Differentiating Charcot Arthropathy from Acute Osteomyelitis Using Combined Labeled Leukocyte and Technetium 99m Sulfur Colloid Marrow Imaging - Case Study

Son Tran 1, Rafay Qureshi 1, Madeleine Barbe 1, Tymoteusz Siwy 1, Andrew Bloom 1, Peter Zakii 2, Elisabeth Pennington 3, Jengyu Lai 4, Madeleine Barbe 5, Harry Penny 6

1. BS, APWH student member, 4th year student at Temple School of Podiatric Medicine, Philadelphia, PA
2. BS, APWH student member, 4th year student at Penn State College of Medicine, Hershey, PA
3. BS, APWH student member, Chapman University in Orange, CA
4. DPM, APWHc, FAPWHc, Rochester Clinic, Rochester, MN
5. MD, UPMC Altoona, PA
6. DPM, APWHc, FAPWHc, UPMC Altoona, PA

Result

Figure 1. Tc99m-methylene diphosphonate (MDP) scan demonstrating focal increased blood flow at the lateral aspect of the foot.

Figure 2. Hyperemia noted during the pool phase (A) with corresponding uptake along the right 5th metatarsal in the delayed phase (B).

Figure 3. Increased uptake at the region of the fifth metatarsal bone on the MDP scan (A) corresponding to the increased uptake on the MDP scan (B).

Figure 4. Increased uptake on the SC scan at the region of the fifth metatarsal bone (A) concomitant with the increased uptake on the Indium scan (B).

Interpretation and Treatment Plan

Bone scan interpretation
- Figure 3A showed a broader signal uptake pattern in the right foot than the uptake of Figure 3B, suggesting that there was widespread involvement.
- Figure 4A (marrow scan) exhibited similar signal intensity and distribution as compared to Figure 3A (MDP scan), suggesting that marrow hyperplasia was responsible for the uptake pattern of figure 3A.
- Figure 4A (marrow scan) demonstrated signal intensity at the right 5th metatarsal head that was congruent to the uptake of Figure 4B (WBC scan). This suggested that the combined scans were negative for OM.
- A positive OM finding would result in a photopenic distribution at the right 5th metatarsal head on the SC scan, which would remain photointense on the WBC scan.

Treatment plan
Clinical findings suggested that the infection was restricted to soft tissue. Bone scans further suggested that there was acute CN in absence of OM. Patient was recommended to discontinue IV antibiotics and follow a strict offloading protocol in a FORS® pixelated offloading insole. His ulcer was closed in 7 weeks with standard wound care.

Discussion

- Combined WBC and SC bone scan imaging supported the suspicion of CN over acute OM at the right fifth metatarsal. In our case study, the patient had cellulitis, in which the WBC scan yielded focal uptake at the right 5th metatarsal head. However, this could have been suggestive of acute OM. Nevertheless, incorporating the SC scan with the WBC scan showed that signal uptake in the right foot had a wider distribution than just the metatarsal head, reducing the suspicion for acute OM due to broader osseous activity. Based on the patient’s history with CN on the contralateral limb, along with the use of combined scans, it was deduced that that patient was experiencing CN changes.

- The leukocyte scan requires extracting WBCs from the patient and tagging them with indium-111 before injecting them back into the patient intravenously. WBC-labeled scans localize leukocytes to areas of recent infection. However, due to its limited resolution, the distinction between bone and adjacent soft tissue infection may be compromised and lead to false positive results of OM. Additionally, WBC imaging interpretation is often complicated when discerning between hematopoietically active marrow and OM.

- Tc99m-labeled sulfur colloid accumulates specifically in bone marrow following its injection. SC scans show potential in differentiating between marrow and infection when determining the cause of leukocyte accumulation in the neurologic joint. SC scan localizes to bone marrow, resulting in photointense signals during hematopoietically active processes (CN) and photopenic uptake during bone necrosis (OM).

- Traditional MDP scans and WBC-labeled scans yield valuable information about osseous and soft tissue pathology. However, results are at times complicated by the lack of specificity. Combining MDP, WBC, and SC bone scans provide better insight in determining the type of osseous processes in question. However, combined scans are not without limitations. Abnormal WBC response or migration to site of infection will not yield useful information in marrow imaging. Proper SC preparation is paramount since image quality may be disrupted with poor technique. Additionally, a skilled radiologist who is familiar with combined scans technique is needed for accurate interpretation.

- Using the combined labeled leukocyte and Tc99m-sulfur colloid bone marrow imaging technique requires a high index of suspicion for CN. However, we are optimistic that these combined imaging techniques will better distinguish between an infectious bone process and a neurogenic disease.

References