

Thoracic Paravertebral Block for Postoperative Pain Management in Percutaneous Nephrolithotomy Patients: A Randomized Controlled Clinical Trial

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Key Words

Pain management · Postoperative pain · Paravertebral block · Levobupivacaine · Morphine consumption

Abstract

Objective: To investigate the effect of thoracic paravertebral block (PVB) on pain control and morphine consumption in percutaneous nephrolithotomy operations. **Subjects and Methods:** This randomized controlled clinical study was performed on 60 American Society of Anesthesiologists (ASA) I-II patients between the ages of 18 and 60 years who underwent percutaneous nephrolithotomy with approval of the ethical committee and written consent of the patients. Patients were randomly allocated into two groups: group P had 4 ml of 0.5% levobupivacaine injected at each of the T10, T11, and T12 paravertebral spaces and a standard PVB, and group C received 4 ml of 0.9% NaCl solution. All patients were given standard general anesthesia. The follow-up of saturation, heart rate, peripheral oxygen, and blood pressure values was recorded before induction, intraoperatively, and postoperatively. At postoperative 1, 2, 6, 12, and 24 h, the visual analog scale (VAS), Ramsey sedation score, respiratory rate, and 24-hour total morphine consumption were recorded. In addition, side effects and satisfaction of patients were recorded. **Results:** VAS scores and total morphine consumption were lower in group P than in group C: 2.3 vs. 4.3 and 22.3 vs. 43.2 mg, respectively ($p < 0.05$). The level of satisfaction was high-

er in group P than group C. Differences between groups in other parameters were not significant. **Conclusions:** Thoracic PVB with levobupivacaine provided a good postoperative analgesia and increased patient satisfaction for those who underwent percutaneous nephrolithotomy.

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Introduction

Percutaneous nephrolithotomy is a very common less invasive method for the management of patients with renal calculi. However, the procedure still causes postoperative pain [1], mostly due to dilatation of the renal capsule, the parenchymal tract, and peritubal distressing of the nephrostomy tube [1, 2].

Postoperative pain is one of the important factors affecting morbidity concerning the cardiovascular, pulmonary, and emotional systems in surgical patients [1, 3]. Pain during the postoperative phase of anesthesia and surgery is still an important problem that requires continued efforts for improvement because adequate analgesia during the postoperative phase not only decreases complications, but facilitates faster recovery [4]. Side effects such as respiratory depression due to opioids are another problem for patients with postoperative pain [5]. Appropriate and adequate treatment of postoperative pain may decrease the incidence of complications, re-

quirements for hospitalization, recovery times, and health costs [4].

Paravertebral block (PVB) is a successful regional method that has been used for the pain management of several procedures such as thoracotomy, breast surgery, abdominal herniorrhaphy, and lithotripsy [6–9], and provides nonopioid analgesia to the somatic nerve roots in a dermatome distribution with no side effects [9, 10]. Although PVB has been used for many procedures, there is limited data for its use for the management of pain in percutaneous nephrolithotomy operations.

In this study, the effect of thoracic PVB with levobupivacaine on pain management and morphine consumption was evaluated in patients having percutaneous nephrolithotomy, and the advantages and disadvantages of PVB were examined.

Subjects and Methods

The study was conducted between October 2010 and November 2011, after approval of the ethics committee of our institution and written informed consent was obtained from each patient. Sixty percutaneous nephrolithotomy patients between the ages of 18 and 60 years with a risk classification of ASA I-II were enrolled in the study, which was a prospective, randomized, controlled clinical trial.

Exclusion criteria were a history of allergy to local anesthesia, hepatic or cardiac dysfunction, unregulated diabetes mellitus, hypertension, coagulation disorders, sepsis, pathological obesity (BMI >35), local infection at the application site, and not volunteering to the study or uncooperative to the use of patient-controlled analgesia (PCA).

Patients were visited 1 day prior to the surgery and briefed on PCA pumps and visual analog scale (VAS) scores for assessing the level of their pain. Mean arterial pressure (MAP), heart rate (HR), respiration rate (RR), and peripheral oxygen saturation (SpO₂) values of patients were monitored in the operating room before the procedure. After peripheral venous catheterization, a 10-ml·kg⁻¹ Ringer lactate infusion was given. Intravenous fluids were administered and subsequently maintained by 0.9% NaCl at the discretion of the anesthesiologist (S.G.). Patients were randomly assigned to one of two groups: group P (PVB) and group C (control) by using the closed envelope technique during the interview with patients, who were blinded to their groups. The two study groups were similar in the terms of age, gender, ASA, height, and weight. Patients were not informed as to which group they had been assigned.

Preoperative basal MAP, HR, RR, SpO₂, and doses of the drugs used were recorded by anesthetists (C.D. and K.K.) who were blinded to the groups. Anesthesia was induced by 5–7 mg·kg⁻¹ thiopental sodium (Pental Sodyum; IE Ulugay, Istanbul, Turkey) and 0.6 mg·kg⁻¹ rocuronium (Esmeron; Organon, Holland). Patients were ventilated by a 50% O₂ and 50% N₂O mixture and 4–6% desflurane (Suprane; Baxter-Eczacibasi, Turkey). In group P patients, at the end of the surgical procedure, the patients were turned to the lateral position with the side to be operated and blocked upwards. Using aseptic precautions and a C-armed fluo-

roscope, a 22-gauge 88-mm Quincke needle was inserted perpendicular to the skin 2.5 cm lateral from the cephalic edge of each of the spinous processes of T10, T11, and T12 using the loss of resistance technique. The needle was withdrawn and redirected in the cephalic direction to walk off the transverse process after the transverse process was contacted. The aim was to insert the needle to a depth of 1 cm past the transverse process. Four milliliters of 5% levobupivacaine were injected at each of three levels in group P. Group C patients were given 4 ml of normal saline by the same procedure with a 22-gauge Quincke needle for each level. Block solutions were prepared by an anesthesiologist other than the anesthesiologist who performed the blocks and this anesthesiologist was not involved in any other aspect of the study. All block procedures were performed by the same anesthesiologist who was blinded to the block solutions. After the block procedure, patients were awakened and transferred to the postoperative care unit (PACU). Patients with an Aldrete score of 9 and over were transferred to the inpatient service [11]. Patients with an Aldrete score of 8 and below were monitored in the PACU until the Aldrete score reached 9, and then they were transferred to the inpatient service too.

The block evaluations were made by pinprick test by an anesthesiologist (A.C.I.) who was blinded to the groups. Analgesia evaluated by pinprick test including the T10, T11, and T12 segments was defined as a successful PVB. If the blockade did not include all 3 segments, it was defined as a failed PVB and excluded from analysis. MAP, HR, RR, SpO₂, and Ramsey sedation scores [12] were recorded at postoperative 1, 2, 6, 12, and 24 h. The VAS pain scores were evaluated using a 0- to 10-cm visual scale: (no pain: 0; to very sharp pain: 10) at postoperative 1, 2, 6, 12, and 24 h by directly asking patients about their maximum sensation of pain. All the patients in the postoperative period received a PCA device upon arrival at the recovery room and a loading dose of intravenous morphine, 0.1 mg·kg⁻¹, by PCA for initiation. The PCA device was set for a 1-mg bolus dose with a 10-min lock-out interval and a 4-hour limit of 10 mg. Time to first PCA use and morphine consumption over 24 h were recorded. Duration of PACU stay was also recorded. If any patient had a VAS score above 5 out of 10, diclofenac sodium analgesic treatment was given intramuscularly in the postoperative period. No other analgesic was used. If patients had nausea, 10 mg metoclopramide hydrochloride (Primperan 10 mg amp, Biofarma Ilac, Turkey) was given intravenously. Patient satisfaction data was evaluated using a 5-point scale (1: very bad; 2: bad; 3: good; 4: very good; 5: perfect).

Three patients from group P were excluded due to inadequate block and 2 patients from group C were excluded due to wrong use of the PCA device. A total of 55 patients were included in the study. Data were analyzed using SPSS (ver. 14.0). Age, height, weight, duration of the operation, VAS scores, and morphine consumption were analyzed by using a t test (all were distributed normally as tested by K.S.), while the χ^2 test was used to compare binary variables of nausea, vomiting, itching, additional analgesic requirement, and satisfaction. A p value <0.05 was considered significant. Data are given as means \pm SD. The amount of morphine consumption at 24 h was the primary endpoint for statistical analysis. A power analysis based on a pilot study in which the amount of postoperative morphine consumption was 35 \pm 12 mg in the control group and 24 \pm 9 mg in the PVB group showed that two groups of 30 patients each would be required to demonstrate a 25% difference in postoperative morphine consumption with $\alpha = 0.05$ and $\beta = 0.20$.

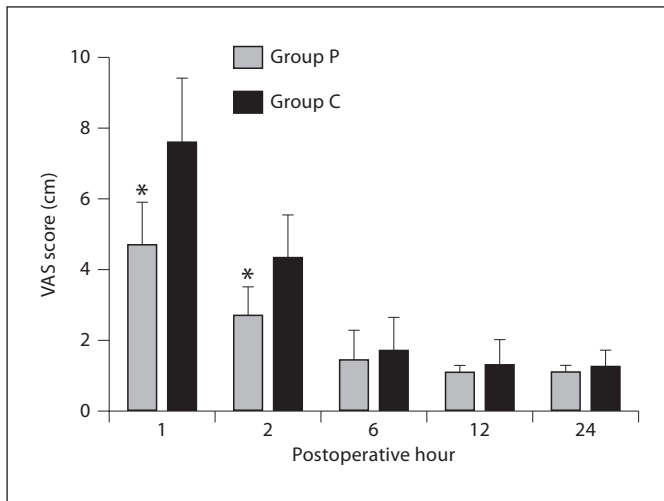


Fig. 1. VAS pain scores. * $p < 0.05$ compared to group C.

Results

There were no significant differences between the groups in terms of surgical characteristics (table 1). There were also no significant differences concerning MAP, HR, RR, and SpO₂ values between groups ($p > 0.05$; tables 2–5). Blocked segments were the same in all patients as including the T10–T12 segments. No epidural spread of local anesthetics was observed.

Postoperative VAS values at the first and second hours were significantly lower in group P than group C ($p < 0.05$; fig. 1). Time to first PCA use value was less in group C than in group P ($p < 0.05$), and 24-hour morphine consumption was found to be significantly lower in group P (22.3 ± 6.1 mg) than the control group (43.2 ± 9.5 mg) at both time points ($p < 0.05$; table 6). The need for additional analgesic (diclofenac sodium) 24 h postoperatively was significantly lower in group P than group C ($p < 0.05$; table 6). The duration of PACU stay of both groups was similar.

Patient satisfaction scores of group P were higher than that of group C ($p < 0.05$; table 6). The Ramsey sedation scores of the two groups were similar, 2 (cooperated, oriented and quiet), at all postoperative hours.

There were no side effects such as respiratory depression, delirium, urinary retention, hypotension, and bradycardia. No significant differences were seen in itching and vomiting between groups; nausea was significantly lower in group P ($p < 0.05$). Additionally, there were no complications related to PVB.

Table 1. Demographic and surgical data

	Group P (n = 27)	Group C (n = 28)	p value
Age, years	48.8 ± 9.9	50.6 ± 9.6	0.450
Gender (female/male)	12/15	14/14	0.168
Height, cm	164.5 ± 13.9	167.1 ± 14.2	0.266
Weight, kg	77.7 ± 10.9	80.7 ± 12.5	0.350
ASA (I/II)	11/16	10/18	0.147
Operation side (right/left)	12/15	13/15	0.621
Duration of operation, min	52.3 ± 15.2	53.5 ± 15.9	0.900

Values are given as means ± SD or n.

Table 2. MAP data (in mm Hg)

	Group P (n = 27)	Group C (n = 28)	p value
Basal	98.25 ± 13.18	99.20 ± 11.62	0.685
Postoperative 1 h	97.00 ± 9.17	95.25 ± 5.18	0.671
Postoperative 2 h	89.10 ± 6.20	89.30 ± 7.98	0.891
Postoperative 6 h	84.50 ± 8.68	88.55 ± 5.61	0.071
Postoperative 12 h	83.05 ± 8.17	86.20 ± 7.48	0.235
Postoperative 24 h	83.90 ± 8.49	86.20 ± 6.08	0.269

Data are means ± SD.

Table 3. HR data (in beats per minute)

	Group P (n = 27)	Group C (n = 28)	p value
Basal	78.20 ± 12.43	75.60 ± 8.68	0.607
Postoperative 1 h	83.75 ± 6.99	82.30 ± 8.63	0.498
Postoperative 2 h	79.00 ± 8.27	74.70 ± 18.57	0.616
Postoperative 6 h	76.80 ± 6.46	71.90 ± 18.12	0.378
Postoperative 12 h	75.95 ± 6.96	75.65 ± 8.39	0.889
Postoperative 24 h	75.55 ± 6.73	75.10 ± 6.71	0.674

Data are means ± SD.

Discussion

In this study, the problem of postoperative pain was overcome by adequate analgesia, which a single injection of PVB provided, as evidenced by high satisfaction scores and low morphine consumption after percutaneous nephrolithotomy operations. It has been reported that

Table 4. RR data (in breathing per minute)

	Group P (n = 27)	Group C (n = 28)	p value
Basal	20.80 ± 1.19	20.60 ± 0.94	0.667
Postoperative 1 h	22.40 ± 0.88	23.00 ± 1.02	0.052
Postoperative 2 h	21.40 ± 0.94	21.70 ± 0.73	0.262
Postoperative 6 h	20.20 ± 0.61	20.30 ± 0.73	0.637
Postoperative 12 h	20.40 ± 0.82	20.40 ± 0.82	1.00
Postoperative 24 h	20.65 ± 0.93	20.30 ± 0.73	0.167

Data are means ± SD.

Table 5. SpO₂ data (in %)

	Group P (n = 27)	Group C (n = 28)	p value
Basal	95.96 ± 2.34	95.96 ± 2.28	0.530
Postoperative 1 h	99.30 ± 0.79	99.36 ± 0.49	0.624
Postoperative 2 h	99.46 ± 0.68	99.53 ± 0.57	0.490
Postoperative 6 h	99.23 ± 0.93	99.43 ± 0.62	0.463
Postoperative 12 h	99.10 ± 0.88	99.36 ± 0.71	0.271
Postoperative 24 h	99.10 ± 0.98	99.50 ± 0.57	0.061

Data are means ± SD.

Table 6. Postoperative data

	Group P (n = 27)	Group C (n = 28)	p value
Time to first PCA use ¹ , min	94.2 ± 24.1	48.3 ± 17.4	0.001
Morphine consumption			
0–24 h ² , mg	22.3 ± 6.1	43.2 ± 9.5	0.001
Nausea (+/-)	2/25	12/16	0.015
Vomiting (+/-)	0/27	2/26	0.900
Itching (+/-)	5/22	7/21	0.910
Additional analgesic (+/-)	1/26	9/19	0.001
Overall satisfaction score at 24 h ³	4.2 ± 0.6	2.4 ± 0.5	0.001

¹ Calculated from transferring time to PACU.

² Recorded from PCA device.

³ 1: very bad; 2: bad; 3: good; 4: very good; 5: perfect.

preoperative or intraoperative application of PVB before awakening from anesthesia decreased acute postoperative pain as well as chronic pain after surgery in a variety of patient populations [13–17]. Consequently, PVB is being used for postoperative analgesia management and provides effective analgesia in many surgical procedures

such as outpatient lithotripsy [9], renal surgery [18], abdominal laparotomy [19], thoracotomies [13, 14], breast surgeries [15–17], and open prostatectomies [20].

Other techniques have been reported to provide postoperative analgesia for percutaneous nephrolithotomy, such as spinal and epidural block, local analgesic infiltration, and systemic analgesic therapy modalities such as nonsteroidal analgesic drugs and opioids [21–24]. Singh et al. [21], Karacalar et al. [22], Chen et al. [23], and Aravantinos et al. [24] all found other techniques that are effective for postoperative pain management of percutaneous nephrolithotomies. However, we think that PVB would provide better analgesia than these other techniques, while reducing additional analgesic doses. PVB is also an easy-to-use technique that has only one injection intraoperatively. Other techniques such as spinal epidural anesthesia provides analgesia, but also has some unwanted effects that would not occur with PVB, such as prolonged motor blockade, bowel movement impairment, and nausea and vomiting. These advantages of PVB make it a better analgesic technique.

Although there is no study comparing PVB and spinal-epidural block in patients undergoing percutaneous nephrolithotomy, there are several studies which have compared two techniques as thoracic epidural block and continuous PVB in thoracic surgery and lower abdominal surgery. Richardson et al. [25] reported that PVB was superior to the epidural block while Kotze et al. [26] reported that PVB in postthoracotomy provided stronger analgesia and fewer systemic opioids. However, Messina et al. [27] reported that epidural block was more effective than PVB. Further, Lönnqvist et al. [28] reported that continuous thoracic PVB provided effective postoperative analgesia equal to or even better than classical lumbar epidural block. Because no comparative studies had been done between these other techniques and PVB, such studies will be necessary for postoperative pain relief of percutaneous nephrolithotomies.

Conclusion

Thoracic PVB using levobupivacaine was an effective regional technique with low morphine consumption, high patient satisfaction, and no side effects for postoperative pain management of patients undergoing percutaneous nephrolithotomy. Hence, a low thoracic PVB technique should be considered as a safe alternative treatment to conventional methods for postoperative pain management of percutaneous nephrolithotomy operations.

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