Encrusted Pyelitis of Native Kidneys

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Abstract. This study reports the first four cases of encrusted pyelitis involving native kidneys. The clinical features, management, and outcome of these patients were analyzed. Predisposing factors were underlying urologic disease and/or urologic manipulations, debilitating diseases, hospitalization, and prolonged antibiotic therapies. Presenting symptoms were renal failure in three patients with ureteroileal urinary diversion and manifestations of cystitis in one patient.Computed tomography scan of the urinary tract was critical for diagnosis. Presence of struvite was demonstrated by crystalluria and infrared spectrophotometry analysis of the encrusted material. *Corynebacterium urealyticum* urinary infection was identified in one case. Surgery (one patient) and palliative ureteral diversion (one patient), respectively, led to death and end-stage renal failure. Successful dissolution of encrusted pyelitis was obtained in two patients treated with intravenous vancomycin and local acidification of the renal collecting system. Clinical observation shows that encrusted pyelitis is a threatening disorder that destroys the native kidneys and may lead to end-stage renal failure. Successful treatment of the disease by chemolysis and antibiotics depends on correct and early diagnosis. Diagnosis required recognition of the predisposing factors, computed tomography imaging of the urinary tract, crystalluria, and identification of urea-splitting bacteria with prolonged culture on selective medium.

Infection stones are composed of magnesium ammonium phosphate (struvite) and carbonate apatite, and are caused by infection of the urine with urea-splitting bacteria. A singular pathologic entity, called “encrusted cystitis,” is characterized by accumulation of struvite crystals in ulceronecrotic lesions of an inflamed and infected chorion of the bladder (1). In 1992, Morales et al. showed that struvite encrustation may also involve the wall of the upper urinary tract of transplanted kidneys (2). This newly recognized disease, termed “encrusted pyelitis,” is mainly caused by *Corynebacterium urealyticum* (3). Encrusted pyelitis is a severe event that can destroy the renal graft of transplanted patients. To our knowledge, no information in the English literature is available about this rare disease in nontransplanted patients. Therefore, we analyzed the clinical features, management, and outcome of four patients with encrusted pyelitis of native kidneys.

Case Reports

Diagnosis of encrusted pyelitis was made on computed tomography (CT) scan and was defined as thickening and linear calcification of the walls of renal collecting system (Figure 1). Presence of struvite was demonstrated in all patients by infrared spectrophotometry analysis (4).

**Patient 1**
A 53-yr-old man was admitted for renal failure. Three years earlier he had urothelial carcinoma requiring left nephrectomy, cystectomy, and ureteroileal urinary diversion. Chemotherapy (cisplatin) was started 3 mo before admission to the hospital for hepatic and pulmonary metastases. At that time, renal function was normal. On admission, he had vomiting, lumbar pain, and anuria. Creatinine level was 1200 μM. Abdominal x-ray film revealed the presence of thin radiopaque opacities outlining the renal pelvis wall. Ultrasound of the kidney detected hyperechogenic material in the pelvis. Staghorn calculus was diagnosed and pyelotomy was performed. Stones were rubbery and extremely adherent to the pelvis wall. Encrusted material could not be resected. Analysis of encrusted stone fragments showed struvite (30% struvite, 35% carbapatite, 5% hydrogen ammonium urate, 30% protein). Postsurgical CT scan revealed encrusted pyelitis (Figure 1). Two days after surgery, fatal renal hemorrhage occurred.

**Patient 2**
A 59-yr-old man was admitted for renal failure. Nine years earlier he had cancer of the bladder treated by radical cystectomy, bilateral ureterostomy drained by two ureteral catheters, external radiotherapy, and chemotherapy. During the follow-up, pyuria and presence of urease-producing organisms such as Proteus mirabilis were often noted. Two months before admission, a left kidney stone was discovered and removed by percutaneous surgery. Stone analysis showed struvite (85% struvite, 10% carbapatite, 5% protein). A ureteroileal urinary diversion was performed to remove the ureteral catheters. At that time, renal function was normal.

On admission, the patient had nausea, abdominal pain, and gross hematuria. He had no fever. Urinary output was normal. Creatinine level was 463 μM. Routine urine culture was positive for *Staphylococcus aureus, Streptococcus D*, and *Pseudomonas aeruginosa*. Abdominal x-ray film showed no calcification. Ultrasonography detected
Encrusted pyelitis is a threatening disorder that can destroy the renal graft of transplanted patients (3,6). Our clinical observations show that this aggressive disease may also occur in native kidneys. Three of our patients with ureteroileal urinary diversion were admitted for obstructive renal failure. In these patients, renal complications were candiduria and pelvic edema. Candiduria was resolved with daily amphotericin B irrigation through nephrostomy catheters. Five months of chemolysis were required for almost total dissolution. After 6 mo off therapy, no recurrence was observed.

**Patient 4**

A 66-yr-old woman was admitted for intermittent gross hematuria, dysuria, and frequency. She had been well until 2 mo earlier, when she developed right pyelonephritis due to *Escherichia coli* complicated by acute endocarditis and numerous cerebral abscesses. She recovered after 2 mo of intensive care, including prolonged intravenous antibiotic therapy and 45 d of mechanical ventilation (requiring vesical catheterization).

On admission, urinary examination showed hematuria and pyuria. Urine culture was sterile. CT scan of the urinary tract was interpreted as normal (retrospective analysis revealed tiny calcifications of right calices). Endoscopy of the bladder showed a purpuric and inflammatory vesical wall. Oral antibiotic was given and the patient was discharged.

Three months later, gross hematuria relapsed. Urine analysis showed pyuria and alkaline pH (7.5). Repeated urinary cultures were negative. X-ray film and ultrasonography of the kidney were normal. CT scan of the urinary tract revealed encrusted calcifications of right calices, thickening of the right renal pelvis, and a 12-mm intravesical stone. The stone, spontaneously evacuated, was composed of struvite (80% struvite, 15% carbapatite, 5% protein), and culture showed *Corynebacterium urealyticum*. No encrusted cystitis was seen on CT scan and on second endoscopy of the bladder. Intravenous vancomycin was started. A right percutaneous nephrostomy catheter and a right ureteral stent were installed for chemolysis of the renal pelvis with Thomas’s solution (300 ml/d). Three weeks of treatment successfully dissolved the encrusted calcifications. Acetoxyhydroxamic acid, an effective urease inhibitor (5), was given for 9 mo. One year later, the patient remains free of stone.

**Discussion**

Encrusted pyelitis is a threatening disorder that can destroy the renal graft of transplanted patients (3,6). Our clinical observations show that this aggressive disease may also occur in native kidneys. Three of our patients with ureteroileal urinary diversion were admitted for obstructive renal failure. In these patients, renal function returned to basal level. However, in the absence of appropriate treatment, encrusted pyelitis progressed, renal insufficiency developed, and, 3 mo later, hemodialysis was started.

**Patient 3**

A 70-yr-old woman was admitted for renal failure. Nine years earlier, she had cancer of the bladder treated by transurethral resection and external radiotherapy. Postradiation fibrosis of the bladder and bilateral hydronephrosis progressively developed. One year before admission, ureteroileal urinary diversion was performed. This diversion was complicated by stomal stenosis, which recurred despite correction. Two months before admission, a permanent Foley catheter and a right percutaneous nephrostomy catheter were inserted under intravenous antibiotic coverage (glycopeptide and quinolone). Examination of a urine specimen collected during percutaneous catheter placement confirmed the presence of struvite (25% struvite, 25% carbapatite, 25% amorphous calcium phosphate, 25% protein).

After relief of the obstruction, renal function improved to a creatinine level of 144 μM. Two ureteral catheters were inserted, and nephrostomy catheters were used for perfusion and local acidification of the renal collecting system with Thomas’s solution (sodium gluconate 120 mM, citric acid 92 mM, malic acid 200 mM, pH 4). Flank pain limited the infusion rate to 50 ml/h. Intravenous vancomycin was maintained during lavage chemolysis. Dissolution of struvite-encrusted pyelitis was ascertained with CT scan performed every 2 wk. Renal complications were candiduria and pelvic edema. Candiduria was resolved with daily amphotericin B irrigation through nephrostomy catheters. Five months of chemolysis were required for almost total dissolution. After 6 mo off therapy, no recurrence was observed.

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cases, development of advanced disease leading to renal insufficiency may be explained by: (1) the paucity of symptoms accompanying this disease in patients without bladder; and (2) the rapid expansion of encrusted pyelitis. Serial CT scan of patients 3 and 4 showed that encrusted pyelitis may develop in less than 3 mo. The poor sensitivity of x-ray film and ultrasonography to detect thin calcifications of renal pelvis walls may also account for the delay in diagnosis. CT imaging of the urinary tract was critical for diagnosis of encrusted pyelitis. Pyuria and alkaline urine, common findings in patients with ureteropelvic urinary diversions, were not helpful criteria of infection stones. Crystalluria was a useful tool to identify struvite crystals in urine, and we recommend performing this laboratory examination in patients considered at risk. Gross hematuria, lumbar pain, and renal insufficiency developed late in the course of the disease and revealed advanced illness. In contrast, an early diagnosis was made in patient 4 because symptoms of cystitis were the presenting complaint. Special attention was given to alkaline urine (a necessary condition for struvite formation), and presence of urea-splitting bacteria was intensively searched.

*Corynebacterium urealyticum* (CU) is reported as the principal micro-organism implicated in this disease (1–3, 6). CU is a Gram-positive, slow-growing, urea-splitting, and multiantibiotic-resistant bacterium that frequently colonizes the skin of hospitalized patients. CU urinary tract infection occurs mainly in immunocompromised patients with underlying urologic disease and/or urologic manipulations who have been hospitalized for a long period and treated with broad-spectrum antibiotics (7). Most of these conditions were associated in our patients. However, the presence of CU was demonstrated in only one case. In this patient, repeated urine cultures on selective medium were negative, and documentation of the infection required stone culture. This finding is characteristic of CU infection. In the other three cases, CU was not appropriately searched, and the possible responsibility of other urea-splitting bacteria cannot be ruled out. Intensive search for CU is mandatory in patients with encrusted pyelitis. Isolation of CU required prolonged urine culture (48 to 72 h), and a selective medium should be used in case of polymicrobial urinary infection. Identification of this micro-organism should be performed by stone culture whenever possible. These observations underscore the difficulty in identifying CU, that most microbiology laboratories do not routinely search or do not characterize further because they regard them as contaminants.

Treatment of struvite stones relies on eradication of urinary infection and the complete removal of the stones that contain the urea-splitting bacteria. Resection of encrusted struvite stones tightly adherent to the pelvic wall by open surgery or percutaneous treatment is extremely difficult and may lead to severe surgical complications (patient 1) (3,8). In the absence of appropriate treatment, patient 1 died and patient 2 required chronic hemodialysis. For patients 3 and 4, we chose to dissolve the encrusted struvite stones by local acidification and chemolysis as recommended by Meria *et al.* (1). Chemolysis acts by acidification of urine that inhibits struvite stone growth by preventing formation of ammonium and carbonate, and by solubilization of calcium ions with citrate (9). We associated intravenous vancomycin during chemolysis because although CU is multiantibiotic-resistant, it is uniformly susceptible to glycopeptides.

Chemolysis was well tolerated overall but required strict medical supervision to prevent the complications during follow-up. The United Food and Drug Administration banned renal pelvic irrigation with 10% hemiacidrin (a buffered solution of citric acid) after six deaths were reported. These deaths were likely due to urosepsis. Necessary precautions are therefore recommended during chemolysis, including maintenance of sterile urine and unobstructed inflow and outflow (intrapelvic pressure should be <25 cm) (9). Five months of chemolysis in patient 3, and 3 wk in patient 4, were necessary to achieve dissolution. The length of chemolysis required for successful treatment is proportional to the severity of encrusted lesions, stressing the importance of early diagnosis for safe and effective treatment.

**References**