

## Case report

# Bone Scintigraphy Hot-Spot in Projection to Rib and Kidney: Role of Single Photon Emission Computer Tomography/Computer Tomography in Distinguishing a Urine Collection in Renal Calyx from a Metastasis to Rib

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## Abstract

On planar bone scintigrams, activity enhancement foci in projection to kidney and lower ribs can arise from the kidney, or from bone lesions. A differentiation based only on the exact location and shape of the hot spot can sometimes be misleading, resulting in a false qualification of a rib metastatic lesion as urine collection in the kidney or opposite. The authors illustrate the problem with three cases: In two patients, such a hot spot appeared to be the solitary metastatic focus; in one, highly suggestive for solitary metastatic focus, it was proven to be a urine collection.

**Keywords:** Bone metastasis, bone scintigraphy, kidney, single photon emission computer tomography/computer tomography

## Introduction

Bone scintigraphy with technetium-labeled diphosphonates, as Tc-99m-methylene diphosphonate (Tc-99m-MDP), is a widely accepted method of screening for bone metastatic lesions in many malignancies. However, the focus of activity enhancement must not indicate a metastatic spread of the disease.

Urinary tract is one of the most common locations of extraskeletal accumulation of bone seekers. Indeed, absent or faint renal uptake on bone scans is considered pathologic.<sup>[1]</sup> On the other hand, homogenously distributed too high activity in both kidneys ("hot kidneys") can be

a sign of toxic damage to the organs (i.e. chemotherapy, calcitonin administration).<sup>[2]</sup> Focally enhanced accumulation is almost always the result of excretion of the radionuclide with urine. This physiologic source of such a hot spot can be considered especially, if its location is typical for renal pelvis/calices, that is, projecting to the medial margin of (typically located) kidney at the middle of its height. One should keep in mind, however that typically located kidneys project to the lower (particularly 12<sup>th</sup>) ribs; ribs in turn are a common location of bone metastases as well as traumatic injuries,<sup>[3,4]</sup> which are sources of hot spots in scintigraphy. In rare cases, bone seekers can be accumulated in (mainly metastatic) tumors of soft tissues,<sup>[5-7]</sup> including kidneys.<sup>[8]</sup>

## Case Reports

### Case I

An 80-year-old male with prostate cancer underwent restaging with bone study. Planar scintigram obtained 2 years earlier in another department showed a solitary

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hot spot in projection to the 12<sup>th</sup> rib left, solitary metastasis was diagnosed. The focus seemed less pronounced in our study; no new foci were detected. Single photon emission computer tomography/computer tomography (SPECT/CT) showed no pathology in the ribs. Instead, radioactive urine collection in (atypically located) renal calyx was visualized [Figure 1].

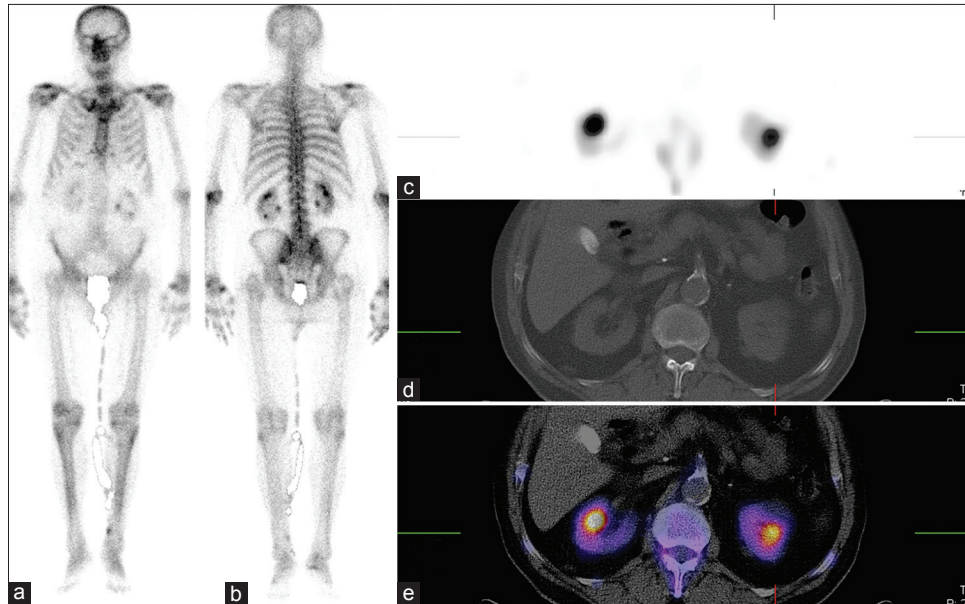
**Case II**

A 63-year-old male with prostate cancer was primarily screened for metastases with Tc-99m-MDP. A planar

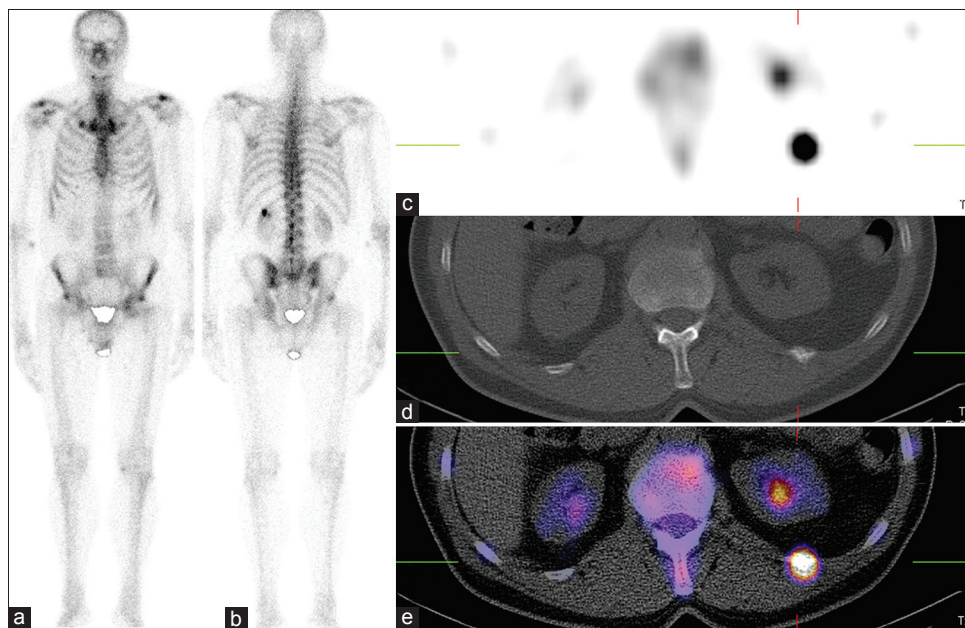
scintigram showed a focus in projection to the left kidney, which not exactly fitted to the 12<sup>th</sup> rib. SPECT/CT showed a strong activity enhancement in the 12<sup>th</sup> rib left in the SPECT as well as bone remodeling and distention in the CT (a pattern typical for a bone metastasis), and no urine collection in the kidney [Figure 2].

**Case III**

A 72-year-old male with eye melanoma was screened for metastases with Tc-99m-MDP (a flurodeoxyglucose-



**Figure 1:** Case I - (a) Anterior view, (b) Posterior view of the planar scintigraphy; (c) SPECT, (d) CT, and (e) Fusion SPECT/CT – slice through the lesion, SPECT: Single photon emission computer tomography, CT: Computer tomography



**Figure 2:** Case II - (a) Anterior view, (b) Posterior view of the planar scintigraphy; (c) SPECT, (d) CT, and (e) Fusion SPECT/CT – slice through the lesion. SPECT: Single photon emission computer tomography, CT: Computer tomography

study was not available). Planar scintigraphy showed a faint focus in projection to the 12<sup>th</sup> rib right/right kidney, and intense, extensive and irregularly shaped activity accumulation in projection to the left kidney. The focus right has been primarily interpreted as “probably rib metastasis” (although osteometabolically “very hot” bone metastases are not typical for melanoma), the focus left as “urine collection in the kidney.” SPECT/CT showed a hot spot in the right kidney (small urine collection) and neither scintigraphic nor radiologic bone abnormalities in the 12<sup>th</sup> rib right. The focus left appeared to have a double origin: Urine collection in the left kidney and enhanced bony metabolism in the 11<sup>th</sup> rib (together with bone remodeling in the CT), which was interpreted as typical for bone metastasis [Figure 3].

### Discussion

In all three cases presented here, precise differentiation of the source of the foci changed the staging of the disease and influenced further therapy. Cases, in which presence of bone metastases was proven in other locations, were not included in this presentation. We have also omitted a case, in which the only hot spot projected to the left margin of Th12 (suggesting an osteophyte); it was accompanied by weaker radiotracer accumulation in lower ribs (which can normally present fainter) on the left side when compared to right. SPECT/CT revealed a tumor mass infiltrating the ribs and the vertebrae left.

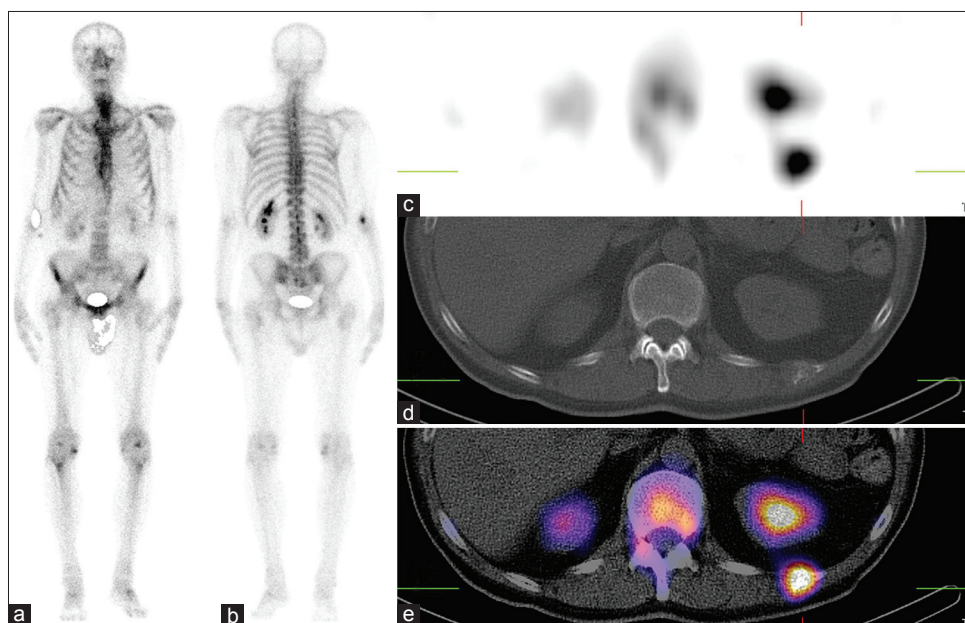
Contrary to kidneys, lower ribs imaged from the back side are able to make virtually no breath movements. For this reason, any hot spot projecting to the 12<sup>th</sup> rib and kidney and ideally fitting the rib could be assumed to arise from the rib rather than kidney. Case I presents an opposite situation. In this case, the image was additionally misleading because of somewhat atypical location of the dilated calyx. On the other hand, any activity accumulation in such a location, which extends even minimally beyond the rib, could be assumed to be related to the kidney rather than to the rib. Case II shows a contrary situation due to distention of the rib by tumor process.

Activity accumulation in such a location can also possess double origin. Case III shows a solitary metastatic lesion to the 12<sup>th</sup> rib masked by urine collection in the kidney.

The precise determination of the location of such a hot spot could also be made with oblique images, whose acquisition is faster, instead of SPECT or SPECT/CT. We presented the differentiation made with SPECT combined with low-dose CT.

### Conclusion

The location, shape and extent of activity accumulation projecting to kidney and rib can sometimes be misleading in the assessment of bone metastatic lesions on planar scintigrams. Additional images can easily differentiate the origin of the hot spot. Therefore, further verification should be taken into consideration in such cases.



**Figure 3:** Case III - (a) Anterior view, (b) Posterior view of the planar scintigraphy; (c) SPECT, (d) CT, and (e) Fusion SPECT/CT – slice through the lesion. SPECT: Single photon emission computer tomography, CT: Computer tomography

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