Skeletal scintigraphy for a patient with a hip fracture

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Answer: Post-operative ischaemic lower limb

The isotope bone scan (Fig. 1) demonstrates significantly reduced radiotracer activity in the right lower limb in keeping with critical ischaemia following the patient's hip replacement surgery. Increased activity at the left knee joint was due to osteoarthritis. The pre- and post-operative radiographs (Fig. 2) show a right intracapsular proximal femoral fracture sustained following a low energy fall and the subsequent implanted femoral prosthesis. Both radiographs demonstrate arterial calcification, signifying peripheral vascular disease. The isotope scan was undertaken shortly following surgery to investigate for skeletal metastases secondary to the known pulmonary adenocarcinoma of mucinous sub-type. Due to the marked asymmetry of uptake between the lower limbs on isotope bone scan, an urgent CT angiogram was arranged, confirming occlusion of the right superficial femoral (Fig. 3a) and popliteal arteries (Fig. 3c). The patient was managed conservatively with heparin.

Skeletal scintigraphy is the most commonly utilised radionuclide study to evaluate skeletal metastatic disease due to its widespread availability, relatively fast acquisition time and high sensitivity. A Technetium-99m-labelled diphosphonate tracer is used, which rapidly accumulates in bone following administration [1–3]. Radiotracer uptake is dependent on multiple factors including blood flow and bone formation as well as patient hydration, renal function and age [4]. In a single-phase scan, imaging is often delayed beyond 2-h to allow for improved soft tissue

clearance and target to background contrast. A triple-phase acquisition obtains additional early blood flow and blood pool images to assess hyperaemia and articular permeability respectively [4]. Vascular injuries are a rare post-operative complication following hip replacement surgery,

Fig. 1 Technetium-99m hydroxymethylene diphosphonate (HMDP) 2-h whole body scintigraphy demonstrating asymmetrical reduced uptake in the right lower limb

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Fig. 2 **a** Pre-operative pelvic radiograph demonstrating an acute right proximal femoral fracture and bilateral vascular calcification (arrows); **b** post-operative right hip radiograph

with a reported prevalence of 0.2–0.3% [5]. The iliac and femoral vessels lie in close proximity to the operative field and are therefore at risk of injury. A range of mechanisms have been described including direct injury secondary to instrumentation or retractor trauma, cement polymerisation heat reaction-related thrombosis, excessive traction or dislocation-relocation manoeuvres resulting in an intimal flap, direct vessel laceration, pseudoaneurysms, traumatic arteriovenous fistula formation and arterial or venous thromboembolic occlusion [5, 6]. Clinical signs and symptoms of ischaemia become apparent in the post-operative period and urgent vascular surgical review is essential to reduce patient morbidity, including amputation, with mortality rates of up to 8% [6]. A similar pattern of reduced uptake has been described on delayed imaging in the clinical scenario of frostbite when associated with deep soft tissue and bone infarction [7].

We report an unusual diagnosis of acute limb ischaemia on skeletal scintigraphy following hip hemiarthroplasty. On scintigraphy, compromise of the lower limb arterial blood flow manifests as reduced radiotracer accumulation and as such can be particularly difficult to identify, as most pathologies increase radiotracer accumulation. It is therefore helpful to assess the symmetry of radiotracer distribution; asymmetric accumulation can be secondary to acute vascular compromise. Less commonly, contralateral compensatory overuse in the case of paralysis can cause reduced tracer uptake. Conversely, during chronic ischaemia, collateral blood flow may normalise distal limb radiotracer uptake [8]. Increased radiotracer activity has a wide differential diagnosis and is useful during the evaluation of occult fracture, infection, inflammatory or metastatic diseases [4] as well as rarer conditions of bone avascular necrosis, such as osteochondrosis [9].

Fig. 3 Axial CT scan with bone [C: 500, W: 2500] and soft tissue [C: 70, W: 500] windowing of the **a, b** proximal and **c, d** distal lower limb, demonstrating absent opacification of the right superficial femoral and popliteal arteries respectively (arrows)

Conclusion

We report an unusual case of acute limb ischaemia on skeletal scintigraphy as a post-operative complication of hip hemiarthroplasty, which is an unexpected and challenging extra-skeletal diagnosis. Asymmetrical reduction in radiotracer can easily be overlooked and should raise the suspicion of acute vascular compromise.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Love C, Din AS, Tomas MB, Kalappambath TP, Palestro CJ. Radionuclide bone imaging: an illustrative review. *Radiographics*. 2003;23(2):341–58.
2. Genant HK, Bautovich GJ, Singh M, Lathrop KA, Harper PV. Bone-seeking radionuclides: an in vivo study of factors affecting skeletal uptake. *Radiology*. 1974;113(2):373–82.
3. McAfee JG, Reba RC, Majd M. The musculoskeletal system. In: Wagner Jr HN, Szabo Z, Buchanan JW, editors. *Principles of nuclear medicine*. 2nd ed. Philadelphia: Saunders; 1995. p. 986–1012.
4. Medina-Gálvez N and Pedraz T (2011). *Nuclear medicine in musculoskeletal disorders: clinical approach*, 12 chapters on nuclear medicine, Gholamrezanezhad A, IntechOpen, <https://doi.org/10.5772/26863>. Available from: <https://www.intechopen.com/books/12-chapters-on-nuclear-medicine/nuclear-medicine-in-musculoskeletal-disorders-clinical-approach>. Accessed 14 Oct 2020.
5. Nachbur B, Meyer RP, Verkkala K, Zürcher R. The mechanisms of severe arterial injury in surgery of the hip joint. *Clin Orthop Relat Res*. 1979;141:122–33.
6. Shoenfeld NA, Stuchin SA, Pearl R, Haveson S. The management of vascular injuries associated with total hip arthroplasty. *J Vasc Surg*. 1990;11(4):549–55.
7. Mehta RC, Wilson MA. Frostbite injury: prediction of tissue viability with triple-phase bone scanning. *Radiology*. 1989;170(2):511–4.
8. Palot Manzil FF, Almodovar SE, Bhambhani P. Looking beyond the indication: bone scan for trauma providing unsuspected initial diagnosis of acute critical lower limb arterial compromise. *J Nucl Med Technol* 2017.
9. Gandhi D, Ahuja K, Sawhney H, Songmen S, Gupta N, Kier R. Roca disease: an osteochondrosis of the inferior pole of the scapula with review of the literature. *Radiol Case Rep*. 2020;15(9):1523–7.

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