

Special Article – Urinary Tract Infections

Emphysematous Pyelonephritis: When Minimally Invasive Approaches are not Enough

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Abstract

The author presents a case of a diabetic patient that developed a severe left emphysematous pyelonephritis manifested by septic shock that was managed initially with minimally invasive techniques with percutaneous drainage and wide-spectrum antibiotics. Besides her clinical improvement the gas wasn't resolved entirely even after a second percutaneous drainage and eventually ended in a simple nephrectomy due to persistent fever. What would seem like a pretty common management for this clinical entity, nowadays it represents the exception rather than the rule. This case exemplifies how even though the minimally invasive approaches are used to spare the kidney, a nephrectomy still plays a role in the management of patients with this complicated infection.

Keywords: Emphysematous pyelonephritis; Nephrectomy; Minimally invasive; Mexico

Abbreviations

UTI: Urinary Tract Infection; CT: Computed Tomography; EPN: Emphysematous Pyelonephritis

Introduction

Urinary tract infections comprehend a wide spectrum of presentations that can vary from mild clinical pictures such as non-complicated cystitis to life-threatening conditions with extensive tissue destruction such as emphysematous pyelonephritis. An emphysematous pyelonephritis represent a gas-producing infection developed by gram negative bacteria that metabolize the excess of carbohydrates (mainly glucose) with formation of carbon dioxide, that starts to accumulate in the urinary tract and collecting systems; this gas later extends through the renal parenchyma and can reach the perinephric and even pararenal space. These patients usually develop sepsis and/or septic shock, and often require intensive care support associated with high mortality [1]. They require wide spectrum antibiotics [2] and a minimally invasive procedure to drain the gas and/or purulent material on most cases. In the past a nephrectomy was performed frequently in early stages of the disease, which lead to a greater overall and trans-surgical mortality due to sepsis and bleeding by trying to dissect a heavily inflamed kidney and surrounding structures [3]. To avoid an increased morbidity, the use of minimally invasive treatments such as percutaneous drainage and ureteral stents replaced the other approaches [4,5] however, there are infections that won't resolve with these treatments and patients will eventually need a nephrectomy to achieve a cure. We present a case of emphysematous pyelonephritis that exemplifies that situation.

Case Presentation

A 48-year-old woman arrived to the emergency department with a one-week history of fever, malaise, nausea and left flank pain. She had a history of diabetes and hypertension with poor control and had been hospitalized six months previously for a urinary tract infection that was treated empirically with quinolones at a community hospital. She had

no follow-up and no cultures taken. On admission she was diagnosed with septic shock, diabetic ketoacidosis and renal failure; after being resuscitated with intravenous fluids and started on inotropes and insulin infusion protocol, wide-spectrum antibiotics (ertapenem and amikacin adjusted to renal function) were also initiated. Once being stable an abdominal computed tomography was performed (Figure 1) establishing a diagnosis of left emphysematous pyelonephritis Huang 3b with extension of the gas throughout Gerota's fascia on the lower pole. Forty-eight hours after admittance an image-guided percutaneous drainage with a 10 French catheter was performed (Figure 2A and 2B) obtaining gas and 100 mL of purulent material; the catheter was left on continuous suction. An extended-spectrum betalactamases-producing *E.coli* strain with resistance to quinolones and trimethoprim was isolated from the obtained material as well as in a blood culture. She had a slow improvement with an average of 50 mL of purulent material drained per day; one week after admission the sepsis and renal failure had remitted but the gas persisted on a follow-up CT (Figure 2C and 2D). Given those findings a second image-guided percutaneous drainage was done obtaining more gas and scarce purulent material. On the thirteenth inpatient day, her evolution was stationary, persisting with spikes of fever and gas on lower renal pole with distortion of renal parenchyma's anatomy was observed on another CT despite the catheter (Figure 3). The decision of performing an open simple nephrectomy was made, with findings

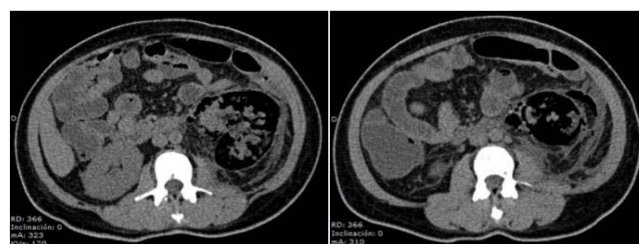


Figure 1: CT scan at admission. Air extending outside of the Gerota, corresponding to Huang 3b.

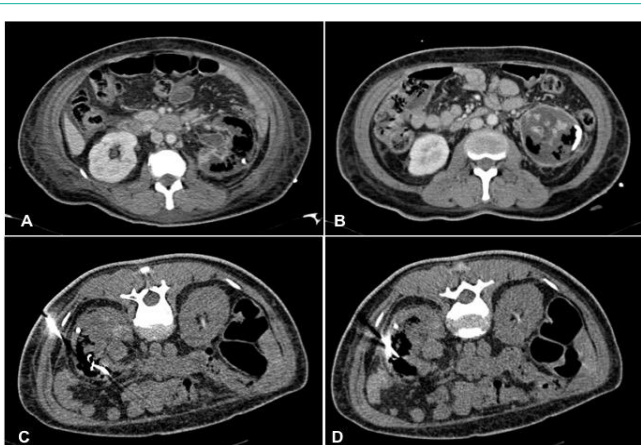


Figure 2: Persistence of gas after first percutaneous drainage (A and B) and second percutaneous drainage(C and D).

of an intense perinephric inflammatory reaction and purulent material within the kidney; chronic pyelonephritis with abscess and multifocal necrosis was reported on the pathological report. After the procedure she remained non-febrile and was discharged on post-operative day 3. On follow-up at the urology clinic she was doing well, had a negative urine culture, normal glycemia and normal creatinine levels.

Discussion

There are several reports of emphysematous pyelonephritis cases in the international literature [6] varying from mild cases confined to collecting systems to severe ones that practically replace the normal anatomy of one or both kidneys; to adequately classify each case in the clinical setting, the Huang classification is preferred [7].

- Class 1: gas in the collecting system only
- Class 2: gas in the renal parenchyma without extension to the extrarenal space
- Class 3A: extension of gas or abscess to the perinephric space
- Class 3B: extension of gas or abscess to the pararenal space
- Class 4: bilateral EPN or solitary kidney with EPN

A high index of suspicion is needed to establish an early diagnosis; usually these patients are admitted with septic shock without an obvious source and acute complications related to the diabetes, such as diabetic ketoacidosis or hyperosmolar non-ketotic diabetic coma, and not uncommonly it can even manifest as the presenting symptom of the disease on a “previously healthy” patient [8]. This situation can often mislead the diagnosis or have the physician underestimate the underlying severity within the kidney and urinary tract, which is why imaging studies are essential to determine if there’s a complication and which one it is. For the particular case of emphysematous pyelonephritis, Huang’s classification on CT is useful to determine extent, treatment modality and it also has prognostic value [9].

Wide-spectrum antibiotics have to be delivered as soon as possible since the delay in the onset of appropriate therapy can result in early deterioration and death. Even though there are reports of cases treated with antibiotics alone [10-12] the idea that the patient

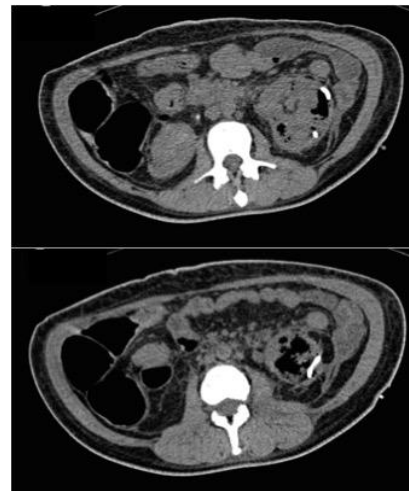


Figure 3: After second drainage, the catheter is in place but there’s still unresolved gas on lower pole and the renal parenchyma’s anatomy remains distorted.

will probably need a complementary treatment has to be present at all times when approaching these patients.

Once the patient has been diagnosed with imaging studies and the extent of the damage has been determined, the minimally invasive approaches to drain the gas and/or purulent material have demonstrated to improve the outcomes [13,14]. In our previous study involving management of complicated UTIs [15] a total of 14 patients with emphysematous pyelonephritis were included on a time span of barely a year and a half, 68% of these patients were at least classified as Huang 3 by CT. 64% of them were treated with a minimally invasive approach, which resolved the gas on all but two patients that ended having a nephrectomy; also we treat these patients with carbapenems empirically and downscale antibiotic only if a susceptible strain is isolated, due to the high prevalence of antibiotic resistance and extended spectrum betalactamases prevalence in our community. The mortality in our group of emphysematous pyelonephritis was 28%. In other studies mortality has been reported as low as 8% (Chen) [16], 18.8% (Huang), 33% (Tsu) [1], 45% (Dutta) [17] and in some patient subgroups can reach 100% (Aswathaman). In the study by Huang *et al* patients that were treated initially with percutaneous drainage but failed to respond appropriately and had to undergo nephrectomy had a survival of 90%. Somani *et al* [13] noted that mortality was higher when treated with medical management alone (50%), that it decreased to half (25%) with emergency nephrectomy but the lowest mortality was achieved with percutaneous drainage (13.5%); in cases when this last approach failed and nephrectomy was made, mortality still was lower than when performed on an emergency setting (6.6%). In the present case, the patient survived without compromise of her overall renal function by performing the nephrectomy in a non-emergency situation.

In patients with emphysematous pyelonephritis the kidney should be spared as much as possible, therefore the current standard of treatment include wide spectrum antibiotics combined with minimally invasive approaches which include percutaneous drainage and ureteral stents; however when nephrectomy is performed accordingly, good results can also be achieved.

Conclusion

An appropriate antibiotic treatment combined with the use of minimally invasive approaches will resolve most cases of emphysematous pyelonephritis, however, nephrectomy still has to be performed in some patients in order to control the infection and improve patients' survival, preferentially in a non-emergency setting.

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