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Emphysematous Cystitis: Report of Two Cases and Review of the Literature

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Abstract

Emphysematous cystitis is a rare complication of lower urinary tract infection whose prognosis is conditioned by the delay in treatment. The predisposition of diabetic patients to urinary infections caused by gas-producing bacteria is considered one of the most common factors in the occurrence of emphysematous cystitis. The currently recommended diagnostic test is CT scanning, which has definite value in assessing gas accumulation in the bladder wall and lumen. The authors report the observations of two patients aged 68 and 80 who were treated for emphysematous cystitis complicating diabetes mellitus. The evolution was favorable under treatment with antibiotic therapy, insulin therapy and bladder drainage.

Keywords

Emphysematous Cystitis, Computed Tomography, Lower Urinary Tract Infection, Diabetes Mellitus

1. Introduction

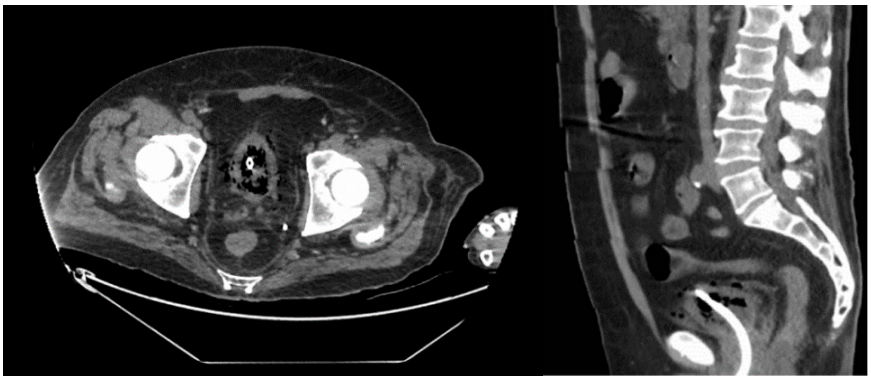
Emphysematous cystitis is a rare complication of lower urinary tract infection [1]. It was described for the first time in 1882 by EL Keyes [2] as pneumaturia and it was in 1961 that it was defined as "emphysematous cystitis" by Bailey [3]. It is a serious infection that can be life-threatening and is most often observed in poorly balanced diabetic patients in 60% to 70% of cases, immunocompromised people and patients with an underbladder obstruction or a neurogenic bladder [1]. Its diagnosis is radiological, based on evidence of gas accumulation in the lumen

and/or wall of the bladder [3] [4] [5] [6]. Its prevalence could be underestimated, because not all patients undergo radiological investigation, especially those without any risk factors [1] [6] or those with mild symptoms. The prognosis of emphysematous cystitis is conditioned by the time taken to treat it [1]. In this article, we report the observations of two diabetic patients who presented with emphysematous cystitis. In one case, emphysematous cystitis was the condition that led to the discovery of diabetes mellitus. The evolution was favorable under treatment with antibiotic therapy, insulin therapy and bladder drainage. A review of the literature will be presented to provide a general description of emphysematous cystitis.

2. Patients

2.1. Observation Number 1

Mr. SB, aged 68, was admitted for diffuse abdominal pain predominantly in the hypogastrium. The interview noted that the patient is hypertensive, does not know he is diabetic; he was being monitored for a prostate tumor complicated by bladder retention for which he had had an indwelling catheter for 3 weeks. On clinical examination it was noted that the patient was febrile at 39.3˚C, with good general condition. He was wearing a urethro-vesical catheter 18 which brought back cloudy urine with the presence of air in the collection bag. The abdomen was soft on palpation, tender in the periumbilical region, the hypogastrium and both iliac fossae. There was no bladder globe. On rectal examination, the prostate was enlarged, approximately 50 ml, painless, regular surface and elastic consistency. An abdominopelvic CT scan revealed diffuse bladder wall thickening, with the presence of multiple air bubbles within the bladder lumen, the bladder wall and at the level of the perivesical fat, thus posing the diagnosis of an emphysematous cystitis (**Figures 1(a)-(b)**). Biologically, we noted an inflammatory syndrome (leukocytes at 22,000/mm^3 with a neutrophil predominance,



(a) (b)

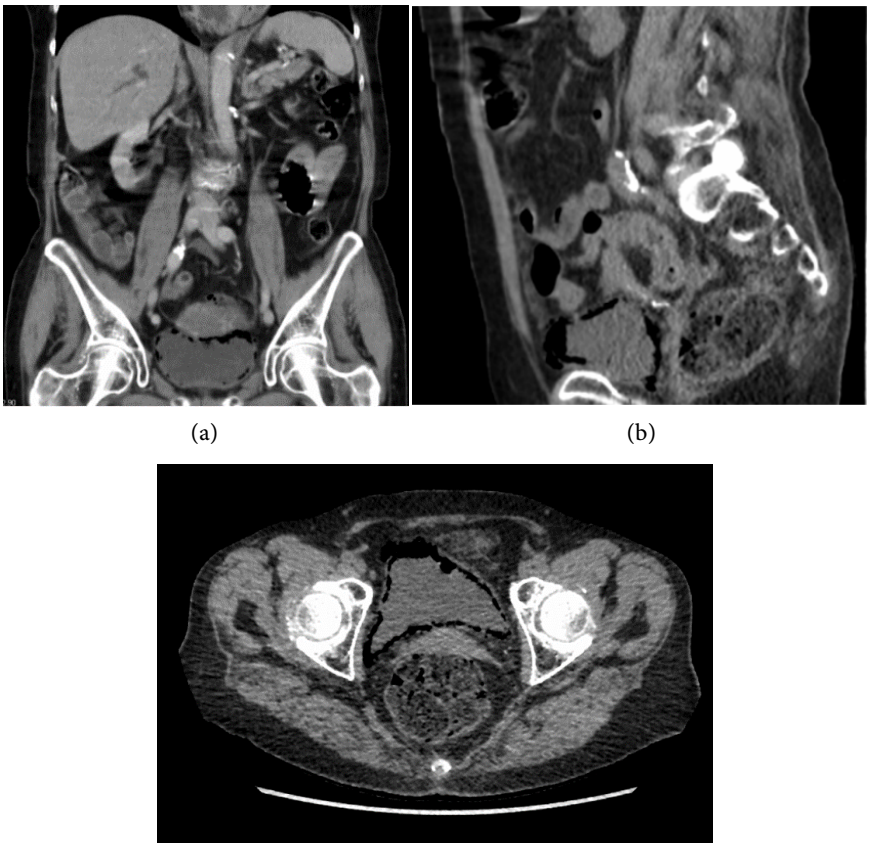
Figure 1. (a) Pelvic CT scan in axial section showing the presence of intraluminal, intraparietal, and perivesical gas bubbles. (b) Abdominopelvic CT scan in sagittal section showing a gas density image in the lumen, the wall of the bladder with gas diffusion in the perivesical spaces.

CRP at 275 mg/L), hyperglycemia at 3.8 g/l with glycated hemoglobin at 9%. The urine test strip noted the presence of leukocyturia, glucosuria, nitrites and acetonuria. Total PSA was 1.46 ng /ml, renal function was normal. Probabilistic broad-spectrum antibiotic therapy was started urgently, combining ceftriaxone and gentamycin, and insulin therapy was initiated. The urethrovesical catheter was changed, the tip of the catheter removed and a urine sample taken from the new catheter was sent to the laboratory. The culture of the two samples made it possible to identify an *Escherichia coli* sensitive to ofloxacin thus allowing the adaptation of antibiotic monotherapy from the fifth day of treatment.

The evolution was satisfactory with apyrexia achieved on the third day. The patient was discharged on the seventh day after adaptation of insulin therapy and good blood sugar control. An upper prostatic adenomectomy was performed three months later; the postoperative course was simple.

2.2. Observation Number 2

Mrs. RJ, 81 years old, was admitted for macroscopic hematuria, painful urination and hypogastric pain. She had a history of arterial hypertension controlled by monotherapy with Amlodipine, of type 2 diabetes mellitus on oral antidiabetics for 26 years. The clinical examination noted hyperthermia at 38.2˚C, deterioration



(a) (b)

(c)

Figure 2. Coronal, sagittal and axial views of plain CT scan of the abdomen showing a diffuse collection of gas in the bladder wall.

in general condition, the patient was conscious. Blood pressure was 150/80 mmHg, cardiopulmonary examination was normal. Pelvic palpation triggered pain, there was no bladder globus, pelvic touch was normal. The biological assessment revealed an inflammatory syndrome consisting of hyperleukocytosis of 19,700 whites with a neutrophil predominance, a CRP of 311 mg/l, a hemoglobin level of 6 g/dl, platelet level of 245,000/mm^3, a blood sugar level of 2.16 g/l with 8% glycated hemoglobin. Renal function was normal. The CT images revealed the presence of multiple diffuse air bubbles within the bladder wall related to emphysematous cystitis (**Figures 2(a)-(c)**). There were no tumor lesions on the urinary tree. A urine sample was taken for culture.

Emergency treatment combined double-current urethrovesical catheterization with continuous physiological saline irrigation, broad-spectrum probabilistic dual antibiotic therapy, and blood transfusion of packed red cells. Oral antidiabetics were stopped and the patient was put on insulin therapy.

The evolution was characterized by an improvement in general condition with apyrexia and cessation of hematuria on the second day of treatment.

Urine culture identified *Klebsiella pneumoniae* sensitive to quinolones. The patient was discharged from the hospital on the tenth day under oral antibiotic coverage, consisting of ciprofloxacin, for a period of 20 days and under insulin therapy. The return to oral antidiabetics was made externally by the diabetologist. A cystoscopy performed at the 3rdweekwas normal.

3. Discussion

Emphysematous cystitis is a rare condition that is considered a complicated form of lower urinary tract infections. Its prevalence has been increasing in recent decades thanks to improvements in radiological diagnostic methods [1].

The etiological factors are mainly poorly controlled diabetes in 60 to 70% of cases, lower urinary tract obstruction, immunosuppression and neurological bladder [1] [7]-[12]. Women are more likely to develop emphysematous cystitis [13] [14] [15] [16] [17], approximately two women are affected for every man [6].

On the physiopathological level, it is believed that the presence of gas in the lumen and/or the bladder wall in emphysematous cystitis is secondary to microbial fermentation in anaerobiosis [5] [15] [18]. This process is increased by urinary stasis, which promotes bacterial overgrowth, and by dehydration which predisposes to ischemia and poor tissue oxygenation of the urinary tract [14] [18] [19] [20] [21]. Glucosuria is one of the key factors because it provides bacteria with the necessary substrate for a fermentation reaction resulting in the formation of carbon dioxide [5] [11]. The germs producing carbon dioxide attack not only the glucose present in the urine of diabetics, which causes gas to appear in the bladder cavity, but also the glucose contained in the parietal cells of the bladder, which results in by the appearance of carbon dioxide bubbles within the bladder wall itself [19]. However, individuals with normal tissue glucose concentration,

such as non-diabetic patients or those with well-controlled diabetes, may also develop emphysematous cystitis in the presence of substrates such as lactose and albumin in the urine [22] [23]. The hemorrhagic character in emphysematous cystitis is the result of the activation of inflammatory molecular mechanisms which result in a diffuse cell death reaction: pyroptosis [12] [24].

The germs most frequently involved are facultative aerobic-anaerobic germs including *Escherichia coli* (60%), *Klebsiella pneumoniae*, *Proteus mirabilis or vulgaris* [7] [14] [25] [26]. Strict anaerobic germs such as *Clostridium perfringens* are exceptional in this pathology [27]. Rare cases of emphysematous cystitis secondary to *Candida albicans* have been reported [26] [28].

The clinical presentation of emphysematous cystitis is very variable, often atypical, unrelated to the degree of inflammation [5]. Approximately 7% of patients are asymptomatic [1] [5] [11]. They are often diagnosed incidentally on abdominal imaging planned to evaluate other medical conditions [1] [29]. The fever is inconstant [30], it is often moderate. Severe sepsis with deterioration of general condition and late-onset disturbance of consciousness sometimes lead to the diagnosis [19] [31] [32]. Abdominal pain is the most common clinical manifestation, reported in 80% of cases [6] [7]. Symptoms such as frequency, urgency and dysuria are non-specific and generally of low intensity, being present in approximately 50% of patients [33] [34]. Macroscopic hematuria is also common (60%) [17]. Pneumaturia may be associated in 7 to 10% of cases [5]. In patients with bladder catheterization, it is observed in the urinary bag in almost 70% of cases [7] [14] [35]. Although pneumaturia appears to be a very specific symptom, it is a rare patient complaint that is not pathognomonic for emphysematous cystitis because it requires the elimination of a perforation of a hollow organ in the pathway urinary excretory [19]. Hypogastric tympanism which can be detected by percussion, indicating pneumaturia, in a patient with a bladder globe is not always evident in a sensitive hypogastrium [19].

Given its clinical presentation, which is very variable and not very specific, the diagnosis of emphysematous cystitis remains radiological [1]. Plain abdominal radiography and ultrasound, which are the most common imaging tests, are not recommended for making the diagnosis of emphysematous cystitis [7]. However, they can sometimes highlight suggestive signs: Radiography of the abdomen without preparation can show a pneumobladder in the lying position and a pelvic fluid level in the standing position [18] [36], ultrasound can reveal bubbles of air with shadow cone within the bladder wall and polypoid islands in the bladder lumen [7]. The reference imaging test is the abdominopelvic tomography: it makes it possible to confirm the positive diagnosis by specifying the presence of air in the lumen and/the bladder wall. It also makes it possible to assess the severity, to carry out an assessment of the extent of the different gas collections and to look for possible associated damage to the upper urinary tract [8] [36] [37] [38]. The scanner also makes it possible to eliminate differential diagnoses (other sources of pelvic air), namely primary pneumaturia or communication with nearby hollow organs such as vesicodigestive or vesicovaginal fistulas [36],

gas gangrene of the uterus and emphysematous vaginitis [14] [36]. In the presence of hematuria, the CT scan makes it possible to make a positive diagnosis of hemorrhagic emphysematous cystitis and to exclude other causes of hematuria (neoplastic or stone disease) [12]. Also allows the evolution to be appreciated on control images [1].

Bacteriological samples are essential to identify the responsible germ and guide antibiotic therapy [1] [6] [14]. A blood culture should be obtained if possible, because approximately 50% of patients with emphysematous cystitis have bacteremia [7] [39].

Emphysematous cystitis is associated with morbidity and mortality which remains high, however its prognosis is improved if it is diagnosed in time and after rapid initiation of well-adapted treatment [1] [10] [19]. The treatment of uncomplicated emphysematous cystitis is medical [14]. Treatment combines drainage of the bladder by the placement of a permanent urinary catheter, broad-spectrum intravenous antibiotic therapy adapted secondarily to the germ in question, strict correction of hyperglycemia and treatment of any underlying comorbidity [12] [38] [40]. The indwelling urinary catheter allows the bladder to rest and urine to be collected and cultured [40]. In the event of hemorrhage, bladder washing with continuous irrigation and hyperhydration is necessary; depending on the severity, cauterization of the hemorrhagic lesions may be necessary urgently [12] as well as correction of the anemia.

The evolution is most often favorable with improvement within 48 hours when the treatment is adequate. After clinical improvement is achieved, parenteral treatment can be replaced by oral treatment [39]. The duration of treatment is poorly defined and depends on the clinical response [36], there is currently no consensus: it can vary between 3 and 6 weeks [4] [7].

In the absence of adequate care or late diagnosis, this condition, considered potentially severe, can develop into complications: emphysematous pyelonephritis with risk of septic shock or peritonitis in the event of necrosis and perforation of the bladder wall [5] [6] [41]. These complications may require surgical intervention (cystectomy, surgical debridement) [1] [42]. The mortality rate does not exceed 7% in the event of early treatment [1].

Preventive measures for the management of emphysematous cystitis are necessary to obtain better results [1] [14] [43]. The most effective strategy for preventing emphysematous cystitis is to educate both healthcare providers and patients by encouraging vigilance regarding this potentially life-threatening condition [1] [14]. Studies report that patients with diabetic imbalance with a glycated hemoglobin level greater than or equal to 8.0% have a higher risk of developing complications such as diabetic macroangiopathy and neurogenic bladder [44]. The use of CT scanning is therefore necessary for any patient presenting signs of urinary infection, even mild ones, with fever and signs of deterioration in general condition and having a history of diabetes or other risk factors, in order to detect early or exclude the presence of emphysematous cystitis [5] and also promote rapid referral. Only early medical intervention can contribute to obtaining a fa-

vorable prognosis.

4. Conclusion

Emphysematous cystitis is a rare infection; its clinical presentation is variable and not very specific. Predisposing risk factors include advanced age and uncontrolled diabetes or complicated by neurogenic bladder. Its diagnosis is relatively easy and is based on the elements of the history and the use of abdominopelvic tomography which constitutes the reference radiological examination. Early and appropriate treatment is necessary to improve the prognosis.

Ethical Consideration

This work was carried out as part of scientific research. Therefore, informed consent was obtained from the patients. It has been carefully explained that anonymity will be respected.

Author Contributions

RBM: project launch, data acquisition, preparation and writing of the manuscript.

AMN, AWO and PAB: revision and correction of the manuscript, and approval of the final version.

All authors read and approved the final version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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