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No Wound for Stones <2 cm in Horseshoe Kidney: A Systematic Review of Comparative Studies

Keywords

Horseshoe kidney · Stone · Shock wave lithotripsy ·
Ureteroscopy · Review

Abstract

Introduction: No wound to the patients is the pursuit of surgeons. Extracorporeal shock wave lithotripsy (SWL) and ureteroscopy (URS) are minimally invasive modalities for treating horseshoe kidney (HSK) stone <2 cm. We aimed to review the outcomes and complications of comparing SWL and URS in HSK stone. **Methods:** The literature was reviewed in the Embase, PubMed, and Cochrane Library up to March 1, 2018. Only 4 articles were available for analysis. Inclusion criteria were all English language articles reporting on the comparison between SWL and URS. **Results:** URS tends to be performed in a relatively heavier stone burden. The higher initial stone-free rate and success rate were demonstrated for URS than for SWL ($p < 0.00001$, $p = 0.02$, respectively). The less retreatment rate was found in URS than SWL ($p = 0.04$). There was no difference in minor complications in the 2 groups ($p = 0.57$). Renal colic episodes were more likely to be observed in the SWL group ($p = 0.02$). There were no major complications found in the review. **Conclusion:** For a stone <2 cm in HSK, both SWL and URS are safe treatment modalities. URS alone is a more feasible and sufficient option for stone in HSK <2 cm than SWL with possibilities of a second session.

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Introduction

Horseshoe kidney (HSK), is the most common congenital renal fusion anomaly, with a prevalence of 0.25% in individuals [1]. Because of urine retention and crystal aggregation resulting from renal structure anomaly, calculi becomes the most common complication of HSK, with a reported incidence ranging from 21 to 60% [2].

Various treatment modalities have been reported to treat HSK stones, such as percutaneous nephrolithotomy (PCNL), extracorporeal shock wave lithotripsy (SWL), and ureteroscopy (URS). PCNL is often indicated for stone >2 cm, reported to have a stone-free rate (SFR) of only 53% (range 50–82%), however, with high complication rate and high rate of auxiliary procedures [3–5]. And the EAU guidelines [6] suggest that PCNL is a better choice for stones larger than 2 cm. However, PCNL needs the puncture to the kidney, which results in a wound to patients. As a result, SWL and URS are commonly favored by HSK patients with stone <2 cm due to the fact that there is no wound but low complications.

Some studies showed the poor outcomes and higher complications in both SWL and URS due to the altered anatomy [7–12]. To our knowledge, there is a dilemma for most physicians and patients alike as to which one is better. To resolve this issue, we conducted a systematic review to summarize the evidence relating to the efficacy and safety of these 2 methods.

Methods

Search Strategy

We performed a computerized PubMed, Embase, and Cochrane search of relevant studies using the search strategy described below. All included studies were then reviewed for eligibility. The reference lists were also reviewed for additional eligible studies. All the references identified were managed in Endnote.

Literature Search

A literature search was conducted in March 1, 2018. The search was limited to the English language, which allows data extraction. References were thoroughly evaluated for inclusion.

The following terms were used: (1) “horseshoe, fused, or fusion”; (2) “kidney or kidneys”; (3) “stone, calculi, calculus”. An updated search was carried in October 2018, with no further study included.

Study Selection and Data Collection

Two authors (H.C. and Y.P.) followed predefined inclusion criteria as per a predetermined protocol to select potential articles for inclusion independently. Where differences of opinion emerged between the researchers regarding article eligibility, discrepancies were resolved by open discussion. And senior author (G.C.) acted as an arbiter. The extracted data consists of study title, year, country, study design, sample size, basic characteristics, and main outcome variables. The quality of the included studies was assessed by the Newcastle-Ottawa Scale (NOS) and NOS scores of ≥ 6 was considered to be of high quality and 5–6 points were considered to be of moderate quality.

Eligibility Criteria

Comparative studies evaluating outcomes relating to stones in HSK via SWL or URS were included in this review. Papers investigating single approach to stones were excluded, as this would lead to a significant lack of equipoise. Data were extracted from each paper separately and outcome measures set as: (1) initial SFR (2) retreatment ratio (3) success rate (4) renal colic episodes (5) minor complications. Severe complication was defined as Clavien-Dindo classification IIIa or worse, such as bleeding with transfusion or Urosepsis. Minor complications were the complications of Clavien-Dindo classification IIa or smaller. And minor complications included the occurrence of renal colic. Success rate was defined as stone free after the final session.

Datasets

Data for each included paper were entered in an Excel spreadsheet and checked by 2 authors prior to analysis.

Data Analysis

The quality of the included studies was assessed using the Cochrane bias assessment tool and statistical analysis was performed using Revman software (Cochrane Collaboration). The weighted mean difference and risk difference (RD) were used to compare continuous and dichotomous variables respectively. Statistical heterogeneity was assessed using the chi-square test with significance set at $p < 0.05$ and heterogeneity was quantified using the I^2 statistic. The random-effects model was used if significant heterogeneity was identified; otherwise, a fixed-effects model was used.

Fig. 1. Studies selection process.

Results

Characteristics of Eligible Studies

The detailed inclusion and exclusion process was illustrated in Figure 1. Our meta-analysis included 4 retrospective studies [13–16]. These studies spanned 4 countries and included 127 patients. A reference search of these studies indicated no further studies for inclusion. All the included studies comprised patients with a mean stone size < 2 cm except Symons et al. [13] reported groups with a digitized surface area. Preoperative stenting before SWL was only reported in Gokce et al. [14]; URS tend to be performed in relatively heavier stone burden. Two studies described the locations of stones treated specifically (Table 1). The main outcomes as SFR, retreatment ratio, and success rate were reported in 4 comparative studies. All researches described no major severe complications with 3 reporting minor complications and renal colic episodes. No study reviewed discussed its assessment of the drainage system of the individual organ in question and how that might have played a role in their decision making.

Table 1. Baselines of studies DSA (mm²), computed as the sum of the products of the maximum dimensions of stones on a plain X-ray

Study location	Design	Period	Number	Presented	Age, years	Male	Female	Stone size, mm	NOS quality score
Gokce et al. [14], 2016	Single center, Turkey	Retrospective cohort	2003–2014	SWL 44 URS 23	44.8±8.4 44.2±9.9	32 18	12 5	16.8±4.4 mm 17.1±5.1 mm	7
Blackburne et al. [16], 2015	Single center, Mayo Clinic	Retrospective cohort	2002–2016	SWL 2 URS 22	32.5 (23–42) 48.1 (29–78)	0 13	2 7	4.5 (4–5) mm 8.4 (2–25) mm	6
Ding et al. [15], 2015	Single center, China	Retrospective cohort	2005–2014	SWL 11 URS 18	36.6±8.2 42.9±11.6	9 14	2 4	11.9±2.0 mm or 110.6 (63–205) mm ² 18.9±3.6 mm or 339.6 (180±538) mm ²	7
Symons et al. [13], 2008	Single center, India	Retrospective cohort	1991–2008	SWL 5 URS 2	Not applicable Not applicable	Not applicable Not applicable	Not applicable Not applicable	149.2 (50–225) mm ² 172 (63–281) mm ²	6
Definition of SFR									
Gokce et al. [14], 2016	SWL URS	Lower pole 12 (27.2%) pelvis and upper pole 32 (72.8%) Lower pole 6 (26.1%) pelvis and upper pole 17 (73.9%)	Renal ultrasonography, plain abdominal radiography and intravenous urography or non-contrast enhanced computerized tomography			1–6 weeks after SWL 2–6 weeks after URS	No residual fragments ≥3 mm in size in plain radiography and either ultrasound or CT		
Blackburne et al. [16], 2015	SWL URS	Not applicable	Not applicable	Not applicable	Not applicable	No residual fragments noted on plain film and CT			
Ding et al. [15], 2015	SWL URS	Not applicable	Intravenous urography or excretory computed tomography ruled out possible ureteropelvic junction obstruction or ureteral stricture			One-month follow-up plain films and ultrasound at 3–5 days after operation	No stones in plain film and ultrasound		
Symons et al. [13], 2008	SWL URS	Upper calyx 1, pelvis 3, lower calyx 1 Pelvis 1, multiple (in the pelvis, superior calyx, middle calyx and isthmus) 1	Not applicable			1 month after operation Not applicable	No stones, follow-up imaging unknown		
DSA, digitized surface area; SFR, stone free rate; URS, ureteroscopy; SWL, shock wave lithotripsy.

Fig. 2. Forest plot of comparison: initial SFR (after one single session). SWL, shock wave lithotripsy; URS, ureteroscopy; RD, risk difference.

Fig. 3. Forest plot of comparison: success rate. SWL, shock wave lithotripsy; URS, ureteroscopy; RD, risk difference.

Methodological Quality of Included Studies

The quality of included studies was generally low with no randomization occurring (NOS evaluation; Table 1). In the retrospective studies, there was no clear protocol for treatment allocation. The studies did not discuss blinding or allocation concealment.

SFR, Success Rate, and Retreatment

On the basis of 4 studies, URS was more likely to achieve good initial SFR and success rate and less retreatment compared with SWL (RD = -0.41 [-0.58 to -0.23], $p < 0.00001$, Fig. 2; RD = -0.21 [-0.39 to -0.04], $p = 0.02$, Fig. 3; RD = 0.15 [0.01 to 0.30], $p = 0.04$; Fig. 4, respectively). No significant heterogeneity was found ($p = 0.18, 0.74, 0.35$, respectively) and the fixed-effect model was applied.

Renal Colic Episodes and Minor Complication

All studies reported no severe complications. Minor complications are found not to be significant different in

the 2 groups (RD = -0.04 [-0.19–0.10], $p = 0.57$; Fig. 5). However, renal colic episodes are more likely to occur in the SWL group (RD = 0.17 [0.03–0.32], $p = 0.02$; Fig. 6). A limitation to this analysis is that Symons et al. [2] report no clear data on the incidence of renal colic episodes and minor complications. No significant heterogeneity was found in the analysis of 2 variables ($p = 0.44, 0.43$, respectively for Fig. 5, 6).

Discussion

The rarity of HSK leads to the lack of surgical experience of stone treatment in this condition. Our study search on different electric databases showed comparative studies reporting on the management of the stone in HSK using single modality of SWL or URS. To our knowledge, there is no comprehensive evidence as to which one was better for stone <2 cm. Our comprehensive analysis

Fig. 4. Forest plot of comparison: retreatment ratio. SWL, shock wave lithotripsy; URS, ureteroscopy; RD, risk difference.

Fig. 5. Forest plot of comparison: minor complications. SWL, shock wave lithotripsy; URS, ureteroscopy; RD, risk difference.

Fig. 6. Forest plot of comparison: renal colic episodes, SWL, shock wave lithotripsy; URS, ureteroscopy; RD, risk difference.

based on 4 cohort studies comparing the outcomes and complications showed the following findings: (1) URS was more efficient in achieving initial stone free status after one single procedure and higher success rate could be realized by URS with less retreatment rate; (2) Renal

colic episodes are more likely to happen in the SWL group and so do the minor complications; (3) Both procedures are safe because no severe complications occur.

When the results of SWL and URS were analyzed, significantly higher initial SFR after one single session, the

success rate and lower retreatment rate favored URS ($p < 0.00001$, $p = 0.02$, $p = 0.04$, respectively; Fig. 1–3). On condition that the stone burdens in the 4 studies were heavier in URS group (Table 1), URS has a better efficacy in the even harder situation on the basis of our analysis. The initial SFR for SWL is 29.03% (18/62) and for URS is 78.46% (51/65). Main advantages of URS compared to SWL are the use of laser lithotripsy and repositioning of the lower pole stone to easy pole and this may facilitate the calculi fragmentation. Unfortunately, it remains unclear whether the reposition is efficient in HSK stone because of no clear data reporting the locations of stone. Usually, SWL is more attractive to physicians and patients due to its noninvasive and cheap properties. However SWL has a low efficacy in HSK. Even the attempt to use double J stent as an auxiliary for improvement of outcomes has been proved a failure [14]. Compared to URS (most patients only went through 1 session in 4 studies), there was a higher retreatment rate and more sessions needed in SWL (2–3 sessions per patient for all 4 studies). This may decrease patients' qualities of life with more operations applied. Therefore, the need of 2–3 sessions for SWL should be informed to patients.

When the complications were reviewed, no severe complications were found in the included 4 studies, except that 1 patient in the SWL group developed a perirenal hematoma, which was treated conservatively. This may be contributed by the recent improvement in skills and equipment. Renal colic episodes tended to be found in the SWL group ($p = 0.02$) and minor complications showed no favors to the 2 groups ($p = 0.57$, $p = 0.61$). And the heterogeneity I^2 equals to 0. These results indicate that SWL was more troublesome to patients with HSK stones although the included studies are normally low in quality.

More costs in health system are inevitably a disadvantage for URS. However, what cannot be neglected is the low efficacy and relatively high complications in SWL. For stone < 2 cm in HSK, URS might be considered to deal with stones in HSK as first-line modality.

We recognize certain limitations of this study. First, this review is limited by the small number of generally low-quality, single-center, and retrospective studies to analyze. Second, the follow-up, patient selection, SFR, and success rate differ in different articles, making comparisons difficult due to significant heterogeneity. Third, no study reviewed discussed its assessment of the drainage system of the individual organ in question and how that might have played a role in their decision making. It is important, for while URS may offer advantages, it is clear from these cases that the more clear the anatomic

understanding of the organ we obtain, the better choice of clinical intervention we can make. Thus, the generalizability of our outcomes is limited. However, the scarcity of HSK stone cases is hard to neglect. And the articles we are reviewing are new and rare (2 in 2016, 1 in 2017, 1 in 2008). Therefore, this analysis provides valuable evidence for stone disease in the HSK by comparing SWL and URS.

Conclusion

Surgeons are facing a significant challenge in surgical management to the nephrolithiasis in HSK. For a stone < 2 cm in HSK, SWL, and URS are both safe treatment modalities. URS alone is a more feasible and sufficient option for stone in HSK than SWL with possibilities of a second session. To determine the best method for treatment of small- and medium-size calculi (< 2 cm) for HSK patients, randomized trials comparing SWL and URS are needed. However, this review has found some advantages of URS, which further studies should aim to corroborate.

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Not applicable.

Statement of Ethics

The authors declare that they have no ethical conflicts to disclose.

Disclosure Statement

The authors declare that they have no conflicts of interest to disclose.

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Author Contribution

G.C., the senior arbiter, reviewed and revised the paper. H.C. collected and analyzed the data and wrote drafts of the paper. Y.P. collected and analyzed the data. C.X., Z.Y., Y.Z., and H.C. provided access to the electrical library and the analysis tool, availability of data and materials. Please contact the author for data requests.

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