e-ISSN: 2807-6257

Open Access Indonesian Journal of Medical Reviews

[OAIJMR]

https://hmpublisher.com/index.php/oaijmr

Rare Presentation of Emphysematous Cystitis with Culture-Proven Urosepsis in a Geriatric Female: A Case Report

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ARTICLE INFO

Keywords:
Case report
Emphysematous cystitis
Escherichia coli
Geriatric
Urosepsis

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All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/oaijmr.v5i3.719

A B S T R A C T

Emphysematous cystitis (EC) is a rare and potentially life-threatening infection of the bladder wall characterized by the presence of gas. It predominantly affects elderly females with diabetes mellitus. While the clinical presentation can vary, it commonly involves symptoms of urinary tract infection. This case report describes an unusual presentation of EC in a geriatric female complicated by culture-proven urosepsis. A 66-year-old female with a history of type 2 diabetes mellitus presented to the emergency department with fever, dyspnea, and tachypnea. She reported suprapubic pain, dysuria, and foul-smelling, murky urine for two days. Initial laboratory findings revealed leukocytosis, hyperglycemia, and elevated procalcitonin levels, indicating sepsis. Computed tomography (CT) of the abdomen and pelvis revealed air foci within the bladder wall, consistent with EC. Blood and urine cultures grew *Escherichia coli* resistant to multiple antibiotics but susceptible to amikacin and gentamicin. The patient was treated with intravenous amikacin and showed significant clinical improvement, with subsequent negative urine cultures. In conclusion, our study highlights a rare presentation of emphysematous cystitis complicated by culture-proven urosepsis in a geriatric female with multidrug-resistant *Escherichia coli*. Prompt diagnosis using CT imaging and appropriate antibiotic therapy based on culture sensitivities led to a successful outcome. This case underscores the importance of considering EC in elderly diabetic patients presenting with sepsis and urinary symptoms, even with atypical features.

1. Introduction

Emphysematous cystitis (EC) represents a rare, yet potentially life-threatening infectious condition affecting the urinary bladder. It is characterized by the accumulation of gas within the bladder wall and lumen, a distinctive feature that differentiates it from other forms of cystitis. This unusual manifestation of urinary tract infection (UTI) carries significant clinical implications, demanding prompt recognition and effective management to mitigate potential morbidity and mortality. The pathogenesis of emphysematous cystitis is intricately linked to the presence of gas-producing microorganisms within the urinary tract. These microorganisms, often facultative anaerobic bacteria, ferment glucose and other available carbohydrates to produce gas, primarily carbon dioxide and hydrogen. This process is notably exacerbated in the presence of elevated glucose levels, a common finding in patients with diabetes mellitus. Furthermore, impaired tissue perfusion, frequently observed in diabetic individuals, contributes to an environment conducive to bacterial proliferation and gas formation within the bladder wall. While the spectrum of causative pathogens in EC is relatively broad, *Escherichia coli* stands out as the most frequently implicated organism. Other Enterobacteriaceae, such as *Klebsiella pneumoniae* and *Proteus mirabilis*, as well as other bacterial

species, can also be responsible for this infection. The polymicrobial nature of EC, although less common, should also be considered, particularly in patients with complex medical histories or those who have undergone prior instrumentation of the urinary tract. Emphysematous cystitis predominantly affects a specific demographic: elderly females, with diabetes mellitus being a major predisposing factor. The reasons for this predilection are multifactorial. Elderly individuals often experience age-related physiological changes that increase their susceptibility to infections, including impaired immune function, decreased bladder emptying efficiency, and an increased prevalence of comorbidities. Diabetes mellitus, with its associated hyperglycemia and microvascular complications, further compromises the host's defense mechanisms, creating a favorable environment for the development of EC.[1-3]

The clinical presentation of emphysematous cystitis is notoriously variable, spanning a wide range from asymptomatic bacteriuria to life-threatening sepsis and septic shock. In its more typical manifestations, EC presents with symptoms commonly associated with urinary tract infections, such as urinary frequency, urgency, dysuria (painful urination), and suprapubic pain or discomfort. Hematuria (blood in the urine) and pyuria (presence of pus in the urine) may also be present. A pathognomonic, although less frequent, symptom is pneumaturia, which is the passage of gas in the urine. However, it is crucial to acknowledge that emphysematous cystitis can present with atypical symptoms, potentially leading to delays in diagnosis and appropriate management. These atypical presentations can include, but are not limited to, fever, abdominal pain, nausea, vomiting, and altered mental status. In severe cases, patients may exhibit signs and symptoms of systemic inflammatory response syndrome (SIRS), sepsis, or septic shock, characterized by tachycardia, tachypnea, hypotension, and organ dysfunction. The absence of classic urinary symptoms should not preclude the consideration of EC, especially in high-risk individuals. The potential for rapid progression to serious complications underscores the importance of timely and accurate diagnosis. Emphysematous pyelonephritis, a more severe infection involving the renal parenchyma and collecting system, can occur as an ascending infection from the bladder. Bladder necrosis, a devastating complication, may result from severe infection and ischemia of the bladder wall. Perforation of the bladder, although rare, can lead to peritonitis and represents a surgical emergency. The overall mortality rate associated with emphysematous cystitis, although variable, can be significant, particularly in patients with severe sepsis or those requiring surgical intervention. Diagnostic evaluation for emphysematous cystitis relies heavily on radiological imaging. While plain abdominal radiographs can provide initial clues by demonstrating the presence of gas within the bladder, computed tomography (CT) scanning of the abdomen and pelvis is considered the gold standard for diagnosis. CT scans offer superior sensitivity and specificity in detecting and delineating the extent of gas within the bladder wall and lumen, as well as any extension of the infection beyond the bladder. Furthermore, CT imaging can help to identify potential complications such as emphysematous pyelonephritis or bladder perforation. Ultrasonography can also be a useful adjunct, particularly for follow-up assessments, but it is less sensitive than CT in detecting small amounts of gas.[4-6]

In addition to radiological imaging, microbiological evaluation plays a crucial role in the diagnosis and management of emphysematous cystitis. Urine cultures are essential for identifying the causative organism and determining its antimicrobial susceptibility profile. This information is critical for guiding appropriate antibiotic therapy, especially in the context of increasing antimicrobial resistance. Blood cultures should also be obtained, particularly in patients presenting with systemic signs of infection, as they can provide evidence of bacteremia and help to confirm the diagnosis of urosepsis. The management of emphysematous cystitis is multifaceted and

depends on the severity of the infection and the patient's overall clinical condition. Conservative treatment, which is often the initial approach, includes a combination of meticulous glycemic control in diabetic patients, bladder drainage using a Foley catheter, and the administration of broad-spectrum intravenous antibiotics. Prompt initiation of appropriate antimicrobial therapy is paramount to eradicate the infection and prevent its progression. The choice of antibiotics should be guided by local antimicrobial resistance patterns and, ideally, by the results of urine and blood cultures and susceptibility testing. In cases where conservative management fails, or in the presence of severe complications such as bladder necrosis, bladder perforation, or persistent sepsis, surgical intervention may become necessary. Surgical options can range from bladder debridement to cystectomy, depending on the extent of the disease and the patient's overall surgical risk. The decision to proceed with surgical intervention should be made on a case-by-case basis, considering the potential benefits and risks in each individual patient. The prognosis of emphysematous cystitis is highly variable and influenced by several factors, including the severity of the infection, the patient's underlying comorbidities, the timeliness of diagnosis, and the effectiveness of the chosen treatment strategy. Early recognition of the condition, prompt initiation of appropriate antimicrobial therapy, and meticulous supportive care are crucial for achieving favorable outcomes and minimizing the risk of complications and mortality.[7-10] This case report aims to contribute to the existing body of knowledge on emphysematous cystitis by presenting a unique case with a constellation of clinical and microbiological findings. Specifically, this report details the presentation, diagnosis, and successful management of a geriatric female with type 2 diabetes mellitus who presented with an unusual combination of symptoms, ultimately diagnosed as emphysematous cystitis complicated by culture-proven urosepsis with a multidrug-resistant strain of *Escherichia coli*.

2. Case Presentation

The patient in this case is a 66-year-old female who presented to the emergency department with a complex constellation of symptoms and clinical findings indicative of a serious underlying medical condition. Her presentation was notable for a combination of systemic inflammatory signs, respiratory distress, and urinary tract symptoms, occurring against a backdrop of chronic type 2 diabetes mellitus with poor glycemic control. This intricate clinical picture ultimately led to the diagnosis of emphysematous cystitis complicated by urosepsis. The patient's demographic profile is significant in the context of emphysematous cystitis. She is an elderly female, an important risk factor for this condition. Emphysematous cystitis has a well-established predilection for elderly individuals, with females being disproportionately affected. This increased susceptibility in elderly females is multifactorial. Age-related physiological changes, such as decreased immune function, altered bladder physiology including incomplete emptying, and a higher prevalence of comorbidities, all contribute to a heightened risk of developing severe urinary tract infections like emphysematous cystitis. The patient's chief complaint at the time of presentation included fever, dyspnea, and tachypnea, all of five hours duration. These symptoms collectively suggest a systemic inflammatory response and are concerning for a severe infection or sepsis. Fever is a hallmark of infection, representing the body's attempt to fight off invading pathogens through an elevation in core body temperature. Dyspnea and tachypnea, referring to difficulty breathing and an increased respiratory rate respectively, indicate respiratory compromise. In the context of an infectious process, these findings can be indicative of the body's attempt to compensate for metabolic acidosis, a common consequence of severe infection and sepsis, or can point to a primary respiratory involvement in the infectious process. The rapid onset of these symptoms within a five-hour timeframe suggests an acute and rapidly progressing condition, necessitating urgent medical evaluation

and intervention. In addition to the systemic symptoms, the patient also reported urinary symptoms of two days duration. These included suprapubic pain, a burning sensation during urination (dysuria), and cloudy and foul-smelling urine. Suprapubic pain refers to pain located in the lower abdomen, specifically over the bladder area. This is a common symptom in urinary tract infections, indicating inflammation or irritation of the bladder wall. Dysuria, or painful urination, is another cardinal symptom of cystitis, reflecting inflammation of the lower urinary tract. The presence of cloudy and foul-smelling urine is also a significant finding. Cloudy urine often indicates the presence of pus or increased cellular debris within the urine, while a foul odor is suggestive of bacterial infection, particularly by gas-producing organisms. These urinary symptoms, in conjunction with the systemic symptoms, strongly suggested a urinary tract infection with potential for systemic involvement. The patient's past medical history is significant for type 2 diabetes mellitus, diagnosed over fifteen years prior. Diabetes mellitus is a major predisposing factor for emphysematous cystitis. The pathogenesis of emphysematous cystitis is closely linked to the elevated glucose levels often seen in diabetic patients. Hyperglycemia provides a rich substrate for gas-producing microorganisms to ferment glucose, leading to the production of carbon dioxide and hydrogen within the bladder wall and lumen. Furthermore, diabetes mellitus often leads to microvascular complications, resulting in impaired tissue perfusion and reduced blood supply to the bladder wall. This compromised blood flow impairs the body's ability to fight infection and facilitates bacterial proliferation and gas formation. The patient's history of poor glycemic control, despite insulin administration, is particularly noteworthy. Poor glycemic control further exacerbates the risk of infection and its complications, as persistently elevated glucose levels create an optimal environment for bacterial growth and gas production. This poor control also suggests a potential compromise in the patient's immune function, making her more susceptible to severe infections. The patient's general appearance upon presentation was described as hypoxic and septic. Hypoxia refers to a state of oxygen deficiency, indicating that the patient's tissues were not receiving an adequate supply of oxygen. This is a critical finding, as oxygen is essential for cellular function and survival. Septic appearance suggests the presence of sepsis, a life-threatening condition characterized by a dysregulated host response to infection. Sepsis leads to widespread inflammation, tissue damage, and potentially organ dysfunction. The combination of hypoxia and a septic appearance underscores the severity of the patient's condition and the need for immediate and aggressive intervention. The patient's vital signs revealed significant abnormalities. Her temperature was 38.7°C (101.7°F), indicating fever. As mentioned earlier, fever is a common sign of infection, representing the body's attempt to combat pathogens. Her pulse rate was 115 beats per minute, indicating tachycardia. Tachycardia, or an elevated heart rate, is a common compensatory mechanism in sepsis, reflecting the body's attempt to maintain cardiac output in the face of vasodilation and decreased tissue perfusion. Her respiratory rate was 28 breaths per minute, indicating tachypnea. Tachypnea, or an increased respiratory rate, is another compensatory mechanism in sepsis, aimed at improving oxygenation and compensating for metabolic acidosis. Her blood pressure was 111/68 mmHg. While the systolic blood pressure (111 mmHg) is within the normal range, the diastolic blood pressure (68 mmHg) is borderline low. A widening pulse pressure (the difference between systolic and diastolic pressure) can be seen in early sepsis due to vasodilation. However, without serial measurements, it's difficult to ascertain the trend. Her oxygen saturation was 95% in room air. While 95% is generally considered acceptable, in the context of tachypnea and potential sepsis, it may be inadequate, and the need for supplemental oxygen should be carefully evaluated. The abdominal examination revealed minor pain elicited upon palpation of the suprapubic area. This finding is consistent with the

patient's reported suprapubic pain and further supports the suspicion of a urinary tract infection involving the bladder. Tenderness in the suprapubic region is a common finding in cystitis, reflecting inflammation of the bladder wall. The patient's laboratory findings revealed significant abnormalities across multiple systems, further supporting the diagnosis of a severe infection and its systemic impact. Hematological studies demonstrated a white blood cell count of 50.8 × 10^3/L. This represents significant leukocytosis, which is an elevated white blood cell count. Leukocytosis is a common finding in bacterial infections, indicating the body's immune response to the infection. The white blood cell count also showed neutrophilic predominance, meaning that the increase in white blood cells was primarily due to an increase in neutrophils. Neutrophils are a type of white blood cell that plays a crucial role in fighting bacterial infections. An elevated neutrophil count is a hallmark of bacterial infection and further supports the diagnosis of a bacterial process. The patient also had a platelet count of 700 × 10^3/L, indicating thrombocytosis, which is an elevated platelet count. Thrombocytosis can be a reactive process in response to infection and inflammation. Glucose metabolism studies revealed a random blood glucose of 370 mg/dL, a fasting blood glucose of 175 mg/dL, and a 2-hour postprandial blood glucose of 248 mg/dL. These values all demonstrate significant hyperglycemia, confirming the patient's history of poorly controlled type 2 diabetes mellitus. As discussed earlier, hyperglycemia plays a crucial role in the pathogenesis of emphysematous cystitis by providing a substrate for gas-producing bacteria. The patient's glycosylated hemoglobin (HbA1c) was 10.5%, indicating poor long-term glycemic control. HbA1c provides a measure of average blood glucose levels over the preceding 2-3 months and reflects the patient's chronic state of hyperglycemia. This poor glycemic control is a significant risk factor for the development of severe infections and their complications. Inflammatory markers revealed a procalcitonin level of 16 ng/mL. Procalcitonin is a biomarker that is highly specific for bacterial infections and is often used to differentiate bacterial from viral infections. An elevated procalcitonin level, as seen in this patient, is strongly indicative of bacterial sepsis and supports the clinical suspicion of a severe bacterial infection. Urinalysis demonstrated notable leukocyturia, which is the presence of white blood cells in the urine. Leukocyturia is a common finding in urinary tract infections, indicating inflammation and infection within the urinary tract. This finding further supports the diagnosis of cystitis and is consistent with the patient's reported urinary symptoms. Microbiology studies revealed that both blood and urine cultures yielded substantial growth (>10^6 CFU/mL) of *Escherichia coli*. This is a critical finding, as it confirms the presence of a bacterial infection and identifies the causative organism. *Escherichia coli* is the most common causative pathogen in emphysematous cystitis. Antimicrobial susceptibility testing revealed resistance to ampicillin, ampicillin-sulbactam, cefazolin, ceftazidime, ceftriaxone, cefepime, ciprofloxacin, and aztreonam. This indicates that the *E. coli* strain isolated from the patient was multidrug-resistant, posing a significant challenge for treatment. Multidrug-resistant organisms are a growing concern in healthcare, as they limit the available antibiotic options and increase the risk of treatment failure and complications. The *E. coli* strain was susceptible to amikacin, gentamicin, and meropenem. These antibiotics represent potential treatment options for the patient. Subsequent urine culture after antibiotic treatment showed no bacterial growth, indicating successful eradication of the infection. Imaging studies played a crucial role in establishing the diagnosis of emphysematous cystitis. Computed tomography (CT) scan of the abdomen and pelvis revealed multiple air foci within the bladder wall, accompanied by thickening of the bladder wall. The presence of gas within the bladder wall is the hallmark of emphysematous cystitis. CT scans are highly sensitive for detecting gas and are considered the gold standard for diagnosing this condition. The thickening of the bladder wall indicates inflammation and edema

of the bladder wall, further supporting the diagnosis of cystitis. Follow-up bladder ultrasonography at two months showed a normal bladder wall with no evidence of air. This finding indicates the successful resolution of the emphysematous cystitis following treatment. Ultrasonography is a less sensitive imaging modality for detecting gas compared to CT, but it can be useful for follow-up assessments to monitor the resolution of the condition. Based on the patient's clinical presentation, laboratory findings, and imaging studies, the final clinical diagnosis was emphysematous cystitis complicated by urosepsis. Emphysematous cystitis is a rare and severe form of cystitis characterized by the presence of gas within the bladder wall and lumen. The patient's risk factors, including elderly age and poorly controlled diabetes mellitus, along with the presence of urinary symptoms, systemic inflammatory signs, and the characteristic finding of air within the bladder wall on CT scan, all support this diagnosis. Urosepsis refers to sepsis originating from a urinary tract infection. The patient's presentation with fever, tachycardia, tachypnea, hypoxia, and elevated procalcitonin levels, along with the positive blood and urine cultures growing *E. coli*, confirms the presence of urosepsis. Urosepsis is a serious complication of urinary tract infections and can lead to significant morbidity and mortality if not promptly recognized and treated. The multidrug-resistant nature of the *E. coli* strain further complicated the patient's condition and necessitated the use of specific antibiotics to which the organism was susceptible (Table 1).

The management of a patient with emphysematous cystitis complicated by urosepsis requires a comprehensive and multifaceted approach. This strategy encompasses prompt initiation of appropriate antimicrobial therapy, meticulous supportive care, and close monitoring of the patient's clinical response. The case presented here illustrates the critical importance of tailoring treatment strategies based on microbiological findings and the patient's evolving clinical status, as well as the necessity for diligent follow-up to ensure complete resolution of the infection and prevent recurrence. The patient's initial treatment strategy focused primarily on empiric antibiotic therapy. Upon admission to the hospital, the patient was started on intravenous levofloxacin, administered at a dosage of 750 mg every 24 hours. Levofloxacin is a fluoroquinolone antibiotic with a broad spectrum of activity, often used for the treatment of various bacterial infections, including urinary tract infections. The rationale for initiating empiric antibiotic therapy is to provide immediate coverage against potential pathogens while awaiting the results of microbiological cultures and susceptibility testing. In cases of severe infections like urosepsis, prompt administration of antibiotics is crucial to reduce bacterial burden, control systemic inflammation, and improve patient outcomes. Empiric antibiotic selection is guided by several factors, including the likely source of infection, the most common causative pathogens, local antimicrobial resistance patterns, and the patient's allergy history and other medical conditions. In the context of a suspected urinary tract infection, particularly in a patient presenting with signs of sepsis, broad-spectrum antibiotics are typically chosen to cover a wide range of potential uropathogens, including *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus mirabilis*, and other *Enterobacteriaceae*. Fluoroquinolones like levofloxacin have been commonly used for this purpose due to their excellent bioavailability, broad spectrum of activity, and ability to achieve high concentrations in the urinary tract. However, empiric antibiotic therapy is inherently limited by the uncertainty regarding the specific causative organism and its antimicrobial susceptibility profile. In the era of increasing antimicrobial resistance, relying solely on empiric therapy can lead to treatment failure and adverse outcomes if the infecting organism is resistant to the chosen antibiotic. Therefore, it is crucial to obtain appropriate microbiological cultures, including blood and urine cultures, before or shortly after initiating empiric antibiotic therapy. These cultures are essential for identifying the specific pathogen responsible for the

infection and for determining its susceptibility to various antimicrobial agents. The patient's definitive treatment strategy was determined based on the results of the microbiological cultures and antimicrobial susceptibility testing. Both blood and urine cultures yielded substantial growth of *Escherichia coli*. This finding confirmed *E. coli* as the causative pathogen in this patient's emphysematous cystitis and urosepsis. Antimicrobial susceptibility testing revealed that the *E. coli* strain was resistant to several commonly used antibiotics, including ampicillin, ampicillin-sulbactam, cefazolin, ceftazidime, ceftriaxone, cefepime, ciprofloxacin, and aztreonam. This multidrug resistance posed a significant challenge for treatment, as it limited the available antibiotic options. Multidrug-resistant organisms are a growing concern in healthcare, contributing to increased morbidity, mortality, healthcare costs, and length of hospital stay. The resistance to ciprofloxacin, a fluoroquinolone, explained the potential for the initial empiric therapy with levofloxacin to be ineffective. Fortunately, the *E. coli* strain was found to be susceptible to amikacin, gentamicin, and meropenem. Based on this susceptibility profile, the patient's antibiotic therapy was changed to intravenous amikacin. Amikacin, an aminoglycoside antibiotic, was administered at a dosage of 1500 mg every 24 hours for a total of ten days. Aminoglycosides are a class of antibiotics known for their potent bactericidal activity against gram-negative bacteria, including *E. coli*. They are often reserved for serious infections or infections caused by multidrug-resistant organisms due to their potential for toxicity, particularly nephrotoxicity and ototoxicity. The decision to switch from levofloxacin to amikacin was a critical step in the patient's management. It highlights the importance of tailoring antibiotic therapy based on culture and susceptibility results. Continuing with an ineffective antibiotic would have likely led to ongoing infection, worsening sepsis, and potentially fatal consequences. The timely switch to an appropriate antibiotic, guided by microbiological data, was crucial for achieving clinical and microbiological cure in this patient. The duration of antibiotic therapy is another important consideration in the management of emphysematous cystitis and urosepsis. In this case, the patient received a ten-day course of amikacin. The optimal duration of antibiotic therapy depends on several factors, including the severity of the infection, the causative pathogen, the patient's clinical response, and the presence of any complications. Generally, a longer duration of therapy is warranted in cases of severe infections, bacteremia, or slow clinical response. In emphysematous cystitis, it is important to ensure complete eradication of the infection to prevent recurrence and complications. In addition to antibiotic therapy, supportive care plays a crucial role in the management of patients with emphysematous cystitis and urosepsis. Supportive care measures are aimed at stabilizing the patient's condition, addressing organ dysfunction, and preventing complications. The patient in this case was admitted to the intensive care unit (ICU) for close monitoring and supportive management. ICU admission is often necessary for patients with severe infections like urosepsis, as it allows for continuous monitoring of vital signs, early detection of complications, and the ability to provide advanced organ support if needed. Strict glycemic control was initiated and maintained throughout the patient's hospital stay. As previously discussed, poorly controlled diabetes mellitus is a major predisposing factor for emphysematous cystitis. Hyperglycemia impairs immune function and provides a substrate for gas-producing bacteria. Therefore, achieving and maintaining strict glycemic control is essential in these patients. This is typically achieved through the administration of insulin, with frequent monitoring of blood glucose levels to guide dosage adjustments. Bladder drainage was likely established with a Foley catheter. Although this is not explicitly stated in the provided text, bladder drainage is a standard component of emphysematous cystitis management. A Foley catheter is a urinary catheter that is inserted into the bladder to drain urine. Bladder drainage serves several purposes in emphysematous cystitis. It helps to decompress the bladder, which may be

distended due to inflammation and gas accumulation. It also facilitates urine flow, which can be impaired by bladder wall thickening and inflammation. Furthermore, bladder drainage can help to remove bacteria and inflammatory debris from the bladder. Other supportive care measures that may be necessary in patients with urosepsis include fluid resuscitation, vasopressor support for hypotension, oxygen therapy or mechanical ventilation for respiratory failure, and renal replacement therapy for acute kidney injury. The specific supportive care needs of each patient will vary depending on the severity of their illness and the presence of any complications. The patient demonstrated a gradual improvement in her clinical condition following the initiation of amikacin. This positive response to the antibiotic therapy confirmed the effectiveness of the antibiotic switch and highlighted the importance of culture-guided treatment. Fever resolved by the eighth day of treatment. The resolution of fever is an important indicator of clinical improvement, suggesting that the infection is being controlled and the systemic inflammatory response is subsiding. Respiratory rate and heart rate normalized. The normalization of vital signs, including respiratory rate and heart rate, further indicates clinical improvement and resolution of sepsis. Tachycardia and tachypnea are compensatory mechanisms in sepsis, and their normalization suggests that the body is no longer under stress from the infection. The white blood cell count trended downwards, indicating a positive response to the antibiotic therapy. The decrease in white blood cell count reflects the resolution of leukocytosis and the body's diminishing immune response as the infection is brought under control. Repeat urine culture on day seven showed no bacterial growth, indicating microbiological eradication of the infection. This is a critical milestone, as it confirms that the antibiotic therapy has successfully eliminated the causative pathogen from the urinary tract. Microbiological eradication is essential to prevent recurrence of the infection and to ensure complete resolution of the emphysematous cystitis. The patient's overall clinical course demonstrates the effectiveness of the tailored antibiotic therapy and the importance of close monitoring and supportive care. The gradual improvement in her clinical condition, the resolution of fever and vital sign abnormalities, and the eradication of the infection all indicate a successful treatment outcome. The patient was discharged from the hospital in stable condition after completing the ten-day course of amikacin. Discharge criteria are typically based on the patient's clinical stability, the resolution of infection, and the absence of any complications. In this case, the patient's clinical improvement, the normalization of laboratory parameters, and the eradication of the infection met the criteria for discharge. Discharge planning is an important aspect of patient care, particularly in elderly individuals with comorbidities. It involves providing the patient and their caregivers with appropriate instructions for follow-up care, medication management, and lifestyle modifications. In this case, the patient was likely provided with instructions on how to monitor for any signs or symptoms of recurrent infection, the importance of maintaining good glycemic control, and the need for regular follow-up appointments. A follow-up appointment was scheduled two months post-discharge. This follow-up visit was crucial to assess the long-term outcome of the patient's treatment and to ensure that there was no recurrence of the emphysematous cystitis. A bedside bladder ultrasonography was performed at this follow-up appointment. The ultrasound revealed a normal bladder wall with no evidence of residual gas or thickening. This finding indicates the successful resolution of the emphysematous cystitis and confirms the effectiveness of the treatment strategy. The absence of residual gas or thickening of the bladder wall suggests that the inflammation and infection had completely resolved, and the bladder had returned to its normal state. Follow-up imaging studies are often used to monitor the resolution of emphysematous cystitis and to detect any potential complications or recurrence. While CT scans are highly sensitive for detecting gas within the bladder wall, ultrasonography

can be a useful and less invasive modality for follow-up assessments. The two-month follow-up visit and the normal bladder ultrasound findings in this case indicate a successful long-term outcome. The patient had recovered well from the emphysematous cystitis and urosepsis, and there was no evidence of recurrence. This positive outcome underscores the importance of appropriate antibiotic therapy, meticulous supportive care, and diligent follow-up in the management of this serious condition (Table 2).

Table 1. Summary of patient's clinical findings.

Category	Detail
Demographics	**Age:** 66 years old**; Gender:** Female
Anamnesis	**Chief Complaint:** Fever, dyspnea, and tachypnea of five hours duration. **Urinary Symptoms:** Suprapubic pain and burning sensation during urination for two days. Cloudy and foul-smelling urine for two days. **Past Medical History:** Type 2 Diabetes Mellitus diagnosed over fifteen years prior. Poor glycemic control despite insulin administration.
Physical Examination	**General Appearance:** Hypoxic and septic upon presentation. **Vital Signs:** Temperature 38.7°C (101.7°F), Pulse rate 115 beats per minute, Respiratory rate 28 breaths per minute, Blood pressure 111/68 mmHg, Oxygen saturation 95% in room air. **Abdomen:** Minor pain elicited upon palpation of the suprapubic area.
Laboratory Findings	**Hematology:** White blood cell count 50.8 × 10^3/L (significant leukocytosis with neutrophilic predominance), Platelet count 700 × 10^3/L (thrombocytosis). **Glucose Metabolism:** Random blood glucose 370 mg/dL (hyperglycemia), Fasting blood glucose 175 mg/dL, 2-hour postprandial blood glucose 248 mg/dL, Glycosylated hemoglobin (HbA1c) 10.5% (poor long-term glycemic control). **Inflammatory Markers:** Procalcitonin 16 ng/mL (elevated, indicative of bacterial sepsis). **Urinalysis:** Notable leukocyturia (presence of white blood cells in urine, suggesting urinary tract infection). **Microbiology:** Blood and urine cultures both yielded substantial growth (>10^6CFU/mL) of *Escherichia coli*. Antimicrobial susceptibility testing revealed resistance to ampicillin, ampicillin-sulbactam, cefazolin, ceftazidime, ceftriaxone, cefepime, ciprofloxacin, and aztreonam. The *E. coli* strain was susceptible to amikacin, gentamicin, and meropenem. Subsequent urine culture after antibiotic treatment showed no bacterial growth.
Imaging Findings	**Computed Tomography (CT) Scan of the Abdomen and Pelvis:** Revealed multiple air foci within the bladder wall, accompanied by thickening of the bladder wall (Figure 1 and Figure 2). **Follow-up Bladder Ultrasonography (at two months):** Showed a normal bladder wall with no evidence of air (Figure 3).
Clinical Diagnosis	Emphysematous Cystitis complicated by Urosepsis.

Table 2. Treatment and follow-up.

Category	Detail
Initial treatment	**Antibiotic Therapy:** Empiric intravenous levofloxacin 750 mg administered every 24 hours upon admission.
Definitive treatment	**Antibiotic Therapy:** Intravenous amikacin 1500 mg administered every 24 hours for a total of ten days. This change was made based on the antimicrobial susceptibility testing of the *Escherichia coli* strain, which showed resistance to levofloxacin but susceptibility to amikacin.
Supportive care	Admission to the intensive care unit for close monitoring and supportive management. Strict glycemic control was initiated and maintained throughout the hospital stay. Bladder drainage was likely established with a Foley catheter, although this is not explicitly stated in the provided text but is a standard component of emphysematous cystitis management to decompress the bladder and facilitate urine flow.
Clinical course	The patient demonstrated a gradual improvement in her clinical condition following the initiation of amikacin. The fever resolved by the eighth day of treatment. Respiratory rate and heart rate normalized. White blood cell count trended downwards, indicating a positive response to the antibiotic therapy. Repeat urine culture on day seven showed no bacterial growth, indicating microbiological eradication of the infection.
Discharge	The patient was discharged from the hospital in stable condition after completing the ten-day course of amikacin.
Follow-up	A follow-up appointment was scheduled two months post-discharge. A bedside bladder ultrasonography performed at this appointment revealed a normal bladder wall with no evidence of residual gas or thickening, indicating the successful resolution of emphysematous cystitis.

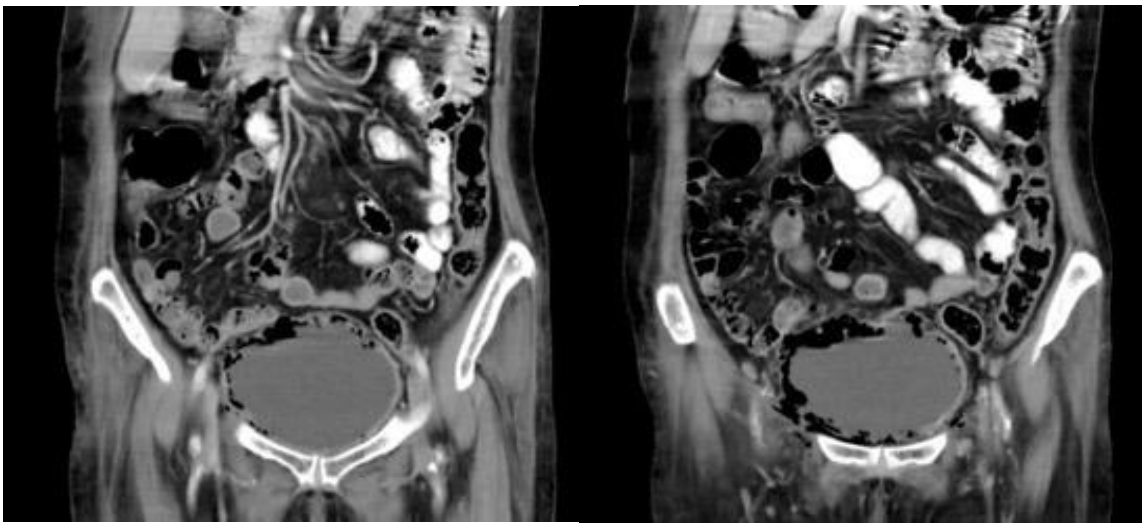

Figure 1. Computed tomography (coronal view) revealed multiple air foci in the bladder with thickening of the bladder.

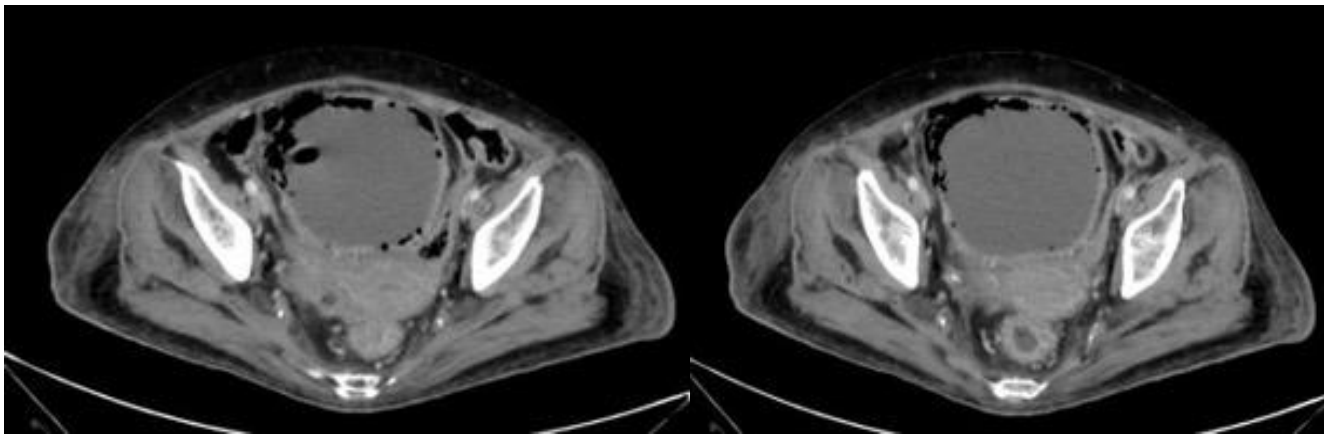

Figure 2. Computed tomography (axial view) also revealed multiple air foci in the bladder with thickening of the bladder.

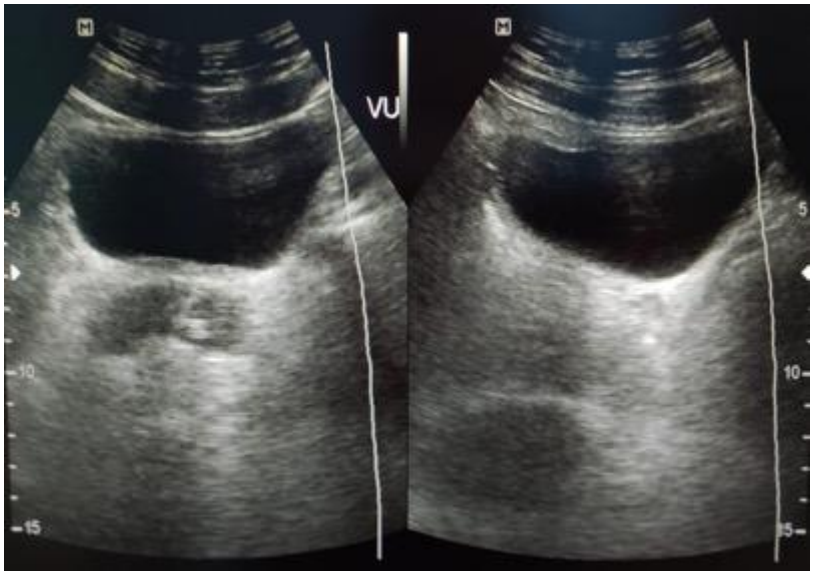

Figure 3. Normal bladder ultrasonography.

3. Discussion

The pathogenesis of emphysematous cystitis is a complex interplay of factors, with the presence of gas-producing microorganisms and the availability of fermentable substrates playing pivotal roles. In this case, the isolation of *Escherichia coli* from both blood and urine cultures implicates this bacterium as the causative agent. *E. coli*, a facultative anaerobic gram-negative bacterium, is a common inhabitant of the gastrointestinal tract and a frequent cause of urinary tract infections. Its ability to ferment glucose and other carbohydrates to produce gas, including carbon dioxide and hydrogen, is central to the development of emphysematous cystitis. The fermentation process is significantly enhanced in the presence of elevated glucose levels, a hallmark of diabetes mellitus. Hyperglycemia provides an abundant source of substrate for bacterial metabolism and gas

production. In this patient, the history of type 2 diabetes mellitus and the laboratory findings of elevated random blood glucose, fasting blood glucose, 2-hour postprandial blood glucose, and a high HbA1c level of 10.5% all indicate poor glycemic control. This chronic state of hyperglycemia likely contributed significantly to the development of EC by creating an environment conducive to bacterial proliferation and gas formation within the bladder wall and lumen. Beyond hyperglycemia, other factors associated with diabetes mellitus also contribute to the pathogenesis of EC. Microvascular complications, common in diabetic patients, can lead to impaired tissue perfusion and reduced blood supply to the bladder wall. This compromised blood flow impairs the delivery of oxygen and immune cells to the affected tissues, hindering the body's ability to combat infection. The resulting ischemia creates an anaerobic environment that favors the growth of gas-producing bacteria and further promotes gas formation. Furthermore, diabetic patients often experience impaired immune function, making them more susceptible to infections and less able to effectively clear invading pathogens. This immunodeficiency can manifest as defects in neutrophil function, impaired chemotaxis, and reduced cytokine production, all of which contribute to an increased risk of severe infections and their complications. In addition to diabetes mellitus, other risk factors can predispose individuals to emphysematous cystitis. These include advanced age, female gender, urinary tract obstruction, neurogenic bladder, and the use of immunosuppressive medications. The patient in this case possessed two major risk factors elderly female gender and diabetes mellitus. The combination of these risk factors significantly increased her susceptibility to developing EC.[11-15]

Emphysematous cystitis is characterized by a wide spectrum of clinical presentations, ranging from asymptomatic bacteriuria to life-threatening sepsis and septic shock. This variability in clinical manifestations can pose a diagnostic challenge, as atypical presentations may not immediately suggest the possibility of EC. In its typical form, EC presents with symptoms commonly associated with urinary tract infections. These include urinary frequency, urgency, dysuria, and suprapubic pain or discomfort. Hematuria and pyuria may also be present. Pneumaturia, the passage of gas in the urine, is a relatively specific symptom for EC but is not always present. The patient in this case presented with a combination of urinary and systemic symptoms. Her urinary symptoms included suprapubic pain, dysuria, and cloudy and foul-smelling urine. These symptoms are consistent with a typical presentation of cystitis. However, her presentation also included fever, dyspnea, and tachypnea, which are not typical of uncomplicated cystitis and suggested a more severe systemic involvement. The presence of fever, dyspnea, and tachypnea in this patient indicated a systemic inflammatory response and raised concern for sepsis. Sepsis is a life-threatening condition characterized by a dysregulated host response to infection, leading to widespread inflammation, tissue damage, and potentially organ dysfunction. The patient's vital signs, including elevated temperature, tachycardia, tachypnea, and a degree of hypoxia, further supported the diagnosis of sepsis. This case highlights the importance of recognizing that emphysematous cystitis can present with atypical symptoms, particularly in vulnerable populations like the elderly with diabetes mellitus. The absence of classic urinary symptoms or the presence of prominent systemic symptoms should not preclude the consideration of EC in the differential diagnosis. A high index of suspicion is crucial for timely diagnosis and appropriate management. The atypical presentation in this case may be attributed to several factors. The patient's advanced age and underlying diabetes mellitus likely contributed to a more severe and systemic response to the infection. Elderly individuals often have impaired immune function and are less able to localize infections, leading to a higher risk of systemic spread. Diabetes mellitus further compromises the host's defense mechanisms, increasing the susceptibility to severe infections and their complications.[16-20]

4. Conclusion

This case report highlights a rare and challenging presentation of emphysematous cystitis complicated by culture-proven urosepsis in a geriatric female with type 2 diabetes mellitus. The patient presented with atypical symptoms, including fever, dyspnea, and tachypnea, in addition to typical urinary symptoms, which initially obscured the diagnosis. The identification of multidrug-resistant *Escherichia coli* in both blood and urine cultures further complicated the clinical picture, emphasizing the importance of prompt and accurate microbiological diagnosis. The successful management of this case hinged on a high index of suspicion for EC, prompt radiological diagnosis using CT imaging, and the timely administration of appropriate antibiotic therapy guided by culture sensitivities. The patient's underlying diabetes mellitus and the presence of a multidrug-resistant organism posed significant therapeutic challenges, necessitating a tailored approach and close monitoring. This case underscores the critical role of considering emphysematous cystitis in elderly diabetic patients presenting with sepsis and urinary symptoms, even when the clinical presentation is atypical. It also highlights the growing challenge of multidrug-resistant organisms in clinical practice and the importance of antimicrobial stewardship and culture-guided therapy to optimize patient outcomes. Furthermore, this case emphasizes the need for diligent follow-up to ensure complete resolution of the infection and prevent recurrence in this vulnerable patient population.

5. References

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