

# Efficacy of Extracorporeal Shock Wave Lithotripsy on the Treatment of Upper Urinary Tract Stones

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**Objectives.** Extracorporeal Shock wave Lithotripsy (ESWL) is an effective and non-invasive treatment for renal and upper ureteral stones. However, appropriate treatment for larger stones (> 2 cm) is still controversial. We aimed to investigate the efficacy of ESWL for larger upper urinary tract stones and the factors that influence outcome.

**Methods.** From December 1999 to July 2000, a total of 703 patients with upper urinary tract stones (470 patients with renal stones and 233 patients with upper ureteral stones) were treated by ESWL at the China Medical University Hospital. One hundred seventy-five cases were excluded from this study because of missing data or because they were lost to follow up. A total of 528 patients were enrolled in this study. We analyzed the difference in outcome by dividing patients into 3 groups according to stone size: Group A < 10 mm (274 cases), Group B < 20 mm but > 10 mm (204 cases), Group C > 20 mm (50 cases). Auxiliary treatment for the complications in the 3 groups included either uretero-renaloscopic lithotripsy (URSL) or percutaneous nephrolithotripsy (PCNL).

**Results.** An overall stone free rate of 69.7% (stone fragment < 3 mm) was achieved during 3-month follow-up. The auxiliary treatment rate differed among the 3 groups ( $p < 0.001$ ). Group C required a higher auxiliary treatment rate (24.0%) and had a lower stone free rate (32.0%) than the other two groups. No serious complications related to ESWL were observed.

**Conclusions.** In conclusion, the ESWL is a safe and effective method for treating renal and upper ureteral stones. However, ESWL is not recommended for treating stones greater than 20 mm because of the higher auxiliary treatment rate and lower stone free rate. (Mid Taiwan J Med 2005;10:38-42)

## Key words

extracorporeal shock wave lithotripsy, stone free rate, upper urinary tract stones

## INTRODUCTION

Extracorporeal shock wave lithotripsy (ESWL) is a relatively non-invasive treatment of upper urinary tract calculi [1,2]. ESWL is

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currently used to treat 85% to 90% of renal and ureteral stones. The technology reduces hospital stay, and results in fewer side effects than traditional open surgery [2-4]. However, the treatment of large (> 20 mm) or impacted stones by ESWL remains a challenge because the procedure can result in significant large residual fragments and lead to other complications [3-5].

**Table 1. The stone free rate, number of secondary ESWL treatments and number of auxiliary treatments after ESWL treatment in groups A, B and C**

	Group A	Group B	Group C	<i>p</i>
	n (%)	n (%)	n (%)	
Patients requiring 2 <sup>nd</sup> ESWL Tx	22 (8.0)	30 (14.7)	23 (46.0)	< 0.001
Patients not requiring 2 <sup>nd</sup> ESWL Tx	252 (92.0)	174 (85.3)	27 (54.0)	
Stone free	231 (84.3)	121 (59.3)	16 (32.0)	< 0.001
Residual stone	43 (15.7)	83 (40.7)	34 (68.0)	
Patients requiring auxiliary treatment	7 (2.6)	29 (14.2)	12 (24.0)	< 0.001
Patients not requiring auxiliary treatment	267 (97.4)	175 (85.8)	38 (76.0)	
Total	274	204	50	

*p* value was calculated by chi-square test.

In our study, the efficacy of ESWL for treating upper urinary tract stones and the factors that influence the outcome were studied. The critical stone size that can be effectively treated by ESWL was also investigated.

#### MATERIALS AND METHODS

From December 1999 to July 2000, a total of 703 patients with upper urinary tract stones (470 renal stones and 233 upper ureteral stones) were treated by ESWL (Dornier Compact Delta Lithotripter, Munich, Germany) at our hospital. One hundred and seventy-five patients were excluded from this study because of missing data or loss to follow-up. The remaining 528 patients were followed in the out-patient department and underwent at least one follow-up KUB within 3 months.

Stone free status was defined as no residual stone or stone fragments less than 3 mm on the KUB. If a residual stone fragment greater than 3 mm was found, another KUB was taken within 3 months. If the residual stone fragment remained after a 3-month follow-up, the ESWL treatment was defined as unsuccessful.

Auxiliary procedures, such as ureterorenoscopic lithotripsy (URSL) or percutaneous nephro-lithotripsy (PCNL), were performed when acute obstructive uropathy or impacted stones were detected after ESWL treatment.

A total of 528 patients (371 men and 157 women) were enrolled in this study. There were 292 stones in the left side and 236 in the right side; 354 were in the kidney and 174 in the upper ureter. Among them, 478 stones (90.5%) were

less than 20 mm in size.

Patients were divided into 3 groups according to stone size: group A < 10 mm (n = 274), group B < 20 mm but > 10 mm (n = 204), and group C > 20 mm (n = 50). Data were analyzed for statistical significance by the chi-square test.

#### RESULTS

The average number of ESWL sessions was 1.2 and the average number of applied shock waves per session was 2966.1. Multiple sessions were performed in 75 patients (14.0%). There were 22 patients in Group A (8.0%), 30 patients in Group B (14.7%) and 23 patients in Group C (46.0%) that needed a second ESWL (Table 1). There were significant differences in stone free rate, second ESWL treatment rate, and auxiliary treatment rate between Group A, Group B and Group C (*p* < 0.001).

An overall stone free rate of 69.7% was achieved during the 3-month follow-up. The stone free rate was 84.3% in Group A, 59.3% in Group B and 32.0% in Group C (Table 1). The differences in stone free rate were statistically significant (*p* < 0.001). The stone free rate of Group A plus Group B (stone size less than 20 mm) was significantly different from Group C (stone size more than 20 mm). URSL was required as an auxiliary treatment after ESWL in 48 patients: 7 patients (2.6%) in Group A, 29 patients (14.2%) in Group B and 12 patients (24.0%) in Group C (Table 1). The differences between Group A, Group B and Group C were statistically significant (*p* < 0.001). In addition, 5

**Table 2. Stone free rate according to age and gender**

	Stone free	Residual stone	Total	<i>p</i>
	n (%)	n (%)		
Male	261 (70.3)	110 (29.7)	371	0.62
Female	107 (68.2)	50 (31.8)	157	
L't	195 (66.8)	97 (33.2)	292	0.10
R't	173 (73.3)	63 (26.7)	236	

*p* value was calculated by chi-square test.

PCNL procedures were performed for large impacted stones.

The stone free rate was 74.4% in men and 68.2% in women. The difference in gender was not statistically significant (Table 2) ( $p = 0.62$ ). The stone free rate was 66.8% in the left side and 73.3% in the right side. The difference in laterality was not statistically significant ( $p = 0.10$ ) (Table 2).

No serious complications related to ESWL were observed in our study.

### DISCUSSION

In this study, 14.2% of patients required secondary session ESWL treatment, a rate compatible with a reported overall rate of 13.5% patients [6-9]. However, we found that second session ESWL treatment rate was much higher in patients with stone sizes greater than 20 mm.

No significant difference in laterality and gender of patients with stones was noted in this study. The number of stones in the left side was higher than in the right side, but the stone free rate in the left side was lower than in the right side. However, laterality failed to predict the stone free rate. The United States Cooperative Study of ESWL observed that the left kidney was more likely to be treated, implying that some unknown process may lead to greater generation or retention of calculi in the left side [2]. Riyadh et al reported a better stone free rate in the right kidney compared with the left kidney [10]. Whether laterality can influence the stone free rate needs to be further studied.

Lee et al reported that the overall stone prevalence in Taiwan was 9.6% (14.5% in men and 4.3% in women) [11]. Men were more prone

to stone formation than women (age-adjusted prevalence of 12.2% in men and 3.1% in women). In our study, the prevalence of upper urinary calculi in men was 2.36 fold higher than in women. The difference might be due to patient selection bias. In this study, no statistical difference in the stone rate between men and women was found; therefore, gender does not seem to play a role in the success rate.

In our retrospective analysis, the stone free rate after ESWL was significantly related to stone size. The efficiency of ESWL decreases rapidly as the stone size increases (stone free rate from 84.3% for the stones less than 10 mm to 32.0% for stones greater than 20 mm). The results were compatible with many studies [3,12-15]. In conclusion, ESWL is a safe and effective treatment for renal and upper ureteral stones less than 20 mm.

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## 體外震波碎石術對上泌尿道結石的治療效果

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**目的** 體外震波碎石術治療腎臟及上泌尿道結石是一種有效和非侵入性的治療方法，但治療大於20毫米的上泌尿道結石仍有爭議。我們的主旨在研究體外震波碎石術對上泌尿道結石的治療效果與預後是否與結石的大小有關。

**方法** 從1999年12月到2000年7月共有703例上泌尿道結石的病人在我們醫院接受體外震波碎石術治療，包括470例腎臟結石和233例上輸尿管結石。175例因資料遺失或未繼續追蹤而排除，在這次研究中總共有528例。我們將所有案例依照結石大小分為3組並分析各組間的差異：A組小於10毫米有274例，B組小於20毫米大於10毫米有204例，C組大於20毫米有50例。

**結果** 三個月追蹤後全部結石排空率為69.7百分比(結石碎片小於3毫米)。術後接受輔助性治療的比率，三組有明顯的不同( $p < 0.001$ )。C組接受輔助性治療的比率(24%)高於其他兩組，而結石排空率低於其他兩組。術後並沒有與體外震波碎石術有關的嚴重併發症發生。

**結論** 體外震波碎石術治療腎臟及上輸尿管結石是有效且安全的，當結石大於20毫米時體外震波碎石術不建議作第一線的治療選擇，因較低的結石排空率與術後接受輔助性治療的比率較高。(中台灣醫誌 2005;10:38-42)

### 關鍵詞

體外震波碎石術，結石排空率，上泌尿道結石

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