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Septic Arthritis Caused by Klebsiella pneumoniae in a Patient with B-cell Acute Lymphoblastic Leukemia: A Case Report

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ABSTRACT

This case report describes a 53-year-old female with newly diagnosed B-cell acute lymphoblastic leukemia (ALL) who developed septic arthritis due to Klebsiella pneumoniae during induction chemotherapy with a modified CALGB protocol. The diagnosis was challenging, requiring multiple imaging modalities (ultrasound, MRI, and PET scan), and was ultimately confirmed via synovial fluid culture obtained through arthroscopy. Despite targeted antibiotic therapy and surgical intervention, the patient experienced persistent joint dysfunction, necessitating referral for total hip arthroplasty. This case highlights the importance of high clinical suspicion for septic arthritis in immunocompromised patients, the critical role of synovial fluid analysis in diagnosis, and the need for multidisciplinary management.

Keywords: Septic Arthritis, Acute Lymphoblastic Leukemia, Arthroplasty, Klebsiella pneumoniae

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1. Introduction

Septic arthritis is a medical emergency characterized by infection within a joint space, leading to rapid cartilage destruction, systemic dissemination, and substantial morbidity and mortality if not promptly managed (1). In immunocompromised patients, particularly those with hematologic malignancies undergoing intensive chemotherapy, diagnosis is often delayed due to blunted inflammatory responses and atypical clinical manifestations (2). In this report, we present a case of Klebsiella pneumoniae-induced septic arthritis in a patient with BCR-ABL1-negative B-cell ALL, diagnosed during induction therapy, and discuss the diagnostic complexities and therapeutic considerations unique to this vulnerable population.

2. Case Presentation

A 53-year-old woman with no significant past medical history initially presented with constitutional symptoms including progressive fatigue, pallor, night sweats, and unexplained bruising. Peripheral blood smear and bone marrow aspiration confirmed the diagnosis of BCR-ABL1-negative B-cell acute lymphoblastic leukemia (ALL), with 85% lymphoblasts and no Philadelphia chromosome by FISH. The patient initially declined chemotherapy. However, after two months of worsening symptoms, she was re-admitted and agreed to induction chemotherapy based on the CALGB protocol (cyclophosphamide, daunorubicin, vincristine, and prednisolone). She developed febrile neutropenia, oral mucositis, and pancytopenia during induction, which

were managed with empirical broad-spectrum antibiotics, antifungal agents, and supportive care measures. Serial blood cultures were negative. After hematologic stabilization, bone marrow biopsy confirmed complete hematologic remission with less than 5% blasts.

On day 24 of hospitalization, the patient developed acute bilateral hip pain and swelling, predominantly in the left hip. On examination, she was afebrile but exhibited limited range of motion and tenderness over the left hip. Given recent exposure to chemotherapeutic agents, particularly corticosteroids and G-CSF, initial differential diagnoses included G-CSF-induced bone pain, steroid-induced avascular necrosis, or chemotherapy-related bone marrow edema. A discrepancy in limb circumference raised suspicion for deep vein thrombosis, but Doppler ultrasonography ruled it out. Cardiac evaluation via transthoracic echocardiography showed a normal left ventricular ejection fraction (55%) with no valvular or pericardial abnormalities, excluding chemotherapy-induced heart failure as the etiology of lower limb edema. Initial hip ultrasonography revealed no joint effusion or hematoma. However, given the persistence and escalation of symptoms, a follow-up ultrasound one week later demonstrated a 40 mL effusion in the left hip joint. Subsequent MRI of the pelvis and hips revealed bone marrow edema in the left femoral head, joint effusion, and perisynovial soft tissue inflammation suggestive of septic arthritis. Given the patient's immunosuppressed state and ambiguous imaging, a PET-CT scan was performed, which showed intense fluorodeoxyglucose (FDG) uptake at the left hip joint, suggesting localized infection or inflammation (Figure 1).

The patient underwent emergent arthrotomy, joint lavage, and biopsy. Intraoperative findings included turbid synovial fluid and inflamed synovium. Synovial fluid analysis showed 85,000 WBCs/μL with 90% neutrophils. Gram staining revealed gram-negative bacilli, and culture identified Klebsiella pneumoniae, which was susceptible to carbapenems but resistant to third-generation cephalosporins. Empirical treatment with vancomycin, piperacillin-tazobactam, and caspofungin was modified to intravenous imipenem-cilastatin, based on culture sensitivity. Histopathology of excised synovial tissue demonstrated fibroconnective tissue with dense neutrophilic infiltration and focal calcification. Concurrent blood cultures remained negative throughout. Due to persistent symptoms and recurrent effusion, a second arthrotomy was performed, yielding K. pneumoniae from synovial cultures again. Postoperatively, the patient completed a six-week course of imipenem with close follow-up by infectious disease specialists.

Despite microbiologic clearance, the patient experienced severe residual pain, refractory to high-dose morphine and nonsteroidal anti-inflammatory drugs (NSAIDs). A rehabilitation consults deferred physiotherapy due to ongoing inflammation, and nerve block was contraindicated due to concerns over movement restriction. She underwent ozone therapy with minimal benefit. Following the second surgical intervention, pain partially subsided. Nevertheless, at six-month follow-up, the patient continued to experience pain and reduced joint mobility, prompting referral for total hip arthroplasty.

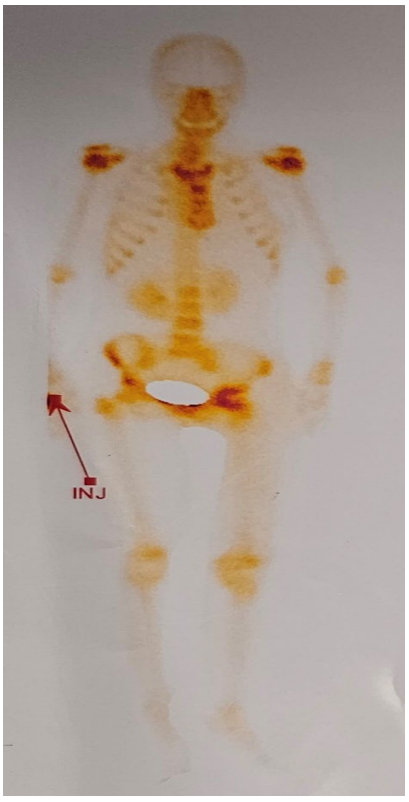

Figure 1. PET-CT scan shows hyper metabolic activity localized to the left hip joint. (**by Authors, 2025**).

3. Discussions

Septic arthritis in immunocompromised patients presents a diagnostic and therapeutic dilemma (3). Gram-negative organisms such as K. pneumoniae, Pseudomonas aeruginosa, and Escherichia coli are increasingly implicated in neutropenic patients and those with hematologic malignancies (4-9), whereas in the general population, staphylococci and streptococci are the most common pathogens (10).

Imaging studies, including MRI and PET scans, play a pivotal role in diagnosing septic arthritis, particularly in immunocompromised patients, where clinical signs may be atypical or masked by underlying conditions such as leukemia or chemotherapy-induced bone marrow changes. MRI remains the most sensitive modality for early detection of joint effusion, osteomyelitis, and soft tissue involvement, particularly in deep-seated joints such as the hip. PET scanning, while not routinely indicated, can be useful in detecting occult infectious foci in complex cases (11). Ultimately, definitive diagnosis relies on synovial fluid analysis and culture. Notably, even in the absence of classic findings or positive blood cultures, a high index of suspicion is warranted (2, 12). If clinical suspicion of septic arthritis is high, then it is recommended to treat it in the absence of bacterial proof (13). The empirical regimen should cover both gram-positive and gram-negative bacteria, as well as fungi, particularly in patients receiving prolonged antibiotic or corticosteroid therapy. Adjustments should be made based on culture results and antimicrobial susceptibility profiles. The prognosis of septic arthritis largely depends on early diagnosis, appropriate antimicrobial therapy, and timely surgical intervention (14). Despite appropriate treatment, joint damage may be irreversible, as seen in our patient who developed chronic pain and immobility necessitating arthroplasty.

Pain management in such patients is complex. Standard analgesics may be ineffective, and interventional strategies may be limited by contraindications. Multidisciplinary collaboration between hematology, infectious diseases, orthopedics, and pain management teams is essential to optimize outcomes. Future research should focus on optimizing diagnostic and therapeutic strategies for septic arthritis in immunocompromised patients, including the role of novel imaging techniques and targeted therapies.

4. Conclusion

Septic arthritis caused by Klebsiella pneumoniae in the context of acute lymphoblastic leukemia is an uncommon but serious complication. Atypical presentation in immunocompromised patients necessitates a high index of clinical suspicion. Prompt diagnosis, utilizing imaging and synovial fluid culture, combined with timely surgical and antibiotic interventions, is crucial. Despite the successful eradication of the infection, long-term joint dysfunction may persist, highlighting the need for coordinated, multidisciplinary care and consideration of reconstructive orthopedic options.

5. Declarations

5.1 Acknowledgments

We sincerely thank the patient for their cooperation and contribution to this study.

5.2 Ethical Considerations

This study was approved by Research Ethics Committee of Tabriz University of Medical Sciences (Ethics Code: IR.TBZMED.REC.1403.797).

5.3 Authors' Contributions

Conceptualization, N.G. and SH.A.; methodology, N.G., G.R., and SH.A., SH.M.; validation, N.G., and SH.A.; investigation, N.G., SH.A., GH.R., and SH.M.; writing—original draft preparation, SH.A.; writing—review and editing, SH.A. and N.G.; supervision, N.G.; project administration, SH.A. and N.G.; funding acquisition, N.G.

5.4 Conflict of Interest

The authors declare no conflict of interest.

5.5 Fund or Financial Support

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5.6 Using Artificial Intelligence Tools (AI Tools)

No artificial intelligence tools were used in the preparation of this manuscript. All content was developed by the authors.

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