

Case Report

## Percutaneous Nephrolithotomy under Local Infiltration Anesthesia in Kneeling Prone Position for a Patient with Spinal Deformity

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Urolithiasis, a common condition in patients with spinal deformity, poses a challenge to surgical procedures and anesthetic management. A 51-year-old Chinese male presented with bilateral complex renal calculi. He was also affected by severe kyphosis deformity and spinal stiffness due to ankylosing spondylitis. Dr. Li performed the percutaneous nephrolithotomy under local infiltration anesthesia with the patient in a kneeling prone position, achieving satisfactory stone clearance with no severe complications. We found this protocol safe and effective to manage kidney stones in patients with spinal deformity. Local infiltration anesthesia may benefit patients for whom epidural anesthesia and intubation anesthesia are difficult.

**Key words:** percutaneous nephrolithotomy, local infiltration anesthesia, kneeling prone position, spinal deformity

The treatment of renal stones in patients with a spinal deformity can be very challenging. Ankylosing spondylitis (AS) affects the body's joints and adjacent structures including vertebra, sacroiliac joints, and the hips and shoulders, resulting in the fusion of the spine. Percutaneous nephrolithotomy (PCNL) is well established in the modern era to treat large renal calculi, even in patients who also have risk factors such as a renal anatomical abnormality, morbid obesity, or a history of renal surgery. Here we report the case of a patient with AS, spinal kyphosis deformity, and renal stones who underwent a PCNL under local infiltration anesthesia (LIA) in a kneeling prone position. A protocol for PCNL under LIA performed with the patient in a kneeling prone position or for patients with renal stones and a severe spinal deformity had not been

reported prior to this case.

### Case Report

A 51-year-old Chinese male with AS was admitted to our clinic due to bilateral multiple renal stones. He had never experienced pain, odynuria, gross hematuria or fever, and he thus paid no attention to the disease. He had recently undergone a health physical examination and was diagnosed with bilateral multiple renal stones, right ureteral calculus, right renal atrophy, and renal insufficiency. Due to the patient's spinal deformity, he had high risks related to anesthesia and surgery, and another clinic hesitated to operate on him. He eventually sought medical advice at our clinic.

The complete laboratory evaluation revealed a urinary tract infection (urine white blood cell (WBC) count > 50/high-power field (HPF), urine red blood cell

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(RBC) count 8/HPF, and urine bacteria > 51/HPF) and renal insufficiency (serum creatinine 4.93 mg/dL), with other test results being normal. Ultrasonography (US) implied bilateral multiple renal stones, a left renal liquid dark area, and right renal volume reduction. The results of computed tomography (CT) were as follows (Fig. 1A): (1) bilateral multiple renal stones in different calyces with left renal hydronephrosis, (2) right middle ureteral stones, (3) right renal atrophy, and (4) a fusion of a sacroiliac joint and hip joint. Radionuclide renal dynamic imaging indicated that excretion reduced slightly in the left kidney, but seriously in the right one. A radioisotope renogram showed that the left kidney's glomerular filtration rate (GFR) was 35.53 ml/min, and that of the right kidney was 8.47 ml/min. Lung function test results were normal.

The patient was informed in detail about the PCNL operation and consented to undergo LIA. To relieve hydronephrosis and save kidney function, we performed the PCNL on the left kidney with the patient under LIA. Pethidine premedication (75 mg) and Phenergan (promethazine) (25 mg) were administered 30 min before the surgery. Ureteral catheterization failed to be completed due to the patient's spinal deformity and hip joint fusion. We then placed a 16-F Foley catheter in the bladder to ensure the urine flow.

We designed a special position for this patient by combining a kneeling position with the prone position (Fig. 2). To accomplish this, the patient first kneeled down on the operating table with his knees on soft

pads. The compressed thoracic region was then filled in with position pads in line with the patient's spinal deformity. These adjustments made the patient's position stable and comfortable. Next, 5 mL of 2% lidocaine was diluted by normal saline for 10 mL 1% lidocaine. A skin wheal was made at the puncture site with the diluted 1% lidocaine, and then a 23-gauge spinal needle was used to infiltrate from the skin to the renal capsule. The total dosage of lidocaine was 100 mg.

Next, the target calyx was percutaneously punctured with an 18-gauge coaxial needle under US guidance. After a 2-step dilatation, the working sheath was well placed. Under direct nephroscope (8.5/11.5-F) vision, the stones were fragmented by a pneumatic lithotripsy system.

More than one working tract was needed to remove multiple renal stones from the patient. Considering the duration of the operation, the first procedure was concluded with the placement of a double-J ureteral catheter (6-F, 26 cm) and a nephrostomy tube (18-F). Similarly, we performed a second PCNL operation a month later when we placed no double-J ureteral catheter but did place a nephrostomy tube; this tube was removed on the fifth post-operative day.

After the 2 surgical procedures, satisfactory renal stone clearance was confirmed without obvious pain, serious bleeding or other complications during and after the patient's operations. Figure 1B provides a postsurgical CT image. The patient was discharged on the sixth post-operative day. Two months after the second oper-

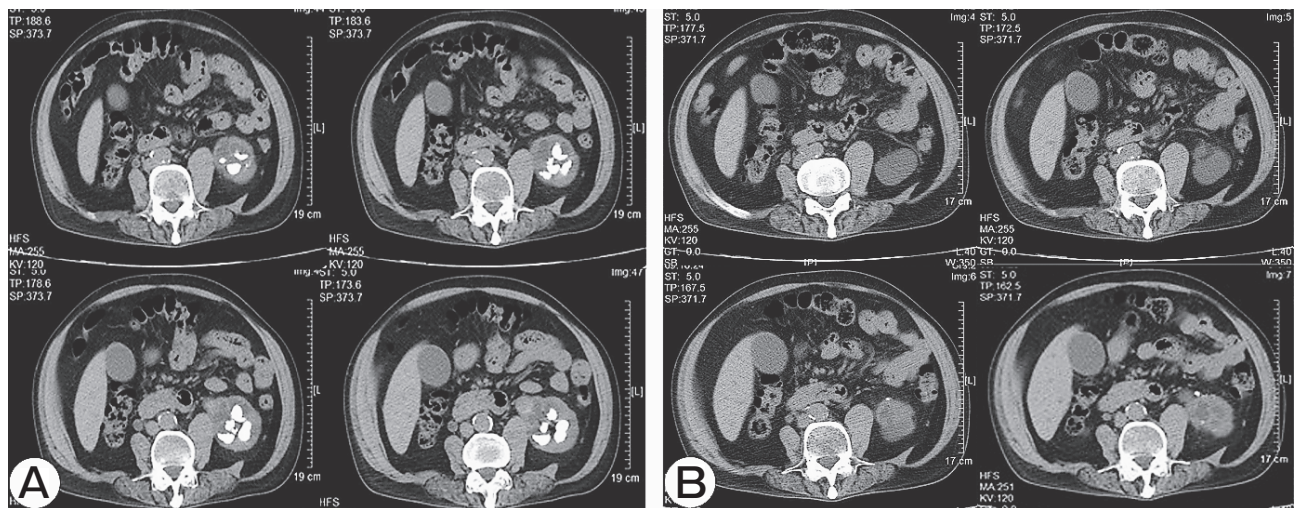
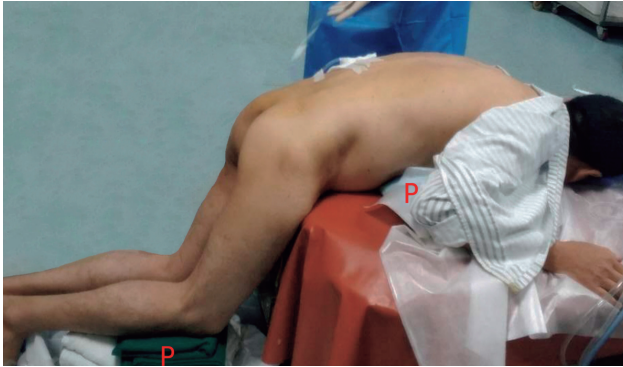


Fig. 1 A, The preoperative CT scan revealed multiple left renal stones in different calyces and right renal atrophy; B, Postsurgical CT indicated a high rate of stone clearance and significant relief of the urinary obstruction after a PCNL was performed twice under LIA.



**Fig. 2** The patient was placed in a kneeling prone position for biomechanical adaptation of the spine kyphosis and hip ankylosis. P: soft pad.

ation, the patient's serum creatinine level had decreased to 4.38 mg/dL. Based on the patient's preference and right renal atrophy, the right renal stones have not been handled positively.

## Discussion

Patients with a spinal deformity have a higher risk of stone diseases, which are caused mainly by immobilization, voiding dysfunction, metabolic disorders, and/or chronic urinary infection [1]. The treatment of renal stones in the presence of a spinal deformity can be challenging because of anatomic variations and respiratory dysfunction [2]. Due to their high-risk factors, these patients should be categorized into a special type. Mousavi *et al.* recommended PCNL as the best strategy to treat renal stones in a patient with spinal deformity, and they reported that the overall complete stone-free rate reached 87% after a second PCNL [3]. Several studies also suggested that a PCNL can be performed on such patients safely and efficiently [4-6].

A spinal deformity can restrict lung ventilation and result in cardiorespiratory dysfunction, which consequently brings about tracheal intubation difficulties and a high risk of epidural anesthesia failure [7,8]. However, our patient's case demonstrates that the combination of PCNL with LIA effectively overcame the above-described problems and avoided anesthesia-related complications. The key determinant of surgical complexity is the relative locations among the affected kidneys, the surrounding organs, and the curved spine.

Proper patient positions provide enough space for the establishment of access and endoscopic instru-

ments. There are different position options including prone, lateral, supine, and other special positions. Because of our patient's spinal angle, pelvic tilt and hip ankyloses, we did not consider the lateral or supine position. Generally speaking, it is also difficult to accommodate such a patient well in the lateral position in light of the width of a standard operation table. PCNL studies in patients with spinal deformities indicate that the prone position is still preferred when possible for a patient's body habitus, because it offers a wider space for percutaneous access and the endoscope instruments [3,6].

PCNL under LIA offers many advantages, as follows. A subset of patients with severe comorbidities can tolerate neither general anesthesia nor epidural anesthesia but can tolerate LIA due to its minimal impact on the respiratory and cardiovascular systems. In addition, patients under LIA remain conscious, and they are free to communicate with the surgeons. Postoperatively, they return to normal eating, walking, and other activities soon in accord with the concept of enhanced recovery after surgery (ERAS). As a result, both shorter hospital stays and reduced costs are achieved when PCNLs are performed under LIA [9].

As a local anesthetic drug, lidocaine is usually well tolerated (with rare occasions of allergic reactions). LIA toxicity is due to the prolonged application of high drug concentrations or the absorption of large doses of lidocaine [10]. For subcutaneous infiltration, the recommended maximum doses of lidocaine with epinephrine and without epinephrine are 4.5 mg/kg and 7 mg/kg, respectively [11]. In our patient's case we used 100-mg lidocaine, which is far below the recommended maximum dose. Based on the above advantages, LIA can act as an alternative to traditional methods of spinal or general anesthesia.

We have successfully performed >6,000 cases of PCNL under LIA without the occurrence of procedural death or serious complications such as septic shock or severe renal bleeding requiring a nephrectomy. Here we applied the same technique to the case of a patient with kidney stones and spinal deformity. The adaptive patient position and the well-tolerated anesthesia ensured a satisfying treatment outcome. We have observed that a PCNL conducted with the patient under LIA is a challenging but feasible way to treat a patient with a spinal deformity in a kneeling prone position, but further clinical research must be conducted before

firm conclusions can be made about this.

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