

P. Honeck · A. Häcker · P. Alken · M. S. Michel  
T. Knoll

## Shock wave lithotripsy versus ureteroscopy for distal ureteral calculi: a prospective study

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**Abstract** We performed a prospective, non-randomised study to determine the appropriate first-line treatment modality for distal ureteral stones. Between 2003 and 2004, a total of 124 patients with distal ureteral calculi were entered into the study (mean age 48 years, 35 women and 99 men). Sixty-two patients were treated with shock wave lithotripsy (SWL) and 62 patients with ureteroscopy (URS). The average stone size was 6.9 mm (3–33 mm) for SWL and 7.2 mm (3–30 mm) for URS. The treatment decision depended on the patients' preference and clinical parameters (i.e. contraindications for anaesthesia). URS was performed under general anaesthesia, using semirigid 8 Fr instruments. SWL was performed under analgo-sedation using a Modulith SLX. Of patients treated with SWL, 84% had a treatment success within 7 days, 98% after URS. These results show a significant success ( $P=0.005$ ) in favour of URS. The average in-patient stay after SWL was 3 days and for URS 4 days (not significant). The results show a high efficacy and a low complication rate for both modalities. The attained stone-free rate shows a significant advantage for primary URS.

**Keywords** Distal ureteral calculi · Treatment · Shock wave lithotripsy · Ureteroscopy

### Introduction

Extracorporeal shock wave lithotripsy (SWL) and ureterorenoscopy (URS) are both treatment modalities that have been established for the treatment of ureteral calculi. For both modalities stone-free rates of more than 90% have been reported [1–5]. While watchful

waiting is the preferred management of small stones  $\leq 3$  mm [6], SWL and URS are regarded as effective modalities with low complication rates for larger or persisting stones. Nevertheless the choice of treatment for distal ureteral stones remains a heavily debated subject in urology. Regarding the existing retrospective studies, success rates are, in general, higher with URS than with SWL [7–13]. Still some groups recommend SWL as the first-line treatment modality for distal stones because of minor invasiveness [10, 11]. Prospective studies have also evaluated the optimal treatment modality for distal stones [14, 15]. Peschel et al. reported a 100% stone-free rate using URS and a 90% rate using SWL. There were no complications seen in either group, but the time needed for the procedure was less in the URS group. Additionally all patients were satisfied after URS, but only 85% after SWL [15]. Based on these results URS was recommended as first-line treatment for distal ureteral calculi. Pearle et al. [14], on the other hand, also prospectively evaluated URS versus SWL. Both modalities had complete stone-free rates but SWL was associated with less postoperative discomfort and greater overall patient satisfaction. Therefore they recommended SWL as first-line treatment.

The technical advancements, like miniaturisation and laser disintegration, have led to an increasing number of URS performances in recent years [16]. The fast stone-free rate after URS and the often needed re-treatments after SWL have led to a new discussion about the optimal treatment for distal calculi. The aim of this prospective study was the evaluation of the efficacy of SWL versus URS for distal ureteral calculi.

### Materials and methods

A total of 124 patients undergoing therapy for distal ureteral calculi were entered into the study (mean age 48 years, 35 women and 99 men). Sixty-two patients were treated with SWL and 62 patients with URS. The average stone size was 6.9 mm (3–33 mm) for SWL and

P. Honeck (✉) · A. Häcker · P. Alken · M. S. Michel · T. Knoll  
Department of Urology, Mannheim University Hospital,  
Theodor-Kutzer-Ufer 1-3, 68135 Mannheim, Germany  
E-mail: Patrick.honeck@uro.ma.uni-heidelberg.de  
Tel.: +49-621-3833245  
Fax: +49-621-3831923

**Table 1** Characteristics of patients by sex, age, mean stone size and mean procedural time

	Gender	No. of patients	Mean age	Mean stone size (mm)	Mean procedural time (min)
SWL	Male	44	45	7.8	50
	Female	18	41	6.2	53
URS	Male	45	53	6.7	42
	Female	17	48	8.5	36

7.2 mm (3–30 mm) for URS (Table 1). Ten patients received a DJ catheter prior to SWL, 16 patients prior to URS. The decision as to which modality to choose depended on the patients' wish and clinical parameters like contraindications for anaesthesia, coagulation disorders and adipositas. URS was performed under general anaesthesia, using semirigid 8 Fr instruments (Karl Storz endoscopes, Germany). If necessary, disintegration was performed with a Ho:YAG laser (Wavelight Lasertech, Starnberg). Extraction was performed using forceps. SWL was performed under analgo-sedation using a Modulith SLX (Storz Medical, Switzerland).

Treatment success was defined as stone-free status 7 days after treatment or clinically not significant calculi  $\leq 3$  mm. Statistical analyses were done with a Chi-squared test.

## Results

About 84% of the patients treated with SWL had a treatment success within 7 days, 98% after URS (Fig. 1). These results show a significant success ( $P=0.005$ ) in favour of URS. Extraction using forceps was performed in 32 cases, Ho:YAG laser disintegration in 30 cases. The average number of treatments needed for SWL was  $1.24 \pm 0.5$ , and  $1.0 \pm 0.17$  for URS (Fig. 2).

Ten patients (16%) after SWL had persistent calculi larger than 3 mm. These calculi were extracted via URS afterwards. Intraoperative complications under SWL treatment included six patients with pain despite analgo-sedation; postoperatively, one patient had urinary retention.

After URS one patient (2%) had a consistent calculus larger than 3 mm because of an endemic ureter. This calculus was lost spontaneously after ureteral stenting. One small ureteral perforation occurred during the

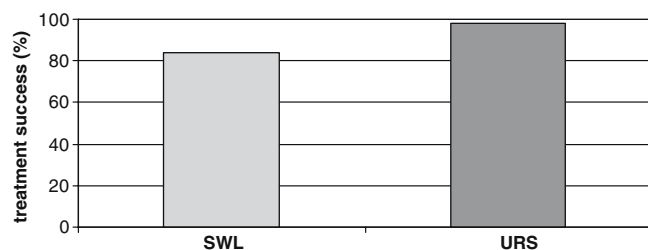
procedure. After stenting for 14 days no complications were seen in this patient. Fifty-three patients were stented after primary URS.

The average in-patient stay after SWL was 3 days, and 4 days for URS (not significant). The average stone size did not differ significantly.

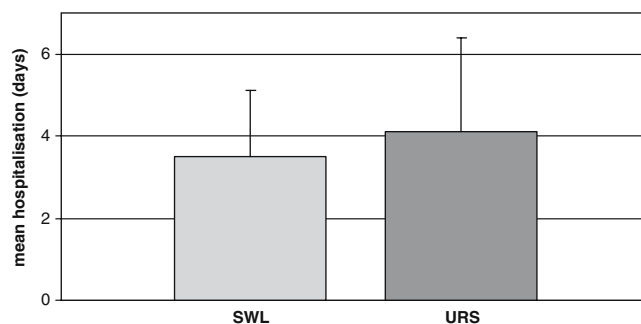
## Discussion

The choice of treatment for distal ureteric stones remains a heavily discussed topic in urology. This question has been evaluated in many retrospective studies. Among these, success rates are generally higher for URS than for SWL. Still some groups recommend SWL as first-line therapy as it is less invasive despite being associated with inferior stone-free rates [10, 11, 14]. The success rate of SWL for distal ureteral calculi varies greatly, ranging from 54 to 99% [17, 18] and re-treatment rates ranging from 0 to 46% [14, 17]. Auxiliary procedures are necessary in up to 41% after SWL [19]. In our present study we achieved a success rate of 84% for SWL with an average number of re-treatments of 1.24. Nevertheless 10 patients (16%) had persistent calculi larger than 3 mm.

Ureterorenoscopy is more invasive than SWL and commonly performed under spinal, epidural or general anaesthesia. Success rates of 90–100% are reported [13, 15]. Modern instruments and technical advancements, like miniaturisation and laser disintegration, have led to an increasing number of URS performances in recent years, on the one hand, and URS has become less invasive with a lower rate of complications, on the other hand [16]. Among the series published between 1996 and 2003, the overall incidence of ureteroscopic complications for distal stone manipulation was 7%



**Fig. 1** Treatment success (%) of shock wave lithotripsy (32 patients) versus ureteroscopy (32 patients)



**Fig. 2** Mean hospitalisation compared between shock wave lithotripsy (32 patients) and ureteroscopy (32 patients)

[20]. Furthermore, the incidence of ureteric stricture was <2% and the incidence of ureteric perforation <4% in recent studies [14, 21–24]. Also, the overall cost of intervention is less than that reported for SWL [25]. In addition, the Ho:YAG laser allows intracorporeal lithotripsy within the ureter regardless of stone composition with good results [26–28]. Success rates in studies using a Ho:YAG laser for distal calculi lithotripsy are 93–100% [14, 21–24]. The characteristics of modern Ho:YAG lasers have even made endoscopic stone treatment possible among patients with uncorrected bleeding diathesis or during pregnancy [29, 30]. In our study, after URS 98% of the patients were stone free, showing a significant success ( $P=0.005$ ) in favour of URS. The average number of treatments needed was 1.0. Regarding complications we have seen ureteral perforation in 2%, which correlates with the aforementioned incidence of ureteric perforations.

The average hospitalisation was 3 days for SWL and 4 days for URS, showing no significant difference. All stents were removed after 4–7 days. Nevertheless URS needs to be performed under general anaesthesia and therefore requires more effort. Moreover urinary symptoms like haematuria, painful urination and urinary frequency due to stenting cannot be ignored [31].

## Conclusion

The results show a high efficacy and a low complication rate for both modalities. The average hospitalisation does not differ significantly but the attained stone-free rate shows a significant advantage for primary URS. Regarding these results, primary URS can be considered as an appropriate treatment modality for distal ureteric calculi.

As most patients were stone free with both modalities, patients' wish and comorbidities should be included in the decision.

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