Successful management of bilateral emphysematous pyelonephritis with abscess formation in a chronic hemodialysis patient: a case report

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Abstract Bilateral emphysematous pyelonephritis (EPN) has seldom been reported in patients on maintenance hemodialysis (HD). Percutaneous catheter drainage (PCD) or nephrectomy is often required in the treatment of bilateral EPN because of its poor response to antimicrobial agents and high mortality rate. We report a patient with bilateral EPN on maintenance HD. An octogenarian man with diabetes mellitus who had previously undergone regular HD for 22 months was admitted to our hospital because of severe inflammation resulting from bilateral EPN. His lesions of EPN had resulted in abscess formation in both kidneys and right and left side retroperitoneal space. As patient refused interventional therapy including nephrectomy or PCD, he was treated conservatively. After treatment with several antimicrobial agents for 50 days, he completely recovered from bilateral EPN. To our knowledge, this is the first case report of successful conservative management (antimicrobial therapy alone) of bilateral EPN that developed in a chronic diabetic HD patient.

Keywords Bilateral emphysematous pyelonephritis · Conservative antimicrobial therapy · Hemodialysis · Abscess

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Introduction

Emphysematous pyelonephritis (EPN) is an acute necrotizing infection of the renal parenchyma involving gas in the renal parenchyma or perirenal tissues. It is associated with high morbidity and mortality [1]. Diabetes and ureteric obstruction are some of the predisposing factors [2]. Treatment modalities for EPN include conservative antimicrobial therapy, percutaneous drainage (PCD), and surgical intervention. With the advancement in imaging techniques and availability of newer antibiotics, medical treatment with or without PCD is becoming an acceptable alternative to radical surgery [3]. Over the past two decades, improved management techniques have resulted in a decreased mortality rate of 21 % [4]. However, there are few reports of bilateral EPN in patients on chronic dialysis, and its optimal treatment has not yet been established.

Case report

An octogenarian man with a high C-reactive protein (CRP) level and hyperglycemia was admitted to our hospital. He underwent surgery for gastric ulcer in his thirties.

He had received insulin treatment of diabetes at another hospital 15 years prior to the present admission.

While renal dysfunction progressed owing to diabetic nephropathy, favorable glycemic control was achieved. Thus, the insulin therapy was discontinued 2 years before the present admission.

In the same year, hemodialysis (HD) was started, and since then, he had been receiving maintenance HD on an outpatient basis.

Twenty months later, he underwent urinary catheter insertion because of urinary retention caused by prostatic hypertrophy; nevertheless, he was independent in his daily

Fig. 1 Clinical course (days after admission) CRP C-reactive protein, Plt platelet, CT computed tomography, MEPM meropenem, VCM vancomycin, LVFX levofloxacin, HD hemodialysis, FOM fosfomycin, SBT/CPZ sulbactam and cefoperazone, HbA1c hemoglobin A1c (NGSP)

life. Seven days before the present admission, he developed myalgia, general malaise, and anorexia and experienced difficulty walking. Then, he was admitted to an outlying hospital.

At admission, his body temperature was 37.0 °C, and blood test revealed a white blood cell (WBC) count of 22880/μL, a CRP level of 31.7 mg/dL, and a blood glucose 600 mg/dL, and he was referred to our hospital because of the aggravation of the general findings.

At the admission in our hospital, body temperature was 37.7 °C (Fig. 1). There were no abnormal findings, except for a mild tenderness in the center of the abdomen. Chest computed tomography (CT) findings were unremarkable. His urine was cream in color, and urinalysis revealed pyuria. After sampling of blood and urine culture, administration of meropenem (MEPM) was initiated at a dose of 0.5 g/day. The blood culture grew gram-positive cocci and gram-negative rods. Plain and contrast-enhanced abdominal CT scans on hospital day 3 revealed emphysematous lesions (collection of air) in both the kidneys extending to the retroperitoneal space, leading to a diagnosis of bilateral EPN (Fig. 2). *Escherichia coli* and *Enterococcus faecalis* were cultured from the blood and urine obtained on admission. On day 3, the WBC count elevated to 43800/μL, the platelet count decreased to $2.3 \times 10^4/\mu\text{L}$, and the CRP level was 28.3 mg/dL. The

score measured according to the criteria of the International Society on Thrombosis and Hemostasis overt disseminated intravascular coagulation (DIC) [5] was 6, and DIC caused by sepsis was thus diagnosed. Despite the administration of MEPM, *Enterococcus faecalis* was cultured from the blood obtained on day 3. Therefore, an intravenous drip infusion of MEPM and vancomycin (VCM, 0.5 g) was used concomitantly at each HD session. Intravenous drip infusion of freeze-dried polyethylene glycol-treated human normal immunoglobulin and continuous drip infusion of nafamostat mesilate were also initiated. *Escherichia coli* and *Enterococcus faecalis* isolated from cultures of blood samples obtained on admission were sensitive to MEPM and VCM, respectively.

The blood culture obtained on day 8 did not grow any bacteria. His general condition gradually improved, and his platelet count increased.

On day 10, we informed him and his family members that PCD or nephrectomy was often required in the treatment of bilateral EPN because of its high mortality rate.

And we recommended him to move to the urology ward of Advanced Treatment Hospital, but they refused the invasive procedures consistently.

Therefore, we decided to continue conservative management.

Fig. 2 **a** Contrast-enhanced abdominal CT scan showing emphysematous lesions in both the kidneys **b** Contrast-enhanced abdominal CT scan showing emphysematous lesions extending to the retroperitoneal space (circled area)

Fig. 3 Contrast-enhanced abdominal CT scan showing fluid collection in the bilateral renal parenchyma and left iliopsoas muscle (arrows and circled area)

On day 10, plain and contrast-enhanced abdominal CT scans showed fluid collection in the bilateral renal parenchyma and left iliopsoas muscle (Fig. 3).

On day 13, he resumed food intake, consuming a sufficient amount of food.

Despite the administration of MEPM and VCM, the blood test showed a poor improvement in CRP level of 7.1 mg/dL. The urine culture obtained on day 15 was positive for *Enterococcus faecalis* (2+) and *Escherichia coli* (1+), both of which were sensitive to levofloxacin (LVFX).

On day 17, intravenous drip infusion of MEPM and VCM was switched to oral LVFX (250 mg) at each HD session.

Fig. 4 Contrast-enhanced abdominal CT scan showing appearance of an encapsulated fluid collection in the right retroperitoneal space, being suggestive of an abscess (arrow)

On day 24, plain and contrast-enhanced abdominal CT scans revealed diminished emphysematous lesions in both the kidneys and the right retroperitoneal space; and a new appearance of an encapsulated fluid collection was observed in the right retroperitoneal space suggesting abscess formation (Fig. 4).

On day 25, the urine culture was negative for *Enterococcus faecalis* but was positive for *Escherichia coli* (3+). The latter was resistant to LVFX and sensitive to fosfomycin (FOM) and oral LVFX was switched to 500 mg/day of oral FOM.

On day 39, the urine culture was positive for *Escherichia coli* (3+), which was resistant to FOM and sensitive to sulbactam (SBT)/cefoperazone (CPZ).

On day 43, oral FOM was switched to intravenous drip infusion of SBT/CPZ (1.0 g/day). On day 50, the CRP level improved to 0.5 mg/dL, and all antimicrobial agents were discontinued.

On admission to our hospital, his HbA1c value was 13.7 % (NGSP).

A rapid-acting insulin analog was administered 3 times daily before each meal. On day 56, his HbA1c value was 4.8 % (NGSP), and his glycemic control had improved. We replaced the urethral catheter with a new one, as appropriate, to prevent occlusion.

His daily urine volume was approximately 100 mL, and pyuria persisted.

On day 101, plain and contrast-enhanced abdominal CT scans did not show any emphysematous lesions in both the kidneys and showed a diminished size of the abscess in the right retroperitoneal space. On day 105, the insulin analog was switched to 25 mg/day of vildagliptin. His fasting blood glucose levels were controlled at approximately 100 mg/dL. On day 157, plain and contrast-enhanced abdominal CT scans showed no evidence of emphysematous lesions in the renal parenchyma or the right retroperitoneal space, or encapsulated fluid collection in the right retroperitoneal space.

On day 162, a trend toward improvement in pyuria was observed. However, *Escherichia coli* was cultured persistently from his urine. Nevertheless, on day 162, the blood test results had improved with a WBC count of 6400/ μ L and CRP level of 0.6 mg/dL. After receiving rehabilitation therapy, he could walk independently. On day 171, he was transferred to another hospital for further rehabilitation.

Discussion

Urinary tract infections (UTIs) are common in dialysis patients [6], but EPN is rare complication even in these patients [7]. Although EPN is rare, these patients frequently encountered the predisposing risk factors of high tissue glucose level if diabetic, presence of gas-forming microorganisms in the urinary tract, and infrequent emptying of the bladder secondary to oliguria [7]. Bilateral EPN often requires percutaneous catheter drainage (PCD) or nephrectomy because of its high mortality rate.

There are several case reports of bilateral EPN in non-dialysis patients who were successfully managed by conservative therapy (antimicrobial therapy alone) [3, 8–10]. To our knowledge, however, only one case of bilateral EPN that developed in a chronic dialysis patient has been reported and was successfully treated by PCD combined with antimicrobial treatment [11]. Abdominal CT scan on day 3 revealed Class 4 in our patient, according to the CT classification of EPN by Huang et al. [12].

Thrombocytopenia, one of the poor prognostic factors, was observed, and PCD or nephrectomy was indicated immediately if the patient's general condition had stabilized [12].

However, our patient was an elderly diabetic patient on HD to have high risk of developing serious complications after nephrectomy or PCD [13]. For those reasons, he and his family members refused the invasive procedures.

Escherichia coli is the most common causative pathogen of EPN, with the organism isolated from urine or pus cultures in nearly 70 % of the reported cases [14]. Bacteremia is present in more than 50 % of the patients, and the organisms are the same as those in urine or pus culture [14]. Based on the blood and urine cultures, the causative pathogens of EPN in the present case were assumed to be *Escherichia coli* alone or both *Enterococcus faecalis* and *Escherichia coli*. Urinary tract obstruction and poor glycemic control are significant risk factors of the development of EPN [2]. Thus, we replaced the urethral catheter with a new one, as appropriate, to prevent occlusion. The patient's blood glucose levels were well controlled.

Abscess formation, as seen on images, is reportedly suggestive of a good prognosis because it reflects a normal inflammatory response against bacterial infections [15]. Wan et al. classified EPN into 2 groups, type I and type II, on the basis of abdominal CT and ultrasonography findings [15].

Type I EPN is characterized by parenchymal destruction and either the absence of fluid collection or the presence of streaky or mottled gas. Type II EPN is characterized as either renal or perirenal fluid collection with bubbly or loculated gas, or gas in the collecting system. The mortality rate for type I EPN (69 %) was higher than that of type II (18 %). Type I EPN follows a more fulminant course with a significantly shorter interval from clinical onset to death ($P < 0.001$).

In the present case, the patient's abdominal CT taken on day 3 revealed type I EPN according to the classification of Wan et al. Moreover, abscess formation was observed in the emphysematous lesions in the retroperitoneal space on both the left and right sides with necrotic infection of the surrounding tissue.

Meta-analysis has shown that bilateral EPN, type I EPN, conservative treatment, and thrombocytopenia are risk factors for mortality in patients with EPN [16]. All of these risk factors were found in the present patient on chronic maintenance HD.

In conclusion, to the best of our knowledge, this is the first patient to be successfully treated with conservative therapy (administration of antimicrobial agents) alone. The abscess formation in the emphysematous lesion during the course of treatment may have been successfully treated with conservative therapy, thereby leading to favorable outcomes.

Conflict of interest The authors declare that there is no conflict of interest.

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