Original Article

Outcome of ureteroscopy for stone disease in patients with horseshoe kidney: Review of world literature

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Abstract

Introduction and Objectives: The management of urolithiasis in patients with horseshoe kidney (HSK) is difficult. Stone formation occurred in 1:5 patients with HSK due to impaired urinary drainage and infections. Percutaneous nephrolithotomy and shock wave lithotripsy can be technically challenging due to altered anatomy.

Materials and Methods: We conducted a systematic review of the literature to look at the role of ureteroscopy for stone management in these patients. We searched MEDLINE, PubMed and the Cochrane Library from January 1990 to April 2013 for results of ureteroscopy and stone treatment in HSK patients. Inclusion criteria were all English language articles reporting on ureteroscopy in patients with HSK. Data were extracted on the outcomes and complications.

Results: A total of 3 studies was identified during this period. Forty-one patients with HSK underwent flexible ureteroscopy and stone treatment. The mean age was 42 with a male:female ratio nearly 3:1. The mean stone size was 16 mm (range: 3-35 mm). The mean operating time was 86 min with multiple stones seen in 15 patients. All 41 patients had a ureteral access sheath used and flexible ureteroscopy and holmium laser fragmentation done. Thirty-two (78%) patients were stone-free with a mean hospital stay of 1-day. Minor complications (Clavien I or II) were seen in 13 (32%) of which 6 had stent discomfort, 3 needed intravenous antibiotics for <24 h, 3 had hematuria of which 2 needed blood transfusion and one had pyelonephritis needing re-admission and antibiotics. There were no major complications found in the review.

Conclusions: Retrograde stone treatment using ureteroscopy and lasertripsy in HSK patients can be performed with good stone clearance rate, but with a slightly higher complication rate. This procedure should, therefore, be done in high volume stone center with an experienced stone surgeon/team.

Key Words: Laser fragmentation, outcomes, stones, horseshoe kidney, ureterorenoscopy

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Received: 11.06.2014, **Accepted:** 04.08.2014

INTRODUCTION

Horseshoe kidneys (HSK) are the most common congenital genitourinary anomaly, with an incidence of 1 every 400 births.[1-3] This malformation is characterized by renal malrotation, a variable blood supply, high ureteric insertion and an increased incidence of ureteropelvic junction (UPJ) obstruction in a third of cases.[4] Due to the altered anatomy, the urinary drainage is affected and thereby increasing the risk of urinary tract infections and renal stone formation; in up to 20% of cases.[5-7]

Stone management in these cases is made challenging due to the abnormal anatomy. The technical feasibility and the medical condition of the patients often dictate the nature of treatment offered and might preclude some procedures,[8] but

Access this article online

Quick Response Code:

Website: www.urologyannals.com

DOI: 10.4103/0974-7796.157969

when possible, the stone-free rate (SFR) is reported to be lower than when compared with patients with normal renal anatomy undergoing a similar procedure.[9]

The advances in flexible ureteroscopy and lasertripsy (FURSL) had allowed alternative method of treatment in anatomically normal kidneys with minimal morbidity and very high SFR. However, the success rate and associated complications of FURSL in HSK have not been widely documented in the literature.

To look at these points, we conducted a systematic review to assess the safety and efficacy of FURSL in patients with HSKs.

MATERIALS AND METHODS

Search strategy and study selection

A systematic review was performed according to the Cochrane reviews guidelines and the preferred reporting items for systematic reviews and meta-analyses guidelines.[10] The search strategy was aimed at finding the relevant studies from MEDLINE, PubMed and the Cochrane Library from January 1990 to April 2013 for results of ureteroscopy and stone treatment in HSK patients.

The terms used in the search included the following: "Ureteroscopy", "HSK", "stones", "calculi", "laser" and "laser therapy". Boolean operators (AND, OR) were used to refine the search.

Criteria for inclusion

The inclusion criteria for this systematic review were all English language articles reporting on ureteroscopic treatment in HSK patients. Patients who had failed previous procedures were included as well as patients with HSK with calculi who underwent ureterorenoscopy (URS) as a first-line surgical intervention. If relevant, the references were evaluated for potential inclusion.

Evidence level of included studies

The levels of evidence and recommendation were based on the center for evidence based medicine.[11]

Data extraction

The following variables were extracted from each study: Population demographics, period of the study, country of origin of the study, prior procedures, stone size and location, anesthesia used, type of ureteroscope used, method of stone extraction, stone-free rates, follow-up period and complications. For complications the Clavien classification for surgical complications was used.[12]

RESULTS

The literature search yielded 54 studies, of which 51 were excluded owing to nonrelevance, based on the title, abstract and full manuscript [Figure 1]. A total of three studies[13-15] [Table 1] was identified during January 1990 and April 2013 that fit the inclusion criteria.

In total, there were 41 patients with 45 renal units treated with a mean age of 42 years (range: 35-69 years). There was a definite preponderance toward the male sex; there were 30 males to 11 females.

Preoperative imaging was done with the use of abdominal X-ray (AXR), renal ultrasound scans (USS), intravenous

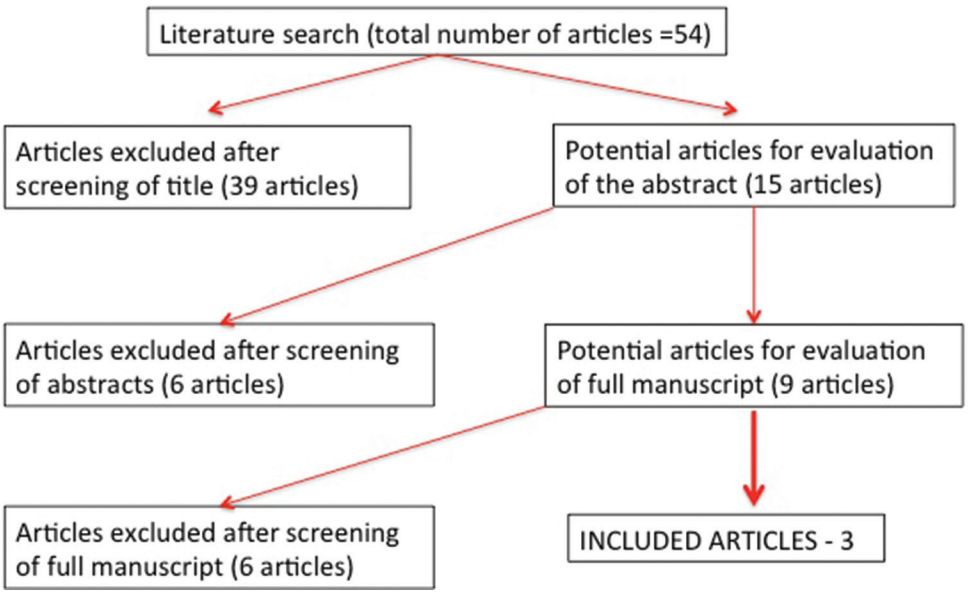

Figure 1: Outcomes of literature search

Table 1: Characteristics of the studies included in the review

Author	Journal	Year	Review period	Country	Evidence level	Number of cases (*n*)	Mean age (range)	Prior procedures (%)	Mean operative time (min)	Stone number	SFR (%)
Weizer[11]	J Urol	2005	1998-2003	USA	4	8, 4 of whom were HSK and 4 were pelvic kidney	50.6 (35-69)	75	126	11	75*
Molimard[12]	J Urol	2010	2004-2009	France	4	17	34.7 (16-52)	100	92	33	88.2
Atis[15]	Urolithiasis	2013	2008-2012	Turkey	4	20	40.9	80	40.5	25	70
Total of the studies' data						45	NA	NA	NA	69	NA
Averages of the studies' data						NA	42.1 (35-69)	85	86.2	NA	77.7

SFR: Stone-free rate, HSK: Horseshoe kidney, NA: Not available

urogram (IVU), a combination of X-ray and IVU and noncontract computed tomography (CT). Urine culture and sensitivity were performed preoperatively, and appropriate antibiotics were given. Thirty-five patients (85%) had undergone prior procedures before URS, including 14 (34.1%) shock wave lithotripsy (SWL), 8 (19.5%) percutaneous nephrolithotomy and 7 (17.1%) open surgery. Four (9.8%) patients had undergone more than one procedure prior to URS.

Thirty-seven patients (90.2%) had their procedure performed under general anesthesia, with 21 cases (51.2%) using solely FURSL, in the remaining 20 cases (48.8%), a combination of semi-rigid ureteroscopy and FURSL was used. Ureteral access sheath (UAS) and a holmium-aluminum garnet laser (Ho-YAG laser) were used in all 41 patients (100%). The laser energy and frequency varied according to study, with two setting the energy between 0.6 and 1.0 J with frequency between 5 and 10 Hz and the third between 0.8 and 1.2 J and 8-12 Hz. The mean stone size was 16 mm (range: 3-35 mm) and while not all the studies mentioned if there were single or multiple stones, the location of the stones was documented [Table 2]. The most common site for stone was the renal pelvis ($n = 12$), followed by the lower calyx ($n = 9$), then the mid calyx ($n = 7$) and mixed caliceal stones ($n = 7$). The rest of the stones were found in the upper calyx and found to be lying across the pelvis and the calicies. Stents were sited in 33 cases (80.5%) after the procedure, and these were removed 14 days later. The mean operative time was 86.2 min (range: 40.5-126).

Stone-free rate was confirmed in 32 cases (78%). The average duration of hospital stay was 1.03 day (range: 1-3 days). There were a total of 13 complications (31.7%), all of which were classified as Clavien criteria grade I or II: 3 patients (7.3%) had postoperative fever requiring intravenous antibiotics, which resolved within 24 h, 2 patients (4.9%) had hematuria requiring blood transfusion and resolved within 3 days, 6 patients (14.6%) complained of the stent discomfort and were treated conservatively with analgesia, one patient (2.4%) had hematuria not requiring blood transfusion and resolved within 48 h and one patient (2.4%) was re-admitted to hospital 3 days after initial discharge with pyelonephritis. There were no Clavien criteria grade III, IV or V complications reported.

Table 2: Breakdown of stone location according to studies

	Weizer *et al.*	Molimard *et al.*	Atis *et al.*
Renal pelvis, UPJ, prox ureter	5		
Upper pole	2		4
Mid pole			7
Lower pole	4		9
Mixed caliceal		7	
Mixed pelvic and caliceal		3	
Renal pelvis		7	5

UPJ: Ureteropelvic junction

Postoperative follow-up varied with regards to imaging modality and time span, but all studies reported a formal follow-up with a form of imaging (AXR/renal USS/noncontrast CT) to assess the SFRs.

DISCUSSION

This review does indeed give an insight into the practical application of ureteroscopy in stone disease affecting HSK patients. Due to the anatomical abnormalities presented by the HSK, the technical difficulty of ureteroscopy is increased significantly compared with performing ureteroscopy a normal urinary system. All the studies utilized a UAS during the procedure to facilitate the ease of access to the renal pelvis and allow continuous irrigation of the renal pelvis and the removal of stone fragments from the kidney.[16,17] The orientation of the calyces are altered compared to normal and combined with the increased likelihood of UPJ obstruction, due to the high insertion of the ureter into the renal pelvis, explains the technical difficulties faced in FURSL in the patients. This is also reflected in a higher than normal mean operative time of 86 min and ranged from 40.5 min to 126 min. The SFR was acceptable at 78%, though this is lower than reported SFRs in a normal kidney.

There were no major complications and 13 minor complications. Most complications were minor Clavien grade I

or II with nearly half of them being the stent discomfort that is quite common even in patients with normal renal anatomy. A short hospital stay is an indicator of the relative safety of the procedure.

Compared to other methods of stone treatment with SWL and percutaneous nephrolithotomy (PCNL), a relatively high SFR without the risk of major complications makes it very attractive as an endourologist [Table 1].[18] A recent study by Ray *et al.*[19] reported on their experience with SWL and HSK stones in 41 patients (61 renal units). Their single treatment success at 3 months was reported at 25%, with an SFR of 9.1%. They also looked at overall (more than one session of SWL) SFR at 3 months, which was reported at 39.1%. Their paper also compared the results from 15 other studies utilizing SWL in HSK stones and found that an average of 2.03 (1-3.8) sessions of SWL only gave a mean SFR of 54%.

Shokeir *et al.*[20] in their paper from mansoura present their experience of 34 patients with HSK. They had a major complication in 6 (13%) patients including blood transfusion ($n = 3$) and septicemia, ureteric injury and colonic injury in one patient each. There was also a high rate of auxiliary procedures 12 (35%) patients with an SFR of 82% on discharge. Another paper by Etemadian *et al.*[21] looked at previous studies utilizing PCNL in the HSK stones and across 7 studies, an average of 19.86% had a minor complication, and 1.57% had a major complication. An average SFR was calculated at 76.4% (range: 66.7-87.5%) across these studies.

The results from our systematic review show that FURSL is a viable and competitive technique when compared to SWL and PCNL. The SFR is similar to PCNL and much better than SWL. Although the complication rates were higher than SWL, it was significantly better than PCNL.

The main limitation of this review is the limited number of included studies; however this is due to the scarcity of HSK cases. This makes it difficult for a large study to be conducted, which may be able to deliver more sound results than those that are only able to report on a few patients. The lack of case numbers also prevents the design and execution of randomized trials or comparative prospective studies, assessing the role of URS in HSK against more traditional techniques. This leads to the reliance on case series for development of evidence. With all the factors taken into account, this review does provide insight into URS use for HSK giving us an idea of the complication and success rate from FURSL.

CONCLUSIONS

The use of URS and laser lithotripsy in patients with HSK and stone disease is shown to be a relatively safe and effective procedure. However, due to the anatomical abnormality, a second look is usually required to render the patient completely stone-free. The efficacy and safety of the procedure can be improved by performing these procedures in high volume centers with experienced endourologists.

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How to cite this article: Ishii H, Rai B, Traxer O, Kata SG, Somani BK. Outcome of ureteroscopy for stone disease in patients with horseshoe kidney: Review of world literature. Urol Ann 2015;7:470-4.

Source of Support: Nil, **Conflict of Interest:** None.