

Emphysematous pyelonephritis: an unusual complication of blunt abdominal trauma

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Clinical record

A 28-year-old woman was involved in a high-speed motor vehicle accident. She had no significant past medical history and did not have diabetes. On arrival at a small regional hospital, her score on the Glasgow Coma Scale was 14/15 (E4 M6 V4), respiratory rate was 20 breaths per min, and oxygen saturation when breathing 8 L/min oxygen was preserved. She was in shock, with tachycardia and blood pressure of 87/55 mmHg, despite administration of 1000 mL of crystalloid fluid. Examination revealed a large scalp laceration extending from the right eye to the right vertex, but no obvious underlying bony injury. Her right elbow and left thumb were dislocated, and she had bruising over the right side of the chest and over both flanks. Her abdomen was generally tender, with maximal tenderness in both iliac fossae, but she had no guarding or rigidity. No abnormalities were detected on rectal examination, but her urine showed frank haematuria.

After administration of a further 500 mL of crystalloid fluid, the patient's blood pressure increased. Computed tomography (CT) showed a contusion of the left lung and a large, complex hepatic laceration, with a haematoma measuring 9.3 × 8.3 cm around the right kidney and evidence of haemoperitoneum (Figure 1A). CT of the brain and vertebral column did not reveal any injuries.

The patient underwent debridement and suturing of the scalp laceration and reduction of the right elbow and left thumb dislocation under general anaesthesia. She remained intubated and was transferred to a tertiary referral centre.

On arrival at the tertiary centre 4 hours later, she required a further 3000 mL of crystalloid fluid and 2 units of packed cells. Noradrenaline (6 µg/min) was required to maintain a mean blood pressure of 65 mmHg. Repeat abdominal CT showed no change since the initial images. After consultation with both the trauma and urology surgeons, a conservative management strategy was adopted.

Over the next few hours, the vasopressor was weaned, and the patient appeared to be haemodynamically stable. By Day 2, the frank haematuria had resolved, and she was successfully extubated but continued to experience back and abdominal pain. This was managed effectively with patient-controlled morphine analgesia.

On Day 5 of the admission, the patient developed a marked fever (temperature, 40°C) and increasing tachycar-

ABSTRACT

We report an unusual case of emphysematous pyelonephritis after blunt abdominal trauma in a 28-year-old woman. She was previously healthy and did not have diabetes. Treatment with antibiotics and percutaneous drainage was successful. We review the diagnostic and management strategies for this condition.

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dia. Her abdomen remained very tender, raising concern about an unidentified duodenal injury. A "septic work-up", including both blood and urine bacterial cultures, was performed. Urgent abdominal contrast CT revealed a persistent perinephric collection (Figure 1B), with delayed-phase images showing contrast flow into the space, consistent with a urinoma. The size of the collection was largely unchanged since the initial CT scan, but gas was identified in the perinephric tissues.

Blood and urine cultures subsequently grew a coliform, later identified as *Escherichia coli*. It was postulated that the patient had pre-existing *E. coli* cystitis, which allowed retrograde seeding of the perinephric haematoma and subsequent development of emphysematous pyelonephritis. Treatment with intravenous piperacillin–tazobactam was begun, and advice was sought from a urologist. Initially, a right ureteric stent was inserted to maintain ureteric flow. A CT scan was performed after 24 hours to assess progress.

The patient remained haemodynamically stable throughout, and renal function was preserved. However, despite appropriate antibiotic therapy, she continued to experience fevers, deemed secondary to inadequate control of the infection. Another CT scan revealed an increase in the size of the perinephric collection, and apparent devascularisation of portions of the mid and upper poles of the right kidney.

Percutaneous drainage of the collection yielded sterile bloodstained urine. Following this procedure, the sepsis resolved. Subsequent CT revealed a reduction in the size of the emphysematous collection. After drain removal, the patient's condition remained stable, and she was discharged home.

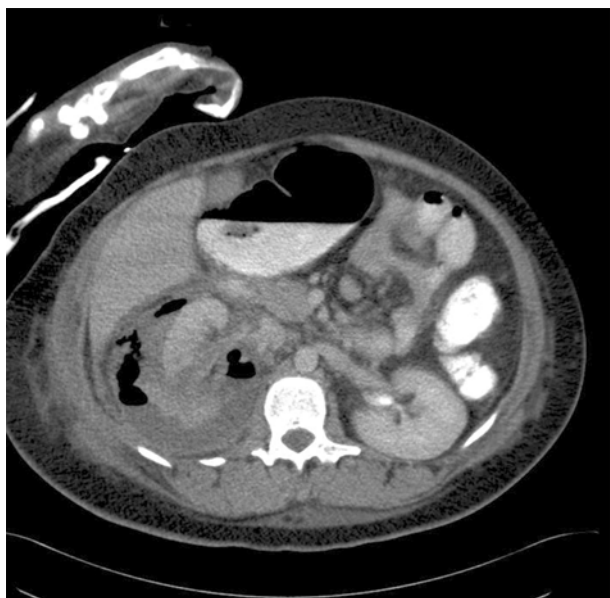
Figure 1. Serial computed tomography scans of the abdomen in a woman after a motor vehicle accident

A. At presentation



Initial scans showed a haematoma measuring 9.3 × 8.3 cm around the right kidney.

B. Repeat scan on Day 5



Repeat imaging revealed evidence of multiple pockets of perinephric gas, the largest being 8.1 × 2.1 × 2.4 cm. There appeared to be no gas outside the perinephric space.

Discussion

Emphysematous pyelonephritis is a life-threatening gas-forming infection of the renal parenchyma and surrounding areas. With the advent of more advanced renal-imaging techniques, it is increasingly being identified. The association with a history of renal trauma remains exceptional, with only one previous case reported, to our knowledge, in

the literature.¹ Almost all patients have diabetes. The most effective management strategy remains controversial.²

The largest published case series, comprising 48 patients, was reported by Huang and Tseng in 2000.³ This confirmed a strong association with diabetes. Most patients initially presented with fever, abdominal pain and pyuria. Evidence of septic shock was seen in a third, and acute kidney injury also in a third; nausea and vomiting were less common, occurring in only 17% of cases.³

Clinically, the condition is difficult to distinguish from more common forms of pyelonephritis. Diagnosis therefore largely depends on radiological imaging. Although the diagnosis may be suggested by plain abdominal x-ray, this technique has low sensitivity for detecting gas in emphysematous pyelonephritis (33% in one case series⁴), largely due to the difficulty of differentiating renal gas from air in overlying bowel loops.

Ultrasound examination of the renal tract is recommended in patients presenting with a clinical syndrome consistent with pyelonephritis, to exclude urinary tract obstruction. However, the radiological literature has cast doubt on its ability to reliably detect gas within the renal tract;⁵ air may appear similar to renal calculi or calcification within the renal parenchyma.

Computed tomography has emerged as the most reliable diagnostic imaging modality for this condition. There is also increasing evidence that it provides significant prognostic information. The condition has been classified radiologically using two different systems.

Wan et al⁶ subdivided emphysematous pyelonephritis into two separate types:

- Type I, with evidence of parenchymal destruction with mottled or streaky presence of gas, but no fluid or fluid collection; and
- Type II, with loculated or bubbly gas and evidence of fluid collection.

Type I appears to carry a higher mortality rate, of up to 69%, versus 18% in patients with Type II.⁶

Huang and Tseng³ developed an alternative radiological classification, dividing cases into four groups based on CT findings:

- Class 1, with gas in the collecting system only;
- Class 2, with gas in the renal parenchyma but no extension to the extrarenal space;
- Class 3, with extension of gas or abscess to the perinephric space (subgroup, 3A) or to the pararenal space (subgroup, 3B); and
- Class 4, with both kidneys affected, or one kidney affected in a patient with a single kidney.

It appeared that progression through Classes 1 to 4 was associated with a progressive rise in mortality.

CASE REPORTS

A causative gas-forming organism is identified in most cases. The organism in our patient, *E. coli*, is the most commonly isolated bacterium, identified as the cause in two-thirds of cases. *Klebsiella pneumoniae* appears to be the second most common bacterium. Bacteraemia is shown in most cases.^{2,3,5}

Significant controversy surrounds treatment strategy in emphysematous pyelonephritis. Traditionally, immediate radical nephrectomy has been considered the most appropriate treatment,⁷ given the condition's high mortality. However, more recently, other treatment options have been explored, such as CT-guided percutaneous drainage and antibiotic therapy alone.

There is evidence that mortality is around 20% with use of antibiotics followed by immediate nephrectomy.⁸ Chen et al⁹ described a series of 25 patients, 20 of whom were treated effectively with CT-guided percutaneous drainage and antibiotic therapy alone; mortality was 12%. Mortality is considerably higher when antibiotic therapy is used alone.³ In the only previous published case of emphysematous pyelonephritis following trauma, percutaneous drainage with antibiotic cover proved to be effective treatment.¹

Huang and Tseng advised that management could be guided by the extent of disease on CT using their four-stage classification system. If CT showed limited disease (Class 1 or 2), then percutaneous drainage with antibiotic therapy appeared effective treatment. For more extensive disease (Class 3 or 4), nephrectomy should be considered. However, they found that emphysematous pyelonephritis Class 3 or 4 could still be effectively managed with percutaneous drainage and antibiotics in the absence of specific risk factors, which appeared to predict failure of this treatment option. These risk factors included the presence of acute kidney injury, evidence of septic shock, altered conscious level and thrombocytopenia. If any two of these were present, then failure of percutaneous drainage was predicted, and nephrectomy was recommended as definitive management.³ It should be noted that previous smaller case series failed to show that CT findings correlated with effective treatment options.⁹

Conclusion

We report an unusual case of emphysematous pyelonephritis as a cause of septic shock in a patient with renal injury secondary to blunt abdominal trauma. The main aid to diagnosis is CT imaging. With antibiotic therapy alone, mortality remains high. A good outcome can be achieved with either percutaneous drainage or nephrectomy. The choice of treatment may be guided by the severity of the disease on imaging and the presence or absence of clinical risk factors.

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References

- 1 Yasuharu T, Jun'ichi H, Shigeru K. Emphysematous pyelonephritis associated with perinephric haematoma of renal trauma: a case report. *Jpn J Clin Urol* 2003; 57: 149-51.
- 2 Peter JA, Vishwanath B, Peake SL. Emphysematous pyelonephritis. *Med J Aust* 2006; 184: 533.
- 3 Huang JJ, Tseng CC. Emphysematous pyelonephritis: clinicoradiological classification, management, prognosis, and pathogenesis. *Arch Intern Med* 2000; 160: 797-805.
- 4 Patel NP, Lavengood RW, Fernandes M, et al. Gas-forming infections in the genitourinary tract. *Urology* 1992; 39: 341-5.
- 5 Roy C, Pflieger DD, Tuchmann CM, et al. Emphysematous pyelitis: findings in five patients. *Radiology* 2001; 218: 647-50.
- 6 Wan YL, Lee TY, Bullard MJ, Tsai CC. Acute gas-producing bacterial renal infection: correlation between imaging findings and clinical outcome. *Radiology* 1996; 198: 433-8.
- 7 Eloubeidi MAS, Fowler VG. Emphysematous pyelonephritis. *N Engl J Med* 1999; 341: 737.
- 8 Shokeir AA, El-Azab M, Mohsen T, El-Diasty T. Emphysematous pyelonephritis: a 15-year experience with 20 cases. *Urology* 1997; 49: 343-6.
- 9 Chen MT, Huang CN, Chou YH, et al. Percutaneous drainage in the treatment of emphysematous pyelonephritis: 10-year experience. *J Urol* 1997; 157: 1569-73. □

Information for authors

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