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Original Article

Extracorporeal Lithotripsy - Our Experiences Presented in a Retrospective 10 - Year Study

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Abstract

Background. Extracorporeal shock-wave lithotripsy (ESWL) is a therapeutic method of a recent date which, thanks to the sophisticated technology, enables the disintegration of a calculus in the urinary system by electromagnetic waves generated outside the human body which penetrate the body, in most cases, without serious affecting any tissues or organs. This procedure is a method of choice for all the cases of calculi of 2 to 3 and more centimeters in diameter identified in the urinary tract, and which along with endourological methods has completely eliminated the need for using surgical methods. The performance of the procedure on an outpatient basis, minimal invasion and being relatively painless without analgo-sedation, with a minor percentage of probable complications, and an average duration of about 20 min, render to a consideration of a convenient and harmless procedure. More than 86% of cases were a complete success and, by combining this method with some of the endoprocedures, a success may be achieved in almost 99% of the cases. Thus the number of patients with a calculus requiring by a surgical procedure has been reduced to a minimum. The mentioned statistical data can be compared with not only the data from the world literature, but the percentage of successfulness is even higher in relation to larger and more well-known healthcare centers in the world.
Methods. 25.321 of patients who underwent extracorporeal lithotripsy in the period from 1996-2006 were retrospectively analyzed. Almost 92% of patients of the average age of 42, predominantly men (the ratio was 52:48%) were treated on an ambulatory basis. This ratio has been by time equalized and, in the last three years, the urinary tract calculosis has been seen in women more than in men. According to the topographic anatomy, calculosis occurs almost equally in the right and left kidney, out of which more than one third is seen in the kidney pelvic, up to 16% in the calyx of the lower and 12% in the calyx of the upper top of the kidney and 14% in the proximal urethra, while all the other regions are ignorable.
Results. Percentage ratio of the numbers of repeated treatments was 60% in the first, 20% in the second and 20% in all other cases but, thanks to the introduction of sophisticated therapeutic approaches in the recent period, that percentage has changed in favor of successfulness of the first treatments and amounted up to 70%. As for complications, the most common were lumbal pains in 48% of cases and macroscopic hematuria in 43% of cases, then steinstrasse in 18% of patients while the percentage of all the other complications was minor.
Conclusion. The procedure has recently undergone some considerable technical-technological modifications. The diagnostic-therapeutic approach has in many ways changed, as well as the number of early detected calculosis including the growing number of children. Therefore, dealing with this problem does not involve only the therapeutic procedure but also the comprehensive metabolic diagnostic procedure, prevention and observation of the patients, which will, in the next study, certainly result in a considerable change of the mentioned correlations to the mutual benefit.

Key words: nephrolithiasis, urolithiasis, calculosis, ESWL, extracorporeal lithotripsy, Shock Wave, complications.

Introduction

More than 15% of today's world population suffers from urinary tract calculosis. There is not a single country, ethnic population, or age group that is spared from this problem [1-6,9,15]. However, once inevitable surgical procedure has been replaced by extracorporeal lithotripsy (ESWL) and endourological procedures; while evaluation of lifestyle, habits, nutrition, biomineral composition and metabolism disorders is gaining in its importance in prevention of relapses that occur in even 80% (50-100%) of the cases today [9,15].
Urinary tract calculosis occurs in all the parts, but calculosis of calyx, pyelon, ureter and calcificates in parenchyma make up 97% of the cases, while only 3% of it occurs primarily in the urinary bladder and urethra. The decision on application of a concrete treatment procedure in order to eliminate the calculosis is determined by localization, size, structure, consistency, surface appearance and the period of calculus persistence, as well as permeability of the pyelo-calyx system and ureter and the possibility of spontaneous elimination [6,9,15].
Extracorporeal shock wave lithotripsy (ESWL) is a semi invasive therapeutic method of a recent date, which thanks to advanced and sophisticated technological procedures, enables disintegration of the calculus in the kidney and urinary canals by electromagnetic waves generated outside the human body, which penetrate the body, in most cases, without serious affecting any tissues or organs [7,10-13]. This method is suitable for all calculi in urinary system from 0.5 to 3 cm in diameter or even bigger. In combination with endourological methods, it has almost completely eliminated the need for surgical removal of the stone from the urinary system. The advantages of ESWL method are that it is practically noninvasive, very safe and relatively

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painless and possible complications are very rare and almost by a rule of a mild nature. The procedure lasts 20 to 30 minutes on average, and it is performed on an ambulatory basis, after which the patient goes home. During and after the procedure, the application of narco-analgo-sedation is not necessary [7-13].

The Department for ESWL at the Military Medical Academy started working in the beginning of 1989 using the apparatus "Siemens - Lithostar®", and in the middle of 1998, the lithotripter "Storz – Modulith SLX®" came into use. Until 2006, more than 25,000 patients were treated at this Department. The youngest patient to have undergone the extracorporeal lithotripsy was 3.5 and the oldest was 95 years old.

Patients and methods

This is a retrospective study of 25,321 of patients who underwent extracorporeal lithotripsy in the period from 1996-2006. In diagnostics, differential diagnostics and indication of ESWL, we used detailed anamnestic data, objective status, echotomographic findings, intravenous urography, dynamic scintigraphy and if necessary CT, MScCT and MR, depending on a particular case. Almost 92% of the patients were treated on an ambulatory basis and only a small number was treated on a stationary basis (elderly people, synergism of severe diseases, bilateral hydronephrosis, complicated urolithiasis, one functional kidney, coagulation disorders...). All the patients with indications for ESWL were treated regardless of their age. The youngest patient was only 3.5 while the oldest was 95 years old. The lithotripter "Siemens - Lithostar®" was used in treatment of 1/5 of the patients, while 4/5 of the patients were treated using the lithotripter "Storz – Modulith SLX®", due to technical reasons. Localizations of the stones was performed with RTG-scopy (minimal conditions of generator only 15 kw power) and integrate multifrecvental inline ultrasound localization system. The number of the applied shock waves per a treatment varied from a few hundred to 4,000 (due to acquirements), at a frequency of 60 to 120 shock waves per a minute (subject to the patients respiratory flicks). The applied shock wave power varied in the range from 14 to 20 kV, depending on a particular case. Positioning of the calculi in the kidney and pyelon was performed with patients in the supine position, while the positioning of the calculi in the medium and distal ureter and in the bladder was performed in the abdominal decubitus position. In most cases analgo-sedation was not used, except in patients with extremely low pain threshold, when Tramadol p.o. 50 – 100mg was administered. The average duration of the treatment was 20 minutes. Immediately upon the completion of the treatment, the follow up ultrasonography of the abdomen was performed, and the regular follow up examination was scheduled for 5-7 days or sooner if needed. Further evaluation of the patients' health condition was performed every 4 to 6 months.

Results

The incidence of urinary tract calculosis in patients of both genders was almost equal - 13,092 (51.70%) men and 12,229 (48.29%) women. The greatest number of patients, about 35%, was between 31 and 40 years old, while the incidence of urinary tract calculosis in patients under 30 and between 41 and 50 was almost equal - about 20% (Table 4). As for localization in the urinary tract, 2/3 of the calculi were in the kidney, one third of which was in the pyelon. One third of the calculi were located in the ureters and only a negligible number of calculi were primarily in the bladder (Table 1 and 2). Over 90% of the patients were treated on an ambulatory basis, while the procedure was performed in hospital conditions only in rare cases (Table 3). The percentage of successfulness after the first treatment was about 60%, while the treatment was repeated more than three times only in 9% of the patients - mainly in cases of calculus consistency (cystine, or similar cases), when the calculus diameter was 4 cm or more, or in cases of staghorn calculosis (Table 5).

Table 1. Urinary tract calculosis - Localisation

	Kidney	Ureter	Ves. urin.
N - patients	16.831	8.480	10
%	66,47	33,48	0,0039

Table 2. Nephrocalculosis - Localisation.

	Kidney pelvic	Calux upper	Calux intermed	Calux lower
N - patients	7.931	3.036	1.854	4.010
%	31,32	11,99	7,32	15,83

Table 3. Ambulatory and stationary treatments - rate

N - Amb. patients	%	N - Stat. patients	%
23.206	91,647	2.115	8,353

Table 4. Urinary tract calculosis – appearance in dependence from stature

Age strata	< 30	31 - 40	41 - 50	51 - 60	> 60
N - patients	5.352	8.865	4.931	3.632	2.541
%	21,13	35,01	19,47	14,34	10,03

Table 5. Effectiveness of the first et other ESWL treatments (stone free rate)

N of treatments	I	II	III	> III
N - patients	14.520	4.721	3.774	2.306
%	57,34	18,64	14,90	9,10

Table 6. Major and Minor complications after ESWL

	N	%
Colic or pain	12.240	48,33
Skin bruising	633	2,5
Transitory hematuria	10.973	43,33
Nausea and vomiting	11.454	45,23
PSVT, VT, arrhythmia	1.231	4,86
Steinstrasse	3.928	17,72
Fever	837	3,30
High blood pressure	372	1,46
Urosepsis	78	0,30
Acute Renal Failure	32	0,92
Renal/Perirenal hematomas	12	0,04
Rupture of the pelvis	0	0
Nephrectomy	1	0,0039
Unknown	0	0

As for complications, they were mostly minor in the form of colic or pain, transitory hematuria, nausea and vomiting. Major complications like paroxysm supraventricular tachycardia, VT, urosepsis or significant renal/perirenal hematomas were registered in a non-significant number of cases (Table 6).

Discussion

Extracorporeal shock wave lithotripsy has been the subject of many studies, even the multicentric ones, but only some of them have evaluated more than a few thousand patients. There are different opinions on frequency and significance of side effects, complications in other organs and systems, and on the matter if this method should be considered primary in treatment of urinary tract calculosis or whether it should be replaced by modern endourological procedures. There are many studies that point out numerous complications after ESWL. According to them, parenchymal lesion, intra- and perirenal hematomas occur even in more than 66% of the undertaken procedures. However, we must not ignore the fact that these are mainly the studies conducted on animal models without calculosis and with direct effect of ultrasound or electromagnetic shock waves on the kidney parenchyma [1,5,16-20]. There are also some dilemmas about the risk of application of ESWL in elderly patients, determination of the upper limit of the calculus diameter suitable for ESWL, as well as on the issue if this procedure is appropriate for cystic calculi, or if the surgical procedure should be performed right away [9,14].

Many studies abstain from giving any definite conclusions on ESWL until all the dilemmas have been resolved by multicentric studies [2-4]. Since 1987, many authors have stated that extracorporeal shock wave lithotripsy is a convenient method with no need for analgesia or anesthesia, and it can be considered safe [7,10-13].

With this ten-year study, we wanted to help resolve these dilemmas and to draw useful conclusions on a really representative sample. The results of this study suggest that this is, in fact, a truly convenient method that involves hospitalization of patients only in rare cases. Furthermore, indications for this procedure do not depend on sex, age, physical constitution, concomitant diseases, localization and consistency of calculi and in many cases they do not even depend on the calculus volume. There is only a question of cost-efficiency in the last case because of possible multiple ESWL treatments. As for complications after ESWL, it is quite clear that they are minor and temporary, and that major complications occur in a negligible percentage. We have gathered important experience in application of this method and our results have been significantly improving for the last few years. The successfulness of the first treatment has increased almost to 70%, the percentage of minor complications has decreased significantly, while the percentage of major complications is almost annulled. Hopefully, the way we have established such an outstanding performance will be the subject of a future controlled prospective study.

Conclusion

Thanks to the general technological advancement, ESWL as a semi invasive therapeutic procedure has an indisputably important place among therapeutic modalities of urinary tract calculosis. In recent years, it has undergone some considerable technical and technological modifications - from Dornier lithotripter (bath unit) to electromagnet shock waves with a whole range of impact heads and shock waves focuses. All these technological novelties have brought a new perspective on extracorporeal lithotripsy in terms of its effectiveness, safety and convenience. Based on many years of experience in application of this therapeutic procedure, we can rightfully conclude that it is a highly effective method with almost negligible side effects. With the right knowledge of the procedure, well-trained staff, proper preparation of patients and adequate clinical support, extracorporeal lithotripsy takes the leading place in treatment of urinary tract calculosis, replacing invasive surgical techniques. Furthermore, combined with endourological procedures, it offers a final solution to urinary tract calculosis in almost 100% of cases.

The diagnostic-therapeutic approach has in many ways changed, thus changing the number of early detected calculosis, including the growing number of children. Therefore, dealing with this problem does not involve only the therapeutic procedure but also the comprehensive metabolic diagnostic procedure, prevention and observation of the patients which will, in the next study, certainly result in a considerable change of the mentioned correlations to the mutual benefit.

Conflict of interest statement. None declared.

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