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Pyonephrosis Associated with Massive Nephrolithiasis and Spontaneous Steinstrasse Managed by Open Nephroureterectomy: A Case Report

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ABSTRACT

Introduction: Pyonephrosis is a urological emergency caused by suppurative infection of an obstructed renal collecting system, most commonly due to urolithiasis. Steinstrasse is typically encountered as a complication following extracorporeal shock wave lithotripsy, whereas spontaneous steinstrasse in the absence of prior intervention is exceedingly rare. Its coexistence with massive nephrolithiasis and pyonephrosis represents an unusual and challenging clinical scenario.

Case Presentation: We report a rare case of pyonephrosis secondary to an obstructing renal pelvic stone, associated with multiple nephrolithiasis and spontaneous steinstrasse. The patient presented with chronic flank pain and was found on imaging to have extensive stone burden involving the kidney and a continuous chain of calculi along the ureter. Despite preserved laboratory parameters, radiological findings suggested a chronically obstructed and infected, non-functioning renal unit. Considering the severity of infection and extensive ureteral involvement, a double-incision open nephroureterectomy was performed. Intraoperatively, more than 50 calculi were removed from the kidney and ureter. The postoperative course was uneventful, and follow-up imaging demonstrated complete stone clearance.

Conclusion: Pyonephrosis associated with massive nephrolithiasis and spontaneous steinstrasse is extremely rare and potentially life-threatening. In the presence of severe infection and a non-functioning kidney, open nephroureterectomy offers definitive source control. This case underscores the continued relevance of open surgery in selected complex urolithiasis cases despite advances in minimally invasive techniques.

Keywords: *Pyonephrosis; Nephrolithiasis; Spontaneous steinstrasse; Nephroureterectomy; Open urological surgery..*

INTRODUCTION

Pyonephrosis represents a severe suppurative infection of the renal collecting system, typically arising from upper urinary tract obstruction in the presence of infection.1,2 If not promptly recognized and managed, it may rapidly progress to sepsis, irreversible renal damage, and life-threatening complications. Urolithiasis remains the most common cause of obstructive pyonephrosis, particularly when stones lodge within the renal pelvis or ureter, leading to impaired urinary drainage and bacterial overgrowth.3 While steinstrasse, defined as a column or chain of stone fragments within the ureter, is classically described as a complication following extracorporeal shock wave lithotripsy (ESWL). Spontaneous steinstrasse in the absence of prior intervention is exceedingly rare, especially when associated with massive stone burden involving both the kidney and ureter.4,5 Such presentations pose significant diagnostic and therapeutic challenges and are rarely described in the literature.

Management of pyonephrosis with extensive nephrolithiasis depends on the patient's clinical stability, renal function, stone burden, and degree of infection.1–3 While minimally invasive approaches are generally preferred, open surgery remains a crucial option in selected cases, particularly in the setting of a non-functioning, infected kidney with extensive ureteral involvement. Nephroureterectomy may be required to achieve definitive source control and prevent recurrent infection.

We report a rare and complex case of pyonephrosis caused by an obstructing renal pelvic stone, accompanied by multiple nephrolithiasis and spontaneous steinstrasse, successfully managed with double-incision open nephroureterectomy, during which more than 50 stones were extracted. This case highlights an unusual clinical presentation, surgical decision-making, and the continued relevance of open surgery in modern urological practice.

CASE PRESENTATION

A patient was referred from the Internal Medicine Department to the Urology service with a chief complaint of left flank pain. The patient reported bilateral flank pain for approximately one month prior to admission. The pain was described as intermittent, occasionally radiating to the lower abdomen, and was more prominent on the left side. There was no history of gross hematuria, dysuria, passage of stones, sandy urine, or cloudy urine. The patient reported spontaneous voiding with clear yellow urine. There was no history of hypertension, diabetes mellitus, hyperuricemia, chronic kidney disease, hemodialysis, or prior abdominal or urological surgery.

On physical examination, vital signs were within normal limits. Left costovertebral angle tenderness was present on percussion. The suprapubic area was not distended. No surgical scars were noted. External genitalia examination was unremarkable, with no evidence of meatal stenosis. Plain abdominal radiograph demonstrated a radiopaque calculus projected over the right renal area, consistent with a renal stone (Figure 1). In addition, multiple radiopaque calculi were seen clustered within the pelvic region, corresponding to multiple vesical (bladder) stones. Computed tomography (CT) of the abdomen confirmed the findings seen on the plain radiograph, demonstrating a radiopaque calculus in the right kidney and multiple calculi within the urinary bladder. In addition, CT imaging revealed multiple calculi in the left kidney with a linear chain of stones extending along the course of the left ureter, consistent with steinstrasse, explaining the obstructive pathology on the left side (Figure 2).

Preoperative laboratory results demonstrated hemoglobin 13.3 g/dL, hematocrit 39%, leukocyte count 4.7 $\times 10^3/\mu L$, platelet count 230 $\times 10^3/\mu L$, serum creatinine 1.12 mg/dL, blood urea 21 mg/dL, serum sodium 144 mmol/L, potassium 4.3 mmol/L, chloride 101 mmol/L, random blood glucose 94 mg/dL, and albumin 4.06 g/dL, with normal coagulation profile. Based on clinical, laboratory, and imaging findings, the patient was diagnosed with pyonephrosis due to an obstructing renal pelvic stone, accompanied by multiple nephrolithiasis and spontaneous steinstrasse involving the ureter.

The patient underwent open nephroureterectomy using a double-incision approach. A Gibson incision was first performed for distal ureterectomy, followed by a flank incision for nephrectomy. The operative findings were consistent with severe stone burden and infected, non-functioning renal unit (Figure 3). More than 50 stones were extracted from the kidney and ureter. Postoperative plain abdominal radiograph demonstrated no residual radiopaque calculi in the urinary tract (Figure 4). A double-J ureteral stent was visualized in situ on the right side, with appropriate positioning. Postoperative laboratory evaluation showed hemoglobin 11.5 g/dL, hematocrit 31%, leukocyte count 4.1 $\times 10^3/\mu L$, platelet count 285 $\times 10^3/\mu L$, serum creatinine 0.73 mg/dL, blood urea 25 mg/dL, sodium 136 mmol/L, potassium 3.4 mmol/L, chloride 106 mmol/L, calcium 8.3 mg/dL, magnesium 1.5 mg/dL, albumin 2.54 g/dL, and elevated D-dimer level of 1260 ng/mL. The postoperative course was otherwise unremarkable.

DISCUSSION

Pyonephrosis is a urological emergency characterized by purulent infection of an obstructed renal collecting system.[2] The condition most commonly results from long-standing urinary tract obstruction, with urolithiasis being the predominant etiology. Delayed diagnosis or inadequate source control may lead to septic shock, irreversible renal damage, and increased mortality.[6] In the present case, chronic obstruction by a renal pelvic stone combined with an extraordinary stone burden resulted in pyonephrosis and complete loss of renal function, necessitating definitive surgical management.

Steinstrasse, or “stone street,” describes a column of calculi aligned within the ureter and is most commonly reported as a complication following extracorporeal shock wave lithotripsy (ESWL).[4,5] In this setting, it results from the fragmentation of a large renal calculus with subsequent migration of multiple stone fragments into the ureter. Spontaneous steinstrasse occurring in the absence of any prior stone intervention is exceptionally rare, with only limited cases described in the literature.[4,5]

The pathophysiology of spontaneous steinstrasse is not fully understood. Stone formation begins with urinary supersaturation, followed by crystal nucleation, aggregation, and retention within the renal papillae or collecting system.[7–9] These fundamental processes determine the overall stone burden and predispose to downstream migration. In spontaneous steinstrasse, several specific mechanisms may contribute to the formation of a continuous ureteral stone column. These include sequential migration and impaction of multiple small calculi originating from the renal collecting system, in situ nucleation and growth within segments of ureteral urinary stasis, and progressive stone coalescence in areas of impaired drainage.[7–9] Chronic obstruction and reduced ureteral peristalsis further facilitate stone retention and alignment along the ureter. Infective processes play an additional role by promoting stone encrustation and accelerated crystal growth, particularly in the setting of altered renal function and chronic inflammation.[10] Unlike the classic post-lithotripsy mechanism, where

multiple fragments stack after extracorporeal shock wave lithotripsy, spontaneous steinstrasse reflects ongoing lithogenesis, aggregation, and retention rather than iatrogenic fragmentation. The development of multiple small calculi instead of a single large stone may be explained by the coexistence of prolonged urinary stasis and a metabolic milieu that favors the formation of multiple crystal nucleation sites rather than progressive stone aggregation.[8] In the present case, the extensive stone burden involving the kidney and ureter suggests a chronic process rather than an acute event.

Spontaneous steinstrasse may remain asymptomatic or present with flank pain, urinary tract infection, or obstructive uropathy.[3,4,7–9] When associated with infection, as in this case, it significantly increases the risk of pyonephrosis and sepsis. Cross-sectional imaging, particularly non-contrast CT, plays a crucial role in diagnosis by accurately delineating the number, size, and distribution of stones, as well as the degree of obstruction and associated complications.[1]

The coexistence of pyonephrosis, extensive nephrolithiasis, and spontaneous steinstrasse presents a significant therapeutic challenge. The treatment generally is urgent decompression of the collecting system, either via percutaneous nephrostomy or ureteral stenting followed by definitive stone management once infection is controlled.[2,3] However, in cases where the kidney is severely infected, non-functioning, and associated with extensive ureteral stone disease, kidney-preserving strategies may be neither feasible nor safe.

In this case, open nephroureterectomy was selected as definitive treatment due to several factors: the massive stone burden involving both the kidney and ureter, the presence of pyonephrosis indicating chronic infection, and the presumed non-functioning renal unit. The use of a double-incision approach, distal ureterectomy via a Gibson incision followed by flank nephrectomy, allowed complete removal of the infected urinary tract and effective source control. The extraction of more than 50 stones intraoperatively underscores the severity and chronicity of the disease process.

Although minimally invasive techniques such as percutaneous nephrolithotomy, ureteroscopy, and laparoscopic nephrectomy are increasingly favored, this case highlights that open surgery retains an important role in complex and advanced urolithiasis. In resource-limited settings or in patients with extensive inflammatory changes, dense adhesions, or gross infection, open nephroureterectomy remains a safe and definitive option.

This case is notable for the rare occurrence of spontaneous steinstrasse without prior ESWL, combined with pyonephrosis and extreme stone burden. It emphasizes the importance of early detection and intervention in urolithiasis to prevent progression to advanced, kidney-destroying complications. Furthermore, it reinforces that individualized surgical decision-making remains essential, and that open surgical techniques continue to have relevance in contemporary urological practice.

CONCLUSION

Pyonephrosis due to chronic obstructive urolithiasis is a serious condition that may progress to irreversible renal damage. This case highlights the rare occurrence of spontaneous steinstrasse with massive stone burden in the absence of prior intervention. In the presence of severe infection and a non-functioning kidney, open nephroureterectomy provides definitive and effective source control. Despite modern minimally invasive options, open surgery remains essential in selected complex cases.

Figure Legends

Figure 1. Preoperative plain abdominal radiograph (BNO/KUB) demonstrating radiopaque urinary tract calculi.

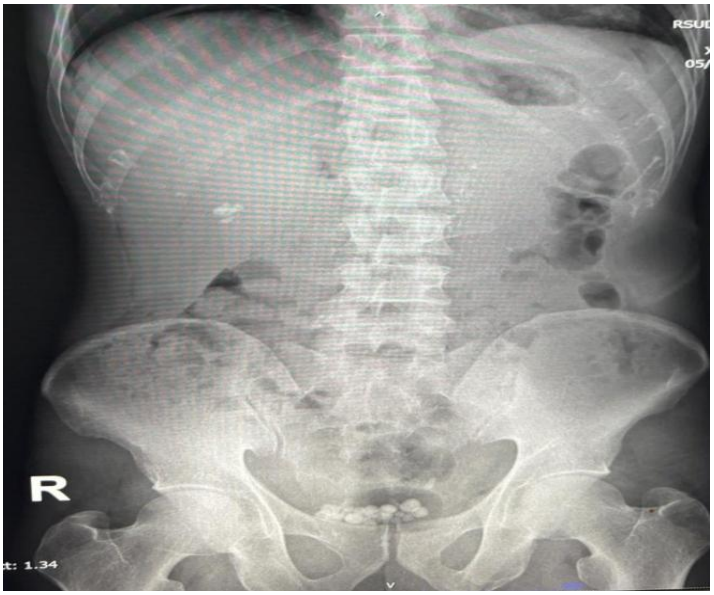


Figure 2. Preoperative computed tomography (CT) scan showing extensive left-sided stone disease: (a) coronal view, (b) axial view, (c) sagittal view, and (d) three-dimensional reconstruction demonstrating multiple calculi in the left kidney with a continuous chain of stones along the left ureter consistent with steinstrasse.

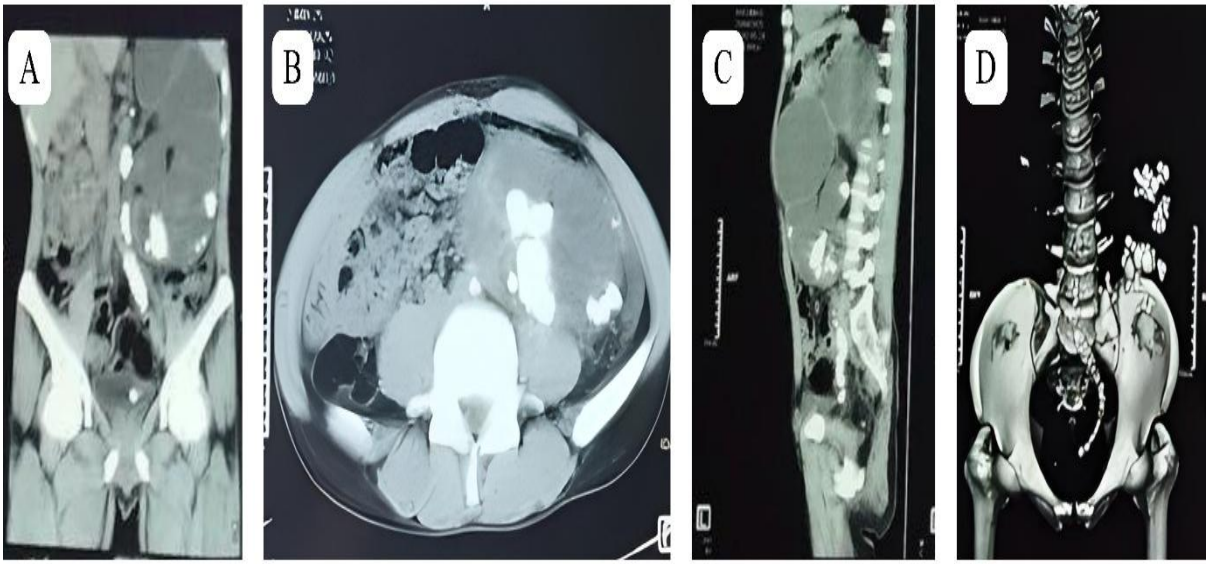


Figure 3. Intraoperative findings following open nephroureterectomy: (a) excised kidney and ureter specimen, (b) incised kidney revealing multiple intrarenal calculi, and (c) extracted stones after complete separation from the renal and ureteral tissue.

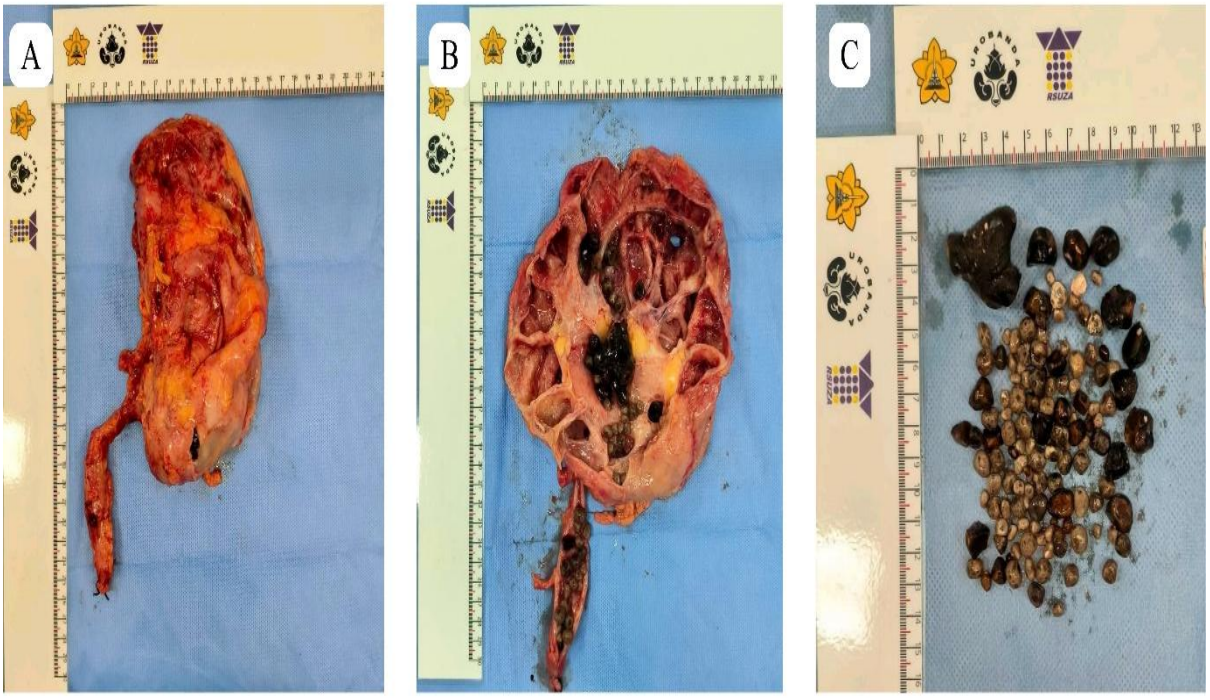
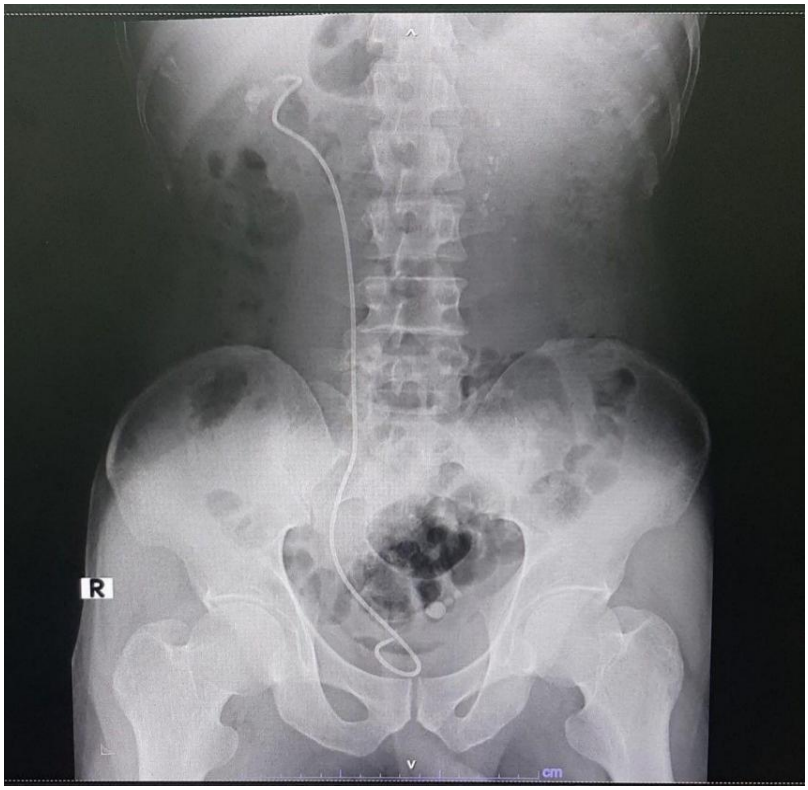


Figure 4. Postoperative plain abdominal radiograph (BNO/KUB) showing no residual radiopaque calculi, with a right-sided double-J ureteral stent in situ



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