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Treatment of bilateral staghorn nephrolithiasis using percutaneous nephrolithotripsy in a patient chronically infected with Proteus mirabilis: a case report with literature review

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Abstract: Although urolithiasis is a common disease in the European population, bilateral staghorn stones are a relatively rare variant of nephrolithiasis. It is often associated with a chronic urinary tract infection or a metabolic disorder.

The aim of this paper is to show an example of the treatment of bilateral staghorn stones in a patient chronically infected with a resistant strain of Proteus mirabilis. Percutaneous nephrolithotripsy (PCNL) is currently the gold standard of treatment. And this is the way the patient was managed.

In the following section, the authors sought to describe new reports on this treatment method and how it could be improved. Conservative treatment does not appear to be a safe alternative. And of the other surgical treatments, PCNL has the greatest benefits.

Nearly 68% of patients with bilateral staghorn stones have some underlying metabolic disorder in a small sample of patients. It seems reasonable, therefore, to introduce genetic and metabolic diagnosis in younger patients with the aim of prevention through diet or pharmacotherapy.

Key words: Urology, Staghorn lithiasis, Bilateral, PCNL, Proteus mirabilis, Calculi

Introduction: Lithiasis impacts 5-10% of the population in Europe. The disease is most common in the 3rd to 5th decade of life, 3 times more frequent in men[1]. Staghorn renal stones are large kidney calculi that besides filling the renal pelvis also fill one or more renal calyxes[2]. In about 15% of patients, both kidneys are affected by staghorn stones, but in the majority of cases only one side is involved[3]. In most cases, they are composed of struvite. This is associated with bacteria producing urease, which causes recurrent or chronic infections of the urinary tract. Women are affected twice as often as men by struvite stones. Between 10-15% of all urinary tract stones are struvite stones in developing countries and this rate is lower in developed countries[2]. Proteus is the most frequently identified pathogen, but E. coli and Enterococcus are also frequently identified[4]. Other factors predisposing to struvite stones include old age, diabetes mellitus, female gender, urinary tract malformations including medullary sponge kidney, neurogenic bladder, urinary stasis, Foley catheter placement and distal tubular acidosis[2]. Percutaneous nephrolithotripsy (PCNL) is the gold standard for the treatment of staghorn stones larger than 2 cm[5].

Case report: Patient 69 years old, female, was admitted to the urology department in order to continue surgical treatment of bilateral staghorn nephrolithiasis.

Patient history: type 2 diabetes mellitus, nicotine dependence, status post thyroidectomy, cervical and right breast removal. State after cholecystectomy. The patient's history of urological procedures can be mentioned: RIRS (retrograde intrarenal surgery) of the right kidney, percutaneous nephrolithotripsy (PCNL) of the right kidney, transurethral resection of bladder tumor (TURBT). Patient has chronic Proteus miriabilis urinary tract infection since October 2021. Proteus mirabilis gentamicin resistance was found in March 2022. In a subsequent culture performed in 3 months' time, only ampicillin resistance was present.

The patient additionally underwent transurethral resection of a bladder tumor (TURBT) 15 months earlier as she was diagnosed with leukoplakia of the bladder triangle. Immediately after surgery, she was treated with the intravenous antibiotic Trimesolphar. Treatment with Urotrim 2x1 tablet for 5 days was prescribed and the patient was discharged home in good condition 3

days after surgery. A minimum intake of 2 liters of still water per day and observation of daily urine collections was recommended.

She is currently taking the drugs Mononit and Siofor 850. Allergies negate. The patient is obese and follows a diabetic diet based on products with a low glycemic index.

In 2018, an abdominal CT scan with contrast revealed the presence of staghorn calculus in the left kidney and, in the right kidney, a stone in the lower 1st row calyx measuring 19x5mm and in the 2nd row calyx measuring 5mm. In 2020, an abdominal CT with contrast showed bilateral staghorn calculus.

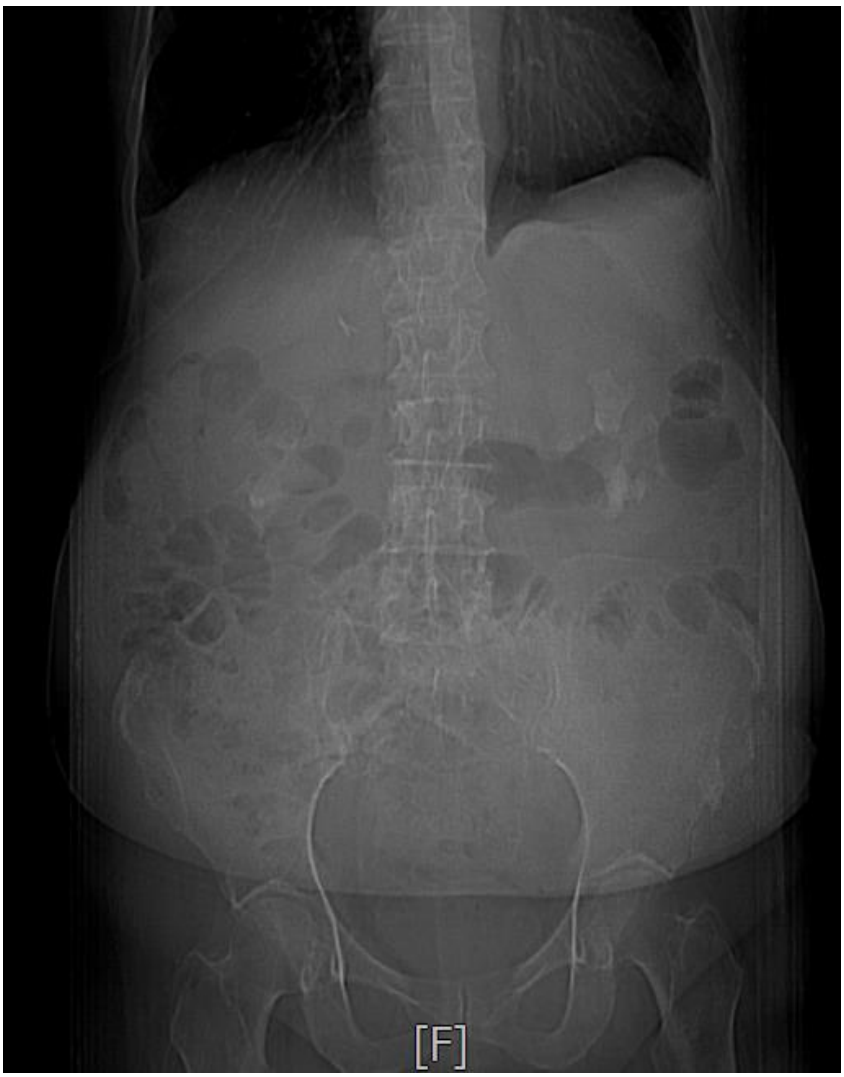

Figure 1: Abdominal CT scan demonstrating bilateral staghorn nephrolithiasis.

On admission, patient was conscious, in full logical contact, auto- and allopsychically oriented. Cardiovascular and respiratory systems efficient. Abdominal region soft, palpation not painful, no pathological resistance and peritoneal signs negative. Goldflam's signs bilaterally negative. Laparotomy scars were noted. Patient denies hospital treatment in the last 6 months.

Quantitative urine culture showed Escherichia coli at 10^4 and Proteus mirabilis at 10^4. Proteus mirabilis has shown resistance to ampicillin.

Day after admission, a percutaneous nephrolithotripsy was performed and general endotracheal anesthesia was administered. Levofloxacin Kabi 0.5 g/100 ml- infusion solution was used prophylactically during the procedure. This antibiotic was also used the day after surgery and 3 days after. 2 units of CRT were reserved.

A cystoscope was inserted into the bladder under visual guidance. The urethra was normal. The ureteral bladder orifices were correctly located. Bladder mucosa normal. A 3 Charr straight urethral catheter was inserted into the right ureter. Contrast was administered, after which no urine flow into the upper calyx was observed. The patient had the catheter replaced. A straight ureteral catheter was inserted into the left ureter. After placing the patient on her stomach, in prone position, contrast was administered and the left lower renal calyx was punctured. Lithotripsy of the staghorn stones of the lower calyx, pelvis, middle calyx and then the upper calyx was performed. X-ray controls were used, a nephrostomy placed and skin sutures. A Foley catheter was placed. The procedure was performed without complications and lasted 2 hours 45 minutes.

In the post-operative period, 2 units of CRT were transfused. Episodes of fever were noted two days after PCNL. Urine flowing from the Foley catheter was clear, diuresis was normal. The patient was independent in daily activities. The abdomen was palpably soft and non-painful. Lumbar region not painful on shaking. The nephrostomy was pulled up into an assurance drain.

Treatment was prescribed: Urotrim 100 mg, Canephron 18 mg+18mg+18mg, Phytolysin Nephrocaps Forte, No-Spa forte, Pyralgina.

The patient was referred for further treatment on an ambulatory basis. Follow-up at the urology outpatient clinic was recommended in one month's time with an updated urinalysis result, a careful lifestyle, a daily intake of at least 2 liters of fluids and removal of skin sutures in 4 days.

The patient had been admitted to the same ward a year earlier for treatment of bilateral staghorn nephrolithiasis. PCNL was performed on the right side in the inferior calyx and renal pelvis. The crushing of the deposit in the upper calyx was abandoned due to the prolonged procedure and bleeding obstructing visibility. After the confluence, the nephrostomy was clamped. Cyclonamine 3 x 2 ampoules and Exacyl 3 x 2 ampoules were ordered. Urine flowing from the Foley catheter was blood colored. A morphology was ordered.

The next day after the procedure, the patient was in a medium general condition, stable. 2 unit of CRC was used due to a significant decrease in morphological parameters. The patient was not feverish, the abdomen was soft and slightly tender by palpation. 4 days after surgery, splinting of the right ureter with a double J catheter was performed. The catheter's validity period was 3 months. The patient's general condition was good. The nephrostomy was removed. 6 days after the procedure the patient was discharged home. Treatment was recommended 200 mg 2x1 tablet Urotrim, MultiUri 2x1 sachet and referral to the outpatient

clinic for follow-up in 3 weeks with an updated urine test. Antibiotics such as Trimesolphar, Furosemide, Meropenem were also used during hospitalization.

3 months after the first PCNL procedure, the patient was admitted to hospital for a Proteus Mirabilis urinary tract infection. Empirical treatment with gentamicin was applied and the double J catheter in the right kidney was replaced. Trimesolphar was also used. The patient was discharged after 6 days of hospitalization in good condition. Treatment with Bactrim forte 2x1 tablet for 10 days was prescribed. 3 months later, the double J catheter was removed and prophylactic treatment with Cirpfloxacin Kabi was administered.

Figure 2: Control abdominal X-ray after the first PCNL operation, with a double J catheter inserted into the right kidney.

Figure 3: Control abdominal X-ray after the second PCNL operation.

Discussion:

And Joual et al. made an epidemiological analysis of lithiasis based on 1,000 cases observed at their institute over a 10-year period. The kidney was the most common site of stones, with 57.8% of cases. Only 12.2% of cases involved staghorn stones[6]. And bilateral staghorn lithiasis is an even rarer phenomenon.

A case of the treatment of staghorn stones in a patient with one kidney and a chronic Proteus mirabilis infection with a titer of 10^6 was described. The patient was treated with intravenous Cypronex 3x0.2 g according to the antibiogram. The procedure was performed from a single puncture under regional anesthesia without complications. At discharge, it was recommended the use of the antibiotic Cipronex 0.5 in a dose of 2×1 tablet [7].

Another case of a patient with bilateral staghorn stones is also described. A 38-year-old man came in with pain in the right kidney region occurring for 3 months. A CT scan was performed and bilateral staghorn stones were found and laboratory tests revealed end-stage renal disease (creatinine 7.2 mg/dl). Urine cultures showed the presence of Klebsiella aerogenes and Escherichia coli. The patient refused surgical treatment and was treated with antibiotics and painkillers[8].

A case of a 50-year-old woman with hematuria present for 2 years is also described. Urinalysis and urine culture showed urine infection by Proteus morganii. Treatment with antibiotics and surgery was applied by a combination of open surgery and percutaneous nephrolitotomy. No metabolic disorders have been identified. And examination of the stones showed that they were composed of calcium struvite[9].

Percutaneous nephrolithotripsy (PCNL) - a procedure involving removal of the entire deposit or its fragmentation by means of a nephroscope introduced directly into the pyelocalyceal system[10].

In recent years, there has been a significant increase in the number of patients treated for urinary tract stones, but at the same time the number of open procedures has decreased. There has been a large increase in the number of endoscopic procedures, including PCNL[11].

Shuba De et al. performed a systematic review and meta-analysis in which they showed that PCNL had a higher stone free rate (SFR), but was associated with complications such as higher blood loss and longer hospitalization time. Standard PCNL offers a higher success rate in stone removal than RIRS (retrograde intrarenal surgery) and RIRS has better results than minimally invasive percutaneous procedures (MIPPs)[12].

Mehmet İlker Gökce et al. compared the results of PCNL in staghorn stone patients in the prone and supine position of the patient. In the supine position, the drop in hemoglobin was significantly less and the duration of surgery was significantly shorter. Stone free rate was 60.4% and 64.1 in the prone and supine groups, respectively ($p = 0.72$). They concluded that PCNL in the supine position should be regarded as the primary method of treatment in staghorn stone patients[13].

Zhenghao Wang et al. performed a metanalysis and concluded that the use of tranexamic acid during PCNL can effectively reduce transfusion rates and blood loss during the procedure. In the groups in which tranexamic acid was used, the duration of hospitalization and surgery was shorter, hemoglobin loss was lower and there was less need for blood transfusions[14].

Metanalysis was conducted by Xiaocheng Liu et al. involving 858 patients to compare the use of regional and general anesthesia during PCNL surgery. Regional anesthesia has shown several potential advantages. Among them are less postoperative pain and less need for analgesics, shorter hospitalization time and shorter operative time, and less postoperative nausea or vomiting. In patients who are carefully selected, regional anesthesia may be a safe and accessible option. However, there were no significant differences in SFR, transfusion rates or postoperative fever rates[15].

Doo Yong Chung et al. sought to compare the SFR results between treatment with RIRS, SWL and also PCNL. SWL showed the poorest success rates and stone-free rates. In the treatment of kidney stones, PCNL demonstrated the highest SFR and chance of success[16].

Foo Cheong N et al compared the results of application fluoroscopy-guided access PCNL (FGA-PCNL) versus ultrasound-guided access PCNL (USGA-PCNL). The outcome of 184 patients was compared. There were no differences in SFR between the two methods. No differences in Clavien-Dindo complications were found. Using ultrasound to guide puncture approaches during PCNL removes the risk of unintentional organ trauma. However, comparable operational and stone results indicate that there is minimal learning curve for USGA compared to conventional FGA[17].

An attempt was made to identify risk factors for complications in patients undergoing PCNL. A total of 1178 patients were studied, of whom 166 (14.1%) had complications. There were 129 patients with hemorrhagic complications requiring transfusion. Of these patients, 70 had intraoperative renal bleeding and 59 had postoperative hematuria. In 14 patients (1.2%) a persistent leakage of urine after removing the nephrostomy was present. In 17 patients (1.4%), fever < (38.5° C) related to urinary tract infection was observed. The preoperative risk factors were the following: stone size of 30 mm or more, infected preoperative urine culture, distribution of stones or stone branches in two or three calyces. In contrast, two scoring systems (Guy's and STONE) have not been predictive of post-PCNL complications[18].

Peng Xu et al. sought to investigate, in patients before PCNL with positive urine cultures, the correct length of antibiotic therapy. Of the 220 participants in the study who developed systemic inflammatory response syndrome (SIRS), the most common bacteria were Escherichia coli and Proteus mirabilis. In patients treated with antibiotics before PCNL ≥ 7 days, SIRS was less common than in patients treated 6 days or less (21.7% VS 40.8%, P = 0.017). They therefore concluded that more than seven days should be the right duration of antibiotic therapy preceding PCNL in those patients with positive urine cultures[19].

Mehrdad Mohammadi Sichani et al studied 78 patients who underwent PCNL. Only 22 patients (28.2%) had bilateral renal stones and 56 patients (71.8%) had unilateral. There was at least one metabolic abnormality was detected in 32 (57.1%) and 15 (68.2%) subjects with unilateral and

bilateral kidney stones. Metabolic factors therefore appear to play roles in the formation of bilateral staghorn stone, which should encourage the implementation of genetic and metabolic testing in such patients[20].

Recent reports state that conservative treatment of staghorn stones is not as safe as lithiasis previously thought. The study included a total of 304 patients. Conservative treatment was associated with complications. There was progressive deterioration of renal function in an average of 27.5% of patients, with higher rates in patients with bilateral staghorn stones (44% vs 9%).The need for dialysis therapy occurred in 20% of patients with bilateral staghorn compared to 6% with unilateral stones. On average, 9% of patients required dialysis. Recurrent UTIs occurred in up to 50% of patients (80% bilateral, 41% unilateral). The mean incidence of severe infections was 8.7%.Illness-specific mortality varied from 0% to 67% (on average 20.5%)[21].

Conclusions:

Bilateral staghorn stone is a rare occurrence. Metabolic factors, genetics and past urinary tract procedures are important in its formation. Undoubtedly, the microflora of the urinary tract contributes. Conservative treatment does not appear to be a safe alternative to surgical treatment. PCNL appears to be the most sensible surgical treatment option as it has the highest SFR and chances of success. However, it is associated with a higher risk of bleeding, which can be mitigated by the use of tranexamic acid. Regional anesthesia and the prone position appear to be effective during PCNL.

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