

## CLINICAL VIGNETTE

# Emphysematous Cystitis

Michael A. Pfeffer, M.D.

Emphysematous cystitis is a type of complicated urinary tract infection in which gas is found within the urinary bladder wall<sup>1</sup>. It is a rare condition typically found in elderly, diabetic patients<sup>2,3</sup> that presents significant diagnostic challenges. When identified early by radiography, emphysematous cystitis responds well to medical therapy.

### Case Report

A 77-year-old female with a history of diabetes mellitus requiring insulin presented to the emergency department complaining of bilateral hip pain after getting out of bed. She was recently hospitalized for hip and back pain 1 month prior to admission. Workup at that time was remarkable for bilateral sacral insufficiency fractures and she was placed on oral hydromorphone. Shortly after that hospitalization, she developed urinary incontinence and was started on tolterodine. She described her current hip pain as sharp, constant, and severe. She denied any recent trauma or falls, and denied any fevers, chills, dysuria, or hematuria.

Physical examination was remarkable for tachycardia, pain with palpation of the pelvic bones, and pain with hip extension and flexion bilaterally. She did not have



FIGURE 1: Supine pelvic radiograph showing an "air and soft-tissue doughnut sign" indicated by the arrow.

any flank or abdominal pain. Routine lab testing was remarkable for a white blood cell count of  $20.3 \times 10^3/\mu\text{L}$  with 92% neutrophils, a creatinine of 3.2 mg/dL (baseline 1.0 mg/dL), and a urinalysis with 50-100 red blood cells per high-powered field, 20-50 white blood cells per high-powered field, and many bacteria. Given her hip pain, an x-ray of the pelvis was obtained (Figure 1). It showed a superior left pubic ramus fracture and abnormal gas in the wall of the urinary bladder. A CT scan of the abdomen and pelvis without contrast (Figure 2) confirmed the finding of emphysematous cystitis.

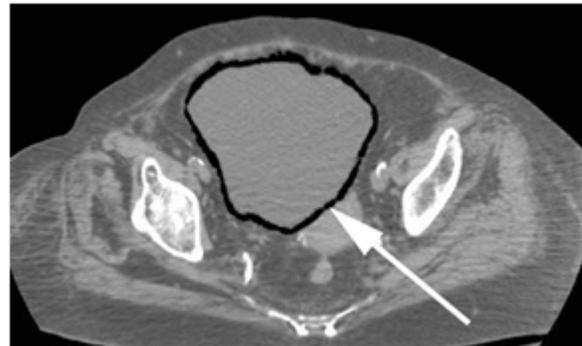


FIGURE 2: CT abdomen and pelvis showing air in the urinary bladder wall indicated by the arrow.

She was admitted for sepsis secondary to acute emphysematous cystitis. A urinary catheter was placed and she was started on piperacillin-tazobactam and intravenous fluids. Her urine culture grew *Klebsiella oxytoca* and her antibiotics were narrowed to ciprofloxacin. Her white blood cell count and creatine normalized. Repeat CT imaging on hospital day 10 showed resolution of the emphysematous cystitis. The Foley catheter was removed and she completed a 4 week total course of antibiotics.

### Discussion

Emphysematous cystitis, or "cystitis emphysematosa," was first defined by Bailey in the medical literature in 1961 in his case series of 19 patients<sup>1</sup>, but was recognized as early as 1926 during autopsies of animals and humans<sup>2</sup>. While the pathophysiology is not completely understood, one mechanism proposes that mixed acid fermentation of glucose by bacteria results in gas formation in the bladder wall<sup>4</sup>. This mechanism explains the occurrence in diabetics who have high glucose levels within tissues and impaired host response<sup>3</sup>. However, this does not explain the development of emphysematous cystitis in patients who are nondiabetic. Therefore, other mech-

anisms that have been proposed involve impaired circulation, local inflammation, inadequate host response, and rapid catabolism of any substrate, such as glucose or protein <sup>2</sup>.

The overall incidence of emphysematous cystitis is unknown, though it is a rare complication of lower urinary tract infections. It is more commonly seen in women (64% to 70%), and most commonly found in diabetics (62% to 67%), both insulin- and noninsulin-dependent. The mean age ranges from 62 to 69 years. Other conditions that are associated with emphysematous cystitis include neurogenic bladder, immunosuppression, bladder outlet obstruction, and recurrent urinary tract infections <sup>2,3</sup>.

*Escherichia coli* is the most common organism identified in emphysematous cystitis (57% to 58%), followed by *Klebsiella* species (21%). Other organisms reported include *Enterococcus*, *Enterobacter*, *Clostridium perfringens*, *Proteus mirabilis*, and *Pseudomonas aeruginosa* <sup>2,3</sup>. More recently, *Candida albicans* has been identified as the causative organism, particularly in patients with chronic indwelling urinary catheters on broad-spectrum antibiotics <sup>5</sup>.

Patients typically present with abdominal pain (80%) according to the case review by Grupper et. al. However, typical symptoms of a urinary tract infection, such as dysuria, hematuria, urinary frequency, and fevers, occurred less than 50% of the time <sup>2</sup>. In the case review by Thomas et. al., approximately 7% of patients were asymptomatic and were diagnosed incidentally on abdominal imaging <sup>3</sup>. Laboratory findings typically mimic that of an uncomplicated urinary tract infection, with microscopic (or gross) hematuria and leukocyturia, with leukocytosis occurring slightly more than 50% of the time <sup>2</sup>. This makes the diagnosis of emphysematous cystitis challenging and requires a high clinical suspicion to obtain imaging.

Radiographic imaging is the easiest and fastest way to make a diagnosis of emphysematous cystitis. A plain film of the abdomen shows an "air and soft-tissue doughnut sign" in the pelvis <sup>6</sup>. Ultrasound may also be used to image the urinary bladder, though it is not as sensitive as plain films <sup>2,7</sup>. CT scanning is the preferred imaging technique, as it can differentiate between emphysematous cystitis and adjacent bowel

gas <sup>8</sup>, and identify emphysematous cystitis in patients without air on plain films. It can also detect intra-abdominal pathology, such as abscesses and involvement of the kidneys, and visualize fistulas that communicate with the urinary bladder that may necessitate surgical intervention <sup>3</sup>. In addition, it is also useful to assess for resolution <sup>4</sup>. Cystoscopy can also be performed. Direct visualization of the bladder may reveal tiny gas bubbles covering the mucosa that can be easily ruptured by the cystoscope <sup>5,9</sup>.

There are no specific guidelines on the management of emphysematous cystitis. Typically, urinary and blood cultures are obtained and then patients are treated with broad-spectrum antibiotics until an organism can be identified. Given the typical organisms cultured in patients with this condition, appropriate empiric coverage includes piperacillin-tazobactam, a carbapenem, a fluoroquinolone, or ampicillin and gentamicin. As these patients typically have a history of recurrent urinary tract infections, obtaining prior culture and sensitivity results is extremely helpful to guide your initial choice of antibiotics. In patients at risk for or with a history of extended spectrum beta-lactamase resistant organisms, such as *E coli* and *Klebsiella pneumoniae*, a carbapenem should be used <sup>10</sup>. Antifungal coverage, such as fluconazole or amphotericin B, should be considered in patients at risk for candiduria. Once an organism is obtained, the antibiotics may be narrowed according to the sensitivity results. Duration of therapy is unknown. The literature ranged from a median of 10 days of treatment <sup>2</sup> to 6 weeks of treatment <sup>8</sup>. Infectious disease consultation can help with decisions on treatment duration.

Additional management may include urinary bladder catheterization, performed in 55% of patients in the Grupper et. al. series <sup>2</sup>, and should include glucose control and deep venous thrombosis prophylaxis. Patients should be closely monitored for peritoneal signs and for clinical improvement within 24 to 28 hours. Patients who do not respond to medical management, or have complications such as peritonitis, may require partial or total cystectomy and/or surgical debridement <sup>3,4</sup>. These complications occurred in 10% to 19% of patients <sup>2,3</sup>.

Prognosis can be good with early medical treatment, although a mortality rate of 7% to 10% has been reported, compared with a mortality rate of 50% in

patients with emphysematous pyelonephritis <sup>2,3</sup>.

### **Conclusion**

Emphysematous cystitis is a rare complication of lower urinary tract infections, more often seen in diabetic, elderly women. Given its nonspecific clinical presentation and laboratory findings, it is a difficult diagnosis to make and requires a high clinical suspicion in high-risk patients. CT scanning is the most sensitive modality to diagnose emphysematous cystitis, but plain films may be diagnostic. Early treatment with broad-spectrum antibiotics typically is sufficient, but up to 1/4 of patients may require surgical management.

There are no guidelines or recommendations on whom to obtain imaging to assess for emphysematous cystitis, nor are there any studies investigating this question. Given its very low prevalence, routine imaging in patients with urinalysis findings consistent with cystitis cannot be warranted. However, keep this diagnosis in mind in high-risk patients with urinary tract infections who do not improve with antibiotic therapy in 1 to 2 days.

### **REFERENCES**

1. **Bailey H.** Cystitis emphysematosa; 19 cases with intraluminal and interstitial collections of gas. *Am J Roentgenol Radium Ther Nucl Med.* 1961 Nov;86:850-62.
2. **Grupper M, Kravtsov A, Potasman I.** Emphysematous cystitis: illustrative case report and review of the literature. *Medicine (Baltimore).* 2007 Jan;86(1):47-53.
3. **Thomas AA, Lane BR, Thomas AZ, Remer EM, Campbell SC, Shoskes DA.** Emphysematous cystitis: a review of 135 cases. *BJU Int.* 2007 Jul;100(1):17-20. Epub 2007 May 17.
4. **Mokabberi R, Ravakhah K.** Emphysematous urinary tract infections: diagnosis, treatment and survival (case review series). *Am J Med Sci.* 2007 Feb;333(2):111-6. Review.
5. **Ankel F, Wolfson AB, Stapczynski JS.** Emphysematous cystitis: a complication of urinary tract infection occurring predominantly in diabetic women. *Ann Emerg Med.* 1990 Apr;19(4):404-6.
6. **Asada S, Kawasaki T.** Images in clinical medicine. Emphysematous cystitis. *N Engl J Med.* 2003 Jul 17;349(3):258.
7. **Hung SF, Liu KL, Yu HJ, Huang KH.** Emphysematous cystitis. *Int J Infect Dis.* 2009 Aug 6. [Epub ahead of print]
8. **Perlemoine C, Neau D, Ragnaud JM, Gin H, Sahnoun A, Pariente JL, Rigalleau V.** Emphysematous cystitis. *Diabetes Metab.* 2004 Sep;30(4):377-9.
9. **Reese AC, Stoller ML.** Emphysematous Cystitis. *Urology.* 2009 Oct 23. [Epub ahead of print]
10. **Paterson DL, Ko WC, Von Gottberg A, Mohapatra S, Casellas JM, Goossens H, Mulazimoglu L, Trenholme G, Klugman KP, Bonomo RA, Rice LB, Wagener MM, McCormack JG, Yu VL.** Antibiotic therapy for *Klebsiella pneumoniae* bacteremia: implications of production of extended-spectrum beta-lactamases. *Clin Infect Dis.* 2004 Jul 1;39(1):31-7. Epub 2004 Jun 8.

Submitted on November 2, 2009.