EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY FOR UPPER URINARY TRACT STONES USING THE DORNIER LITHOTRIPTER COMPACT: AN EXPERIENCE IN JAPAN

Manabu KAWANO, Ryoji YASUMOTO and Tomoaki TANAKA
From the Department of Urology, Osaka Municipal Juso-Shimin Hospital

Nobuyasu NISHISAKA, Toshihide NAGANUMA and Taketoshi KISHIMOTO
From the Department of Urology, Osaka City University Medical School

Between May 1997 and February 1998, 40 cases of renal stones and 40 cases of ureteral stones in 60 males and 20 females were treated with the Dornier Lithotripter Compact. The size of the stones ranged from 5 mm to 80 mm. Three patients required epidural anesthesia and 4 patients required a ureteral stent. Fragmentation of the stones was observed in all patients. After 1 month, the efficacy and stone free rates were 91% and 54%, respectively. After 3 months, they were 91% and 68%, respectively. There were no serious side effects such as pyelonephritis, perirenal hematomas, and massive hematuria.

In conclusion, the Dornier Lithotripter Compact proved to be a safe and highly effective lithotripter for the treatment of renal and ureteral stones.

(Acta Urol. Jpn. **46**: 701–704, 2000)

Key words: ESWL, Dornier Lithotripter Compact, Elderly patients

INTRODUCTION

The introduction of extracorporeal shock wave lithotripsy (ESWL) has dramatically changed the management of urinary tract stones[1], and as a result, the accepted mode of urological stone management has progressed from open surgery to ESWL and other endoscopic urological techniques. Recently, a third generation ESWL machine, the Dornier Lithotripter Compact, was developed. This lithotripter consists of three main components, X-ray, lithotriptic, and ultrasound systems. The X-ray system is connected to the lithotriptic system and calculates the three-dimensional position of the stone based on 2-directional views. The ultrasound system based on the AI 5200S Envision is also connected to the lithotriptic system and calculates the three-dimensional position. A cylindrical shock-wave generator is built into the lithotriptic system. Shock waves are generated by an electromagnetic source and transmitted to the body through a dome-shaped water bag. In 1999, Tailly reported an improvement in the treatment rate using the Dornier Lithotripter Compact compared with those using other Dornier Lithotripters such as HM4 and MPL 9000[2]

In our experience, all stones were fragmentated in spite of their composition. The efficacy rate and stone-free rate were similar to those in Tailly's report[2] No serious side effects, particularly in elderly patients, were noticed. We thus report the usefulness of this lithotriptic machine herein.

PATIENTS AND METHODS

Between May 1997 and February 1998, 80 patients were treated with the Dornier Lithotripter Compact. There were 60 males and 20 females, ranging in age from 16 to 83 years old, with a mean age of 51.4 years. There were 40 renal cases, with the renal stones located in the renal pelvis (R2) in 29 cases and at the ureteropelvic junction (R3) in 11 cases. There were 40 ureteral cases, with the ureteral stones located in the upper ureter (U1) in 16 cases, in the middle ureter (U2) in 3 cases and in the lower ureter (U3) in 21 cases. The stones were located on the right side in 33 patients and on the left side in 47 patients. The stones ranged in size from 5 mm to 80 mm and averaged 13, 14, 10, 6 and 7 mm at R2, R3, U1, U2 and U3, respectively (Table 1). In 7 patients, a second session was applied. The sizes and locations of those stones were 5–9 mm in a case (R2), 10–19 mm in 2 cases (U1), 20–29 mm in one case (R2) and more than 30 mm in 3 cases (R2 and R3). A third

Table 1. Stone location and size

Location	Right		33		Left		47
Kidney	40	R2	29	R3	11		
Ureter	40	U1	16	U2	3	U3	21
Size	5– 9 mm		38				
	10–19 mm		34				
	20–29 mm		3				
	30–80 mm		5				

session was not applied in any patients. The average treatment time of each location was R2; 46 minutes, R3; 44 minutes, U1; 36 minutes, U2; 32 minutes and U3; 39 minutes.

Biochemistry studies, radiology and ultrasound evaluations were all performed in the outpatient clinic, and excretory urography (IVP) was performed in all patients. Urinalysis was performed in all patients, and when pyuria was noted, antibiotics were prepared in a few days for the patient.

The patients were admitted the day before the operation. On the day of the procedure, an analgesic suppository was inserted and an analgesic drug was injected intramuscularly before ESWL treatment. Epidural anesthesia was required in 3 patients, 2 cases of renal stones and one of a ureteral stone. A double-J stent was placed in 4 patients: 2 cases with staghorn calculi and 2 cases with renal calculi larger than 30 mm. No preparation was necessary for ESWL treatment. The X-ray system usually depicted most stones, and radiolucent stones were visualized using echography and contrast media for IVP. Most patients were discharged within 4 days.

Preoperative stone conditions, therapeutic effects, side effects and other items are described in accordance with the evaluation criteria of the ESWL study committee[3] A follow-up X-ray film was taken within 24 hours, and 1 and 3 months later. Treatment was considered effective if the patient was stone-free or had residual fragments less than 4 mm in diameter.

RESULTS

Most stones were easily depicted by radiography, and radiolucent stones were visualized using echography and contrast media for IVP. Focusing time, including patient positioning, ranged from 2 to 25 minutes, with an average time of less than 10 minutes.

The average shock wave count was 2,212 shots for R2 stones, 2,671 for R3 stones, 3,056 for U1 stones, 2,549 for U2 stones, and 3,161 for U3 stones. The average shock wave count was 2,846 shots for a 5–9 mm stone, 2,941 shots for a 10–19 mm stone, 2,652 shots for a 20–29 mm stone, and 2,315 shots for more than a 30 mm stone, the average time for fragmentation according to each stone size being 34, 47, 45 and 42 minutes, respectively. Among the patients treated with ESWL, a second session was carried out in 7 patients: 3 patients with R2, 2 with R3 and 2 with U1. The remaining patients received only one session.

All stones were well fragmented in spite of their composition. It was noteworthy that uric acid stones and cystine stones were also well fragmented. Stone analysis revealed 37 Ca oxalate and Ca phosphate stones, 3 uric acid stones, a struvite stone and a cystine stone (Table 2).

Table 2. Stone composition

Composition	Number of stones (%)
Calcium oxalate and/or calcium phosphate	37 (88.1)
Struvite	1 (2.4)
Uric acid with ammonium	3 (7.1)
Cystine	1 (2.4)

Table 3. Clinical results

		Efficacy (%)		Stone-free rate (%)	
	Number	1 month	3 months	1 month	3 months
R2	29	90	90	38	45
R3	11	81	81	45	72
U1	16	88	88	63	88
U2	3	100	100	67	100
U3	21	100	100	71	90
Total	80	91	91	54	68

The overall efficacy was 91% at both 1 and 3 months. The stone-free rate was 54% at 1 month and 68% at 3 months (Table 3). Efficacy against renal stones (R2 and R3) was 86% at both 1 and 3 months. In contrast, efficacy against ureteral stones was 96% at both 1 and 3 months, and thus the efficacy was greater than that against renal stones. The stone-free rate after treatment of ureteral stones was more than 63% at 1 month and more than 88% at 3 months, whereas the rates for R2 renal stones were 38% at 1 month and 45% at 3 months. The stone-free rates for R3 renal stones were 45% at 1 months and 72% at 3 months (Table 3).

Almost 70% of the patiants had mild bruising of the skin following treatment. Moderate side effects were encountered in 5 patients (6%). All of them were in the renal calculi group. Four patients experienced renal colic during ESWL, and one patient (1.3%) developed cardiac arrhythmia. Macroscopic hematuria was noted in 26 patients (33%) and microscopic hematuria was noted in the others (67%). Slight fever (<37°C) was noted in 11 patients (13.8%). However, there were no serious side effects such as pyelonephritis, perirenal hematomas, and massive hematuria.

In most of the 14 patients whose age was over 70 years old, there was no severe renal, hepatic, or circulatory impairment during or after ESWL treatment. However, diastolic hypertension was observed in one patient at 1-month follow-up.

DISCUSSION

ESWL has become the preferred treatment modality for urinary calculi since its initial application in 1980 by Chaussy et al.[1] Recently, third generation lithotripters, operating without

anesthesia, and locating stones by X-rays and ultrasound have made treatment easy and safe. The shock waves generated by the electromagnetic source are no less powerful than those of the Dornier HM-3 modified type[4] Small-focus ESWL equipment supplemented by ultrasound location has yielded satisfactory results on an outpatient basis.

In comparing the four Dornier Lithotripters, Tailly found a slight improvement in the treatment rate using the Compact, compared with HM4, MPL 9000 and U/50[2] He also showed that there was an overall improvement in the effectiveness quotient that could be attributed to several factors: machine-related (improved imaging with better targeting, small focus), patient-related (decrease in average stone size), and operator-related (better treatment strategies, experience). In our experience, this machine has not caused any serious side effects, particularly in elderly patients. Most patients experienced mild pain during treatment but did not require analgesic drugs. In addition, it was so easy to focus that treatment took less than 60 minutes that is similar to the duration reported previously[5,6]

The overall efficacy rate was 91% and the stone-free rate was 54% at 1 month follow-up. These values improved to 91% and 68% at a 3-month follow-up, respectively. These results are similar to those in previous reports[5–7]. In contrast, the stone-free rates for R2 and R3 were lower compared with those in other reports[5–8]. However, these stone-free rates were lower compared with the 88.8% at the 3-month follow-up reported by Tailly[2]. We think that these differences are due to the size of the stones treated.

Cystine stones and uric acid stones are considered as problematic stones because of the difficulty of focusing on the stones[9]. However, ESWL could be the first choice for treatment of these stones[10]. For cystine stones larger than 25 mm in diameter, more than two ESWL sessions were reportedly necessary[9] However, in our experience all stones were well-fragmented regardless of their composition, as shown in Table 2. In particular, it is noteworthy that uric acid stones and cystine stones were also well fragmented.

An earlier study showed rare serious complications, for example, thoracic bleeding, gastrointestinal bleeding, and subcapsular hematoma[11], but no such serious side effects occurred in our study. No direct bioeffects of the shock waves were detected because of the small size of focusing.

The safety in terms of renal, hepatic, circulatory function and so on, has not being established in elderly patients treated with this machine. In our experience of 14 patients whose age was over 70 year old, no severe renal, hepatic, or circulatory impairment has been observed during or after ESWL treatment in most elderly patients. However, diastolic hypertension was found in a 71-year-old male at the 1 month follow-up. We believe that long-term observation is needed in elderly patients treated with ESWL.

In conclusion, the Dornier Lithotripter Compact has proven to be a safe and effective lithotripter for the treatment of renal and ureteral stones, especially in elderly patients.

REFERENCES

1) Chaussy CH, Brendel W and Schmiedt E: Extracorporeally induced destruction of kidney stones by shock waves. Lancet **ii**: 1265–1268, 1980
2) Tailly GG: Consecutive experience with four Dornier Lithotripters: HM4, MPL 9000, Compact, and U/50. J Endourol **13**: 329–338, 1999
3) Sonoda T: Evaluation standards for stone treatment by endourology and ESWL. Jpn J Urol **80**: 505–506, 1989
4) Kishimoto T, Kanazawa T, Sakamoto W, et al.: Long term results of ESWL treatment with stones in the upper urinary tract. Jpn J Endourol ESWL **4**: 181–188, 1991
5) Tolon MC, Erol H, Tolon J, et al.: A report on extracorporeal shock wave lithotripsy results on 1569 renal units in an outpatient clinic. J Urol **145**: 695–698, 1991
6) Bierkens AF, Hendrikx AJM, De La Rosette JJM, et al.: Treatment of mid and lower ureteric calculi: extracorporeal shock wave lithotripsy vs laser ureteroscopy. a comparison of costs morbidity and effectiveness. Br J Urol **81**: 31–35, 1998
7) Kinoshita H, Kanaya H, Yamamoto S, et al.: Treatment of urinary tract calculi with The ultrasonic lithotripsy treatment system, a third generation piezoelectric shock wave lithotripter. Jpn J Endourol ESWL **6**: 45–50, 1993
8) Drach GW, Dreter S, Fair W, et al.: Report of the United States cooperative study of extracorporeal shock wave lithotripsy. J Urol **135**: 1127–1133, 1986
9) Cranidis AI, Karayannis AA, Delakas DS, et al.: The efficacy of percutaneous and shockwave lithotripsy. Urol Int **56**: 180–183, 1996
10) Martin X, Salas M, Labeeus M, et al.: The impact of new treatment. Br J Urol **68**: 234–239, 1991
11) Yokoyama M: Side effects and complications of extracorporeal shock wave lithotripsy for urolithiasis: clinical aspects. Jpn J Endourol ESWL **6**: 13–28, 1993

(Received on Augest 26, 1999
Accepted on June 10, 2000)

和文抄録

ドルニエリソトリプターコンパクトを用いた上部尿路結石症に対する体外衝撃波による結石破砕術の経験

大阪市立十三市民病院泌尿器科（部長：安本亮二）
河野　学，安本　亮二，田中　智章
大阪市立大学医学部泌尿器科学教室（主任：岸本武利教授）
長沼　俊秀，西阪　誠泰，岸本　武利

1997年5月から1998年2月の間に腎結石40例，尿管結石40例（男性60例，女性20例）についてドルニエリソトリプターコンパクトを用いた治療を行った．結石のサイズは5 mmから80 mmであった．大多数の症例は無麻酔で行ったが，3例に硬膜外麻酔を必要とした．また4例に尿管ステント留置後に治療を行った．すべての症例において結石砕石は認められた．1カ月後の評価では砕石効果と完全排石率は91％と54％，また，3カ月後の評価では砕石効果と完全排石率は91％と68％であった．腎盂腎炎や腎周囲血腫，大量の血尿などの重篤な副作用はみられなかった．

ドルニエリソトリプターコンパクトは腎尿管結石の治療において安全で砕石効果が優れていると考えられた．

（泌尿紀要 **46**：701-704，2000）