
Comparison of Bone and Gallium-67 Imaging in Heroin Users' Arthritis

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Nine cases of primary septic arthritis in heroin addicts are reported. Fibrous and cartilaginous joint localizations are prominent (four sternoarticular, three sacroiliac, one sacroccocygeal, and one knee). In all patients but one, conventional roentgenographic studies were negative. In six cases the causative agent was *Staphylococcus aureus* and in two cases, *Candida albicans*. In one case, it could not be determined. Our clinical observations, correlating the radioisotopic studies, suggest that in the first week of evolution the diagnostic procedure of choice is the [⁶⁷Ga]citrate scintigram. Indeed, during this period the [⁹⁹Tc]MDP bone scan is usually negative. The early demonstration and localization of the disease, together with the rapid bacteriologic diagnosis, allows for an early and more appropriate antibiotic treatment and better results.

J Nucl Med 26:1377-1381, 1985

Primarily septic arthritis is one of the many infectious complications occurring in heroin addicts (1-6). Although synovial joints like the knee and hip joints are commonly involved (7-10), in this group of patients the articular infection is mainly localized in the fibrous and cartilaginous joints (vertebral disk, sacroiliac, sternocostal and sternoclavicular joints, and pubic symphysis) (11-16). Laboratory data are nonspecific and, usually, conventional roentgenographic studies are not diagnostically useful to show abnormalities in the early stage of the disease.

The use of bone scanning with technetium-99m methylene diphosphonate ([^{99m}Tc]MDP), and the [⁶⁷Ga]citrate scintigram in the diagnosis of such cases as well as the sensitivity and reliability of both methods have been under discussion for some years (17-19). The aim of our work is to determine which of these diagnostic procedures is more helpful in making an early diagnosis.

MATERIALS AND METHODS

We studied nine patients (six men and three women). All satisfied the criteria proposed by Roca and Yoshikawa

(14) for primary septic arthritis in drug addicts, namely: (a) a history of addiction to heroin; (b) symptoms and signs of osteoarticular infection; (c) absence of endocarditis or any other bacteriemic focus; and (d) germ isolation by blood and/or articular material culture, or else an histologic study compatible with osteoarticular infection.

All patients had a conventional roentgenographic study and a bone scan using [^{99m}Tc]MDP was carried out. Gallium-67 (⁶⁷Ga) citrate was administered during the first 24 hr after admittance.

Bone scanning was carried out using [^{99m}Tc]MDP (average labeling efficiency of nearly 97%), giving a dose of 20 mCi and starting the procedure after 2-3 hr. Scintigraphy was performed using a large field-of-view gamma camera equipped with a low-energy, parallel-hole collimator. A 15% window over the 140-keV peak was used. 500k counts were accumulated for each image.

Gallium-67 citrate scintigram was carried out by giving a dose of 5 mCi without any previous preparation of the patients. Images were made at 6, 24, and 48 hr after injection of the tracer, using a large field-of-view gamma camera equipped with a medium-energy, parallel-hole collimator, selecting windows over the three most important energy level peaks. 500k counts were accumulated for each image, and data were stored in a computer in order to permit analysis of images by enhancement, background subtraction, filtration, etc.

Received Dec. 27, 1984; revision accepted Aug. 22, 1985.

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TABLE 1
Patient Characteristics

| Case no.* | Age | Sex | Site | Agent | Source |
|-----------|-----|-----|--------------|--------------------|-----------|
| 1 | 29 | M | Sternocostal | <i>S. aureus</i> | Blood |
| 2 | 20 | M | Sacroiliac | <i>S. aureus</i> | Blood |
| 3 | 27 | M | Sacrococcyx | <i>S. aureus</i> | Blood |
| 5 | 29 | M | St-costal | <i>S. aureus</i> | Blood |
| 6 | 26 | M | St-costal | <i>S. aureus</i> | Blood |
| 9 | 24 | F | St-costal | <i>C. albicans</i> | Joint |
| 4 | 18 | F | Sacroiliac | <i>S. aureus</i> | Histology |
| 7 | 26 | M | Sacroiliac | <i>S. aureus</i> | Blood |
| 8 | 24 | F | Knee | <i>C. albicans</i> | Joint |

*All but Cases 4, 7, and 8 were seen less than 1 wk after onset.

RESULTS

The clinical and bacteriologic data are summarized in Table 1. All were young patients. Six consulted early in their evolution, i.e., within 1 wk of the start of their symptoms, while three consulted later, i.e., more than 3 wk from the beginning. The infection was localized in sternoarticular joint structures in four patients, in sacroiliac joints in three patients, in the sacrococcygeal joint in one patient and in the right knee in one patient. *Staphylococcus aureus* was isolated by hemoculture in six cases and *Candida albicans* in two cases, by culture of the infected tissue. In one patient (Case 4) blood cultures were repeatedly negative and the articular material culture was also sterile. Nevertheless, in this case, the histologic findings were compatible with osteitis of the iliac bone.

TABLE 2
Results of Osteoarticular Imaging

| Group* | X-ray | [^{99m} Tc]MDP | [⁶⁷ Ga]citrate |
|---------------|-------|-------------------------|----------------------------|
| Early (N = 6) | 0 | 0 | 6 |
| Late (N = 3) | 1 | 3 | 3 |

*Early is less than 1 wk and late is more than 3 wk after onset. Numbers indicate positive results. Only positive x-ray is in Case 4.

As shown in Table 2, the roentgenographic studies were normal in all cases except in Case 4, who showed a right sacroiliac joint structural loss with irregularity and sclerosis at the articular borders. All patients had a positive [⁶⁷Ga]citrate scintigram in the images obtained at 24 hr. Only three patients had a positive [^{99m}Tc]MDP bone scanning and they were precisely those with the longer evolution (Case 8, Fig. 1). In patients with an evolution shorter than a week, the [^{99m}Tc]MDP bone was negative as illustrated by Cases 5 (Fig. 2) and 6 (Fig. 3).

DISCUSSION

The prognosis of nongonococcal septic arthritis depends upon three factors: the patient's previous health status, the virulence of the agent, and the duration of the evolution (20, 21). Functional results are usually bad if the treatment is initiated after the first week of evolution (10, 21, 22), especially when the causal germ is *Staphylococcus aureus*. Diagnosis is not difficult when the infec-

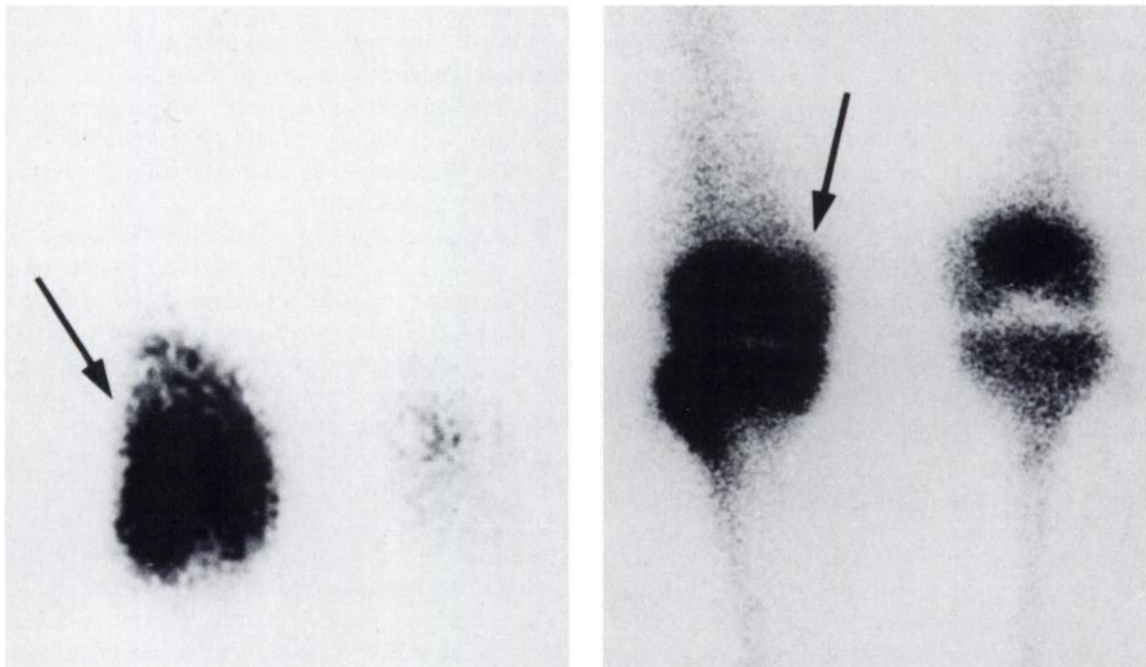


FIGURE 1
Case 8: *C. albicans* arthritis in right knee joint. Arrow shows abnormal [⁶⁷Ga]citrate (left) and [^{99m}Tc]MDP (right) accumulation after 30 days of evolution

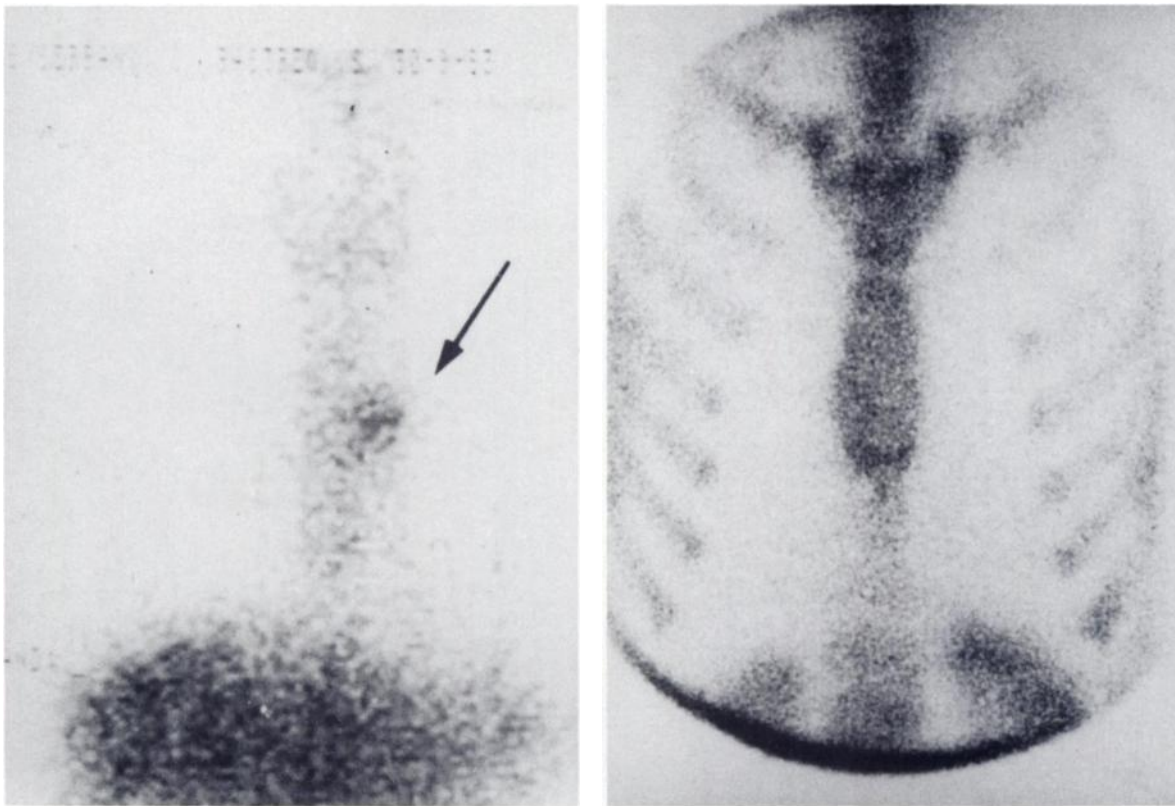


FIGURE 2

Case 5: *S. aureus* infection in third left costosternal joint. Arrow shows abnormal $[^{67}\text{Ga}]$ citrate accumulation in affected joint (left). After 2 days of evolution there is normal $[^{99\text{m}}\text{Tc}]$ MDP distribution (right)

tious process has a sudden onset in a peripheral joint and is accompanied by fever and leukocytosis. However, when the disease has an insidious onset or affects fibrous or cartilaginous joints, the clinical picture can be nonspecific and it is difficult to localize and confirm the infectious focus. Thus, lumbosacral or pubic pain can be discarded or attributed to a urinary infection (14, 16). Further complicating the issue in heroin addicts, septic arthritis can run its course without fever or leukocytosis (11, 14).

For some years, $[^{99\text{m}}\text{Tc}]$ MDP bone scanning has been used for the diagnosis of osteomyelitis, and, in addition, blood-pool imaging has been used to try to improve the results (23-28). The $[^{67}\text{Ga}]$ citrate scintigram has been used more recently, at first as an adjuvant to bone scanning (29, 30). It has been suggested that the gallium scan may be positive earlier than the bone scan in bone infection (25-27, 31).

In our patients, roentgenographic studies were always negative, except in Case 4. The $[^{99\text{m}}\text{Tc}]$ MDP bone scan was positive only in three cases with protracted evolution. However, the $[^{67}\text{Ga}]$ citrate scintigram was positive both in cases with a short and with a long evolution.

The fixation mechanisms of $[^{99\text{m}}\text{Tc}]$ MDP and that of $[^{67}\text{Ga}]$ citrate are clearly different. Technetium-99m MDP is deposited by virtue of an increased local blood flow and

bone metabolic activity. Accordingly, bone hypercaptation should not be present in early cases. On the other hand, $[^{67}\text{Ga}]$ citrate binds to serum proteins (transferrin, heptoglobin, albumin) and to cells, especially to polymorphonuclear leukocytes and macrophages. This would explain why it is concentrated and deposited early on in the infectious focus, and thus allows for its greater early sensitivity. Our observations serve to illustrate that in primary osteoarticular infections such as in those of drug addicts, the $[^{67}\text{Ga}]$ citrate scintigram is positive earlier and is thus a more useful localization method. It also allows for asymptomatic focus detection.

In summary, an infectious process should be suspected in every heroin addict with pain of osteoarticular origin, even in the absence of fever and leukocytosis. In such a case, early diagnosis can be based upon the $[^{67}\text{Ga}]$ citrate scintigram which, together with a proper bacteriological investigation, will allow early and appropriate antibiotic treatment and thus avoid functional sequelae.

ACKNOWLEDGMENTS

The authors thank Dr. Henri Menard for the critical review of the manuscript, and Mr. Deogracias Magdalena for the scans.

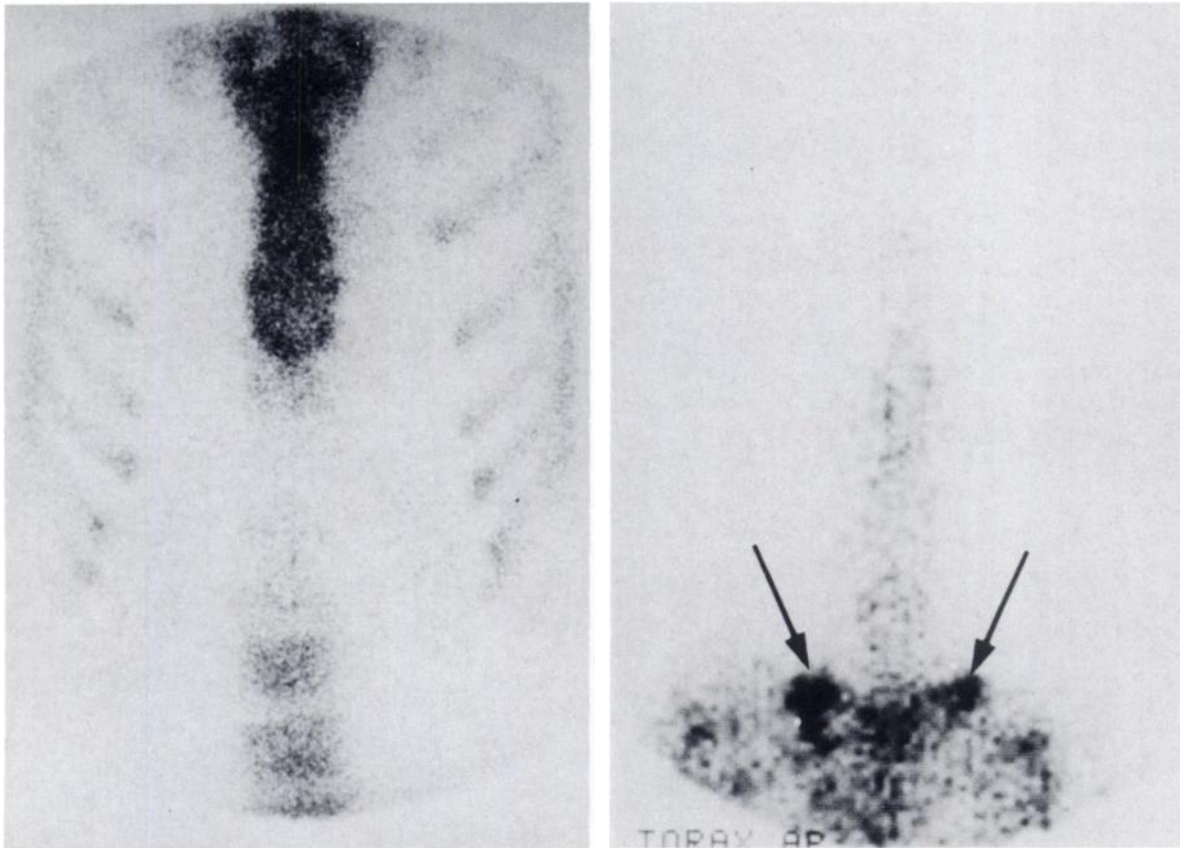


FIGURE 3
Case 6: *S. aureus* infection at seventh right and left costosternal joints. After 5 days of evolution there is normal [^{99m}Tc]MDP distribution (left). Arrows show abnormal [^{67}Ga]citrate accumulation in seventh right and left costosternal joints (right)

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