Treatment of Steinstrasse by Transureteral Lithotripsy

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Introduction: Extracorporeal shock wave lithotripsy (SWL) is an essential treatment for urinary calculi, but Post-SWL steinstrasse is a potential complication, especially in large-burden calculi. Our purpose was to evaluate the efficacy of transureteral lithotripsy (TUL) in the treatment of steinstrasse caused by SWL.

Materials and Methods: Twenty-four patients with steintrasse following SWL were treated by TUL. The length of steinstrasse varied from 1.5 cm to 6 cm. The patients were followed up after TUL and failed treatment was considered if the steinstrasse was not cleared within 6 weeks.

Results: Fourteen patients (58.3%) became stone free, of whom 8 had a double-J stent before SWL. Partial response was seen in 6 patients (25.0%). The remained 4 patients (16.7%) with failed TUL underwent open ureterolithotomy. One patient developed nonfunctioning kidney during the follow-up. Transureteral lithotripsy was successful in 6 out 8 patients with type 1, 8 out of 12 with type 2, and none of those with type 3 steinstrasse. All of the successful cases of TUL were in the patients with lower ureteral calculi.

Conclusion: Successful treatment of steinstrasse by TUL can be achieved in less than two-thirds of the cases. Type and location of steinstrasse may influence the outcomes. This complication seems sometimes to be troublesome and may even cause kidney loss.

Keywords: urinary calculi, complications, steinstrasse, ureteroscopy, shock wave lithotripsy

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INTRODUCTION

Steinstrasse or "stone street," is an aggregation of particles in the ureter formed following extracorporeal shock wave lithotripsy (SWL). It is a well-recognized, but usually transient and asymptomatic, complication of SWL and is a common radiological finding on routine radiographic images taken between 24 and 48 hours after lithotripsy (15%).[1] However, it may cause partial or complete ureteral obstruction, often superimposed with urinary tract infection. Steinstrasse has 3 types[1]; type 1 is made up of particles 2 mm in diameter or smaller. Type 2 has a leading large fragment of 4 mm to 5 mm in diameter with a tail of 2-mm particles. Type 3 is composed of large fragments.

All patients with steinstrasse are initially treated conservatively. In case of obstruction, infection, pain, or failed passage of the calculus fragments, further treatment should be used, ranging from repeated SWL, percutaneous nephrostomy (PCN), endoscopic manipulation, and finally, open surgery.[1-3] There is no standard treatment protocol for the steinstrasse and choosing

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a therapeutic modality depends on the degree of obstruction, infection, kidney function, and response to each kind of therapy.[1-3] In this study, we used transureteral lithotripsy (TUL) as an available procedure for the treatment of steinstrasse, when there was an indication for intervention, regardless of the type of the steinstrasse.

MATERIALS AND METHODS

We diagnosed 76 patients with steinstrasse after SWL in a period of 26 months beginning from April 2005. Steinstrasse was defined as fragments of calculi that form a column occupying more than 17% of the length of the ureter.[1,4] All of the patients had received analgesics, antibiotics, and hydration in the period of conservative management after SWL with a plain abdominal radiography, every week, and ultrasonography, every 2 weeks. During a maximum follow-up period of 1.5 month, passage of the calculus fragments occurred in 52 patients (68.4%) without the need for further surgical intervention. The remained 24 patients (31.6%) underwent TUL. The mean length of steinstrasse in this group was 2.62 cm (range, 1.5 cm to 6 cm). Type 1 steinstrasse was present in 8 patients (33.3%), type 2 in 12 patients (50%), and type 3 in 4 patients (16.7%). The calculi were in the lower, middle, and upper ureter in 17 (70.8%), 2 (8.3%), and 5 (20.8%) patients, respectively.

All of the patients underwent TUL by 8-F to 9.8-F semirigid ureteroscopes (Richard Wolf, Knittlingen, Germany). Function of the kidneys was checked before TUL by blood urea nitrogen and serum creatinine levels, intravenous urography, and ultrasonography. Intervention was done at least 1 month after the initial SWL and conservative management. Fourteen patients (58.3%) had double-J stents before SWL.

The patients were followed up after TUL and failed treatment was considered if the steinstrasse was not cleared within 6 weeks. In cases with failed TUL, the treatment was repeated or other modalities were used based on the availability of the facilities and the patient and surgeon's preferences.

RESULTS

We managed 24 patients with steinstrasse following SWL. There were 16 men (67%) and 8 women (33%) with a mean age of 34.5 years (range, 22 to 48 years). Fourteen patients (58.3%) had successful TUL and became stone free, 8 of whom had a double-J stent before SWL.

Six patients (25.0%) had only partial response to TUL (debulking, but not stone free), 1 of whom responded to the second TUL, and 1 developed nonfunctioning kidney during the follow-up, and 4 responded to SWL. The remained 4 patients (16.7%) underwent open ureterolithotomy. No procedure-related complication was detected in our patients.

Transureteral lithotripsy was successful in 6 out 8 patients with type 1, 8 out of 12 with type 2, and none of those with type 3 steinstrasse. All of the successful cases of TUL were in the patients with lower ureteral calculi. The Table shows the outcomes in relation to the calculi location and type.

DISCUSSION

Since the introduction of percutaneous nephrolithotripsy, calculi greater than 2 cm are more commonly treated by this method rather than SWL. As a result, the incidence of complicated steinstrasse has been reduced. Management of the three types of steinstrasse has been previously discussed. Type 1 is more likely to be passed by conservative management. Type 2 steinstrasse that usually has a herald calculus greater than 4 mm to 5 mm may respond well to SWL or TUL. Type 3 steinstrasse almost always does not respond to conservative management and needs a suitable intervention.[1] The use of double-J stenting before lithotripsy significantly lowers the incidence of steinstrasse in patients with a stone burden of 1.5 cm to 3.5 cm; however, the incidence of steinstrasse increases with the size of the calculi, whether or not a double-J stent is placed.[5-7]

Overall, steinstrasse occurs in about 5% of cases in most series.[8] Fedullo and colleagues reported that 75% of steinstrasse cases occurred in the lower ureter;18%, in the upper ureter; and 6%, in the

Outcome of TUL for Steinstrasse in Relation to Type and Location of Calculi*

Outcome	Steinstrasse Ureteral Location			All Calculi
	Lower	Middle	Upper	
Type 1 Steinstrasse				
Successful TUL	6	0	0	6
Repeat TUL	0	1	0	1
SWL	0	0	0	0
Open lithotomy	1	0	0	1
Type 2 Steinstrasse				
Successful TUL	8	0	0	8
Repeat TUL	0	0	0	0
SWL	2	0	2	4
Open lithotomy	0	0	0	0
Type 3 Steinstrasse				
Successful TUL	0	0	0	0
Repeat TUL	0	0	0	0
SWL	0	0	0	0
Open lithotomy	0	1	2	3
Nonfunctioning kidney	0	0	1	1
All Types				
Successful TUL	14	0	0	14
Repeat TUL	0	1	0	1
SWL	2	0	2	4
Open lithotomy	1	1	2	4
Nonfunctioning kidney	0	0	1	1

*TUL indicates transureteral lithotripsy and SWL, shock wave lithotripsy.

middle ureter. They also reported 35% of patients required intervention and 75% of interventions were endoscopic.[9] In our study, only about 30% of the patients with steinstrasse needed intervention, the calculi of whom were located in the lower, upper, and middle ureter in 71%, 21%, and 8%, respectively. Nearly 70% of the patients had spontaneous passage of the calculi within a 4-week follow-up.

Indications for intervention in steinstrasse are basically the same as those used for calculus-induced obstruction of a solitary kidney with rising creatinine levels, urosepsis, and failure of fragments passage within a reasonable time. Steinstrasse should be treated if it is symptomatic (pain and sepsis) or causes a silent obstruction over a 30-day period.[8] The Alternatives include placement of a drainage percutaneous tube to allow fragments to pass, ureteroscopy and TUL, SWL of a lead fragment, or open ureterolithotomy.[8] The choice of TUL or SWL for the treatment of lower ureteral calculi is still open to debate.[10] In our series, SWL was not easily available and the patients would have to travel to other cities nearby. On the other hand, due to the costs, they preferred TUL. Regarding our speculation of the ease and efficacy of TUL especially in lower ureteral steinstrasse, we decided to attempt TUL. Several studies have shown that repeat SWL is a safe and efficient sort of treatment for steinstrasse after failed conservative management,[11-13] but in our experience, only type 2 steinstrasse was a suitable case for repeat SWL.

There is continuing controversy in the literatures about the success rate of conservative management of steinstrasse, mainly due to different designs of the studies. We evaluated the patients for steinstrasse during the first 48 hours after SWL; however, in other studies, they started evaluation at least 1 week after SWL, and this causes different rates of detected steinstrasse.[14]

In a study by Mahmod and colleagues, 29 patients with steinstrasse were followed for 2 months of conservative management with weekly radiography and ultrasonography. They found 51.7% spontaneous calculus passage and treated 13.8% by repeat SWL and 34% by TUL. In

their study, a 100% success rate was seen. They concluded that TUL was a definitive treatment modality with about 100% success rate.[15] In our opinion, this may be true only in selected cases within such a multimodality options of treatments. Ibrahim used TUL and SWL in his study for the treatment of steinstrasse in 22 patients. He performed TUL in 12 selected cases, with good results.[14] Goyal and associates treated 27 patients with steinstrasse and selected 3 of them for TUL with good results.[3] Sulaiman and colleagues, in their experience on treating steinstrasse with SWL, mentioned that failed SWL cases could be cleared by laser lithotripsy even if they were extended and persistent. We did not have laser lithotripter in our center.[12] All of these studies show that different modalities of treatment may be used to treat steinstrasse depending on the type and location of the calculi and the overall situation of the patients. Hence, careful selection of the patients for each option has a major role in this way. However, selection of the optimal surgical therapy for complicated steinstrasse remains one of the controversial topics in urology. We used TUL, which was easily available for us, regardless of the type or location of steinstrasse in our series. Since we had limited number of cases, the results cannot be definitive; nonetheless, we can speculate that successful TUL is not dependent on the length of the steinstrasse, but on its type. For instance, a 6-cm type 1 steinstrasse in the lower ureter was treated successfully, while a 2-cm type 3 in the middle ureter was not cleared by TUL. Also, presence of a double-J stent could ease ureteroscopy.

In this study, we encountered some difficulties. First, a wire cannot be passed through the steinstrasse, because the ureter is fully packed. Therefore, the usual over-the-wire dilating balloon cannot be used to open the ureteral orifice which is usually smaller than normal; large amount of fragments displaced upward in the dilated ureter towards the kidney that again might cause obstruction. Second, endoscopic intervention is sometimes very difficult, especially in a large type 1 steinstrasse, because the small particles interlock in a similar way to the resilient dry calculus walls, making it impossible to pass a guide wire through this wall. Although it may be possible to destruct this wall gradually by water jet, it takes too much time. Third, we had 1 case of kidney loss is our study. The loss of renal units following steinstrasse is a risk if the SWL follow-up is suboptimal.[16]

CONCLUSION

Steinsrasse is sometimes troublesome and may cause even kidney loss. In our experience, success rate of TUL in the treatment of this complication is only about 60%. The most important factors to predict the efficacy of TUL in steinstrasse might be its type and location, with type 3 having the most negative impact. Larger series are warranted to confirm our conclusions.

CONFLICT OF INTEREST

None declared.

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