Incremental Value of Three-Phase Bone Scintigraphy and Single-Photon Emission Computed Tomography–Computed Tomography in a Case of Postpartum PUO in the Wake of The Antibiotic-Resistance Era

Abstract

Postpartum methicillin-resistant *Staphylococcus aureus* (MRSA) infection occurs in patients with complicated vaginal delivery or cesarean section. The infection can manifest as mastitis, endometritis, and if untreated may lead to toxic shock syndrome. We report a case of postpartum MRSA osteomyelitis diagnosed by 99mtechnetium-methylene diphosphonate skeletal scintigraphy and single-photon emission computed tomography–computed tomography (CT) that was further confirmed by magnetic resonance imaging and CT-guided biopsy. This multimodal imaging approach helped reach the diagnosis and in further management of the patient.

Keywords: *Multimodal approach, postpartum methicillin-resistant Staphylococcus aureus, single-photon emission computed tomography–computed tomography, toxic shock syndrome*

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Introduction

Osteomyelitis (OM) is an infectious disease of the bone, which leads to destruction and deterioration of function performed by the affected bone. The occurrence of disease is not high, owing to high resistance to infection. Patients affected are those with risk factors such as diabetes, decubitus ulcers, surgery, trauma, and intravenous drug use.[1]

Staphylococcus aureus has been commonly found to be the causative organism. The majority of these cases involve the methicillin-resistant *S. aureus* (MRSA) strains acquired through the community. These MRSA strains are ones that are resistant to β-lactam antibiotics including penicillin, cephalosporins, and carbapenems.[2]

The microorganism reaches the bone by hematogenous dissemination, by spread from a contiguous focus of infection, or by a penetrating wound.[3] MRSA infection leads to extraosseous spread of the infection and also increased morbidity.[4] This is attributed to the production of a toxin known as Panton–Valentine leukocidin by MRSA strains.[5]

Mastitis, cellulitis, breast abscess, pelvic thrombophlebitis, pneumonia, septicemia, wound infection (cesarean and episiotomy), and urinary tract infections have been reported in patients with postpartum infection. Cases of pyogenic OM involving femoral heads,[6] pubic symphysis,[7,8] and tibia[9] have been reported with sacroiliac joint involvement[10] being a rare entity which the clinician needs to keep in mind to arrive at a diagnosis.[11] It is believed that puerperal sacroiliitis is related to microscopic areas of injury on the joint surfaces produced by the changes during pregnancy.[12]

Case Report

A 32-year-old female presented with complaints of pain in the lower back for 6 months. The pain was insidious in onset, gradually progressive, radiating to the right gluteal region, and associated with low-grade fever.

The patient had a history of cesarean section after a full-term pregnancy, 6 months before presentation to the clinic. On physical examination, the patient was conscious, normotensive (130/80 mmHg), with elevated heart rate (144 beats/min) and tachypneic (23 breaths/min). Her body temperature was 40.2°C.

Blood investigations revealed the following [Table 1].

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She was then referred for a 99mtechnetium-methylene diphosphonate (99mTc-MDP) three-phase skeletal scintigraphy with single-photon emission computed tomography–computed tomography (SPECT-CT) after the regular investigations, 20 mCi of 99mTc-MDP was injected after securing an intravenous line. The scan revealed increased perfusion in the first pass and mild tracer pooling on the second pass in the right sacroiliac region [Figure 1a and b]. The static study [Figure 1c] and delayed whole-body sweep [Figure 1d] showed increase in tracer concentration in the sacroiliac joints (R > L), and mildly increased tracer concentration was seen in the symphysis pubis.

SPECT-CT with low-dose nondiagnostic CT of the pelvic region was done for localization. It showed increased tracer concentration in the articular margin erosions with adjoining sclerosis in bilateral sacroiliac joints (Right > Left) with minimal soft-tissue component on the right side [Figure 2a and b]. Subchondral erosions were seen in the pubic symphysis with mild tracer concentration. Old healed fracture was noted in the left inferior pubic ramus [Figure 2c].

Magnetic resonance imaging (MRI) of the spine and pelvis was performed, which revealed bilateral sacroiliitis with small amount of peripherally enhancing collection around both the sacroiliac joints, right joint affected more than the left [Figure 3a and b].

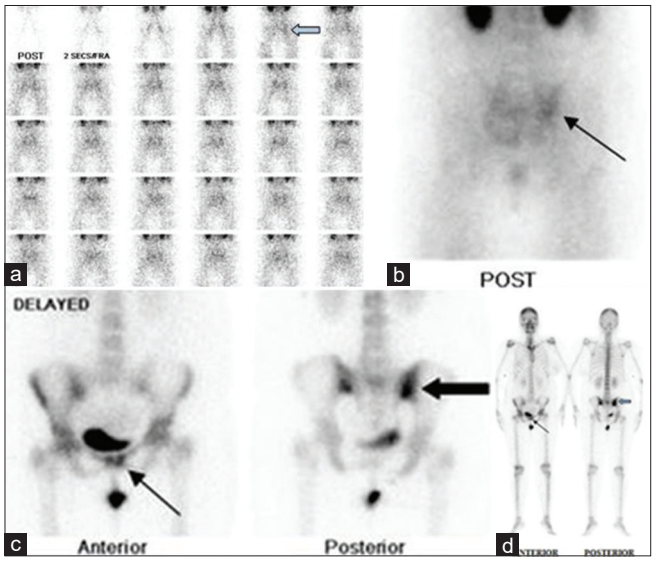

Figure 1: (a) 99mtechnetium-methylene diphosphonate three-phase perfusion-phase skeletal scintigraphy in posterior view shows abnormal perfusion in the region corresponding to the right sacroiliac joint. (b) 99mtechnetium-methylene diphosphonate blood-pool phase scintigraphy in posterior view shows mild tracer pooling in the right sacroiliac region. (c) Increased tracer uptake in the delayed phase seen in the region corresponding to the right sacroiliac region (bold arrow) and symphysis pubis (arrow). (d) 99mtechnetium-methylene diphosphonate delayed whole-body sweep showing increased tracer concentration in the sacroiliac joints (R > L, marked by bold arrow) and mildly increased tracer concentration was seen in the symphysis pubis (arrow). Injection site is noted near the right elbow

MRI of the right thigh revealed edema in the right iliopsoas muscle, extending into the upper thigh along with the iliacus muscle [Figure 4].

The patient underwent a CT-guided fine-needle aspiration cytology of the right sacroiliac joint collection. Microscopy revealed a predominantly disperse population of intact and degenerated polymorphs against the background containing scanty chronic inflammatory cells and necrotic material. No evidence of granuloma or malignancy was observed. Ziehl–Neelsen staining showed no evidence of acid-fast bacilli. Pus collected was subjected to culture and sensitivity using colorimetric VITEK-2 method showed growth of *S. aureus* after 24 h of the incubation period. The organism was found to be resistant to benzyl penicillin and oxacillin and sensitivity to teicoplanin.

Blood culture and sensitivity under aerobic conditions using colorimetric VITEK-2 method revealed the growth of *S. aureus* after 48 h of incubation period. The organism was found to be resistant to benzylpenicillin. Urine culture and sensitivity showed no growth after 48 h of incubation.

The patient was started on intravenous teicoplanin 400 mg twice a day. The patient responded to a long course of intravenous antibiotic treatment.

Discussion and Review of Literature

Postpartum OM is a rare disease with few case reports in literature. Pyogenic sacroiliitis is an uncommon condition with a reported incidence rate varying from 1.5% to 10% of all pyogenic joint infections.[13]

The radiologic diagnosis in OM includes techniques such as plain radiography, CT, MRI, and nuclear medicine

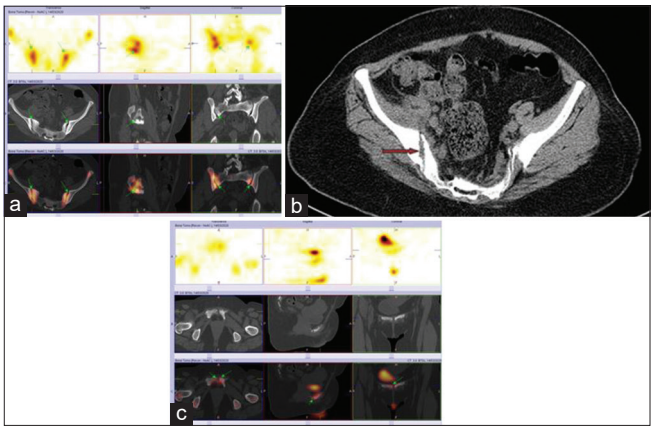

Figure 2: (a) Single-photon emission computed tomography with low-dose screening computed tomography of the pelvic region showing increased tracer concentration in the articular margin erosions with adjoining sclerosis in bilateral sacroiliac joints. (b) Computed tomography scan acquired with single-photon emission computed tomography for attenuation correction showing soft-tissue involvement in the right sacroiliac joint. (c) Single-photon emission computed tomography with low-dose screening computed tomography of the pelvic region showing increased tracer concentration corresponding to healed fracture in the left inferior pubic ramus

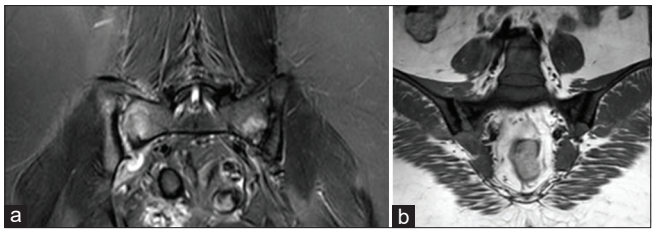

Figure 3: (a) STIR coronal section of the pelvis showing bilateral sacroiliitis with peripherally enhancing collection around bilateral sacroiliac joints (Right > Left). (b) T1-weighted magnetic resonance imaging image showing bilateral sacroiliitis with peripherally enhancing collection around bilateral sacroiliac joints (Right > Left)

Table 1: Laboratory investigations

Parameters	Results	Reference (range)
Hemoglobin	12.1 g/dL	11.5-16.5 g/dL
Packed cell	36.5	37-47%
WBC count	16.2	4-11×10^3 mm^3
ESR	108	0-20 mm/h
Differential count		
Neutrophils	91	40%-80%
Lymphocytes	6	20%-40%
Eosinophils	0	1%-6%
Monocytes	3	2%-10%
HLA B27	Not detected	
CRP	9.71	<5.0 mg/mL
Random plasma glucose	110	<140 mg/dL
Serum uric acid	6.7	2.5-6.2 mg/dL
Alkaline phosphatase	43	38-126 U/L

WBC: White blood cell, ESR: Erythrocyte sedimentation rate, CRP: C-reactive protein, HLA: Human leukocyte antigen

techniques such as triple-phase scan, SPECT-CT, and 18fluorodeoxyglucose-positron emission tomography combined with CT.

Triple-phase bone scan provides information regarding the blood flow, abnormal pooling of blood in the immediate images, and persistence of tracer activity in the delayed images. OM is an infectious disease of the bone; the tracer activity is related to both osteoblastic and vascular activity leading to focal increased uptake in all three phases.

SPECT combined with a CT scan for the purpose of attenuation correction helps in the localization of additional regions of disease that would otherwise have missed on planar scintigraphy. SPECT-CT will also be able to provide clues regarding the involvement of soft tissues, which will guide the clinician to confirm the same by investigating further, which in our case was by MRI and CT-guided biopsy.

The triple-phase skeletal scintigraphy with SPECT-CT helped clinch the diagnosis by being able to locate the foci of interest, rule out the involvement of other joints in the delayed whole-body sweep study, and help confirm the diagnosis with the aid of biopsy.

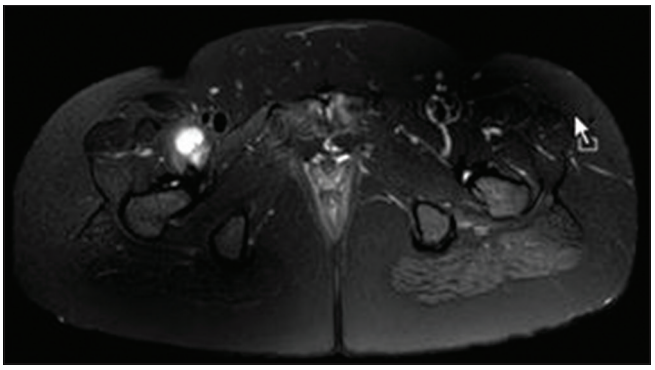

Figure 4: T2 SPAIR axial section showing hyperintensity in the right iliopsoas muscle

Lee *et al*.[14] in their study have described the key imaging findings in OM with various imaging modalities. The authors concluded that MRI is the imaging modality of choice for establishing the diagnosis of OM in view of better soft-tissue delineation, whereas the triple-phase bone scan has high sensitivity for detecting acute OM in a nonviolated bone.

Arican *et al*.[15] in their retrospective study involving 85 patients with suspicion of OM evaluated the contribution of SPECT/CT to three-phase bone scintigraphy for the assessment of OM and patient's management. Their statistical analysis confirmed the superiority of SPECT/CT over planar scan in not only helping in the diagnosis and management of the study population but also differentiating acute from chronic OM.

Cornejo and Mandell[16] described the distribution of MRSA OM mentioning the multifocal and long segment distribution of the disease on bone scintigraphy. These findings correlated well with the MRI scan.

Conclusion

99mTc-methylene diphosphonate planar triple-phase bone scintigraphy along with a SPECT-CT scan forms an integral part of the diagnostic workup in a case of postpartum low back pain associated with fever. The modality aids in providing a differential diagnosis and confirms the presence of polyarthritis in addition to the primary suspected pathology.

Planar triple-phase bone scintigraphy helps locate the foci of infection and rule out the involvement of other joints. A SPECT-CT scan done along with bone scintigraphy helps confirm the diagnosis by planning a CT-guided biopsy to accurately localize the site of biopsy.

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Conflicts of interest

There are no conflicts of interest.

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