

## In the era of flexible ureteroscopy is there still a place for Shock-wave lithotripsy?

### *Opinion: YES*

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#### INTRODUCTION

The prevalence of urolithiasis has increased to 8.8% in the United States of America, due to diet and lifestyle changes and associated increasing diabetes and obesity (1). Urinary stones represent a significant economic burden both directly (treatment associated costs) and indirectly (e.g. time off work) (2). The emergence of a non-invasive intervention in 1980, shock wave lithotripsy (SWL), revolutionised the treatment of urinary calculi (3).

Miniaturisation and refinements to endourologists' armamentarium over the past two decades have increased the efficacy and application of endoscopic stone management. The lower renal pole calyces can now be accessed with "near certainty" using modern flexible ureteroscopes (4). However, innovation and refinement to the technology and technique used for SWL have also improved its efficacy and reduced associated side-effects in recent decade (5). The optimal treatment modality for renal and ureteric calculi is therefore controversial (6).

#### EFFICACY

Small (<10 mm) renal stones respond well to SWL, with stone free rates (SFR) up to 91.5% reported by randomised controlled trials (RCTs) (6, 7). For medium sized (10-20 mm) middle or upper calyceal stones a large retrospective analysis found no difference between URS and SWL (92% vs. 87%;  $p>0.05$ ): no randomised studies are available (8). Medium sized lower pole stones respond less well to lithotripsy as fragments clear less well from this dependent location: a recent meta-analysis showed a risk ratio (RR) of 1.50 (95% CI 1.20-1.87;  $p=0.0003$ ) in favour of URS (SFR were 85-86% vs. 54-60%) (9). However, the benefit for URS was clinically insignificant for small lower pole renal stones in the same meta-analysis (RR 1.1 95%CI 1.03-1.19), although this remained statistically significant ( $p=0.004$ ).

Distal ureteric calculi, although often more difficult to access with SWL, responded as effectively to SWL and URS for  $\leq 20$  mm radio-opaque stones (SFR 92.7% vs. 94.9%,  $p > 0.05$ ) in the only large RCT which used modern equipment (10). A large RCT examining the treatment of  $\leq 10$  mm proximal ureteric calculi found no significant difference in the SFR following SWL or URS (SFR 80% {46/58 patients} vs. 100% {52/52},  $p > 0.05$ ) (11). However, SWL was less effective than URS for  $> 10$  mm proximal ureteric stones (88% vs. 60%,  $p < 0.05$ ) in the same RCT (12).

The efficacy and safety of SWL have been improved by using shock wave sources with larger focal zones and improved coupling mechanisms. Further improvements have been gained with modified techniques including pulse rate, ramping strategies, improved localisation with real-time monitoring (e.g. using colour duplex ultrasonography) and analgesics (limiting patient movement) (6, 13). Finally, adjuvant therapy following SWL might improve SFR as many as 1.77 fold, such as: medical expulsive therapy (14), potassium citrate (15), thiazide diuretics (16) and percussion, diuresis and inversion (PDI) therapy for lower pole stones (17). However, these adjuvants have yet to be included in randomised trials comparing SWL with adjuvant vs. endourological interventions.

### Secondary outcomes: beyond stone free rates

Judgements regarding the relative benefits and harms of SWL and endourological techniques in the treatment of urolithiasis go beyond SFR. URS may have higher complication and re-treatment rates (6,12). A Cochrane review of RCTs comparing URS and SWL for ureteric stones found SWL has a lower auxiliary treatment rate and a shorter hospital stay (12). A recent systematic review of RCTs on lower pole renal stones found no difference in re-treatment or unplanned procedure rates between SWL and URS, although the quality of evidence (GRADE) was low or very low and incidence rates were low for both interventions (9).

For patients the most important outcome may be the effect of each treatment on their health related quality of life (QoL) including time off work and pain. Time till return to normal activities (including driving, non-strenuous activity and work) and post-operative analgesic requirements were shorter in two RCTs following a single session of SWL vs. URS for renal stones (18, 19). An RCT comparing URS and SWL for ureteric calculi similarly demonstrated less pain and a quicker convalescence for SWL (20). However, there are currently no validated questionnaires to robustly assess QoL in the treatment of urolithiasis and as such the evidence for QoL outcomes is lacking.

Pearle et al. asked patients with  $\leq 10$  mm lower pole stones whether they would undergo the same treatment again after URS and SWL: patients favoured SWL: 63% vs. 90%;  $p = 0.031$  (18). However when patients underwent multiple SWL sessions for larger lower pole stones the same results were not replicated (19). Pearle et al., in a separate RCT, found a higher satisfaction following SWL vs. URS for ureteric calculi, although statistical significance was not reached (94% vs. 87%;  $p > 0.05$ ) (20).

Ureteric stenting is more frequently required with URS than SWL, typically for 1-2 weeks (6). Stent related symptoms including suprapubic pain, frequency and dysuria are commonly bothersome (21). One RCT reported 46% of patients required anticholinergics for stent related symptoms following URS (19). SWL is now typically conducted without general anaesthesia, which is typically required for URS and may necessitate an overnight hospital stay and/or present significant risks in co-morbid patients. Finally, renal scarring induced by SWL has been linked with renal impairment and diastolic hypertension (22). However, no prospective study with long-term follow-up has proven this association (23).

## CONCLUSIONS

SWL produces acceptable SFR in the treatment of small and medium sized renal and ureteric calculi. URS may be more effective in terms of stone clearance, from a single session, particularly for larger lower pole renal stones. However, SWL is less invasive and has a lower complication rate than URS for renal stones. SWL is associated with a shorter hospital stay and quicker return to normal activities. SWL typically avoids stent insertion (with its associated bothersome symptoms) and general anaesthesia. Patients report a higher satisfaction rate with a single session of SWL than URS. Further technological and technique modifications will further improve the safety, efficacy and acceptability of SWL in the future.

## ABBREVIATIONS

SWL = Shock wave lithotripsy

URS = Ureteroscopy

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