Original Article

Steinstrasse after Extracorporeal Shockwave Lithotripsy: Aetiology and Management

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Abstract

Background: Renal stone is the most common disease managed by an urologist. Extracorporeal shock wave lithotripsy (ESWL) is one of main modality of management of renal stone. Steinstrasse one of complication of ESWL is not an uncommon event. Steinstrasse may be managed with conservative management, ESWL or ureteroscopy (URS) or open surgery. We describe our experience of management of steinstrasse patients in IGMC Shimla. **Subjects and Methods:** Extracorporeal shockwave lithotripsy (ESWL) is given to patients presenting with renal and upper ureteric stones. This study included diagnosis and management of 7 patients developing steinstrasse after ESWL. **Results:** All steinstrasse developed in patients of renal stone and size more than 2cm. Four patients had pain after ESWL and 3 patients were asymptomatic. Four patients had pre-ESWL DJ stenting in view of large stone, 2 patients did not require DJ stenting and one patient required DJ stenting after persistent pain. Five patients required URS at 3 weeks after an incomplete response to conservative treatment. One patient received ESWL for fragments in ureters, and 1 patient didn't require intervention. **Conclusion:** Stone size and site were the significant factors predicting steinstrasse formation. URS and ESWL are very effective interventions for patients not responding to conservative management.

Keywords: Steinstrasse, Double J stent, extracorporeal shock wave lithotripsy (ESWL), Ureteroscopy.

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Received: October 2018
Accepted: December 2018

Introduction

Steinstrasse is defined as a column of stone fragments obstructing the ureter after shock wave lithotripsy (SWL). It is known and recognized complication of ESWL. (1) The incidence of steinstrasse is 2–10% of the cases. 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. Steinstrasse may be asymptomatic or symptomatic which may or may not require treatment. It may cause renal colic, hematuria, urinary tract infection, partial or complete ureteral obstruction, renal failure secondary to obstructive uropathy. 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.[1,2]

Subjects and Methods

We have the third generation Electromagnetic shockwave lithotripter in IGMC Shimla. It is composed of shock heads with water bath membranes. It is integrated with fluoroscopy unit and ultrasound.

We select the patient according to the following prerequisite

- Renal pelvic calculus < 2cm
- Upper/lower ureteric calculus < 1cm
- Patient's Demand

We prefer power settings 1- 20 kV with ramping, 1-2 minutes pause after 500 shock pulses, the rate of delivery of Shock pulse 30-120 per minute, number of shock pulses per session 500-3000 and average time per session 40 minutes. We included all patients developing steinstrasse after ESWL.

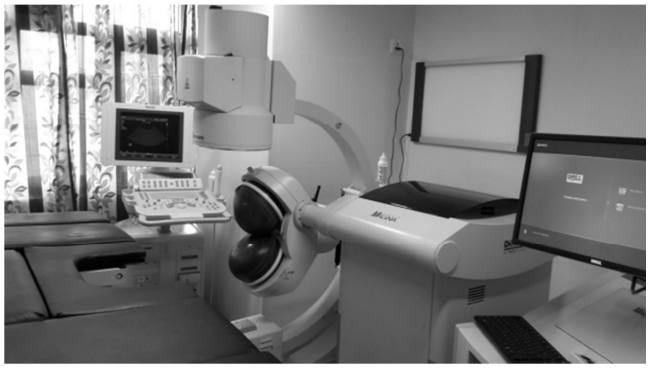

Figure 1: ESWL setting in IGMC Shimla

J-J stenting is done in stone size> 2 cm, obstructed /infected, pelvicalyceal system and urologist preference. We give analgesic, antibiotic and alpha-blocker as per standard guideline. We present our diagnosis and management of steinstrasse after ESWL in 7 patients treated over 6 months.

Our case series comprises of 7 patients developed steinstrasse after ESWL. Patients underwent hemogram, coagulation profile, urine culture. After ESWL patient were given plenty of fluids, analgesics, alpha blockers. Patients were reviewed after 1 week after ESWL with x ray KUB. We managed these 7 patients of steinstrasse. In patients developing steinstrasse, 4 patients had pain after ESWL and 3 patients were asymptomatic. Four patients had pre-ESWL DJ stenting, 2 patients did not require DJ stenting and one patient required DJ stenting after ureteric colic. Five patients required URS at 3 weeks after an incomplete response to conservative treatment. One patient received ESWL for fragments in ureters, and 1 patient didn't require intervention.

Table 1: Patient's summary

Cases	Age	Presentation	Stone size	ESWL Sessions	HU	Location of steinstrasse	Conservative treatment	Stent	URS	ESWL
1	35	Renal colic	3 x3 Renal pelvis	Yes (4)	1020	Mid, Lower	yes	Yes	yes	no
2	42	Renal colic	2.5 x 2.6 Renal pelvis	Yes (3)	920	Upper, mid, lower	Given for 3 weeks.	No	Yes	no
3	25	Renal pain	2.2 x2.1 cm	Yes(3)	1120	lower	Given for 3 weeks	Yes	yes	no
4	65	B/l Renal pain	3.5 x 2.8 cm Renal pelvis+ calyx	Yes (4)	980	upper	Given for 3 weeks	Yes	no	yes
5	42	Lt renal pain	3 x 2.9 cm	Yes (3)	988	Upper, lower	Given for 3 weeks	Yes	Yes	no
6	38	Lt renal pain	2.2 x2	Yes (2)	850	lower	Given for 3 weeks	No	no	no
7	22	Rt flank pain	4 x 2.5	Yes (4)	1060	lower	Given for 3 weeks	Yes	yes	no

Case 1

Figure 2: Left Renal stones with DJ stent with steinstrasse left lower ureter

35 years male presented with left renal stone 3 x 3 cm, NCCT KUB suggestive of renal pelvic stone 3 x 3 cm, HU 1050. The patient opted for ESWL after all options were discussed. In view of large stone, left DJ stenting was done. After 2 sitting patient had fragmentation of stone with the development of steinstrasse in lower ureter. The patient has advised alpha blockers, analgesics, increased fluids. Patient had spontaneous passage of stone fragments, at 3 weeks complete resolution of steinstrasse was found. Patient had complete response to after 4 sitting of ESWL.

Case 2

Figure 3: Right renal stone with right mid and lower ureteric stone fragments (steinstrasse)

A 45 years male presented with right renal stone 2.5 x 2.6 cm. NCCT KUB was suggestive of renal pelvic stone with HU 920. Patient developed steinstrasse, which was managed with conservative management, most fragments pass spontaneously, except 3 fragments which require URS for persistent lower ureteric stones. At the completion of 3, sitting patient had complete fragmentation of stone with the complete passage of stones.

Case 3

Figure 4: Left RSD developing left steinstrasse lower and mid ureter

A 25 years male presented with 2.2 cm left renal stone. NCCT KUB was suggestive of renal stone 2.2 x 2 cm left renal pelvic stone. After one sitting patient had complete fragmentation of stone, with the development of steinstrasse of left lower ureteric fragments. In view of left renal colic, the patient underwent DJ stenting. Patient had minimal response to medical management. Patient underwent URS at 3 weeks with complete clearance of stone.

Case 4

Figure 5: Bilateral RSD developing right steinstrasse with stent in situ

A 65 years female presented with bilateral renal stones. Patient insisted on ESWL. NCCT was suggestive of multiple renal stones with largest measuring 3.5 x 2.8 cm renal pelvic stone in right kidney. Left kidney also had multiple stones with largest measuring 3.1 x 3.3 cm renal pelvic stone. The patient had bilateral DJ stenting prior to ESWL. Patient was started on conservative treatment. Patient underwent ESWL to leading fragment obstructing the ureter. After ESWL fragments spontaneously passed., patient required 2 sitting of ESWL to clear the steinstrasse in right ureter. Patient had multiple residual renal fragments which were subsequently cleared by RIRS.

Case 5

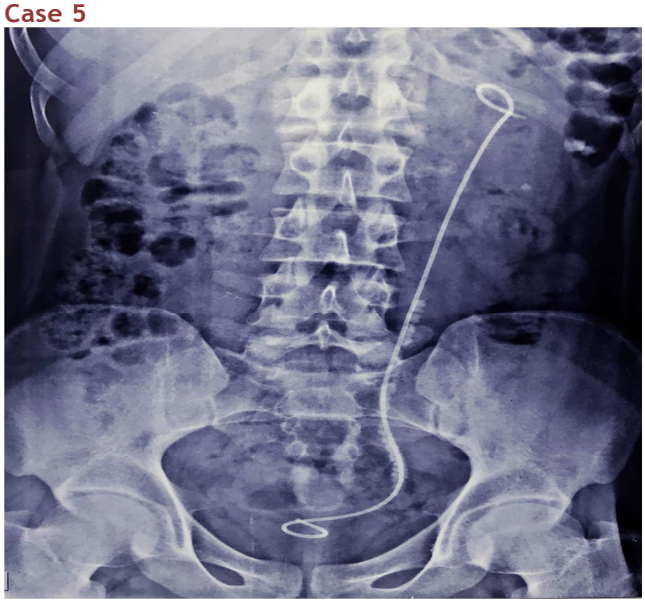

Figure 6: Left RSD developing steinstrasse after ESWL

A 42 years female had left renal stone 3 x 2.9 cm with HU 985. The patient had pre ESWL DJ stenting. After 2 sittings stone fragmented with the development of steinstrasse in left lower ureter. Patient passed few fragments but required URS for complete clearance of lower ureter.

Case 6

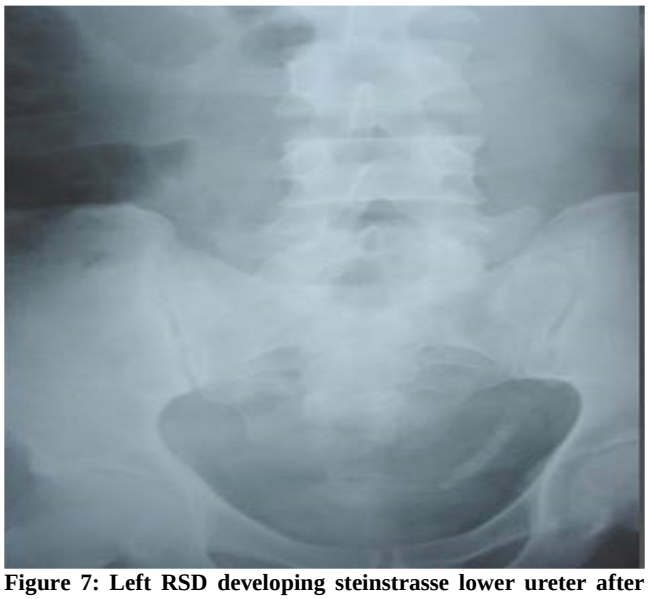

Figure 7: Left RSD developing steinstrasse lower ureter after EWSL

A 38 years female had 2.2 x 2.0 cm renal stone with HU 1090. The patient was started on conservative management.

Within 3 weeks all fragments passed without DJ stent

Case 7

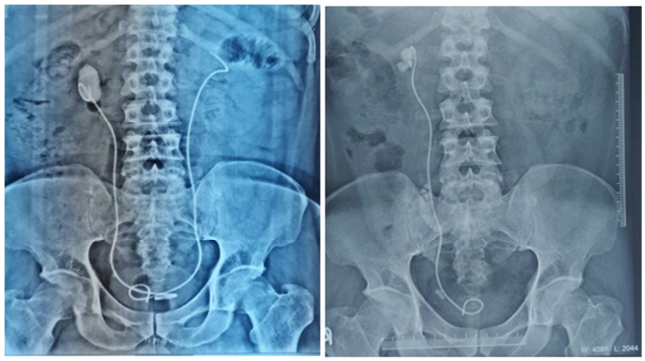

Figure 8.(a-c) Right renal stone developing rt mid and lower ureter steinstrasse

Figure 8c. Steinstrasse lower ureter

A 22 years male with bilateral renal stone underwent bilateral DJ stenting. Patient underwent bilateral ESWL. Patient developed right steinstrasse, patient was given conservative treatment for 3 weeks. At 3 weeks URS was done with complete clerance of ureteric stone fragments.

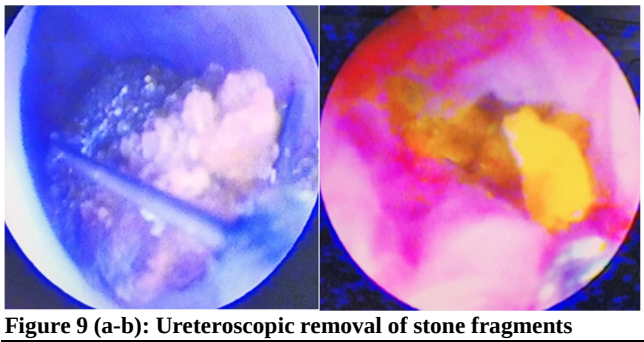

Figure 9 (a-b): Ureteroscopic removal of stone fragments

Discussion

Shock wave lithotripsy (SWL) is the mainstay of treatment of renal and upper ureteric stones. ESWL is a minimally invasive, safe and effective method for the treatment of most patients having upper urinary tract stones. The complications are minor however includes renal colic, haemorrhage, septicaemia, steinstrasse formation, and cardiac arrhythmias.[1]

The ESWL leads to fragmentation of renal stone and accumulation of these in the ureter is called ‘steinstrasse. It is usually a transient phenomenon detected radiologically, followed by passage of fragments of stones. If this column of stone fragments stays and obstructs ureter, the symptoms appear. Appropriate use of percutaneous techniques, ESWL, double-J stents, ureteroscopy, and medical expulsive therapy can minimize the potentially serious complications associated with steinstrasse.[1,2]

A steinstrasse occurs in 2–10% of the cases, with direct correlation, was found between stone size and subsequent steinstrasse development. The steinstrasse incidence rates in renal stones less than 1 cm, 1–2 cm, and more than 2 cm were 4.4, 15.7, and 24.3%, respectively with the incidence rising with increasing stone burden.[2]

The stone site had a statistically significant impact on steinstrasse formation. There was a significant correlation in steinstrasse formation between renal (10.95%) and ureteral (3.7%) stones. Ureteral stones are more likely to fully disintegrate to pass spontaneously with rapid elimination. This finding may be due to a higher ureteral peristaltic rate and greater amplitude of peristaltic contractions as compared with the intrapelvic activity. There was no statistically significant difference between the number of stones (single or multiple) and the steinstrasse incidence in renal stones.[3]

In order to decrease the steinstrasse incidence in patients with a large stone burden, an indwelling ureteral stent can be placed before the SWL procedure. It has been reported that placing an indwelling ureteral stent may lower the steinstrasse incidence and symptoms in patients with a large stone burden.[4]

Renal morphology is another important factor that influences the process of elimination of stone fragments. Many studies revealed that high renal intrapelvic pressure is associated with reduced or absent renal pelvic motility and a profound inhibition of pelvic and ureteral peristalsis. Thus, radiologically dilated systems have less propulsive power and a decreased antegrade fluid pressure with a higher probability of stone fragment stasis and prolonged calculus transit time.[5]

The decreased ureteral peristaltic activity can be explained by the propulsive effect of the higher intrapelvic pressure of kidneys with normal parenchyma. This propulsive effect may push post-SWL fragments to the bladder.[6]

Steinstrasse should be treated if it is symptomatic (pain and sepsis) or causes a silent obstruction over a 30-day period. The Alternatives include placement of a drainage percutaneous tube to allow fragments to pass, ureteroscopy, SWL of a lead fragment, or open ureterolithotomy.[7]

Our patients developed steinstrasse in patients with renal stone more than 2 cm. Steinstrasse developed exclusively in large stones more than 2 cm, given to patients who opted for it. Most patients had pain at presentation, 4 patients had DJ stent in situ, and one required double j stenting for persistent pain. Our first approach to these patients is assessment; if patient had persistent pain then DJ stenting was done. Conservative treatment comprises of an alpha blocker, analgesic (diclofenac) and antibiotic. Patient not responding

to conservative treatment were divided on basis of main fragment location in the ureter. Upper ureteric fragments were given ESWL and lower ureteric fragments underwent URS. All our patients responded to treatment without complications.

Conclusion

Stone size and site were the significant factors predicting steinstrasse formation. Our all patients had significant bulk of stones developing exclusively in large renal pelvic stones. We concluded that steinstrasse respond to conservative management and if fail ESWL and URS are very effective interventions with complete resolution in all patients.

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How to cite this article: Kumar M, Barwal K, Kumar G, Raina P, Dhiman P, Pathania R. Steinstrasse after Extracorporeal Shockwave Lithotripsy: Aetiology and Management. Acad. J Surg. 2018;1(2):11-15.

DOI: dx.doi.org/10.21276/ajs.2018.1.2.3

Source of Support: Nil, **Conflict of Interest:** None declared.