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URINARY TRACT OBSTRUCITON FOLLOWING ESWL

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SUMMARY

Among 2379 patients with upper urinary tract stones who underwent ESWL (Extracorporeal Shock Wave Lithotripsy) at Sina Hospital using the *Siemens Lithostar*, 638 developed Stone Street (*Stein Strasse*). Of these, 516 (81%) passed all of the stone fragments spontaneously and no treatment was required, 90 cases (14%) had more ESWL sessions to complete the treatment, and 30 (4.7%) required further interventional procedures. Only two cases (0.3%) needed an open ureterolithotomy.

In this paper, we report the results of our experience in treating *Stein Strasse* as a complication of the ESWL.

KEY WORDS: *ESWL; Obstruction; Stein Strasse.*

INTRODUCTION

(ESWL) Extracorporeal shock wave lithotripsy has been used as a successful means of treating urinary tract stones, achieving 98% complete fragmentation rate, but the clinical success depends on the spontaneous passage of the fragments. Most fragments pass easily, but occasionally some particles remain in the ureter and rarely within the urethra. *Stein Strasse* (Stone Street) is the term given to the presence of multiple fragment particles present in the

ureter as seen in a KUB (Kidney Ureter Bladder). *Stein Strasse (St. St.)* is a known complication of ESWL which is seen typically in KUB's 24-48 hours post-ESWL; however, only a single fragment may be the cause of obstruction. In this paper, we have suggested a possible evaluation and management plan for patients with *St.St.* based on a study of 2379 patients who underwent ESWL within 27 months (from June, 1990 till Sept., 1992).

PATIENTS AND METHODS

Two thousand nine hundred and five patients were treated with ESWL at Sina Hospital during a 27-month period, from June, 1990 till Sept., 1992; of which 526 were excluded from the study for various reasons. Each of the patients in the study were followed for a duration of six months. One thousand eight hundred and thirty one (77%) of the total 2379 patients were male and the remaining 548 (23%) female. The mean age of patients was 41 years; the range was 9-47. A plain film of abdomen was taken after 24 hours Post-ESWL to assess the degree of stone fragmentation. The patients were asked to return for a repeat X-ray within 1-4 weeks according to the results of the initial X-ray. However, if the patient developed any fever, nausea, vomiting, severe flank pain, or voiding problems, they were instructed to come back immediately. The course of management for these patients who developed *St.St.* was decided upon the following criteria: the function of the countralateral kidney; the presence of nausea, vomiting, flank pain, fever, the type of *St.St.*, the time at which *St.St.* was discovered, movement of particles, dilatation of upper urinary tract as seen on ultrasound or IVP (Intravenous Pyelography) and other patient's related factors. The patients with *St.St.* were divided into two groups according to whether or not they had acute symptoms such as refractory pain, fever, and anticipated sepsis.

***Group 1**: Patients with acute symptoms*: These patients were managed with the placement of a stent, repeated urgent ESWL, antibiotics and analgesics.

***Group 2**: Patients without acute symptoms*: These patients included those who developed *St.St.* within two weeks of the ESWL, or diagnosed on their last visit.

If the patients had type I of *St.St.*, they were asked to return two weeks later, and if on reassessment, the patient showed any sign of passage of stones or any movement, two further weeks were allowed before subsequent reassessment. An IVP was carried out on those patients who failed to show any movement of fragment(s). Antibiotics were given to patients with upper urinary tract dilatation and a repeat ESWL carried out for those who did not respond within a two-week course of management.

If the patient developed any acute symptoms

during this period, he or she was managed as in ***group 1***. Patients without upper urinary tract dilatation on IVP would be treated with ESWL if they did not pass the stones spontaneously within four weeks.

An IVP was carried out in patients with type II of *St.St.* Patients, who revealed no upper urinary tract dilatation, was followed with KUB films at the interval of two weeks, and if no stone passage was observed within four weeks, ESWL would be repeated. Patients with upper urinary tract dilatation were treated immediately with ESWL.

Type III of *St.St.* were also investigated with IVP. Dilatation of the upper urinary tract was managed immediately with ESWL and those without dilatation were managed with ESWL if they failed to pass stones spontaneously within two weeks.

Any patient, who developed severe pain during the course of management, was treated immediately with analgesics and antibiotics.

All of the patients were not hospitalized and the ESWL procedure was carried out without general or regional anesthesia.

RESULTS

A total of 2617 stones were treated with ESWL, of which 2382 (91%) were kidney stones (pelvis 49%, calyx 42%) and 235 (9%) were located in the ureter. The number of ESWL sessions for each patient ranged from 1-4.

Fifty two percent of the stones were located in the right side and the remaining in the left side. Figure 1 shows the relationship between stone size and the completeness of stone passage after the treatment.

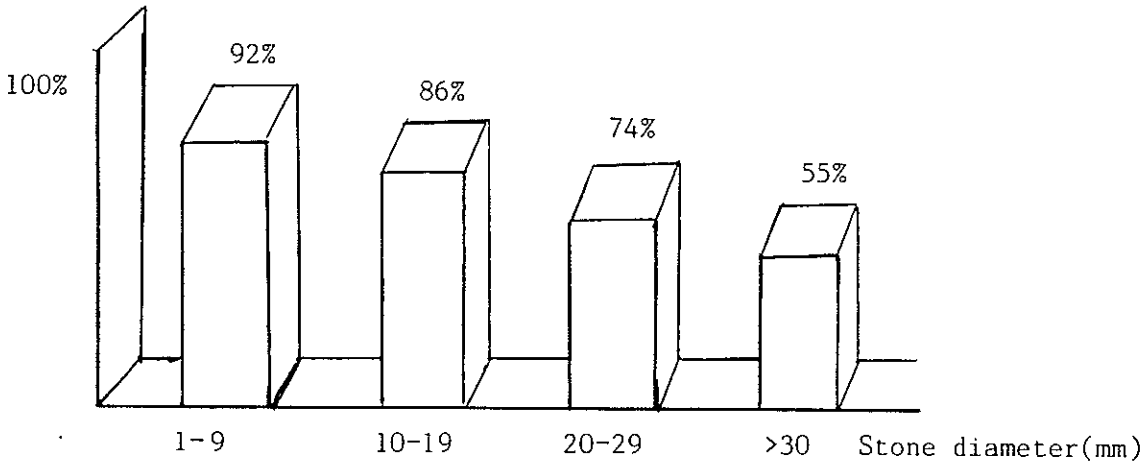


Figure 1. Results of ESWL in patients with renal stones according to the stone size

This figure seems to suggest that the complete passage of stones after treating with ESWL was inversely proportional to stone size.

Figure 2 shows the relationship between complete passage of stones after ESWL with the location of the stone within the ureter.

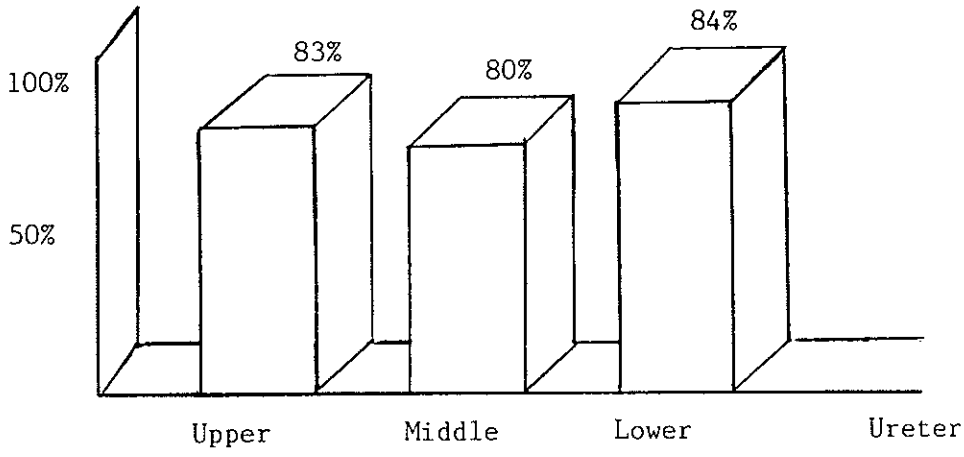


Figure 2. Results of ESWL in patients with ureteric stones according to the stone location

From the 235 patients with ureteric stones, 99 (42%) were located in the upper ureter, 40 (17%) in the mid-ureter, and 96 (41%) were located in the lower ureter. The diagram in Figure 2 points to the fact that the location of the stone in the ureter did not relate to the complete passage of stones after ESWL.

Stein Strasse was observed in 638 cases (24.4% of stones or 26.8% of patients). Table 1 shows the incidence of *St.St.* and the location of the primary stone in the urinary tract. This table shows a greater incidence of *St.St.* for stones located in the ureter rather than in the kidney.

The incidence of *St.St.* increased in accordance with the increase of stone size (Table 2).

The length of *St.St.* ranged from 1-28 cm with a mean of 6.3 cm (Fig. 3).

Primary Site	**Primary Stone No. of cases**	***St.St.* Formation**	*%*
Pelvis	1283	332	26
Calices	1099	221	20
Ureter	235	85	36
Total	2617	638	24.4

Table 1. Incidence of *St.St.* according to the stone location.

Stone Size (mm)	**Primary Stone No. of Cases**	***St.St.* Formation**	*%*
≤ 9	904	88	9.7
10-19	1256	325	25.9
20-29	364	167	45.9
> 30	93	57	62.3
Total	2617	637	24.3

Table 2. Incidence of *St.St.* according to the stone size

The most common type of *St.St.* was type I and the least common type was type III (Table 3). The accumulation of *St.St.* was observed most commonly in the lower ureter followed by the upper and lastly in the mid-ureter (Table 4).

Fifty three percent of patients with *St.St.* had the symptoms listed in Table 5. The most common complaints were irritative bladder symptoms.

St.St.	**Type I**	**Type II**	**Type III**	**Total**
No.	376	198	64	638
%	59	31	10	100

Table 3. Distribution of *St.St.* type

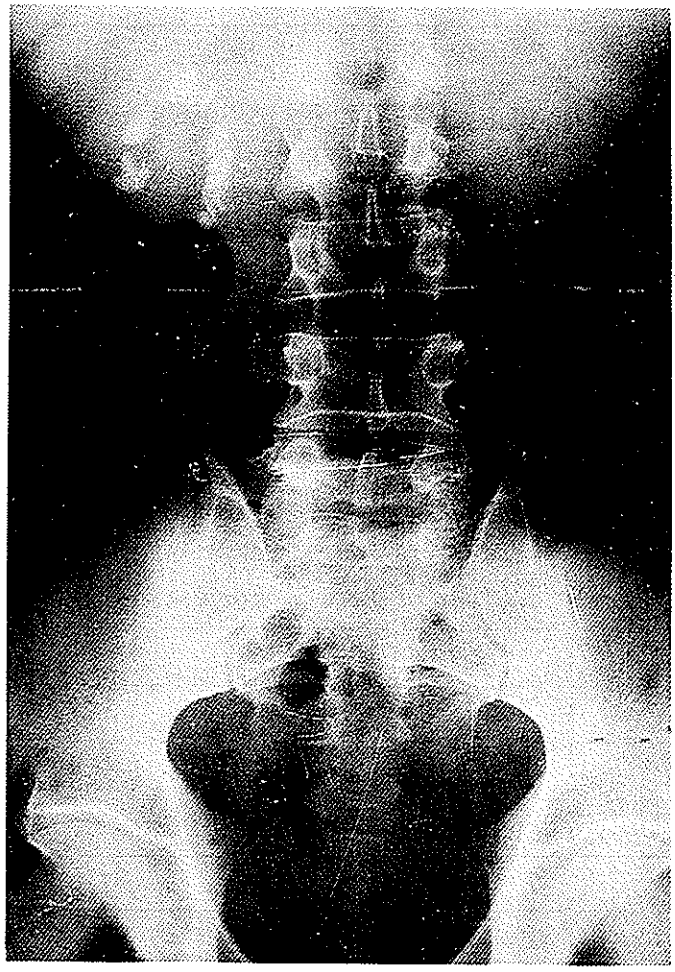


Figure 3. A long *St.St.*

Ureter / *St.St.*	**Upper**	**Middle**	**Lower**	**Total**
No.	153	108	37	298
%	24	17	59	100

Table 4. Distribution of *St.St.* location.

Of 638 patients with *St.St.*, 516 spontaneously passed all of the stone fragments. ESWL monotherapy with or without additional procedures were performed on the remaining 122. Percutaneous nephrostomy was done on two of the five patients with acute symptoms,

who did not respond to stent placement, ESWL, antibiotics, and analgesics. The remaining 117 patients without acute symptoms were subjected to ESWL monotherapy only (Fig. 4). Of these, 90 cases passed all the *St.St.* completely and 27 required additional endourological and surgical interventions (Tables 6 & 7).

The patients with additional procedures included cases with middle and upper ureter stones who were treated with *Push & Bang* method. Twenty cases with lower ureter *St.St.* were treated by dilatation, basketing, and internal meatotomy. The remaining two patients who failed to respond to these additional procedures underwent ureterolithotomy. These two patients had type III of *St.St.* with stones located in the upper and lower ureter. No mortality resulted from any of the procedures. Tables 6 & 7 shows the incidence of spontaneous passage of stones and response to re-ESWL and additional procedures in relation to the *St.St.* type and location. The incidence of *St.St.* and spontaneous passage of stones according to the sex of the patients is shown in Table 8.

Symptoms *%* Asymptomaytic	**Bladder Irritation**	**Flank Pain**	**Nausea & Vomiting**	
No.	306	204	166	300
%	48	32	26	47

Table 5. Percentage of symptoms seen in patients with *St.St.*

Ureter	**No.** *St.St.*	**Spontaneous Passage(%)**	**Re-ESWL (%)**	**Additional Procedures(%)**	**Acute* Symptoms**
Upper	153	110 (72)	35 (23)	7 (4.3)	1 (0.7)
Middle	108	87 (80.5)	18 (16.7)	3 (92.8)	----
Lower	377	312 (89)	37 (6.9)	20 (3.8)	1 (0.4)
Total	638	516 (81)	90 (14)	30 (4.6)	1 (0.4)

Table 6. Results of *St.St.* treatment according to the site

* Patients that needed percutaneous nephrostomy [in addition to stent placement, ESWL, antibiotics, and analgesics]

St.St.	No. Patients	Spontaneous Passage(%)	ESWL(%)	Additional Procedures(%)	Acute* Symptoms(%)
Type I	376	338 (90)	35 (9.2)	3 (0.8)	----
Type II	198	144 (72.9)	42 (21)	11 (5.6)	1 (0.5)
Type III	64	34 (53)	13 (20.4)	16 (25)	1 (1.6)
Total	638	516 (81)	90 (14)	30 (4.6)	2 (0.4)

Table 7. Results of *St.St.* treatment according to the type

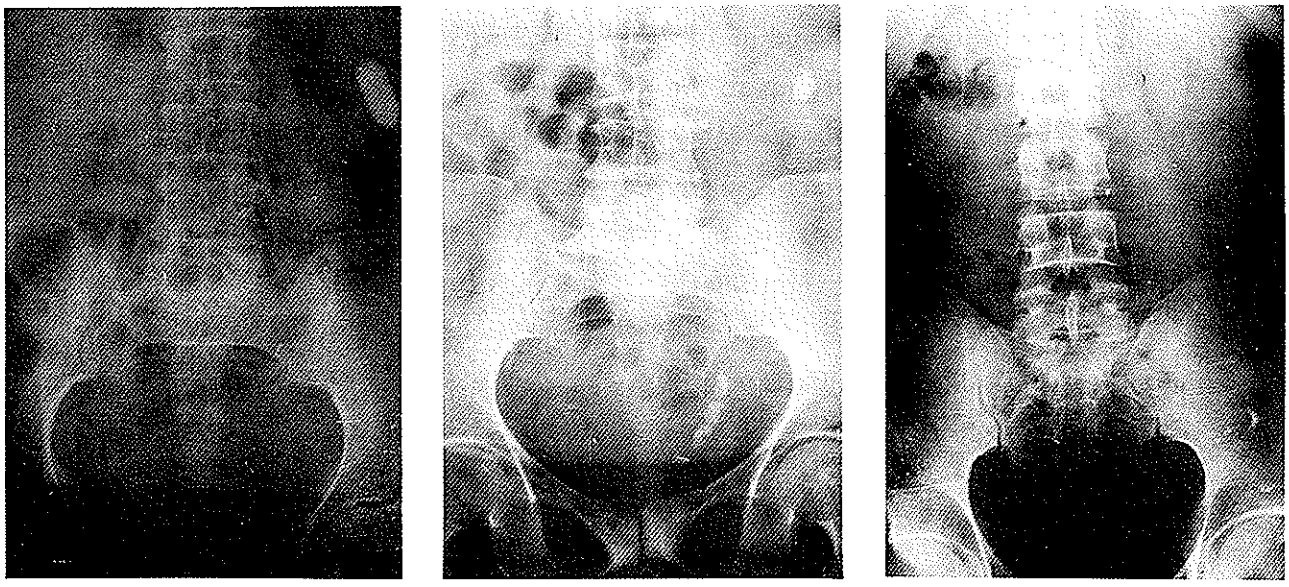
* Patients that needed percutaneous nephrostomy [in addition to stent placement, ESWL, antibiotics, and analgesics].

No. Sex	Patients	*St.St.*	Spontaneous Passage(%)
Male	1831	492 (26.9)	383 (20.9)
Female	548	146 (26.6)	133 (24.3)

Table 8. Distribution of *St.St.* and spontaneous passage seen in different sexes

DISCUSSION

The incidence of post-ESWL *St.St.* for renal stones has been reported to be 2-25% (1-3). The relationship between *St.St.* formation and stone size is quite simple "the larger the size, the greater the likelihood of *St.St.* formation". The incidence of *St.St.* following the treatment of stones smaller than 1 cm is 9.8% for stones greater than 2 cm in size, no pre-ESWL accessory procedure was carried out. A further explanation for the higher incidence of *St.St.* in our experience can be attributed to the fact that most studies related mainly to renal stones, whereas our study included ureteric stones which may have a naturally higher incidence of *St.St.* (35%) than renal stones (22%). The most common type of *St.St.* in our experience was type I (59%) followed by type II (31%) and type III (10%) (according to Copcoat classification) (4).



A B C

Figure 4. One patient with *St.St.* treated with ESWL alone.
A: Before ESWL
B: After ESWL with type III of *St.St.*
C: After treating *St.St.* with re-ESWL

The incidence of type I of *St.St.* in the Copcoat study was (54%), type II (34%) and type III was (12%). The comparatively higher incidence of types I and II of *St.St.* in our experience seems to suggest that *Siemens Lithostar* Lithotriptor disintegrated the stones into smaller fragments and perhaps due to a greater accuracy of stone fragmentations achieved by our colleagues. Type III usually results from an inadequate number of shock waves per stone mass, and type II usually follows the dropping of a large fragments into the ureter during the early course of treatment due to poor focusing (2, 3). The most common location of

St.St. in our study was distal ureter (59%) followed by upper ureter (24%) and middle ureter (17%), showing similar trends to the other studies. Kim *et al* reported that 60% *St.St.* accumulated in the distal ureter and Fedullo *et al* reported 47% incidence (2, 3). Forty seven percent of our patients were asymptomatic during the detection of *St.St.* Irritative bladder symptoms were observed in 48%, flank pain in 32%, and nausea and vomiting in 25%. These symptoms were reported with higher incidence by the others (3).

Several different methods of post-ESWL follow up have been used in various studies. One method, which was carried out in our study, includes a KUB after 24 hours following ESWL, with an IVP performed 2-4 weeks later if the patients continue to have *St.St.* Another method includes KUB being carried at two weeks and IVP or ultrasound four weeks after ESWL. Dretler proposed that with *St.St.* we should have an ultrasound every four weeks in order to forecast the development of silent hydronephrosis. Fedullo *et al* and Coptcoat *et al* followed patients with *St.St.* clinically and with repeated IVPs and ultrasounds (3, 4).

Complicated *St.St.* are those entraped in ureter causing partial or complete obstruction, and many methods proposed of interventional management have been highlighted in various studies. Reihle and Nausland suggested that prolonged proximal ureteral fragments should be treated by retrograde method followed by ESWL (3). Coptcoat *et al* performed percutaneous nephrostomy as a first line management of complicated *St.St.* They reported that type I would probably pass during the following two or three weeks, type II would perhaps require further fragmentation via a ureteroscope (4), and treatment of *St.St.* in the lower ureter can be performed by using basket dislodger, laser, or electrohydrolic refragmentation via a percutaneous nephrostomy tract. (5, 6). The aforementioned interventions would be always used for type III.

Extracorporeal shock wave lithotripsy is the method of choice for treating of large leading fragments of *St.St.*, and if this fails, then percutaneous nephrostomy or ureteral meatotomy would be used.

Symptomatic *St.St.* which does not respond to conservative management is better treated by percutaneous nephrostomy (PCN) (4, 7). Both of emergency ESWL and PCN resulted in good therapeutic response.

Extracorporeal shock wave lithotripsy provided effective management of impacted *St.St.* without any large leading fragments (8), and if this failed high pressure, pulsatile ureteric irrigation through an end-hole catheter would be performed. Ultrasonic lithotripsy through a ureteroscope is also a good management of this kind of *St.St.* However, as expected, ureteroscopy of distal ureter for type I and

impacted *St.St.* is very difficult because the small particles interlock in a similar way to bricks in a wall without mortar (4).

Among the recently introduced different procedures for the management of the urinary tract obstruction following ESWL, repeated ESWL is the procedure of choice. ESWL is a non-invasive, easily repeated, effective and safe method for treating the obstruction of the urinary tract as an outpatient therapy. Eighty-one percent of our 638 patients with *St.St.* were treated conservatively and in the remaining 19% ESWL was effective in 74%. Only two patients required open ureterolithotomy for ureteric obstruction.

With an encouraging outcome to the treatment of *St.St.*, ureteric obstruction of any type or location, using ESWL as in our study at Sina Hospital, it was concluded that this is a simple procedure giving a high success and low complication rate.

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