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Silent Ureteral Stones: Impact on Kidney Function—Can Treatment of Silent Ureteral Stones Preserve Kidney Function?

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OBJECTIVE To report our experience with silent ureteral stones and expose their true influence on renal function.

METHODS We analyzed 506 patients who had undergone ureterolithotripsy from January 2005 to May 2010. Silent ureteral stones were calculi found in the absence of any specific or subjective ureteral stone-related symptoms. Of the 506 patients, 27 (5.3%) met these criteria (global cohort). All patients were assessed postoperatively with dimercaptosuccinic acid scintigraphy (DMSA). A difference in relative kidney function of >10% was considered abnormal. Pre- and postoperative comparative DMSA analyses were electively obtained for 9 patients (kidney function cohort). A *t* test was used to assess the numeric variables, and the chi-square test or Fisher's exact test was used for categorical variables. Two-tailed $P < .05$ was considered statistically significant.

RESULTS Stones were diagnosed by radiologic abdominal evaluation for nonurologic diseases in 40% and after previous nephrolithiasis treatment in 33%. The primary therapy was ureterolithotripsy in 88%. The mean follow-up time was 23 months. The overall ureteral stone-free rate after 1 and 2 procedures was 96% and 100%, respectively. In the global cohort, the mean pre- and postoperative serum creatinine levels were similar ($P = .39$), and the mean postoperative function on DMSA was 31%. In the kidney function cohort, no difference was found between the pre- and postoperative DMSA findings (22% ± 12.1% vs 20% ± 11.8%; $P = .83$) and serum creatinine (0.8 ± 0.13 mg/dL vs 1.0 ± 0.21 mg/dL; $P = .45$).

CONCLUSION Silent ureteral stones are associated with decreased kidney function present at the diagnosis. Hydronephrosis tends to diminish after stone removal, and kidney function remains unaltered. UROLOGY 79: 304–309, 2012.

The prevalence of nephrolithiasis is increasing worldwide, reaching 5.2% in North America and 10.1% in Italy.[1-3] The widespread use of computed tomography and ultrasonography have resulted in a greater detection rate of asymptomatic stones and, in part, might explain the trend.[1] Clinically, kidney or ureteral stones range in severity from asymptomatic to presenting with complete renal failure. North American dialysis centers reported an incidence of nephrolithiasis-related end-stage renal disease of 4.7%.[4] Therefore, it is not only the alarming incidence of urinary stone disease, but also the associated burden that makes this 1 of the most concerning conditions in public health.

The situation becomes even more distressing when managing asymptomatic stones. Studies of the natural history of stones have revealed that only 20% of patients yearly actually become symptomatic from a new stone, and one half of those require surgical intervention at some point.[5-7] The guidelines are well established for the treatment of symptomatic urolithiasis, and many investigators have extensively studied the management of silent kidney stones. However, the same is not true for silent ureterolithiasis. To date, only 1 report has addressed silent ureteral stones, emphasizing the diagnostic workup and surgical management.[8] However, no conclusions were made regarding the calculi or the effect of treatment on renal function. The purpose of the present study is to report our 5-year experience managing silent ureteral stones and to expose their true influence on renal function.

MATERIAL AND METHODS

Selection Criteria and Case Definition

We analyzed the data from patients who had undergone ureteral stone removal from January 2005 to May 2010. We included all patients referred to our urology emergency division or elective office setting for the evaluation of ureteral calculi. Silent ureteral

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stone disease was defined as a ureteral stone found in a patient without any type of specific or subjective ureteral stone-related symptoms, including acute or chronic flank pain, nonspecific abdominal pain, dysuria, gross hematuria, anuria, or urinary tract infection. The presence of hydronephrosis or decreased renal function at diagnosis and the development of pain or infection were considered the main indications for interventional treatment. The internal review board approved the present study.

Patient and Data Collection

In the 5-year period analyzed, 506 patients underwent ureterolithotripsy for ureteral stone removal at our institution. Data were collected retrospectively and included the following: patient age, sex, body mass index, comorbidities, diagnostic workup, stone characteristics, intensity of hydronephrosis, intervention type, operative findings, complications, stone-free rate, and effect on renal function. Stone-free status was defined as the absence of any new calculi-related symptoms and complete absence of ureteral stones on ultrasonography or computed tomography performed 90 days after surgical treatment. When double-J catheter implantation was required, the surgeon evaluated the local ureteral conditions, and the stenting time was established. Ultrasonography or computed tomography and dimercaptosuccinic acid scintigraphy (DMSA) were performed routinely in all cases 3 months postoperatively to evaluate for hydronephrosis and renal function. Of the 506 patients, 27 (5.3%) met the criteria for silent ureteral stone disease (global cohort) and underwent DMSA after treatment. Pre- and postoperative DMSA studies were performed in 9 (34%) of the 27 patients (kidney function cohort). In the other 18 patients, only postoperative DMSA scans could be obtained. We considered a difference in kidney relative function of >10% on DMSA performed preoperatively and 90 days after treatment to be abnormal.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for Social Sciences software program (SPSS, Chicago, IL). The results are presented as the mean ± standard deviation and range. We used the *t* test for numeric variables and the chi-square test or Fisher's exact test for categorical variables. Two-tailed $P < .05$ was considered statistically significant.

RESULTS

Demographic Data

The mean age in the global cohort was 52 ± 15 years (range 10-80), and most patients were men (n = 15; 66%; Table 1). The mean body mass index was 26 ± 4.7 kg/m^2 (range 20-35), and almost one half of the patients (n = 13; 48%) had ≥2 comorbidities, including hypertension in 13, diabetes mellitus in 3, dyslipidemia in 3, previous cancer in 4, and other diseases in 3. Most had stones that were left-sided (n = 17; 63%) and distal (n = 15; 55%), with a mean size of 14 ± 9.3 mm (range 6-45). The mean preoperative serum creatinine was 0.9 ± 0.26 mg/dL (range 0.43-1.44). The demographic data for the global and kidney function cohorts are listed in Table 1.

Stones were diagnosed by radiologic abdominal evaluation for nonurologic disease in 11 patients (40%) and by routine ultrasound examination in 5 (18%). Sixteen patients were diagnosed with a silent stone due to urologic disease, and 9 stones (33%) were found during a follow-up visit after previous nephrolithiasis treatment (Table 2). Among those, 4 had undergone previous ipsilateral lithiasis treatment, 2 of whom underwent extracorporeal shock wave lithotripsy and 2 were treated with open pyelolithotomy. Hydronephrosis was present in all patients.

Table 1. Demographic data

Variable	Global Cohort	Kidney Function Cohort
Patients (n)	27 (100)	9 (34)
Age		
Mean ± SD	52 ± 15.8	58 ± 12.9
Range	10-80	38-80
Women (%)	44.4	66.7
BMI (kg/m^2)		
Mean ± SD	26 ± 4.7	24 ± 3.3
Range	20-35	20-30
Comorbidities (%)		
0	25.93	33.33
1	25.93	22.22
≥2	48.15	44.44
Diagnostic reason (%)		
Nonurologic	40.74	33.33
Urologic	59.26	66.67
Left stone side (%)	63.0	66.7
Stone localization (%)		
Proximal	14.81	22.22
Mid	29.63	11.11
Distal	55.56	66.67
Preoperative sCr (mg/dL)		
Mean ± SD	0.9 ± 0.26	0.8 ± 0.13
Range	0.43-1.44	0.7-1.1
Stone size (mm)		
Mean ± SD	14 ± 9.3	12 ± 2.5
Range	6-45	8-15
Hydronephrosis (%)		
Mild	18.5	11.1
Moderate	48.1	55.6
Severe	33.3	33.3

SD, standard deviation; BMI, body mass index; sCr, serum creatinine. Data in parentheses are percentages.

Table 2. Investigative indication for silent ureteral stone diagnosis

Indication	Patients (n)
Nonurologic	11 (40.7)
Routine ultrasonography	5 (18.5)
Intestinal tumor staging	1 (3.7)
Lumbar spine pain	1 (3.7)
Trauma investigation	1 (3.7)
Aortic aneurysm	1 (3.7)
Ultrasound for hepatic disease	1 (3.7)
Systemic lupus erythematosus investigation	1 (3.7)
Urologic	16 (59.3)
Follow-up after previous nephrolithiasis	9 (33.3)
Renal artery stenosis	2 (7.4)
Prostatic tumor staging	2 (7.4)
Microscopic hematuria	1 (3.7)
Urinary tract infection	1 (3.7)
Pyeloplasty follow-up	1 (3.7)

Data in parentheses are percentages.

Clinical Outcome

The primary therapy was ureterolithotripsy with laser or ballistic lithotripters in 24 patients (88%). Of the remaining 3 patients, 2 were treated with ureteroscopy and stone removal without fragmentation and 1, with a 25-mm proximal ureteral calculus, underwent laparoscopic ureterolithotomy. A stone was considered impacted according to the intraoperative findings in 19 patients (70%). Double-J catheter insertion after the procedure was required in 23 patients (90%), and the mean interval to retrieval was 39 ± 26 days (range 7-100, median 33).

The mean follow-up period was 23 ± 15.4 months (range 3-54). The overall ureteral stone-free rate after 1 procedure was 96%. One patient required a second procedure and was successfully treated with laser ureterolithotripsy. No urinary tract infections were seen. Two patients presented to our emergency room because of double-J catheter-related pain and were successfully treated with customary analgesics. Ureteral stenosis was seen in 1 patient during the initial ureteroscopy and in another patient after stone treatment. Both were successfully treated with laser incision and were free of recurrence at the last follow-up date.

Kidney Function Outcome

The global cohort's mean postoperative serum creatinine was 0.96 ± 0.17 mg/dL (range 0.72-1.42) and did not differ from preoperative levels (P = .39). The mean postoperative relative kidney function on DMSA was 31% ± 20% (range 0%-77%). In 17 patients (63%), postoperative DMSA revealed impaired renal function (comparative DMSA difference >10%). When analyzing the effect of stone size on renal function, we found that 11 of the 27 patients had stone size ≤10 mm (mean 8.1 ± 1.99, range 5-10). In that population, the mean pre- and postoperative DMSA finding was 20% ± 13.5% (range 0%-30%) and 33% ± 19.2% (range 0%-60%), respectively. In the 16 patients with calculi >10 mm (mean 19.1 ± 9.8, range 12-45), the mean pre- and postoperative DMSA finding was 24% ± 17.2% (range 0%-49%) and 32% ± 19.1% (range 0%-77%), respectively. We found no association between stone size and the pre- or postoperative DMSA findings.

Improvement of hydronephrosis was seen in 19 (70%) and stabilization in 7 (26%) patients. Only 1 case showed worsened hydronephrosis (from grade II to grade III). Of the 9 patients with severe preoperative hydronephrosis, 5 remained unaltered and 4 improved. Of the 4 with improvement, 1 had grade II, 1 grade I, and 2 had no hydronephrosis on the postoperative radiologic examination. Of the patients with preoperative grade II hydronephrosis, 1 worsened to grade III, 1 remained at grade II, and 11 improved (3 to grade I and 8 to no hydronephrosis). Finally, of the patients with mild preoperative hydronephrosis, 1 stayed at the same grade and 4 showed complete resolution. We found no association between stone size and postoperative hydronephrosis resolution.

Preoperatively, all 9 patients in the kidney function cohort presented with impaired renal function and a mean DMSA of 22% ± 12.1% (range 0%-38%). The mean preoperative serum creatinine was 0.8 ± 0.13 mg/dL (range 0.7-1.1; Table 3). Of the 3 patients who presented with severe hydronephrosis preoperatively, 1 remained unchanged and 2 improved. Five patients presented with moderate hydronephrosis (grade II) preoperatively. Of these 5, 1 worsened and 4 had complete resolution. The only patient with mild hydronephrosis showed resolution after stone removal. Postoperatively, the mean DMSA was 20% ± 11.8% (range 0%-30%), and the mean serum creatinine was 1.0 ± 0.21 mg/dL (range 0.7-1.4). No difference was seen between the pre- and postoperative DMSA findings (P = .83) and creatinine levels (P = .45; (Table 3).

COMMENT

The number of patients seeking urologic counseling because of the incidental finding of an asymptomatic kidney stone is increasing.[1] Management algorithms have been established for both symptomatic and silent kidney stones based on research of the natural history of nephrolithiasis.[6,7] In contrast, quiet ureteral calculi disease and its potential burden have been poorly studied. Our report is the first to study the influence of stone removal on the recovery of renal function using pre- and postoperative DMSA analysis in this population. For the most part, studies published on the topic of asymptomatic ureteral calculi have been case series investigating the natural history of ureterolithiasis or revisions for post-treatment follow-up.[7,9,10]

Weizer et al[10] retrospectively reviewed the data from 241 patients who had undergone endoscopic procedures for ureteral/renal calculi and found postoperative obstruction due to residual stone fragments in 30 patients. Of these 30 patients, 7 (2.9% of the total cohort) presented with silent obstruction, and 1 of these patients developed renal failure requiring dialysis. This group emphasized the importance of routine postoperative imaging, and they were the first to report a case of complete kidney function loss because of a silent ureteral stone. Wimpissinger et al[8] were the first to prospectively investigate the natural history of silent ureteral stones. In a 12-year period, they found that of 3711 patients diagnosed with a ureteral stone requiring surgical or medical intervention, 1.1% had silent ureteral calculi disease. Only 22.5% of the 40 patients had pre-existing nephrolithiasis disease. Silent disease was found based on the incidental diagnosis of hydronephrosis in 10 patients, the finding of microscopic hematuria in 8 patients, and on nonurologic radiographic examinations in 13 patients. The percentage of silent disease reported in their study was lower than reported in ours, probably because they included patients treated clinically. In our series, silent calculi disease represented 5.3% of all patients needing intervention. Undoubtedly, our study had a selection bias because all our patients were referred for urologic evaluation. We did not include

Table 3. Characteristics of 9 patients in kidney function cohort and comparison of pre- and postoperative sCr and DMSA

Pt. No.	Sex	Age (y)	Stone Side	Stone Size (mm)	Stone Site	Hydronephrosis		DMSA*		sCr†	
						Preoperatively	Postoperatively	Preoperatively	Postoperatively	Preoperatively	Postoperatively
1	F	71	L	8	Distal	Severe	Mild	30	29	0.7	1,42
2	M	66	L	10	Distal	Moderate	None	26	26	0.98	0.95
3	F	59	L	12	Proximal	Moderate	Severe	29	30	1.01	0.9
4	F	55	L	9	Distal	Moderate	None	24	27	0.74	0.75
5	M	80	L	15	Distal	Moderate	None	26	26	0.95	1.1
6	M	56	R	13	Distal	Mild	None	5	4	1.1	1.2
7	F	44	R	15	Distal	Moderate	None	38	35	0.8	0.9
8	F	38	L	12	Proximal	Severe	None	0	0	0.89	0.85
9	F	55	R	14	Mid	Severe	Severe	24	25	0.8	0.99
Mean ± SD	—	55 ± 12.9	—	12 ± 2.5	—	—	—	22 ± 12.1	20 ± 11.8	0.8 ± 0.1	1.0 ± 0.2

Pt. No., patient number; DMSA, dimercaptosuccinic acid scintigraphy; sCr, serum creatinine; F, female; L, left; M, male.
* P = .83.
† P = .45.

patients with an incidentally discovered ureteral stone who were not referred to a urologist or those with a stone not requiring surgery, simply because we did not have access to that population. In contrast, those patients are probably at the best end of the disease spectrum and might have better outcomes than our cohort. With regard to diagnostic modality, our numbers were similar, with 33% of stones found after previous nephrolithiasis treatment. In their series, most patients (65%) had at least some grade of hydronephrosis, and the mean creatinine level was 1.1 mg/dL (range 0.8-2.4). Only 1 patient had spontaneous passage of the stone before treatment. Extracorporeal shock wave lithotripsy was performed in 87.5% of their patients. Auxiliary ureteroscopy or extracorporeal shock wave lithotripsy was required in 30% of patients, and the final stone-free rate was 90%. In contrast, our main treatment modality was ureteroscopy with laser fragmentation, and our stone-free rate was higher (96% after 1 procedure) with fewer auxiliary interventions. Ultrasonography was the follow-up imaging modality for most of our patients. In contrast to our series, pyelography was not routinely performed for all patients. Furthermore, we only included patients with some degree of hydronephrosis. Collecting system dilation can precede and predispose to stone formation, as well as be secondary to silent calculi obstruction. In general, such discrimination is not possible. Our double-J stenting time was long, mainly because most patients presented with an impacted ureteral stone. One patient missed the postoperative visits and had her stent removed only 3 months after surgery. Also, we had a tendency to leave the stents in place longer than we would for symptomatic cases because the sequence of local events after silent ureteral stone removal remains unclear.

Few publications have address the effect of ureteral stones on kidney function, and most studies have considered symptomatic disease. Mahmoud et al[9] reported a case of silent distal ureteral obstruction seen on a follow-up pyelogram 6 weeks after extracorporeal shock wave lithotripsy. Kidney function was decreased at diagnosis and did not change after stone removal. Andrén-Sandeberg et al[11] prospectively followed up 358 patients with ureteral stones until the calculus was spontaneously eliminated, and they found renal function impairment in 25%. Intervention was required in 27% of patients without any symptoms. Persistent decreased renal function on pyelography was seen in 7% of patients and was mostly mild. Kelleher et al[12] studied 76 patients with radiographically proven acute calculous obstruction and found that stones >5 mm were more likely to cause an obstruction and decrease the relative renal function and, therefore, demand intervention. Decreased renal function was found in 18% of patients, but only 2 patients who had had previous treatment for a calculus had persistent kidney impairment after stone removal. Finally, Irving et al[13] prospectively followed up 54 patients with ureteral calculi >4 mm and found that 28% of patients had silent loss of renal function, obligating treatment at diagnosis. For this particular group, they also studied the effect of treatment timing on the recovery of renal function, with better results when the intervention took place within the first week. The same significant relationship was not found for patients with stones causing diminished function when a coexisting infection was present, suggesting the infection itself might cause additional cellular damage and direct parenchymal impairment. In our series, all patients had stones >5 mm and the interval from stone impaction to removal could not be obtained, because it is impossible to determine the exact time of calculi migration toward the ureter owing to the lack of symptoms. We found no relationship between stone size and renal function on DMSA. In our global cohort, a creatinine level greater than the normal limit (>1.2 ng/dL) was seen in only 1 patient preoperatively and in 2 postoperatively. Although hydronephrosis improved or stabilized in almost all patients (96%), the postoperative ipsilateral DMSA revealed impaired renal function in most patients (63%). Renal lesions caused by chronic calculi obstruction were evident. If we had decided to simply observe our patients, it is likely we would have seen a progressive deterioration in renal function. Therefore, such a practice seems illogical and unethical.

Although small in size, the demographic data of our kidney function cohort were very similar to those of our global cohort. Our findings for the global cohort were corroborated by preoperative DMSA pyelograms obtained for 9 of the patients studied. At diagnosis, all had significant renal function impairment, although the creatinine levels were normal. Comparative pre- and postoperative DMSA analyses showed no worsening of renal function. Although lesions of nephrons could not be prevented or reversed, stone treatment stabilized the relative kidney function, and immediate treatment after diagnosis seems imperative. We only considered patients with hydronephrosis, and we cannot speculate whether the same treatment is suitable for patients with an asymptomatic ureteral stone without collecting system dilation. We advocate DMSA pyelography for all patients with a silent ureteral stone, even for those without any degree of hydronephrosis. The observation of patients without DMSA-altered results cannot be advocated. However, if relative renal function is decreased, immediate calculi treatment is mandatory to avoid additional kidney function impairment. In our series, the attempt to improve renal function in patients with preoperative DMSA findings <5% failed. We consider observation of those patients or laparoscopic simple nephrectomy if any complication develops. One could raise the question of whether we should be more invasive and surgically treat all patients with silent ureteral stone disease, regardless of whether hydronephrosis is present, to prevent potential renal injury. We cannot answer that question from the findings from our series because we did not include such a cohort. A prospective randomized trial comparing the pre- and postoperative DMSA studies of patients treated with silent stone removal in the absence of hydronephrosis seems feasible and will be performed in our department. Our institution plays an important role in the healthcare for a particular low socioeconomic population in Brazil. This fact might influence the imaging modality and motive for radiologic investigation at incidental findings of calculi. Moreover, those individuals tend to underestimate the disease burden, because it is foremost an asymptomatic abnormality. Finally, difficulty in healthcare access could lengthen the time from diagnosis to treatment and worsen the disease prognosis.

CONCLUSIONS

Silent ureteral stones causing hydronephrosis are associated with decreased kidney function present at diagnosis. Although hydronephrosis tends to diminish or resolve after stone removal, renal function is likely to remain unchanged. The treatment of a silent ureteral stone at diagnosis might slow or stop continuous renal scarring and preserve kidney function.

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