

A case of hematuria and vomiting in the emergency room: Never forget the emphysematous pyelonephritis

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Abstract

We describe the case of a 68-year-old man with a known history of hypertension and diabetes mellitus presented to our Emergency Department, complaining of hematuria and vomiting in the last 12 hours, stypsis and urinary incontinence in the last week, and worsening hyporexia in the last 6 months. Bedside ultrasound documented a slight right pleural effusion with B lines in the middle and basal right field, gastrectasis, dilated fluid-filled bowel loops, potential signs of gas in the upper right quadrant, grade 3 bilateral hydronephrosis, and bladder globe. Abdominal CT scan confirmed the bilateral hydronephrosis and showed the right kidney with Emphysematous Pyelonephritis (EPN) with extension into the perinephric and muscular planes for 24 cm, and

initial EPN in the left kidney. A RT-PCR nasopharyngeal swab for SARS CoV-2 was negative. A diagnosis of ileum paretic, acute renal failure and urosepsis due to EPN was made.

Case Report

A 68-year-old man affected by hypertension and well controlled diabetes mellitus presented to our Emergency Department with complaints of painless gross hematuria and vomiting in the last 12 hours, progressive and worsening hyporexia, dehydration, asthenia, weight loss in the last 6 months, and a new onset of stypsis and urinary incontinence in the last week. His medications included salicylic acid, bisoprolol, Olmesartan and repaglinide. He denied dysuria, cough, fever, or chills. His blood pressure was 120/60 mmHg, heart rate 75 beats/min, temperature 36°C, respiratory rate 22 breaths/min and he had an oxygen saturation of 95% at room ambient and 98% on 2 L O₂ delivered via nasal prongs. On examination he had severe signs of dehydration, including dry skin and oral mucous membranes and flat neck veins, and cachexia with muscle hypotrophy and weakness involving both the legs and the arms. Abdomen was distended with mild tenderness to palpation of his right upper quadrant with no Blumberg's sign. The pulmonary flow murmur was absent in the right lower lobe.

Sinus rhythm and Right Bundle Branch block (RBB) was detected on ECG. Point-of-care ultrasound (PoCUS) documented a slight right pleural effusion with B lines in the middle and basal right field, gastrectasis, dilated fluid-filled bowel loops with hyper-echoic spots of gas moving within the fluid and absent peristalsis, potential signs of gas in the upper right quadrant and grade 3 bilateral hydronephrosis with bladder globe (Figure 1); inferior vena cava was completely collapsed, as sign of volume depletion.

Venous blood gas analysis showed a metabolic acidosis (pH 7.29, HCO₃ 16.2 mmol/L) with acute renal failure (creatinine 5 mg/L), hyperkalemia (5.6 mEq/L) and an increased anion gap (21.4 mmol/L), moderate anemia (Hb 9.1 g/dL, Hct 27.8%), and elevated lactate (38 mg/dL, normal value 5-15). Glucose and bilirubin were normal.

Firstly, we inserted a nasogastric tube and we aspirated 600 mL of fecaloid material, then we placed a foley catheter that drained 500 mL of dark urine without clots. Urine dipstick showed turbid appearance with hematuria and proteinuria. We removed the foley catheter and placed a three-way urinary catheter. Manual bladder irrigation and empiric broad-spectrum intravenous antibiotic therapy with Piperacillin/Tazobactam at dose of 4.5 gr were immediately started, and then adjusted to the degree of acute renal impairment. The patient was hydrated with intravenous glucose 5% solution 500 mL, sodium chloride 0.9% 1000 mL and sodium bicarbonate 8.4% 500 mL, and he was transfused with one unit of blood without side effects. PoCUS documented a persistent bilateral grade 2 hydronephrosis even with empty bladder. Laboratory investigations are reported in Table 1, and confirmed acute renal

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Informed consent: The patient provided consent for the access to medical records at the time of admission.

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failure with hyperkalemia, significantly increased white blood cell count with neutrophilia and elevated C-reactive protein, and moderate microcytic anemia. Liver function and coagulation times were within normal limits. In addition, urine analysis showed turbid appearance with obvious hematuria, glycosuria (50 mg/dL, normal value 0-15) and proteinuria (100 mg/dL, normal value 0-30) with an increased urine albumin-to-creatinine ratio (>300 mg/g, normal value <30). A RT-PCR nasopharyngeal swab for SARS-CoV-2 was negative. Serology test revealed a previous SARS-CoV-2 infection (IgG positive, IgM negative). Legionella and Streptococcus pneumoniae urine antigens resulted absent.

High resolution chest CT scan confirmed the slight right pleural effusion, showed bilateral bronchial secretions with the com-

plete segmental bronchial obstruction of the right lower lobe, and excluded interstitial pneumoniae. Urgent abdomen CT scan without contrast documented a bilateral hydroureteronephrosis and showed the right kidney with Emphysematous Pyelonephritis (EPN) with extension into the perinephric and muscular planes for 24 cm, and initial EPN in the left kidney (Figure 2). In addition, CT scan revealed distended small bowel loops in the hypogastric

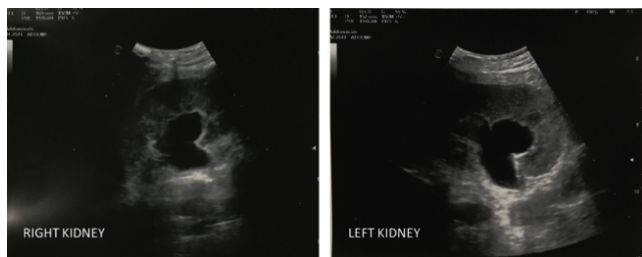


Figure 1. Bilateral grade 3 hydronephrosis.



Figure 2. Abdomen CT scan without contrast showing enlarged right kidney with a gas collection within the renal parenchyma with extension into the perinephric and muscular planes for 24 cm, and distended small bowel loops (coronal and transverse section).

Table 1. Patient's laboratory findings at admission and during recovery. WBC, white blood cells; RBC, red blood cells; Hb, hemoglobin; MCV, mean cell volume; MCH, mean cell hemoglobin; PLT, platelet; PT, prothrombin time; PTT, partial thromboplastin time; CRP, C-reactive protein; PCT, procalcitonin; LDH, lactate dehydrogenase; ALT, alanine transaminase; AST, aspartate transaminase; GGT, gamma glutaryltransferase. ND, not done. Normal range values are in brackets, altered values in bold.

	At admission	Recovery day 3
WBC (4-10 x 10 ⁹ /L)	11.27	13.95
Neutrophil Count (2-8 x 10 ⁹ /L)	10.65	12.57
Lymphocyte Count (1.5-4 x 10 ⁹ /L)	0.35	0.97
RBC (4.3-5.7 x 10 ⁶ /L)	2.94	3.66
Hb (13.2-17.3 g/dL)	8.5	10.6
MCV (82-98 fL)	87.1	86.6
MCH (27-32 pg)	25.6	29
PLT Count (150-450 x 10 ⁹ /L)	156	37
PT-INR	1.57	1.53
PTT sec	30.6	33
Glucose (74-100 mg/dL)	112	189
CRP (<0.5 mg/dL)	25.97	28.85
PCT (<0.5 ng/mL)	ND	92
Fibrinogen (150-400 mg/dL)	ND	656
LDH (0-248 U/L)	666	ND
Creatinine (0.6-1.2 mg/dL)	5.11	4.27
Blood urea nitrogen (10-50 mg/dL)	276	241
Potassium (3.5-5.0 mEq/L)	6.2	6.6
Sodium (135-146 mEq/L)	136	138
Calcium (8.1-10.4 mg/dL)	ND	7.16
Fosphate (2.6-4.5 mg/dL)	ND	5.8
AST (10-37 U/L)	48	41
ALT (10-37 U/L)	27	25
GGT (7-40 U/L)	ND	40
Cholinesterase (4620-11500 U/L)	ND	2695
Total bilirubin (0.1-1.1 mg/dL)	0.17	1.2

region, with diffuse coprosthesis, in absence of air-fluid levels.

Urology consultation was obtained in the emergency room. Given the extensive involvement of the renal parenchyma and bilateral collecting systems, the urologist decided to do an immediate right percutaneous nephrostomy using ultrasound guidance, along with supportive care. After the procedure, the patient was admitted to the subintensive care unit with a diagnosis of acute renal failure and ileum paretic owing to bilateral EPN. Urine and blood cultures obtained on presentation to the Emergency Department quickly grew out multi-resistant *Escherichia Coli*. Unfortunately, the patient died from septic shock after 3 days of hospitalization. Laboratory data during the recovery are reported in Table 1.

Discussion

EPN is a rare but severe life-threatening acute necrotizing infection of the kidney, predominantly in patients with diabetes (70–90%)¹ and/or with urinary tract obstruction.² It is more common in females than males, particularly in female patients with poorly controlled diabetes,³ and only in 10% of cases involves both the kidneys.^{4,5} EPN is characterized by gas production and accumulation in the renal parenchyma, collecting system, or perinephric tissues.^{6,7} Over 90% of the reported cases are due to *Escherichia Coli*, but other microbes can be *Proteus mirabilis*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Bacteroides fragilis*, *Aerobacter aerogenes*, *Candida albicans*, and *Cryptococcus neoformans*.^{6,8–10} The first case of EPN was described in 1898 by Kelly and MacCallum as “pneumaturia” for the detection of gas in the urinary tract during cystoscopy.¹¹ The pathogenesis of EPN is still unclear. Several authors reported hyperglycemia, altered tissue perfusion, and impaired immune response as contributors to the development of EPN.^{2,12,13} Gas-production infections of the kidney and urinary tract can be due to EPN, emphysematous pyelitis, and emphysematous cystitis.¹⁴ It is extremely important to early recognize and diagnose these conditions because of their life-threatening potential. Patients with EPN can rapidly develop septic shock and multiple organ failure, with a mortality rate of up to 30%. Unfortunately, signs and symptoms of EPN are nonspecific and can include fever, nausea, pain in the abdomen, in the flanks or back.^{15–17} Rare cases of pneumomediastinum and subcutaneous emphysema, or multiple septic emboli to the brain, lungs, and liver have been reported as unusual presentation of EPN.^{18,19} Acute renal failure, thrombocytopenia, sepsis, altered mental status, including delirium, and need for hemodialysis are considered as poor prognostic risk factors.^{6,20} EPN is a radiological diagnosis. Abdominal CT scan is the gold standard technique for early diagnosis and staging.^{21–22} It can define the extent and quantification of the gas, and any destruction of the renal parenchyma. Huang-Tseng classified EPN into four stages based on CT findings: stage 1 is classified as gas in collecting system only, stage 2 as gas in renal parenchyma only, stage 3 as gas in renal parenchyma with extrarenal extension - 3a extension of gas or abscess to perinephric space, and 3b extension of gas or abscess to pararenal space, and stage 4 as bilateral emphysematous pyelonephritis or solitary kidney with emphysematous pyelonephritis, as in our patient.⁶ The key is to identify EPN as early as possible so that less invasive interventions can be successfully used. Control of diabetes, correction of diabetic ketoacidosis, systemic antibiotics and hydration are mandatory in all the cases. Patients in classes 1 and 2 can be treated conservatively with

prompt hydration, antibiotics, and Percutaneous Catheter Drainage (PCD) or stent. Bilateral PCD should be performed in patients in class 4; immediate nephrectomy for class 3 patients with more than two risk factors; and nephrectomy for all cases where PCD fails.^{23,24} As reported in literature, PCD is now the most appropriate strategy and the gold standard in management of EPN.^{25–28} Our patient has a 4 class EPN with acute renal failure and sepsis, which are risk factors associated with poor prognosis. He presented also an adynamic ileus, which can be caused by several conditions, including sepsis, especially for Gram-negative bacteria, as in our case, and he was in extremely poor general condition, making the patient an unlikely surgical candidate. An attempt at PCD has been proposed by the urologist even if the risks associated with the procedure were substantial.

Conclusions

The diagnosis of EPN is a challenge for the emergency clinicians by virtue of its rarity and nonspecific clinical signs and symptoms, with a higher mortality than conventional cases of pyelonephritis. EPN should be suspected in multimorbid patients with a poorly controlled diabetes mellitus, who present with recurrent pyelonephritis or relapsing urosepsis, generally caused by *E. Coli* species not responding to antibiotics. Non-contrast CT abdominal imaging is mandatory for the diagnosis and the classification of EPN. Severe sepsis, delirium, thrombocytopenia, or need for hemodialysis are negative prognostic factors. Given the multiple comorbid nature of patients who present with EPN, the management of EPN should be based on a multidisciplinary team decision-making, inclusive of urologists, nephrologists, radiologists, and microbiologists. A conservative approach using percutaneous drainage and microbiology-guided intravenous antibiotics is currently considered as preferable to bilateral nephrectomy.

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