Case Report

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Clinical application of percutaneous nephrolithotomy in a patient with kyphoscoliosis

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Abstract

This case report describes the performance of ultrasound-guided percutaneous nephrolithotomy in a 50-year-old woman who had scoliosis with kyphosis and a history of tuberculosis of the lumbar spine. The operation was performed with the patient under general anesthesia and in the prone position. Residual stones were found in the right lower kidney calyx postoperatively, resulting in a second-phase surgery using the same approach 2 weeks later. All stones were successfully removed during the second surgery. No complications occurred in either operation, and the patient recovered well. This study suggests that ultrasound-guided percutaneous nephrolithotomy is a safe and effective approach in treating renal calculi in patients with scoliosis.

Keywords

Percutaneous nephrolithotomy, renal calculus, scoliosis, case report, ultrasound guidance, lithotomy

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Introduction

Percutaneous nephrolithotomy (PCNL) is the gold standard for treating kidney stones of >2 cm and achieves a stone-free rate as high as 74% to 100%.[1] The postoperative complications include hemorrhage,

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adjacent organ damage, and impaired renal function. The presence of renal calculi with scoliosis significantly increases the surgical risks of PCNL because of anatomical deformity and is therefore an essential technical barrier to PCNL. The American Urological Association guideline lists severe scoliosis as a relative contraindication for PCNL.[2] This report describes the performance of PCNL on a patient with acquired scoliosis accompanied by kyphosis. During the operation, a trocar was accurately impaled under B-type ultrasound guidance, and renal calculi were successfully removed through two-phase lithotomy.

Case report

Patient's record

A 50-year-old woman was admitted to the hospital for bilateral renal calculi discovered through physical examinations. She had scoliosis with kyphosis and a surgical history of lumbar spine tuberculosis (Figure 1(a), (b)). The patient underwent a routine ultrasound examination, intravenous pyelogram, kidney–ureter–bladder (KUB) plain films (Figure 2(a)), an abdominal plain computed tomography (CT) scan (Figure 2(b)), and cardiopulmonary function evaluation. The intravenous pyelogram showed renal stones in both kidneys and hydronephrosis in the right kidney. The right kidney stone was located in the right lower calyx. Ultrasound examination showed multiple calculi, the largest measuring 3.0 cm, and a spinal Cobb's angle of 60 degrees. Pulmonary function assessment showed a 75% predicted vital capacity, 80.1% predicted forced vital capacity, forced expiratory volume/forced vital capacity ratio of 76.1%, and small airway ventilation dysfunction. Echocardiography showed an ejection fraction of 57%, E/A ratio of 1.2, left ventricular systolic dysfunction, moderate mitral valve reflux, and mild to moderate pulmonary hypertension. Ultrasound was used to determine the scope and depth of the trocar entrance before the operation. Bacterial culture indicated no urinary tract infection. The patient's renal function was normal.

Surgical procedures

The patient underwent general anesthesia and was placed in the lithotomy position with the abdomen elevated to fit the patient's deformed spine. A 5-Fr ureteral catheter was

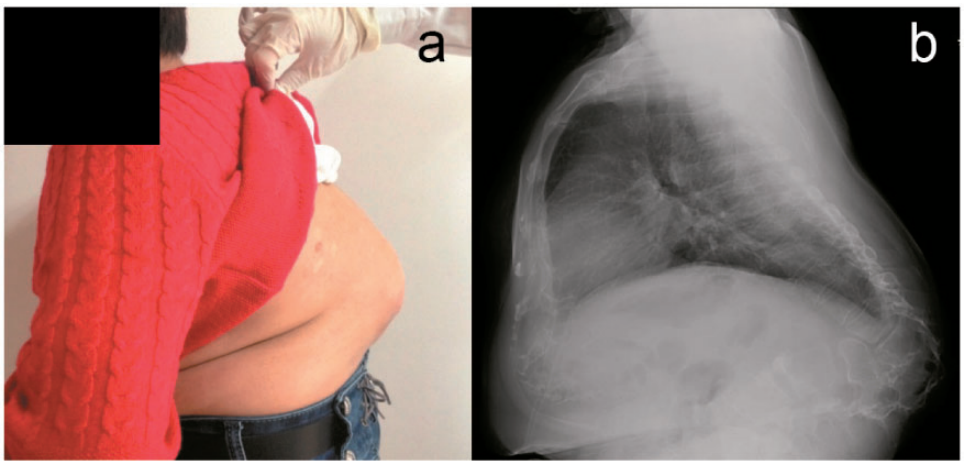

Figure 1. (a) Photograph and (b) X-ray film of the patient with scoliosis and kyphosis.

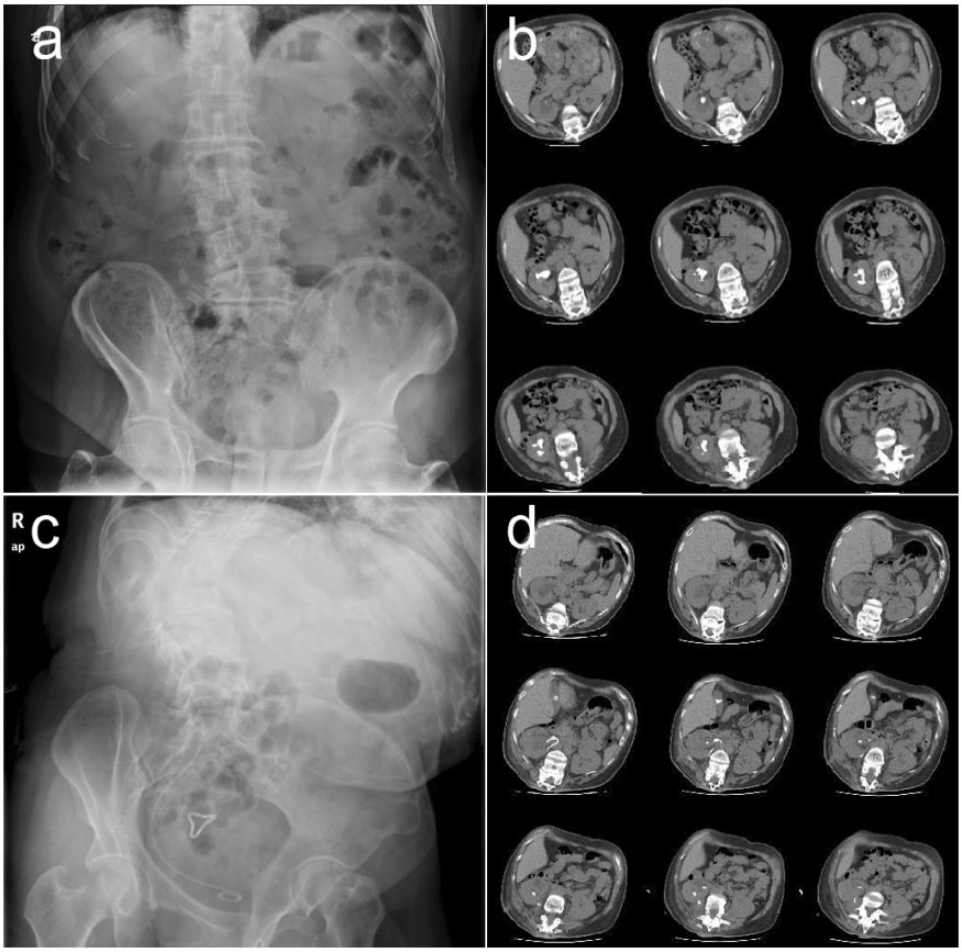

Figure 2. (a) Kidney–ureter–bladder plain film and (b) abdominal plain computed tomography image before the first operation. (c) Kidney–ureter–bladder film and (d) computed tomography image 3 days after the first operation.

retrogradely placed on the right side under the cystoscope, and a 16-Fr catheter was retained. The patient was then placed in the prone position with the belly side raised to match the spinal deformity as much as possible and stretch the waist for the operation. A puncture was made under the right 12th rib, extending along the posterior axillary line to the middle calyx of the right kidney under ultrasound guidance. The guidewire was retained, and the trocar sheath was retracted. A fascial dilator and nested metal expander were used to expand the pathway from 12 to 24 Fr, and a 20.8-Fr nephroscope was placed after establishing the pathway. Pneumatic and ultrasound lithotripsy was performed to disperse visible stones, which were flushed out or clipped out of the pathway using lithotomy forceps. Intraoperative ultrasound suggested residual stones in the lower renal calyx; therefore, a second-phase operation was considered. Anterograde placement of a 5-Fr double J catheter was difficult. The patient was placed in the

lithotomy position before introduction of a Zebra urological guidewire.

A 4.7-Fr ureteral stent was placed along the guidewire between the renal pelvis and bladder, and a 22-Fr nephrostomy tube was retained. The nephrostomy tube was occluded for 2 hours because of intraoperative bleeding, after which time no further bleeding was observed. The patient underwent KUB (Figure 2(c)) and CT (Figure 2(d)) examinations 3 days postoperatively to check the locations of the ureteral stent, nephrostomy tube, and residual stones. The second-phase PCNL was performed 2 weeks after the first procedure. The trocar was introduced from the right lower renal calyx, and the same procedure was adopted to remove the residual stones. A 20-Fr nephrostomy tube was retained. The nephrostomy tube was removed 5 days after the second operation, and the double J catheter was removed 4 weeks postoperatively.

Outcomes

The first operation lasted 90 minutes, and the intraoperative blood loss volume was 30 mL. The second operation lasted 30 minutes with 10 mL of intraoperative blood loss. The nephrostomy tube was removed 3 days after the second operation. The patient underwent another KUB examination 5 days postoperatively, and the catheter was removed. The KUB examination showed that the double J catheter was properly located, and no residual calculus was detected (Figure 3). There was no significant change in the serum creatinine concentration from before to after the operation, indicating that the patient's renal function was not affected by the operation. The right-side double J catheter was removed under cystoscopy 4 weeks postoperatively. The patient was followed up for 3 months, and no obvious complications occurred.

Figure 3. Kidney–ureter–bladder film 5 days after the second operation.

Discussion

Scoliosis is characterized by abnormal three-dimensional changes in the structure and shape of the spine, and its incidence is approximately 1%.[3] Scoliosis can be divided into three types: congenital, syndromic, and idiopathic. Congenital scoliosis is spinal deformity caused by abnormal formation of the vertebrae.[4] Syndromic scoliosis is related to dysfunction of the neuromuscular system, skeletal system, and connective tissue as well as diseases such as neurofibromatosis. Idiopathic scoliosis is scoliosis of unknown cause. In the present case, the patient had a history of lumbar vertebral tuberculosis and was therefore considered to have syndromic scoliosis combined with kyphosis.

Few epidemiological reports have focused on renal calculi in patients with severe scoliosis. The standard treatment strategy for this condition is unclear and has been rarely reported, representing a challenge in the field of urological surgery. Extracorporeal shock wave lithotripsy was

once reported to be used to treat renal calculi in patients with severe scoliosis.[5] However, this application was limited because of postoperative intestinal bleeding.[6,7] Additionally, the effect of extracorporeal shock wave lithotripsy on hard stones or those of >2 cm was unsatisfactory.[8] Open surgery is another routine strategy; however, it has high rates of complications and mortality.

In the 1950s, Goodwin et al.[9] first reported the use of PCNL to treat hydronephrosis caused by obstruction. Not until 20 years later was PCNL reportedly used to treat renal calculi. PCNL is currently recommended by the American Urological Association as the first-line treatment choice for most kidney stones. However, PCNL is challenging to perform in patients with scoliosis, mainly because of the likelihood of damaging the surrounding dislocated or deformed organs during the establishment of pathways. Therefore, the presence of renal calculi combined with severe spinal deformity is listed as a relative contraindication for PCNL.

In 2010, Goumas-Kartalas and Montanari[10] treated eight patients with renal calculi and severe spinal deformity using ultrasound-guided PCNL. In 2011, Kara et al.[11] treated five patients with renal calculi and scoliosis using X-ray-guided PCNL. Both studies suggested that PCNL can be an effective surgical procedure for patients with scoliosis.

Pulmonary dysfunction is the main systemic effect of spinal deformity. The effective volume of the chest decreases, especially for patients with severe scoliosis characterized by thoracic deformity, kyphosis, or kyphosis. This results in decreased lung compliance, increased respiratory and circulatory resistance, and dysfunction of pulmonary blood–gas exchange.[12,13] These effects significantly affect cardiopulmonary function and significantly reduce operative tolerance. Therefore, it is essential to evaluate the patient's cardiopulmonary function to ensure surgical safety. Our patient had asthma and experienced difficulty in breathing after heavy physical labor. Pulmonary function assessment showed restrictive ventilatory dysfunction; therefore, routine epidural anesthesia would have aggravated the burden on the heart and lungs and increased the anesthetic and operative risks. General anesthesia was thus adopted with the abdomen raised to reduce the chest compression as much as possible. The use of a low-pressure system during PCNL reduces fluid absorption and avoids volume overload.[14] However, there is a potential risk of fluid absorption in patients who have scoliosis with poor cardiac and pulmonary circulation.[15] The circulatory load should be closely monitored during the operation to prevent water intoxication.

Spinal deformity also affects the body position during the operation. For patients with scoliosis, choosing the right location is key to successfully establishing a percutaneous renal channel. Unconventional positions can be used, including the supine, prone, lateral, and lateral prone positions, depending on the angle of the spinal curvature. In patients whose spine curves toward the affected side where the stones are located, the lumbar region of the affected side is stretched, allowing the affected kidney to be more easily exposed. Therefore, an effective body position and puncture pathway are more easily achieved. Conversely, if the spine curves toward the unaffected side, the lumbar region on the affected side is adducted and the affected kidney is located deep inside. Therefore, the adjacent organs are easily damaged during the puncture. In the present case, the patient's spine curved toward the affected side. A prone position was used, and the outcome of the operation was satisfactory.

Establishing the puncture pathway under ultrasound guidance can effectively avoid intraoperative damage to abdominal organs

caused by spinal deformity. Our patient sustained no colon or other internal organ damage. Likewise, Goumas-Kartalas and Montanari[10] and Kara et al.[12] reported no such complication. No recent reports have compared the safety and efficacy of ultrasound-guided or X-ray-guided PCNL in patients with scoliosis. Matlaga et al.[16] treated renal calculi in six patients with scoliosis, among whom the puncture pathway was established under CT guidance in five. The findings suggested that more accurate information can be obtained from the cross-sectional images of patients with scoliosis. CT guidance can indeed provide more accurate images than ultrasound guidance. However, ultrasound guidance requires simpler equipment and avoids radiation.[17]

The three major considerations when performing PCNL for renal calculi in patients with scoliosis are choosing the type of anesthesia based on the patient's cardiopulmonary function, choosing the proper surgical position, and establishing the most effective percutaneous pathways. Ultrasound-guided PCNL has many advantages in increasing operation safety provided that the patient's imaging examination results are carefully interpreted before the operation, the puncture route is carefully planned, and a proper position is chosen to minimize chest compression and the cardiopulmonary burden. PCNL is effective and safe for treatment of renal calculi in patients with scoliosis.

Ethics

The Ethics Committee of the Affiliated Yantai Yuhuangding Hospital of Qingdao University (Yantai, Shandong) gave ethics approval for this study. The patient provided written informed consent to use her personal identification information and medical records for publication. Consent for treatment was also provided.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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