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Renal manifestations of brucellosis: a case report

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Abstract

Background Brucellosis is one of the most prevalent zoonotic diseases worldwide, posing a significant public health concern across both developed and developing nations. While musculoskeletal system involvement is the most common form of focal brucellosis, the genitourinary system represents the second most affected site. However, *Brucella*-related kidney involvement remains a rare manifestation of genitourinary brucellosis.

Case presentation We herein present the case of a 55-year-old Iranian male patient, initially admitted with symptoms indicative of osteoarticular brucellosis, who subsequently developed pyelonephritis confirmed by positive urine culture for *Brucella*. He was treated with gentamicin for 10 days and rifampin and doxycycline for a period of 6 weeks. The patient fully recovered.

Conclusion Our case highlights the importance of considering brucellosis as a potential cause of pyelonephritis, especially where brucellosis is endemic and when musculoskeletal involvement is present. Additionally, a comprehensive review of the literature on kidney involvement in brucellosis was conducted to provide further insights into this condition.

Clinical Trial number Not applicable.

Keywords Pyelonephritis, Brucellosis, Urine culture, Treatment, Case report

Introduction

Brucellosis, a zoonotic bacterial infection, is commonly transmitted to humans through contact with infected small bovine animals such as cattle, sheep, and goats. This typically occurs via the consumption of unpasteurized dairy products or direct exposure to their bodily fluids [1]. The causative agent of brucellosis is a gram-negative, facultative intracellular coccobacillus belonging to the *Brucella* species, comprising six classical species: *Brucella abortus*, *B. melitensis*, *B. ovis*, *B. canis*, *B. suis*, and *B. neotome*. The diagnosis of brucellosis is typically achieved through the isolation of the bacteria from clinical samples or serology tests, which detect antibodies to *Brucella* in the patient's serum [2].

Brucellosis poses a considerable public health challenge in both developed and developing nations. Endemic regions for brucellosis span across the Mediterranean basin, The Middle East, Central Asia, China, the Indian subcontinent, sub-Saharan Africa, and parts of Mexico, Central, and South America. It is estimated that approximately 500,000 cases are reported worldwide annually, with the disease exhibiting a seasonal pattern, with a

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higher prevalence during the spring and autumn months ([3]. Iran, in particular, has seen a concerning rise in brucellosis cases in recent years, indicating a growing trend [4].

Typically, brucellosis manifests with a gradual onset of symptoms including fever, malaise, night sweats, and joint pain. Other common symptoms encompass weight loss, back pain, headache, dizziness, loss of appetite, digestive issues, abdominal pain, and coughing. Osteoarticular involvement is the most common complication, occurring in up to 70% of patients. However, any organ system can be affected, including the genitourinary, nervous, cardiovascular, pulmonary, intra-abdominal, and ocular systems [5].

Genitourinary involvement ranks is the second most common form of focal brucellosis, with the *Brucella* bacteria detected in the urine of 4 to 50% of patients, and urological complications occurring in 2 to 20% of these cases [6]. Urological manifestations include prostatitis, orchitis, epididymitis, cystitis, pyelonephritis, interstitial nephritis, glomerulonephritis, and renal abscesses [7, 8]. Due to the nonspecific symptoms, urinary tract infection caused by *Brucella* species is frequently misdiagnosed or unreported. Herein, we present a rare case of *Brucella* pyelonephritis, initially mimicking bacterial pyelonephritis, in a patient with a history of nephrolithiasis.

Case report

A 55-year-old Iranian male patient was referred to the urology clinic due to persistent lower back pain suspected to be caused by nephrolithiasis and its complications. He presented with a 6-week history of fever, fatigue, myalgia, persistent low back pain, vomiting, dysuria, and urinary frequency. His medical records indicated a prior diagnosis of kidney stones. Ultrasound examination revealed mild hydronephrosis in the right kidney, severe hydronephrosis in the left kidney, multiple stones in both kidneys, a left staghorn renal stone, and increased bladder wall thickness with debris. Prior to surgical intervention, the urologist requested a urinalysis and urine culture. The urinalysis showed considerable numbers of red blood cells (RBCs), protein (+++), white blood cells (WBCs) at 25–28 per high-power field (hpf), and moderate bacterial growth. The urine culture confirmed the presence of *Brucella* species. The patient was subsequently referred to the infectious disease clinic for further evaluation.

The patient resides in a rural area where several other cases of brucellosis have been reported. He had a history of smoking, opium addiction, and consumption of unpasteurized dairy products. His family history was unremarkable, with no known hereditary conditions or a history of chronic kidney disease or autoimmune disorders.

On presentation to the infectious disease clinic, the patient appeared ill and exhibited tenderness in the bilateral costovertebral angles, hypogastrium, right lower quadrant, and lumbar spine. He also had pain, swelling, and restricted movement in his left ankle and left knee joints, and had difficulty in movement, walking with a limp due to pain and swelling. His vital signs were within the normal range, with a blood pressure of 120/85 mm Hg, a heart rate of 88 beats per minute, a respiratory rate of 18 breaths per minute, a temperature of 36.7 °C, and an oxygen saturation of 95%. Laboratory investigations revealed a white blood cell count of 7.1×10^9/L (neutrophils: 59.2%; lymphocytes: 35%), a hemoglobin level of 10.7 g/dL, a platelet count of 364×10^9/L, a urea level of 29 mg/dL, a creatinine level of 1.2 mg/dL, a sodium level of 138 mEq/L, a potassium level of 4 mEq/L, a C-reactive protein (CRP) level of 38 mg/L (normal range: 0–8 mg/L), and an erythrocyte sedimentation rate (ESR) of 92 mm/hour. The results of blood cultures were negative on two occasions. Additionally, the Wright test and 2-mercaptoethanol (2ME) were positive, with titers of 1/1280 and 1/640, respectively (Table 1).

Abdominal radiography showed the presence of bilateral renal stones and a narrowing of the L1–L2 disc space (Fig. 1). Magnetic resonance imaging (MRI) of the lumbar spine revealed signal intensities in the L1 and L2 vertebrae, with irregularities in the lower endplates of the L1 vertebrae and upper endplates of the L2 vertebrae (Fig. 2).

Table 1 Laboratory data of the patient, including reference ranges

Laboratory parameter	Result	Reference range
White blood cell count	7.1×10^9/L	$4.0–11.0 \times 10^9$/L
Neutrophils	59.2%	40–70%
Lymphocytes	35%	20–40%
Hemoglobin	10.7 g/dL	13.5–17.5 g/dL
Platelet count	364×10^9/L	$150–450 \times 10^9$/L
Urea	29 mg/dL	7–20 mg/dL
Creatinine	1.2 mg/dL	0.6–1.2 mg/dL
Sodium	138 mEq/L	135–145 mEq/L
Potassium	4 mEq/L	3.5–5.0 mEq/L
CRP	38 mg/L	0–8 mg/L
ESR	92 mm/hour	0–20 mm/hour
Urine RBCs	Present	None
Urine protein	+++	Negative
Urine WBCs	25–28 per hpf	0–5 per hpf
Urine culture	Positive for *Brucella* species	Negative
Wright test	1/1280	< 1/160
2-mercaptoethanol test	1/640	< 1/40

WBC, white blood cells; RBC, red blood cells; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; hpf, high-power field

Increased signal intensity and evidence of destruction in the intervertebral disc were observed, with enhancement in post-contrast images. An abdominal CT scan identified a right renal stone and a left ureteral stone, accompanied by hydronephrosis and renal enlargement (Fig. 3).

The patient was diagnosed with brucellosis, presenting as oligoarthritis involving the left wrist, knee, and sacroiliac joint, in addition to simultaneous involvement of the urinary system in the form of pyelonephritis. He was initially treated with gentamicin 5 mg/kg/day, rifampin 600 mg/day, and doxycycline 100 mg twice daily. Gentamicin was continued for 10 days, after which it was discontinued, and the patient was prescribed doxycycline and rifampin for another 6 weeks. Follow-up evaluations at 3, 6, and 12 months post-treatment showed complete recovery with no recurrence or relapse of symptoms (Table 2).

Discussion

This case presents a rare and unique presentation of brucellosis, notable for the uncommon association with pyelonephritis, staghorn nephrolithiasis, and a positive urine culture for *Brucella* species. While brucellosis has been recognized for its involvement in the genitourinary system, to the best of our knowledge, no other case in the literature has reported such an association. This highlights the need to consider brucellosis as a potential cause of urinary tract infections, particularly in endemic regions, and underscores the importance of urine culture in confirming the diagnosis. The patient initially presented with symptoms suggestive of nephrolithiasis and its complications, characterized by low back pain and urinary symptoms. However, further evaluation revealed the unexpected presence of *Brucella* species in the urine culture. This finding underscores the diverse clinical presentations of brucellosis and highlights the importance of considering unusual manifestations, particularly in endemic regions.

In this case, the presence of concurrent musculoskeletal symptoms raises concerns about a systemic disorder. Brucellar arthritis typically manifests as migratory polyarthritis, affecting large joints such as the knees, hips, and sacroiliac joints. The inflammatory response triggered by *Brucella* infection can lead to joint inflammation, pain, and swelling, which may mimic other rheumatic conditions such as rheumatoid arthritis or reactive arthritis.

Complication involving the genitourinary system may manifest as a consequence of *Brucella* endocarditis or as a direct consequence of infection of the urinary system. A multicenter study involving 390 patients diagnosed with genitourinary brucellosis revealed that the scrotal area was the most commonly affected site in men (83.8%), while pyelonephritis was the predominant manifestation in women (86.8%) [6].

As documented in the medical literature, the clinical manifestations of *Brucella*-associated kidney disease present in three main forms: infectious complications, immune-mediated involvement, and kidney injury leading to renal failure.

A variety of *Brucella* species, such as *Brucella abortus*, *Brucella melitensis*, and *Brucella suis*, have the potential to cause infectious complications affecting the kidneys. The literature reports a number of renal infectious complications, including acute and chronic pyelonephritis [6, 9–11], focal nephritis [12], renal abscess or brucelloma [13, 14], and infection of renal cysts [15]. Infectious complications of the kidneys due to brucellosis present a range of clinical manifestations and diagnoses, as documented in case reports from various countries. Patients, who are primarily male and span a wide age range, commonly present with fever, flank pain, and urinary symptoms, alongside systemic issues such as weight loss, hepatosplenomegaly, and fatigue. Microbiological testing, often positive for *Brucella* species in blood cultures or serological tests, usually confirms the diagnosis. While

Table 2 Timeline of patient's brucellosis case

Week	Event
Week 1	Initial symptoms and clinical evaluation: Patient presented with 6 weeks of symptoms (fever, fatigue, myalgia, lower back pain, vomiting, dysuria, and urinary frequency). Diagnosed with nephrolithiasis. Ultrasound showed mild hydronephrosis (right kidney), severe hydronephrosis (left kidney), multiple kidney stones, and bladder wall thickening.
Weeks 2–3	Urinalysis and urine culture: Urinalysis shows RBCs, protein, and WBCs (25–28 per high-power field). Urine culture confirms *Brucella* species. Referral: Patient referred to infectious disease clinic.
Week 4	Further evaluation: Diagnosis of brucellosis (oligoarthritis and pyelonephritis) confirmed. Treatment initiated with gentamicin, doxycycline, and rifampin.
Week 6	Therapy adjustment: Gentamicin discontinued after 10 days; doxycycline and rifampin continued for 6 weeks.
Follow-up (3, 6, and 12 months)	Outcome: Full recovery; no relapse or recurrence noted.

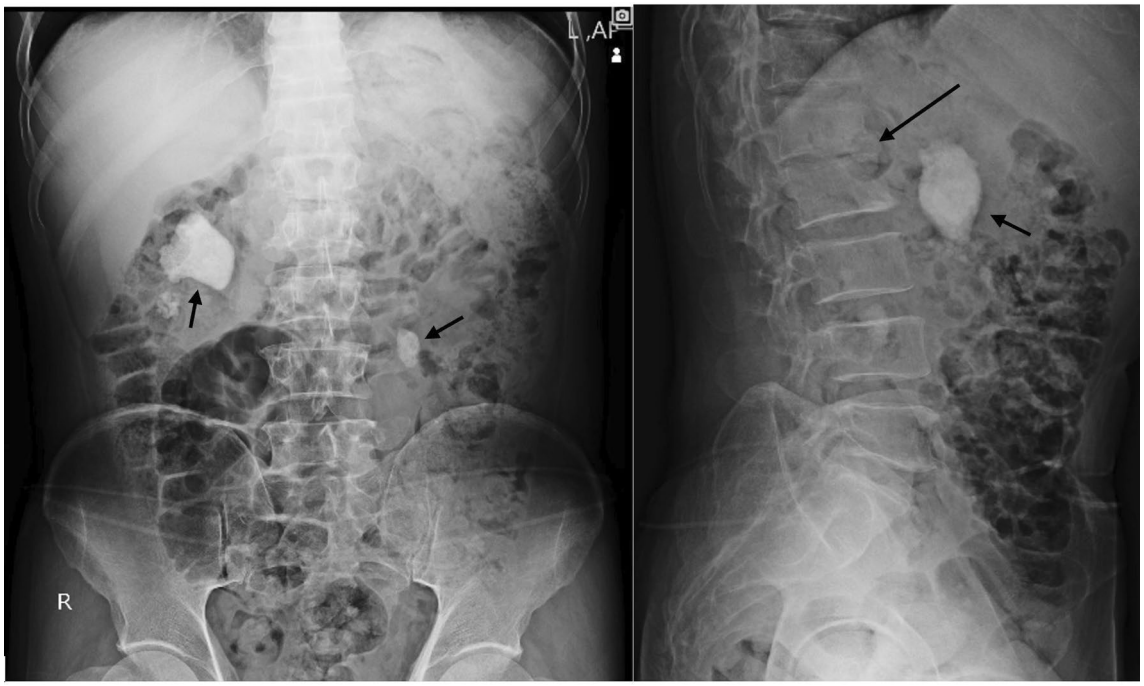

Fig. 1 Radiography of the patient's abdomen. The lumbar spine anteroposterior and lateral view images reveal bilateral renal stones (short arrows) and narrowing of the L1–L2 disc space (long arrow)

older literature suggested a relatively high prevalence of *Brucella* isolation from urine [6], we did not find an additional case of *Brucella*-related renal complications associated with positive urine cultures apart from the case we reported. In the majority of cases, *Brucella* organisms are isolated from blood specimens [9–11, 14–18]. Imaging findings typically reveal kidney abnormalities, including calcifications or renal calculi [11, 17], cystic lesions [15], and abscesses [6, 9]. Treatment approaches vary, commonly involving antibiotics such as doxycycline, rifampicin, tetracycline, and streptomycin, with courses ranging from weeks to months. Most patients experience favorable outcomes with appropriate treatment, although some older cases required invasive procedures such as nephrectomy [19] (Supplementary Table 1). These findings underscore the complexity of *Brucella*-associated renal infections and the need for tailored therapeutic strategies. There are no distinct clinical, laboratory, or imaging findings that differentiate infectious renal complications resulting from brucellosis from those attributable to common uropathogens. However, epidemiological evidence, the subacute to chronic nature of the presentation, and the association with the involvement of other organs can be suggestive of diagnosis. It is occasionally associated with renal calculi or calcification.

Immune-mediated renal complications of brucellosis are rare but diverse, presenting in a variety of clinical forms across documented cases in the literature. The reports include cases of nephrotic syndrome [20], glomerulonephritis [21, 22], nephritis, rapidly progressive glomerulonephritis (RPGN) [23, 24], and even complex syndromes such as cryoglobulinemia and anti-neutrophil cytoplasmic antibody (ANCA)-associated vasculitis [25]. These complications were seen across

(See figure on next page.)

Fig. 2 Magnetic resonance imaging of the patient's lumbar spine. T1 (**a**): Heterogeneity and narrowing of disc space with low signal in adjacent endplates (indicative of bone marrow edema). T2 and short inversion time inversion recovery (**b** and **d**): High signal in disc space (indicating fluid) and high signal in adjacent endplates (suggesting bone marrow edema). T1 post-contrast (**c**): Peripheral enhancement around fluid collection(s) and enhancement of vertebral endplates. Axial T2-weighted image (**e**): High-signal lesion in paravertebral soft tissues (long arrow) and hyperintensity within the psoas muscle with rim enhancing (short arrow) indicative of abscess formation (consistent with the psoas sign). Axial T1 post-contrast (**f**): Enhancement of paravertebral soft tissues (long arrow) and enhancement around a low-density center (short arrow), indicative of abscess formation on axial views. Bilateral hydronephrosis and a right renal stone are also noted

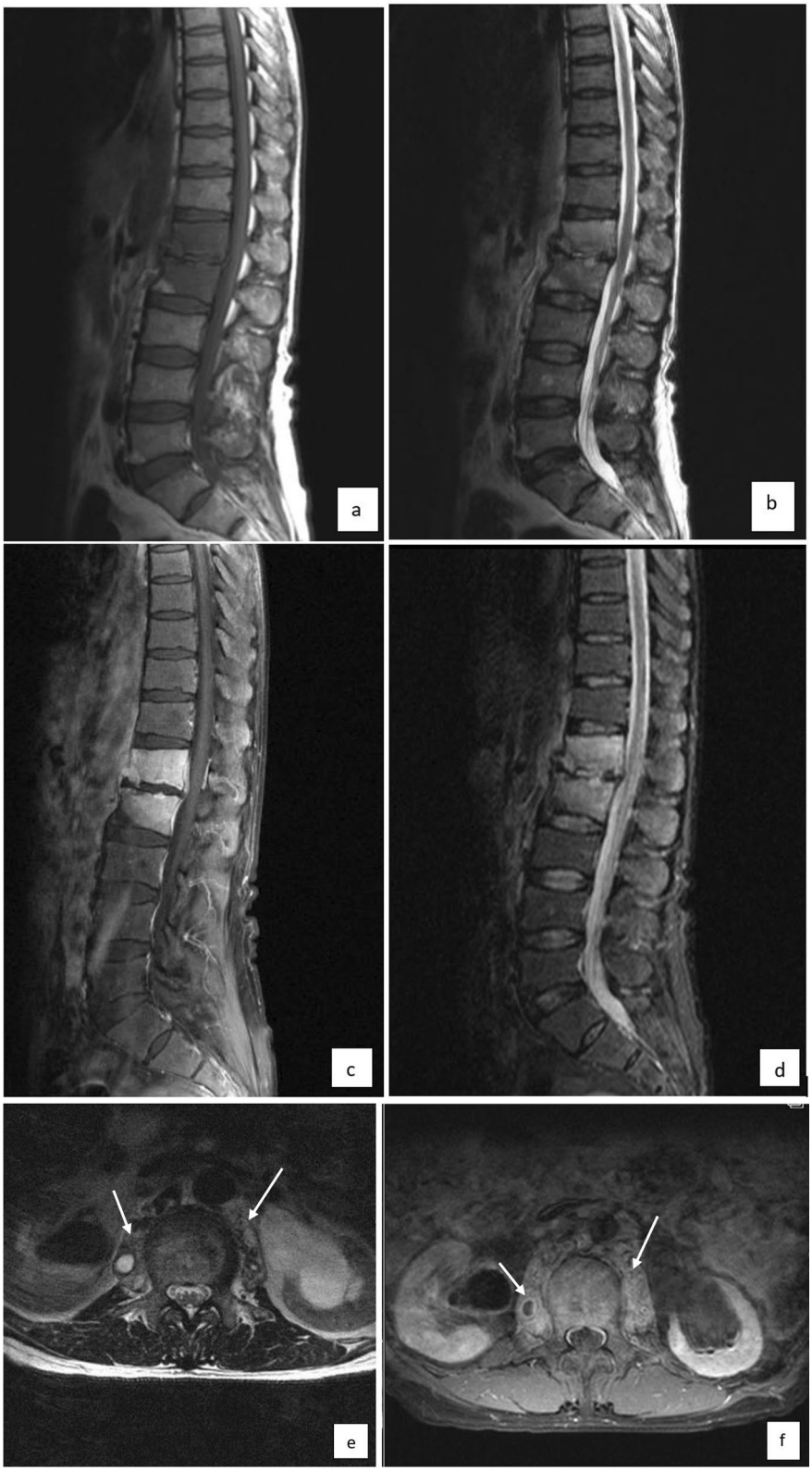

Fig. 2 (See legend on previous page.)

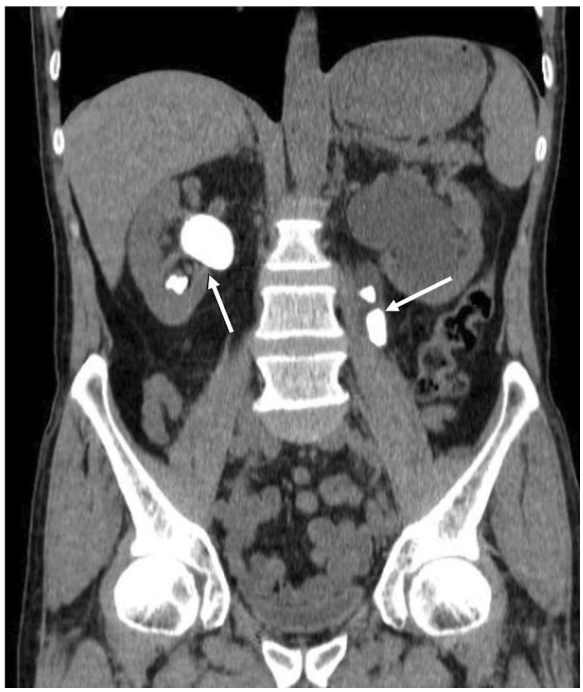

Fig. 3 Computed tomography scan of the patient's abdomen. The computed tomography scan of the abdomen reveals a right renal stone and a left ureteral stone (arrows) accompanied by hydronephrosis and enlargement of the kidneys

a range of ages and sexes, with patients often exhibiting symptoms such as proteinuria in the range of nephrotic or non-nephrotic syndrome, hematuria, and, in severe cases, renal failure. Some patients presented with systemic symptoms, such as fever, fatigue, and weight loss. A diagnosis is typically made on the basis of epidemiological clues and the results of microbiological test, particularly agglutination tests for *Brucella* species, as culture-based methods rarely isolate the microorganism [26–29]. Treatment regimens generally involved antibiotics such as doxycycline and rifampin and, in severe cases, combinations with corticosteroids or additional immunosuppressive therapies [30–34]. Clinical outcomes were generally favorable with proper intervention, though one reported case progressed to end-stage renal disease (ESRD) despite therapy and resulted in death due to severe metabolic acidosis related to missed hemodialysis sessions [32]. The range of immune-mediated renal manifestations and outcomes underscores the need for individualized therapeutic approaches based on the severity and nature of the immune response (supplementary Table 2).

While rare, renal failure associated with brucellosis is a serious and varied complication, and more frequently associated with septicemic brucellosis in patients infected with *B. melitensis* [35–39] or in those with glomerular involvement of the kidneys by the organism. It often presents alongside systemic symptoms such as fever, joint pain, hepatosplenomegaly, and gastrointestinal symptoms. Reported cases demonstrate a range of presentations from acute renal failure to complex, multiorgan dysfunction, with some patients also experiencing neurological complications [40, 41] or signs of disseminated intravascular coagulation (DIC) [42]. Symptoms such as proteinuria, oliguria, and hematuria frequently accompany kidney failure in these cases, emphasizing the immune-mediated impact of brucellosis on renal function. Microbiological confirmation through positive agglutination tests and cultures is common, while imaging often reveals nonspecific findings, such as hepatosplenomegaly or diffuse renal enlargement, without always directly pinpointing kidney abnormalities. Treatment typically involves prolonged antibiotic regimens including combinations of doxycycline, rifampin, and streptomycin, with most patients responding well, though some experience relapses or extended recovery. One fatality due to DIC highlights the potential severity of *Brucella*-associated renal failure [42] and the importance of prompt, appropriate therapy (Supplementary Table 3).

Given the infrequency of *Brucella* pyelonephritis and other forms of kidney involvement, there is currently no consensus on the specific treatment regimen and duration. In the case of focal brucellosis, such as that affecting the genitourinary system, a combination of antibiotics is often recommended to enhance efficacy and prevent the development of resistance. A recent meta-analysis has revealed that triple antibiotic regimens are more efficacious than dual antibiotic regimens with no additional adverse effects [43]. The most commonly used antibiotics include doxycycline, rifampicin, and aminoglycosides such as gentamicin or streptomycin. These antibiotics are selected for their ability to penetrate tissues effectively and their synergistic action against *Brucella* species. However, the prescription of aminoglycosides in cases of renal involvement, especially in cases of renal insufficiency, may prove to be a significant challenge.

The duration of antibiotic therapy for focal brucellosis is variable but typically lasts for several weeks to months to ensure complete eradication of the bacteria and to prevent relapse. In uncomplicated cases, the recommended treatment duration is typically between 6 weeks to 3 months. However, cases of more severe or complicated infections may require a longer duration of therapy [43].

Conclusion

Our case report highlights the significance of considering *Brucella* infection as a potential etiology of pyelonephritis, especially in regions where brucellosis is endemic. Renal involvement in brucellosis can present through a variety of mechanisms, including infectious complications and immune-mediated manifestations, which can eventually lead to renal failure in severe cases. While the prognosis is generally favorable, there have been reports of recurrent and fatal outcomes. The management of *Brucella* pyelonephritis remains challenging, necessitating further research to establish optimal treatment strategies and duration of therapy.

Abbreviations

CRP	C-reactive protein
DIC	Disseminated intravascular coagulation
ESR	Erythrocyte sedimentation rate
ESRD	End-stage renal disease
hpf	High-power field
MRI	Magnetic resonance imaging
RBC	Red blood cell
RPGN	Rapidly progressive glomerulonephritis
WBC	White blood cell

Supplementary Information

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Supplementary Material 1.

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Author contributions

ZG, MH, BA, and FS conceived the presented idea. ZG, MH, BA, and FS wrote the manuscript with support from FK, FA, and SE. ZG, MH, BA, and FS contributed to the design and implementation of the research. FK, FA, and SE contributed to the writing of the manuscript. MH and BA prepared the figures and tables with support from FK, FA, and SE. All authors reviewed the manuscript.

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Availability of data and materials

All relevant data are within the paper.

Declarations

Ethics approval and consent to participate

The patient and the attendant provided written informed consent for the publication of this case report and any accompanying images.

Consent for publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing interests

Authors declare that they have no competing interests.

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