STONE STREET AFTER EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY: CHANGING TRENDS UPON CHANGING LITHOTRIPSY INDICATIONS

BEDEN DIŞI ŞOK DALGALARIYLA TAŞ KIRMA SONRASI TAŞ YOLU OLUŞUMU: DEĞİŞEN LİTOTRİPSİ ENDİKASYONLARINA BAĞLI OLARAK DEĞİŞEN EĞİLİMLER

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ABSTRACT

Purpose: *One of the main complications of extracorporeal shock wave lithotripsy (ESL) is the formation of stone streets. Although this complication may result in the spontaneous passage of stone fragments with urine, it may cause partial or full obstruction of the urinary system and affect renal functions. In this study, we evaluate the occurrence of stone streets and our clinical approach regarding the changing trends in both ESL and stone-street treatments in the 1990-1998 and 1998-2002 periods.* ***Methods:*** *Between April 1990 and December 2002, 6300 patients underwent ESL with a Siemens Lithostar Plus lithotriptor. Of these, 360 (5.7%) patients were found to have stone streets during their treatment; however, 50 (13.8%) patients were excluded from the study due to irregular follow-up. Mean length of the stone streets was 2.95 (1-15.2) cm.* ***Results:*** *Between 1990 and 1998, 256 (6.1%) patients had stone streets, whereas, between 1998 and 2002, 104 (4.9%) stone streets were observed. Of these patients, spontaneous relief was attained in 133 (43.1%) patients while additional ESL was necessary in 149 (48%) patients. Twenty (6.5%) and 8 (2.6%) patients in whom ESL was unsuccessful underwent ureterorenoscopy and ureterolithotomy, respectively. While the clearance rate of stone streets in the proximal ureter with spontaneous passage or ESL was 25% and 63.7%, these rates were 27.2% and 59.2% in the middle ureter and 51.4% and 40.8% in the distal ureter, respectively. Invasive procedures were performed in 4.1% of patients with a stone surface area less than 3 cm²; however, this rate increased to 20.4% in patients with a stone surface area larger than 3 cm². Also in this subgroup of patients, the need for invasive measures decreased from 20.8% to 14.3% between the 1990-1998 and 1998-2002 periods.* ***Conclusion:*** *Patients with stone street formation should be observed carefully. Ureterorenoscopy in stone street patients is the method of choice if ESL remains unsuccessful, and open surgery may be necessary in rare complicated cases. Treatment modalities other than ESL should be considered, especially if the pre-ESL stone surface area is larger than 3 cm².*

Key Words: *Stone-Street, Lithotripsy, Ureteroscopy, Urolithiasis.*

ÖZET

Amaç: *Beden dışı şok dalgalarıyla (ESL) taş kırmanın ana komplikasyonlarından biri de taş yolu oluşumudur. Bu komplikasyon taş parçalarının spontan olarak idrarla atılmasıyla sonlanabileceği gibi üriner sistemin parsiyel veya komplet obstrüksiyonuna yol açarak böbrek fonksiyonlarını etkileyebilir. Biz çalışmamızda, 1990-1998 ve 1998-2002 yılları arasında taşyolu oluşumunu ve değişen eğilimlere bağlı olarak bu duruma klinik yaklaşımımızı değerlendirdik.* ***Metod:*** *Nisan 1990 ve Aralık 2002 yılları arasında Siemens Plus Litotriptörle 6300 hastaya ESL uygulanmıştır. Tedavi sırasında 360 (%5.7) hastada taş yolu oluşurken 50 (%13.8) hasta yetersiz takip nedeniyle çalışmaya alınmamıştır. Taş yolunun ortalama uzunluğu 2.95 (1-15.2) cm olarak ölçülmüştür.* ***Bulgular:*** *1990- 1998 yılları arasında 256 (%6.1), 1998- 2002 yılları arasında 104 (%4.9) hastada taş yolu oluşmuştur. 133 (%43.1) hasta taşı spontan olarak düşürmüştür ve 149 (%48) hastaya ek ESL seansı gerekmiştir. ESL'nin başarısız olduğu 20 (%6.5) hastaya üreterorenoskopi ve 8 (%2.6) hastaya da üreterolitotomi uygulanmıştır. Proksimal üreterdeki taş yolunun spontan veya ESL ile temizlenme oranı sırasıyla %25 ve %63.7 olarak tespit edilirken bu oranlar üreter orta bölümünde %27.2 ve %59.2, distal üreterde ise %51.4 ve %40.8 olarak belirlenmiştir. Yüzey alanı 3 cm²'den küçük taşlarda invazif prosedür hastaların %4.1'ine uygulanırken bu oran yüzey alanı 3 cm²'den büyük taşlarda %20.4'e yükselmiştir. Ayrıca bu hasta grubunda 1990-1998 ve 1998-2000 yılları arasında invazif girişim gereksinimi %20.8 den %14.3'e düşmüştür.* ***Tartışma ve Sonuç:*** *Taş yolu oluşan hastalar dikkatle takip edilmelidir. Taş yolu gelişen ve ESL'nin başarısız olduğu olgularda üreterorenoskopi tedavi metodudur ve açık cerrahi komplike vakalarda gerekli olabilir. Ayrıca taş yüzey alanı 3 cm²'den büyük olduğunda ESL'den başka tedavi yöntemleri de göz önüne alınmalıdır.*

Anahtar Kelimeler: *Taç Yolu, Litotripsi, Üreteroskopi, Ürolitiyozis.*

INTRODUCTION

Extracorporeal shock wave lithotripsy (ESL) was first introduced in clinical practice by Chaussy et al (1) in 1980 and became the first-

line treatment in many centers (2). The complications of this procedure are hematuria, perinephric and renal hematomas, pancreatitis, biliary colic and submucosal hematomas of the colon. Furthermore, the formation of stone streets is one of the main complications of this treatment modality (3, 4). Although most of the fragments of the stones spontaneously pass to the bladder through the ureters after ESL and are washed out by micturation, the accumulation of multiple stone fragments within the ureter may result in stone-street formation. These accumulations are associated with ESL of large stone burdens and may be prevented by choosing other treatment modalities. Patients with this complication may be asymptomatic or may present with any of the symptoms characteristic of ureteral calculi. Asymptomatic patients may be observed for the spontaneous passage of the stones and those with obstruction or urinary tract infection should be managed with prompt urinary tract decompression. Fragments that do not pass may be managed with ureteroscopic fragmentation and retrieval or ureterolithotomy (5-7). In this retrospective study, we evaluated the results of stone street treatment and the approach of our clinic to this complication of ESL.

PATIENTS AND METHODS

From April 1990 to December 2002, 6300 patients with urolithiasis were treated using the Siemens Lithostar Plus Lithotriptor at Gazi University School of Medicine, Department of Urology. Of these, 360 (5.7%) patients were found to have stone streets during their treatment. Fifty (13.8%) of these patients were excluded from the study because their follow-up was irregular. All of the patients were evaluated with renal function tests, prothrombin time, partial prothrombin time, urinalysis, urine culture and electrocardiography prior to ESL. Patients who had urinary tract infection documented with urine culture were treated with an appropriate antibiotic regimen according to the antibiogram starting 3 days before and continuing 7 days after the ESL. All patients underwent an evaluation with intravenous urography (IVU) before ESL if renal functions were normal. ESL was performed with the second generation Siemens Lithostar Plus and patients were treated as outpatients, receiving no anesthesia. The mean shock wave energy and the number of shock waves delivered per person were 17.8 (9- 19) kV and 2900 (1350-4000), respectively. The average fluoroscopic exposure time was 2.3 min/session. The surface area of the stones was measured by multiplying the largest two diameters of the stones in centimeters using the plain abdominal film of the patient. Between 1990 and 1998, 86 of 262 (32%) patients who had a stone surface area larger than 3 cm^2 underwent ESL and the others underwent open pyelolithotomy or nephrolithotomy. However, after we started to perform percutaneous procedures in 2000 this ratio decreased to 3.6% (7/193) in the same group of patients between 1998 and 2002.

Patients were evaluted 15 days after ESL with a plain abdominal film. If a stone street was detected the patient underwent abdominopelvic ultrasonography (USG) and/or IVU. Patients who had dilatation of the upper urinary tract and severe obstructive symptoms underwent additional ESL to the stone fragments on the stone street. The others were checked one month later and if the stone street did not ameliorate spontaneously they underwent ESL too. If the stone street did not ameliorate during this treatment and dilatation of the upper tract persisted, patients underwent ureterorenoscopy (URS) or ureterolithotomy.

RESULTS

The study group consisted of 194 (62.5%) males and 116 (37.5%) females with a mean age of 42.4 (16-84) years. A stone street was detected after one session of ESL in 248 (80%), after two sessions in 42 (13.5%), after three sessions in 13 (4.1%) and after four sessions in 7 (2.4%) of the patients. 224 (72.2%) patients presented with flank pain and 114 patients (36.7%) with nausea and vomiting after ESL. The occurrence of stone street according to stone size and treatment approaches are summarized in table 1. Of the 217 patients with a pre-ESL stone size smaller than 3 cm^2, 9 (4.1%) underwent invasive procedures whereas 19 (20.4%) of 93 patients with a pre-ESL stone size larger than 3 cm^2 had to undergo invasive procedures like URS and ureterolithotomy. Between the 1990-1998 and 1998-2002 periods, stone streets were detected in 86 and 7 patients who had a pre-ESL stone surface area larger than 3 cm^2 , respectively. Of these patients, the need for invasive procedures was 20.9% and 14.3%, respectively, for periods prior to and after 1998. Again, overall invasive

Table-1: The occurrence of stone streets according to stone size and treatment approaches.

Size (cm^2)	Number of patients	Spontaneous passage	Re-ESL	Ureterorenoscopy	Ureterolithotomy
≤ 1 cm^2	47(15.1%)	26 (19.5%)	20 (13.5%)	1(5%)	-
1-≤ 2 cm^2	112(36.1%)	68 (51.2%)	41 (27.5%)	3(15%)	-
2-≤ 3 cm^2	58 (18.8%)	22 (16.6%)	31 (20.8%)	4 (20%)	1(12.5%)
> 3 cm^2	93 (30%)	17 (12.7%)	57 (38.3%)	12 (60%)	7 (87.5%)
Total	310(100%)	133 (%42.9)	149(48%)	20 (6.5%)	8 (2.6%)

procedures decreased from 10.5% to 8.9% during the second period. Before ESL, 146 (47%) patients had a stone in the renal pelvis, 86 (27.7%) in the renal calices, 10 (3.2%) in the proximal portion of the ureter, 20 (6.4%) in the middle portion of the ureter and 48 (15.7%) in the distal portion of the ureter. The mean length of the stone street is 2.95 (1-15.2) cm. The localization of stone streets and the incidence of spontaneous relief of these stones along with other treatment modalities are seen in table 2. Of the 28 patients whose stone street did not ameliorate spontaneously or with ESL, 20 (71.4%) underwent URS and 8 (28.6%) underwent ureterolithotomy. Patients who underwent invasive procedures had a pre-ESL stone size larger than 2 cm^2 and a stone street longer than 4 cm.

DISCUSSION

The incidence of stone streets after ESL is declared to be 0.5-20% (8). Although stone streets are generally seen in the first days after ESL treatment it should be considered that this risk continues for weeks after the treatment. Fedullo et al detected 80% of stone streets in the first 48 hours following treatment (5). Kim et al detected stone streets in first week after treatment in 54.5% of patients and after 1 to 3 months in 10.9% (7). In our study we obtained similar results. We detected 80% of the stone streets after only one session in our patients and this percentage declined as the number of sessions increased.

Pre-treatment stone burden is the most important factor affecting the incidence of stone street formation. Stone streets are reported as 0.3-9.7% when the pre-ESL surface area of the stone is less than 1 cm^2 and 34.5-48.7% when the surface area is larger than 3 cm^2 (7). Grantham et al could not find a relationship between stone surface area and stone street formation in their series of more than 100 patients (9). In our study, 4.1% of the patients with a stone surface area less than 3 cm^2 underwent invasive procedures whereas 20.4% of those with a stone surface area larger than 3 cm^2 underwent surgery. The high incidence of stone-street formation and the need for invasive procedures in patients with a stone surface area larger than 3 cm^2 can limit the non-invasiveness of the lithotripsy treatment. These data support the idea that percutaneous nephrolithotripsy plus ESL may be a better treatment choice in this subgroup of patients. For these reasons, the rate of invasive procedures performed in our clinic declined from 10.5% between 1990 and 1998 to 8.9% between 1998 and 2002. Currently, we are performing percutaneous nephrolithotripsy when the stone surface area is larger than 3 cm^2, especially if the stone is located in the lower calix. This tendency towards percutaneous surgery is clearly understood if we consider that only 3.6% of the patients with a stone surface area larger than 3 cm^2 underwent ESL between 1998 and 2002 while 32% of the patients with the same features underwent ESL between 1990 and 1998.

Stone streets are generally seen at the physiological narrowing of the ureter-like ureterovesical junction, iliac vessels traversing

Table- 2: The localization of stone streets and incidence of spontaneous relief of these stones along with other treatment modalities.

Position of stone street	Number of Patients	Spontaneous passage	Re-ESL	Ureterorenoscopy	Ureterolithotomy
Upper ureter	80 (25.8%)	20 (14.1%)	51(34.2%)	1(5%)	8 (100%)
Middle ureter	22 (7.1%)	6 (5.3%)	13(8.8%)	3 (15%)	-
Lower ureter	208(67.1%)	107 (80.6%)	85(57%)	16(80%)	-
Total	310	133	148	20	8

the ureters and ureteropelvic junction. Inflammation of the ureters and strictures due to previous operations may also lead to stone street formation (5, 10, 11). In our study, 25.8% of the patients had stone streets in the proximal portion of the ureter, 7.1% in middle portion and 67.1% in distal portion.

Fragments forming the stone street generally spontaneously ameliorate within days or weeks. During this time symptoms related to obstruction may be seen and this may cause the patients discomfort. If urinary tract infection supervenes this may affect renal functions severely. For these reasons, patients with stone streets should be carefully evaluated and closely followed-up. Drettler et al evaluated these patients with USG performed every 4 weeks and Fedullo et al followed these cases with IVU every 4 to 6 weeks (12).

When the stone street is complicated with urinary tract infection, percutaneous nephrostomy, URS, percutaneous nephrostomy plus URS, ureterolithotomy or insertion of a D-J stent must be performed in order to decompress the urinary tract (4,7,13). When comparing ESL with other treatment modalities, it is logical to choose ESL as first line treatment because of its non-invasiveness. In our study, the incidence of spontaneous relief is 42.9% and, if ESL is performed, an additional 48% of the patients became stone-free. It is important to note that the rest of the patients who underwent invasive procedures had stone streets longer than 4 cm. Kim et al reported spontaneous relief in 63.6% of patients, relief with ESL in 32.8% and relief after invasive procedures in 3.6% (7). In our study, it is seen that the treatment of choice should be ESL for stone streets located in the proximal portion of the ureter and watchful waiting is the best choice for stone streets located in the distal portion of the ureter. On the other hand, the need for invasive procedures decreased simultaneously within the 1990-1998 and 1998-2002 periods (20.8% versus 14.3%). Furthermore, decreasing stone-street rates within these 2 periods (6.1% versus 4.9%) show that the indications of ESL are changing against larger stones. Additional ESL sessions for the stone street may have an impact on this decline in invasive procedures.

In conclusion, stone streets after ESL are seen with high probability, especially when the stone surface area is large, but almost half of the cases ameliorate spontaneously. Therefore, ESL monotherapy does not seem to be the ideal treatment modality in stones with a surface area larger than 3 cm^2 because of the high incidence of stone-street formation and the need for invasive procedures. Patients with stone streets should be followed very closely and ESL should again be the first line treatment for cases with upper urinary tract dilatations. URS can be considered for cases in which ESL failed, and open surgery should be reserved for complicated cases.

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