Percutaneous Nephrolithotomy of Kidney Calculi in Horseshoe Kidney

Mohammad Reza Darabi Mahboub, Ali Ahanian, Maryam Zolfaghari

Introduction: The aim of this study was to evaluate percutaneous nephrolithotomy (PCNL) in horseshoe kidneys with calculi.

Materials and Methods: Between 1995 and 2005, we performed PCNL in 9 patients with horseshoe kidney. In 3 of them, there was a single calculus and the rest had multiple calculi in the pelvis and at least 1 in the calyxes. Ultrasonography, plain abdominal radiography, and intravenous urography (IVU) were performed in all patients. We used fluoroscopy for entering the system and then, pneumatic or ultrasonic lithotripsy was used.

Results: In all except 1 patient (88.9%) we could access the system. Single calculi in 3 patients were removed. In 5 patients with multiple calculi, the calculus causing obstruction was removed, and in 3, the calculi located in the calyxes were removed too. Consequently, 66.7% were stone-free at the end of the procedure. In 2 patients, there were residual calculi in the calyxes and they underwent candidates for extracorporeal shockwave lithotripsy.

Conclusion: Percutaneous nephrolithotomy can be used in patients with horseshoe kidney if the patient selection is appropriate and the surgeon is experienced enough. The success rate and complications are the same as the patients with normal anatomy. However, access to the lower calyx is more difficult due to its anatomic status.

Keywords: urogenital abnormalities, horseshoe kidneys, percutaneous nephrolithotomy, urinary calculi

Urol J. 2007;4:147-50.
www.uj.unrc.ir

INTRODUCTION

Horseshoe kidney is the most common fusion abnormalities in the kidney and occurs in 1 per 400 people with the male-female ratio of 2:1.[1] Urogenital abnormalities are detected clinically in all age groups; however, they are more common in the autopsy specimens of children. This is due to the higher incidence of the congenital abnormalities in pediatric patients some of which being in contrast to long survival.[2]

The most common complication of horseshoe kidney is kidney calculus.[3] It was previously believed that such a high frequency of calculus formation in these patients was due to the higher rate of infection, stasis, and obstruction because of the abnormal position of the pelvis and the ureter. However, the last reviews are suggestive for metabolic causes in most of the patients.[4] Extracorporeal shock wave lithotripsy (SWL) is the method of choice for the treatment of small calculi.[5] For calculi larger than 2 cm, those in the anterior middle calyx, or those that do not respond to SWL, percutaneous nephrolithotomy (PCNL) is preferred.[3] Although the anatomical position of the collecting tubules in a horseshoe kidney interfere with the calculus passage after SWL,

Department of Urology, Imam Reza Hospital, Mashhad University of Medical Sciences, Mashhad, Iran

Corresponding Author:
Mohammadreza Darabi, MD
Department of Urology, Imam Reza Hospital, Mashhad, Iran
Tel: +98 511 854 3031
E-mail: j_darabi@yahoo.com

Received September 2006
Accepted June 2007

this abnormal anatomic position causes PCNL to be easier and more safe.[3] Also, the arteries entering the umbilicus of the kidney may originate from the aorta, hypogastric artery, or common iliac artery, and the site of kidney puncture is far from the main arteries.[2] The posterior position of the calyxes reduce the possibility of intestinal injury, as well.[3]

Hereby, we report our experience in PCNL for kidney calculi in patients with horseshoe kidney.

MATERIALS AND METHODS

Between October 1995 and October 2005, we had 9 patients with horseshoe kidney referred to Imam Reza Hospital for PCNL. The major complaint of the patients was flank pain accompanied by gastrointestinal symptoms including nausea and vomiting. Five patients had gross hematuria. Laboratory tests including complete blood count, fasting blood glucose, blood urea nitrogen, serum creatinine, urinalysis, and urine culture (in case of positive urinalysis for infection) were performed in all patients. Radiological assessments included plain abdominal radiography and intravenous urography (IVU) in all patients, and ultrasonography in 3. Size and number of the calculi (stone burden) were determined. The horseshoe kidney was confirmed by IVU.

Due to the impossible spontaneous passage of the calculi and low success rate of SWL, the patients were candidates for PCNL. Potential complications of the PCNL were discussed with the patients and their families before the procedure and after taking written consent, they underwent PCNL. Patients with urinary tract infection were treated, and 1 hour before the procedure, received prophylactic antibiotic (intravenous cephalothin, 1g). After induction of anesthesia, a 5-F ureteral catheter was inserted via cystoscope. In the prone position, the entrance site into the kidney was determined using fluoroscopic guidance and injection of diluted contrast medium. Tilting the side of the calculus up to 30 degrees, the site of entrance was determined. Due to deviation of the horseshoe kidney axis, a more medialized pathway was needed for entering the kidney. The appropriate place was the posterior auxiliary line at the end of the 12th rib. Since most of the horseshoe kidney calyxes are dorsomedial or dorsolateral, a better position for kidney puncture in comparison with that in normal kidneys can be achieved.[2] We accessed the system from the lateral side of the sacrospinalis muscle. After entering the targeted calyx, a guide wire was placed, and using facial dilators, the tract was dilated up to 16 F. Then, the tract was dilated up to 28 F, using metal dilators. A 28-F Amplatz sheath was utilized and the relation between the interior part of the kidney and outside was maintained and nephroscopy was performed by a 24-F nephroscope. After washing the kidney and removal of the blood clots, the calculi were identified. A grasping forceps was used for removal of small calculi, and pneumatic and ultrasonic lithotripters were used for fragmentation of large calculi.

RESULTS

Six patients (66.7%) were men and 3 (33.3%) were women with the age range of 20 to 59 years. Five patients had the calculi in the left side and the 4 in the right. In 3 patients (33.3%), the calculus was solitary and in the other 6 (66.7%), there were multiple calculi in the pelvis and calyxes. Four patients (44.4%) had previously undergone SWL which was unsuccessful and in 1 (11.1%), the calculus was fragmented into small pieces which had not passed spontaneously. History of the surgery due to previous calculi was positive in 2 patients (22.2%). In 4 (44.4%), metabolic evaluations had been performed for the diagnosis of the cause of the calculus formation which were unremarkable. Based on the results of urinalysis and urine culture, urinary tract infection was detected in 2 patients (22.2%) who underwent appropriate treatment.

We could access the collecting system in 8 patients (88.9% success rate). After entering the kidney, the single calculi in 3 patients were removed. In 5 patients with multiple calculi, the one that had caused the obstruction was removed, and 3 patients became stone free. In the remaining 2 patients, all of the calculi could not be removed. Overall, the stone-free rate was 66.7% (6 out of 9). Residual calculi were present in 2 out of 8 patients with successful access (25%) in whom nephrostomy tube was placed and fixed. These patients underwent SWL. Tubeless and standard (nephrostomy tube and ureteral catheter) methods were used in 1 and 5 patients without residual calculi, respectively. In 1 patient that access to the system was not achieved, open surgery was performed.

Intraoperative and postoperative bleeding that would require transfusion did not occur in any of the patients. In patents with nephrostomy catheter, it was clamped for 4 hours and then opened. On the 3rd postoperative day, it would be removed if there was no bleeding from the tube. The patients were discharged on the 4th postoperative day after removal of the ureteral catheter. The patient in the tubeless group was discharged on the 3rd day.

DISCUSSION

Many factors affect the PCNL success rate in horseshoe kidneys. These kidneys are located inferior and medial to the normal place of the kidneys, and the superior and medial calyxes are more dorsalized. Due to the anterior movement of the kidneys, we need a longer tract for achieving access to the kidney which may result in limitations in using the conventional rigid nephroscopes.[6] Also, the abnormal position of the kidney causes abnormal neighboring with other organs, especially the colon that can be placed at the posterior part of the kidney.[7] Therefore, antegrade access is safer than the retrograde access which needs computed tomography (CT) before the procedure.[8] In most cases, nephrostomy tract should be placed medially crossing the erector spinae and quadratus lumborum muscles. This makes a long and rigid tract accompanied by the rather immobility of the kidneys, and therefore, evaluation of all calyxes with a rigid nephroscope via a single nephrostomy tract is commonly impossible. In centers that routinely use antegrade nephrostomy techniques (as our center), nephrostomy tract is made medially, and there is no need for CT to evaluate the position of the colon in cases with horseshoe kidneys.[8] In 1985, the relation between the horseshoe kidney and retrorenal colon was firstly reported and it was stated that preoperative CT scan could show the retrorenal colon.[4] However, due to the low incidence of this condition (1%),[2] we did not use CT before the procedure. We routinely chose a more medial position than usual for the tract (nearer to the spine) in cases of horseshoe kidney.

The ureter of the horseshoe kidney typically originates from the upper part of the pelvis and this may be accompanied by ureteropelvic junction obstruction and calculus formation.[9,10] Entering the kidney via the upper pole facilitates access to the upper pole calyxes, the pelvis, the calyxes of the lower pole, and the proximal ureter. Additionally, because the longitudinal axis of the nephroscope is along with the longitudinal axis of the kidneys, pressure on the kidney tissue by nephroscope and the subsequent bleeding reduces.[6] In 1 patient, we successfully accessed the kidney via the upper calyx.

In patients with normal kidney anatomy, calyxes of the upper pole are in front of the ribs 11 and 12 and entering them needs a supracostal approach that may cause thoracic complications such as pneumothorax.[11] However, in a horseshoe kidney, since the kidney is placed lower than the normal position, there is usually no need for supracostal approach. Usually, we can reach the pelvic calculi by a rigid nephroscope and fragment them using rigid instruments such as pneumatic and ultrasonic probes, but we can only reach calculi in the calyxes with flexible nephroscopes and should guide them to the parts that can be accessed by rigid or flexible instruments such as electrohydraulic or laser probes.[8] The medial calyxes of the lower pole may be hided by the spine and the calculus in them may not be seen during fluoroscopy; therefore, repeated PCNL may be needed.

Blood circulation is often abnormal in the horseshoe kidneys; however, in most cases, this is related to the displaced vessels in the isthmus and causes no problem for PCNL. The blood enters the kidney from the antromedial site and sometimes, the lower pole and isthmus of these kidneys are getting their blood supply directly from the aorta or the inferior hypogastric, external iliac, or common iliac arteries. Consequently, the collecting system and blood supply provide a proper position for percutaneous procedure, and access can be made from the upper pole calyx. However, direct access to the isthmus calyxes are not suggested because the aberrant vessels often enter the kidney in a dorsomedial direction.[8] Finally, it should be noted that flexible nephroscopes, longer rigid nephroscopes, and multiple access attempts are necessary to increase the possibility of achieving a stone-free outcome.

The possibility of calculus fragmentation in horseshoe kidneys by SWL is high, but the possibility of spontaneous passage of fragmented residues is low and often needs further intervention.[12,13] It has been reported that the most common type of the crystal in these kidneys is calcium oxalate which is similar to the normal kidneys and addresses the same metabolic factors.[6] Additionally, results of the treatment with SWL is different in these patients and the rate of becoming stone free is 27% to 28%, and these patients need more shocks in each SWL session; incidence of repeated treatment is 30% in comparison with 10% in patients with normal kidneys.[2]

CONCLUSION

It seems that performing PCNL is not more difficult in horseshoe kidneys than in normal kidneys. Also, the rate of success and becoming stone free is comparable with the patients without anatomical abnormalities. Therefore, we believe that PCNL is the treatment of choice for kidney calculi in a patient with horseshoe kidney who has not responded to or is not an appropriate candidate for SWL. Regarding the low prevalence of retrorenal colon, CT is not needed and the pelvis or upper calyxes can be served as proper access entrance sites if antegrade method is used.

CONFLICT OF INTEREST

None declared.

REFERENCES

1. Evans RM. Percutaneous access in difficult kidney. In: Sosa RE, editor. Textbook of endourology. 1st ed. Philadelphia: WB Saunders; 1997. p. 114-28.
2. Campbell 2007 p. 1497-8.
3. Yohannes P, Smith AD. The endourological management of complications associated with horseshoe kidney. J Urol. 2002;168:5-8.
4. Evans WP, Resnick MI. Horseshoe kidney and urolithiasis. J Urol. 1981;125:620-1.
5. Esuvaranathan K, Tan EC, Tung KH, Foo KT. Stones in horseshoe kidneys: results of treatment by extracorporeal shock wave lithotripsy and endourology. J Urol. 1991;146:1213-5.
6. Raj GV, Auge BK, Weizer AZ, et al. Percutaneous management of calculi within horseshoe kidneys. J Urol. 2003;170:48-51.
7. Skoog SJ, Reed MD, Gaudier FA, Dunn NP. The posterolateral and the retrorenal colon: implication in percutaneous stone extraction. J Urol. 1985;134:110-2.
8. Al-Otaibi K, Hosking DH. Percutaneous stone removal in horseshoe kidneys. J Urol. 1999;162:674-7.
9. Pitts WR, Muecke EC. Horseshoe kidneys: a 40-year experience. J Urol. 1975;113:743-6.
10. Baskin LS, Floth A, Stoller ML. The horseshoe kidney: therapeutic considerations with urolithiasis. J Endourol. 1989;3:51-54.
11. Munver R, Delvecchio FC, Newman GE, Preminger GM. Critical analysis of supracostal access for percutaneous renal surgery. J Urol. 2001;166:1242-6.
12. Jones DJ, Wickham JE, Kellett MJ. Percutaneous nephrolithotomy for calculi in horseshoe kidneys. J Urol. 1991;145:481-3.
13. Lampel A, Hohenfellner M, Schultz-Lampel D, Lazica M, Bohnen K, Thürof JW. Urolithiasis in horseshoe kidneys: therapeutic management. Urology. 1996;47:182-6.