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UROLITHIASIS

Double J stent reduces the efficacy of extracorporeal shock wave lithotripsy in the treatment of lumbar ureteral stones

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Introduction. We evaluated the effect of the presence of a double J stent on the efficacy of extracorporeal shock wave lithotripsy (ESWL) in the treatment of lumbar ureteral stones.

Material and methods. Between January 2007 and February 2012, we performed a retrospective cohort study. Forty–four patients were treated by ESWL for lumbar ureteral stones and included into two groups for the analysis: group 1, non–stented (n = 27) and group 2, stented patients (n = 17). Treatment efficacy was evaluated by abdominal X–ray or CT–scan at 1 month. Stone–free patients and those with a residual stone ≤4 mm were considered to be cured.

Results. Mean stone size and density in groups 1 and 2 were 8.2mm/831HU, and 9.7 mm/986HU respectively. Both groups were comparable for age, BMI, stone size and density, number, and power of ESWL shots given. The success rates in groups 1 and 2 where 81.5% and 47.1%, respectively (p = 0.017). There was no difference between the groups for stones measuring 8 mm or less (p = 0.574). For stones >8 mm, the success rates were respectively 76% and 22.2% for groups 1 and 2 (p = 0.030). Logistic regression analysis revealed a higher failure rate when a double J stent was associated with a stone >8 mm (p = 0.033).

Conclusions. The presence of a double J stent affects the efficacy of ESWL in the treatment of lumbar ureteral stones. This effect is significant for stones >8 mm. Ureteroscopy should be considered as the first–line treatment in such patients.

Key Words: shock wave lithotripsy ‹› double J stent ‹› ureteral stone ‹› lumbar

INTRODUCTION

Since its introduction in 1980 [1], extracorporeal shock wave lithotripsy (ESWL) has become the first–line treatment for stones <20 mm in the upper urinary tract [2, 3, 4]. In cases of complicated renal colic it is necessary to divert the urine; this can be achieved by using of a double J or ureteral stent, or by percutaneous nephrostomy [5], with subsequent use of ESWL to fragment the stone. A mean stone–free rate of 77.4% (range 63–100%) has been estimated after ESWL has been used in cases of proximal ureteral stone; however, multiple sessions are required in 10% of cases [6].

Several prognostic factors of the success of ESWL have been studied [7, 8, 9]. These include the size of the stone, its location and density, its degree of impaction and the presence of ureterohydronephrosis. Studies of the effect of the presence of a double J stent on the ESWL success rate have given conflicting results. Furthermore, although lumbar ureteral stones pose a therapeutic challenge, the effect of the presence of a double J stent has not yet been the focus of any reported study. Lumbar ureteral stones can be treated by either ESWL or by ureteroscopy. Ureteroscopy is an effective alternative treatment for such stones and, according to the European and French Guidelines [2, 10], is indicated for stones >10 mm or in those cases where ESWL has failed.

The objective of the retrospective cohort study reported here was to assess the effect of the presence of a double J stent on the treatment of lumbar ureteral stones by ESWL.

MATERIALS AND METHODS

From January 2007 to February 2012, 244 patients received ESWL treatment in our Department of Urology. Of these, 44 had been found to have a lumbar ureteral stone, and were included in our retrospective cohort study. A lumbar site was defined as the proximal part of the ureter, between the pyelo–ureteral junction and the iliac bone. The criterion for inclusion of a patient in this study was the presence of a radio–opaque lumbar ureteral stone ≤20 mm, given ESWL as a first–line course of treatment. The patients were divided into two groups for analysis, group 1 comprising patients without a double J stent ('non–stented') and group 2 those in whom a double J stent had been inserted ('stented'). Double J stents have been inserted in cases of complicated renal colic (obstructive pyelonephritis, acute renal insufficiency, and severe colic).

All 44 patients had a plain abdominal X–ray to assess the opacity, size, and location of the stone. The density of each stone was assessed by a CT scan without the use of contrast medium.

The age, gender and body mass index (BMI) of each patient, together with the side of the stone, its size and density; the tolerance of the procedure by the patient; and the number, frequency and power of the ESWL shots, were all recorded.

The ESWL sessions were conducted using a Dornier Compact Delta® lithotriptor under radioscopic control, with analgesia (alfentanil) and sedation according to how well the patient tolerated the procedure. In those patients who had received a double J stent, the ESWL session took place with a minimum of 3 weeks after the stent placement. ESWL was not used in cases of urinary infection, acute pain, or acute obstructive renal insufficiency.

Imaging of all patients by plain abdominal X–ray or CT scan took place 1 month after treatment in order to assess the efficacy of the treatment; stone size was measured. Treatment was considered to be successful where the patient was stone free, or had a residual stone ≤4 mm, at that time. If the stone was either unchanged or >4 mm, treatment was considered to have failed.

The Student *t* test was used to analyze patients' characteristics. The chi–square test was used to compare groups 1 and 2. A bivariate analysis evaluated the results in terms of stone size. Logistic regression analysis was applied to evaluate the hypothesis of an interaction between stone size and the presence of a double J stent. The results were given with their odds ratio (OR) and 95% confidence interval ($CI_{95\%}$), a p value <0.05 being considered to be significant.

Table 1. *Patient characteristics*

Total n = 44	Group 1	Group 2	p
Patients	n = 27	n = 17	
Gender – Male – Female	 20 (74%) 7 (26%)	 11 (64.7%) 6 (35,3%)	
Age (years)*	48.6 (+/–13.5)	46.8 (+/–17.3)	0.694
BMI (kg/m^2)*	27.2 (+/–4.5)	28.6 (+/–4.8)	0.324
Stones			
Side –right –left	 12 (44.5%) 15 (55.5%)	 8 (47%) 9 (53%)	
Size (mm)*	8.2 (+/–2.5)	9.7 (+/–4.7)	0.172
Density (HU)*	831 (+/–236)	986 (+/–221)	0.100
ESWL			
Number of shots	2885 (+/–730)	2894 (+/–417)	0.964
Power (watt)*	4.4 (+/–0.6)	4.4 (+/–0.5)	0.707
Frequency (hertz)*	77 (+/–14)	80 (+/–14)	0.560

*mean values (+/– standard deviation)

RESULTS

Patient characteristics are shown in Table 1. Of the 44 patients included in the statistical analysis, 27 were in group 1 and 17 in group 2. The mean stone size was 8.8 mm. Groups 1 and 2 were comparable in terms of age, BMI, size and density of stones, and in number, power, and frequency of ESWL shots. All ESWL sessions were well tolerated by the patients, none of whom have been excluded from the analysis. The overall success rate was 68.2% (n = 30/44). The success rate was higher in group 1 (81.5% *vs.* 47.1%; OR = 4.95; $CI_{95\%}$ {1.27–19.23}; p = 0.017) (Table 2). There was no significant difference between the two groups for stones ≤8 mm (84.2% *vs.* 75% in groups 1 and 2, respectively; OR = 1.78; $CI_{95\%}$ {0.23–13.4}; p = 0.574). For stones >8 mm, the success rate was lower in group 2 (75% *vs.* 22,2%; OR = 10.5; $CI_{95\%}$ {1.115–98.9}; p = 0.03) (Table 3). Logistic regression

Table 2. *Success and failure rates in groups 1 and 2*

	Success	Failure
Group 1 (JJ–) n = 27	81.5% (n = 22)	18.5% (n = 5)
Group 2 (JJ+) n = 17	47.1% (n = 8)	52.9% (n = 9)
p	0.017	

Table 3. *Success rates in groups 1 and 2 according to stone size*

	Size ≤8 mm	Size >8 mm
Group 1 (JJ–) n = 27	84.2% (n = 16/19)	75% (n = 6/8)
Group 2 (JJ+) n = 17	75% (n = 6/8)	22.2% (n = 2/9)
p	0.574	0.030

analysis showed a higher failure rate when a double J stent was associated with a stone >8 mm (OR = 2.82: $CI_{95\%}$ {1.088–7.307}; $p = 0.033$).

DISCUSSION

ESWL is an effective, non–invasive treatment of most ureteral stones. Its effectiveness in the treatment of proximal ureteral stones has been reported as varying from 60% to 96%. In the study reported here, the overall success rate was 68.2%, with a rate of 81.5% for those patients who had not been fitted with a double J stent. These results are comparable to those found in meta–analyses [2, 11]. In the present study, the treatment by ESWL of lumbar ureteral stones was impaired by the presence of a double J stent, and this was even more significant when the stone was >8 mm.

According to Mobley et al., the presence of a ureteral stent did not affect the success rate of ESWL, no matter where the stone was situated in the ureter [12]; however, in that large retrospective study, only 19.3% of the patients had been fitted with a stent before treatment. Similarly, in a study by Middela et al. [13], no significant difference was found between the outcome for patients with stones treated by ESWL in the presence of double J or nephrostomy stents or in case of patients without stent. However, these results were not attributed to a lumbar location, and multiple sessions were needed in most cases (52% with two sessions, 30% with more than three).

Many authors have assessed the factors that may affect the efficacy of ESWL in the treatment of ureteral stones. These factors may be associated with the characteristics of the patient (age, gender, BMI), or with those of the stones (size, density, situation or degree of impaction), or with the lithotriptor itself (the type of device, its power and the frequency used). In a study by Gomha et al. [14], the two factors pinpointed were a lumbar situation, which was associated with a higher success rate, and the presence of a double J stent, which was associated with a lower success rate (80% *vs*. 93% for non–stented patients; $p = 0.01$).

Pace et al. [15] estimated that the presence of a ureteral stent caused a 12% reduction of the stone–free success rate ($p = 0.001$). Other authors [16, 17] have reported similar results, confirming that the presence of a double J stent conferred no advantage on the results of ESWL or, in fact, impaired its success rate.

Several theories have been advanced to explain the effect of the presence of a double J stent on the efficacy of ESWL in fragmenting ureteral stones. In order to exert the maximum effect, the shock waves must impinge on a stone surrounded by liquid. Thus, the effect of the double J stent on the effectiveness of ESWL may be attributable to two mechanisms: first, the double J stent may absorb some of the energy created by the shock waves, thus reducing their effect on the stones [18]; second, the presence of such a stent may cause ureteral edema, thus hindering the passage of the stone fragments [7, 19, 20, 21].

Stone size is another factor that influences the efficacy of ESWL in this context: according to Park et al. [22] and a meta–analysis reported in 2007 [11], the success rate of ESWL falls significantly, from 86% to 67.5%, for stones >10 mm.

Under those circumstances where the efficacy of ESWL is reduced, ureteroscopy is a good alternative procedure. According to the most recent European Associations of Urology (EAU) Guidelines [2], the treatment of choice for proximal ureteral stones >10 mm is still arbitrary between the two. Netto et al. [23] found ESWL to be less effective than ureteroscopy for lumbar ureteral stones >10 mm. Failure of an initial session of ESWL may be followed by several other sessions, all of which are associated with a reduced rate of success. According to Pace et al. [15], the proportion of stone–free patients falls from 68% to 46% after the first re–treatment, and to 31% after the second one ($p = 0.001$).

Ureteroscopy is an effective way of treating proximal ureteral stones, with a 75% stone–free rate after one session; however, its drawback is the need for general anesthesia and its 5–10% morbidity. Nevertheless, ureteroscopy is now an ambulatory procedure; improvements in its technique and practice have reduced its rate of major complications and the risk of ureteral stenosis to 1% [24, 25].

Many authors have compared ureteroscopy (flexible or semi–rigid with laser) with ESWL for the treatment of proximal ureteral stones, and most have come to the conclusion that ureteroscopy has a success rate similar to or better than that of ESWL (88% *vs*. 60% for stones ≥1 cm; 100% *vs*. 80% for stones <1 cm). If long–term costs are taken into account, ureteroscopy is less expensive than ESWL, which calls for imaging and consulting [26, 27]. In the study reported here, ESWL was found to be less effective in fragmenting lumbar ureteral stones >8 mm in those patients in whom a double J stent had been inserted. Ureteroscopy is an effective alternative to this procedure, and should be considered to be the first line of treatment under these circumstances. In addition, the fact that the double J stent was already in place, would prepare the ureter for endoscopy, thus reducing the rate of complications.

We acknowledge that this study has some limitations: the small number of patients and the retrospective nature of the study are common constraints in such studies. The stone size and density were slightly higher in the stented group (9.7 mm and 986 UH, *vs*. 8.2 mm, 831 UH for non–stented patients); however, this difference was not statistically significant.

In conclusion, the results of this study indicate that the presence of a double J stent, in patients with lumbar ureteral stones, impairs the efficacy of ESWL in their treatment. This effect is significant for stones >8 mm. Ureteroscopy can be an effective alternative mode of treatment, and should be considered as the first–line treatment in such cases.

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