Experience with 395 extracorporeal shockwave lithotripsy in the treatment of renal and ureteric calculi.

H. M. Tan, FRCS (Edin) , FRCS (Glasg)
Consultant Urologist

Humairah S. Cheung, FRCR (England)
Consultant Radiologist

Subang Jaya Medical Centre , Subang Jaya, Selangor

Summary

Three hundred and ninety five cases in 358 consecutive patients (male – 232, female – 126) with renal and ureteric stones were treated with extracorporeal shockwave lithotripsy (ESWL) from March to November 1988. They either had ESWL alone, or in combination with stone manipulation or debulking percutaneous nephrolithotripsy (PCNL). Seventy five percent of the stones were found in the pelvicalyceal system and 25% in the ureter. Seventy-six percent of the stones were less than 25mm size. Two hundred and ninety (79%) cases were followed up to three months. Two hundred and forty nine (85.9%) cases were stone free and 36 (12.4%) had residual sand less than 3mm size. Five (1.7%) cases failed to fragment with ESWL monotherapy and were salvaged by either percutaneous or ureteroscopic intervention. None of the cases required any open surgery intervention.

Key words: ESWL, PCNL, Ureteroscopy, lithotripter, endourology.

Introduction

Extracorporeal shockwave lithotripsy is presently an established form of treatment for urinary calculi.[1–8] Simultaneous introduction of endourological service i.e. percutaneous stone removal, transurethral ureteroscopic stone removal, ureteric stone manipulation and ureteric stenting together with ESWL have enabled nearly all types of urinary calculi to be managed successfully by non-open surgical means.[9–13]

Our management of urinary calculi is based on this intergrated practice offering all forms of stone treatment modalities. This study of 395 consecutive cases of extracorporeal shockwave lithotripsy is to highlight the impact of the introduction of ESWL in the management of urolithiasis. It also reveals the importance of endourological support to a lithotripter centre so as to achieve the optimal success rate.

Patients and methods

From March 28, 1988 to November 30, 1988, 395 ESWL procedures were performed in 358 consecutive patients. During this period, a total of 486 urinary stone cases (excluding bladder

calculi) were managed in the Subang Jaya Medical Centre. Three hundred and ninety five (81.3%) cases were indicated for ESWL either alone or in combination with auxillary endourological procedures following the guideline shown in Table 1. Forty three (8.8%) cases were managed by percutaneous nephrolithotripsy, 39 (8%) cases by ureteroscopic lithotripsy and only nine (1.9%) cases by open surgery.

All patients indicated for ESWL were treated with the Dornier HM3 Anaesthesia Free Lithotripter using oral, per rectal or intravenous analgesia when only ESWL was needed. Patients needing auxillary procedures like stone manipulation, ureteric stenting or debulking PCNL, were given epidural or general anesthesia.

Post ESWL X-rays or ultrasound (for radiolucent calculi) examination were performed on all patients. Patients with residual sand or fragments were followed-up in the clinic. Repeat ESWL was performed on residual fragments that were bigger than 3mm size.

The Chi-square test was used to compare the results of this centre with those of other centres. Age was expressed as mean ± standard error of the mean.

Table 1
Treatment modalities guideline for urinary calculi

Renal Calculi	
Stone size (mm)	Treatment
Less than 25*	ESWL Monotherapy
25 – 35*	J-stenting & ESWL
More than 35	Percutaneous nephrolithotripsy ± ESWL
Ureteral Calculi	
Mid and Upper Third	
Nature of Obstruction	Treatment
No obstruction	ESWL monotherapy
Minimal obstruction	ESWL monotherapy
Moderate or tight obstruction	Push-up, J-stenting & ESWL or percutaneous antegrade ureteroscopy
Lower Third	
Nature of Obstruction	Treatment
No obstruction	ESWL monotherapy
Mild obstruction	ESWL monotherapy
Tight obstruction	Retrograde ureteroscopy

* Non-impacted stones

Results

Of the 358 patients with 395 ESWL treatments, 232 (65%) were male and 126 (35%) were female. Their age ranged from two years to 86 years (46.7 ± 0.7 years). There were six paediatric cases. Two hundred and sixty eight (75%) of the patients were between 30 to 60 years of age.

The commonest symptom was that of loin pain, 295 patients (82.4%). Haematuria, 169 patients (47.2%), and urinary tract infection, 66 patients (18.4%), were also common presentations. Only seven patients (2%) presented with renal failure. Seventy six patients (21.3%) had past history of open surgery for urinary stones.

Kidney stones including staghorn calculi made up of 295 (75%) of the stones treated whereas 100 stones (25%) were found in the ureter. There were 37 patients with bilateral stones. Of the 395 cases, 298 cases (76%) were stones of less than 25mm size; 56 cases (14%) were between 25–35mm size and 41 cases (10% were more than 35mm size. One hundred and ninety seven cases (49%) were complicated stones viz 100 ureteric stones and 97 renal stones of more than 25mm size.

Two hundred and thirty three cases (60%) were treated with ESWL monotherapy. One hundred and thirty five cases (34%) required stone manipulation, 27 cases (6%) required debulking PCNL before ESWL.

Of the 395 cases, 290 (73.4%) were followed up for 3 months. Twenty three (5.8%) cases were referred to be followed up with out-station doctors. Only 82 (20.8%) cases failed to return for a three month post ESWL assessment. Of these 290 cases analysed, 249 (85.9%) cases were found to be stone free and another 36 (12.4%) cases had residual fragments of less than 3mm size. The overall result of 98.3% success rate is not significantly different ($p > 0.1$) from that of other ESWL centres (Table 2).

Only five cases were considered to have failed ESWL. Of these, two patients were subsequently treated with percutaneous nephrolithotripsy and three with ureteroscopic stone removal. None of the patients needed open surgery.

The main complications were that of fever (24%), colic (17%) and subcutaneous ecchymosis (27%). Most of the patients developed mild to moderate haematuria lasting less than 24 hours post treatment. No patient required any blood transfusion. Only eight (2%) cases developed post-ESWL obstruction; four cases required nephrostomy defunctioning, two had ureteroscopic clearance of residual fragments and two others were treated conservatively with fluids and antibiotics.

Discussion

Extracorporeal shockwave lithotripsy (ESWL) is presently the most common therapy for urinary calculi.[1–10] It has been found to be very effective if used within its limitations.[8,9,10] The availability of endourological facilities has increased its range to cover all types and sizes of urinary stones in both upper and lower urinary tract.[8–12]

Patient compliance is excellent with ESWL because the treatment is done without anaesthesia and the pain is very tolerable. Small children and old patients with multiple medical problems are not contraindicated.[17,18]

Table 2
Comparison of ESWL procedures and outcome at different centres

Centre	Authors	Results			Auxillary Procedure	Open Surgery Post ESWL
		Stone Free (%)	Spontaneously Passable	Overall Success (%)		
University of Munich, 1984	Chaussy[4] N = 860	88	11	99	16.4%*	1%
Katherinen Hospital Stuttgart, 1985	Eisenberger[5] N = 1215	88	11	99	17.6%*	0
Methodist Hospital Indianapolis 1986	Lingeman[6]	91	8	99	14.0%*	0
UCLA, 1986	G. Fuch[7] N = 1025	80	16	96	19.0%	0
Cornell Medical Centre New York, 1986	Robert A. Riehle[8] N = 300	75	23	98	30.0%	0
Subang Jaya Medical Centre Malaysia, 1988	HM Tan N = 395	86	12	98	40.0%**	0

* Only stones less than 20mm size were included in these studies
** 49% were complicated stones i.e. stones 25mm size or greater and impacted or ureteric stones

Our high success rate is mainly due to the liberal use of auxillary procedures viz 'push-up', ureteric stenting and PCNL for complicated stones. Because of the high frequency of complicated stones seen in this centre, 40% of our cases required such auxillary procedures. This is significantly different ($p < 0.01$) from earlier studies[4,5,6] which only selected uncomplicated renal stones during the early days of ESWL.

The overall success rate (stone free and residual sand less than 3mm size) of between 96–98% is now achievable in most urological centres.[6,9,10] This is possible even in the treatment of complicated and large stones because of the availability of a wide range of supportive endourological services.

Complications are generally minor when ESWL is done with the correct indications.[1–6] Occasional major complications and ESWL failures can be salvaged by non-open surgical means.[8,9,10]

The efficiency and safety of ESWL suggests that the majority of urinary calculi (renal calculi less than 25mm size and non-impacted ureteric calculi) are best treated with this technique.[3,5,6,8,9,10] Generally with the introduction of ESWL to any country, only about 60–70% of all urinary calculi can be treated with ESWL monotherapy,[9–13] another 30–40% would require pre ESWL auxillary procuedres to ensure success and minimise complication. Open surgery is eventually needed in less than 1% of all urinary stone needing intervention.[3,9,10]

References

1. Drach GW, Dretler S, Fair W, Finlayson B, Gillenwater J, Griffith D, Lingeman J and Newman D. Report of the United States Cooperative Study of Extracorporeal Shockwave Lithotripsy. Journal of Urology, 1986; 135: 1127–1135.

2. Chaussy C. Schmiedt E, Jocham D, Brendel W, Forssmann B, Walther V. First clinical experience with extracorporeal induced destruction of kidney stones by shockwaves. Journal of Urology, 1982; 127: 417–423.

3. John W Scott, James E Lingeman. Renal and Ureteral Calculi: Current Management. Indiana Medicine, 1987; 80: 450–454.

4. Christian Chaussy, Long Schuller, Egbert Schmiedt, Herbert Brandl, Dieter Locham, Bernard Liedl: Extracorporeal Shockwave Lithotripsy (ESWL) for the Treatment of Urolithiasis. Special Issue of Urology, 1984; XXIII: 59–66.

5. Eisenberger F, Fuchs G, Miller K, Rassweiler J: Extracorporeal Shockwave Lithotripsy, One-year experience with the Donier Lithotripter. Eur Journal of Urology, 1985; 11: 145–150.

6. James E Lingeman, Daniel Newman, Jack H O Mertz, Philip G Mosbaugh, Ronald E Steele, Richard J Kahnoski, Thomas A Coury, John R Woods: Extracorporeal Shockwave Lithotripsy: The Methodist Hospital of Indiana Experience. Journal of Urology, 1986; 135: 1134–1137.

7. G Fuch, Christian G Chaussy: Extracorporeal Shockwave Lithotripsy for the Treatment of Urinary Tract Stones. Extract Hospimedia, 1986; 10: 5–10

8. Robert A Riehle, William R Fair, E Darracott Vaughan: Extracorporeal Shockwave Lithotripsy for Upper Urinary Tract Calculi, JAMA 1986; 255: 2043–2048.

9. Rassweiler J, Cumpinger R, Miller K, Holzermann F, Eisenberger F. Multimodal treatment (Extracorporeal Shockwave Lithotripsy and Endourology) of complicated renal stone disease, Eur Journal of Urology, 1986; 12: 294–299.

10. LeRoy AJ, Segura JW, Williams HJ Jr and Patterson DE: Percutaneous renal calculus removal in an extracorporeal shockwave lithotripsy practice. Journal of Urology, 1987; 138: 703–706.

11. Schulze H, Hertle L, Graff J, Funke PJ and Senge T: Combined treatment of branched calculi by percutaneous nephrolithotomy and extracorporeal shockwave lithotripsy. Journal of Urology, 1986; 135: 1138–1143.

12. Dickinson K, Fletcher MS, Bailey MJ et al: Combination of percutaneous surgery and extracorporeal shockwave lithotripsy for the treatment of large renal calculi. Br Journal of Urology, 1986; 58: 581–584.

13. Lingeman JE, Coury TA, Newman DN and Kahnoski RJ: Comparisons of results and morbidity of percutaneous nephrostolithotomy and extracorporeal shockwave lithotripsy. Journal of Urology, 1987; 138: 485–490.

14. Winfield HN, Clayman RU, Chaussy CG, Weyman PJ, Fuchs GJ and Lupu AN: Monotherapy of staghorn renal calculi a comparative study between percutaneous nephrolithotomy and extracorporeal shockwave lithotripsy. Journal of Urology, 1988; 139: 895–899.

15. Kahnoski RJ, Lingeman JE, Coury TA, Steela RE and Mosbaugh PG: Combined percutaneous and extracorporeal shockwave lithotripsy for staghorn calculi: An alternative to anatrophic nephrolithotomy. Journal of Urology, 1986; 135: 679–681.

16. Stevan B Streem, Michael A Gersinger, Barbara Risius, Margaret G Zelch, Steven W Siegel: Endourologic 'Sandwich' Therapy for Extensive Staghorn Calculi. Journal of Endourlogy 1987; 1: 253–259.

17. EV Krambolowsky, BL Wiloughby, SA Loemg: Extracorporeal Shockwave Lithotripsy in Paediatric Patients. Dornier User Newsletter, May 1987: 16–20.

18. Daniel M Newman, Thomas Coury, James E Lingeman: Extracorporeal Shockwave Lithotripsy Experience in Children. Journal of Urology, 1986; 136: 238–240.