

Artifacts and non-osseous uptake in bone scintigraphy. Imaging reports of 20 cases

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Background. Numerous possible artifacts may render the evaluation of bone scans difficult.

Case reports. This article provides a pictorial survey of both typical and extraordinary pitfalls in bone scintigraphy, which are caused by increased or reduced tracer accumulation of soft tissue or bone.

Conclusions. One should be aware, that in individual patients, "artifacts" in bone scintigraphy lead to formerly unknown diagnoses, and the diagnostic and therapeutic procedure may be influenced decisively.

Key words: radionuclide imaging; bone; ^{99m}Tc -diphosphonates; artifacts; benign bone diseases; malignant bone diseases

Introduction

Bone scintigraphy is commonly used for the diagnosis and staging of both benign and malignant bone diseases.¹ After the intravenous injection and the initial distribution through the whole body by simple perfusion, the radiotracers used commonly, i.e. ^{99m}Tc -labelled diphosphonates such as HDP or MDP in a standard dose of 600-800 MBq, diffuse into the extracellular space. The initial local distribution is predominately influenced both by the blood flow and the vascularization of the

perfused region. Thus, early acquisitions reflect perfusion and blood pool images. Due to its affinity to calcium, diphosphonates are then bound in a simple physicochemical way to bone structures within some 3 hours. Then, the regional skeletal uptake is determined both by the initial perfusion and the metabolism of the bone.² Bone scans taken after a three to five hours interval after injection usually provide a good contrast between soft tissue and skeletal structures, since the background activity of the soft tissue is as less as 2-10%.³

In order to ensure proper scan reading a thorough indication and a detailed medical history are mandatory prior to the injection. All relevant past illnesses and therapies must be included (drainages, biopsies, surgery). An inspection and an examination at least of the region under investigation should be performed routinely. In most cases these simple

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things help to avoid misinterpretations. If there still remains doubt on the interpretation, additional spot images or SPECT-imaging may be required for clarification.

Apart from physiological, age-related or typical pathological patterns, numerous causes of artificial tracer distribution patterns are known, which have to be taken into account when reading bone scans.⁴ The main causes for artifacts are contaminations of the skin or of the clothes, paravenous or subcutaneous injection sites.⁵ However, causes for artifacts in bone scans are numerous, and case reports have been published dealing with hyperhidrosis,⁶ foreign body⁷ and constitution,⁸ etc. McAfee and Silberstein⁹ published a survey of various causes of non-osseous uptake.

Case reports

The following bone scans are intended to give an overview of numerous artifacts, which have been collected over the last few years in a large university-based nuclear medicine department. Figures 1-7 show artifacts, e.g. technical causes, reduced tracer uptake etc., Figures 8 and 9 display malignant soft tissue tumors, Figure 10 shows inflammation, Figures 11-17 display non-inflammatory artifacts, e.g. lymphatic edema, adipositas, trauma, anatomical variants etc, and Figures 18-20 depict artifacts associated with the renal system. Unless otherwise noted, all images were acquired 3 hours after injection using a standard dual-headed whole-body gamma camera (Bodyscan, SIEMENS, Erlangen, Germany) equipped with low-energy high-resolution collimators.

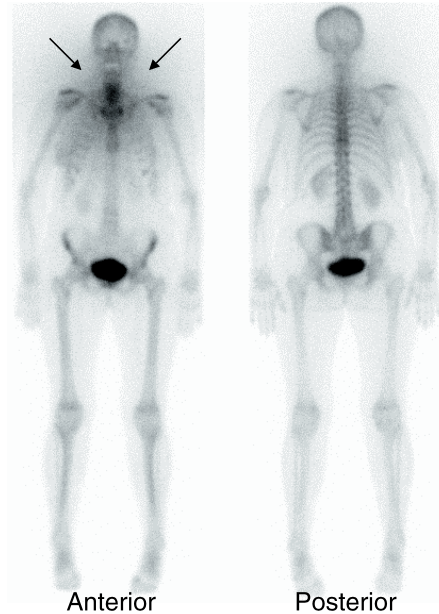


Figure 1. Diffuse radiation surrounding the neck resulting from a septa penetration of the high energy radiation (364 keV) of ¹³¹I three weeks after radioiodine treatment.



Figure 2. Uptake of free ^{99m}Tc-pertechnetate within the salivary glands, thyroid gland, gastrointestinal tract, and the urinary tract caused typically by absent radiolabelling of the diphosphonate complex of HDP.

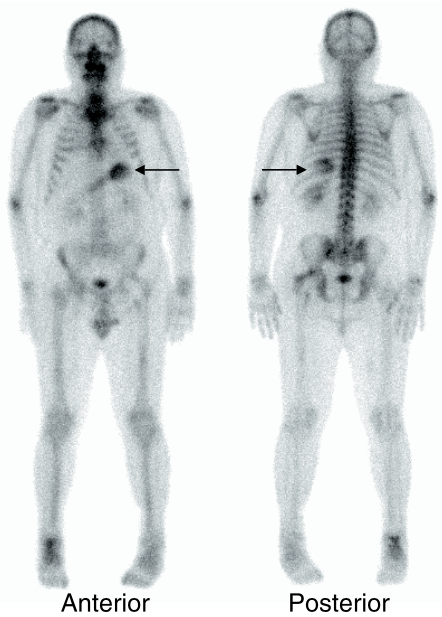


Figure 3. Bone scintigraphy following 3 hours after salivary glands scintigraphy. Note, uptake of free ^{99m}Tc -pertechnetate in the stomach.



Figure 4. Blood pool images acquired 5 min after i.v. injection of ^{99m}Tc -HDP. Note a ringlike reduced tracer uptake in the anterior view in a patient with ascites.

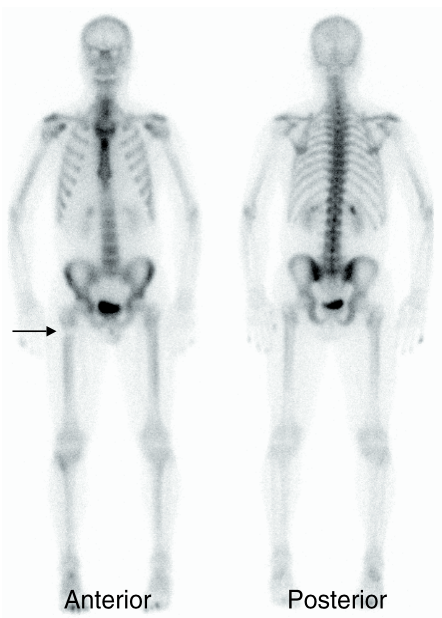


Figure 5. Cold spot in projection to the right proximal femur in the anterior view as a result of attenuation due to a purse in the trouser pocket.



Figure 6. Cold spot on the right upper thoracic wall as a result of attenuation due to an implanted pacemaker.

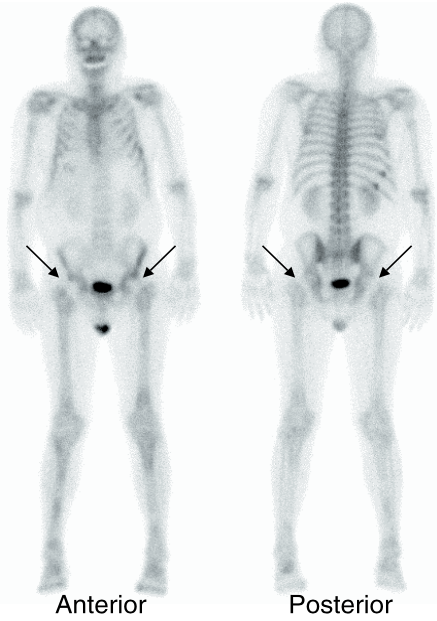


Figure 7. Symmetric cold spots on both femoral heads in a patient with bilateral hip prosthesis.



Figure 8. Massive increased tracer uptake in the soft tissue of the lung and the liver caused by calcifying metastasis in a patient with breast cancer.

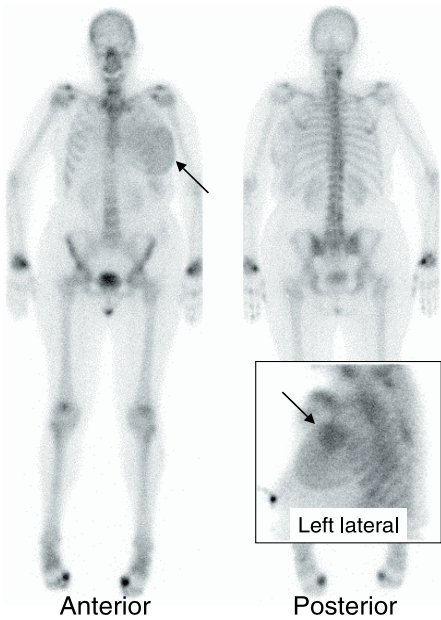


Figure 9. Massive soft tissue accumulation in the left breast in a patient with an inflammatory breast cancer detected by bone scanning.



Figure 10. Focal tracer accumulation in the right upper thoracic wall caused by an infected tip of a Buelau-drainage.

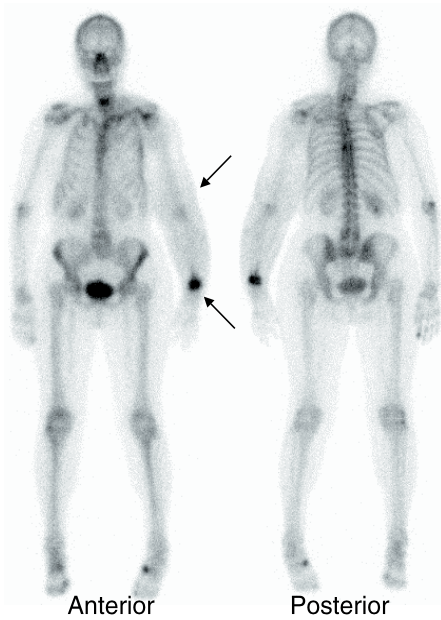


Figure 11. Increased tracer uptake in the complete left arm caused by lymphatic edema following axillary lymph node dissection. Note, paravenous injection of the ^{99m}Tc -HDP at the left wrist.

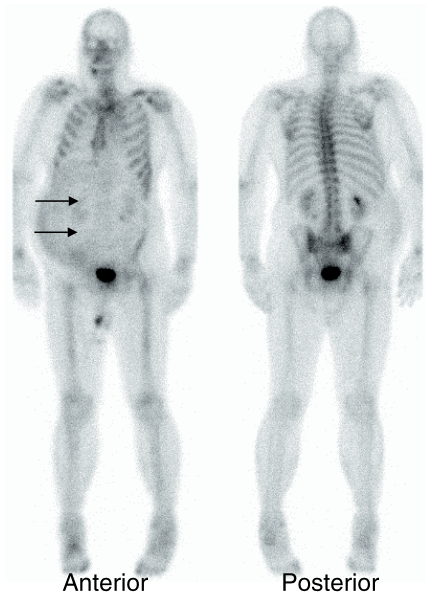


Figure 12. Attenuation of photons caused by massive abdominal fat in a male subject, which renders the interpretation of the lumbar spine difficult in the anterior view.

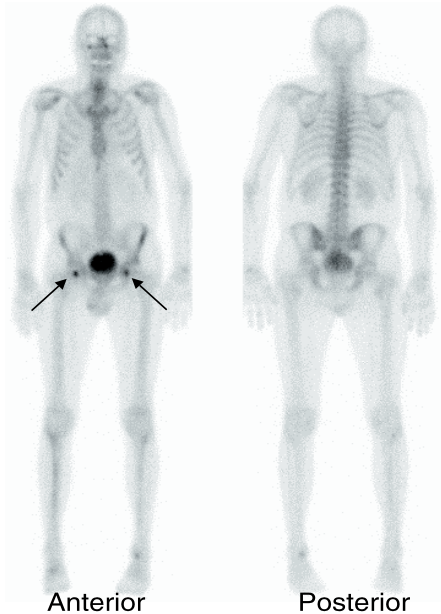


Figure 13. Bilateral focal hot spots at the head of the femora caused by inguinal puncture using Seldinger technique during coronary angiography. Note, that both foci are seen in the anterior view only.

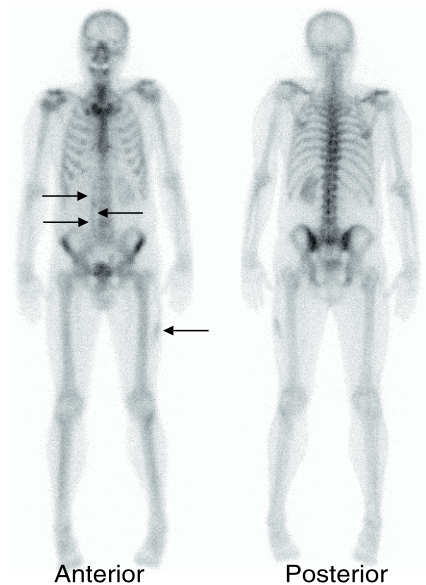


Figure 14. Longitudinal tracer uptake in the right abdomen caused by a calcifying scar following nephrectomy. Note, this tracer uptake is seen in the anterior view only. In addition soft tissue accumulation of ^{99m}Tc -HDP can be seen in the left lateral thigh, which is caused by repeated subcutaneous injection of heparine.

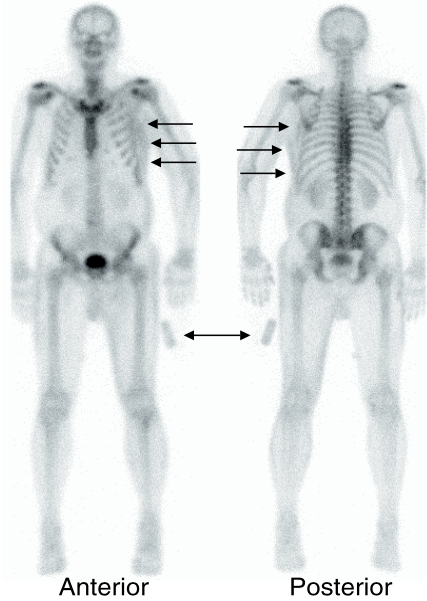


Figure 15. Soft tissue accumulation in the left axilla caused by an organizing hematoma following lymphodectomy in a patient with malign melanoma of the left arm. Note a contaminated handkerchief in the left pocket of the trousers.



Figure 16. Cold lesion in the left sacro-iliac joint caused by removal of bone graft.

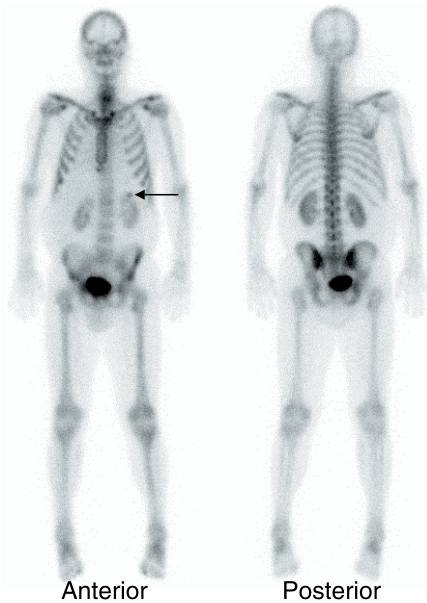


Figure 17. Focal soft tissue accumulation in the left upper abdomen caused by the insertion site of a percutaneous gastric tube in a patient suffering from esophageal cancer.

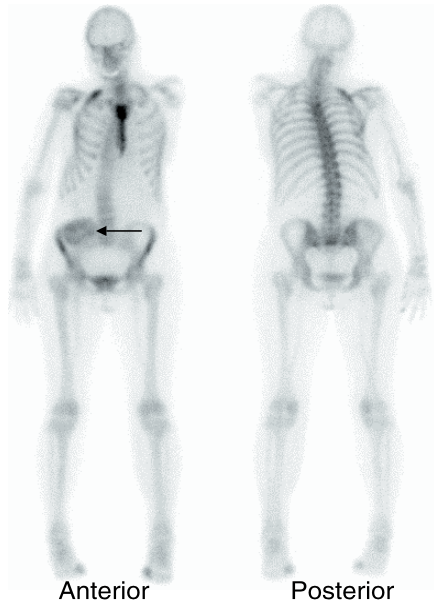


Figure 18. Absent tracer accumulation in both kidneys *in loco typico* and tracer accumulation in a kidney grafted into the right pelvis following bilateral nephrectomy due to renal cancer. Note, tracer uptake in the upper right ribs and in the sternum caused by thoracotomy due to aortocoronary bypass-grafting. Also, note the loss of the left arm in an accident 40 years ago.

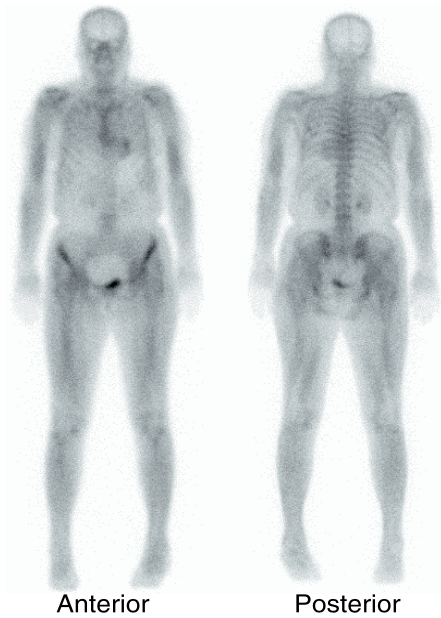


Figure 19. Reduced bone uptake and high background activity due to renal failure.

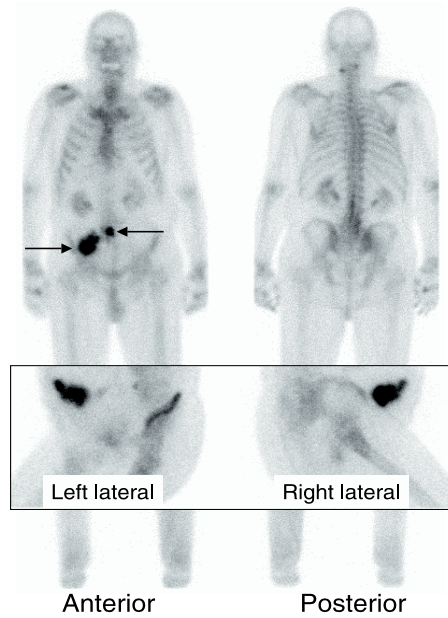


Figure 20. Urinary accumulation in the right lower abdomen due to an appendix-pouch constructed after bladder excision in a patient suffering from prostate and urothelium cancer.

Conclusions

One should be aware, that in individual patients, "artifacts" in bone scintigraphy lead to formerly unknown diagnoses, and the diagnostic and therapeutic procedure may be influenced decisively.

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