

Nonsurgical Management of Emphysematous Pyelonephritis: a short report of four cases

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Abstract

Emphysematous pyelonephritis (EPN) is an acute necrotizing and suppurative infection of the kidney parenchyma. It is defined by the presence of gas within the kidney parenchyma and surrounding tissues. This rare condition is usually seen in diabetic or immunocompromised adults. In this paper, we report four cases of emphysematous pyelonephritis (including two diabetic patients) managed by broad spectrum antibiotics and drainage. These patients were in different clinical stages of the disease (1, 2, 3a, and 4). All of them were discharged after a mean hospital stay of two to three weeks without needing a major surgery. Patients with kidney stone were referred to an endo-urologist for percutaneous nephrolithotomy after hospital discharge. We managed our four cases conservatively with an aggressive medical treatment including rapid control of dehydration, high blood glucose level (for diabetic cases), hypoxia, sepsis and kidney failure. The results were promising. Thus, we believe that in EPN patients, nephrectomy can be replaced by conservative therapy.

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Introduction

Emphysematous pyelonephritis (EPN) is a severe infection defined by the presence of gas within the collecting system, kidney parenchyma or perinephric tissue (1, 2). This rare condition is usually seen in diabetic and immunocompromised patients (1, 3). Urinary tract obstruction or urinary stones can be the other predisposing factors (1). Urine culture is generally

positive and the most common organism isolated is *Escherichia coli* (4).

It has different presentations from severe acute pyelonephritis to septic shock (5). Plain abdominal X-ray often shows mottled gas shadows in the affected kidney. (6) Ultrasound imaging shows an obstruction, but it is less sensitive than computed tomography (CT) scan in showing traces of kidney gas. The standard method for detecting EPN is

abdominal CT scan, because it shows 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).

Its management is based on the clinical presentations and radiological findings. It ranges from conservative management (antibiotics and percutaneous drainage) to nephrectomy considered as a major surgery (8). In this report, we explain four cases of EPN in different clinical stages of the disease managed conservatively. Demographic and clinical characteristics of the

reported cases and their outcomes have been presented in Table 2.

Table 1. Staging of emphysematous pyelonephritis

Class 1	Gas is confined to the collecting system
Class 2	Gas is 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

Table 2. Demographic and clinical characteristics of the reported cases and their outcomes

Patient	Age (years old)	Sex	Side	Class	Other Features	Intervention	Outcome	Kidney Function, %
1	20	Female	Right	2	Kidney stones, Hydronephrosis, diabetes mellitus	Antibiotics, control of Diabetes, nEPNthrostomy	Recovered	Right; 57% Left; 43%
2	45	Female	Left	3A	kidney stones, hydronephrosis, perinephric collection, diabetes mellitus	Antibiotics, control of diabetes, drainage of abscess, nEPNthrostomy	Recovered	Right; 60% Left; 40%
3	67	Female	Bilateral	4	kidney stones, hydronephrosis	Antibiotics	Recovered	...
4	71	Female	Transplanted kidney	1	Kidney transplantation	Antibiotics	Recovered	...

Case 1

She was a 20-year-old woman who had referred to our center in Kerman city, Iran. She did not have a history of diabetic mellitus. She had been suffering from the right flank pain, fever and chills, nausea and vomiting, dysuria and hematuria for one week before referring. She had a natural vaginal delivery 20 days before referring to us. It was an uncomplicated pregnancy, but the baby had died. The physical examination confirmed an ill appearing, dehydrated patient with 39°C body temperature, 22 per min respiratory rate, 90/60 mmHg blood pressure and 114 per min pulse rate. Cardiac,

respiratory, vaginal, and neurological examinations did not show any remarkable finding. The right costovertebral angle was tender. There were no organomegalies. In the primary laboratory evaluation, total leukocyte count, hemoglobin, blood urea and serum creatinine levels were 15300/cumm, 10.9 gr/dL, 28 gr/dL and 1 mg/dL, respectively. The random blood glucose was normal and urine culture revealed the presence of *Escherichia coli*. I erythrocyte sedimentation rate was 125 and C-reactive protein was positive.

Ultrasound imaging revealed an enlarged hydronephrotic right kidney with decrease of parenchymal echo and multiple

posterior shadows, suggesting the presence of kidney stones. Ipsilateral ureteral and the opposite kidney did not show any remarkable finding.

CT scan revealed a moderate to severe hydronephrosis, the presence of multiple stones in the right pelvicalyceal system and a small amount of gas in the kidney parenchyma. Dimercaptosuccinic acid (DMSA) scan demonstrated a non-homogenous cortical activity with a decreased parenchymal function in the lower pole of the right kidney. Also, a moderate decrease of parenchymal function in the left kidney was observed (right kidney function: 57.4%, left kidney function: 42.6%). Thus, we confirmed the diagnosis of EPN.

A nephrostomy tube was placed on the pelvicalyceal system to drain the right kidney. Intravenous fluid (with normal saline) and empiric intravenous antibiotics (with ceftriaxone, metronidazole and amikacin) were administered. Because of persistent fever, hypotension and minor increase of creatinine level, we administered other antibiotics including imipenem/cilastatin (teina), ciprofloxacin, and vancomycin. After 15 days, the total leukocyte count decreased to 2700/cumm and fever had stopped. We administered an intravenous granulocyte-colony stimulating factor. So, the leukocyte count increased immediately. The patient's clinical condition started to improve after 20 days of the treatment. The patient's abdominal CT scan showed complete disappearance of EPN signs. Hence, we stopped using the parenteral antibiotics. The patient was discharged with a prescription of oral antibiotics. She was referred to an endourologist for percutaneous nephrolithotripsy after one month.

Case 2

A 45- year- 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 diabetes

mellitus and was under the treatment with oral medications. She had a history of open surgery due to a Staghorn stone of the left kidney 10 years before referring to us. The patient was ill-looking, agitated and febrile (38.5°C). Her respiratory rate was 18 per minute. Her heart rate and blood pressure were 120 bpm and 130/90 mmHg, respectively.

The systemic examinations revealed an angle tenderness of left kidney. Severe swelling, erythema and warmth of the skin were noticeable at the same side. The cardiovascular and respiratory examination results were normal. The primary laboratory evaluation included complete blood count (hemoglobin level: 9.5 g/ dL and total leukocyte count: 7800/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: 30mmHg, PO₂: 41mmHg and HCO₃: 25.1 meq/L) and urinary analysis (WBC many, RBC 6-8, bacteria few). The urine culture revealed *Escherichia coli*. Her blood culture result was negative and the liver function tests were normal.

Ultrasound imaging showed an enlarged hydronephrotic left kidney with normal echo of parenchyma and multiple large kidney stones. Non-contrast abdominal CT scan at admission had revealed gas in the left pelvicalyseal system and parenchyma, indicating the presence of EPN. A subcutaneous collection size of 77×45 mm was reported at the costovertebral angle in both CT scan and ultrasound imaging. The right kidney did not show any remarkable finding. DMSA scan showed mild decrease of parenchymal function in the left kidney (right kidney function was 60% and left kidney function was 40%). Consequently, we confirmed the diagnosis of EPN.

The patient was managed with intravenous fluid (normal saline) and insulin infusion to achieve euglycemia. We administered intravenous antibiotics (ceftriaxone and metronidazole). Amikacin was added to maintain appropriate

gram negative coverage. Nephrostomy tube was placed on the pelvicalyceal system for draining the left kidney. This was done percutaneously and included 500 cc turbid liquid like pus. After 48 hours, the urine culture result was positive for the presence of gram-negative rods of *Escherichia coli*. It was sensitive to ciprofloxacin and imipenem. So, we changed the intravenous antibiotics to imipenem and ciprofloxacin.

The patient's body temperature was 37.5°C on the 6th day of admission and she had a better clinical condition. Blood sugar was controlled with insulin administration. Abdominal CT scan, on the day 10th, revealed a decrease in the size and extent of EPN and the subcutaneous collection. The patient had a remarkable recovery after two weeks. She was prescribed to use oral antibiotics (levofloxacin and metronidazole). We stopped using parenteral antibiotic. She was discharged with a prescription of oral antibiotics, eating diet and two dosages of premixed insulin to be used after three weeks. She was referred to an endourologist for percutaneous nephrolithotripsy after one month.

Case 3

A non-diabetic 67-year-old woman came to our center with fever and chills. She had a bilateral flank pain more than 10 days before referring to us. She was looking ill and dehydrated with 38.7°C body temperature, 22 per minute respiratory rate, 80/50 mmHg blood pressure, and 112 per minute pulse rate. The primary 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). Blood culture result was negative (U/C *Escherichia coli*). Non-contrast abdominal and pelvic CT scans showed significant gas gathered in the parenchyma of the

right kidney, and there was a small bubble of gas in the left kidney.

The patient was hospitalized. Her urine output was about 4 liters immediately after the Foley catheter insertion. Intravenous antibiotic therapy included imipenem (500 mg stat and 250 twice daily) and ciprofloxacin (400 mg stat and 200 mg BID). She was planned to undergo nephrostomy. However, due to the improvement of her symptoms and the imaging evidence after antibiotic therapy, it was unnecessary. The creatinine level decreased from 4 to 1.7 during the treatment.

Severe uterine prolapse was detected in the vaginal examination and she was referred to do hysterectomy for treating the obstructive urinary symptoms.

Case 4

A 71-year-old woman referred to our hospital with chills and fever. She had suffering from the right flank pain since five days ago. There were no symptoms of dysuria and frequency in this patient. She had a history of diabetes and hypertension from eight years ago and had done kidney transplantation because of kidney failure five years before her admission to our center.

She had a low grade fever (37.8°C), 140/90 mmHg blood pressure, 68 bpm heart rate and 16 per minute respiratory rate. The patient was looking good and her systematic physical examination results were completely normal. The primary laboratory evaluations included complete blood count (hemoglobin: 11.4mg/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). The blood culture result was negative and urine culture result revealed the presence of *Escherichia coli*.

Ultrasound imaging showed a moderate hydronephrosis on the transplanted kidney, but there was no collection. CT scan demonstrated a small amount of gas formation in the kidney's pelvicalyseal system, but the parenchyma was completely intact. The patient was treated with antibiotics (imipenem and

vancomycin) and insertion of Foley catheter. There was no need for a drainage system. This was the only case of EPN, which was diagnosed in a non-diabetic woman with an obstructed urinary system. In our other patients, EPN was the first manifestation of diabetes mellitus.



Case 1



Case 2



Case 3



Case 4

Figure 1. zNon-contrasted abdominal and pelvic computed tomography scan

Discussion

EPN is a potentially life threatening condition which was explained in 1898 (8). It has an unclear pathogenesis, but gas producing bacteria, urinary tract obstruction, kidney stones, diabetes mellitus, insufficient tissue perfusion, alcohol and substance abuse and neuropathic bladders are its risk factors (9).

Many patients have diabetes mellitus as the single most common risk factor (10). Others have urinary tract obstruction and kidney stones with or without diabetes mellitus. In our study, case 1 had multiple enlarge stones in the right kidney. Case 2 had Staghorn stones in the left kidney. Case 3 had a lower urinary tract obstruction. There was a history of hydronephrosis and hydroureter in the right (case 1), left (case 2) or both (case 3) kidneys. One of our patients had a history of kidney transplantation as a predisposing factor of EPN (Table 2).

Ecoli, Klebsiella pneumonia, Proteus mirabilis and Pseudomonas aeruginosa are the essential causing microorganisms (11). Escherichia coli was present in all of our cases. All of them had chills, fever, flank pain, lethargy and were severely ill at admission that is similar to what has been reported in other studies (10). CT scan without intravenous

contrast demonstrates gas collection, and kidney parenchyma, fluid-gas levels and urinary tract obstruction. It is the preferred diagnostic study. The most famous staging models for EPN have been shown in Table 1 (11).

In another accepted classification, EPN has been classified into two types based on the radiological appearance (12). Type I is characterized by parenchymal destruction with streaky or mottled gas. Type II is characterized by either perirenal or kidney fluid collections with bubbly gas or gas in the collecting system. Accordingly, all of our cases were of type 2.

We managed our four EPN cases conservatively with an aggressive medical treatment including rapid control of dehydration, glucose (diabetic cases), hypoxia, sepsis and kidney failure, acid base balance, and minimally invasive surgical intervention if needed. The outcomes were promising. Thus, we believe that nephrectomy can be replaced by conservative therapy in the treatment of EPN. Conservative therapy should not be the preferred treatment for all cases.

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