



Pan African Urological Surgeons' Association

**African Journal of Urology**

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# Extensive emphysematous pyelonephritis leading to renal destruction

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Received 2 February 2012; received in revised form 8 February 2012; accepted 15 February 2012

## KEYWORDS

Emphysematous;  
Pyelonephritis;  
Renal destruction;  
Diabetes mellitus;  
Nephrectomy

## Abstract

Emphysematous pyelonephritis (EPN) is a severe necrotizing infection of the kidney characterized by the presence of gas in the renal parenchyma, collecting system or perinephric tissues. It can be life-threatening if not recognized and treated promptly. We report the case of a 56-year-old woman, on treatment for diabetes mellitus, who presented with left-sided flank pain and fever. Computerized tomography revealed EPN with extensive destruction of the left kidney. Intravenous antibiotics were administered and left nephrectomy was performed. The postoperative course was uncomplicated, but during 4 months follow-up the patient's renal function rapidly deteriorated. This case report emphasizes the need for appropriate management of EPN.

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Peer review under responsibility of Pan African Urological Surgeons' Association.



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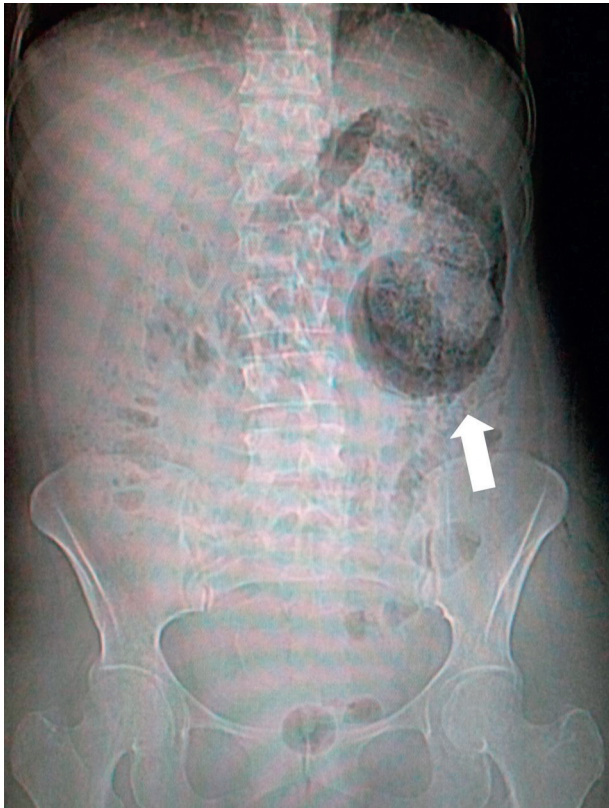
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<http://dx.doi.org/10.1016/j.afju.2012.08.003>

## Introduction

The first case of emphysematous pyelonephritis (EPN) was reported by Kelly and MacCullum (in 1898) [1]. It is a severe infection of the upper urinary tract associated with gas formation secondary to facultative anaerobic gas-producing Gram-negative bacteria. The risk of developing EPN is increased in females with diabetes mellitus and/or urinary tract obstruction. It can be life-threatening if not recognized and treated promptly. Gas in the collecting systems only (emphysematous pyelitis) is a separate condition with a better prognosis.

## Case report

A 56-year-old woman with a history of poorly controlled diabetes mellitus treated with hypoglycemic agents presented to the emergency department with left-sided flank pain and fever of 4 days duration. She reported recurrent episodes of urinary tract infection but no hypertension or renal calculi. On physical examination, she



**Figure 1** Plain abdominal radiography shows a reniform collection of air in the left flank (arrow).

was alert and well oriented, pyretic (39 °C), with left flank tenderness and a palpable mass.

Blood investigations showed leukocytosis (25 000 ml<sup>-1</sup>) with thrombocytopenia (60 000 ml<sup>-1</sup>), hyperglycemia and impaired renal function (serum creatinine 2.8 mg/dL). Urine dipstick test revealed hematuria and ketones. Blood and urine cultures were initiated.

Plain abdominal X-ray showed gas in the left renal bed (Fig. 1). Non-contrast computerized tomography (CT) revealed extensive destruction of the left kidney and the presence of air within Gerota's fascia with no evidence of hydronephrosis or calculi (Fig. 2).

After resuscitation and administration of intravenous antibiotics (ceftriaxone and gentamicin), left nephrectomy was performed. *Escherichia coli* were isolated from urine and blood cultures. The postoperative course was uncomplicated and the patient was discharged on day 10. On follow-up, the patient remained well, but the renal function rapidly deteriorated within 4 months.

## Discussion

EPN is an acute, severe necrotizing infection of the renal parenchyma and surrounding tissues that results in the presence of gas in the renal parenchyma, collecting system or perinephric tissue [2]. Diabetes mellitus is the most common predisposing factor, with a preponderance of females (90%) [3]. Other reported factors include obstruction of the urinary tract (most commonly

**Table 1** Classifications of emphysematous pyelonephritis based on CT findings.

Classification by Wan et al. [8]:

- Type I: Renal necrosis with presence of gas but no fluid
- Type II: Parenchymal gas associated with fluid in renal parenchyma, perinephric space or collecting system

Classification by Huang and Tseng [7]:

- Class I: Gas in collecting system only
- Class II: Parenchymal gas only
- Class IIIa: Extension of gas into perinephric space
- Class IIIb: Extension of gas into paranephric space
- Class IV: Emphysematous pyelonephritis in solitary kidney, or bilateral disease

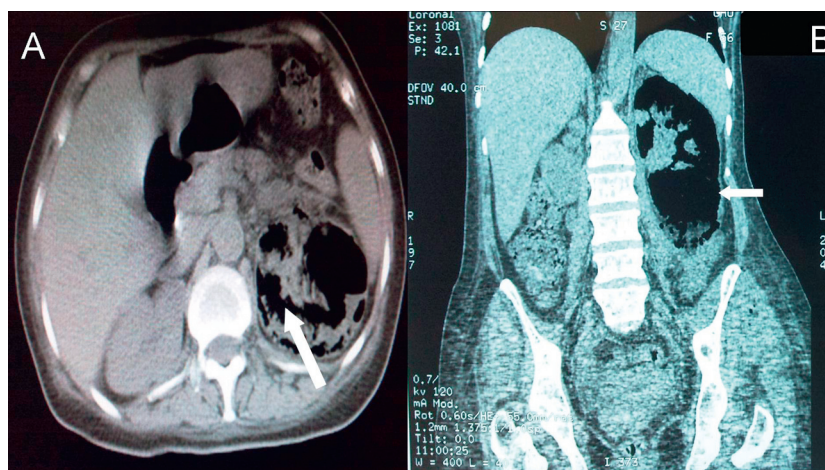
from calculi) and immunological impairment (e.g. renal transplant recipients) [4,5].

The mean age of patients with EPN ranges from 44 to 61 years and the left kidney is more frequently affected [6]. The pathogenesis of EPN includes the presence of gas-forming bacteria, high levels of glucose in tissues, impaired tissue perfusion, reduced host immunity and urinary tract obstruction. Gram-negative facultative anaerobic bacteria are responsible for the production of gas via fermentation of glucose and lactate, resulting in rapid production of carbon dioxide and hydrogen, which accumulate in the kidney because of the relative ischemia [3,5]. The most common causative pathogens are *Escherichia coli* (70% of reported cases), *Klebsiella pneumoniae* (9–29%) and *Aerobacter aerogenes* (10%). Anaerobic organisms (*Bacteroides fragilis*, *Clostridium septicum*) and fungi (*Candida*, *Aspergillus*) have been reported on rare occasions [3].

The presenting symptoms are usually those of pyelonephritis, but rapid progression to septic shock may be the presenting feature [3,4]. Complete blood count typically shows leukocytosis and sometimes thrombocytopenia. High blood glucose is a common finding as well as acute renal failure, microscopic or macroscopic hematuria and severe proteinuria.

EPN is a radiological diagnosis [4–6]. Plain abdominal X-ray and intravenous pyelography may provide a positive diagnosis in the case of large collections of gas in the collecting system or perinephric tissues. Ultrasonography may show a 'dirty shadow' in the renal bed and hydronephrosis, but has several limitations (obesity, gas in the bowel). CT is the most sensitive imaging method, and non-contrast CT should be used in patients with renal failure. It demonstrates the presence of gas, the extent of renal destruction and involvement of the surrounding tissues, and the presence of hydronephrosis or calculi. CT is also valuable for monitoring the response to treatment.

Two staging classifications based on CT findings have been proposed in order to determine the prognosis and management of EPN (Table 1) [7,8]. EPN can be life-threatening and the risk factors for mortality include disturbance of consciousness, shock, thrombocytopenia, hypernatremia, and increased serum creatinine [7–10]. According to Falagas et al. [11] significant risk factors for mortality were conservative treatment alone (odds ratio (OR) 2.85), bilateral EPN (OR 5.36), type I EPN (OR 2.5) and thrombocytopenia (OR 22.68). Systolic blood pressure less than 90 mm Hg, serum



**Figure 2** Non-contrast computerized tomography of the abdomen in (A) axial and (B) coronal view shows extensive destruction of the left kidney with massive air collection within Gerota's fascia (arrows).

creatinine greater than 2.5 mg/dL and disturbance of consciousness were also associated with increased mortality.

Management of EPN includes resuscitation measures, appropriate antibiotics and percutaneous drainage. Ureteric obstruction must be managed by percutaneous nephrostomy or a ureteric stent, unless nephrectomy is indicated. Resuscitation with intravenous fluids, acid–base balance correction and appropriate antibiotics should be commenced along with good glycemic control. The initial antibiotic regimen should be guided by the local hospital policy and target Gram-negative bacteria, Aminoglycosides,  $\beta$ -lactamase inhibitors, cephalosporins and quinolones are usually considered. Special care must be taken in patients with impaired renal function.

Percutaneous drainage is the gold standard, particularly in patients with localized areas of gas and functioning renal tissue. It helps preserve the function of the affected kidney, especially in the case of bilateral EPN or a solitary kidney, and is associated with a lower mortality than medical management alone or emergency nephrectomy [12]. The catheter should be inserted under CT or ultrasonography guidance and multiple catheters may be used. The drainage tubes are kept until follow-up CT shows resolution of the EPN.

The indications for nephrectomy are a nonfunctioning kidney, massive renal destruction, class IIIa or IIIb gas pattern, multiple organ failure, and patients who do not respond well to conservative management [5–7].

## Conclusion

EPN is most commonly associated with poorly controlled diabetes mellitus and requires early diagnosis and urgent treatment. CT is the best imaging method. The choice of initial management depends on the classification of the disease and the clinical condition of the patient.

## Financial disclosures

None.

## Conflict of interest

None.

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