

Typical Imaging of Emphysematous Cystitis: Illustrative Case Report

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Abstract

Case Report

Emphysematous cystitis is a rare disease characterized by primary infection of the urinary bladder with gas-producing pathogens. We report the case of a patient admitted to the Ibnou Roch emergency department for 2 weeks of abrupt onset of low back pain, with an elevated infectious workup. Abdomino-pelvic CT revealed a typical case of emphysematous cystitis. The exact mechanism contributing to the formation of gas in such cases is unknown. Various theories have been suggested, including fermentation of glucose in urine, with emphasis on disequilibrium between gas formation and clearance. Emphysematous cystitis has a highly variable presentation and course, with a considerable potential for complications. Further diagnostic imaging is highly recommended in diabetic patients with urinary tract infection who present with abdominal pain and hematuria. Knowledge of this rare entity may lead to early diagnosis and appropriate management.

Keywords : Emphysematous Cystitis, Computed Tomography, Urinary Bladder.

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INTRODUCTION

Emphysematous cystitis is a rare infection of the urinary bladder produced by gas forming uropathogens. *Escherichia coli* and *Klebsiella pneumoniae* are the predominant pathogens. The major risk factor is diabetes mellitus [1]. It has been postulated that the high tissue glucose levels provides the substrate for the microorganisms which are able to start fermentation of the glucose, resulting in the production of carbon dioxide.

The presence of gas in the urinary tract may be due to other pathological entities, such as infarction or fistula with a hollow viscera. Air can be introduced into the genitourinary tract by instruments, during surgery or following penetrating external trauma [6].

Gaseous infections of the urinary tract are sporadic and can affect any part of this system [7]. Gaseous infections of the urinary tract are sporadic and can affect any part of this system. The clinical presentation may be atypical and unrelated to the degree of inflammation. Abdominal pain is the major clinical manifestation [1]. The best diagnostic tool is abdominal CT [2], which may demonstrate the extent and the location of the gas collection in and around the bladder wall, or an air-fluid level in the bladder [3-5].

CASE REPORT

A 53-year-old man presented to the emergency department complaining of generalized weakness, macrohematuria, lower abdominal pain and dysuria for the past 2 weeks. He had fever, chills, nausea, vomiting, diarrhea, a history of hematuria and vesico sphincter disorders of urinary incontinence. Her medical history was marked by type 2 diabetes mellitus, complicated by diabetic retinopathy and nephropathy (baseline creatinine 2 mg/dl), essential hypertension and hyperlipidemia. She did not consume alcohol or tobacco.

On admission, the patient was hemodynamically and respiratory stable with a Glasgow score of 15/15, walking with steppage, his blood pressure was 173/86 mm Hg, pulse 121/minute and rectal temperature 36.9°C. Physical examination revealed bilateral lumbar and suprapubic tenderness. Blood count showed 45,000 white blood cells/ml. Urinalysis revealed large numbers of white blood cells and 8-10 red blood cells per high-power field (HPF), and a C-reactive protein (CRP) of 101.3 mg/dL. Serum glucose was 460 mg/dL.

Ultrasound examination of the urinary system showed normal-sized kidneys with dilatation of the excretory cavities on the right. A stone was suspected in the right kidney. The patient was admitted with a presumptive diagnosis of urinary tract infection.

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Empirical treatment was initiated with IV ceftriaxone. The following day, due to persistent abdominal pain and ultrasound findings, an abdominal CT scan was performed without contrast.

A CT scan revealed thickening of the bladder wall, with intramural and intraluminal gas bubbles and opacification of the perivesicular fat. A diagnosis of CE was made and a urinary catheter was inserted, which drained macrohematuria with a large number of blood clots, but no pneumaturia. On the second day of hospitalization, empiric therapy was replaced by

piperacillin/tazobactam and gentamicin. Over the following days, the patient's condition improved, urine became clearer and laboratory tests gradually normalized. A urine culture revealed 106 *E.coli* colonies. Cystoscopy was performed 9 days after admission, showing a significant reduction in the number of intramural gas bubbles and the amount of intraluminal gas. Perivesicular fatty opacification had disappeared. Cystoscopy revealed no pathology. The patient was treated with intravenous antibiotics for a total of 8 days and discharged.

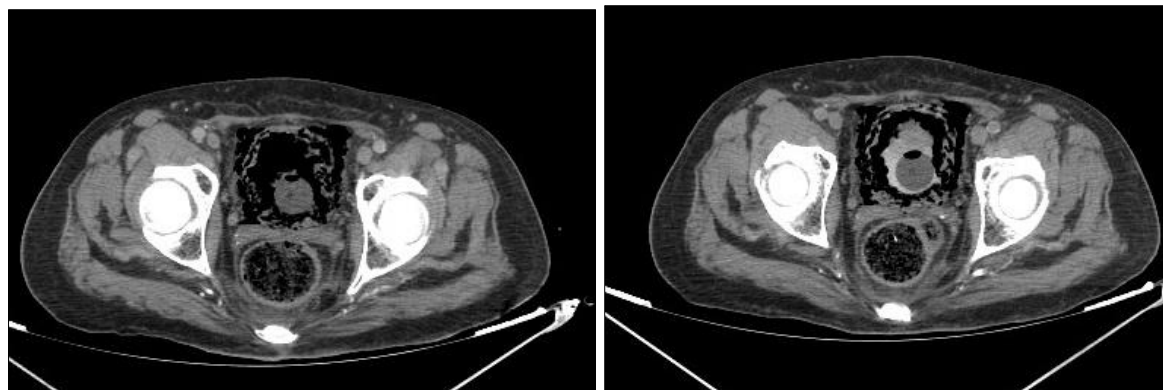


Figure 1 : CT scan revealed thickening of the bladder wall, with intramural and intraluminal gas bubbles and opacification of the perivesicular fat

DISCUSSION

Gas forming bacteria are uncommonly reported as pathogens in the urinary tract mostly in diabetic patients. Emphysematous pyelonephritis is presented by air detected in the kidney or collecting system. It may be a life threatening infection frequently requiring surgical treatment. Emphysematous cystitis is a rare condition associated with an increased risk of asymptomatic bacteriuria. Patients with indwelling urethral catheters, long standing UTIs, bladder outlet obstruction or neurogenic bladders are considered to be at higher risk to develop complicated UTIs such as emphysematous cystitis.

As in the presented case, emphysematous cystitis is characterized mainly by pockets of gas forming in and around the bladder wall caused by ferment bacteria [8].

The exact mechanism of gas formation in emphysematous infections is unclear. A proposed explanation in diabetic patients includes production of CO₂ by infecting microorganisms demonstrating gas-forming ability. This is made feasible by fermentation of the high glucose concentration in the urine and tissues, leading to the accumulation of acids, and thus lowering the local pH. Gas-forming microorganisms produce enzymes, which convert the acids to CO₂ when the pH reaches 6 or lower. A variety of fermentation pathways has evolved in microorganisms, including lactic acid fermentation (*Streptococcus*, *Lactobacillus*), alcohol

fermentation (a large number of yeasts and a smaller number of bacteria), mixed acid (formic acid) fermentation (most *Enterobacteriaceae*), butyric acid fermentation (*Clostridium*), butanediol fermentation (*Enterobacter*), and propionic acid fermentation (*Propionibacterium*). The fermentation capabilities of these pathogens, which are not always considered to be classical gas producers, may explain their involvement in emphysematous infections [9].

Because emphysematous infections of the urinary tract may occur in nondiabetic patients, it has been proposed that urinary lactose or tissue proteins may serve as substrates for gas formation. A unifying mechanism for the different patient populations suggested that the pathogenesis of gas bubble formation involves rapid catabolism of any type, resulting in increased production of gas. In addition, there is impaired transportation of the formed gas, due to local inflammation or obstructive uropathy increasing the local pressure and impairing the circulation, or vascular disease (for example, in diabetes). The accumulation of gas further increases the local pressure and may lead to infarction of the adjacent tissues. The infarcted tissue might in turn provide a good culture medium for gas-forming pathogens, augmenting the barrier to gas transportation and thus creating a vicious circle [10].

As symptoms are of no help in reaching a diagnosis, appropriate diagnostic imaging is imperative to establish the diagnosis of EC. Our data indicate that

abdominal and pelvic CT is the most valuable imaging modality for the diagnosis of EC. Plain X-ray radiography (Figure 3) has reportedly been regarded as a highly sensitive tool, but findings on plain X-ray may be confused with rectal gas, emphysematous vaginitis, pneumatosis cystoides intestinalis, and gas gangrene of

the uterus, resulting in poor specificity. The use of CT, intravenous pyelogram, cystoscopy, and/or lower gastrointestinal imaging is important for ruling out a colo-vesical fistula secondary to diverticulitis of the colon, colonic carcinoma, or less commonly, Crohn disease [11].



Figure 2: A plain abdominal X-ray demonstrating the presence of pelvic gas in a case of emphysematous cystitis. From emergency radiology department, CHU Ibn roched, Casablanca, Morocco

CONCLUSION

Clinicians should be aware of the clinical entity of EC. Based on our findings, suspicion of this disease should be aroused by abdominal pain in a diabetic patient, with or without a clinical presentation suggestive of UTI, especially when hematuria is present. In such cases, we suggest conducting a plain abdominal X-ray for screening, followed by abdominal CT when urinary bladder gas is present.

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