Endoscopic Management of Urolithiasis in the Horseshoe Kidney

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OBJECTIVE To assess the endourologic outcomes of patients diagnosed with a horseshoe kidney (HK) and symptomatic urolithiasis.

METHODS A retrospective review was performed of patients diagnosed with an HK who underwent endoscopic management from 2002 to present.

RESULTS We identified 45 patients with 64 stone-bearing moieties who underwent 56 procedures, of which 31 (69%) were male. Mean age was 49.4 years (23-78) and mean stone size was 1.6 cm (0.2-5.7). Of the 64 moieties, 37 (58%) underwent percutaneous nephrolithotomy (PCNL), 25 (39%) underwent ureteroscopy (URS), and 2 (3%) underwent extracorporal shockwave lithotripsy (SWL). More than one access was utilized in 2 (5.7%) moieties undergoing PCNL. Additional procedures were required in 10 (28.5%) PCNL patients, of which 7 were URS, 2 were secondary PCNL, and 1 sandwich therapy with SWL and PCNL. Stone-free rate by moiety was 81.1% for PCNL, 84% for URS, and 50% for SWL. Postoperative complications occurred in 3 patients in the PCNL group, including readmission for pain and complicated urinary tract infection. With a mean follow-up of 20.5 months (range 0-118 months), stone recurrence was noted in 7 (16%) patients with a total of 11 events. Calcium oxalate was the most common stone type and 20/24 (83%) of patients with metabolic evaluations were found to have at least one abnormality.

CONCLUSION After careful consideration of the anatomy, individuals with HK and symptomatic urolithiasis can be managed safely by a variety of endoscopic approaches with excellent outcomes; however, secondary procedures and recurrence are common. UROLOGY 90: 45–49, 2016. © 2016 Elsevier Inc.

Horseshoe kidney (HK) is a common congenital renal fusion anomaly, occurring in approximately 1 in 400 to 1 in 666 individuals.[1,2] Ascent of the kidney is limited superiorly by the inferior mesenteric artery. The result is a kidney that is displaced inferiorly with an anteriorly located renal pelvis. The ureteral pelvic junction lies in a more anterior position, overlying the isthmus with a higher than normal insertion, which places individuals with HK at an increased risk for ureteral pelvic junction obstruction, urinary stasis, urinary tract infection, and nephrolithiasis.[3]

Nephrolithiasis in individuals with HK is common, with up to 21%-60% of individuals affected with stone disease.[4] Historically, the high rate of stone disease was thought to be due to urinary stasis secondary to anatomic abnormalities; however, recent literature has demonstrated that a metabolic abnormality was found to contribute to lithiasis in nearly 100% of individuals with HK and likely supports a multifactorial cause for stone disease.[3]

Due to the significant anatomic variability, endoscopic management can prove to be difficult in individuals with HK. Treatment options for HK patients include ureteroscopy (URS), extracorporal shockwave lithotripsy (SWL), and percutaneous nephrolithotomy (PCNL). Whereas success rates utilizing SWL can be quite poor due to the altered anatomy of a HK, URS has been successful in the HK with higher stone-free rates than SWL, but still lower than that of individuals with normal renal anatomy.[5-11] PCNL would appear to be the procedure of choice in individuals with HK; nevertheless, stone-free rates range from 65% to 93% and anatomic issues may require multiple access point, increasing the risk for postoperative complication.[12-23] Given these considerations and a paucity of data in the literature, we reviewed our experience with individuals with HK requiring stone surgery to further define the stone-free rates, need for secondary procedures, and complications.

METHODS

After approval by our Institutional Review Board, a retrospective review was performed of patients diagnosed with

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an HK who underwent endoscopic management from January 2002 to May 2015. Utilizing International Classification of Diseases, Ninth Revision diagnosis codes, we identified 45 adult patients with 61 moieties who were treated at our institution for urolithiasis and had a diagnosis of HK. We included all adult (18 years of age or older) patients who underwent PCNL, SWL, or URS.

Management of stone disease was determined by individual surgeons based on patient presentation, total stone burden, potential success of procedure, and patient preference. Patient demographic data were collected, with characteristics of the stones, preoperative investigations, operative details, complications, stone clearance rates, and follow-up. Stone analysis was performed postoperatively at the discretion of the surgeon. Measurement of stone burden was based on largest measured dimension of preoperative imaging. In patients undergoing bilateral procedures, the sum of the total stone burden was calculated. Postoperative stone-free status was determined by kidney, ureter, and bladder x-ray (KUB), nephrostogram, or computed tomography (CT) scan based on surgeon preference. Stone free was defined as no residual fragments noted on imaging. Success was defined as fragments less than 4 mm on postoperative imaging. Stone-free rate and success rate are defined per moiety.

Metabolic evaluation was performed at the discretion of the provider and all 24-hour urine samples were evaluated using the Mayo Clinic Metabolic Stone Lab. Laboratory value cutoffs were based on institutional-defined normals and were as follows: low urine volume was less than 2 L of urine per day, hypernatruria as > 227 mmol/24 hour, hypercalciuria as >350 mg/spec, hypocitraturia as < 320 mg/spec, hyperuricosuria as > 750 mg/spec, and hyperoxaluria as >40 mg/spec. All stone analyses were performed at the Mayo Clinic and stone type was defined by the component that made up greater than 50% of the total composition. When a stone had equal components of two compositions, it was defined as mixed.

RESULTS

We identified 45 patients who underwent 56 primary procedures. Of these patients, 31 (69%) were male and 14 (31%) were female. The mean age at the time of procedure was 49.4 years (range 23-78). The primary procedure was PCNL in 33 cases, URS in 22 cases, and SWL in 2 patients. There were 3 cases of bilateral PCNL and one URS was converted to PCNL due to inability to access a lower pole stone, for a total of 37 renal moieties undergoing PCNL. In the URS group, 3 were bilateral, for a total of 25 renal moieties undergoing URS. SWL was performed in 2 moieties including one patient who underwent contralateral PCNL. The average stone size was 22.4 mm (range 10-57) for PCNL, 8.4 mm (range 2-25) for URS, and 4.5 mm (range 4-5) for ESWL (Table 1). Follow-up imaging was at the discretion of the surgeon, and 26/64 (40.1%) moieties were followed with KUB, 22/64 (34.4%) with CT, and 16/64 (25%) with a nephrostogram. Follow up imaging by procedure type is noted in Table 1.

Table 1. Patient demographics and presentation

Procedure	PCNL	URS	SWL
Mean age years (range)	51.2 (23-75)	48.1 (29-78)	32.5 (23-42)
Male : Female	19:7	13:7	0:2
Number of renal moieties (%)	37 (58)	25 (39)	2 (3)
Mean stone size mm (range)	22.4 (10-57)	8.4 (2-25)	4.5 (4-5)
Follow-up imaging (by moieties)			
CT (%)	15 (40.5)	6 (24)	2 (100)
KUB (%)	6 (16.2)	19 (76)	
Nephrostogram (%)	16 (43.2)		

CT, computed tomography; KUB, kidney, ureter, and bladder x-ray; PCNL, percutaneous nephrolithotomy; SWL, shockwave lithotripsy; URS, ureteroscopy.

Table 2. Stone-free rates per moiety

Procedure	Stone-free Rate (%)	Success* Rate (%)	% of Moieties Requiring Secondary Procedure
PCNL (N = 37)	81.1	94.6	27
URS (N = 25)	84	100	0
SWL (N = 2)	50	100	0

Abbreviations as in Table 1.
* Success defined as asymptomatic stone fragments less than 4 mm in size.

In the PCNL cohort, a single upper pole access was utilized in all but 2 (5.4%) patients who required two access points. The stone-free rate per moiety after primary PCNL was 70.3% (26/37). In one patient, the residual fragment was less than 4 mm and a secondary procedure was not performed. A secondary procedure was performed in 10/37 (27%) renal moieties after primary PCNL, which included: 3 PCNL, 5 URS, and 1 secondary PCNL + URS, and 1 secondary SWL + PCNL. Residual fragments remained after secondary procedures in 7 moieties, with a resulting overall stone-free rate of 81.1% (30/37) for PCNL (Table 2). If stones less than 4 mm in size are considered clinically insignificant, then the overall success rate for PCNL was 94.6% (35/37). There were 3 complications in the PCNL group. One patient required hospitalization for a fever requiring antibiotics (Clavien grade II), one was readmitted for postoperative pain (Clavien grade I), and one failed nephrostomy clamping trials requiring antegrade ureteral stent placement (Clavien grade III). Of these patients, the patient admitted for a fever requiring antibiotics had required two access points for PCNL. We compared stone-free and success rates after PCNL from before 2009 and from 2009 to present day as we began routinely using flexible nephroscopy in 2009. The stone-free rate per moiety before