

Gas in the inferior vena cava from severe emphysematous pyelonephritis

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Emphysematous pyelonephritis is a life-threatening, urologic emergency. We present the case of a 54-year-old female who was found to have a large volume of

air in her renal vein and inferior vena cava from severe emphysematous pyelonephritis. In this case report, the medical and operative management of this patient are reviewed, and the literature on the management of emphysematous pyelonephritis is summarized.

Key Words: necrotizing pyelonephritis, nephrectomy, percutaneous nephrostomy

Introduction

Emphysematous pyelonephritis is a rare, gas-forming infection of the renal parenchyma. Patients are often female, diabetic and critically unwell on presentation.¹ Given the rarity of emphysematous pyelonephritis, there is a paucity of literature to guide medical and operative management for these patients. In this case report, we describe the presentation of a middle-aged female who presented in diabetic ketoacidosis and was

found to have severe emphysematous pyelonephritis. Unique to her case was a large volume of intravascular air in the renal vein and inferior vena cava. In this paper, we review the details of this patient's presentation and management including our surgical approach to her open nephrectomy. In addition, we summarize the available literature on the management of patients with emphysematous pyelonephritis.

Case presentation

A 54-year-old female presented to the emergency department with a 1 week history of progressive left flank pain, weakness and anorexia. Her past medical history was significant for type 2 diabetes mellitus. She was on no home medications and had not seen a doctor for many years. In the emergency department,

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she was hypothermic (35.3°C), tachycardic (104 beats per minute) and hypotensive (98/64) with an elevated creatinine (314 $\mu\text{mol/L}$), mild leukocytosis ($12.6 \times 10^9/\text{mm}^3$), thrombocytopenia ($44 \times 10^9/\text{mm}^3$) and significant hyperglycemia (24.5 mmol/L). A computed tomography (CT) scan revealed extensive destruction of the left renal parenchyma secondary to a gas-forming process consistent with severe emphysematous pyelonephritis, Figure 1. Gas was also seen tracking into the left renal vein and inferior vena cava (IVC).

The patient was medically stabilized with broad spectrum antibiotics and intravenous fluids in the intensive care unit (ICU). Blood cultures were positive for *Escherichia coli*. She initially responded well to medical management with improvement in her vital

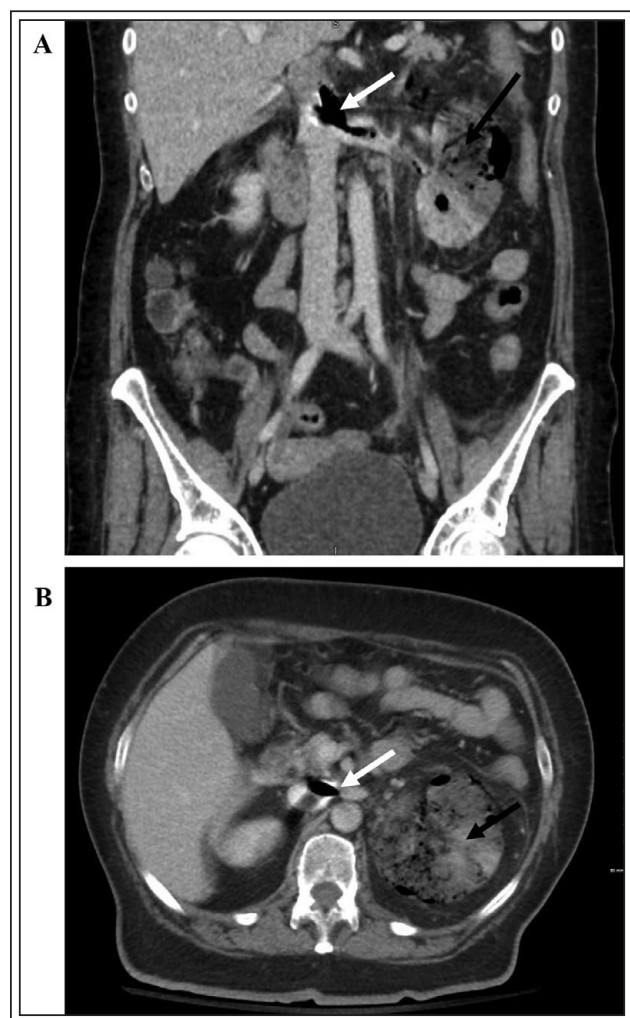


Figure 1. Coronal (A) and axial (B) CT scan images of severe left emphysematous pyelonephritis (**black arrows**) with gas tracking into the left renal vein and IVC (**white arrows**).



Figure 2. Coronal (A) and axial (B) CT scan images after 72 hours of medical management with broad spectrum antibiotics in the intensive care unit. Gas was noted to track into the perisplenic space (**white arrow**). Gas in the IVC had resolved.

signs and blood work, however on the third day of her admission she decompensated with worsening hypotension, tachycardia and new somnolence. Repeat imaging showed progression of gas to the left upper quadrant, superior to the kidney (perisplenic) with resolution of the gas in the IVC, Figure 2.

Repeat blood cultures remained positive for *E. coli* susceptible to the antibiotics she was receiving (intravenous Piperacillin-Tazobactam). A percutaneous drain was placed urgently for source control and was positioned into the air-filled upper pole within Gerota's fascia. Injected contrast remained confined within Gerota's fascia and opacified an atypical distribution in keeping with destroyed renal architecture, Figure 3.

Her clinical status significantly improved following insertion of the drain. The output of the drain was 60 cc of dark-sanguineous liquid over the initial 24 hours after

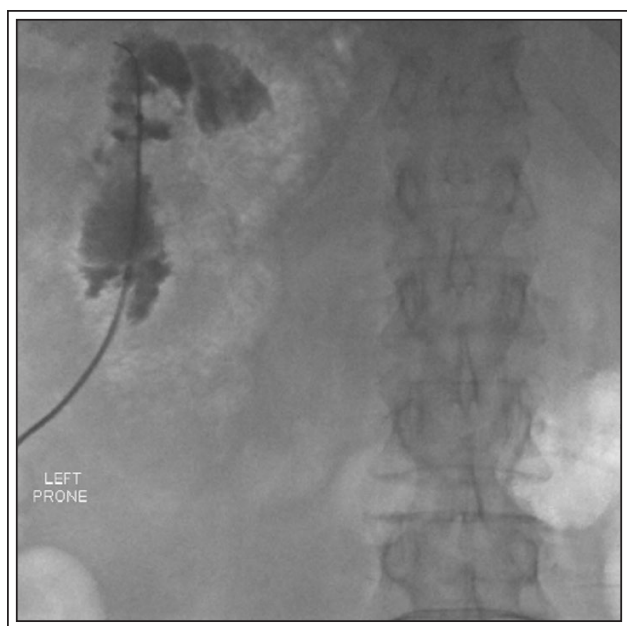


Figure 3. Fluoroscopic image of contrast injected into left renal space within Gerota's fascia. Severe destruction of the renal parenchyma apparent with atypical distribution of contrast.

insertion. She was weaned off vasopressors within 24 hours yet remained in the ICU for close monitoring. She was taken to the operating room for a left radical nephrectomy 5 days after her admission for definitive source control. We opted for a midline incision and opened the posterior peritoneum superior to the inferior mesenteric artery (IMA) to expose the aorta, secure the renal hilar vessels, and limit manipulation of the left kidney prior to vascular control. A single artery and vein were identified and controlled. During dissection of the left renal vessels, minor pressure was applied over the left renal bed and the patient became febrile, hypotensive and tachycardic likely secondary to acute bacteremia. Cooled intravenous fluids and a cooled Bair Hugger were provided by the anesthesia team.

Following vascular control, the descending colon was reflected and Gerota's fascia was noted to be intact with no gross evidence of disruption from the necrotizing infection. The kidney was maintained within Gerota's fascia and the entire specimen was removed in toto. On palpation, Gerota's fascia was very tense secondary to the contained gas-forming, necrotizing infection. Following surgery, the patient was transferred to the ICU where she recovered remarkably well postoperatively and was medically stable for hospital discharge 1 week after her operation.

Discussion

Emphysematous pyelonephritis is a rare presentation of a urologic emergency caused by a necrotizing infection of the renal parenchyma. Causative organisms are gas-forming uropathogens with *E. coli* and *Klebsiella pneumoniae* as the two most commonly isolated bacteria.^{2,3} There is a significant female predominance (6:1) and nearly all patients presenting with emphysematous pyelonephritis have diabetes mellitus.¹ Classic presenting symptoms are flank pain, nausea/vomiting, fever and dysuria. Many patients are found to have a significant leukocytosis and significant hyperglycemia on presentation.⁴

Several classification systems for emphysematous pyelonephritis have been developed. The classification system by Huang et al is widely cited in the literature and has been shown to correlate with mortality rates, Table 1.⁵ The Michaeli and Wan classification systems, similarly stratify patients based on radiographic findings.^{6,7}

Patients presenting with severe emphysematous pyelonephritis should be stabilized and monitored closely. Broad spectrum antibiotics should be initiated that must cover Gram-negative bacteria given the high prevalence of *E. coli* and *K. pneumoniae* as causative organisms.¹ A percutaneous drain should be considered for source control if the patient is not responding to medical management.⁸ Immediate operative

TABLE 1. Huang and Tseng classification of emphysematous pyelonephritis⁵

Type	Radiological findings
1	Gas within the collecting system
2	Gas within the renal parenchyma
3a	Gas outside the kidney and in the prinephric space
3b	Gas outside the kidney and in the pararenal space
4	Bilateral emphysematous pyelonephritis or gas in a solitary kidney

intervention for emphysematous pyelonephritis has a 40%-50% mortality rate and should be avoided if possible.⁸ Delayed surgical intervention once the patient has stabilized significantly reduces morbidity and mortality. Medical management and percutaneous drain insertion have decreased the mortality rate to 8% in recent case series.^{8,9}

Gas in the IVC from severe emphysematous pyelonephritis has been described in a few case reports with poor clinical outcomes.¹⁰ For our patient, the vascular surgery team was consulted to provide guidance on any investigations or interventions required for the large volume of gas in the renal vein and IVC, Figure 1. They did not recommend any targeted treatment for the intravenous air beyond source control with medical management (antibiotics) and/or surgical intervention. On repeat imaging, 72 hours after initiation of medical therapy, there was no evidence of gas in the IVC or renal vein, Figure 2.

We approached this patient's radical nephrectomy transperitoneally through a midline incision and applied the principles of a trauma nephrectomy and retroperitoneal lymph node dissection for exposure. We used this approach to obtain early renal vascular control and limit manipulation of the kidney before entering a potentially disrupted and hostile retroperitoneum. In hindsight, our approach proved to be correct as evidenced by the systemic changes that occurred even with a minor amount of indirect manipulation of the kidney. Had a flank or subcostal incision been used, the degree of manipulation required to identify and secure the renal hilum would have been much more significant, likely resulting in severe hemodynamic instability and preventing safe continuation of surgery. Limited information exists in the literature regarding the most appropriate surgical approach for cases of emphysematous pyelonephritis and it is our belief that, in more acute cases, efforts should be directed at early vascular control with limited renal manipulation.

Emphysematous pyelonephritis is a rare, yet life-threatening urologic emergency. Resuscitation and medical stabilization of a patient presenting with this necrotizing infection are critical for management. Strong consideration for a percutaneous drain should be discussed with interventional radiology as several recent series have shown improved outcomes and decreased mortality when compared to immediate operative intervention. It is our strong belief that the percutaneous drain insertion for the patient in this case presentation, saved the patient's life as it allowed her condition to stabilize prior to definitive removal of the severely infected and necrotic kidney. □

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