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Anesthesia management with ultrasound-guided thoracic paravertebral block for donor nephrectomy: A prospective randomized study☆

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ABSTRACT

Study objective: To determine the efficacy of ultrasound-guided thoracic paravertebral block intraoperatively and 24 hours postoperatively in patients undergoing donor nephrectomy.
Design: Prospective randomized controlled study.
Setting: Private foundation university hospital; November 2014 to June 2015.
Patients: Thirty-two patients undergoing donor nephrectomy (exclusion criteria: coagulation disorders, allergy to local anesthetics, and unwillingness to participate). The final study population comprised 30 patients (15 male, 15 female) randomly assigned to either Group P (paravertebral block, n = 14) or Group M (morphine, n = 16).
Interventions: In Group P, a unilateral paravertebral catheter was inserted 1 day preoperatively; on the day of surgery, a single-level unilateral paravertebral block was administered through the catheter before general anesthesia. Infusion of bupivacaine continued intraoperatively and postoperatively. Patients in Group M received only general anesthesia, and morphine patient-controlled analgesia was begun postoperatively.
Measurements: Intraoperative analgesic and anesthetic requirement, postoperative numerical rating scale pain scores, additional analgesic consumption during the postoperative period, and incidence of complications related to thoracic paravertebral block (TPVB) like pleural puncture, pneumothorax, epidural spread, injection into the subarachnoid space, intravascular injection, and Horner's syndrome and rate of opioid related adverse reactions like nausea and vomiting, itching, constipation, and respiratory depression.
Results: Intraoperative remifentanil consumption was significantly higher in Group M, and postoperative morphine consumption was significantly lower in Group P ($P < .001$). During the first 24 hours postoperatively, the mean numerical rating scale pain scores were similar and there were no significant differences between the 2 groups. There were no statistically significant differences in the additional analgesic consumption and rate of adverse reactions between the 2 groups. We didn't detect any complication related to TPVB in group P.
Conclusions: Continuous thoracic paravertebral block provides good intraoperative stability with a low anesthetic requirement and reduces postoperative morphine consumption for up to 24 hours. Ultrasound guided technique enhanced the safety of TPVB and provides analgesia without major complications.

1. Introduction

A flank approach may allow better dissection of the renal pelvis and pedicles and be advantageous in open nephrectomy; however, this approach induces more persistent pain [1]. Intravenous patient-controlled analgesia (IV-PCA) with opioids is one of the most widely used methods of pain control, but IV-PCA alone is insufficient for managing some patients with severe postoperative pain [2]. Thoracic paravertebral block (TPVB) is a simple and a safe method with significant advantages over neuraxial or intercostal blocks and results in ipsilateral somatic motor and sensory nerve block of multiple contiguous thoracic dermatomes above and below the injection site [3]. TPVB may also reduce anesthetic and analgesic requirements and provide hemodynamic stability in surgical patients. Many studies have shown that TPVB is an effective form of analgesia after thoracotomy, multiple fractured ribs, major breast surgery, and inguinal hernia repair [4]. However, data on the use of TPVB in patients undergoing renal surgery [2,5-7], especially donor nephrectomy [2,8,9] are limited.

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Three randomized studies have assessed the efficacy of PVB for percutaneous nephrolithotomy [5-7]. In one study, lumbar (L_1–L_2) PVB was performed and a catheter inserted to provide intraoperative surgical anesthesia [5], and in another, multiple-level TPVB (T_{10}–T_{12}) was performed at the end of surgery to provide postoperative analgesia [6]. In a recent prospective, observer-blinded randomized controlled study, single-level ipsilateral TPVB with a catheter was administered at T_9–T_{10} for percutaneous nephrolithotomy [7]. The authors concluded that PVB provides intraoperative and postoperative pain relief and improves the quality of recovery in patients undergoing percutaneous nephrolithotomy.

PVB has also been described as a technique for postoperative analgesia for open renal surgery in adults [2,8,9] and children [10,11]. Recently, an observer-blinded, randomized controlled study using TPVB for nephrectomy added preoperative single TPVB to IV-PCA, which resulted in better analgesia than with IV-PCA alone [2].

Several reports [2,5-11] have shown that TPVB provides safe and effective perioperative analgesia for renal procedures. However, differences between the level of catheter placement and technique make study comparison difficult. Also, to our knowledge, there are no randomized controlled studies of ultrasound-guided continuous TPVB in donor nephrectomy. Therefore, our aim in this prospective randomized controlled study was to determine the efficacy of ultrasound-guided TPVB intraoperatively and during the first 24 hours postoperatively in patients undergoing donor nephrectomy.

2. Methods

Ethical approval for this study (project no: KA14/102) was provided by the Baskent University Institutional Review Board and Ethics Committee, Ankara, Turkey (chairperson H. Ozkardes, MD, PhD) on 17 November 2014. After obtaining written informed consent from the study participants we enrolled 32 patients undergoing donor nephrectomy in this prospective randomized controlled study from November 2014 to June 2015.

We excluded patients with coagulation disorders, those with a history of allergy to local anesthetics, and those who elected not to participate. Patients were randomly assigned to one of 2 groups: Group P (PVB) and Group M (morphine) using the closed-envelope technique. The number of patients required for each group was determined using a power analysis. Anticipating a 2.5 point difference in the numerical rating scale (NRS) score for pain (where 0 = no pain, 10 = worst pain) as the desired difference with a standard deviation of 2 points (observed in a previous study of PVB), the estimated sample size was 14 per group with $\alpha = 0.05$ and power = 90%. The study was conducted with 16 patients in each group to ensure adequate final numbers. A unilateral paravertebral catheter was inserted 1 day before surgery in patients in Group P, and on the day of surgery, a single-level unilateral paravertebral block was administered through the paravertebral catheter, followed by general anesthesia. Patients in Group M received only general anesthesia. During and after the surgery, bupivacaine infusion continued through the catheter in Group P. In Group M, morphine PCA was begun in the postanesthesia care unit.

A thoracic paravertebral catheter was inserted at T_{11}–T_{12} in 16 donor nephrectomy cases by the same anesthetist with the help of a radiologist under ultrasound guidance (Siemens Antares ultrasound unit; Siemens Healthcare, Mountain View, CA) with a 5- to 13-MHz frequency range VF13–5 linear probe. We previously used the study reported by Baik and coll. [2] to determine the ideal level of the PVB in a pilot study of four cases. Two catheters inserted at T_9 provided inadequate analgesia, and both patients suffered pain at the distal incision. A catheter inserted at T_{11}–T_{12} in the other 2 cases did provide adequate analgesia.

One day before surgery on the proposed side of operation, a thoracic paravertebral catheter was inserted under ultrasound guidance with the patient in a sitting posture and under strict aseptic precaution. The transducer was placed at a point approximately 2 cm lateral to the tip of the spinous process in a vertical and/or longitudinal orientation alongside the probe in an "in-plane" technique (Fig. 1). After obtaining a sonographic view of the pleura and transverse process, local anesthetic was infiltrated into the skin. Next, a Tuohy needle was advanced into the paravertebral space until the pleural border was reached. Saline was then injected into the paravertebral space under real-time ultrasound guidance. Thereafter, a compatible catheter (18-G multi-orifice epidural catheter; B. Braun Medical Inc., Bethlehem, PA) was advanced 4 cm into the paravertebral space and fixed to the skin. Patients then received a bolus test dose of 3 ml of 2% lidocaine with epinephrine 1:2 000 000.

After premedication with 0.03 mg/kg of intravenous midazolam, all patients were admitted to the operating room, and noninvasive blood pressure, pulse oximetry, and electrocardiography were monitored continuously. In Group P after administration of the test dose of local

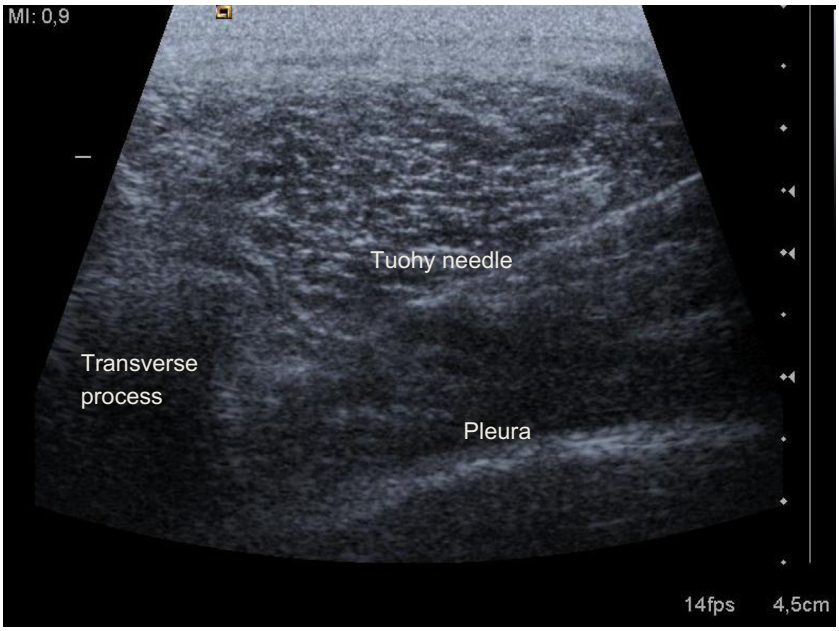

Fig. 1. Ultrasound view of Tuohy needle while inserting the paravertebral catheter.