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When gas lights up the urinary tract: a rare Case Report

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ABSTRACT:

Gas-forming infections of the urinary tract are uncommon but potentially life-threatening, and they occur almost exclusively in patients with diabetes mellitus. Concomitant emphysematous cystitis and emphysematous pyelonephritis is rare, and contiguous extension of the infection to the prostate and to the pelvic spaces is rarer still. We report a 55-year-old man with untreated type 2 diabetes mellitus admitted with sepsis of urinary origin, in whom contrast-enhanced computed tomography showed gas within a thickened bladder wall, gas in the right renal collecting system with bilateral non-enhancing parenchymal foci and perinephric fat stranding, two communicating prostatic collections, and a gas-containing Douglas-pouch collection measuring 70 × 32 mm, corresponding to Huang–Tseng class II. This case highlights that a single gas-forming infection can involve the bladder, both kidneys, the prostate and the pelvic spaces simultaneously, and that gas anywhere along the urinary tract on computed tomography in a septic patient with diabetes is an indication for urgent source control rather than antibiotics alone.

KEYWORDS :

Emphysematous cystitis; Emphysematous pyelonephritis; Emphysematous urinary tract infection; Diabetes mellitus; CT imaging; Prostatic abscess.

MAIN ARTICLE :

INTRODUCTION:

Gas-forming infections of the urinary tract are uncommon but potentially life-threatening. They occur almost exclusively in patients with diabetes mellitus, in whom high tissue glucose provides the substrate for mixed acid fermentation by Enterobacteriaceae, chiefly *Escherichia coli* and *Klebsiella pneumoniae* (1,2). The gas produced may remain confined to the collecting system, involve the renal parenchyma, or extend to the perinephric and pararenal spaces, and this anatomical progression largely determines the prognosis (1,3).

Emphysematous cystitis is the most common and usually the least severe of these infections, with an overall mortality of about 7% in a review of 135 cases, whereas emphysematous pyelonephritis is a necrotising process with a mortality approaching 20% despite drainage (1–3). Combined disease is reported far less often, and simultaneous involvement of the bladder, both kidneys, the prostate and the pelvic cul-de-sac has been described only anecdotally (4,5). We report such a case, emphasizing the role of contrast-enhanced computed tomography (CT) in defining the full anatomical extent of a single gas-forming infection and in guiding source control.

CASE REPORT:

A 55-year-old man with a history of type 2 diabetes mellitus diagnosed but never treated, active tobacco smoking and regular alcohol consumption was admitted with sepsis of urinary origin. He reported a three-day history of fever, right flank pain, dysuria and vomiting. On admission his temperature was 39.1 °C, blood pressure 92/58 mmHg, heart rate 118/min and respiratory rate 24/min. Examination disclosed tenderness of the right costovertebral angle and diffuse abdominal tenderness without guarding. Laboratory investigations showed a white blood cell count of 15,600/mm³ with 84% neutrophils, a C-reactive protein level of 150 mg/L, a creatinine level of 186 µmol/L, and a blood glucose level of 3.1 g/L with a glycated haemoglobin of 11.2%. Urinalysis showed leucocyturia with positive nitrites, and urine culture grew *Escherichia coli* susceptible to ceftriaxone, amikacin and ciprofloxacin.

Contrast-enhanced CT of the chest, abdomen and pelvis, performed on a 64-slice scanner in helical mode before and after intravenous injection of iodinated contrast, showed a thickened bladder wall containing a gas bubble (Figure 4). Both kidneys were of normal size and contained multiple subcapsular hypodense foci that did not enhance after contrast, consistent with multifocal nephritis (figure 2), with bilateral infiltration of the perinephric fat; gas

bubbles were present within the lower calyceal collecting system of the right kidney (Figure 1) . There was no hydronephrosis and no calculus. The prostate harboured two contiguous collections communicating with each other around the prostatic urethra, and a collection containing gas bubbles, measuring 70 × 32 mm, occupied the rectovesical pouch (Figure 3). The liver, biliary tree, spleen, adrenal glands and pancreas were unremarkable, no deep lymph nodes were enlarged, and there was no peritoneal effusion. In the chest, a focus of consolidation with an air bronchogram in the left lower lobe and bilateral bronchiectasis with mucous plugging were also noted.

The findings were reported as pyelonephritis with emphysematous cystitis, complicated by a prostatic abscess and an abscess of the cul-de-sac of Douglas, graded class II of the Huang–Tseng classification, and a delayed-phase acquisition was recommended to look for a fistulised collection or bladder rupture.

Apyrexia was obtained on day 5 and the C-reactive protein level fell to 28 mg/L by day 12. Control CT on day 14 showed resolution of the gas within the bladder wall and the renal collecting system, and a marked reduction in the size of the prostatic and pelvic collections. Ceftriaxone was continued for a total of three weeks and no nephrectomy was required. The patient was discharged on day 24 with a creatinine level of 132 µmol/L. At follow-up three months later he was asymptomatic, had recovered full urinary continence, and control imaging showed no residual collection or recurrence. Written informed consent for publication was obtained from the patient.

DISCUSSION:

Emphysematous urinary tract infection is best understood as a single pathological process whose severity is set by the compartment it reaches. Gas confined to the collecting system carries a comparatively good prognosis, gas within the renal parenchyma defines emphysematous pyelonephritis, and extension to the perinephric or pararenal space turns the infection into a surgical problem (1,3). Gas within the bladder wall defines emphysematous cystitis, the commonest and usually the most benign of these infections, for which medical management alone is sufficient in 90% of reported patients (2). Our patient sat at the severe end of this spectrum, with bladder, bilateral renal, prostatic and pelvic involvement present on a single examination.

The mechanism is metabolic rather than purely bacterial. Mixed acid fermentation of glucose by Enterobacteriaceae produces carbon dioxide and hydrogen, both documented by gas

analysis in the original series, and impaired tissue perfusion allows the gas to accumulate; infarction, vascular thrombosis and arteriosclerosis are common in nephrectomy specimens (1). Both conditions converge in uncontrolled diabetes, present in 96% of patients with emphysematous pyelonephritis and 67% of those with emphysematous cystitis (1,2). Our patient had never been treated for a diabetes that was by then longstanding, a situation in which chronic hyperglycaemia, microangiopathy and a blunted immune response coexist.

CT is the diagnostic modality of choice and has displaced the plain abdominal film on which most historical cases were diagnosed (2). Three tasks fall to the radiologist: to confirm and locate the gas precisely, since its location drives both staging and treatment; to identify complications that change management, including abscess formation, perinephric and pararenal extension, and collections in the prostate and pelvic spaces; and to establish a baseline for follow-up. The Huang–Tseng classification grades the renal component from the collecting system (class 1) through the parenchyma (class 2) to the perinephric (3A) and pararenal (3B) spaces, with bilateral disease forming class 4 (1,3). Its limitation is that it describes the kidney alone and says nothing about the bladder, the prostate or the cul-de-sac, each of which may carry its own need for drainage; the anatomical extent should therefore be reported explicitly alongside the grade.

Emphysematous prostatic abscess is rare, almost always affects diabetic men, and is usually caused by *Klebsiella pneumoniae* or *Escherichia coli* (6). Its importance lies in how quickly it can progress, since the abscess may rupture into the periprostatic space, the retroperitoneum or the peritoneal cavity (6,7). In our patient the prostate contained two collections communicating around the prostatic urethra, and a gas-containing collection occupied the rectovesical pouch, suggesting either rupture of the prostatic abscess into the cul-de-sac or a primary gas-forming pelvic collection. In either case, gas outside the urinary tract converts a medical problem into a drainage problem.

Management rests on four simultaneous actions: resuscitation, glycaemic control, broad-spectrum antibiotics adapted to culture results, and early source control (1–3). Antibiotics alone are insufficient in emphysematous pyelonephritis, with a mortality of 40% in the original series, whereas percutaneous catheter drainage combined with antibiotics succeeded in 66% of patients (1). Nephrectomy retains a role in extensive disease or after failure of drainage, with a success rate of about 90% but at the cost of a kidney in a patient who is often critically ill (1). Prognosis is driven less by the radiological class than by physiological

reserve: two or more of thrombocytopenia, acute renal impairment, disturbed consciousness and shock predicted failure of percutaneous drainage in 92% of cases, against 15% when none or only one was present (1). This is why such patients belong in a high-dependency setting from the outset, and why drainage should not wait for culture results.

The strength of this report is the complete anatomical documentation, in a single contrast-enhanced examination, of a rare combination of gas-forming infections. Its limitations are those of any single case: one patient at one time point, no histological confirmation, no MRI because of limited resources, and a follow-up limited to three months, so the outcome cannot be extrapolated and the place of delayed-phase imaging and of systematic pelvic drainage in this presentation remains to be defined by larger series.

CONCLUSION:

A gas-forming urinary tract infection is a radiological emergency as much as an infectious one. In this patient, untreated diabetes allowed a single process to involve the bladder, both kidneys, the prostate and the rectovesical pouch, and the extent of disease — not the organism — determined what had to be done and how quickly. Contrast-enhanced CT defined that extent in one examination. Clinicians should treat gas anywhere along the urinary tract in a septic patient with diabetes as an indication for immediate resuscitation, glycaemic control, broad-spectrum antibiotics and urgent surgical or radiological source control, delivered by a team that includes urology, radiology, intensive care and endocrinology.

FIGURES

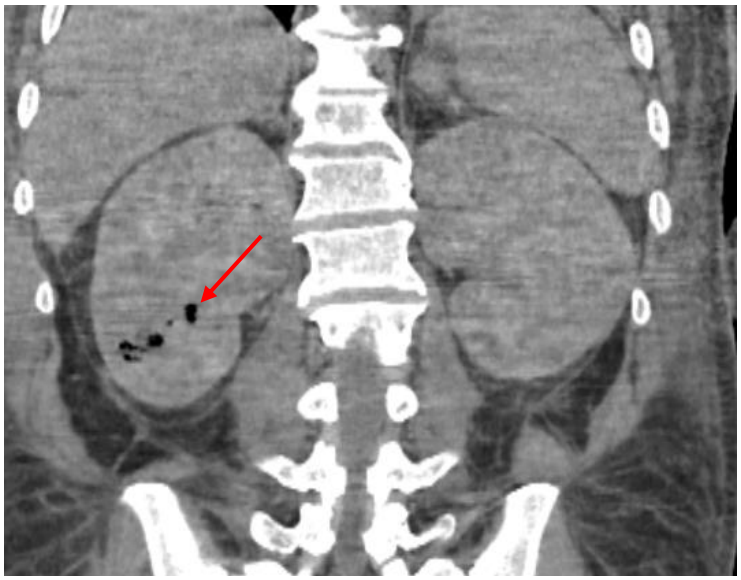


Figure 1: Coronal CT reconstruction (non-contrast-enhanced) showing gas within the lower calyceal system of the right kidney (red arrow), consistent with class II emphysematous pyelonephritis according to the Huang and Tseng classification.

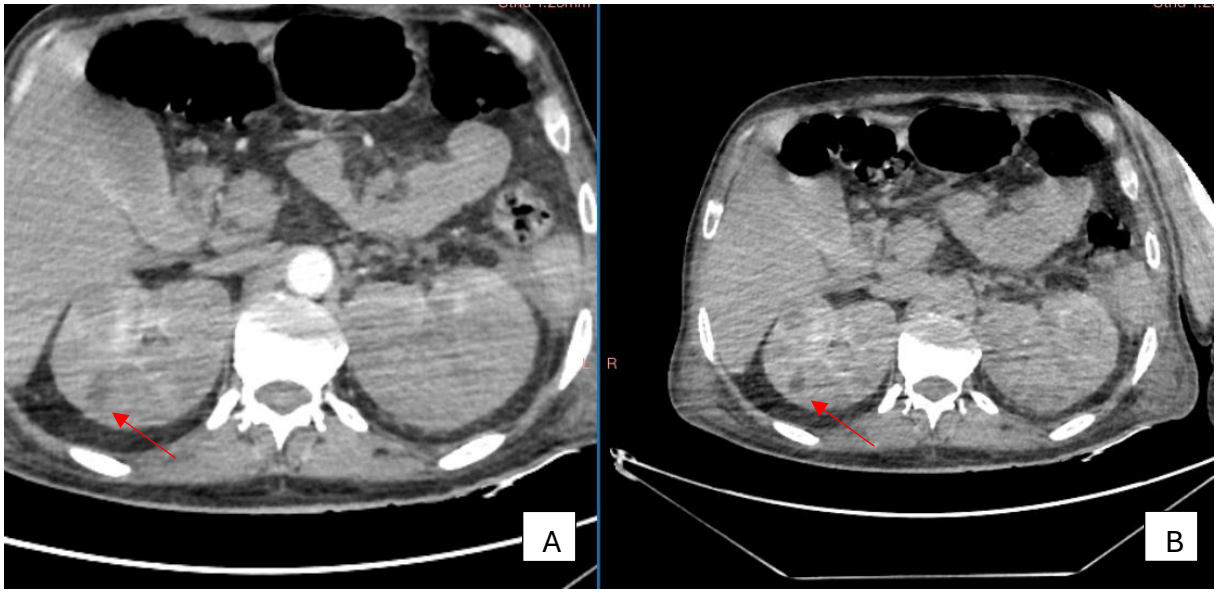


Figure 2. Axial non-contrast-enhanced (A) and contrast-enhanced CT(B) images showing multiple subcapsular hypodense renal lesions without post-contrast enhancement, consistent with focal areas of nephritis.

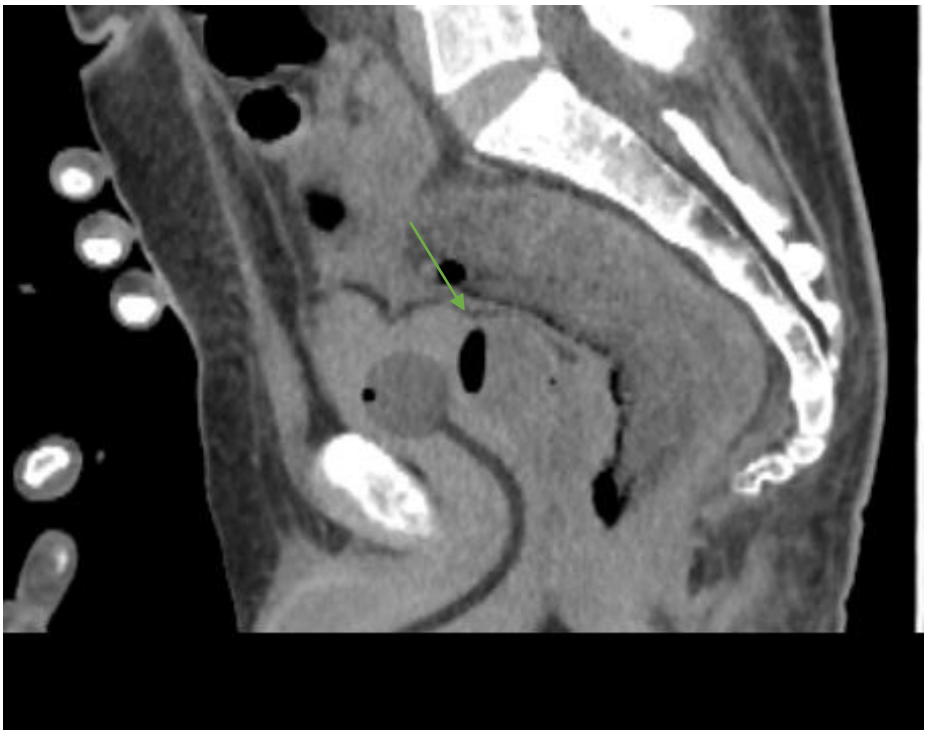


Figure 3. Sagittal contrast-enhanced CT image showing two contiguous prostatic collections communicating with each other around the prostatic urethra, and a gas-containing collection (green arrow) measuring 70 × 32 mm in the rectovesical pouch.

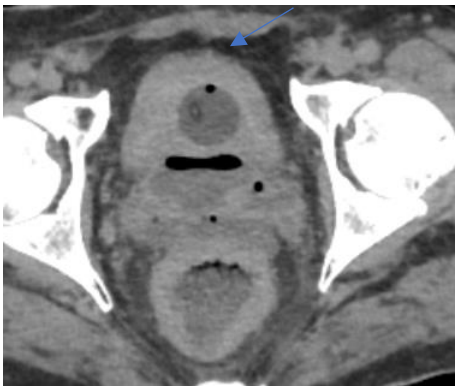


Figure 4. Axial CT image showing diffuse bladder wall thickening with intramural gas (Blue arrow), consistent with emphysematous cystitis.

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DECLARATIONS

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Informed Consent: Written informed consent was obtained from the patient for publication of this case report and the accompanying radiological images.
Author Contributions: All authors contributed to the conception of the case report, data collection, radiological image analysis, and manuscript preparation. All authors reviewed and approved the final version of the manuscript.

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