

## Extracorporeal Shockwave Lithotripsy and Intracorporeal Lithotripsy for Proximal Ureteric Calculi – A Comparative Assessment of Efficacy and Safety

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### Abstract

**Introduction:** Extracorporeal shockwave lithotripsy (ESWL) is the treatment modality of choice of many urologists for proximal ureteric calculi. In this study, we compared the efficacy and safety of ESWL versus ureteroscopy with holmium laser lithotripsy for the treatment of this group of stones. **Materials and Methods:** Between May 1999 and October 2000, 50 patients had ESWL and another 51 patients underwent ureteroscopy with holmium laser lithotripsy for proximal ureteric calculi. The two groups were similar in age, sex ratio and stone size. ESWL was performed with the Dornier Compact lithotripter whereas holmium laser lithotripsy was performed via retrograde ureteric access with a Wolf 7.5 Fr semirigid ureteroscope. **Results:** Ureteroscopy with holmium laser lithotripsy was significantly better in terms of the mean procedure time (56 min in ESWL; 25 min in ureteroscopy;  $P < 0.001$ ) and the 1-month stone free rate (50% in ESWL; 80% in ureteroscopy;  $P = 0.001$ ). The 3-month stone free rate was also higher for ureteroscopy (78% in ESWL; 90% in ureteroscopy) but this difference was not statistically significant ( $P = 0.09$ ). Minor complications of steinstrasse (6%) occurred in ESWL and proximal stone migration (8%) occurred during ureteroscopy. **Conclusion:** Ureteroscopy with holmium laser lithotripsy is a viable and safe alternative to ESWL for the management of proximal ureteric calculi.

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**Key words:** Holmium, Shockwave, Ureteroscopy

### Introduction

The introduction of extracorporeal shockwave lithotripsy (ESWL) by Chaussy and his co-workers in 1980<sup>1</sup> revolutionised the management of urinary calculi.<sup>2-4</sup> Since then, ESWL has become the modality of choice of many urologists for proximal ureteric calculi.<sup>5,6</sup> A review by Segura et al in 1997<sup>7</sup> suggested ESWL as the first-line treatment of most proximal ureteric calculi. On the other hand, the advent of smaller diameter and semirigid ureteroscopes yielded good stone clearance rate of over 90% with intracorporeal modalities of stone fragmentation.<sup>8-10</sup> For both modalities, the complication rates varied between 0 and 20%.<sup>8-17</sup> To our knowledge, there is no literature comparing the efficacy and safety of intracorporeal and extracorporeal lithotripsy for proximal ureteric calculi. Thus, the objective of our present study was to

compare the efficacy and safety of ESWL and ureteroscopy with Holmium laser lithotripsy for proximal ureteric calculi.

### Materials and Methods

A total of 101 consecutive patients who received treatment for proximal ureteric calculi between May 1999 and October 2000 were considered for the present study. These patients had solitary radio dense ureteric calculi proximal to the bony pelvis on excretory urogram or computed tomography (CT). Patients were included in the study only if the intervention, either ESWL or ureteroscopy, was the primary modality and there was a minimum follow-up period of 6 months. Patients with pyonephrosis, prior percutaneous nephrostomy, sepsis, bleeding diathesis and pregnancy were excluded from the study. Of the 101 patients, 50 underwent ESWL and 51 had ureteroscopy

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with Holmium laser lithotripsy. There were no significant differences in the mean age, sex ratio and stone size in both groups (Table 1).

ESWL was performed using the Dornier Compact lithotripter that deploys electromagnetic shockwaves for fragmentation. All patients were positioned supine and the calculi were localised with fluoroscopic guidance. The energy in the shockwave is concentrated onto the target by focusing with an acoustic lens. Patient controlled intravenous alfenatanil was used routinely and the level of shockwave energy was progressively stepped up till satisfactory stone fragmentation within the comfort of the patient. Ureteroscopy was performed under general or spinal anaesthesia with a Wolf 7.5 Fr semirigid ureteroscope connected to a video monitor. Access to the ureter was achieved initially with a guide wire through the working channel into the ureteric orifice. No cases of difficult catheterisation of the ureteric orifice were encountered. The stones were disintegrated with a single Holmium:YAG laser machine (Coherent, Palo Alto, California). Use of Dormia basket for extraction of stone fragments or insertion of double-J ureteric stent was left to the discretion of the surgeons. The stones were assessed postoperatively using plain X-ray of the kidneys, ureters and bladder (KUB). Treatment outcome was assessed by the post-procedure stone size. Stone-free status was defined as complete absence of calculus at 4 or 12 weeks of follow-up. Efficacy quotient (EQ) at 3 months was calculated using this formula:  $\text{Stone-free rate (\%)} \times 100 / 100 + \text{retreatment rate (\%)} + \text{rate of auxiliary procedures (\%)}$ . Statistical analysis was performed using SPSS version 10 software with Pearson's chi-square test and *t*-test.

## Results

For the extracorporeal modality, i.e. ESWL, the average treatment time and shockwave energy delivered were 56 minutes (range, 20 to 105 minutes) (Table 2) and 204.8J (range, 58.2 to 316.5 J), respectively. The mean stone size was 10.7 mm (range, 5 to 30 mm) (Table 1). Majority of the patients had the treatment as an outpatient procedure (72%). Stone-free status at 1 month and 3 months were 50% (*n* = 25) and 78% (*n* = 39) respectively (Fig. 1). In total, 7 patients (14%) required 2 sessions of ESWL for disintegration, whereas another 7 patients (14%) required secondary ureteroscopy and holmium laser lithotripsy after a single session of ESWL. In these patients, the indications for conversion to ureteroscopy were non-fragmentation and steinstrasse. EQ at 3 months was 61. There were 3 documented cases of steinstrasse (6%) after ESWL and only 1 was treated conservatively; the other 2 required ureteroscopy. No cases of perinephric haematoma were reported.

For the intracorporeal modality, i.e. ureteroscopy with Holmium laser lithotripsy, the average procedure time was 25 minutes (range, 5 to 120 minutes) (Table 2). The mean stone size was 9.0 mm (range, 4 to 30 mm) (Table 1). The majority of these procedures (56%) were performed on an outpatient basis. None required preoperative stenting or ureteric dilata-

Table 1. Demographic and Stone Characters of Patients who Underwent ESWL and Ureteroscopy

	ESWL	Ureteroscopy	<i>P</i> value
Mean age (y)	49 (29-85)	43 (29-90)	>0.1
Male-to-female ratio	1:0.3	1:0.13	>0.05
Mean stone size (mm)	10.7 (5-30)	9.0 (4-35)	>0.05

Table 2. Results of ESWL vs Ureteroscopy

	ESWL	Ureteroscopy	<i>P</i> value
Mean op time (min)	56 (20-105)	25 (5-120)	<0.01
No. of re-treatment	7 (14%)	1 (2%)	<0.01
No. of auxiliary procedures	7 (14%) (Holmium laser)	4 (8%) (ESWL)	0.3
EQ at 3 months	61	82	

tion. Dormia basket was deployed in 20 patients (39%); 5 patients (10%) required postoperative double-J ureteric stenting due to high stone load. There was no intraoperative ureteric injury. The stone-free status at 1 month and 3 months were 80% (*n* = 41) and 90% (*n* = 46), respectively (Fig. 1). With respect to complications, there were 4 cases (8%) of proximal stone migration, which was treated by ESWL subsequently. Repeat ureteroscopy with laser lithotripsy was required in 1 patient (2%) who had a hard 15-mm stone. EQ at 3 months was 82. No other long-term complications, such as ureteric stricture, were documented during the period of follow-up.

## Discussion

For proximal ureteric calculi, the chance of spontaneous passage is lower than that of mid and distal ureteric calculi. In 1991, Reid et al<sup>18</sup> reported a spontaneous passage rate of only 22%. This was especially so in stones more than 5 mm.<sup>7</sup> ESWL is the treatment of choice for proximal ureteric calculi in many centres. A 3-month stone-free rate of 67% to 91% with re-treatment rate of 10% to 13% have been reported in different centres.<sup>12-17</sup> Our study showed similar stone-free and re-treatment rates for ESWL. In addition, we had a significantly lower re-treatment rate with URS and Holmium laser lithotripsy as

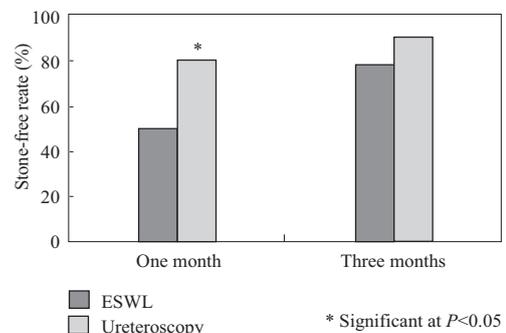


Fig. 1. Stone-free rate at 1 month and 3 months.

compared to ESWL (14% in ESWL; 2% in ureteroscopy). Secondary treatment was required in 14% of patients who had ESWL and 8% of patients who had ureteroscopy. From the patient's viewpoint, achieving an immediate stone-free status with a single modality is the ultimate goal for any therapeutic approach chosen.<sup>19</sup> In the present study, we have found that with ureteroscopy and Holmium laser, a significantly higher stone-free rate at 1 month was achieved (50% in ESWL; 90% in ureteroscopy).

However, the invasiveness of ureteroscopy cannot be neglected. Before the emergence of modern techniques for stone fragmentation and newer, better-designed ureteroscopes, complications like ureteric perforation and avulsion were not uncommon. A comprehensive review of acute endoscopic injuries reported in the literature from 1984 to 1992 identified 314 ureteric perforations that occurred in 5117 procedures (6.1%) and complete ureteric avulsion in another 17 procedures, though infrequent, were documented (0.3%).<sup>20</sup> Harmon et al<sup>21</sup> observed a decrease in overall complications from 20% to 12% during a 10-year period which were attributed to smaller ureteroscopes and increased surgeon's experience. A recent study<sup>11</sup> suggested a significant reduction in ureteric perforation with a less operative time and postoperative complications with the surgeon's experience. Our centre has accumulated substantive experience with the use of semi-rigid ureteroscopy and intracorporeal lithotripsy for the past 10 years<sup>22-24</sup> and there was no ureteric injury in our present study. Proximal migration of stones occurred in 4 patients (8%); similar rate of stone migration has been reported.<sup>8</sup> With the emergence of flexible ureteroscopes that could reach all the calyces in the kidney, migrated stone could be retrieved with basket. However, these state-of-the-art ureteroscopes are fragile and experience in our centre is still limited. Thus semi-rigid ureteroscopes are still routinely used for upper ureteric calculi.

In our centre, ureteroscopy is performed via video monitoring and on-table fluoroscopy is performed only when there is a need for double-J ureteric stenting. Overall, only 5 patients (10%) had a double-J ureteric stent inserted for high stone load. This significantly reduces the occurrence of colic, haematuria and other complications of obstruction. Furthermore, with ureteroscopy, the radiation exposure to the patient was nil to minimal as compared to ESWL. In addition, it is also important to notice that with ESWL, more follow-up visits to the clinic were required until a stone-free state was achieved and at each visit, the patient was exposed to radiation from plain radiography. When we compare the cost effectiveness of the 2 modalities, ureteroscopy with holmium laser lithotripsy is superior in terms of better EQ and fewer outpatient visits.

On the other hand, an important disadvantage of ureteroscopy is that the procedure has to be performed under general or spinal anaesthesia as compared to ESWL, which uses intravenous analgesia. This exposes the patient to the risks of anaesthesia and makes it unfavourable to patient with significant medical problems. This is a potential limitation when consid-

ering ureteroscopy over ESWL. From this study, we suggest that the choice of treatment modality for upper ureteric stone will depend mainly on the patient since the expertise for both modalities are equally available. Patient's factors will include acceptance of invasive procedure, physical health and preference for earlier stone-free status. Though this is not a randomised prospective study, patient selection bias is minimised by matching the two groups in terms of age, sex and stone size and studying consecutive patients managed by the same group of urologists.

## Conclusion

Although ESWL is regarded by many urologists as the preferred choice of treatment for proximal ureteric calculi, our results suggest that ureteroscopy with Holmium laser lithotripsy, is a viable and safe alternative, with an advantage of obtaining an earlier or immediate stone-free status.

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