

# Multimodal Approach in the Management of 1163 Ureteric Stone Cases

H M Tan, FRCS

R P C Liew, FEARACS

C C W Chan, FEARACS

A T N Wong, FEARACS

K W Ngun, FEARCS

*Subang Jaya Medical Centre, Subang Jaya, Selangor*

## Summary

One thousand one hundred and sixty three patients (male – 852, female – 311) with ureteric calculi requiring intervention were treated between April 1988 to July 1992. Four hundred and eleven cases were treated by ESWL Monotherapy, 414 by stone manipulation plus ESWL, 301 by retrograde ureteroscopic lithotripsy, 36 by percutaneous antegrade ureteroscopic lithotripsy and 1 case by open ureterolithotomy. There were 25 failures of the initial procedures. Only three cases that failed primary procedures required open surgery. Other complications include minor ureteric mucosal perforation (3%), infection (3%), transient moderate to gross haematuria (20%), loin ache (26.4%), irritative urination (34.4%) and low grade fever (30.1%). Current modalities used in the treatment of ureteric calculi produce good results and there is generally no primary role for any open surgery.

**Key Words:** ESWL (Extracorporeal shockwave lithotripsy), Stone manipulation, Ureteroscopic lithotripsy, Ureterolithotomy

## Introduction

The treatment of ureteric stones has exemplified the recent trends of minimally invasive surgery in all surgical disciplines. From the 1880's when various approaches to open ureterolithotomy were described viz transperitoneal, extraperitoneal and dorsal lumbotomy, the main stay of treatment of ureteric calculi were by these open surgical means until the 1980's<sup>1</sup>. In the 1980's, new modalities such as percutaneous antegrade approach, were described by Smith and associates, and retrograde ureteroscopic approach by Perez Castro and Martinez<sup>2</sup>. These minimally invasive techniques were quickly adopted, and perfected by urologists worldwide within a short period. In the mid 1980's, after Extracorporeal Shockwave Lithotripsy (ESWL) was proven to be safe

and effective for upper urinary tract calculi by Chaussy and associates, this highly revolutionary treatment was quickly extended to all ureteric calculi<sup>3</sup>. Clayman and Lingeman, both pioneers in endourology were quick to adopt endourological means viz percutaneous antegrade ureteroscopy and retrograde ureteroscopy, combining with ESWL, to achieve better success<sup>4,5</sup>. Marberger in 1992 eventually reported that ESWL is the first line of treatment for all ureteric calculi and endourological procedures a close second when ESWL fails or is anticipated to fail<sup>6</sup>.

This paper examines our results in the management of ureteric stones requiring intervention, using current modalities of treatment.

## Materials and Methods

Between April 1988 and July 1992, 1,163 consecutive cases of ureteric calculi requiring intervention were reviewed, and formed the basis of our study. No cases needing intervention were excluded. The indications for intervention include urosepsis, persistent obstruction, intractable pain, and occasionally the desire of patient to be stone-free. Small non-obstructing ureteric calculi (< 4mm) were treated conservatively with analgesics if they caused only colic. These patients were closely followed up until the ureteric calculi were excreted spontaneously. Stone-free status and normal urinary system would subsequently be confirmed either by ultrasound scan or intravenous urogram (IVU).

Of the 1,163 consecutive ureteric procedures done, 852 were males and 311 females (male: female ratio = 2.7:1). The average age was 44 with a range of 16 to 87 years. Measured radiographically in its longest dimension the ureteric stone size range from 4 to 60mm with an average of 9.5mm.

The stones were located within the upper ureter in 358 cases, mid ureter in 195 and lower ureter in 610. The upper ureter is defined as that portion beginning at the pelvoureteric junction and extending downwards to the level of the transverse process of the 5th Lumbar Vertebra. The mid-ureter extends from this level (L5 transverse process) to the inferior border of the sacroiliac joint. Below that to the vesicoureteric junction is the lower ureter.

Between 1988 and 1991, ESWL monotherapy was used to treat only non-obstructing or partially obstructing ureteric calculi. All other cases were managed by endourological means with or without ESWL. After 1991, the ESWL monotherapy option was extended to include all ureteric calculi no matter where they were located except those very large ureteric calculi (> 15mm) or very tightly impacted calculi causing gross hydronephrosis; or those with evidence of urosepsis where urgent relief of obstruction was necessary. Upper ureteric calculi needing ESWL monotherapy were treated in supine position, mid ureteric calculi in prone position and lower ureteric calculi in the sitting position.

All patients needing endourological intervention were treated under general or regional anaesthesia (epidural or spinal). Intravenous analgesia was the standard when only ESWL monotherapy was carried out. A standard single dose of intravenous Gentamycin 80mg was given intraoperatively by our anaesthetists for all endourological procedures. For patients with compromised renal function, one dose of intravenous Ceftriaxone (Rocephin) 1G were given instead. Prophylactic antibiotics were not given for ESWL monotherapy cases unless there was evidence of urinary tract infections. Indwelling J-stents were inserted for all patients after endourological procedures. These J-stents (with or without suture attached) were left indwelling for between 1 day to 6 weeks. Check KUB X-rays were routinely done on the following day postprocedure. The duration of hospitalisation ranged from 0.5 to 5 days with a mean of 1.1 days. Repeat KUB X-rays were done 3 to 6 weeks after ESWL monotherapy. Check intravenous urograms were done routinely for all patients after undergoing endourological procedures, 6 weeks after removal of the indwelling J-stents or 3 months post endourological procedure.

The lithotripter used in our centre is the HM3 Anaesthesia free unit. Endourological support equipment included the Ureteromat (hydrostatic pressure pump), ureteroscopes with sizes ranging from 6Fr to 14Fr. The latter mainly for antegrade ureteroscopic procedures. The 9.5F short ureteroscope (Wolff) was most frequently used. Nearly all cases required dilatation of the submucosal ureteric tunnel to F12 diameter. The miniscopes (ACMI 6.9F and Wolff 7.2F) were used commonly in the latter part of our study, no ureteric tunnel dilatation being necessary. Routine J-stents were inserted whenever ureteroscopy was performed. In cases where miniscopes were used, the indwelling J-stents with attached sutures were left in situ for about 3 days to reduce postoperative ureteric colic. The patients were discharged after recovery from anaesthesia and followed up at the clinic for check KUB and removal of the indwelling J-stent after 1 to 3 days. A wide range of ureteric dilators and intracorporeal lithotripsy energy sources, together with standard endourological disposables were used as a routine.

All statistical comparisons between groups were done by the Chi-square test with Yate's correction.

**Results**

The various procedures used in the treatment of 1,163 ureteric stone cases are shown in Table I. The treatment outcome of each procedure is shown in Table II.

**Table I  
Procedures used**

Type of procedures	Number of cases	Percentage %
ESWL monotherapy	411	35.4%
Stone Manipulation + ESWL		
- 'Flushing' or J-stenting + ESWL	204	17.5%
- Ureteroscopic (URS) 'push-up' + ESWL	210	18.0%
Retrograde ureteroscopic lithotripsy	301	25.9%
Percutaneous antegrade ureteroscopic lithotripsy	36	3.1%
Ureterolithotomy	1	0.1%
<b>Total</b>	<b>1163</b>	<b>100.0%</b>

Of the 1,163 ureteric stones, 411 were treated by ESWL monotherapy, 414 by stone manipulation plus ESWL, 301 by retrograde ureteroscopic lithotripsy, 36 by percutaneous antegrade ureteroscopic lithotripsy (PAUL) and 1 case by open ureterolithotomy. Eighty-five out of 825 cases which required ESWL either as primary or adjunctive procedure needed a repeat session to complete the treatment. No patient was subjected to more than 2 sessions of ESWL. No repeat ureteroscopic procedures were done, but ESWL was needed as an adjunctive procedure to pulverise large residual stone fragments in 35 cases. In 25 patients the primary procedure failed. These 25 failures cases were subsequently managed as per Table III.

There was no statistical difference in the rated successful treatment with respect to site of stone ( $p=0.496$ ). Analysis of success rate according to sex also showed no significant difference between the male and female population ( $p=0.090$ ).

Only three cases of failed procedures required open surgery; one case of a large upper ureteric calculus in a horseshoe kidney that failed a 'push-up' procedure and two cases of failed retrograde ureteroscopy, one resulting in major perforation of the ureteric wall and another in avulsion of the lower ureter. The latter occurred in a small frail 68-year-old woman. Other complications

**Table II  
Results of procedures used**

Type of procedures	Number of cases		
	Total	*Success (%)	Failures (%)
ESWL monotherapy	411	392 (95%)	19 (5%)
Stone manipulation + ESWL	414	410 (99%)	4 (1%)
Retrograde URSL	301	299 (99%)	2 (1%)
Percutaneous antegrade URSL	36	36 (100%)	0
Ureterolithotomy	1	1 (100%)	0
<b>Total</b>	<b>1163</b>	<b>1138 (97.8%)</b>	<b>25(2.2%)</b>

\* Success : Stone free or residual fine sand fragment (1-2mm)

\* URSL : Ureteroscopic Lithotripsy

**Table III**  
**Outcome of failed primary procedures**

25 Failures	Salvaged Procedures
19 ESWL monotherapy	12 retrograde URS 4 URS 'push-up' + ESWL 2 J-stenting + ESWL 1 defaulted
2 URS 'push-up' + ESWL	1 J-stenting + ESWL 1 ureterolithotomy
2 J-stenting + ESWL	2 Retrograde URS Lithotripsy
2 Retrograde URS lithotripsy	2 Ureterolithotomy + reimplantation of Ureter

**Table IV**  
**Treatment outcome versus sex and site**

Site	Success		Failure		Total
	Male	Female	Male	Female	
Upper	236	116	5	1	358
Mid	139	51	4	1	195
Lower	455	141	13	1	610
Total	830	308	22	3	1163

included minor ureteric mucosal perforation in 35 cases (3%) (documented intra-operatively), minor infection in 37 cases (3%); transient moderate to gross haematuria in 233 cases (20%) and loin ache in 307 cases (26.4%). Irritative urinary symptoms such as frequency, dysuria and urgency occurred in 395 cases (34.4%); and transient low grade fever in 350 cases (30.1%). None of these minor complications needed any or extra hospitalisation. The ESWL group has higher failure rate but fewer complications.

A 3 months follow-up was available in 963 cases which represented 82.8% of our total number of procedures done. 200 cases (17.2%) defaulted from follow-up. There were 163 cases of residual sand fragments when ESWL was done either as monotherapy or used as an adjunctive procedure. 130 of these cases with residual

sand fragments were among the 200 defaulted cases. The majority of these cases with fine residual sand would most probably result in spontaneous excretion. Intravenous urograms and ultrasound scanning of the urinary tract performed during follow-up did not show any ureteric stricture or ureteric obstruction. Residual hydronephrosis with no evidence of obstruction was commonly seen in those patients with large ureteric calculi and prolonged obstruction preoperatively.

Table V shows the stone free status when the ureteric calculi were treated with only endourological procedures or when ESWL was used with or without endourological procedures.

When ESWL is necessary in addition to endourological procedures, there is significantly less chance of achieving stone-free status ( $p=0.001$ ) compared with solely endourological procedures used in the primary treatment of ureteric calculi.

**Table V**  
**Stone-free status with respect to ESWL and endourological procedures**

Site	ESWL ± Endourological Procedures		Only Endourological Procedures	
	Number	Stone-free	Number	Stone-free
Upper	317	257	41	41
Mid	174	132	21	21
Lower	334	275	276	274
Total	825	664	338	336

## Discussion

Non invasive ESWL and minimally invasive endourological procedures were already well established and accepted during our study period. Even with these new technologies, more than 50% of our patients with acute ureteric colic secondary to small stones opted for conservative treatment because of the high hospital cost. Small ureteric stone (less than 5mm size) made up about 25% of our total cases. The majority of these cases who eventually opted for intervention (usually

ESWL monotherapy under intravenous sedation) were because of recurrent intractable pain, and others were due to social or work-related reasons.

During our first 36 months, ESWL monotherapy was used only for non or partially obstructing ureteric calculi. Tightly obstructing or impacted ureteric calculi were subjected to endourological lithotripsy or disimpaction into the renal pelvis. Other studies have shown an improvement of at least 30% in the success rate when the stones were not tightly held by the ureteric mucosa<sup>5,10</sup>. However in 1991/1992, when there were more publications of a high success rate with ESWL monotherapy even for obstructing ureteric calculi, more of our cases received ESWL as a first line treatment<sup>6,7,8,15,16</sup>. We were able to continue to achieve a success rate of 95% because we did not subject tightly impacted or large ureteric calculi (more than 15mm size) to ESWL monotherapy.

Impacted or large ureteric calculi were either fragmented by ureteroscopic lithotripsy or dislodged into the renal pelvis followed by ESWL. Potential major complications such as perforations or strictures were not encountered after 1989. Our 35 cases of documented minor ureteric mucosal perforations diagnosed intraoperatively, were most probably superficial as we have not detected any ureteric strictures in our routine intravenous urograms done 3 months postoperatively for all ureteroscopic cases. Major ureteric perforations or through perforations have about 35% rate of ureteric stricture even with prolonged J-stenting, and these are usually evident by the 6th postoperative week<sup>24</sup>.

Ureteroscopies done with ease using miniscope or even larger scopes, after adequate ureteral dilatation, have no significant long term complications. El Gammal and Selmy studies showed perfect healing of the ureteric muscle and mucosa after 3 to 6 weeks<sup>12,13</sup>. All cases requiring ureteric dilatation of more than F12 diameter were stented routinely for 3 to 6 weeks using bio-compatible siliconised indwelling ureteric stents that cause minimal irritation.

This routine precautionary measure may have ensured that no case of ureteric stricture occurred in our series. Endourological procedures done without ureteric

dilatation were only stented for 1 to 3 days to allow ureteric mucosal oedema to settle. In such cases requiring a short period of stenting, a suture attached to the indwelling ureteric stent was left hanging out of the external urinary meatus to facilitate removal in the outpatient clinic. Routine J-stenting for postendourological procedures has resulted in a reduction of postoperative ureteric colic and also reduced hospitalisation significantly.

Almost all our ureteric calculi needing intervention are successfully treated with either ESWL or endourological means or combination of both. Non invasive ESWL monotherapy can achieve up to 95% success rate in the treatment of ureteric calculi which are not or only partially obstructive. We are equally successful with impacted or large ureteric calculi. Our results of treatment of large impacted ureteric calculi (>15mm size) indicate that even very large complicated stones do not require open surgery. These calculi, usually located in upper or mid ureter, are treated by stone manipulation + ESWL or percutaneous antegrade ureteroscopic lithotripsy. For very large and tightly impacted lower ureteric calculi, retrograde ureteroscopic lithotripsy is advocated. This has a more than 97% success rate with very low morbidity<sup>18,19,21</sup>. We have not performed any open surgery as **primary** treatment for ureteric calculi after 1988. This has been the experience of many authors<sup>5,6,17,21,25</sup>.

Minimally or non-invasive treatment for urinary stones had been widely accepted and established in the 1980's and will be well consolidated in the 1990's. Open ureterolithotomy which has at least a 17% major complication rate even in the best of institutions will eventually be a rarity<sup>22,23</sup>.

## Conclusion

Today, current modalities of management of ureteric calculi are well defined and safe. Complications are few and mainly minor. These new procedures cause much less morbidity, require shorter hospitalisation (mean hospitalisation of 1.1 days) and allow an early return to work. Open ureterolithotomy with a very much higher major complication rate, has no **primary** role in the treatment of ureteric calculus as shown in our experience and also recently expounded by Marberger<sup>6</sup>.

## References

1. Murphy LJT. The Ureter: The History of Urology, Springfield, Illinois: Charles C. Thomas Publisher, 1972; Ch. 9: 277-283.
2. Perez-Castro Ellendt E and Martinez-Pinero JA. Transureterorenoscopy, a current urological procedure. Arch Esp Urol 1980;33 : 445-9.
3. Chaussy C, Schmiedt E and Brendel W. Extracorporeally induced destruction of kidney stones by shock waves. Lancet 1980;2 : 1261-5.
4. Preminger GM, Clayman RV, Hardeman SW, Franklin J, Curry T and Peters PC. Percutaneous nephrolithotomy vs. open surgery for renal calculi. JAMA 1985;254 : 1054-9.
5. Lingeman JE, Shirrell WC, Newman DN, Mosbaugh PG, Steele RE and Woods JR. Management of upper ureteral calculi with extracorporeal shockwave lithotripsy. Journal of Urology 1987;138 : 720-6.
6. Marberger M. Current options of ureteric stones, 10th World Congress on Endourology and Extracorporeal Shockwave Lithotripsy, Sept 1992.
7. Alexander S Cass. De Novo Extracorporeal Shockwave Lithotripsy for Ureteral Calculi. Journal of Endourology 1992; 6(5) : 315-8.
8. Z Kircali, U Mungan and M Sade. Extracorporeal Shockwave Lithotripsy of Ureteric Stones in situ. Journal of Endourology 1992; 6(6) : 411-2.
9. Cesare Selli and Marco Carini. Treatment of Lower Ureteral Calculi with Extracorporeal Shock Wave Lithotripsy, Journal of Urology 1988;140 : 280-2.
10. Lingeman JE, Saint R, Newman DN, Mosbaugh PG, Steele RE, John W Scott J. Management of Ureteral Calculi, Current and Future Concept. Journal of Urology 1990;143 : 274-9.
11. GM Watson. Lecture on Ureteroscopic Lithotripsy. 10th World Congress on Endourology and Extracorporeal Shockwave Lithotripsy, Sept 1992.
12. M El Gammal, M Hassouna, JS Li, NS Wang, Coolsaet, Ellulali. Effect of Balloon Catheter Dilatation of the Ureter on Upper Tract Dynamics and Ureteral Wall in Swine. Journal of Endourology 1990; Vol 4, No: 15-26.
13. G Selmy, M Hassouna, LR Begin, Coolsaet, Ellulali. Effects of Balloon Dilatation of Ureter on Upper Tract Dynamics and Ureteral Wall Morphology. Journal of Endourology, 1993; 7(3) : 211-9.
14. Masaya Itoh, Nono Katoh, Yoshinari Ono, Shinichi Ohshima. Transurethral Ureterolithotripsy with the Rigid Ureteroscope: Efficacy of Balloon Dilatation of Ureteral Orifice and Intradural Ureter. Journal of Endourology 1992; 6(4) : S119.
15. D Nersuis, S Alloussi, T Zwergel, M Netzer and M Ziegler. Extracorporeal Piezoelectric Lithotripsy for Ureteral Stone Treatment, Journal of Endourology, August 1992; Vol 6, No 4.
16. Z Kircali, A Esen, C Gwler, Izmir. Extracorporeal Lithotripsy of Ureteral Stones in situ. Journal of Endourology, August 1992; Vol 6, No 4: S93.
17. D Jocham, C Chaussy, E Schmiedt. Extracorporeal Shockwave Lithotripsy. Urology Int 1986;41 : 357-68.
18. Stephen P Dretler and Alex Weinstein. A Modified Algorithm for the Management of Ureteral Calculi: 100 consecutive cases. Journal of Urology 1988;140 : 732-6.
19. Peter Fugelso and Peter M Neal. Endoscopic Laser Lithotripsy: Safe, Effective Therapy for Ureteral Calculi. Journal of Urology 1991;145 : 949-51.
20. Joseph W Segura. Percutaneous Endourology, AUA Update Series 1984; Vol III, Lesson 26.
21. Gerhard J Fuchs, Christian G Chaussy and Armlf Stenzi. Current Management Concepts in the Treatment of Ureteral Stones. Journal of Endourology 1988; 2(2), 117-21.
22. Stephen P Dretler. Management of Ureteral Calculi, AUA Update Series 1988; Vol VII, Lesson 6.
23. John W Scott, James E Lingeman. Renal and Ureteral Calculi. Current Management Indiana Medicine 1987; 80(5) : 450-5.
24. Eugene V Kramolowsky. Ureteral Perforation During Ureteroscopy: Treatment and Management. Journal of Urology 1987;138 : 36-8.
25. Stephen P Dretler. In Situ ESWL vs Ureteroscopy: The case for ureteroscopy. Journal of Endourology 1989; 3(3) : 301-5.