Case report

A case of osteomyelitis caused by *Salmonella enterica*: Key aspects of diagnostic imaging

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Abstract

Case presentation. A 46-year-old man with a history of Hodgkin's lymphoma, treated fifteen years earlier, in complete remission. In March 2024, the patient presented with fever, abdominal pain, and diarrhea, leading to a diagnosis of intestinal infection by *Salmonella enterica*, which resolved after antibiotic treatment. Two months later, he consulted for progressive pain in his right elbow, without fever or history of trauma. Physical examination revealed pain on palpation of the proximal ulna, without swelling or erythema. The initial X-ray was normal; ultrasound showed cortical irregularity, and magnetic resonance imaging revealed medullary edema and cortical erosion, findings consistent with osteomyelitis. **Treatment.** An image-guided percutaneous bone biopsy was performed, confirming osteomyelitis and isolating *Salmonella enterica* serotype Typhi sensitive to ceftriaxone, ciprofloxacin, and trimethoprim-sulfamethoxazole. Sequential treatment was initiated with intravenous ceftriaxone for two weeks, followed by intravenous ciprofloxacin for two weeks, and finally, oral trimethoprim-sulfamethoxazole for four weeks, for a total of eight weeks of treatment. **Outcome.** The patient progressed favorably, with disappearance of pain and functional recovery of the affected limb. Surgery was not necessary, and at the end of follow-up, he was asymptomatic, with no clinical recurrence.

Keywords
Osteomyelitis, *Salmonella*, Radiology, Ulna, Case Reports.

Resumen

Presentación del caso. Hombre de 46 años con antecedente de linfoma de Hodgkin, tratado 15 años antes, en remisión completa. En marzo de 2024, el paciente presentó fiebre, dolor abdominal y diarrea, por lo que se estableció el diagnóstico de infección intestinal por *Salmonella enterica* con resolución tras tratamiento antibiótico. Dos meses después consultó por dolor progresivo en el codo derecho, sin fiebre ni antecedente traumático. Al examen físico el paciente manifestó dolor a la palpación del cúbito proximal, sin tumefacción ni eritema. La radiografía inicial fue normal; la ecografía mostró irregularidad cortical y la resonancia magnética reveló edema medular y erosión cortical, hallazgos compatibles con osteomielitis. **Intervención terapéutica.** Se realizó biopsia ósea percutánea guiada por imagen que confirmó osteomielitis y aisló *Salmonella enterica* serotipo Typhi sensible a ceftriaxona, ciprofloxacina y trimetoprim-sulfametoxazol. Se instauró tratamiento secuencial con ceftriaxona intravenosa por dos semanas, luego se indicó ciprofloxacina intravenosa por dos semanas, y finalmente, trimetoprim-sulfametoxazol oral durante cuatro semanas; para completar ocho semanas de tratamiento. **Evolución clínica.** El paciente evolucionó de manera favorable, con desaparición del dolor y recuperación funcional del miembro afectado. No fue necesaria cirugía y al cierre del seguimiento se encontraba asintomático, sin recurrencia clínica.

Palabras clave
Osteomielitis, *Salmonella*, Radiología, Cúbito, Informes de Casos.

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Un caso de osteomielitis por *Salmonella enterica*, claves diagnósticas por imagen

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Introduction

Osteomyelitis is a rare bone infection with diverse etiology that can be acute or chronic. The most common agent is *Staphylococcus aureus*, but other microorganisms, including Gram-negative bacilli such as *Salmonella spp.*, may also be involved.[1] The global incidence of *Salmonella* infections is estimated at 94 million cases of gastroenteritis annually, with around 155 000 deaths.[2] Although most cases are limited to the gastrointestinal tract, between 1 % and 5 % can progress to invasive forms with bacteremia and extraintestinal complications, including meningitis, septic arthritis, soft tissue abscesses, and osteomyelitis.[3,4]

Salmonella osteomyelitis accounts for less than 1 % of all cases of osteomyelitis and usually occurs in patients with hemoglobinopathies, immunosuppression, or comorbidities such as diabetes *mellitus*.[5,6] However, in recent decades, cases have been reported in previously healthy individuals, including immunocompetent children and adults.[7-9] In most published series, long bones are the most affected (femur, tibia, humerus), although unusual locations such as the ulna, radius, clavicle, and vertebrae have been described.[10-12]

In Latin America and countries such as El Salvador, *Salmonella enterica* serotype Typhi (*S.* Typhi) infections are among of the main causes of bacterial gastroenteritis; however, reports of osteomyelitis are scarce and limited to isolated case reports.[13] This lack of local data underscores the need to disseminate clinical experiences that contribute to epidemiological and therapeutic understanding in the region.

Imaging, particularly magnetic resonance imaging, plays an essential role in confirming bone involvement and differentiating it from other pathologies such as neoplasms or non-infectious inflammatory processes.[14,15] The correlation of clinical, microbiological, and radiological findings is crucial for a comprehensive approach and timely treatment.

Given the rarity of this presentation in patients without predisposing factors, the objective of this study is to describe a case of *Salmonella* osteomyelitis in the ulna, highlighting its diagnostic imaging approach and the value of microbiological confirmation.

Case presentation

A 46-year-old male patient with a history of mixed-cell Hodgkin's lymphoma, diagnosed 15 years ago and treated with chemotherapy in 2009. No detailed information was available on the treatment regimen, number of cycles, or duration of treatment. No documented data on associated radiotherapy or immunotherapy were found either. The patient achieved complete remission, with no evidence of recurrence to date. No other relevant comorbidities were recorded.

In March 2024, the patient developed acute fever, abdominal pain, and diarrhea. Microbiological studies confirmed the diagnosis of intestinal salmonellosis caused by *Salmonella enterica*; therefore, he began outpatient treatment with 160/800 mg of trimethoprim-sulfamethoxazole every 12 hours orally, which resulted in complete resolution of the gastrointestinal symptoms. No documented hematological and microbiological studies are available for the initial gastrointestinal episode.

Two months later, he consulted for progressive pain in the posterior region of the right elbow, with no history of recent trauma, fever, or local inflammatory signs. On physical examination revealed selective pain on palpation in the proximal third of the right ulna, without tenderness, erythema, or increased local temperature. During the initial evaluation, laboratory tests were performed. The complete blood count showed a white blood cell count of 4.4×10^3/µL, red blood cells of 4.9×10^6/µL, hemoglobin of 14.7 g/dL, hematocrit of 43.7 %, and platelets of 182×10^3/µL. The white blood cell differential showed neutrophils 55 %, lymphocytes 32 %, monocytes 12 %, and eosinophils 1 %. C-reactive protein was elevated (47.5 mg/L), and erythrocyte sedimentation rate was 11 mm/hour (0-9).

Coagulation times were normal (PT 10.5 s, INR 0.97, TPT 31.8 s). Given the oncological history and clinical presentation, osteoarticular tuberculosis was considered in the differential diagnosis, and rapid molecular tests for *Mycobacterium tuberculosis* were performed, with negative results. Fever antigens were also requested, with positivity for *S.* Typhi (antigen H 1:160 and antigen A 1:40).

The initial plain radiograph of the right forearm showed no obvious bone abnormalities (Figure 1). Given the persistence of pain, a musculoskeletal ultrasound was performed, which revealed irregularity and disruption of the cortical bone in the proximal diaphysis of the ulna. Since the ultrasound record is not available, this finding is documented on computed tomography in bone window (Figure 2), which showed irregularity of the cortical surface in the same bone segment. The study was complemented with magnetic resonance imaging, which showed the presence of medullary edema in fluid-sensitive sequences, cortical erosion, and a linear cortical image suggestive of bone sequestration, findings consistent with diaphyseal osteomyelitis (Figure 3 and Figure 4).

Treatment

S. Typhi was isolated by bone biopsy, allowing targeted antibiotic treatment to be initiated based on the antibiogram. The transition from intravenous to oral therapy was made after evidence of sustained clinical stability of the patient. A blood culture was performed to document bacteremia and confirm the mechanism of dissemination to bone tissue; however, access to

the institutional registry was not available, which is recognized as a limitation of this report. In the literature,[16] third-generation cephalosporins, fluoroquinolones, and trimethoprim-sulfamethoxazole have been used in *Salmonella* osteomyelitis, with prolonged treatments (often ≥ 6-8 weeks) and the possibility of completing with highly bioavailable oral antimicrobials when clinical stability is achieved. The patient received intravenous ceftriaxone (2 g every 24 hours) for 14 days, followed by intravenous ciprofloxacin (400 mg every 12 hours) for 14 days and subsequently, oral trimethoprim-sulfamethoxazole (160/800 mg every 12 h) for four weeks, completing a total regimen of eight weeks of antimicrobial treatment. Surgical intervention was not necessary, as no collections or significant bone destruction were identified that would indicate the need for debridement.

Outcome

The patient responded favorably to medical treatment, as evidenced by pain remission and normalization of his general condition. Although no follow-up radiological studies were obtained to document imaging resolution, the therapeutic response was evaluated through clinical follow-up and objective laboratory parameters. During post-treatment follow-ups, normalization of the blood count was documented (leukocytes 5.6 x 10^3/µL, neutrophils 43 %, lymphocytes 37 %, monocytes 11.1 %, eosinophils 7.2 %, hemoglobin 14.4 g/dL, platelets 334 000/µL), as well as inflammatory markers within the normal range (C-reactive protein 0.1 mg/dL and erythrocyte sedimentation rate 6 mm/h), which supported the favorable response to antibiotic treatment. The case ended with the patient's complete recovery.

Clinical diagnosis

Osteomyelitis caused by *S. Typhi.*

Discussion

Salmonella osteomyelitis is a rare infection, accounting for less than 1 % of osteomyelitis cases described in the literature.[1,2] It is generally associated with hemoglobinopathies such as sickle cell anemia[5] and thalassemia, where splenic dysfunction and impaired immune response favor severe bacterial infections.[5] It has also been described in patients with diabetes, acquired immunodeficiencies, prolonged use of steroids, or a history of trauma and orthopedic surgery.[7,11] However, cases in immunocompetent adults and children have been documented in recent years.[2,3,9] In this case, a history of Hodgkin's lymphoma in remission constitutes a factor of relative immunosuppression that can favor the development of invasive infections such as *Salmonella* osteomyelitis.

From an epidemiological perspective, *Salmonella enterica* infection remains a

Figure 1. Initial radiographs of the right forearm. A) Anteroposterior projection. B) Lateral projection. The study revealed no significant radiological findings (e.g., bone destruction, periosteal reaction, or sequestration), which is common in the early stages of osteomyelitis.

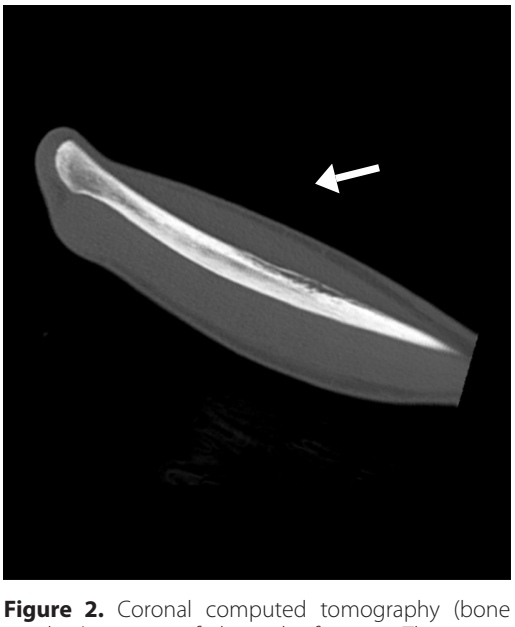

Figure 2. Coronal computed tomography (bone window) section of the right forearm. The image shows an irregularity of the cortex in the diaphysis of the ulna (arrowhead), an initial finding that prompted further investigation with magnetic resonance imaging.

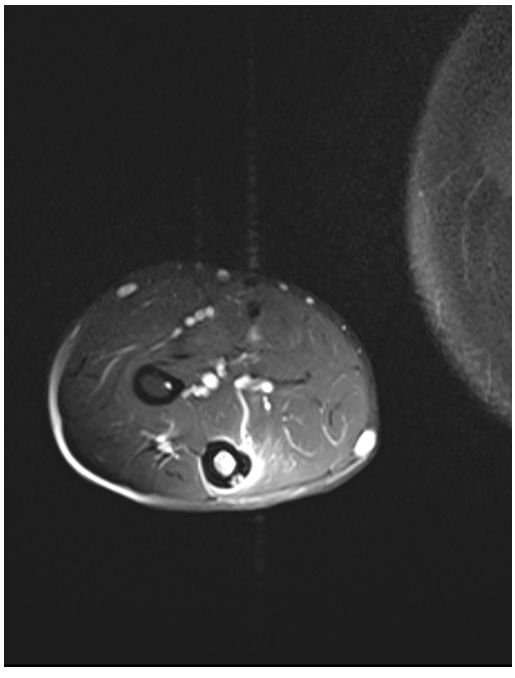

Figure 3. T2-weighted axial magnetic resonance imaging scan showing medullary edema as a hyperintense signal, as well as adjacent soft tissues (arrow).

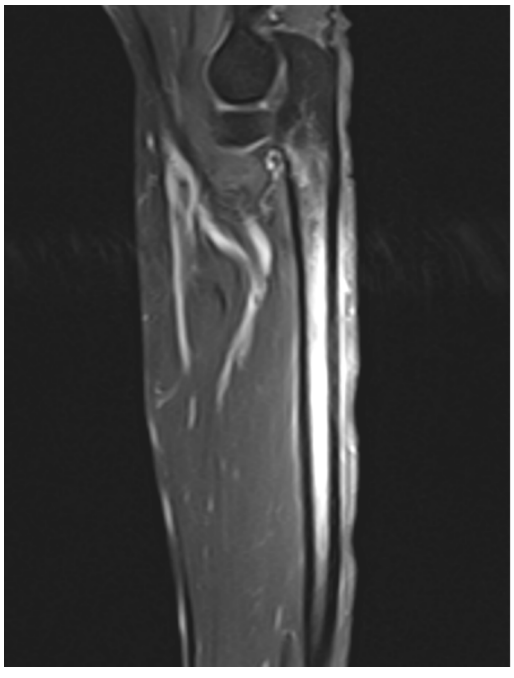

Figure 4. T2-weighted coronal MRI scan showing medullary edema as a hyperintense signal, as well as adjacent soft tissues (arrow).

global problem, with millions of cases of gastroenteritis and thousands of deaths annually.[10] Only a minority of them progress to invasive infections, including bacteremia, abscesses, and osteomyelitis. In endemic regions of Africa and Asia, *Salmonella* osteomyelitis is more common, particularly in patients with hemoglobinopathies.[5] In Latin America, reports are scarce and tend to be limited to isolated clinical cases.[12] This highlights the importance of communicating local experiences, especially when the infection affects atypical locations such as the ulna.

The most commonly reported locations are the long bones (tibia, femur, and humerus), followed by the spine, clavicle, and ribs.[7,13] In children with sickle cell anemia, multifocality and diaphyseal predilection are also observed.[5,15] In this case, diaphyseal involvement of the ulna is exceptional and broadens the clinical spectrum of this entity.

The clinical presentation is usually nonspecific. Some patients present with fever and localized pain, while others develop subacute symptoms without obvious signs of inflammation.[2] In this case, the patient consulted for progressive pain in the elbow, without fever or local changes, which is consistent with reports in immunocompetent adults where the clinical presentation may be limited.[3,8] In patients with hemoglobinopathies, recurrent bone pain and fever can be confused with vaso-occlusive crises, delaying the diagnosis of osteomyelitis.[5]

The differential diagnoses should include bacterial osteomyelitis caused by *Staphylococcus aureus*, which is the most common cause and is distinguished by its metaphysical predilection and tendency toward more extensive cortical destruction.[4] Osteoarticular tuberculosis in endemic areas should also be included, as it can mimic chronic lytic lesions.[10] Other entities to exclude are primary bone tumors such as osteosarcoma or lymphoma, and metastases in adults, all of which have overlapping radiological findings.[4]

Imaging studies play a crucial role. Plain radiography may be normal in the early stages[4,6] which was the case here. Musculoskeletal ultrasound helps to identify cortical irregularities and exclude adjacent collections. Magnetic resonance imaging is essential in the early stages, as it shows T1 hypointense signal, T2/STIR hyperintense signal, cortical erosion, and possible soft tissue involvement.[6,15] Computed tomography is useful in advanced stages, as it can detect devitalized bone fragments embedded in lytic areas and confirm the presence of necrosis.[7] In this patient, MRI was decisive in confirming diaphyseal osteomyelitis of the ulna and guiding percutaneous bone biopsy.

Treatment of *Salmonella* osteomyelitis combines prolonged antibiotics and, in selected cases, surgery. Intravenous ceftriaxone for four to six weeks is considered the initial choice, followed by oral therapy with fluoroquinolones or trimethoprim-sulfamethoxazole for another four to

six weeks.[7,11,13] Surgical debridement is reserved for cases with extensive necrosis or abscesses. In this patient, no collections or significant destruction were identified, so no surgical procedure was necessary. Targeted treatment was initiated with antibiotics administered sequentially, four weeks of intravenous therapy and four weeks of oral treatment, for a total of eight weeks. This regimen is consistent with recent reports in immunocompetent adults, where clinical resolution is achieved with sequential and targeted therapy.[2,9,14]

The prognosis for *Salmonella* osteomyelitis is generally favorable when diagnosis is early and treatment is complete. However, recurrences have been described in patients with persistent predisposing factors such as hemoglobinopathies or immunodeficiencies.[5,12] In this case, the outcome was satisfactory after eight weeks of antibiotics, with no recurrences at the end of follow-up. This outcome is consistent with recent reports in adults without hemoglobinopathies, where recovery is possible with timely management.[1,3,8]

In conclusion, *Salmonella enterica* osteomyelitis is a rare infection that should be suspected in patients with a history of immunosuppression, hemoglobinopathies, or previous gastrointestinal infections. The correlation between clinical findings,imaging, and microbiology is essential for diagnosis. This case reinforces the need to consider *Salmonella* in the differential diagnosis of diaphyseal lesions of the ulna, even in contexts where it is exceptional, and shows that targeted antibiotic treatment can ensure a favorable outcome.

Ethical considerations

This study complied with the ethical principles established in the Declaration of Helsinki and international guidelines for health research involving human subjects. Informed consent was obtained from the patient for the publication of the clinical case and diagnostic images included in this report. The images used are our own and were obtained as part of the diagnostic process, ensuring the anonymity and confidentiality of the patient.

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History of Salmonella enterica intestinal infection two months prior, resolved after antibiotic treatment; S. Typhi was subsequently isolated via bone biopsy, confirming a diagnosis of S. Typhi osteomyelitis.

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