ORIGINAL RESEARCH

The Potential Value of Paraspinal Nerve Block (PVB) in Percutaneous Nephrolithotomy (PCNL) Compared with General Anesthesia and Epidural Anesthesia

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ABSTRACT

Objective • To analyze the potential value of paraspinal nerve block (PVB) in percutaneous nephrolithotomy (PCNL) and to compare it with general anesthesia and epidural anesthesia.

Methods • 120 patients undergoing PCNL surgery in Shanghai Jiao Tong University Affiliated Sixth People's Hospital from January 2021 to June 2022 were selected and divided into PVB anesthesia group, general anesthesia group, and epidural anesthesia group according to different anesthesia methods, with 40 cases in each group. The anesthesia index (anesthesia operation time, anesthetic effect time, anesthesia time), the vital signs (heart rate, mean arterial pressure), postoperative pain [visual analog scale (VAS)], stress response index (cortisol and noradrenaline), the incidence of adverse reactions (nausea and vomiting, lethargy, dizziness, skin itching, bradycardia) were compared among the three groups.

Results • The operation time of the anesthesia in the PVB anesthesia group was 5.72±1.25, which was significantly lower than that in the the general (7.95±1.15) and epidural anesthesia groups(8.23±1.43), and the differences were statistically significant (P = .000). The time of onset of anesthesia in the PVB anesthesia group was 6.63±1.87, which was significantly lower than that in the the general (9.84±2.41) and epidural anesthesia groups(10.14±2.89), and the differences were statistically significant (P = .000). The heart rate during percutaneous puncture and intraoperative lithotripsy in the PVB anesthesia group was statistically lower than in the general and epidural anesthesia groups (P < .05). The mean arterial pressure 20 minutes after anesthesia and at the end of operation in the PVB anesthesia group was higher than that in the general anesthesia group, and the mean arterial pressure during percutaneous puncture and intraoperative lithotomy was lower than that in the general anesthesia group (P < .05). The VAS scores of the PVB anesthesia group at 2, 6, 12, 24, and 48 hours after the operation were lower than those of general and epidural anesthesia groups (P < .05). The incidence of adverse reactions was 5.00% (2/40) in the PVB anesthesia group and 35.00% (14/40) in the general anesthesia group, which was lower than that of 27.50% (11/40) in the epidural anesthesia group. (P < .05).

Conclusion • The potential value of PVB in PCNL is high is better than that of general anesthesia and epidural anesthesia, anesthesia can shorten operation time and work time, extend the time of anesthesia to maintain, and be helpful to the intraoperative vital signs in patients with stable, mild postoperative pain and stress, low incidence of adverse reactions, efficacy and safety are good, can be introduced. (*Altern Ther Health Med.* 2024;30(10):442-447).

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INTRODUCTION

Kidney stones for clinically common disease, often due to urinary tract infections, infarction, or foreign bodies, form in the majority of male patients, good hair at 21 to 50 years old crowd, the clinical symptom is given priority to with pain, hematuria can form secondary ureteral calculi, severe cases will cause urinary tract obstruction, infection and even local damage renal failure, as well as the uremia.[1,2] Especially for patients with complex kidney stones, the treatment is more difficult and the incidence of complications is higher.

Percutaneous nephrolithotomy (PCNL) is an important method for the clinical treatment of complex renal calculi, which has the characteristics of simple operation, mild trauma, good curative effect, and a high cure rate.[3] PCNL, commonly known as "perforation lithotomy", is suitable for large renal stones and upper ureteral stones, etc. Percutaneous

nephrolithotomy is an important part of urological surgery, in the treatment of kidney stones and upper ureteral stones, ureteroscopy technology and extracorporeal shock wave lithotripsis together become the main treatment methods for stones, has completely changed the traditional treatment of kidney stones. This procedure has a low requirement for muscle relaxation during percutaneous puncture, but it requires good analgesic effect, prevention of movement, and reduction of patient discomfort during operation.[4] Therefore, anesthesia should be effective in blocking the nociceptive nerve in the relevant area of percutaneous puncture and reduce the stimulation of the kidney during the operation. Paravertebral nerve block (PVB) is a new anesthesia method that can directly inject anesthetics into the paraspinal space, block the sensory, motor and sympathetic nerves in the area, and then achieve unilateral physical anesthesia effect, with advantages of simple operation, safety and reliability.[5]

To further analyze the potential value of PVB in PCNL surgery, this study aimed to analyze the anesthesia methods and effects of 120 patients, and the anesthesia indicators, vital signs, postoperative pain, stress response indicators, and incidence of adverse reactions, to evaluate the potential value of paraspinal nerve block (PVB) in PCNL and to compare it with general anesthesia and epidural anesthesia.

DATA AND METHODS

Patient Selection

120 patients undergoing PCNL surgery in our hospital from January 2021 to June 2022 were selected and divided into PVB anesthesia group, general anesthesia group, and epidural anesthesia group according to different anesthesia methods, with 40 cases in each group. In the PVB anesthesia group, there were 23 males and 17 females. The age ranged from 18 to 64 (55.82 ± 8.35) years old. Body mass index 18-24 (21.31±1.26) kg/m^2; The course of the disease was 10-35 days (23.13 ± 5.25). The diameter of stones ranged from 2 to 6 cm (4.06 ± 0.84) cm. The number of stones ranged from 1 to 5 (3.74 ± 1.16). The operation time was 45-78 (56.23 ± 11.47) min. There were 22 cases of bilateral kidney stones and 18 cases of unilateral kidney stones. Complications included urinary tract infection in 4 cases, gross hematuria in 7 cases, and renal insufficiency in 10 cases. In the general anesthesia group, there were 24 males and 16 females. The age ranged from 18 to 64 (57.86±10.32) years old. Body mass index 18-24 (21.34±1.23) kg/m^2; The course of the disease was 9-36 days (23.15±4.22). The stone's diameter ranged from 2 to 6 cm (4.08±0.81) cm. The number of stones ranged from 1 to 5 (3.76±1.14). The operation time was 43-77 (50.28±11.43) min. There were 23 cases of bilateral kidney stones and 17 cases of unilateral kidney stones. Epidural anesthesia group: 24 males, 16 females; Aged 18 to 64 (35.89±10.30) years old. Body mass index 18-24 (21.35±1.24) kg/m^2; The course of the disease was 1-6 months (3.16±1.20). The diameter of stones ranged from 2 to 6 (4.10±0.80) cm. The number of stones ranged from 3 to 23 (11.75±5.16). The operation time was 73-102 (90.21±11.49) min. There were 22 cases of bilateral kidney stones and 18 cases of unilateral kidney stones. Comorbidities included urinary tract infection in 4 cases, gross hematuria in 7 cases, and renal insufficiency in 11 cases. There was no significant difference in the basic data among the three groups ($P > .05$).

Inclusion Conditions and Exclusions

Inclusion conditions :(1) confirmed by clinical symptoms, laboratory tests and imaging examinations, meeting the diagnostic requirements for renal calculi; (2) Elective surgery, consistent with surgical indications, American Society of Anesthesiologists (ASA) grade I to II; (3) Be aware of the research content, participate voluntarily, and have signed the informed consent.

Exclusion rules: (1) previous history of urinary calculi surgery; (2) Severe hydronephrosis; (3) Serious diseases of major organs; (4) Malignant tumor; (5) Mental disease, cognitive dysfunction; (6) Diseases of the blood system; (7) immune system diseases; (8) Coagulation dysfunction; (9) pregnant and lactating women; (10) Excessive obesity; (11) Taking painkillers for nearly a month; (12) allergic to anesthetics; (13) Poor compliance; (14) Patients with incomplete clinical data.

Anesthesia Procedures

After entering the room, the nasal catheter was given oxygen (2L/min). The upper limb venous access was opened with 18G sealed venous indwelling needle, and the acetic acid Ringer's solution was injected. GE's multifunctional anesthesia monitor was set up to monitor vital signs.

PVB anesthesia group: PVB anesthesia was applied. The patient was lying on the side, and the skin was routinely disinfected. Local anesthesia was performed with 1% lidocaine (Jicchuan Pharmaceutical, Sinics approval H20059049) at the puncture point. Ai-5200s color Doppler ultrasound diagnostic instrument was used for ultrasound guidance, and the paravertebral block was performed at T10/T11, T11/T12, and T12/L1. Ultrasonic puncture positioning: the ultrasonic probe was coated with a coupling agent, wrapped in a sterile bag, parallel to the midline of the spine, and scanned up and down at the level of the transverse process of the T10-L1 intersegment. After fine-tuning, the best Angle was selected for display. After probing the "horse's head" sign, the ribs showed a parietal pleural strip hypoechoic in the triangle composed of the ribs, transverse process of the ribs, and transverse process, that is, the paraspinal nerves were accurately located. In the sagittal scanning plane, 5ml of 0.375% ropivacaine (Tiantai mountain, Chengdu, sinopomission H20052666) was injected into each gap. The anesthesia block plane was detected by acupuncture five minutes later, and T9-L1 was covered to indicate that the block was successful. If not, the corresponding segment was remedied.

General anesthesia group: general anesthesia was applied. Induction of anesthesia: Intravenous injection of midazolam (Jiangsu Enhua, Sinopharm H10980026) 0.02~0.05 mg/ kg, fentanyl (Yichang Renfu, Sinopharm

H42022076) 3.0 μg/ kg, etomidate (Jiangsu Hengrui, Sinopharm H32022379) 0.2mg/kg, cis-atracurium (Jiangsu Hengrui, Sinopharm H32022379) 0.2mg/kg. H20060869) 0.2mg/ kg, low tidal volume, fast frequency mask pressure ventilation for 5 minutes, video laryngoscope effectively exposed the glottis, tracheal intubation, connected to a ventilator for mechanical ventilation, closely observe the patient's breathing. Anesthesia maintenance: propofol 2-3 mg/ (kg·h) + remifentanil (Jiangsu Enhua, Sinophosphatin approval H20143314) 0.2μg/ (kg·min). During the operation, the PCO2 was kept at 30-40 MMHG, and vecuronium (Hubei Keyi, Sinophosphatidic approval H20084581) 0.03mg/kg was added according to the patient's specific conditions to maintain muscle relaxation, and anesthesia was stopped 5 minutes before operation.

Epidural anesthesia group: epidural anesthesia was applied. Epidural anesthesia was performed in the T11-12 space, the puncture needle reached the epidural space, the epidural catheter was placed 3cm in the head position, and 3ml 1% lidocaine was injected. If there was no sign of subarachnoid block, 10 ml of 0.375% ropivacaine was injected. After 10 minutes, the anesthetic plane was observed, and an additional 5ml ropivacaine was injected if T9-L1 was not covered.

If the patient's vital signs were stable, spontaneous breathing was smooth, and there was no discomfort, the patient was sent back to the ward. Pain assessment was performed 48 hours after operation [Visual analog scale[6] (VAS), total score 10, a lower score indicates less pain]. Visual Analog Scale: A tool used to measure subjective feelings or assess a particular attribute, usually consisting of two extreme markers on a straight line and a movable marker that is moved to the appropriate position to indicate the degree of feeling by the desired person. Tramadol (Shenzhen Haiwang, Sinopharm Approval H20033331) was intravenously administered at 1.0mg/kg if the score was > 4, which could be repeated.

Observation Indicators

Anesthesia indicators, vital signs, postoperative pain, stress response indicators, and incidence of adverse reactions were compared among the three groups. (1) Anesthesia indicators: anesthesia operation time, onset time, and maintenance time. (2) Vital signs: heart rate and mean arterial pressure were recorded before anesthesia, 20 minutes after anesthesia, during percutaneous puncture, intraoperative lithotripsy, and at the end of surgery. (3) Postoperative pain: VAS score was used to evaluate the pain at 2, 6, 12, 24, and 48 hours after operation. (4) Stress response indicators, including cortisol and norepinephrine, were measured before and 1 day after surgery, and an enzyme-linked immunosorbent assay was used after blood collection. (5) Adverse reactions: including the number of cases of nausea and vomiting, drowsiness, dizziness, pruritus, and bradycardia, and the total incidence was calculated.

Data Processing

SPSS 22.0 software was used. Measurement and count data were expressed as ($\bar{x}$ ±s) and %, and t and χ^2 tests were performed. For multiple comparisons, data were analyzed via analysis of variance (ANOVA) with the Tukey-Kramer Multiple Comparisons Test. $P < .05$ was considered statistically significant.

Table 1 Comparison of anesthesia indicators in three groups ($\bar{x} \pm s$, min)

grouping	Number of examples	Anesthesia operation time	Time of onset of anesthesia	Duration of anesthesia maintenance
PVB anesthesia group	40	5.72±1.25	6.63±1.87	497.56±45.71
General anesthesia group	40	7.95±1.15	9.84±2.41	411.62±42.05
Epidural anesthesia group	40	8.23±1.43	10.14±2.89	388.99±36.93
t value (PVB anesthesia group versus general anesthesia group).	-	8.30	6.61	8.75
P value (PVB anesthesia group versus general anesthesia group).	-	.000	.000	.000
t value (PVB anesthesia group versus epidural anesthesia group).	-	8.36	6.45	11.69
P value (PVB anesthesia group versus epidural anesthesia group).	-	.000**	.000	.000

RESULTS

Comparison of anesthesia indexes among the three groups

The operation time of the anesthesia in the PVB anesthesia group was 5.72±1.25, which was significantly lower than that in the the general (7.95±1.15) and epidural anesthesia groups(8.23±1.43), and the differences were statistically significant ($P = .000$). The time of onset of anesthesia in the PVB anesthesia group was 6.63±1.87, which was significantly lower than that in the the general (9.84±2.41) and epidural anesthesia groups(10.14±2.89), and the differences were statistically significant ($P = .000$). The anesthesia maintenance time of the PVB anesthesia group was shorter than that of the general and epidural anesthesia groups, and the difference was statistically significant ($P < .05$). See table 1.

Comparison of vital signs among the three groups

The heart rate during percutaneous puncture and intraoperative lithotripsy in the PVB anesthesia group was lower than that in the general and epidural anesthesia groups, and the differences were statistically significant ($P < .05$). The mean arterial pressure 20 minutes after anesthesia and at the end of operation in the PVB anesthesia group was higher than that in the general anesthesia group. The mean arterial pressure during percutaneous puncture and intraoperative lithotomy was lower than that in the general anesthesia group, and the differences were statistically significant ($P < .05$). The mean arterial pressure 20 minutes after anesthesia in the PVB anesthesia group was higher than that in the epidural anesthesia group. The mean arterial pressure during percutaneous puncture and intraoperative lithotomy was lower than that in the epidural anesthesia group, and the differences were statistically significant ($P < .05$). Are shown in Table 2.

Postoperative pain in the PVB anesthesia group was lower

The VAS scores of the PVB anesthesia group was 4.59±0.48 at 2 hours, which was lower than those of the general(5.96±0.62) and epidural anesthesia groups(5.84±0.60). The VAS scores of the PVB anesthesia group was 3.87±0.52 at

Table 2. Comparison of vital signs in the three groups ($\bar{x} \pm s$)

grouping	Number of examples	Heart rate (times/min). Before anesthesia	20 minutes after anesthesia	During intraoperative percutaneous puncture	During intraoperative lithotripsy	At the end of the operation	Mean arterial pressure (mmHg). Before anesthesia	20 minutes after anesthesia	During intraoperative percutaneous puncture	During intraoperative lithotripsy	At the end of the operation
PVB anesthesia group	40	82.21±5.57	81.69±5.16	79.45±7.04	72.54±5.38	72.03±6.03	91.65±6.72	93.14±9.71	94.83±8.82	94.61±7.61	88.04±7.72
General anesthesia group	40	82.20±5.53	81.73±5.45	86.29±6.34	85.24±6.89	72.43±6.72	91.60±6.77	85.24±8.22	98.04±7.93	98.11±7.24	85.24±6.90
Epidural anesthesia group	40	82.23±5.44	81.42±5.88	87.82±6.92	87.34±8.15	72.24±7.51	91.70±6.65	84.36±7.32	98.52±7.74	98.53±7.50	85.83±6.78
t value (PVB anesthesia group versus general anesthesia group).	-	0.008	0.034	4.566	9.188	0.280	0.033	3.927	1.712	2.107	1.710
P value (PVB anesthesia group versus general anesthesia group).	-	.497	.487	.000	.000	.390	.487	.000	.045	.019	.046
t value (PVB anesthesia group versus epidural anesthesia group).	-	0.016	0.218	5.298	9.585	0.138	0.033	4.567	1.989	2.320	1.360
P value (PVB anesthesia group versus epidural anesthesia group).	-	.494	.414	.000	.000	.445	.487	.000	.025	.011	.089

Table 3. Postoperative pain (VAS score) comparison ($\bar{x} \pm s$, points) in the three groups

grouping	Number of examples	2 hours	6 hours	12 hours	24 hours	48 hours
PVB anesthesia group	40	4.59±0.48	3.87±0.52	2.54±0.59	1.50±0.43	0.75±0.27
General anesthesia group	40	5.96±0.62	4.34±0.74	3.18±0.72	2.14±0.69	1.01±0.35
Epidural anesthesia group	40	5.84±0.60	4.15±0.70	2.98±0.66	1.96±0.61	0.94±0.32
t value (PVB anesthesia group versus general anesthesia group).	-	11.051	3.287	4.348	4.979	3.720
P value (PVB anesthesia group versus general anesthesia group).	-	.000	.001	.000	.000	.000
t value (PVB anesthesia group versus epidural anesthesia group).	-	10.289	2.031	3.143	3.898	2.870
P value (PVB anesthesia group versus epidural anesthesia group).	-	.000	.023	.001	.000	.003

Table 4. Stress response indicators for three groups ($\bar{x} \pm s$, ng/ml)

grouping	Number of examples	Cortisol(μg/L) Preoperative	Cortisol(μg/L) 1 day after surgery	norepinephrine Preoperative	norepinephrine 1 day after surgery
PVB anesthesia group	40	59.34±6.32	76.49±7.22	40.30±4.35	45.71±5.87
General anesthesia group	40	59.30±6.35	113.52±8.93	40.34±4.26	53.93±6.65
Epidural anesthesia group	40	59.22±6.30	108.34±8.37	40.26±4.13	52.31±6.22
t value (PVB anesthesia group versus general anesthesia group).	-	0.028	20.394	0.042	5.861
P value (PVB anesthesia group versus general anesthesia group).	-	.489	.000	.483	.000
t value (PVB anesthesia group versus epidural anesthesia group).	-	0.085	18.223	0.042	4.881
P value (PVB anesthesia group versus epidural anesthesia group).	-	.466	.000	.483	.000

6 hours, which was lower than those of the general (4.34±0.74) and epidural anesthesia groups(4.15±0.70).

The VAS scores of the PVB anesthesia group at 12, 24, and 48 hours after operation were lower than those of the general and epidural anesthesia groups, and the differences were statistically significant ($P < .05$). See Table 3.

Stress response indicators in the PVB anesthesia group was lower

One day after the operation, cortisol and norepinephrine in the PVB anesthesia group were lower than those in the general and epidural anesthesia groups, and the differences were statistically significant ($P < .05$). See Table 4.

The incidence of adverse reactions in the PVB anesthesia group was lower

In the PVB anesthesia group, there was 1 case of nausea and vomiting 1 case of bradycardia, and the incidence of adverse reactions was 5.00% (2/40). In the general anesthesia group, there were 5 cases of nausea and vomiting, 2 cases of drowsiness, 3 cases of dizziness, 1 of pruritus, 3 of bradycardia, and the incidence of adverse reactions was 35.00% (14/40). In the epidural anesthesia group, nausea and vomiting occurred in 4 cases, drowsiness in 1 case, dizziness in 2 cases, pruritus in 1 case, bradycardia in 3 cases, and the incidence of adverse reactions was 27.50% (11/40). The incidence of adverse reactions in the PVB anesthesia group was lower than that in the general anesthesia and epidural anesthesia groups, and the difference was statistically significant (χ^2=11.250, $P = .000$; χ^2=7.440, $P = .006$).

DISCUSSION

Ultrasus-guided paravertebral nerve block under anesthesia minimally invasive percutaneous nephrolithotomy, guided by B-ultrasound, "precise" block of the intraoperative paravertebral nerve, reducing intraoperative use of opioids and other general anesthesia, preserving lower limb and contralateral muscle strength, patients can undergo postural changes in response to surgical needs, and the incidence of intraoperative adverse reactions of blood pressure and heart rate is low. It provides more effective and safe anesthesia and analgesia for patients undergoing percutaneous nephrolithotomy. It continues the advantages of traditional percutaneous nephrolithotripsy with less trauma, less bleeding, faster recovery, and a high stone removal rate. PCNL surgical puncture is usually selected in the 12th subcostal or 11th and 12th intercostal area of the posterior axillary line, about 10cm beside the midline of the spine, toward the kidney.[7] The trauma of this operation mainly lies in the pain during puncture expansion and the stimulation of high-pressure flushing fluid and stones during lithotripsy.[8]

As a common anesthesia method of this operation, general anesthesia can ensure the smooth breathing of patients in the prone position and meet the operation's needs. Especially

for patients with long operation times, obesity, the elderly, complicated stones, and the risk of infection and shock, this operation has high comfort and safety.[9] However, the use of general anesthesia is high, which is prone to adverse reactions, and the postoperative recovery time of patients is long, which is not conducive to early rehabilitation, leading to its application is limited. Epidural anesthesia has the advantages of simple operation, economy and practicality. Moreover, patients are awake during the operation and can timely inform medical staff of their discomfort, which is conducive to timely treatment and can reduce the occurrence of adverse events.[10] In theory, an epidural block can be used for any procedure except the head. However, from the perspective of safety, epidural block is mainly used for abdominal and lower surgery, including urinary, maternity and lower limb surgery. The neck, upper limbs and chest can be applied but are complex to manage. However, the anesthesia method also has shortcomings, mainly manifested in: under special position, the elderly, obese, long operation time patients often appear abdominal compression and cause discomfort, then make patients appear anxious, restlessness, and other negative emotions, leading to the smooth operation affected.

Paravertebral blockade (PVB) is a technique that reduces pain caused by thoracic and abdominal surgery by injecting local anesthetics around the lateral spinal nerve formed by the spinal nerve through the foramina in the paravertebral space, blocking the conduction of somatosensory and motor nerves. Compared with general anesthesia and epidural anesthesia, PVB anesthesia has more obvious advantages. This anesthesia method can significantly reduce the dosage of opioids and then reduce adverse reactions, which is conducive to the stability of intraoperative hemodynamics of patients.[11] PVB can inject local anesthetics into the paravertebral space and then block the corresponding nerves so as to achieve the dual effect of blocking unilateral body pain and visceral pain, so as to alleviate the pain of patients and then maintain the stability of intraoperative vital signs and reduce the stress response of patients.[12,13] With the development and application of ultrasound technology, accurate positioning of PVB puncture has been achieved, greatly improving the success rate of anesthesia.[14] Related research report pointed out that the PVB in ultrasonic assisted, vertical, the high-frequency ultrasound probe and the patient's spine contribute to achieving global visual operation, can directly show the puncture site, and understand that puncture and the correlation of adjacent viscera organization, as well as the needle into the path, etc., can greatly improve the safety of anesthesia. The best anesthesia effect can be achieved by avoiding damage to the body's main organs and blood vessels during the puncture operation.[15]

The analysis results of this study showed that the operation time and onset time of anesthesia in the PVB anesthesia group were shorter than those in the other two groups, and the maintenance time of anesthesia was longer than that in the other two groups, suggesting that PVB anesthesia can obtain the better anesthetic effect, and has the advantages of simple operation, rapid onset, and lasting effect.[16,17] The stability of vital signs during operation is the basic premise to ensure a smooth operation. Results in this study, PVB in anesthesia group, when the skin puncture, intraoperative gravel at the time of the heart rate is lower than the general anesthesia and epidural anesthesia group, 20 minutes after anesthesia PVB anesthesia group, when integrated by skin biopsy in rubble when the mean arterial pressure, is better than that of general anesthesia and epidural anesthesia group, intraoperative vital signs of patients with PVB anesthesia group. It is proved that PVB anesthesia is more helpful to the smooth operation of PCNL.[18] The results of postoperative pain analysis showed that the VAS score of the PVB anesthesia group was lower than that of the general anesthesia group and the epidural anesthesia group at each time point after operation. In the comparison of stress response, cortisol and norepinephrine in the PVB anesthesia group were lower than those in the general anesthesia group and epidural anesthesia group one day after operation, indicating that the stress response of patients in the PVB anesthesia group was mild and less affected by surgery and anesthesia. In the safety comparison, the incidence of adverse reactions in the PVB anesthesia group was lower than in the general anesthesia group and the epidural anesthesia group, suggesting that PVB anesthesia has better safety.

This study suggested that PVB anesthesia can reduce postoperative pain and help to carry out early postoperative rehabilitation training, which has a positive impact on promoting postoperative rehabilitation of patients. However, there are also limitations. First, specific patient population were not enough and further studies still needs more researches. Second, there are no underlying mechanisms of this study, which needs molecular exploring.

CONCLUSION

To sum up, the potential value of PVB in PCNL can shorten operation time and work time, extend the time of anesthesia in comparison with general anesthesia and epidural anesthesia, which will be helpful to the patients and clinicians.

AUTHOR CONTRIBUTIONS

Chao Deng and Tao Liang contributed equally to this work.

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