surgery is the objective of the study. 100 patients who underwent arthroscopic surgery in our hospital from March 2021 to March 2022 were randomly divided into observation group (n=50) and control group (n=50). General anesthesia was used in the control group and brachial plexus block and superficial cervical plexus block combined with general anesthesia was used in the observation group. The amount of analgesics and recovery, hemodynamics, pain and postoperative complications were compared between the two groups. The amount of analgesics used in the observation group was significantly less than that in the control group and the recovery time of the patients was shorter than that in the control group ($p<0.05$); the heart rate, and mean arterial pressure of the two groups at the time of skin incision (T1) were significantly different from those at the time of intubation (T0), 30 min (T2) after skin incision and 15 min (T3) after entering the anesthesia monitoring room after operation (all $p<0.05$). At T1, the heart rate of the observation group was lower than that of the control group and the map level was higher than that of the control group. The difference was statistically significant ($p<0.05$); the scores of visual analog scale and Ramsay sedation scale in the observation group at 2 h, 8 h and 24 h after operation were lower than those in the control group ($p<0.05$); there was no significant difference in the incidence of adverse reactions between the two groups ($p>0.05$). Brachial plexus block and superficial cervical plexus block combined with general anesthesia has a relatively good effect in shoulder arthroscopic surgery, which is conducive to scoring hemodynamics, reducing pain and good safety.

Key words: Brachial plexus block, superficial cervical plexus block, general anesthesia, shoulder arthroscopic surgery

In recent years, the number of patients with shoulder joint pain has been increasing year by year due to the popularity of electronic devices and instruments, as well as work-related factors, seriously affecting their quality of life. Currently, the emphasis on the treatment of shoulder joint-related diseases has greatly increased. Shoulder arthroscopy surgery has the characteristics of small trauma, minimal bleeding, low infection rate and rapid recovery[1-3]. It is widely used in the treatment of rotator cuff injuries and other surgeries. Fine surgical operations and anesthesia management are the basis and key to reducing complications and ensuring surgical success. Continuous pressurized irrigation is required in shoulder arthroscopy surgery to ensure a clear surgical field. However, a large amount of irrigation fluid can cause tracheal compression and upper airway obstruction, so general anesthesia with tracheal intubation is generally selected. Studies have shown that nerve blocks can effectively reduce intraoperative stress and have application value in shoulder joint surgery. This study compares the application of pure general anesthesia with ultrasound-guided interscalene brachial plexus block and superficial cervical plexus block combined with general anesthesia in shoulder arthroscopy surgery from the aspects of intraoperative analgesic drug use and hemodynamic status, postoperative recovery time and pain scores, aiming to provide a reference for further improving the anesthesia quality of shoulder arthroscopy surgery[4,5].

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MATERIALS AND METHODS

Clinical data collection:

100 patients who underwent shoulder arthroscopy surgery between March 2021 and March 2022 at the First Affiliated Hospital of Fujian Medical University, Longyan were randomly assigned to an observation group (n=50) and a control group (n=50). The control group comprised of 27 males and 23 females with ages ranging from 42 to 65 y and an average age of (50.23±5.21) y. The Body Mass Index (BMI) ranged from 18.5 to 26.7 kg/m^2, with an average BMI of (22.4±3.9) kg/m^2. Based on the American Society of Anesthesiologists (ASA) classification, 20 patients were classified as ASA grade I and 30 patients were classified as ASA grade II. The observation group included 26 males and 24 females with ages ranging from 41 to 66 y and an average age of (50.89±5.26) y. The BMI ranged from 18.4 to 26.8 kg/m^2, with an average BMI of (22.5±3.8) kg/m^2. According to the ASA classification, 22 patients were classified as ASA grade I and 28 patients were classified as ASA grade II. Both groups underwent shoulder arthroscopy surgery with an average operation time of (112.45±20.15) min. There were no significant differences in general information such as age between the two groups and they were comparable ($p>0.05$).

Inclusion criteria: ASA grade I-II; patients diagnosed by a surgeon as requiring shoulder arthroscopy surgery; conscious, able to communicate and cooperate with the doctor during the operation.

Exclusion criteria: History of hypertension, coronary heart disease, liver or kidney dysfunction, or other major diseases; mental disorders or poor compliance; blood disorders or coagulation dysfunction and history of drug abuse.

Nerve block method:

The patient was placed in a supine position with the head turned to the healthy side and both arms placed on the sides. The high-frequency ultrasound probe was placed at the site of the carotid artery pulse, 2 cm below the annular cartilage. After obtaining the ultrasound images of the carotid artery and internal jugular vein, the probe was moved outward to the lateral edge of the sternocleidomastoid muscle, where multiple circular or oval-shaped low-echoic grape-like structures were visible in the anterior middle scalene gap, representing the nerve roots of the interscalene brachial plexus. Using the in-plane technique, 20 ml of 0.33 % ropivacaine was injected. Subsequently, the ultrasound probe was slid laterally to the midpoint of the sternocleidomastoid muscle to locate the prevertebral fascia and 8 ml of 0.33 % ropivacaine was injected into the superficial cervical plexus below the prevertebral fascia.

General anesthesia method:

After all patients entered the operating room, routine monitoring of body temperature, Electrocardiogram (ECG), Blood Pressure (BP) and Saturation of Peripheral Oxygen (SpO_2) was performed. After establishing a peripheral venous route, invasive blood pressure monitoring was performed with radial artery puncture and catheterization. The observation group underwent nerve block of the interscalene brachial plexus and superficial cervical plexus guided by ultrasound before induction of general anesthesia. The amount of local anesthetic used was 20 ml of 0.33 % ropivacaine for interscalene brachial plexus and 8 ml for superficial cervical plexus. The effective blockade was confirmed when temperature sensation and pinprick sensation disappeared from the affected limb. After satisfactory nerve block, general anesthesia induction was performed. The control group received only general anesthesia. Anesthesia induction was carried out by intravenous injection of midazolam (Yichang Renfu Pharmaceutical Co., Ltd., National drug approval number: H20067040, specification: 2 mg/ml) at a dose of 0.05 mg/kg, sufentanil (Yichang Renfu Pharmaceutical Co., Ltd., National drug approval number: H20054172, specification: 100 μg/ml) at a dose of 0.3 μg/kg, cisatracurium besylate (Jiangsu Hengrui Medicine Co., Ltd., National drug approval number: H20171002) at a dose of 0.15 mg/kg and propofol (Beijing Fresenius Kabi Pharmaceutical Co., Ltd., National drug approval number: J20171055) at a dose of 2 mg/kg. After complete muscle relaxation, tracheal intubation was performed and mechanical ventilation was initiated at a frequency of 8-12 breaths/min with a tidal volume of 8-10 ml/kg and end-tidal carbon dioxide pressure maintained at 30-35 cm. Anesthesia maintenance was done as propofol was continuously infused at a dose of 4-8 mg/kg/h, remifentanil (Yichang Renfu Pharmaceutical Co. Ltd., National drug approval number: H20030197) was infused at a dose of 0.1-0.2 μg/kg/min, sevoflurane (Lunan Beite Pharmaceutical Co., Ltd., National drug approval number: H20080681) was adjusted between 0-2 %

as needed to maintain the Bispectral Index (BIS) value between 40-60 and the Mean Arterial Pressure (MAP) was maintained between 45-60 mmHg. If the anesthesia depth was appropriate but blood pressure control was inadequate, nitroglycerin was used for controlled hypotension.

Postoperative analgesia method:

All patients received Patient-Controlled Intravenous Analgesia (PCIA) for postoperative pain management. The formula for PCIA was as follows. 100 μg sufentanil citrate+200 mg flurbiprofen ester+200 μg dexmedetomidine+10 mg dezocine+5 mg tropisetron hydrochloride injection (Beijing Double-Crane Pharmaceutical Co., Ltd., National drug approval number: H20052460), mixed with normal saline to a total volume of 150 ml. The parameters were set as follows. Loading dose of 3 ml, background infusion rate of 3 ml/h, patient-controlled bolus dose of 3 ml per click and a lockout time of 15 min.

Assessment of pain and sedation effects:

The sedation effect was evaluated using the Ramsay sedation scale[6] at 2 h, 8 h and 24 h postoperatively. The total score is 6 points, with a higher score indicating a deeper level of sedation. A score below 2 indicates inadequate sedation, a score of 2-4 indicates optimal sedation and a score above 4 indicates excessive sedation. The severity of postoperative pain was evaluated using the Visual Analog Scale (VAS) [7] and the scores of the two groups at 2 h, 8 h and 24 h postoperatively were recorded and compared. A higher score indicates more severe pain.

Comparison of adverse reactions:

Record postoperative adverse reactions such as nausea, vomiting, hypoxemia and infection, and compare the incidence of adverse reactions between the two groups.

Observation indicators:

Assessment of analgesic drug dosage and recovery time: Record the intraoperative dosage of relevant analgesic drugs and the patient's recovery time.

Assessment of hemodynamic indicators: Measure and compare the Heart Rate (HR) and MAP of the two groups at the time of intubation (T0), skin incision (T1), 30 min after skin incision (T2) and 15 min after surgery completion when entering the post-anesthesia recovery room (T3).

Statistical methods:

Statistical Package for the Social Sciences (SPSS) 22.0 software was used for data processing and count data were expressed as n (%). The chi-square test was used for data analysis. Measurement data were expressed as mean±standard deviation ($\bar{x}\pm s$) and analyzed using the independent sample t-test. The significance level was set at alpha (α)=0.05 and a two-tailed $p<0.05$ was considered statistically significant.

RESULTS AND DISCUSSION

Comparison of intraoperative analgesic drug dosage and recovery between the two groups was explained here. The amount of intraoperative analgesic drugs used in the observation group was significantly lower than that in the control group and the recovery time was shorter than that in the control group. The difference was statistically significant ($p<0.05$), as shown in Table 1.

Comparison of hemodynamic indicators between the two groups was shown here. There was no significant difference in HR or MAP between the two groups at T0, T2 and T3 ($p>0.05$). However, there were significant differences in HR and MAP between the two groups at T1 compared to T0, T2 and T3 ($p<0.05$). At T1, the observation group had a lower HR and lower MAP than the control group and these differences were statistically significant ($p<0.05$), as shown in Table 2.

Comparison of Ramsay sedation scale scores and VAS scores between the two groups were shown here. The Ramsay scores and movement VAS scores of the observation group at 2 h, 8 h and 24 h postoperatively were lower than those of the control group and the differences were statistically significant ($p<0.05$), as shown in Table 3.

Comparison of adverse reactions between the two groups was shown here. There were no significant differences in the incidence of postoperative complications between the two groups ($p>0.05$), as shown in Table 4.

Arthroscopic surgery of the shoulder joint is a minimally invasive procedure that involves removing and repairing damaged tissue through small incisions. It is an effective method for treating various upper limb surgeries, particularly rotator cuff injuries, with faster healing times and reduced postoperative infection rates compared to traditional

open surgery[8,9]. However, the complex anatomical structure of the shoulder and stress response during arthroscopic surgery often leads to significant postoperative pain.

With the development of Enhanced Recovery After Surgery (ERAS) protocols, perioperative analgesia has become a crucial component of anesthesia management[10,11]. One commonly used method is continuous interscalene brachial plexus nerve block, which provides good pain relief but can also cause ipsilateral phrenic nerve paralysis. Yet, there remains controversy over the best anesthesia and analgesia methods for arthroscopic shoulder surgery.

TABLE 1: COMPARISON OF INTRAOPERATIVE ANALGESIC DRUG DOSAGE AND RECOVERY BETWEEN THE TWO GROUPS

Group	Sufentanil dosage (μg)	Sevoflurane dosage (ml)	Recovery time (min)
Control (n=48)	51.79±10.26	21.45±2.68	25.45±3.48
Observation (n=48)	42.52±8.59	9.26±2.33	16.51±3.41
t	2.456	2.600	5.115
p	0.004	0.003	0.002

TABLE 2: COMPARISON OF HEMODYNAMIC INDICATORS BETWEEN THE TWO GROUPS ($\bar{x}$±s)

Group	Time	HR (times/min)	MAP (mmHg)
Control (n=50)	T0	70.45±8.56	93.24±6.61
	T1	80.56±9.56	95.21±6.11
	T2	71.28±9.59	92.59±6.57
	T3	70.48±9.47	92.89±6.77
F		15.265	8.05
p		0.004	0.006
Observation (n=50)	T0	68.26±9.01	90.26±6.28
	T1	76.45±9.56[a]	88.56±6.21[a]
	T2	69.56±9.23[b]	90.52±6.25[b]
	T3	68.56±9.74[c]	90.85±6.54[c]
F		15.36	3.92
p		<0.001	0.021

Note: [a]Compared with the control group, p<0.05; [b]Compared with the control group, p>0.05 and [c]Compared with the control group, p>0.05

TABLE 3: COMPARISON OF RAMSAY SCORE AND VAS SCORES BETWEEN THE TWO GROUPS

Group	Time	Ramsay score	VAS score
Control (n=50)	Post 2 h	3.86±0.38	2.64±0.61
	Post 8 h	2.63±0.64	3.80±0.21
	Post 24 h	2.60±0.19	3.84±0.25
F		5.41	6.05
p		0.007	0.021
Observation (n=50)	Post 2 h	2.65±0.12	2.01±0.28
	Post 8 h	2.22±0.24[a]	3.34±0.11[a]
	Post 24 h	2.10±0.27[b]	3.39±0.57[b]
F		4.18	6.92
p		0.005	0.009

Note: [a]Comparison with group A, p<0.05 and [b]Comparison with control group, p<0.05

TABLE 4: COMPARISON OF ADVERSE OUTCOMES BETWEEN THE TWO GROUPS (%)

Group	Nausea and vomiting	Infection	Hypoxemia	Overall incidence rate (%)
Control (n=50)	2 (4.00)	1 (2.00)	1 (2.00)	4 (8.00)
Observation (n=50)	0 (0.00)	1 (2.00)	1 (2.00)	2 (4.00)
χ^2	-	0.354	5.41	5.41
p	-	0.741	5.41	5.41

Therefore, this study aims to evaluate the analgesic effect of combined interscalene and superficial cervical plexus nerve block with general anesthesia in arthroscopic shoulder surgery[12,13].

The study found that the combination of interscalene and superficial cervical plexus nerve block with general anesthesia significantly reduced the amount of analgesic drugs used during surgery and shortened awakening time compared to the control group. This is because intravenous general anesthesia can inhibit neural excitatory stress near the cerebral cortex and blocking C3 to C6 nerves that supply the shoulder and neck skin and deep tissues helps to reduce surgical stress. Furthermore, the approach of interscalene nerve block through the muscle groove effectively inhibits anesthesia at the surgical site, produces comprehensive anesthesia, reduces surgical stress and stabilizes hemodynamic indicators[14,15].

Postoperative pain after shoulder surgery is usually severe, especially with activity. The study showed that combining interscalene and superficial cervical plexus nerve block with general anesthesia significantly lowered Ramsay scores and movement VAS scores in the observation group at 2 h, 8 h and 24 h, postoperatively compared to the control group. This approach effectively provided local anesthesia to the shoulder without affecting lower limb muscle strength, improving patient comfort while reducing pain[16,17]. Intravenous general anesthesia may cause complications such as nausea and vomiting, which can increase the risk of wound tearing after shoulder joint arthroscopy and affect patient outcomes. However, the study found no significant difference in the incidence of complications between the observation and control groups, indicating that combining interscalene and superficial cervical plexus nerve block with general anesthesia is safe and does not increase postoperative complications[17,18].

Overall, combined interscalene and superficial cervical plexus nerve block with general anesthesia provides good sedative effects during arthroscopic shoulder surgery, promotes stable hemodynamics, reduces pain and has excellent safety.

Conflict of interests:

The authors declared no conflict of interest.

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