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ORIGINAL PAPER

Do renal stones that fail lithotripsy require treatment?

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Abstract The rates of extracorporeal shock wave lithotripsy (SWL) appear stable in the UK. However, there is little evidence on the natural history of these calculi if SWL fails. We set to look at the effectiveness of SWL in patients with a single, previously untreated renal stone and the natural history of those stones that failed treatment. We retrospectively reviewed all data from our prospectively collected database of patients undergoing a first treatment for a single renal stone between October 2010 and November 2013. Outcomes after SWL were categorised as success, subsequent intervention needed or conservative management. The medical records of patients managed conservatively were reviewed to determine whether further intervention was required and why. We further sought to define, in those patients where SWL failed, whether subsequent active intervention was needed. For the remainder, we examined whether conservative management was a reasonable management option. 313 patients fitted the inclusion criteria. Of these, 144 were treated successfully. Of the 170 patients with a residual stone, 51 went on to flexible ureteroscopy directly at their next clinical review mainly due to persistent symptoms. 79 patients were managed conservatively, and for 39 follow-up data were unavailable as their follow-up was at a different hospital. 63 patients (80%) were successfully managed conservatively with no recurrence of symptoms over the follow-up period (mean 2 years 4 months). 16 (20%) patients that were initially managed conservatively required subsequent intervention. Of these, 87% had a stone in an upper pole calyx. Conservative management of renal stones after failed SWL is a suitable option for asymptomatic patients with stones not located in the upper pole. For patients with upper pole stones, early intervention is warranted due to the high risk of requiring intervention.

Keywords Urolithiasis · Stones · Lithotripsy · Surveillance

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Introduction

The overall prevalence of urolithiasis in the adult population has been estimated to be approximately 5% for women and 10% for men [1], and the incidence is felt to be increasing. In addition, there has been an increasing detection of incidental, asymptomatic renal stones as patients are increasingly imaged (particularly with CT) at the presentation of other pathologies. It is estimated that the prevalence of symptomatic renal stones is around 8% of screened populations. Boyce et al. [2] have reported on their series of 5047 adults undergoing CT colonography. Asymptomatic stone disease was identified in 395 patients (7.8%).

Table 1 Demographics

Patient demographics	Number
Age range (mean in years)	19–93 years (58 years)
M:F	207:106
Stone location	
UP	50
MP	63
LP	200
Stone side	
L:R	179:134

As a result of both the increasing prevalence of urolithiasis and the increasing detection by imaging of patients with asymptomatic renal stones, increasing numbers of patients are presenting to urologists with stone disease. Furthermore, the use of SWL, at least in the UK, appears to be increasing. Turney et al. have reported on data from the Hospital Episode Statistics (HES) which showed a 69% increase in the use of SWL for renal stones from 2000 to 2001 to 2010, and this has remained stable in the years since [3].

Very little is known about the natural history of stones in patients undergoing SWL if this treatment unsuccessful. What is clear, however, is that because of its relatively non-invasive nature, if SWL fails then some patients and urologists would not progress to a more invasive treatment in order to try and render the patient stone free.

In this study, we set out to look at the effectiveness of SWL in patients with a single renal stone and the natural history of those stones that failed treatment.

We further sought to define, in those patients where SWL failed, whether subsequent active intervention was needed. For the remainder, we examined whether conservative management was a reasonable management option.

Materials and methods

We retrospectively reviewed our prospectively maintained SWL database. Patients were included who had a single, previously untreated calyceal stone between October 2010 and November 2013. Patients underwent between one and four treatments on our Wolf piezolith 3000 fixed site machine. Baseline patient and stone demographics were obtained including stone size and location. The outcome from treatment was determined as either subsequent intervention (either in the form of ureteroscopy or PCNL) or conservative management. For those patients initially managed conservatively after failed SWL, the medical records and subsequent imaging were obtained. We then looked at whether any further intervention was required and if so, what this intervention was and the reason for it.

Success after SWL was defined as the patient being both stone (on repeat imaging) and symptom free at their next clinical review which is usually undertaken at 6 weeks post SWL treatment at our institution. At our institution, all patients presenting with a suspected urinary tract stone have a non-contrast CT as the first-line investigation. A plain KUB X-ray is also performed to see whether the stone is radio-opaque. Follow-up imaging and stone-free rates are determined by KUB X-ray unless there was a specific indication for repeat CT.

Results

Between October 2010 and November 2013, a total of 1703 patients underwent SWL in our unit. Of these, 313 patients fitted the inclusion criteria of having a single, previously untreated renal stone.

The basic demographics are shown in the Table 1.

The range of stone size (maximum diameter as measured on axial CT) treated by SWL in this study is shown in the Table 2.

The decision to treat these 313 patients was based on a variety of reasons. The majority of these were for symptoms in 281 patients (90%). The remaining 32 patients (10%) were booked for SWL treatment of their stone and of these 13 were entirely asymptomatic and 9 remained so after treatment.

Of the 313 patients that fitted the inclusion criteria, 144 (46%) were treated successfully. Therefore, 169 (54%) were left with a residual stone after SWL and were therefore said to have been unsuccessfully treated.

51/169 (30%) patients who failed SWL went to be booked directly for flexible ureteroscopy and laser fragmentation of their residual stones at their next clinical review for a variety of reasons. Of these 51 patients, 37 (73%) required further treatment for ongoing pain, 6 (12%) for concern regarding stone size, 4 (8%) due to patient choice, and 1 each for solitary kidney, patient job (pilot),

Table 2 Range of stone size

Stone size (mm)	Number
≤4	88
5	57
6	42
7	38
8	29
9	23
≥10	36

young age, and infections (all <1%). No patients had a PCNL after failed SWL.

Follow-up data was not available for 39 of the patients as they were followed up in other hospitals.

The remaining 79 patients who had a residual stone disease after SWL were managed conservatively.

The mean follow-up for this group was 2.3 years (range 1–3.7 years).

Of these 79 patients, 63 (80%) required no further intervention over the follow-up period.

16 patients required subsequent intervention after initial conservative management. 8 were in the form of rigid ureteroscopy (for a stone that had passed into the ureter after a failed trial of medical expulsive therapy) and 8 with flexible ureteroscopy (because of the recurrence of symptoms in an unchanged stone).

Further details of the patients that were successfully managed conservatively after failed SWL are shown in the Table 3.

Discussion

In our unit, the overall success rate of stones treated with SWL is 54% which is lower than much of the published outcome data. There is a wide range of published success rates of SWL in the literature. For example, Neisius et al. [4] have published overall SWL success rates of 88% for renal stones. This may, in part, be accounted for by the definition of successful outcome and insignificant residual fragments. However, a more recent publication which looked at SWL outcomes in over 9000 patients from an SWL service in New Zealand [5] showed a stone-free rate of 45%, with a further 13% being deemed successful with CIRFs of under 4 mm. Our current outcome data are similar to this.

Table 3 Outcomes of patients managed conservatively following failed SWL (% shown as a proportion of each stone size group)

Demographics	Total = 79	Conservative = 63 (80%)	Intervention = 16 (20%)
Gender (M:F)	52:27	40:23	12:4
Stone position			
LP	49	48 (98%)	1 (2%)
MP	15	13 (87%)	2 (13%)
UP	15	2 (13%)	13 (87%)
Stone size (mm)			
≤4	22	20 (91%)	2 (9%)
5–7	35	27 (77%)	8 (23%)
8–9	12	8 (67%)	4 (33%)
≥10	10	8 (80%)	2 (20%)

The natural history of residual stones in such patients is poorly understood and indeed there are no clear guidelines as to when and how such stones should be managed post SWL failure. The literature varies in the outcome for patients with asymptomatic renal stones managed conservatively.

Glowacki et al. [6] were one of the first to report on the natural history of asymptomatic urolithiasis in 107 patients. In a follow-up period of 31 months, 68% remained asymptomatic with the remaining 32% developing a symptomatic stone event. Of these, 47% had spontaneous stone passage, 26.5% required intervention, and the remaining 26.5% were referred for SWL. It was also shown that there was a linear relationship between the number of previous stones and the development of a symptomatic event.

More recently, Koh et al. [7] reported a retrospective series of 50 patients with a total of 85 asymptomatic stones who were managed conservatively with annual imaging follow-up. The overall progression rate was 45% (defined by increasing stone size), and the overall intervention in the 46-month follow-up period was low at 7.1%. It was therefore concluded that observation was a reasonable management strategy for these patients as the chance of subsequent intervention was low.

The long-term outcome of the conservative management of asymptomatic lower pole stones was also investigated in a prospective randomised study by Yuruk et al. [8] who reported a higher overall stone event rate of 20%.

The optimal treatment modality for small renal stones has been the subject of much research and is not discussed further here although the role of prophylactic SWL is an interesting and relevant one. In their review, Collins et al. [9] concluded that does not appear to improve the clinical outcome of patients with small, asymptomatic calyceal calculi.

The fact that 13 patients who underwent SWL were entirely asymptomatic pre-treatment and 9 remained so after treatment raises an interesting question as to whether these stones require treatment in the first place; however, the small numbers of these patients are such that no meaningful conclusion can be drawn. This shall be a focus of the ongoing future data gathering in this area.

The best treatment modality for small renal stones, either symptomatic or asymptomatic, is yet to be established.

The latest EAU guidelines [10] on Urolithiasis acknowledge that the question of whether residual renal stones should be treated remains unanswered. It concludes that stone growth, de novo obstruction, associate infection, and pain (acute or chronic) are all indications for treatment. These guidelines also make reference to stone size with the suggestion that stone size >15 mm is an indication for treatment. In practice, however, it is likely that only stones much smaller than this would be considered for

conservative management although the stone size threshold is not well established.

Certainly for a subset of patients with asymptomatic small renal stones, observation alone may be a reasonable management option with intervention reserved for patients with the development of symptoms or evidence of progression. Periodic follow-up (initially after 6 months and yearly thereafter) in untreated renal stones is recommended [10].

As with any surveillance strategy within medicine, the key is to identify those patients at high risk of progression for whom early intervention may be offered and also for those patients at low risk of progression who need not risk the side effects or potential complications of treatment.

This study adds to the body of evidence that conservative management for some renal stones is a viable option. For example, Keeley et al. have shown that in a prospective RCT with 2.2-year follow-up, there was no significant difference between SWL and observation of asymptomatic calyceal stones (<15 mm) in stone-free rates, symptoms or requirement for additional treatment [11].

We have shown that stones in the upper pole which fail SWL are likely to require treatment subsequently and therefore should be managed aggressively. Those in the lower pole, however, are much less likely to require intervention during the follow-up period. This is intuitive when considering the anatomy of the pelvi-calyceal system. Stones in the upper pole may be more likely to pass from their original position into the ureter and hence cause obstruction due to the effect of gravity and the large infundibular-pelvic angle. For those stones in the lower pole, the reverse may be true with stones less likely to move from their original position due to having to overcome the much more acute infundibular-pelvic angle and the effects of gravity. This may account for the results seen in this study. The results from stones in the interpolar calyx are between the two which would be expected, albeit much more in keeping with outcomes for lower pole stones.

Our current findings allow for the development of a tailored approach to the management of stones that have failed SWL such that patients with upper pole stones should be offered early treatment as they are likely to need subsequent intervention, rather than risk an episode of painful renal colic. Conversely, it would allow a level of reassurance to both doctor and patient of the low risk of needing intervention for an asymptomatic lower or inter pole stone.

From this study, whilst stone position is a strong indicator of whether further intervention is needed after failed SWL, stone size does not. This may of course dictate what treatment strategy is offered the patients and may be a reflection of why SWL was offered in the first place.

The limitations of this study are its retrospective design and the relatively small numbers. The inclusion criteria of a single previously untreated renal stone were chosen in order that one could be certain that any further stone episode in the future was not due to a new stone forming after spontaneous (and perhaps unnoticed) stone passage but does result in these small numbers observed. Prospective data collection is ongoing which may be added to the existing data set.

A further limitation is the 39 patients that were not followed up at our institution. However, the stone position in these patients was consistent with the remaining analysed data with approximately half being in the lower pole and the remainder split evenly between the mid pole and upper pole. It is felt therefore that available follow-up data for these patients probably would not have had a significant impact on the overall results.

Despites its limitation, this study reflects previous publications that conservative management of some renal stones is a reasonable treatment option, but is specific to those that have failed SWL, and will help guide management in specific patient groups. Further work is needed to gain a better understanding of which patients may be most suitable for this conservative approach and, if necessary, which subsequent intervention is most efficacious.

Conclusions

Conservative management of renal stones after failed SWL is a suitable option for patients with asymptomatic renal stones in the lower and interpolar calyces. For patients with residual stones in upper pole calyces, the chance of intervention is high, and thus active treatment should be considered in this group at their first follow-up after failed SWL.

Compliance with ethical standards

Conflict of interest OW is a consultant to Boston Scientific and Porges Coloplast; Education for Boston Scientific, Porges Coloplast, EMS. Research study for Porges Coloplast. All other authors declare that they have no conflicting interests.

Ethical approval This article does not contain any studies with human participants performed by any of the authors.

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