Diagnostic Images

Renal metastases shown by ^{99}Tc -methylene diphosphonate scintigram which failed to detect vertebral metastases

Presented by L. Kreel, A. Thornton and I. Stewart

Department of Diagnostic Radiology and Organ Imaging, Faculty of Medicine, The Chinese University of Hong Kong, Prince of Wales Hospital, Shatin, N.T., Hong Kong.

Introduction

Renal abnormalities are frequently detected as an incidental finding on scintigraphy with bone imaging agents in cases of hydronephrosis or a non-functioning kidney.¹ However, the demonstration of soft tissue tumours is uncommon, apart from neuroblastoma,² although well documented and includes metastases³ and insulinoma.^{3,4}

A case is presented where metastases to the kidney were first detected on routine bone scintigraphy. Incidentally vertebral body metastases were not seen on scintigraphy although clearly shown on computed tomography.

Methods

The bone scan was performed using 15 mCi (555 MBq) of ^{99}Tc -MDP (Mallinckrodt Diagnostica, Petten, Holland) with 2-hour delayed imaging on a Philips Diagnostic Gamma Camera (Philips, Eindhoven, Holland). The CT scan was performed on a GE 8800 using 5 mm sections through the kidneys, plain scan and contrast enhanced after 40 ml of 'Conray' 280.

For the DMSA scan 2 mCi were given intravenously with dynamic scan and static scan 2 hours later.

The patient

A 37 year old Chinese woman with breast carcinoma had a right mastectomy 18 months previously. Post operatively she received radiotherapy and tamoxifen. At that time a bone scan (^{99}Tc -MDP) was normal with normal renal excretion of the isotope.

At a follow-up examination a chest radiograph showed a rib metastasis and there was also a large lytic lesion in the right ilium (Figure 1). Serum calcium and alkaline phosphatase were normal.¹

A bone scan (^{99}Tc -MDP), however, revealed a number of small areas of increased uptake in the ribs and marked increased uptake in the right ilium (Figure 2) corresponding to the lytic lesion on the pelvic radiograph. In addition there were marked focal areas of increased activity in both kidneys suggesting renal metastases (Figure 3). The DMSA scan of the renal areas was, however, normal with no photopaenic areas (Figure 4). Sonography performed subsequently showed a number of small round hypoechoic areas in both kidneys and one of mixed echogenicity (Figures 5 and 6). Computed tomography revealed multiple non-enhancing renal lesions (Figure 7) but there were also large round lytic lesions in several dorso-lumbar vertebral bodies within which there was contrast enhancement of the soft tissue (Figure 8). At T12 the posterior margin of the vertebral body was destroyed with soft tissue impinging on the thecal space (Figure 9). On review of the concurrent bone scan no increased uptake of isotope was visible even though there was slight compression of a vertebral body at this level as shown on a radiograph (Figure 10). The imaging investigations in summary therefore showed multiple bone metastases with renal metastases even though the alkaline phosphatase and serum calcium levels were normal.

Figure 1 Large osteolytic lesions in the pelvis (arrows) due to metastases.

Figure 3 Collimated view of the kidneys showing round localized areas of increased isotope uptake.

Figure 2 A technetium methylene diphosphonate bone scan showed multiple areas of localized increased activity in ribs and pelvis but localized round areas of increased activity were also noted in both kidneys and on the right, possibly in the adrenal.

Figure 4 DMSA scintigram of the kidneys that are normal in size, shape and position with no abnormal areas of diminished or increased activity.

Figure 5 Renal sonography demonstrating low echogenic areas longitudinal on left.

Figure 6 In the right kidney there was also a nodule with more reflective echoes (arrow).

Figure 7 Contrast enhanced CT images of the kidneys showing poorly enhanced nodules (arrows) corresponding to those on the scintigram and on sonography.

Figure 8 In addition there were large lytic lesions in vertebral bodies but no corresponding increased isotope uptake on the scintigram.

Figure 9 Following contrast enhancement the soft tissue nodules are shown within the lytic bone; the most posterior is encroaching on the spinal canal (arrows).

Figure 10 Thoraco-lumbar radiograph shows early compression of the inferior margin of the body of T12 as indicated.

Table I Increased isotope uptake in kidneys during MDP scintigraphy.³

*1.	Hydronephrosis
2.	Radiotherapy, chemotherapy
*3.	Metastatic calcification associated with breast cancer and lymphocytic lymphoma
*4.	Renal carcinoma
*5.	Metastases from breast, lung
6.	Multiple myeloma
7.	Acute pyelonephritis
8.	Iron overload
9.	Paroxysmal nocturnal haemoglobinuria

* Can or does produce focal areas of increased uptake.

Discussion

Renal abnormalities detected incidentally on scintigraphy using the bone agent ^{99m}Tc -stannous pyrophosphate have been classified (Table I) by a number of authors^{1,5} and include absent activity, small kidneys, displaced kidneys, obstructive uropathy, both acute and chronic, unilateral disease, asymmetric uptake and, more rarely, focal renal abnormalities. In many papers renal abnormalities are considered as part of the general concept of extraosseous uptake of isotope during bone scanning.⁶

Focal renal abnormalities can be further subdivided into photopaenic lesions and those with increased uptake seen as 'hot' areas on the scintigram, the latter being in a distinct minority. However, both breast and colonic metastases have been reported as producing increased uptake in the liver⁶ and from bronchogenic carcinoma in the kidney.⁷ Both renal and liver metastases producing increased uptake appear to be uncommon whereas the demonstration of primary neuroblastoma and their metastases is well recognized and is recommended as a standard diagnostic procedure,^{2,8} the primary tumour being detected in some 80% and metastases in approximately 30%.² Adrenal uptake by its location could be mistaken for renal uptake and similarly uptake in pancreas by an endocrine adenoma could overly the renal area. However, the clinical context should clarify the diagnosis.

Breast tissue has a special affinity for bone seeking isotopes.⁹ Normal breasts, benign lesions and malignant tumours have produced scintigrams with increased uptake. Schmitt *et al.*⁹ have postulated high levels of alkaline and acid phosphatase present in breast tissue acting on phosphate substrates and thereby binding the polyphosphonate and diphosphonate bone seeking agents as false substrates. A similar mechanism could, of course, apply to breast metastases in lung, liver and kidney.

Other possible explanations include the presence of calcification¹⁰ in the tumour, a not uncommon finding in breast and neuroblastoma tumours, and hypervascularity of the tumour. However, in this patient the lesions in the

kidneys showed no calcification on the plain CT scan and less contrast uptake than normal tissue on the contrast enhanced scan, suggesting hypovascularity compared to normal renal parenchyma. Other possible mechanisms that have been suggested are leakage of tracer through abnormal capillary walls and ion exchange at crystal surfaces in areas of calcification.¹¹

Increased renal uptake can also follow irradiation to kidneys but appears more uniform and diffuse within the radiation field^{3,12} and can also be caused by chemotherapy with cyclophosphamide, vincristine and doxorubicin.

The other aspect of diagnostic interest in this case was the detection of obvious metastases in vertebral bodies on CT that were not shown on the scintigram although the large metastasis in the pelvis produced marked increased activity. The vertebral body most markedly involved, namely T12, had slight but definite indentation of its inferior margin indicating early compression and the soft tissue component of the metastasis could be seen encroaching on the spinal theca.

Summary and Conclusion

A patient with breast metastases is presented showing increased nodular renal uptake of tracer on bone scintigraphy that also demonstrated rib metastases and a large metastasis in the pelvis. However, vertebral body metastases were not shown when clearly demonstrated on CT with even partial compression on a thoracic spine film. Most of the renal lesions were hypoechoic on sonography, showed hypoattenuation areas on plain CT and after contrast enhancement but no calcification could be demonstrated. This case once again illustrates the value of scrutinizing the soft tissues on scintigraphy but also the possibility of showing some metastases on CT not visible on scintigraphy.

References

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