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# Five Years Experience in the Management of Steinstrasse Post Shock Wave Lithotripsy

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*Abstract.* To identify the incidence rate of Steinstrasse post shock wave lithotripsy, to evaluate the efficacy of shock wave lithotripsy using Dorniers Doli U/50 Lithotripter in treating the Steinstrasse and to confirm that auxiliary procedures are not always necessary prior to shock wave lithotripsy. Between October 2001 and July 2007, 1647 patients with 2241 renal stones were treated. 63 patients who developed Steinstrasse were included in this study. Steinstrasses were classified according to the location and the size of the fragments using Coptcoat classification. Patients' data including the complications, management and Steinstrasse clearance were reviewed. Steinstrasse were detected in 63 of 2241 (2.8%) renal stones. Of the 63 Steinstrasse patients, 61 (96.8%) patients were presented with no obstructive complications; 34 patients with type I were conservatively treated and required no shock wave lithotripsy, while type II and III Steinstrasse required shock wave lithotripsy therapy. The incidence rate of Steinstrasse post shock wave lithotripsy therapy procedure was low. Shock wave lithotripsy therapy was an effective method treating these Steinstrasse. This study confirms that the use of prophylactic auxiliary procedure prior to shock wave lithotripsy therapy was unnecessary in the majority of the cases.

*Keywords:* Extracorporeal shock wave lithotripsy; Renal calculi, Steinstrasse.

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## Introduction

Shock wave lithotripsy (SWL) efficacy, low morbidity, and the advancement in its technology kept these skills as gold standard and the first line treatment for almost all urinary calculi[1]. However, the morbidity associated with SWL is due to ureteral obstruction as a result of the failure in the passage of stone fragments out of the ureter; resulting in a column of sand called (Steinstrasse) which became common radiological findings on routine radiography taken 24-48 h post SWL (15%)[2].

The causes of Steinstrasses after SWL monotherapy are well documented in the literature such as, SWL in large stones (> 2.5 cm), ureteral meatal stenosis, ureteral stricture as a result of bilharzial infection, or previous surgery of the ureter, and using high energies during the initial treatment leading to Steinstrasse[3-7].

Steinstrasse can occupy part or rarely all of the ureter. They are most commonly seen in the lower third of the ureter. Coptcoat *et al.* classified the Steinstrasse into 3 types, Type I is made of particles of 2 mm in diameter or less, Type II has a leading large fragment of 4-5 mm in diameter with a tail of 2 mm particles and Type III is composed of large fragments[8].

## Patients and Methods

Out of 1647 patients with 2241 renal stones, 63 (2.8%) developed Steinstrasse post SWL. The most common presentations were renal pain in 12 patients, renal colic in 8 patients, fever due to obstructive fragments in 2 patients, and 41 patients were asymptomatic (Table 1).

**Table 1. Patients' presentation with Steinstrasse.**

| | Number of patients | Percentage (%) |
|---|---|---|
| Non obstructive | 41 | 65.1 |
| Obstructive | 22 | 34.9 |
| Asymptomatic or mild symptoms | 61 | 96.8 |
| Severely symptomatic | 2 | 3.2 |

After SWL plain abdominal x-ray films and ultrasonography, the patients were monitored monthly; in the first 3 months were to monitor stone disintegration, detect symptoms, and to record the complications.

Steinstrasse may develop after the first SWL session or after several sessions. Management depends upon the patient's symptoms, the degree of obstruction, the presence of infection, and the size and discharge of the fragments. Antibiotics and analgesics were used to manage patients who had mild renal symptoms and mild dilatation of the upper tract, conservatively.

Repeated SWL were performed when the passages of the fragments were delayed by more than 3-4 weeks, or if it led to obstruction with considerable hydronephrosis, and for all patients with Type II or III Steinstrasses.

## Results

Steinstrasse was developed in one day – three months after stone fragmentation. The overall incidence of Steinstrasse was 2.8%. Out of 63 patients with Steinstrasse, 61 (96.8%) were asymptomatic or had no mild obstructive symptoms, while the remaining 2 patients (3.2%) had complications with obstructive pyelonephritis that necessitated an insertion of Percutaneous Nephrostomy (PCN) tube. The locations of the Steinstrasse were 33 (52.4%) in the distal third ureter, 23 (36.5%) in the proximal third ureter and 7 (11.1%) in middle third ureter. The Steinstrasse in 60 (95.2%) of Steinstrasse were 21-50 mm in length (Table 2).

**Table 2. Length of Steinstrasse.**

| Length of Steinstrasse | No. of patients |
|---|---|
| 21-30 mm | 15 |
| 31-40 mm | 18 |
| 41-50 mm | 27 |
| 61-70 mm | 1 |
| 110 mm | 1 |
| 130 mm | 1 |
| Total | 63 |

Steinstrasse of Type I was detected in 34 patients, Type II in 12 patients and Type III in 17 patients (Table 3).

**Table 3. Type of Steinstrasse.**

| Type | Number of patients | Percentage (%) |
|---|---|---|
| I | 34 | 54 |
| II | 12 | 19 |
| III | 17 | 27 |
| Total | 63 | 100 |

The formation of Steinstrasse were directly dependent on the size of the renal stones, were with stone size up to 9 mm no Steinstrasse were detected. On the other hand, Steinstrasse were detected in 3 stones with stones size of 10-19 mm, 11 Steinstrasse with stones size of 20-29 mm, 14 Steinstrasse with stones size of 30-39 mm, and 35 patients with stones size equal or more than 40 mm (Table 4).

**Table 4. The relation of Steinstrasse to the stone size.**

| Stone size | Number of stones | Steinstrasse | Percentage (%) |
|---|---|---|---|
| 0-9 mm | 561 | 0 | 0 |
| 10-19 mm | 702 | 3 | 0.1 |
| 20-29 mm | 553 | 11 | 0.5 |
| 30-40 mm | 278 | 14 | 0.6 |
| >40 mm | 147 | 35 | 1.6 |
| Total | 2,241 | 63 | 2.8 |

Of the patients with Steinstrasse, only a special group of them required Double-J Stents (DJS) insertion. These groups were; 19 patients had stag horn stones, 4 patients had a solitary kidney, 3 patients with obstructed kidney, 3 in obese patients, 1 in patients with chronic renal impairment and one patient with renal anomalies.

Of the 63 patients with Steinstrasse, 61 were associated with no or with partial obstruction. They were treated by conservative measures; 34 patients with the Type I and SWL sessions to the leading stone in 12 and 15 patients with Type II and III Steinstrasse, respectively. While the remaining 2 patients with Steinstrasse; one of them suffered from obstructed pyelonephritis caused by Type II Steinstrasse and treated effectively by insertion of DJS, followed by SWL sessions to the leading stone fragments; the second one has suffered from acute obstructive renal

failure post SWL associated with fever, treated effectively with insertion of bilateral PCN, short term hemodialysis, SWL to the leading stones and urethroscopic extraction of the stone fragments. The average number of sessions required to fragment the leading stones in Type 2 were 2-3 sessions, while in Type 3 were 3-5 sessions with stone clearance over a period of 4-8 wks.

## Discussion

Steinstrasse were commonly occurring in up to 20% in the early versions of SWL[3]. After refining the technique of SWL, the incidence of Steinstrasse decreased, it was 6% in the series of Kim *et al.*[5] and Type 1, Steinstrasse occurred in 61% in the series of Madbouly *et al.*[7]; however, we reported an overall low incidence of Steinstrasse of 2.8%.

In this present study, the most common location for Steinstrasse was the lower third of the ureter (52.4%); followed by the upper third (36.5%). This distribution may be the result of the anatomical narrowing at the vesico-ureteric junction, which may cause fragments to accumulate above it, and sometimes due to ureteric meatal stenosis. Similar findings were reported by Kim *et al.*[5], Fedullo *et al.*[3], and Sayed *et al.*[6].

A direct correlation was found between stone size and subsequent Steinstrasse development, and the complication rate is increased in patients with stones more than 2.5cm in diameter[9,10].

Complicated Steinstrasse occurs when the collection of particles is held up in the ureter and causes partial or complete obstruction with loin pain and progressive proximal dilatation. Furthermore, during stone fragmentation, bacteria may be liberated, which in the presence of shock wave induces local tissue trauma, will result in entry of bacteria into the blood stream. When overt obstruction by fragments is added, a serious of risk in urosepsis is created. Patients usually present with renal colic, nausea and vomiting, and even fever with rigors when sepsis occurs. We reported only 2 patients that suffered from acute obstruction with fever (pyelonephritis). Those patients were treated with insertion of PCN tube drainage, appropriate chemotherapeutic agent and then SWL for the leading stones. Placing a PCN in patients with obstruction or infection was successful in relieving the obstruction and infection, which usually lead to the decrease in the intrapelvic pressure, and re-establishes ureteral peristalsis facilitated in the passage of the fragments. A PCN may also

decrease ureteral edema around the fragments, which helps to dislodge them and allow them to pass with no further treatment, Dretler[11] and Ryan *et al*.[12].

In analyzing our results, led us to believe that placing an ureteric stent before SWL does not prevent Steinstrasse, but prevents their complications. Stenting before SWL should be considered only in patients with large renal stones (> 2 cm); solitary function kidney; obstructed kidney; chronic renal impairment; combined ureteric and renal stones; stones in patients with intrarenal pelvis; stag horn stones; pre-ureteroscopy and intracorporeal lithotripsy in non-SWL responders; bilateral renal stones and diseased ureter.

The conservative management of uncomplicated Steinstrasse was effective in most of the patients (61 of 63 patients) with and without repeated SWL session of the leading stone. This also was reported by Kim *et al.*[5].

The risk of Steinstrasse formation after SWL sessions of renal stones is increased in patients with stones size more than 2 cm. Other factors that have the most significant role in Steinstrasse formation are stone site, dilated renal units and use of power more than 22 kV. The optimum selection of cases and the accurate stone targeting are essential to minimize the development of Steinstrasse. Close follow-up monitoring and early relief of obstruction are necessary to prevent any loss of renal function. When there is obstruction and/or infection or renal damage, active treatment is indicated, of which SWL and PCN are the most effective procedures. Prophylactic pre-SWL ureteral stenting is another alternative. We found PCN was effective in 2 patients with Type II Steinstrasse due to obstructed infected kidney and endoscopic stone extraction in one patient.

The length of ureter affected by Steinstrasse appeared to have no effect on the success of the treatment.

## Conclusion

The incidence rate of Steinstrasse post-SWL procedure is low; SWL is an effective method of treating these Steinstrasse. This present study confirms the unnecessary prophylactic auxiliary procedure pre-SWL,

except in special groups of patients, such as staghorn stones or solitary kidney.

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# خمسة سنوات خبرة في متابعة و علاج ممر الحصوات الناتج عن التفتيت بجهاز الموجات التصادمية لتفتيت الحصوات

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*المستخلص.* الهدف: لإيجاد معدل ممر الحصوات المتكونة ما بعد تفتيت حصوات الكلى بجهاز التفتيت من خارج الجسم، لتقييم قدرة جهاز التفتيت دورنير دولي يو ٥٠ في علاج حصوات ممر الحصوات، ولإثبات أنه ليس من اللازم عمل تدخلات مرادفة قبيل تفتيت الحصوات.

المرضى والطرق: ما بين أكتوبر ٢٠٠١م ويوليو ٢٠٠٧م تم معالجة ١٦٤٧ مريضا يعانون من ٢٢٤١ حصوة بالكلى بجهاز تفتيت الحصوات. تعرض ٦٣ مريضا منهم لتجمع ممر حصوات بالحالب. تم تقسيم ممر الحصوات طبقا للدراسة المنشورة من كوبكت وذلك طبقا لمكان وحجم الأجزاء. تم أيضًا دراسة النتائج، والمضاعفات، والعلاج، ومعدل زوال ممر الحصوات. وجد ممر الحصوات في ٦٣ حالة من ٢٢٤١ حصوة كلى، ٦١ (٩٦,٨٪) من ٦٣ مريضا عانوا من الحصوات الممرية لم يكونوا يعانون من مضاعفات انسداد كلوي. ٣٤ مريضا من النوع الأول، عولجوا بالطرق الملاحظية، ولم يحتاجوا لتفتيت للحصوات، في حين أن الحصوات من النوع الثاني والثالث تطلب علاجهم تفتيت للحصوات. إن معدل تكون الحصوات الممرية بعد عمليات تفتيت

الحصوات من خارج الجسم قليل، جهاز تفتيت الحصوات طريقة مؤثرة في علاج الحصوات الممرية، دراستنا تؤكد أنه ليس من الضروري عمل تدخلات مرادفة استباقية لعملية تفتيت الحصوات.