

CME Article

Clinics in diagnostic imaging (99)

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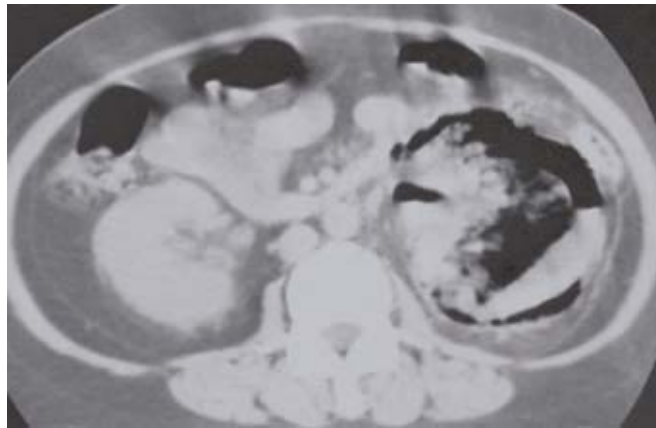


Fig. 1a Unenhanced axial CT image of the kidneys.

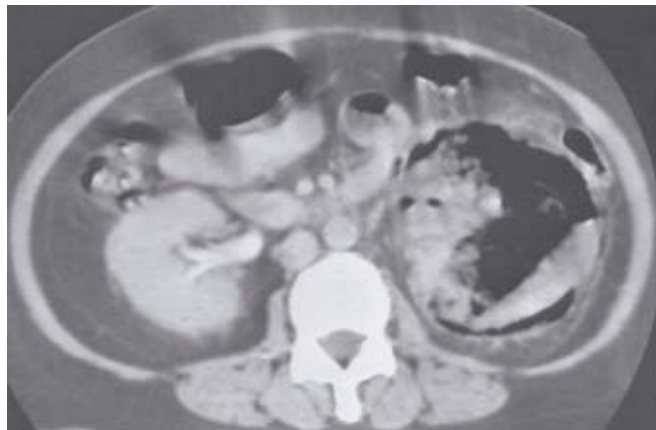


Fig. 1b Enhanced axial CT image of the kidneys.

CASE PRESENTATION

A 57-year-old woman presented with a one-week history of fever, dysuria and left flank pain. She had a known medical history of diabetes mellitus. On physical examination, the woman was noted to be ill-appearing. She had tenderness on the left side of abdomen. Blood pressure was 130/80mmHg, and temperature was 39°C. Laboratory investigations

were notable for elevated leucocyte counts of $22 \times 10^9/dL$ (neutrophils 92% and lymphocytes 8%), blood urea nitrogen of 13mg/dL (normal range 7-24), and blood glucose of 600mg/dL (normal range 70-110). Urinalysis revealed numerous white blood cells and glycosuria. What does computed tomography (CT) of the kidneys show (Figs. 1a-b)? What is the diagnosis?

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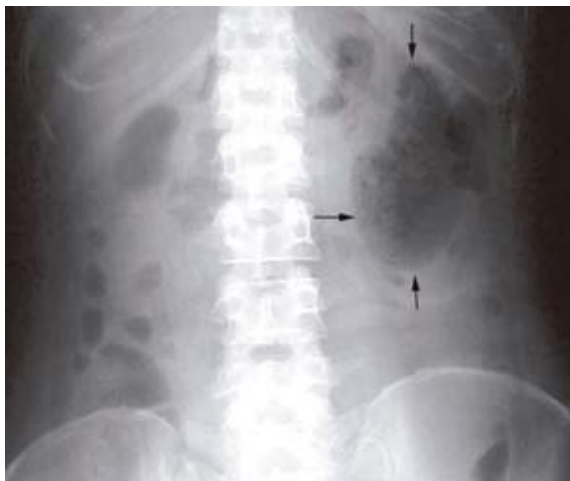


Fig. 2 Left emphysematous pyelonephritis in a 45-year-old woman who presented with fever and left flank pain. Abdominal radiograph shows gas within the left kidney (arrows).



Fig. 3 Left emphysematous pyelonephritis in a 60-year-old woman who presented with fever and chills. Longitudinal US image of the left kidney shows the gas as a linear band of high echogenicity (arrow) in the left kidney.

IMAGE INTERPRETATION

Unenhanced CT (Fig. 1a) shows enlargement of the left kidney with an extensive area of gas in the almost-completely destroyed renal parenchyma. Enhanced CT (Fig. 1b) shows excretion of contrast into the normal right renal pelvis. There is no excretion of contrast from the left kidney.

DIAGNOSIS

Left emphysematous pyelonephritis.

CLINICAL COURSE

Urine culture grew *Escherichia coli*. The patient was then treated with intravenous antibiotics and insulin. Subsequently, she underwent left nephrectomy. The left kidney was found to be necrotic, with collections of gas and pus. She made a good post-operative recovery and was discharged 34 days after admission.

DISCUSSION

Emphysematous pyelonephritis (EPN) is a rare fulminating gas-forming infection of the renal parenchyma. More than 90% of patients have diabetes mellitus. In non-diabetic patients, EPN is nearly always associated with ureteric obstruction. More of the affected patients are women than men, with a female:male ratio of 1.8:1. The average age at presentation is 54 years, with a range of 19 to 81 years. Most patients present with fever and chills, flank or abdominal pain, and nausea and vomiting^(1,2). *Escherichia coli* is the most common infecting organism. However, *Klebsiella pneumoniae*, *Enterobacter aerogenes*, *Proteus mirabilis*, *Pseudomonas* species, anaerobic streptococci, and fungi also occasionally cause this condition.

The cause of gas formation is not well understood but it has been postulated that high tissue and urinary levels of glucose are a rich substrate for organisms that are capable of producing carbon dioxide and hydrogen by fermentation of sugar. Other factors include obstruction and diminished immune response, leading to impaired response to infection and resulting in severe necrotising pyelonephritis. This is also considered a rich substrate for fermentation⁽²⁻⁴⁾. The typical pathological features of EPN are a severe acute and chronic necrotising pyelonephritis and multiple cortical abscesses⁽²⁾.

Diagnosis of EPN is difficult if it is based only on the history, physical examination and laboratory results. It requires radiological confirmation of gas within the kidney and/or collecting system. Abdominal radiographs, intravenous urography (IVU), and renal ultrasonography (US) are able to suggest the presence of gas in approximately 85% of cases^(3,4) (Figs. 2 & 3). However, CT is the best imaging technique for detecting gas and for defining the extent of disease^(1,3,5). CT is also useful in identifying and localising gas in the renal parenchyma, perinephric or paranephric space (Fig. 4), collecting system or occasionally, the vascular system.

Wan et al⁽⁶⁾ classified EPN, on the basis of CT and radiographical features, into two types. Type I EPN is the classical form of EPN which is characterised by renal parenchymal destruction and diffuse gas throughout the parenchyma in a streaked or mottled pattern, and little or no fluid. This type has a grave prognosis. Type II EPN is defined either as the presence of renal or perirenal fluid in association with a bubbly or loculated gas pattern, or gas in the collecting system with acute bacterial nephritis or renal or perirenal fluid-containing abscesses. Type II EPN has a better prognosis than type I EPN.

EPN must be differentiated from emphysematous pyelitis, in which the gas is limited to only the

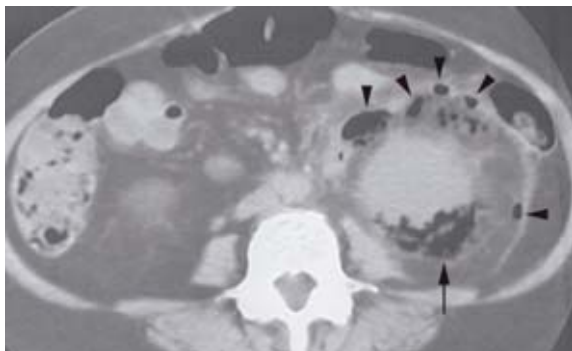


Fig. 4 Left emphysematous pyelonephritis. Unenhanced axial CT image of the left kidney of the same patient as in Fig. 1 shows gas collections in the lower renal pole (arrow) and perinephric space (arrowheads).

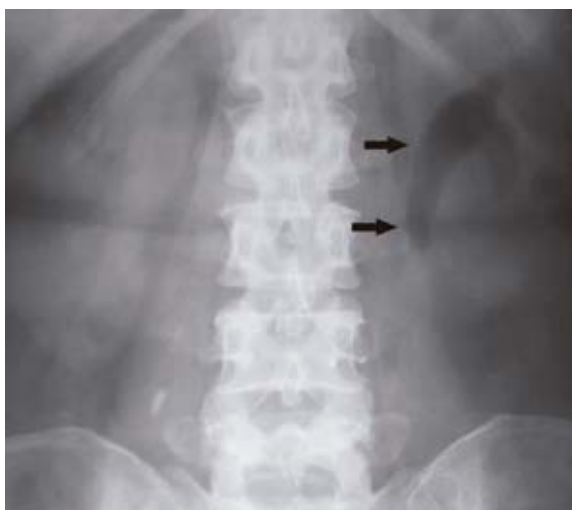


Fig. 5 Emphysematous pyelitis in a 55-year-old woman who presented with left flank pain and fever. Abdominal radiograph shows air (arrows) in the left renal pelvicalyceal system and upper ureter.

collecting system of the affected kidney (Fig. 5). This entity is also associated with diabetes mellitus in 50% of the cases, and has a better prognosis than EPN^(3,5). In patients with gas-forming renal abscess and pyonephrosis, the gas does not infiltrate the renal parenchyma. CT is valuable for differentiating EPN from other types of gas-forming renal infections (Fig. 6). Management of EPN should begin with medical therapy, and followed by nephrectomy. Mortality rates are as high as 80% to 90% for patients managed on medical therapy alone, and decreases to 11% to 36% for combined therapy^(2,5). This is in contrast to an approximate mortality rate of only 20% for emphysematous pyelitis. For this condition, medical therapy alone is sufficient if there is no obstruction. If there is associated obstruction, surgery is required for relief of obstruction.

ABSTRACT

A 57-year-old woman, known to have diabetes mellitus, presented with a one-week history of fever, dysuria, and left flank pain. Computed

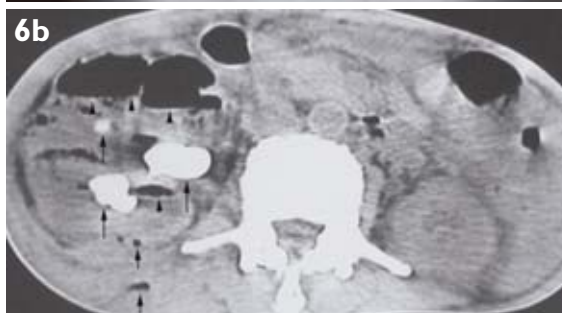


Fig. 6 Pyonephrosis in a 58-year-old man who presented with fever and right flank pain. (a) Abdominal radiograph shows an enlarged right kidney with multiple stones and prominent bubbles of gas. (b) Unenhanced axial CT image shows multiple stones (long arrows) and air-fluid levels (arrowheads) in the dilated calyces. Extension of gas (short arrows) into the posterior pararenal space and paravertebral muscle is also shown.

tomography showed extensive left renal parenchymal destruction and a large gas collection. Urine culture revealed growth of Escherichia coli. The diagnosis of emphysematous pyelonephritis was confirmed at left nephrectomy. The clinical manifestations of emphysematous pyelonephritis, types of gas-forming renal infection, and their radiological findings are discussed.

Keywords: computed tomography, emphysematous pyelonephritis, gas-forming organisms, kidney, renal infection

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SINGAPORE MEDICAL COUNCIL CATEGORY 3B CME PROGRAMME

Multiple Choice Questions (Code SMJ 200407B)

	True	False
Question 1. Concerning emphysematous pyelonephritis, the following clinical presentations are true:		
(a) More than 90% of patients have diabetes mellitus.	<input type="checkbox"/>	<input type="checkbox"/>
(b) Affected patients are predominantly men, with a male:female ratio of 3:1.	<input type="checkbox"/>	<input type="checkbox"/>
(c) Most patients present with fever, chills and flank pain.	<input type="checkbox"/>	<input type="checkbox"/>
(s) Mortality rate is high, in the range of 80%.	<input type="checkbox"/>	<input type="checkbox"/>
Question 2. Concerning emphysematous pyelitis:		
(a) Pathological features are severe necrotising pyelitis and multiple cortical abscesses.	<input type="checkbox"/>	<input type="checkbox"/>
(b) Diagnosis is usually made from the typical clinical presentation.	<input type="checkbox"/>	<input type="checkbox"/>
(c) Medical therapy alone is usually successful.	<input type="checkbox"/>	<input type="checkbox"/>
(d) Nephrectomy will increase the mortality rate.	<input type="checkbox"/>	<input type="checkbox"/>
Question 3. Concerning emphysematous pyelonephritis, the most common causative organism is:		
(a) Anaerobic bacteria	<input type="checkbox"/>	<input type="checkbox"/>
(b) Escherichia coli	<input type="checkbox"/>	<input type="checkbox"/>
(c) Staphylococcus aureus	<input type="checkbox"/>	<input type="checkbox"/>
(d) Streptococcus species	<input type="checkbox"/>	<input type="checkbox"/>
Question 4. Concerning the imaging features of emphysematous pyelonephritis:		
(a) Gas is seen only in the collecting system.	<input type="checkbox"/>	<input type="checkbox"/>
(b) Abdominal radiograph can show gas in the affected kidney.	<input type="checkbox"/>	<input type="checkbox"/>
(c) CT is better than abdominal radiograph in detecting the extent of disease.	<input type="checkbox"/>	<input type="checkbox"/>
(d) Magnetic resonance imaging is needed for confirming the diagnosis.	<input type="checkbox"/>	<input type="checkbox"/>
Question 5. Concerning gas-forming renal infections:		
(a) Type I emphysematous pyelonephritis has a worse prognosis than type II infection.	<input type="checkbox"/>	<input type="checkbox"/>
(b) CT is valuable in differentiating emphysematous pyelonephritis from other types of gas-forming renal infections.	<input type="checkbox"/>	<input type="checkbox"/>
(c) Emphysematous pyelitis has better prognosis than emphysematous pyelonephritis.	<input type="checkbox"/>	<input type="checkbox"/>
(d) Renal abscess with gas formation is one of the recognised types of emphysematous pyelonephritis.	<input type="checkbox"/>	<input type="checkbox"/>

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Submission instructions:**A. Using this answer form**

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1. Answers will be published in the SMJ September 2004 issue.
2. Successful candidates will be notified by email in September 2004.
3. Passing mark is 60%. No mark will be deducted for incorrect answers.
4. The SMJ editorial office will submit the list of successful candidates to the Singapore Medical Council.