Clinical note
Asymmetrically increased uptake in upper extremities on $^{99m}$Tc-MDP bone scintigraphy caused by intra-arterial injection: Different uptake patterns in three cases
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Abstract
Unexpected findings on bone scintigraphy such as asymmetrical uptake in extremities may cause confusion for the diagnosis. The authors describe three cases of accidental intraarterial injection of Tc-$^{99m}$methylene diphosphonate ($^{99m}$Tc-MDP) on the antecubital region and discuss the findings and differential diagnosis.

Aumento asimétrico de la captación en las extremidades superiores de una gammagrafía ósea con $^{99m}$Tc-MDP producida por inyección intra-arterial: diferentes patrones de captación en tres casos

Resumen
Hallazgos inesperados en la gammagrafía ósea, tales como la captación asimétrica en las extremidades, pueden causar confusión en el diagnóstico. Los autores describen tres casos de inyección intraarterial accidental de $^{99m}$Tc-metilenodifosfonato ($^{99m}$Tc-MDP) en la región antecubital, discutiendo el origen de los hallazgos y su diagnóstico diferencial.

Introduction
Bone scintigraphy with $^{99m}$Tc labeled radiopharmaceuticals is a valuable technique in nuclear medicine practice for the evaluation of skeletal system. In routine practice bone scintigraphy has been performed 3 hours after the injection of $^{99m}$Tc labeled diphosphonate compounds into a peripheral vein. Unexpected findings such as asymmetrically increased activity of a limb may cause diagnostic confusion. At this point, it is important to be aware of the differential diagnosis. In this report we present three cases with different uptake patterns in the upper extremities caused by accidental intraarterial injection on the antecubital region.

Clinical cases
Case 1
An 83 years old woman with a suspicious mass at the 9th vertebra underwent three phase bone scintigraphy. Whole body imaging showed increased activity at the right side of 9th thoracic vertebra and heterogeneous increased activity on the left forearm. Patient had a history of fracture at the right arm 30 years prior to the study but she had no complaint on her left forearm. Reevaluation was done in another day after pedal vein injection, and no abnormality in the left forearm was detected in all three phases (fig. 1).

Case 2
A 51 years old woman was referred to our department for whole body bone scan. Bone scintigraphy revealed diffusely increased activity on the right forearm. For clarification reevaluation was done with three phase bone scintigraphy with pedal vein injection and there was no abnormality on the right forearm in all three phases (fig. 2).

Case 3
A 60 years old man with recently diagnosed prostate carcinoma was evaluated for bone metastases. Whole body imaging and static views showed diffusely increased activity at the right forearm which was significant on the radial half of the wrist; first, second and third metacarpals and fingers. There was no clinical history to explain this finding. Differential diagnosis could not be made. Confirmative three phase study with a pedal vein injection had shown no abnormality on the right hand and wrist (fig. 3).

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Figure 1. Whole body (A) and static images (B) showed heterogeneous uptake of Tc-99m MDP on the left forearm which was not observed on blood pool (C) and static images (D) of repeated bone scan.

Figure 2. Whole body (A) and static images (B) showed diffusely increased activity on the right forearm. Blood pool (C) and static images (D) of repeated bone scan revealed no abnormality on the right hand and wrist.
Figure 3. Whole body imaging (A) and static views (B) revealed increased activity at the right forearm which was significant on the radial half of the hand and wrist. Blood pool (C) and static images (D) of repeated bone scan showed no abnormality.

Discussion

The uptake mechanism of $^{99m}$Tc-MDP is thought to result from binding to the surface of hydroxyapatite crystals on bones. Increased activity on bone scan could be secondary to increased blood flow and expanded surface area due to increased osteogenesis. Intra-arterial injection of bone seeking agents may cause diffusely increased activity distal to the injection site. Varieties may also be seen secondary to the injected arteries. Intra-arterial injection of Tc-$^{99m}$ MDP on the antecubital region was previously described as "glove" phenomenon in which increased activity at the bones of wrist and hand, and the soft tissue of the distal forearm is seen. Since the intra-arterial injection is inadvertent, unusual images may cause confusion and result in rise of suspicion of metastasis or reflex sympathetic dystrophy (RSD). Differential diagnosis includes frostbite injury and tourniquet effect too. In our patients there was no clinical evidence of complex regional pain syndrome. Tourniquet effect and frostbite injury were also eliminated by clinical history. The patterns of the images were also not typical for metastasis. Confirmatory three phase bone scan was considered mandatory. Repeated bone scans with pedal vein injection revealed no abnormality in all three cases. Abnormal findings which were seen in the previous scan were attributed to the intra-arterial injection.

The hyperfixation mechanism of intra-arterial injection of the radiotracer could be secondary to the increased arterial blood flow at the first step of the radiotracer binding mechanism which is similar for RSD. Complex regional pain syndrome (used to known as RSD) shows significant increased activity on all three phases probably due to increased arterial flow in soft tissue around the joints, increasing functional entry of capillaries and expanded diffusion surface secondary to accelerated osteogenesis. Physicians must be aware of intra arterial injection before the diagnostic evaluation of asymmetricaly increased activity especially when clinical information is inadequate. Injection site and vascular variations may even cause different uptake patterns. Intra arterial injection to the radial artery near the wrist can cause a different uptake pattern due to arterial network anatomy of the hand. It was previously described as hot thumb and palm in which thumb and the rest of the metacarpals except distal half of the fifth metacarpal showed significant increased activity. In our patients uptake patterns were also differing from each other.

Intra-arterial injection of radiotracer causes a similar pattern to RSD. But flow or blood pool images of intra-arterial injection are usually missing if scintigraphy has been performed for a reason other than RSD or another factor not requiring three phase evaluation.
It is better to be careful not to administrate radiotracer to arterial system and prevent the probable reevaluation. We believe a good clinical assessment is very important before diagnosis. If nuclear medicine stuff is not certain about the inadvertent intra-arterial injection, confirmatory three phase bone scintigraphy might be necessary for differentiation.

As a conclusion, increased activity of extremities caused by intra-arterial injection may show different uptake patterns, and intra-arterial injection should be considered in mind when increased activity is detected in an extremity, especially with no clinical history.

References