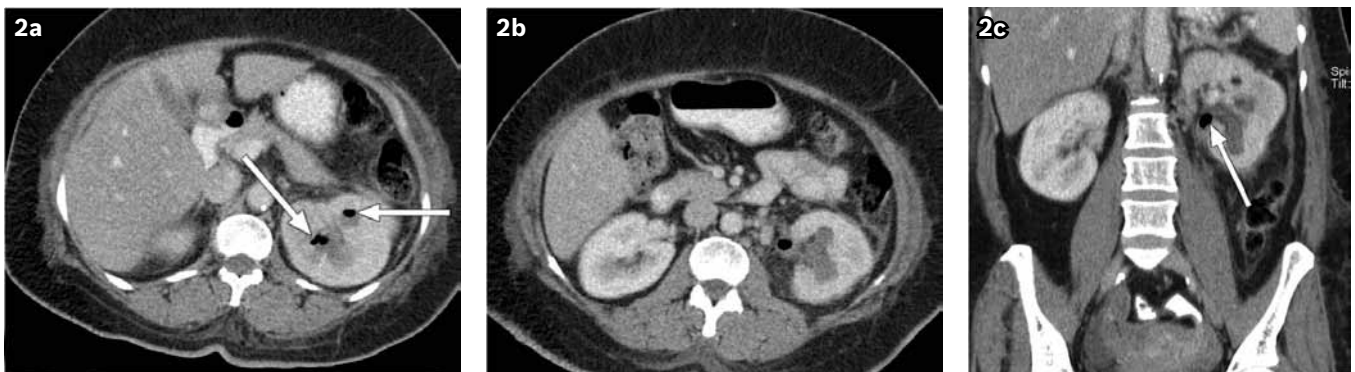


## CMEARTICLE

## Clinics in diagnostic imaging (138)

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**Fig. 1** US image of the left kidney (longitudinal section) shows a mildly dilated collecting system. Subtle posterior shadowing is seen, which is unlike the 'clear' shadowing usually seen with calculus.



**Fig. 2** (a & b) Contrast-enhanced axial CT sections and (c) coronal reformation images show gas in the left renal collecting system (arrows). No calculus is seen and no dilatation of the ureter is present.

## CASE PRESENTATION

A 49-year-old woman presented to the emergency department with one-day history of worsening left lower abdominal pain, two days of intermittent fever with chills and frequency of micturition. She had a past history of poorly controlled type 2 diabetes mellitus of ten years' duration. On clinical examination, the patient was febrile (38.6°C). She appeared tired and was mildly dehydrated but not toxic. Tenderness was present in the left iliac fossa and left renal angle. No guarding was elicited. Laboratory tests revealed normal total leucocyte count ( $10.3 \times 10^9/L$ ) with a mild

neutrophilia ( $7.8 \times 10^9/L$ ). Random blood glucose level was very high (23.4 mmol/L; normal range 3–6 mmol/L). Renal function tests were normal. Glycated haemoglobin was 12% (reference range 4.5%–6.4%). Blood culture revealed growth of *Escherichia (E.) coli*. Urine examination showed the presence of glucose (3+), numerous leucocytes (3+) and ketone bodies. Abdominal radiograph was normal, with no calculi seen.

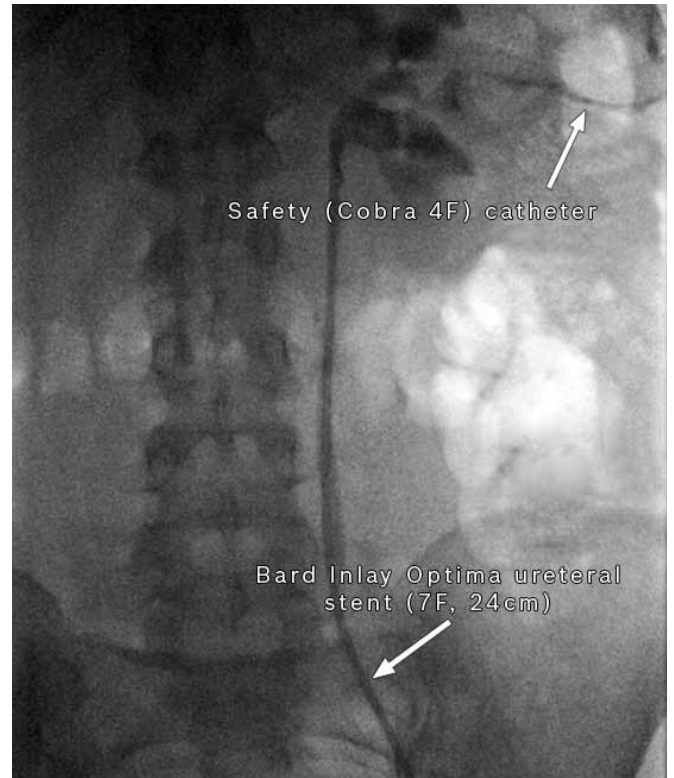
What do the ultrasonography (US) of the abdomen (Fig. 1) and computed tomography (CT) image of the abdomen and pelvis (Fig. 2) show? What is the diagnosis?

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**Fig. 3** Spot radiograph shows percutaneous nephrostomy 8-F Navarre pigtail catheter (CR Bard) *in situ*.



**Fig. 4** Spot radiograph shows the 7-F, 24-cm double 'J' ureteric stent (Inlay Optima®) in the left ureter.

**IMAGE INTERPRETATION**

US of the left kidney (Fig. 1) shows mild dilatation of the left pelvicalyceal system, with no dilatation of the ureter. No calculus is seen. Subtle posterior acoustic shadowing is seen. CT of the upper abdomen (Fig. 2) shows an enlarged left kidney with gas and dense fluid (35–40 HU) within the dilated pelvicalyceal system.

**DIAGNOSIS**

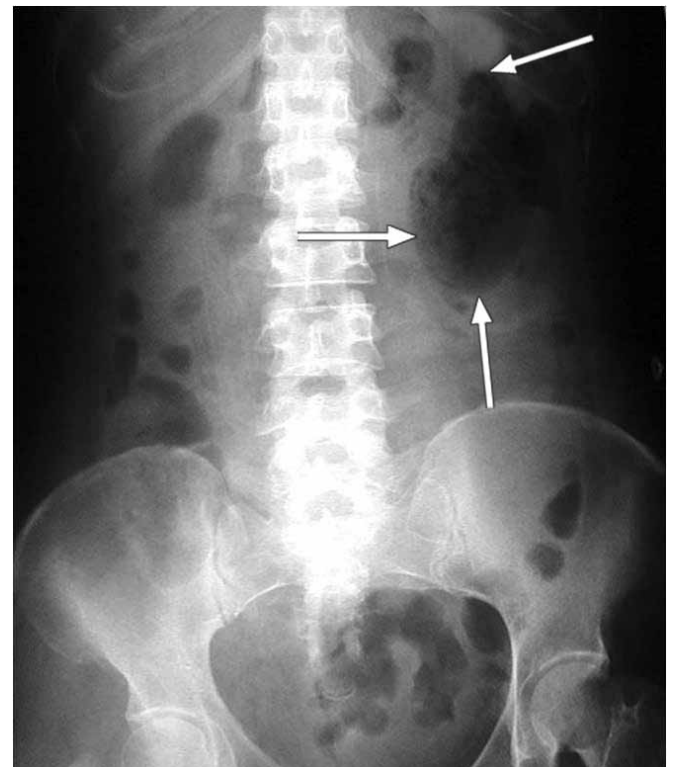
Emphysematous pyelitis.

**CLINICAL COURSE**

An emergency percutaneous nephrostomy with an 8-French (F) Navarre pigtail catheter (CR Bard) (Fig. 3) was performed under US- and fluoroscopic-guidance. On aspiration of the left renal collecting system, thick pus and gas was obtained. Microscopy showed Gram-negative rods and neutrophils. Culture grew *E. coli*. The patient's condition improved after the nephrostomy and parenteral antibiotics. A few days later, a 7-F, 24-cm double 'J' ureteric stent (Inlay Optima®) was inserted and the nephrostomy tube removed (Fig. 4). The patient was well when discharged home after two weeks, and continued on a course of oral antibiotics.

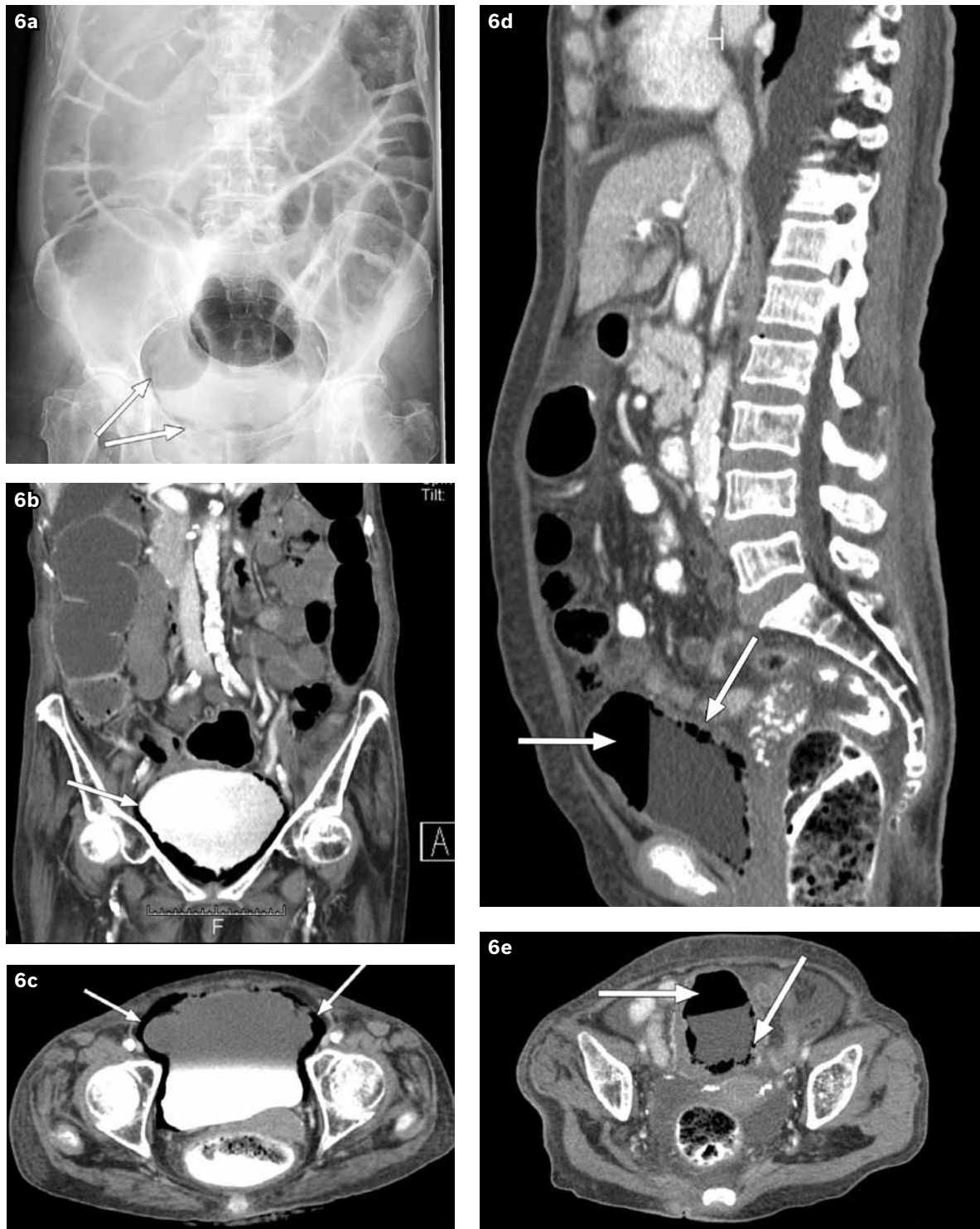
**DISCUSSION**

Gas-forming infections in the kidney can be classified into two main groups.<sup>(1)</sup> One involves only the pelvicalyceal system and is known as emphysematous pyelitis, and the other involves the renal parenchyma with or without involvement of the collecting system, known as emphysematous pyelonephritis.



**Fig. 5** Emphysematous pyelonephritis. Plain radiograph shows air in the left kidney, which is seen to be separate from the bowel gas (arrows).

Emphysematous pyelonephritis has been subdivided into two types by Wan et al;<sup>(2)</sup> Type I has a very high mortality rate, and is the more severe form of infection, where there is parenchymal destruction with mottled air in the parenchyma and little or no collection.<sup>(2)</sup> Type II is characterised by loculated gas within the



**Fig. 6** Emphysematous cystitis. (a) Plain radiograph shows air outlining the urinary bladder (arrows). Dilated bowel loops consistent with paralytic ileus are also seen. (b) Coronal and (c) axial CT images show intramural air in the urinary bladder wall (arrows). (d) Sagittal and (e) axial CT images of another patient with emphysematous cystitis show air inside the lumen and the wall of the urinary bladder (arrows).

parenchyma or collecting system, with associated renal or perirenal fluid collection, and is likely due to a favourable immune response. Type II carries a lower mortality rate.<sup>(2)</sup>

Early diagnosis of these conditions is very important due to their high mortality rates<sup>(3)</sup> (emphysematous pyelitis 20% and emphysematous pyelonephritis 50%).<sup>(4)</sup> Differentiation of emphysematous pyelitis (air only in the collecting system) from intraparenchymal gas is important, as the former has a better prognosis and may resolve with medical therapy while the latter

usually requires intervention. Approximately 90% of patients are known to have diabetes mellitus.<sup>(1,2)</sup> Emphysematous pyelonephritis or pyelitis may be associated with an obstructive calculus in the collecting system or ureter.

Diagnosis of emphysematous pyelonephritis or pyelitis on radiography is difficult,<sup>(5)</sup> as locules of gas may be seen in the region of the kidneys or renal pelvis (Fig. 5). Sometimes, infection may be confined to the urinary bladder with the presence of intramural or intraluminal air (Fig. 6), which is known as emphysematous

cystitis. US may be misleading and may give an appearance of calculus due to the presence of gas in the dilated collecting system.<sup>(4)</sup> Infection of the urinary bladder by gas-forming organisms is very rare, and the gas may be present in the wall of the urinary bladder either by transluminal dissection or true infection of the bladder wall.<sup>(6,7)</sup> However, on careful examination, the posterior acoustic shadowing caused by gas is 'dirty' compared to a calculus, which produces sharp, 'clean' shadowing. In some cases, both gas and calculus may be present, causing confusion.<sup>(8)</sup>

CT is the modality of choice<sup>(1,3)</sup> to diagnose gas-forming renal infections. Apart from gas-forming infections, gas may rarely be seen in the kidney/collecting system due to a fistula with gastrointestinal tract, iatrogenic (after procedures) or reflux from the urinary bladder. Common organisms causing gas-forming upper urinary tract infections include *E. coli*, *Klebsiella pneumoniae* and *Aerobacter*.<sup>(3)</sup> Differentiation between emphysematous pyelonephritis and pyelitis<sup>(3)</sup> is important, as management is more aggressive in the former case. Drainage or nephrectomy is usually required for emphysematous pyelonephritis, whereas only antibiotic therapy with or without drainage is required for emphysematous pyelitis.<sup>(3)</sup>

In conclusion, we stress the importance of emergent imaging with CT for poorly-controlled diabetic patients with clinical features that suggest urinary tract infection or obstructive uropathy. CT can accurately diagnose emphysematous pyelonephritis or pyelitis and can detect any associated calculous disease. This allows prompt management with parenteral antibiotics and drainage of the infected collecting system, which improves the prognosis in this serious condition.

### ACKNOWLEDGEMENT

The authors thank Prof Wilfred CG Peh, Head and Senior Consultant, Department of Diagnostic Radiology, Khoo Teck Puat Hospital, for providing the image for Fig. 5.

**ABSTRACT** We present the case of a 49-year-old woman with poorly controlled diabetes mellitus of ten years' duration. She presented to the emergency department with nonspecific left lower abdominal pain. Ultrasonography showed mild left renal hydronephrosis, but the cause was not demonstrated. Computed tomography (CT) showed a swollen left kidney with a mildly dilated collecting system containing gas and dense fluid, confirming the diagnosis of emphysematous pyelitis. Management consisted of emergency antegrade nephrostomy drainage and parenteral antibiotics. Subsequently, the patient made a good recovery and was well when discharged home after two weeks. Gas-forming infections of the genitourinary tract carry high mortality and morbidity, and usually occur in patients with poorly controlled diabetes mellitus. *Escherichia coli* is the most common microorganism. This case emphasises the importance of CT in making an early diagnosis of emphysematous pyelitis, which allows prompt treatment and improves prognosis.

*Keywords:* diabetes mellitus, emphysematous pyelitis, gas-forming organisms, renal infection

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# SINGAPORE MEDICAL COUNCIL CATEGORY 3B CME PROGRAMME

(Code SMJ 201203B)

**Question 1.** The following organisms can cause emphysematous pyelonephritis:

- (a) *Escherichia (E.) coli*.
- (b) *Streptococcus*.
- (c) *Aerobacter*.
- (d) *Staphylococcus aureus*.

True      False

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<input type="checkbox"/>	<input type="checkbox"/>
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**Question 2.** Gas can be seen in the collecting system in the following cases:

- (a) Diabetics with *E. coli* infection.
- (b) After percutaneous nephrostomy.
- (c) Reflux from urinary bladder.
- (d) Xanthogranulomatous pyelonephritis.

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**Question 3.** The following imaging modalities are often useful in diagnosing emphysematous pyelonephritis or cystitis:

- (a) Plain radiography.
- (b) Computed tomography.
- (c) Ultrasonography.
- (d) Magnetic resonance imaging.

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**Question 4.** The following are statements regarding emphysematous pyelonephritis:

- (a) Gas-forming infections of the kidneys are usually managed conservatively.
- (b) Mortality is around 5%.
- (c) Interventional radiology has a role in management.
- (d) Patients may need nephrectomy.

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**Question 5.** Regarding emphysematous pyelitis:

- (a) It is synonymous with emphysematous pyelonephritis.
- (b) It has a mortality rate of 50%.
- (c) It requires nephrectomy.
- (d) Drainage and antibiotic therapy are usually the treatments of choice.

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**Doctor's particulars:**

Name in full : \_\_\_\_\_

MCR number : \_\_\_\_\_ Specialty: \_\_\_\_\_

Email address : \_\_\_\_\_

**SUBMISSION INSTRUCTIONS:**

(1) Log on at the SMJ website: <http://www.sma.org.sg/cme/smj> and select the appropriate set of questions. (2) Select your answers and provide your name, email address and MCR number. Click on "Submit answers" to submit.

**RESULTS:**

(1) Answers will be published in the SMJ May 2012 issue. (2) The MCR numbers of successful candidates will be posted online at [www.sma.org.sg/cme/smj](http://www.sma.org.sg/cme/smj) by 20 April 2012. (3) All online submissions will receive an automatic email acknowledgment. (4) Passing mark is 60%. No mark will be deducted for incorrect answers. (5) The SMJ editorial office will submit the list of successful candidates to the Singapore Medical Council. (6) One CME point is awarded for successful candidates.

**Deadline for submission: (March 2012 SMJ 3B CME programme): 12 noon, 13 April 2012.**