Treatment of large and complex renal calculi with extracorporeal shock wave lithotripsy

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One hundred three large and/or complex renal calculi (>25 mm) were treated with Extracorporeal Shock Wave Lithotripsy (ESWL) by using Dornier lithotriptor MPL 9000. All of the treatments were performed on an out-patient basis under sedoanalgesia. Evaluation of the success rates in the short follow-up period (5-7 days) revealed an overall stone free rate of 56.3%. However, evaluation of the stone free rates with respect to the size, localization of the stones and the degree of dilatation in renal pelvi-caliceal system revealed different results. Relatively smaller stones (with a diameter of between 25-35 mm) in pelvic or upper caliceal localization in a non-dilated pelvi-caliceal system seemed to be the best ones in order to get a complete stone free status. Considering the aforementioned characteristics of the stones and the pelvi-caliceal system as well, ESWL monotherapy may be an efficient alternative to the other treatment modalities in the management of large and complex renal calculi in selected cases. [Turk J Med Res 1995, 13(4):154-158]

Key Words: Renal calculi, Extracorporeal shock wave lithotripsy

Clinical introduction of recent endourological techniques such as percutaneous lithotripsy (PCNL) and ESWL has changed the treatment concepts of symptomatic urinary calculi dramatically. Consequently, treatment of large and/or complex renal calculi has also been revolutionized to a point where open surgery especially some original surgical techniques are now rarely performed (1-4). Regarding the range of indications for ESWL, a highly strict criteria were applied to selection of the patients in the beginning, however, increasing experience in this field together with the practical and non-invasive nature of the technique widened the indication range singificantly (5-8). Hence, increasing number of patients with partial and total staghorn stones have also been treated. However, in the beginning absence of the use of some auxiliary procedures has resulted in both greater morbidity secondary to ureteral obstruction and a lower stone free rate in ESWL treatment of such stones (2,9,10).

Traditionally, anatrophic nephrolithotomy defined by Boyce et al and other some special surgical techniques have been used for years in the management of large and complex renal calculi. Despite their successful results, some serious complications observed during open surgery or PCNL and the risk of repeated punctures has led the physicans to use the least invasive methods for such calculi. Even if it is not recommended by some authors as the therapy of choice because of its high economic cost, patients behaviour against multiple therapy sessions and high incidence of reno-ureteral obstruction, ESWL monotherapy began to be preffered with its practical and noninvasive nature (1,5,6,11).

On the other hand, considering the results of many studies many authors believe that combination of PCNL and ESWL will lower the incidence of some life threatining serious complications and improve the success rates (1,9,11-13).

We present the results of ESWL monotherapy in the management of large and/or complex renal calculi with a multidimensional evaluation regarding the characteristics of the stone itself, renal collecting system and the complications observed as well.

Received: May 2,1995 **Accepted:** June 13, 1995

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MATERIALS AND METHODS

One hundred three patients with 103 solitary large and/or complex renal calculi were treated with ESWL monotherapy between October 1990 and January 1992. Of these 103 patients 70 patients were male

Table 1. Patients characteristics

No. of patients	103
Male/Femali	70/33
Right/Left	47/56
Age range (year)	7-68 (39.6)
Previous operation	23/103

Table 2. Stone characteristics (PR: Pelvis renalis, UC: Upper calix, MC: Middle calix, LC: Lower calix)

No. of stones		103
Right/Left		47/56
Stone size (mm)		25-55 mm (av. 30.3)
		25-35 : 73 cases
		35-45 : 20 cases
		45 and over: 10 cases
Localization		
	PR	60 cases
	PR+LC	10 cases
	PR+UC	8 cases
	PR+LC+UC	5 cases
	LC+MC	13 cases
	UC+MC	7 cases

(M/F ratio 2.1). The age of the patients ranged between 7-68 with an average value of 39.6 years. 23 patients had previous operation because of recurrent stone disease (2 times in 18 patients and 3 times in 5 patients). Most of the stones were located in renal pelvis (60 cases, 58.2%) and in calices (20 patients, 19.4%). In other cases the stones were located in pelvic and caliceal localization together. Large and complex renal calculi was defined as the stones filling renal pelvis and/or at least two adjacent calices. Stone size (in longitudinal axis) ranged from 25 to 55 mm (mean 30.3 mm). Patients characteristics and size, localization of the stones are summarized in Table 1-2.

Preoperative evaluation of the patients consisted of a detailed history, careful physical examination, routine laboratroy tests including coagulation tests and urine analysis and radio-sonographic evaluation of the kidneys. In case of a urinary tract infection, an appropriate antibiotic therapy was begun based on the results of culture-antibiogram tests. 2-3 days before ESWL. A double-J catheter insertion was performed under operative conditions in all patients in the beginning period, however with increasing experience in this type of patients we began to apply catheter insertion in selected patients especially with complete staghorn stones.

All of the treatments were performed with Dornier Lithotriptor MPL 9000 under sedo-analgesia (Phentanyl 3-7 ugr/kg).

The maximum number of shock waves used in one session was 2500 and the maximal electrical discharge (KV) was 26 KV. If the first session was not succesful enough a second or the other sessions were performed in 3-7 days following the previous session.

Following ESWL treatment, a plain film was obtained and sonographic evaluation of the kidney was performed in order to assess the degree of disintegration and to be aware of the possible complications. All of the evaluations were repeated 3 months after ESWL treatment and the results were interpreted as successful when there was no residual stone particle or when clinically insignificant stone particles (asymptomatic fragments less than 4 mm in diameter and expected to pass spontaneously) were observed.

RESULTS

Totally 255 sessions were performed in the treatment of 103 large and/or complex renal calculi in 103 patients. All of the stones were treated with ESWL monotherapy under either sonographic or X-ray

Table 3. Evaluation of ESWL parameters in the treatment of 103 large and complex renal calculi

No. of session	255	
	1 session	26 cases
	2 session	40 cases
	3 session	18 cases
	4 session	9 cases
	5 session	4 cases
	6 session	4 cases
	7 session	1 cases
	8 session	1 cases
SW number	:	1200-2500 (One session)
		1200-14950 (Total)
		2895/patient
		1969/session
KV value		17-26 KV(av. 20.2)
Time (min)		25-75 (av. 42.6)

Table 4. Evaluation of the auxiliary procedures applied and complications observed during treatment of large stones

Auxiliary procedures	50/103 (48.5%)
Double -J insertion	37/103 (35.9%)
-Preoperative	35/103 (33.9%)
-Postoperative	2/103(1.9%)
Percutaneous nephrostomy	5/103 (4.8%)
Ureterorenoscopy	8/103 (7.7%)
Complications	40/103 (38.8%)
Perirenal hematoma	1/103 (0.9%)
Fever	7/103 (6.7%)
Colic pain	13/103 (12.6%)
Stone street formation	19/103 (18.4%)

Table 5. Evaluation of success rates with respect to stone size

Stone size (mm)	n	Stone-free	Residual stone	Unsuccessful
25-35	73	49/73 (67.1%)	22/73 (30.1%)	2/73 (2.8%)
35-45	20	8/20 (40%)	10/20 (50%)	2/20 (10%)
>45	10	1/10(10%)	6/10(60%)	3/10(30%)
Overall	103	58/103(56.3%)	38/103(36.9%)	7/103(6.8%)

Table 6. Evaluation of success rates with respect to the degree of dilatation

Dilatation	n	Stone-free	Residual stone	Unsuccessful
Minimal	43	34/43 (79.0%)	8/43 (18.6%)	1/43 (0.2%)
Moderate	32	18/32 (56.2%)	13/32 (40.6%)	1/32 (0.3%)
Marked	28	6/28 (21.4%)	17/28 (60.7%)	5/28 (17.8%)
Overall	103	58/103(56.3%)	38/103(36.9%)	7/103(6.8%)

Table 7. Evaluation of success rates with respect to the localization of the stones in the kidney

Localization	n	Stone-free	Residual stone	Unsuccessful
PR, MR+UC	39	34/39 (87.2)	5/39 (12.8)	—
PR, MC+LC	55	23/55 (41.8)	31/55 (56.4)	1/55 (0.2)
Complete staghorn	9	1/9(11)	2/9 (22)	6/9 (67)
Over all	103	58/103 (56.3%)	38/103 (36.9%)	7/103 (6.8%)

localization. The number of shock waves ranged between 1200 and 14950 in 255 sessions. The average number of shock waves per patients was 2895 (1960/session). Electrical discharge during the treatment sessions was 17-26 KV with an average value of 20.2 KV. Average treatment time was 42.6 min (25-75 min). A summary of the treatment parameters is shown in Table 3. We inserted a double-J catheter in all of our patients routinely in the beginning under operative conditions. However, as a result of our increasing experience in the treatment of such calculi, we began to insert the catheter selectively especially in patients with complete staghorn stones. Following ESWL treatment in these patients, 15 patients required auxiliary procedures in order to get a stone free status and* to eliminate the present pathology. 5 patients required percutaneous nephrostomy and in 8 patients we performed ureteroscopy to remove the obstructing stone particles. If we add the 35 double-J inserted cases preoperatively, the overall rate of auxiliary procedures was 35.9% (37 out of 103 cases).

In one patient we observed perirenal hematoma formation and in 19 patients stone street formation was detected as severe complications following these treatments. On the other hand, as minor complications we observed severe renal colic in 13 patients and fever in 7 patients. The overall rate of complications was 38.8% in our group (40 out of 103 cases). However, the rate of severe complications which required the hospitalization of the patients was not significantly high.

Evaluation of our results in the short follow-up period (5-7 days) revealed a stone free rate of 56.3%. In 36.9% of our patients, we observed residual stone particles (majority of which were in lower caliceal localization) and in 6.8% of our patients, we were completely unsuccessful. On the other hand, evaluation of our success rates with respect to the of size of the stones treated, the degree of dilation renal pelvicaliceal system and the localization of the stones in the kidney as well, showed that relatively smaller stones (25-35 mm) located in renal pelvis and/or upper calices together with no, or little dilation have been disintegrated and passed easily than the other ones (Table 5,6,7).

All of these treatments were performed on outpatient basis except the hospitalization of 9 patients because of perirenal hematoma and stone street formation. Of these 9 patients, 8 with stone street forma-

tion were undergone ureterorenoscopy during their hospital stay. Convalescence period following ESWL procedure ranged from 2 to 9 days with an average value of 3.2 days.

DISCUSSION

Treatment of large and complex renal calculi remained controversial despite new endourological techniques such as PCNL and ESWL. Operative management of these stones, especially in patients with recurrent stone disease, is techniqually difficult and causes deterioration of renal function at every intervention (5,14). Despite its less invasive nature, PCNL usually requires multiple punctures of the kidney which may result in reduction in renal functional capacity (2,4,11,15). Morover, some serious complications observed during PCNL suhc as bleeding, perforation or arterio-venous fistula formation may be life threatining for the patients treated (11). At the same time, higher mortality incidence, longer hospital stay and late convalescence in PCNL were the main disadvantages of this technique which lowered its popularity (1,2,9,16,17).

Regarding the ESWL treatment of urinary stones, at the beginning a highly strict criteria were used in to selection of the patients for ESWL treatment and it was contrandicated in the management of such stones. However, increasing experience in this field as well as the routine use of some auxiliary procedures in recent years caused the range of indications to be widened further in order to include large stones (2,3,5,6,7,15).

While some authors claim that, monotherapy for large and complex renal calculi requires multiple treatments, has a high incidence of auxiliary procedures and low stone free rates, the results of some studies proved that ESWL monotherapy even with multiple treatment sessions was noted to be less morbid than than the other methods (3,5,16). On the other hand, treatment is simple, practical, safe and can be performed on an out-patient basis, especially with anesthesia-free lithotriptors.

Evaluation of the success rates reported in the literature, ESWL monotherapy for large and complex renal stones has generally resulted in lower stone free rates ranging from 30 to 63% (17). Lingenman et al, reported that only 28% of kidneys containing stones larger than 3 cm eventually became stone free without other measures. On the other hand, Gleson and Griffith reported stone free rates of 55% and 40% with single and multiple stones exceeding 3 cm in diameter. Again Pode and co-workers reported a 44% stone free rates in 41 patients with staghorn calculi treated with ESWL monotherapy (5,10,18).

Consideration the ESWL monotherapy of large calculi, the importance of Stone size, localization and the appearance of renal collecting system have been pointed out previously. Patients with large stones located in pelvic and/or upper caliceal position showed stone free rates following ESWL whic is about the same achieved with open surgical lithotomy or PCNL. Again, patients with non-dilated or mild dilated renal collecting system seemed to have higher stone free rates than the other ones. Clinical use of indwelling ureteral stents prior to ESWL has allowed the passage of stone particles and lowered the incidence of renoureteral obstruction (2,15).

Our serie consists of 103 large and complex renal calculi which were treated with ESWL monotherapy alone. Of these 103 patients 64% required 1 or 2 sessions and 9.7% or more sessions in order to get a successful result.

In the beginning insertion of a double-J stent was performed regularly in order to avoid a possible obstruction and to ease the passage of disintegrated stones particles. However with increasing experience in this aspect, we performed stent insertion selectively for more complex especially complete staghorn stones.

Evaluation of our results proved the effect of stone size and the degree of hydronephrosis on the final outcome of ESWL monotherapy in these stones. While overall stone free rate was 56.3% it was higher in patients with stones located in pelvic or middle-upper caliceal position. On the other hand, the degree of dilation in renal collecting system seemed also to be very important in the effectiveness of ESWL among our patients. Thus the stone-free rates and the complications observed in our group seemed acceptable. With the addition of the patients with residual small stone particles in lower caliceal position majority of whom became stone free in a certain time period, the success rates became more acceptable than the initial values. We observed a perirenal hematoma formation in one patient following ESWL which subsided conservatively without any spesific measure. No other serious complication and no loss of kidney could be encountered during these treatments. Another important finding was the evaluation of the blood pressure changes in these patients who received higher number of shock waves than the other ones. Again no statistically significant alteration could be demonstrated in 1 year follow-up after ESWL application.

In conclusion, we believe that, treatment of large and complex renal calculi must be planned by taking every possible treatment methods available into account. The stone size and the degree of dilation are the two important factors which directly affect the rate of stone free status of the patients treated. With the help of prophylactic use of internal ureteral stents, ESWL monotherapy in selected group of patients will be safe and practical with acceptable success rates. However in patients with complete staghorn calculi and marked hydronephrosis, ESWL-PCNL combination therapy will be the method of choice with its much better success rates than ESWL monotherapy alone.

Ekstra korporal şok wave litotiripsi ile büyük ve kompleks böbrek taşlarının tedavisi

Büyük ve/veya (>25mm) kompleks 103 böbrek taşı, Dornier litotriptor 9000 kullanılarak ektrokorperal şok wave litotripsi ile tedavi edildi. Tedavinin tümü sedasyon ve analjezi kullanılarak ayakta yapıldı. Kısa takip periodunda (5-7 günler) başarı oranlarının değerlendirilmesi total taşsızlık oranı %56.3 idi. Bununla birlikte, taşın büyüklüğü, taşın lokalizasyonu ve renal pelvi-kalisiyal dilatasyon derecesi dikkate alınarak yapılan değerlendirme farklı sonuçlar göstermiştir. Rölatif daha küçük taşlar (çapı 25-35mm arasında) ve özellikle pelvik veya dilate olmayan pelvikalisiyal sistemde lokalize olan taşlar taşsız duruma ulaşmak için en iyi adaylardır. Taşların şimdiye kadar bahsedilen özellikleri ve aynı zamanda pelvi-kalisiyal sistemin özellikleri dikkate alındığında, ESWL monoterapisi, seçilmiş vakalarda, büyük ve kompleks böbrek taşlarının diğer tedavimodalitelerine alternatiftir. [TurkJMedRes 1995, 13(4):154-158]

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