

CLINICAL STUDY

The efficiency of urolithiasis treatment with extracorporeal lithotripsy in relation to the shock waves frequency

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Abstract: *Objectives:* To compare the results of two frequencies of shock waves (1 SW/1 sec. and 1 SW/2 sec.) in the treatment of urolithiasis using the shock wave lithotripsy.

Background: SWL is the most frequent modality of the treatment of urolithiasis. The information on a better efficiency of applying shock waves of a lower frequency was proved both "in vitro" and "in vivo". After having corroborated the better efficiency of shock waves of lower frequency (1 SW per second) in extracorporeal lithotripsy, the authors compared it "in vitro" to still lower frequency (1 SW per 2 seconds). The still lower frequency did not result in any pronounced improvement of efficiency of extracorporeal lithotripsy. Now, the authors present the results of a study "in vivo".

Methods: The authors treated a set of 20 patients with urolithiasis of comparable size and location using the method of SWL and SW of identical intensity – 20. The patients were divided into the two groups according to the frequency of the applied SW (A – 1 SW/1 sec, B – 1 SW/2 sec).

Results: In the group A, fragmentation was observed in 100 % after on average 3550 SW. In the group B, fragmentation was observed in 90 % after on average 3100 SW, leaving of concrements was observed in 70 % after on average 3465 SW.

Conclusion: The comparison of the results of two frequencies of shock waves (1 SW/1 sec and 1 SW/2 sec) in the treatment using SWL and the Piezolith 3000 device, did not prove any significant difference of effectiveness (Tab. 4, Ref. 16). Full Text in free PDF www.bmj.sk.

Key words: urolithiasis, extracorporeal shock wave lithotripsy, frequency.

SWL (shock wave lithotripsy) is the most frequent modality of treating urolithiasis up to the size of 2 cm. Information on a better efficiency of shock waves (SW) of a lower frequency was proved both "in vitro" and "in vivo" by a series of authors (5, 6, 8, 9, 13, 15). After having corroborated the better efficiency of shock waves of lower frequency (1 SW per second) in extracorporeal lithotripsy using the Piezolith 3000 device, the authors compared it "in vitro" to still lower frequency (1 SW per 2 seconds). The still lower frequency did not result in any pronounced improvement of efficiency of extracorporeal lithotripsy (11). Now, the authors present the results of a study "in vivo".

Methods

The authors treated a set of 20 patients with urolithiasis of comparable size and location using the method of SWL (device Piezolith 3000) and SW of identical intensity – 20. The patients were divided into the two groups (10 patients in each) ac-

Tab. 1. Stratification of patients into groups.

Group	Number of patients	Intensity	Frequency of shock waves
A	10	20	1 SW/1s
B	10	20	1 SW/2s

SW – shock waves

cording to the frequency of the applied

SW (Tab. 1): A (1 SW/1 sec), B (1 SW/2 sec). The size of concrements oscillated between 5 – 12

mm. In most cases, the reason was nephrolithiasis. Dual measurement was carried out (fluoroscopic – C – arm and ultrasound). The efficiency of treatment was evaluated according to the degree of fragmentation of the lithiasis (using visualisation examination – simple KUB and ultrasound) after the application of each 250 SW, as well as according to the start of passing stone fragments, up to the last SWL stage (Tab. 2).

Results

The results are summed up in Tables 3 and 4. In the group A, fragmentation was observed in all patients (100 %) after on average 3550 SW. In the group B, fragmentation was observed in 9 patients (90 %) after on average 3100 SW, leaving of concrements

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Tab. 2. Characteristics of urolithiasis in groups.

	Group A	Group B
Lower calyx	6	5
Middle calyx	3	1
Pelvis	1	2
Ureter	1	2
Ureter Average size of concrement	5,1 mm	5.9 mm
Radiopaque	10	8
Semiradiopaque	–	2
Non-radiopaque	–	–

Tab. 3. Results of SWL treatment in the group A.

GroupA	X-Ray effect after (number of SW)	Passing of lithiasis after (number of SW)
1	2500	3000
2	2250	3000
3	2500	3000
4	2250	3000
5	2500	3000
6	11250	12000
7	5250	6000
8	2500	3000
9	2250	3000
10	2250	0
median	3550	4330

SW – shock waves, SWL – shock wave lithotripsy

Tab. 4. Results of SWL treatment in the group B.

GroupB	X-Ray effect after (number of SW)	Passing of lithiasis after (number of SW)
1	2500	3000
2	3000	4750
3	2000	6000
4	5500	3000
5	4250	0
6	2500	0
7	3000	2250
8	2500	0
9	3000	2750
10	2750	2500
median	3100	3465

SW – shock waves, SWL – shock wave lithotripsy

was observed in 7 patients (70 %) after on average 3.465 SW.

Discussion

SWL is the least invasive and most frequent modality in the treatment of urolithiasis. The main merits of the development of this technology consist in increasing efficiency, reducing pain and reducing the traumatic effect on both the parenchyma of the kidney and the adjacent tissues. The efficiency of treating urolithiasis using SWL depends on the location, size and composition of concrements. Other important factors are the technical parameters

of the lithotripters, such as the type of the generated SW, the size of the focal zone, the size of the aperture of the head of the device, the peak pressure and voltage. One of the factors considerably affecting the process of fragmentation is the cavitation effect on the surface of the concrement (4, 7). The new generation of lithotripters makes it possible to apply shock waves of higher frequency, which produce more micro-bubbles on the concrement's surface. This environment adversely affects (reduces the force and changes the direction of shock waves) the fragmentation of concrements (14). Recently, in connection with these findings, the information that the success of this therapeutic method can also be affected by the frequency of SW application appeared. Wiksel et al carried out ESWL of 15 mm ceramic balls with a pause between SW 2 sec and 0.4 sec. It was found that SWL was more effective with a longer pause (2 seconds) between the applied shock waves, than with the intervals of 0.4 seconds (16). Greenstein et al. tried to change the repetition frequency of the SW pulses emitted by the Econolith 2000 apparatus and proved the pulse repetition frequency (PRF) 1/s to be the most effective, in comparison with 1.5/s, 2/s a 2.5/s (5). Other authors examined the extent of kidney lesion (in dogs) in dependence on PRF; it was proved that a bigger lesion was caused by shock waves at PRF 100/s in comparison with PRF 1/s (1, 2, 3). Paterson et al studied in „in vivo” the efficiency of SWL (they carried out SWL of gypsum balls, located earlier operatively into the lower calices of laboratory pigs, and subsequently examined them after operative extraction). Two frequencies of SW were applied: 1 SW per second and 2 SW per second. The result was substantially better (12) in the group with lower frequency. In 2003, in Canada, a randomized single blinded study was carried out, in which 149 patients with contrast nephrolithiasis were treated using extracorporeal lithotripsy of identical intensity and different frequency of SW application. After three months, the success of treatment was 82 % in the first group (1 SW per second, n = 78) and 63 % 8 in the second group (2 SW per second, n = 71). Another randomized double blinded study was made by the same authors in 2005. In this study, 136 patients were treated with contrast proximal ureterolithiasis. After 2 weeks, the „stone-free rate” in the first group (1 SW per second, n = 64) was 57.8 %, in the second group (2 SW per second, n = 72) 39.4 % (9). The better results of lower frequency were proved also by our team, at first “in vitro” and, subsequently, in current clinical practice (10). In order to further improve the efficiency of SW treatment, we decided to compare the effective frequency of 1 SW /1 sec. with the lower frequency of 1 SW/2 sec. According to our information, we first proved “in vitro” the fact that this slowing down of frequency did not markedly improve the results of SWL treatment. The results were presented at the WCE 2006 (24 th World Congress of Endurology) in Cleveland (11). At present, we publish the results of a study „in vivo” comparing the treatment using two frequencies (1 SW/1 sec and 1 SW/2 sec) and the Piezolith 3000 device. To our knowledge, this is the first publication of this kind.

Conclusion

The comparison of the results of applying two frequencies

of shock waves (1 SW/1 sec and 1 SW/2 sec) in the treatment using SWL and the Piezolith 3000 device, did not prove any significant difference of effectiveness.

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