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A large series of extracorporeal shockwave lithotripsy in the very elderly

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Abstract

Background: The incidence of urinary lithiasis has been increasing in recent decades at all ages, including the elderly. In parallel, the world population is aging and there is a paucity of data on treatment of urinary stones in very elderly people. Our main objective was to evaluate the effects of extracorporeal shockwave lithotripsy (ESWL) in patients older than 75 years, and the characteristics of this population. Complications and mortality rates after this procedure in octogenarians were also described.

Methods: We retrospectively evaluated very elderly patients who underwent ESWL at our institution from 1998 to 2015, through chart review, telephone interviews, and consultation with the municipal mortality information program. Measured outcomes included demographic and clinical data, ESWL characteristics and complications, interval between ESWL and death, and cause of death.

Results: Demographic and treatment characteristics were similar between very elderly and younger patients who underwent ESWL during the same period. No severe complications occurred among older patients. Octogenarians treated in our cohort had a significant life expectancy when ESWL procedures were performed. Even though 38.9% of the patients passed away during the studied period, mortality occurred on average 4.38 years after the ESWL session.

Conclusions: In conclusion, ESWL has been used by urologists as a first-line treatment for uncomplicated urinary calculi in very elderly patients. Despite changes associated with aging, and the high prevalence of comorbidities, this procedure seems to be safe and well tolerated in elderly people.

Keywords: lithotripsy, aged 80 and over, lithiasis, kidney, therapeutics

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Introduction

Urinary lithiasis is a highly prevalent condition, affecting approximately 11% of the world's population and there is evidence of increment in incidence over the last decades.[1–4] Stone disease is a chronic disease characterized by high recurrence rates that affects mostly young adults; however, it can present at any age.[3,5]

The elderly population is increasing very fast. It is estimated that by 2050 there will be twice as many individuals older than 65 years than in 2015.[6] Along with the change in global age distribution, an increment in the incidence of urinary lithiasis in elderly patients can also be observed.[7] Stone disease prevalence in the elderly increased from 2% to 10% between 1980 and 2000.[1,8,9] This particular population has a higher comorbidity burden, which may lead to greater frailty and decline in their physical and cognitive functions.[10] In addition to that, polypharmacy is extremely frequent in the elderly and may lead to additional risks.[11] Over the last decades, minimally invasive technologies have been proposed

to increase the safety and effectiveness of urinary stone disease management. Extracorporeal shockwave lithotripsy (ESWL) was first used to treat renal calculi in 1980 and has become widely popular since then.[12] Currently, ESWL is one of the first-line options for the treatment of renal and ureteral calculi,[13,14] although ureteroscopy has been progressively more frequent in recent decades.[13–15] For young individuals, treatment of even asymptomatic stones is often indicated due to the high risk of symptoms or complications. However, there is a paucity of data in the literature, and no current guidelines or standardization regarding urinary stone disease treatment in the elderly population have been proposed.[16] The aim of the present study was to assess the characteristics of older adults (>75 years old) treated with ESWL in a very large volume center. As secondary objectives, we will also describe the complications and mortality rates after this procedure in octogenarians.

Materials and methods

Records of all ESWL procedures performed at the Center of Renal Calculus Treatment of Hospital São Luiz Jabaquara from 1998 to 2015 were evaluated. During this period, 54,298 treatments were performed in 33,938 patients. Patients were referred for ESWL by 2056 different urologists. Our institution is a tertiary center that receives the patients undergoing ESWL sessions; however, the referring urologists are usually responsible for the postprocedure follow up. We evaluated all patients older than 75 years who underwent ESWL during this period. Among these patients, we performed additional analysis on the subset of octogenarians. All patients aged more than 80 years were additionally evaluated, and these patients or their caregivers were invited to participate in the present study. Those who accepted had their charts reviewed and were interviewed by telephone.

All patients were treated under the same protocol, which includes venous sedation performed by an anesthesiologist who accompanied the patient during and after the procedure. Treatments were performed according to the protocol established by the institution. From 1998 to 2003, we used the Dornier MPL9000; from 2003 to 2013 the Dornier Doli S; from 2007 to 2015 the Dornier Compact Sigma; and from 2013 to 2015 we also used the Dornier Gemini (Dornier MedTech, Wessling, Germany). An outpatient treatment scheme was adopted. Data from these patients were organized in a database with the following variables: sex, age, laterality, stone location (such as upper, middle, or lower calyx groups; renal pelvis; ureter; or bladder), number of shock waves, stone size, and type of application (first application or reapplication). Data related to patient deaths (date, cause of death) were additionally reviewed at the Mortality Information Improvement Program of the Municipality of São Paulo (PROAIM-SP), as a 'double check' procedure for all patients. Continue and categorical variables were presented as mean, standard deviation (SD) and frequencies, percentages (%), respectively. Complications were classified according to Clavien–Dindo classification.[17] Statistical analysis was performed using Stata/IC 12.0. Student's *t*-test was used to compare means and the chi-square test was applied for frequency comparison between groups; $p < 0.05$ was established as statistically significant. The present study was approved by the institutional review board (Process 935.640-9-26-2014).

Results

Among the 33,938 patients undergoing ESWL at our institution in this period, 602 ESWL procedures were performed in 371 patients older than 75 years. Baseline characteristics variables are presented in Table 1.

We also analyzed the 96 octogenarians in our cohort, corresponding to 0.28% of the total. Figure 1 shows the age distribution of patients undergoing ESWL at our institution. The mean age of the octogenarians was 82.7 (80–90) years; 43 patients were female and 53 were male. Mean stone size for this subgroup was 10.21 mm (3–30 mm). Most calculi were located at the kidney. Mean number of shock waves per session was 2605, yet this varies according to the observation of real-time stone fragmentation.

Of the 96 octogenarians in our cohort, we were able to interview 45 patients or caregivers; 14 had died and information was obtained from the municipality information service (PROAIM-SP), and 2 refused to participate. The 45 octogenarians who answered the questionnaires underwent a total of 66 ESWL sessions. We were not able to obtain information about the remaining 35 octogenarians.

Five octogenarians had already passed away when the questionnaire was applied and four were alive

Table 1. Demographic characteristics of all patients and clinical information of the urinary calculi.

	⩾75 year (*n* = 371)	<75 year (*n* = 33,464)	*p*
Age (years)	78 (75–90)	42.1 (3–74)	<0.001
Number of sessions	604	53,542	
Gender			0.915
Male	53 (55.2%)	19,043 (56.3%)	
Female	43 (44.8%)	14,799 (43.7%)	
Side			0.036
Right	273 (45.2%)	26,533 (49.6%)	
Left	331 (54.8%)	27,009 (50.4%)	
Application			<0.001
First	502 (83.1%)	47,366 (88.5%)	
Reapplication	102 (16.9%)	6176 (11.5%)	
Shockwaves			0.58
Mean (SD)	2688.5 (779.1)	2650.8 (919.9)	
Size (mm)			<0.001
Mean (SD)	10.1 (4.48)	8.5 (4.0)	
Topography			0.98
Renal	517 (85.6%)	46,866 (87.5%)	
Ureteral	72 (11.2%)	6542 (12.2%)	
Bladder	15 (0.2%)	127 (0.3%)	

SD, standard deviation.

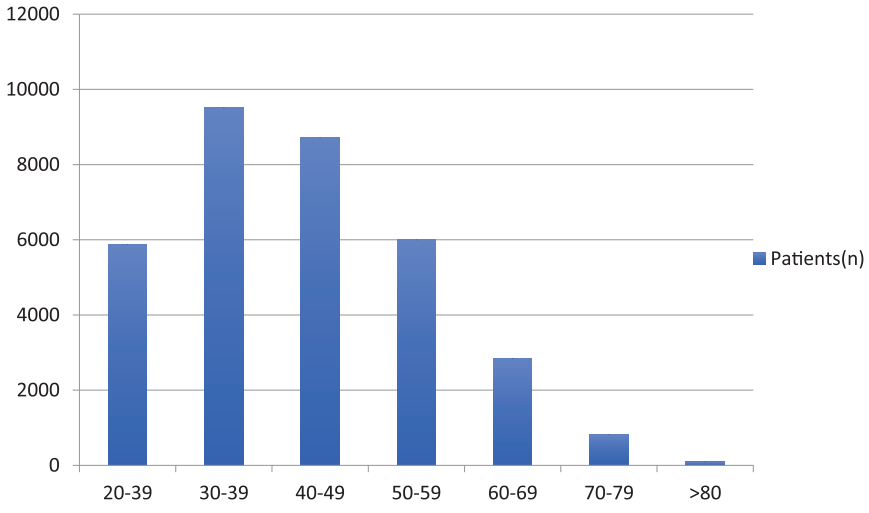

Figure 1. Distribution of 33,938 patients who underwent ESWL according to age group.
ESWL, extracorporeal shockwave lithotripsy.

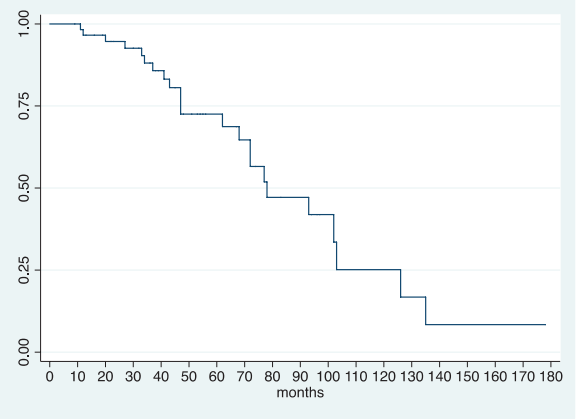

Figure 2. Kaplan–Meyer's survival curve of octogenarians who underwent ESWL.
ESWL, extracorporeal shockwave lithotripsy.

at the time of the interview, but died after that. Additionally, 14 patients had their mortality data obtained from PROAIM-SP (23/47 patients). Mean interval between ESWL treatment and death was 53 months. The main causes of death were malignancies (eight patients) followed by cardiovascular disease (five patients). Figure 2 shows the Kaplan–Meyer's survival curve of octogenarians after the ESWL procedure.

The most common comorbidities among octogenarians were systemic arterial hypertension (66.67%) and dyslipidemia (26.67%). Most commonly used medications within this group were antihypertensives (66.67%) and lipid-lowering agents (28.89%); 19 patients were using two or more drugs when treated with ESWL.

No intraoperative complications were seen during the procedures, and none of the procedures had to be cancelled. Postoperative complications included one patient with macroscopic hematuria and three patients required ancillary stone-clearing procedures (6.6%). Obstructive pyelonephritis occurred in one man who was treated successfully after ureteral stent placement and intravenous antibiotics. Another patient underwent ureteroscopy to remove an obstructive ureteral stone, and a third patient with a 3-cm kidney stone underwent percutaneous nephrolithotripsy as definitive treatment.

Prevalence of comorbidities, age-adjusted Charlson comorbidity index (CCI), medications used by these patients, Clavien-Dindo classification, interval between ESWL session and death, and death causes are shown in Table 2.

Discussion

Studies analyzing trends in urinary lithiasis incidence have observed that the elderly population represents 12% of cases. In this group of patients, 40% presented their first calculus before the age of 50, and 10% were diagnosed with urinary calculus for the first time after the age of 70.[6] In Japan, the country with the oldest population in the world, a study published by Yasui and colleagues showed an increase in the incidence of urinary lithiasis among octogenarians, from 21×10^{-5} in men and 3.6×10^{-5} in women in 1965 to 113.5×10^{-5} in men and 62.9×10^{-5} in women in 2005. These data demonstrate that urinary stone disease has become a more relevant condition in older individuals as it can interfere with quality of life and bear complications.[7] Additionally, it is well known that urinary lithiasis represents an important economic burden.[18,19] For elderly patients, these costs might be even higher, as they normally present higher rates of hospitalization and longer length of hospital stay. Expenses with patients aged 65 years or older in Medicare in the United States have increased 36%, from $613 million in 1992 to $834 million in 1998.[5]

Our study has some important findings. First, we observed that the subgroup of very elderly patients (>75 years) had larger stones and more retreatments than the younger group. Nevertheless, we observed that demographics and specific characteristics of the treatment (gender distribution, mean stone size, laterality, reapplications, number of shock waves and topography within the upper urinary tract) were similar between octogenarians and patients younger than 80 years old who underwent ESWL during the same period (Table 1). Larger stones and more frequent additional repeated procedures were probably a consequence of the intention to avoid the greater surgical and anesthetic risks of endoscopic or open surgical treatments. Our cohort of 33,938 patients were treated by 2056 different urologists. Therefore, we believe our cohort to be a good reflection of current practice patterns in a nonacademic setting.

Before the development of minimally invasive techniques for the treatment of renal calculi, many

Table 2. Death causes, comorbidities, CCI, medications used and complications of ESWL according to Clavien–Dindo index among octogenarians.

Cause of death	***n***	**Mean interval between treatment and death (months)**	
Malignancies	8	53	
Cardiovascular	5	44	
Lung	3	61	
Stroke	2	114	
Others	2	87	
Unknown	3	52	
Comorbidities	***n* (%)**		
Cardiopathy	11 (24.4%)		
Pneumopathy	4 (8.9%)		
Arterial Hypertension	30 (66.7%)		
Malignancies	5 (11.1%)		
Prostate Pathologies	6 (25% of men)		
Neurological Pathologies	10 (22.2%)		
Bone Pathologies	10 (22.2%)		
Dyslipidemia	12 (26.7%)		
Diabetes	8 (18.2%)		
CCI	***n* (%)**	**Clavien-Dindo**	***n***
3	21 (47.7%)	I	1
4	10 (22.7%)	II	0
5	6 (13.6%)	IIIA	3
6	6 (13.6%)	IIIB	0
7	1 (2.3%)	IVA	0
Medications	***n* (%)**		
Antihypertensive	30 (66.7%)		
Antidiabetic	9 (20.0%)		
Hypolipemiant	13 (28.9%)		
Insulin	0		
Antiplatelet	8 (17.8%)		
Prostate	3 (12.5% of men – 6.7% total)		
Anticoagulants	1 (2.2%)		
Neurological	7 (15.6%)		
Supplements	5 (11.1%)		
Antiarrhythimic or Cardiologic	3 (6.8%)		

CCI,Charlson comorbidity index; ESWL, extracorporeal shockwave lithotripsy.

elderly patients were no longer treated because of the great risk of open surgery, which could present a greater risk than the calculus itself. However, ESWL represented a good treatment alternative when it was introduced as an option for stone disease management. Studies evaluating the efficacy of ESWL treatment for elderly patients suggested worst outcomes for this group of patients. In a multivariate analysis, Ng and colleagues demonstrated that kidney stone free rate (SFR) is lower in older patients when compared with patients under 40 years of age *versus* 40–60 years *versus* 60 years and older (54%, 43%, and 37.6%, respectively).[20] SFR for ESWL in patients older than 70 years has been reported to be between 52.1 and 63.5%.[21,22] These results are worse than those reported by Simunovic and colleagues, who reported SFR of 67.98% for patients over 60 years of age. These rates are significantly lower than the overall SFR of 80.95% at Simunovic's institution.[23] A considerable number of studies have suggested that ESWL is less effective in elderly patients, and many have found similar results for younger *versus* elderly patients.[22,24–26] The mechanism that may explain worse outcomes in the elderly is not fully understood, but it is believed that senile physiological changes, such as sclerotic alterations of the renal parenchyma and lower glomerular filtration rate, contribute to these findings.[27] ESWL is still the one of the first treatment options for small kidney stones and proximal ureteral stones.[28]

Second, we observed no severe complications during the procedures. No procedure was interrupted for any immediate complications, and postoperative complications were not common. All postoperative complications were easily managed. There was one patient with a minor complication, which was macroscopic hematuria with resolution after clinical observation. Another patient presented an obstructive pyelonephritis secondary to stone migration, which was treated successfully after ureteral stent placement and administration of intravenous antibiotic. Ureteroscopy as an auxiliary procedure was necessary in two patients, and another one patient underwent percutaneous nephrolithotripsy due to failure of the ESWL. Consistent with previous reports, there were no serious complications in our series, suggesting shock waves to be safe in the treatment of older patients with urinary stone disease.[21–23,26,29]

Moreover, octogenarians treated in our cohort may benefit from a longer life expectancy if ESWL procedures were performed. Even though 38.9% of the patients passed away during the study period, mortality occurred, on average, 4.38 years after the ESWL treatment session. Only one patient died within the first year following treatment. Additionally, the causes of death were not associated with lithiasis or ESWL (Table 2), which reinforces the safety of ESWL in this population. ESWL is a relatively simple and low-risk procedure, and can prevent the acute manifestation/complications that may predispose this elderly population to longer hospitalization times, and more antibiotics.[19]

As expected, the comorbidity burden was higher in this group, with hypertension being the most prevalent (66.7%), followed by dyslipidemia (26.7%), heart disease (24.4%), and diabetes (18.2%). Most patients had a CCI of 3 or 4. Only one patient had CCI 7. These comorbidities, however, brought little interference to other treatments. Only one patient was required to interrupt acetylsalicylic acid prior to ESWL treatment, and, as previously stated, no ESWL session was interrupted.

The present study has some limitations. It was retrospective in its design, with a relatively low number of patients. However, there are no other studies in the literature specifically evaluating very elderly patients, and, besides, this is a rare population (only 1.1% of all patients treated in our series). Another limitation was the high rates of patients lost to follow up. Nonetheless, data obtained from PROAIM provided precise information on mortality, so we could be assured that uncontacted patients had not died. We evaluated patients after a long follow-up period, with a mean of 6.22 years. The most important limitation is the lack of information about the results, which does not allow us to draw conclusions regarding the efficacy of ESWL in this population. However, studies evaluating ESWL efficacy in elderly patients have been published.[20,21,23–26] Prospective and controlled studies are warranted to confirm our findings.

Conclusion

In conclusion, ESWL has been used by urologists for the treatment of uncomplicated urinary stone disease in elderly patients despite the suggested changes associated with aging and high burden of comorbidities. ESWL was indicated and performed in a similar way as for

younger populations, except for larger stones that needed additional sessions. The complication profile seemed similar to that in the general population. Octogenarians undergoing ESWL may have some survival benefit, justifying active treatment in this population.

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Conflict of interest statement

The authors declare that there is no conflict of interest.

Ethical statement

Our study was approved by The Hospital São Luiz Jabaquara Research Ethics Committee. All patients provided written informed consent prior to enrollment in the study.

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References

1. Gentle DL, Stoller ML, Bruce JE, *et al*. Geriatric urolithiasis. *J Urol* 1997; 158: 2221–2224.
2. Hesse A, Brandle E, Wilbert D, *et al*. Study on the prevalence and incidence of urolithiasis in Germany comparing the years 1979 vs. 2000. *Eur Urol* 2003; 44: 709–713.
3. Scales CD Jr, Smith AC, Hanley JM, *et al*. Prevalence of kidney stones in the United States. *Eur Urol* 2012; 62: 160–165.
4. Yoshida O, Terai A, Ohkawa T, *et al*. National trend of the incidence of urolithiasis in Japan from 1965 to 1995. *Kidney Int* 1999; 56: 1899–1904.
5. Pearle MS, Calhoun EA and Curhan GC. Urologic diseases in America project: urolithiasis. *J Urol* 2005; 173: 848–857.
6. Department of Economic and Social Affairs, Population Division. *World Population Prospects 2015 – Data Booklet*. New York: United Nations, 2015.
7. Yasui T, Iguchi M, Suzuki S, *et al*. Prevalence and epidemiological characteristics of urolithiasis in Japan: national trends between 1965 and 2005. *Urology* 2008; 71: 209–213.
8. Arampatzis S, Lindner G, Irmak F, *et al*. Geriatric urolithiasis in the emergency department: risk factors for hospitalisation and emergency management patterns of acute urolithiasis. *BMC Nephrol* 2012; 13: 117.
9. Asper R. Epidemiology and socioeconomic aspects of urolithiasis. *Urol Res* 1984; 12: 1–5.
10. Anand S, Johansen KL and Kurella Tamura M. Aging and chronic kidney disease: the impact on physical function and cognition. *J Gerontol A Biol Sci Med Sci* 2014; 69: 315–322.
11. Chao CT, Tsai HB, Wu CY, *et al*. Cumulative cardiovascular polypharmacy is associated with the risk of acute kidney injury in elderly patients. *Medicine* 2015; 94: e1251.
12. Chaussy C, Eisenberger F and Forssmann B. Extracorporeal shockwave lithotripsy (ESWL): a chronology. *J Endourol* 2007; 21: 1249–1253.
13. Assimos D, Krambeck A, Miller NL, *et al*. Surgical management of stones: American urological association/endourological society guideline, PART I. *J Urol* 2016; 196: 1153–1160.
14. Turk C, Petrik A, Sarica K, *et al*. EAU guidelines on interventional treatment for urolithiasis. *Eur Urol* 2016; 69: 475–482.
15. Turney BW, Reynard JM, Noble JG, *et al*. Trends in urological stone disease. *BJU Int* 2012; 109: 1082–1087.
16. Freitas Junior CH, Mazzucchi E, Danilovic A, *et al*. Metabolic assessment of elderly men with urolithiasis. *Clinics (Sao Paulo, Brazil)* 2012; 67: 457–461.
17. Clavien PA, Barkun J, de Oliveira ML, *et al*. The Clavien-Dindo classification of surgical complications: five-year experience. *Ann Surg* 2009; 250: 187–196.
18. Hyams ES and Matlaga BR. Economic impact of urinary stones. *Transl Androl Urol* 2014; 3: 278–283.
19. Korkes F, Silva Ii JL and Heilberg IP. Costs for in hospital treatment of urinary lithiasis in the Brazilian public health system. *Einstein (Sao Paulo)* 2011; 9: 518–522.
20. Ng CF, Wong A and Tolley D. Is extracorporeal shock wave lithotripsy the preferred treatment option for elderly patients with urinary stone? A multivariate analysis of the effect of patient age on treatment outcome. *BJU Int* 2007; 100: 392–395.
21. Sighinolfi MC, Micali S, Grande M, *et al*. Extracorporeal shock wave lithotripsy in an elderly population: how to prevent complications

and make the treatment safe and effective. *J Endourol* 2008; 22: 2223–2226.

22. Philippou P, Lamrani D, Moraitis K, *et al*. Is shock wave lithotripsy efficient for the elderly stone formers? Results of a matched-pair analysis. *Urol Res* 2012; 40: 299–304.
23. Simunovic D, Sudarevic B and Galic J. Extracorporeal shockwave lithotripsy in elderly: impact of age and comorbidity on stone-free rate and complications. *J Endourol* 2010; 24: 1831–1837.
24. Ichiyanagi O, Nagaoka A, Izumi T, *et al*. Age-related delay in urinary stone clearance in elderly patients with solitary proximal ureteral calculi treated by extracorporeal shock wave lithotripsy. *Urolithiasis* 2015; 43: 419–426.
25. Kramolowsky EV, Quinlan SM and Loening SA. Extracorporeal shock wave lithotripsy for the treatment of urinary calculi in the elderly. *J Am Geriatr Soc* 1987; 35: 251–254.
26. Polat F, Yesil S, Ak E, *et al*. Safety of ESWL in elderly: evaluation of independent predictors and comorbidity on stone-free rate and complications. *Geriatr Gerontol Int* 2012; 12: 413–417.
27. Tonner PH, Kampen J and Scholz J. Pathophysiological changes in the elderly. *Best Pract Res Clin Anaesthesiol* 2003; 17: 163–177.
28. Assimos D, Krambeck A, Miller NL, *et al*. Surgical management of stones: American urological association/endourological society guideline, PART II. *J Urol* 2016; 196: 1161–1169.
29. Philippou P, Lamrani D, Moraitis K, *et al*. Shock-wave lithotripsy in the elderly: safety, efficacy and special considerations. *Arab J Urol* 2011; 9: 29–33.