



Our Experience in Managing Emphysematous Pyelonephritis: A Short Review of Four Cases

Mahboubeh Mirzaei*, Mohammad Reza Ebadzadeh, Ali Kamalati and Rayka Sharifian-Amiri

Department of Urology, Kerman University of Medical Sciences, Iran

Abstract

Emphysematous pyelonephritis is an acute necrotizing and suppurative infection of the kidney parenchyma. It is described as presence of gas within the kidney parenchyma and surrounding tissues. This rare condition is usually seen in diabetic women or immunocompromised patients. In this report, we describe four cases of emphysematous pyelonephritis, all of whom were managed by broad spectrum antibiotics and drainage. Our cases were in different clinical stages of the disease and all of them were discharged after two to three weeks without need for a major surgery to treat emphysematous pyelonephritis. Patients with kidney stone were referred to an endourologist for percutaneous nephrolithotomy after hospital discharge. We managed these four cases conservatively with aggressive medical treatment including good and rapid control of dehydration, high blood glucose level (in diabetic cases), and hypoxia, sepsis, and kidney failure. All patients had a good treatment outcome. Thus, we believe that in most patients conservative therapy can replace nephrectomy to treat emphysematous pyelonephritis.

Keywords: Emphysematous pyelonephritis; Computed tomography; Percutaneous intervention

Introduction

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*Correspondence:

Mahboubeh Mirzaei, Department of Urology, Bahonar Hospital, Kerman University of Medical Sciences, Kerman, Iran, Tel: 983432235011, Fax: 983432239188; E-mail: mirzaeimahboubeh@yahoo.com

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Emphysematous Pyelonephritis (EPN) is a severe infection in which there is presence of gas within collecting system, kidney parenchyma or perinephric tissue [1,2]. This condition is seen in diabetic women and immunocompromised people [1,3]. Presence of urinary tract obstruction or urinary stone can be another predisposing factor [1]. In this condition, urine culture is generally positive and the most common isolated organism is *Escherichia coli* [4].

It has different presentations from severe pyelonephritis to septic shock [5]. Plain abdominal X-ray often shows mottled gas shadows over the affected kidney [6]. Ultrasound imaging can show the obstruction, but it is less sensitive than Computed Tomography (CT) scan at showing kidney gas. So EPN's standard diagnosis is abdominal CT scan, since it can show the presence of gas along with the width of kidney parenchymal demolition [7]. The most famous staging model for EPN is demonstrated in Table 1 [8]. In this report, we describe four cases of EPN in different clinical stages of the disease that were treated in our center in Kerman city, Iran (Table 2).

Case Presentation

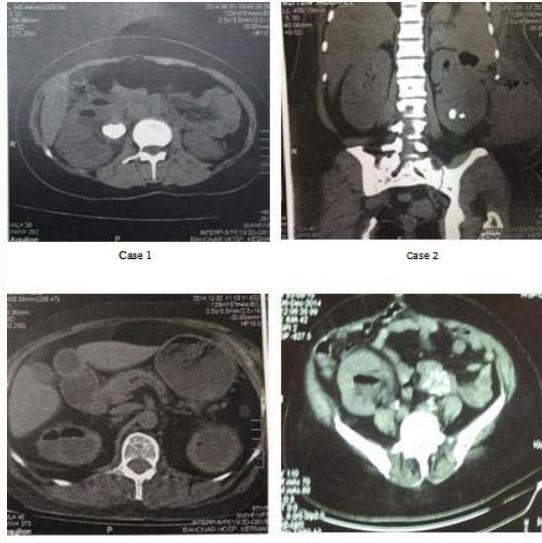
Case 1

A 20 years old Afghan woman without any history of diabetic mellitus referred to our center. She had been suffering from right flank pain, fever and chills, nausea, vomiting, dysuria and hematuria for one week. She had a history of natural vaginal delivery 20 days before her referral with an uncomplicated pregnancy, but the baby had died. Physical examination confirmed that she was an ill appearing, dehydrated patient with 39°C temperature, 22 times per minute respiration rate, blood pressure of 90/60 mmHg and a pulse rate of 114 per minute. Her cardiac, respiratory and neurological examinations were normal. Her right costovertebral angle was tender. There was no organomegalias and her vaginal examination result was also normal.

Primary laboratory evaluation included complete blood count (hemoglobin 10.9 gr/dl, total leukocyte count 15300/cumm), kidney function (blood urea 28, serum creatinine 1 mg/dl), random blood glucose (129 Mg/dl), the erythrocyte sedimentation rate and C-reactive protein (125 and above), urinary analysis (many white blood cells and bacteria). Urine culture revealed *Escherichia coli*. Ultrasound imaging revealed an enlarged hydronephrotic right kidney with decrease of parenchymal echo and multiple posterior shadows suggesting the presence of a kidney stone. Ipsilateral ureter and the opposite kidney were also normal.

Table 1: Staging of emphysematous pyelonephritis.

Class 1	Gas was confined to the collecting system
Class 2	Gas was only confined to the kidney parenchyma
Class 3A	Perinephric extension of gas or abscess
Class 3B	Extension of gas beyond the Gerota fascia
Class 4	Bilateral EPN or EPN in one kidney

**Figure 1:** CT scan of abdomen and pelvis without contrast.

CT scan (Figure 1) showed moderate to severe hydronephrosis, multiple stones in the right pelvicalyceal system and a small amount of gas in the kidney parenchyma. Dimercaptosuccinic Acid (DMSA) scan showed non-homogenous cortical activity with decrease of parenchymal function in the right kidney and moderate decrease of parenchymal function in the left kidney (right kidney function 57.4%, left kidney function 42.6%).

So, we diagnosed that she had EPN. A nephrostomy tube was placed on her pelvicalyceal system for right kidney drainage. Intravenous fluid in the form of normal saline and empiric intravenous antibiotic in form of ceftriaxone, metronidazole and amikacin were administered to her. Because of persistent fever, hypotension and worsening kidney function, the antibiotic spectrum was broadened in the form of imipenem/cilastatin (teina), ciprofloxacin and vancomycin. Her leukocyte count decreased to 2,700/cumm and her fever was permanent after 15 days. Then intravenous granulocyte-colony stimulating factor was administrated and leukocyte count increased immediately. Her clinical condition began improving after 20 days of treatment and abdominal CT scan revealed complete disappearance of EPN. Subsequently, administering parenteral antibiotic was stopped. She was discharge with oral antibiotics. She was referred to an endourologist for percutaneous nephrolithotripsy after one month.

Case 2

A 45 years old woman referred to our hospital. She had been suffering from low grade fevers and left flank pain for two weeks before referring to us. She was a known case of diabetic mellitus that was under treatment with oral medication. She had a previous history of open surgery because of a Staghorn stone of left kidney 10

years before her referral. She was ill looking, agitated and febrile at 38.5°C. Her respiratory rate was 18 times per minute, heart rate 120 bpm and blood pressure 130/90 mmHg. On systemic examination, her left kidney angle was tender. Severe swelling, erythema, and warm skin were noticeable in this side. Her cardiovascular and respiratory examination results were normal.

Primary laboratory evaluation included complete blood count (hemoglobin 9.5 g/dl, total leukocyte count 7,800/Cumm), kidney function test (blood urea 25 mg/dl and serum creatinine 0.8 mg/dl), random blood glucose (291 mg/dl), arterial blood gas analysis (pH 7.53, SaO₂ 83 %, PCO₂ 30 mmHg, PO₂ 41 mmHg and HCO₃ 25.1 meq/l) and urinary analysis (many white blood cells, 6-8 red blood cells, few bacteria). Urine culture revealed *Escherichia coli*. Her blood culture was negative and liver enzyme and function tests were normal.

Ultrasound imaging showed left enlarged hydronephrotic kidney with normal parenchymal echo and multiple large kidney stones (Staghorn stone). Non-contrast abdominal CT scan (Figure 1) at her admission revealed gas in her left pelvicalyceal system and parenchyma, suggesting EPN. A subcutaneous collection size of 77 mm × 45 mm was reported at costovertebral angle in both CT scan and ultrasound imaging. Her right kidney was normal. DMSA scan showed mild decrease of parenchymal function in left kidney (right kidney function 60%, left kidney function 40 %).

It was diagnosed that she had EPN. She was managed with intravenous fluid in form of normal saline and insulin infusion to achieve euglycemia. Intravenous antibiotics, including ceftriaxone and metronidazole, were administered and amikacin was added to maintain appropriate gram negative coverage. Nephrostomy tube was placed on pelvicalyceal system for left kidney drainage and subcutaneous collection was drained percutaneously that included 500 cc turbid liquid like pus.

After 48 hrs, urine culture was positive for gram negative rods *Escherichia coli* that were sensitive to ciprofloxacin and imipenem. So, intravenous antibiotics changed to imipenem and ciprofloxacin.

Her temperature on the 6th day was 37.5°C and she had better clinical conditions. Her blood sugar was controlled with insulin administration. Abdominal CT scan on the 10th day revealed significant improvement in the size and extent of EPN and subcutaneous gas collection. The patient made a remarkable recovery after two weeks. She started to use oral antibiotics (levofloxacin and metronidazole) and her parenteral antibiotic were stopped. She was discharged at the end of three weeks with an administration of oral antibiotics, oral diet and two dosages of premixed insulin. She was referred to an endourologist for percutaneous nephrolithotripsy after one month.

Case 3

She was a non-diabetic 67 years old woman who referred to our center with fever, chills and bilateral flank pain. She had been suffering for more than 10 days. She looked ill and dehydrated with 38.7°C temperature, 22 times per minute respiratory rate, 80/50 mmHg blood pressure and 112 times per minute pulse rate. Her initial laboratory evaluation included complete blood count (hemoglobin 11.4 g/dl, total leukocyte count 9200/Cumm), kidney function test (blood urea 90 mg/dl and serum creatinine 4 mg/dl), random blood glucose (100 mg/dl) and urinary analysis (many white blood cells, 20-25 red blood cells, many bacteria). Her blood culture was negative (U/C *Escherichia coli*).

Table 2: Demographic and clinical characteristics of our patients.

Kidney Side	Class	Other Features	Intervention	Outcome	Kidney Function (%)
Right	2	Kidney stone, hydronephrosis, diabetes mellitus	Antibiotics, control of diabetes, nephrostomy	Recovered	Right 57%; Left 43%
Left	3A	Kidney stone, hydronephrosis, perinephric collection, diabetes mellitus	Antibiotics, control of diabetes, drainage of abscess, nephrostomy	Recovered	Right 60%; Left 40%
Both	4	Kidney stone, hydronephrosis	Antibiotics	Recovered	...
Transplanted kidney	1	Kidney transplantation	Antibiotics	Recovered	...

She underwent abdominal and pelvic CT scan (Figure 1) without contrast. There was gas in her right kidney parenchyma, plus one small bubble of gas in her left kidney. She stayed in the hospital. Her urine output was about four liters immediately after insertion of Foley catheter. Intravenous antibiotic therapy with imipenem (500 mg stat and 250 twice daily) and ciprofloxacin (400 mg stat and 200 mg twice daily) was administered. She was chosen for nephrostomy. However, due to the improvement of symptoms and imaging evidence after antibiotic therapy, it was unnecessary and not done. In the course of treatment her creatinine fell from 4 to 1.7.

Severe uterine prolapse was detected in her vaginal exam and she was referred for hysterectomy to improve obstructive urinary symptoms.

Case 4

A 71 years old woman referred to our hospital with chills, fever, and right flank area pain. She had been suffering for five days before admission. There were no symptoms of dysuria and frequency. She had a history of diabetes and hypertension eight years before her referral to us. Also, she had done kidney transplantation due to kidney failure five years before her referral.

She had a low grade fever (37.8°C), 140/90 mmHg blood pressure, 68 bpm heart rate and 16 times per minute respiratory rate. The patient was good looking and her systematic physical examination result was completely normal. Initial laboratory evaluation included complete blood count (hemoglobin 11.4 mg/dl, total leukocyte count 3800/Cumm), kidney function test (blood urea 47 mg/dl and serum creatinine 1.44 mg/dl), random blood glucose (198 mg/dl), and urinary analysis (many white blood cells, red blood cells, and bacteria). Her blood culture was negative and urine culture revealed *Escherichia coli*.

Ultrasound imaging showed moderate hydronephrosis of the transplanted kidney but there were no gas collection. CT scan (Figure 1) demonstrated a small amount of gas formation in her pelvicalyceal system but the kidney parenchyma was completely intact. She was treated with antibiotics (imipenem and vancomycin) and Foley catheter insertion alone.

Discussion

EPN is a potentially life threatening condition which was explained by Kelly and MacCallum in 1898 [9]. It has an unclear pathogenesis but the gas producing bacteria, urinary tract obstruction, kidney stones, diabetes mellitus, insufficient tissue perfusion, alcohol and substance abuse, and neuropathic bladders are its risk factors [10].

Many EPN patients have diabetes mellitus [11]. Some others have urinary tract obstruction and kidney stone with or without diabetes mellitus. In our study, case 1 had multiple enlarged kidney stones in her right kidney and case 2 had Staghorn kidney stones in her left kidney. Case 3 had a lower urinary tract obstruction. There was a history of hydronephrosis and hydroureter of right (case 1), left (case

2) or bilateral (case 3) kidneys. A patient had a previous history of kidney transplantation as a predisposing factor of EPN (Table 2).

Escherichia coli, *Klebsiella pneumonia*, *Proteus mirabilis* and *Pseudomonas aeruginosa* are the essential causative microorganisms (*Escherichia coli* were found in all our cases. Our patients had chill, fever, flank pain, lethargy and they were severely ill like most patients with EPN in other studies [11]. CT scan without contrast of such patients demonstrates gas collection, kidney parenchyma, fluid-gas levels and urinary tract obstruction and is the preferred diagnosis method.

We managed our four EPN cases conservatively with aggressive medical treatment containing good and rapid control of dehydration, glucose (diabetic cases), hypoxia, sepsis and kidney failure, acid base balance, and minimally invasive surgical intervention if needed. The patients had favorable outcomes.

Conclusion

We believe that in most patients conservative therapy can be used instead of nephrectomy to treat emphysematous pyelonephritis.

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