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Case report of nuclear medicine, bone scan imaging on a patient with heat stroke induced rhabdomyolysis.

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Unusual presentation of non-malignant findings on a bone scan.

Abstract:

We present a case which caused a diagnostic dilemma on bone scan with our review highlighting the broad spectrum of non-malignant findings which can impact the interpretation of a bone scan and the value of correlative imaging using single-photon emission computed tomography/computed tomography (SPECT/CT), for exact localization and characterization of the lesions. The imaging features of important benign pathologies – which are "metastatic mimics" are elaborated so that the reader can incorporate them while reporting so as to avoid misinterpretations.

A major focus of this case report is to elucidate findings which direct image interpretation towards several uncommon benign findings to include rhabdomyolysis, myositis ossificans, organizing chest wall hematoma, acute tubular necrosis on a bone scan.

Rhabdomyolysis is a result of lysis of skeletal muscle with release of cell contents, such as myoglobin and muscle enzymes and is mostly a sum of clinical appearance and laboratory values.

Myositis ossificans is the most common form of heterotopic ossification usually within large muscles. Its importance stems in large part from its ability to mimic more aggressive pathological processes. Myositis ossificans is one of the skeletal "don't touch" lesions.

Acute tubular necrosis is kidney injury caused by damage to the kidney tubule cells (kidney cells that reabsorb fluid and minerals from urine as it forms). Common causes are low blood flow to the kidneys, drugs that damage the kidneys, and severe underlying infectious etiology.

Introduction:

Bone scan continues to be the second greatest-volume nuclear imaging procedure, offering the advantage of total body examination, low cost, and high sensitivity not only for metastatic lesions but also benign conditions. Its power rests in the physiological uptake and pathophysiologic behavior of 99m technetium (99mTc) diphosphonates. [1] The localization of radiotracers in damaged skeletal muscles is because calcium builds up in them and provides a site for radiotracer deposition when combined with phosphate. [1]

In a case of suspected rhabdomyolysis, bone scintigraphy is not only a sensitive indicator of muscle damage, but the amount of uptake is proportional to the extent of myonecrosis. [2,3,5,6,7] Specifically, in sports medicine, this could be a valuable tool in discriminating bone or muscle trauma. [4]

Our aim is to present an unusual case of a 19 year old female patient who suffered of heat stroke and presented with several unusual findings seen on her bone scan and to demonstrate important teaching points.

Methods:

As per our institute protocol, the patient was injected with 925 Megabecquerel (MBq) of 99mTc Methyldiphosphonate and after 2.5 hours whole body anterior and posterior images of the entire skeleton were obtained using a gamma camera with gantry motion of 10 cm/min, matrix size 256 x 1024, no magnification.

Subsequently for better visualization of related pathologies SPECT images of the chest and upper abdomen were obtained using a 360 degree rotation, non circular step and shoot, 128 steps, 20 seconds per step with a matrix size of 128 x 128, no magnification.

Findings: Whole body planar and SPECT CT images demonstrated:

1. Abnormal radiotracer uptake identified in lower extremity muscles suggestive of rhabdomyolysis.
2. Abnormal cortical uptake within bilateral kidneys suggestive of acute tubular necrosis.
3. Abnormal uptake in the right greater than left pleural space is suggestive of organizing hematoma.
4. Abnormal uptake within abdominal musculature suggestive of myositis ossificans.

Discussion:

Rhabdomyolysis is a complex medical condition leading to disruption of skeletal muscle integrity. This can lead to the direct release of intracellular muscle components, including myoglobin, creatine kinase (CK), aldolase, and lactate dehydrogenase into the bloodstream and extracellular space. [2,5,6]

99mTc diphosphonate bone scans are a sensitive way to visualize muscle injury and has been used along with a number of similar agents in a wide variety of conditions including exercise, [4] seizures, crush injury, polymyositis and is a good indicator of acute rhabdomyolysis. Myositis ossificans is essentially metaplasia of the intramuscular connective tissue resulting in extraosseous bone formation. Examination of the soft tissue lesion using 99mTc diphosphonate bone scans has been helpful in establishing the diagnosis and in determining the full extent of the process early in its evolution. [7]

Another important utility of 99mTc diphosphonate bone scans lies in evaluation of acute renal failure

after exercise with flank pain and patchy renal vasoconstriction due to acute tubular necrosis. This has been shown in multiple reports with a prominent example being one written by Watanabe and Shimizu. [8]. We also demonstrate the finding of an organizing pleural hematoma with radiotracer uptake. Localization of bone imaging agents of 99mTc diphosphonates has previously been described in abdominal, chest wall and pelvic hematomas. [9,10]

In summary all four benign conditions as described above are extremely important to detect on a bone scan. The purpose of our review is to educate the reader of several uncommon conditions seen on this peculiar bone scan.

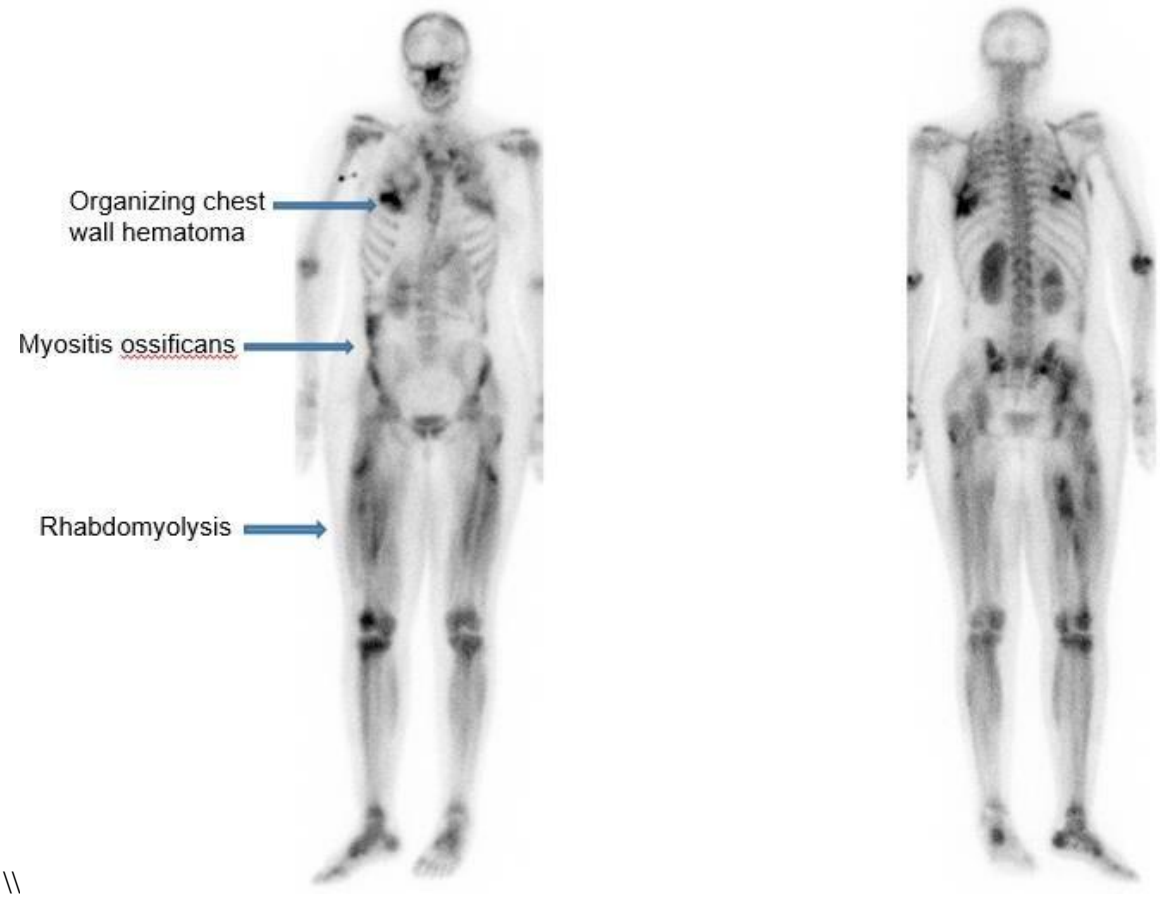

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Image 1: Whole body image demonstrating abnormally increased uptake in an organizing chest hematoma, myositis ossificans, and rhabdomyolysis. The increased uptake in bilateral lower extremities in several locations along the length of the muscle corresponding to a pattern of rhabdomyolysis.

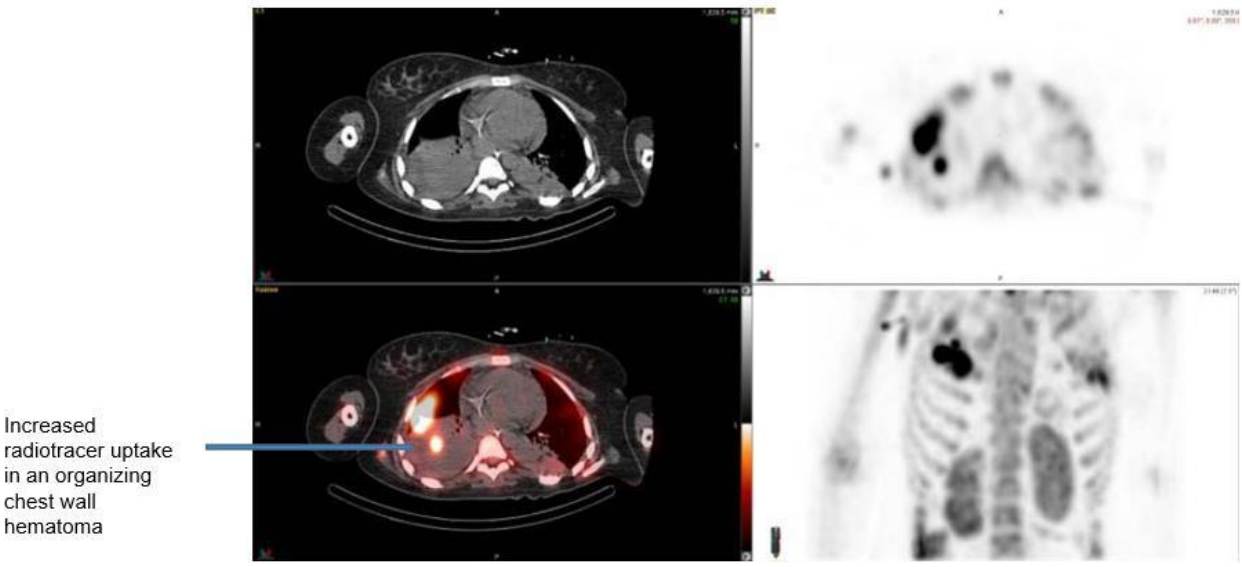

Image 2: SPECT/CT images demonstrating abnormally increased radiotracer uptake in an organizing chest wall hematoma.

Top Left Image is a CT image of the chest demonstrating a chest wall hematoma.
Top Right Image is the SPECT image demonstrating abnormally increased radiotracer uptake within the hematoma.
Bottom left is the fused SPECT/CT image demonstrating abnormally increased radiotracer uptake corresponding to the underlying chest wall hematoma.
Bottom right is the rotating maximum intensity projection image demonstrating foal region of uptake in the right chest. Also seen is a faint focus of uptake in the left chest (an additional site of hematoma).

Image 3: CT images in bone window demonstrating a focus of myositis ossificans (new bone formation) in the pelvis.

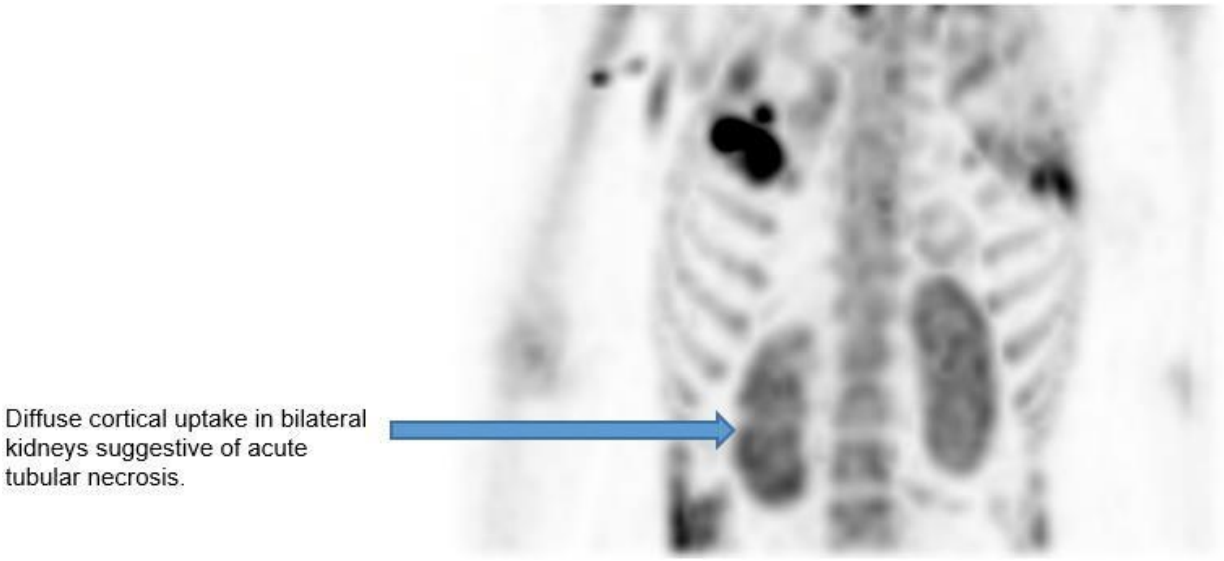

Image 4: Planar images demonstrating abnormally increased cortical retention of the radiotracer in bilateral kidneys in a pattern of acute tubular necrosis.

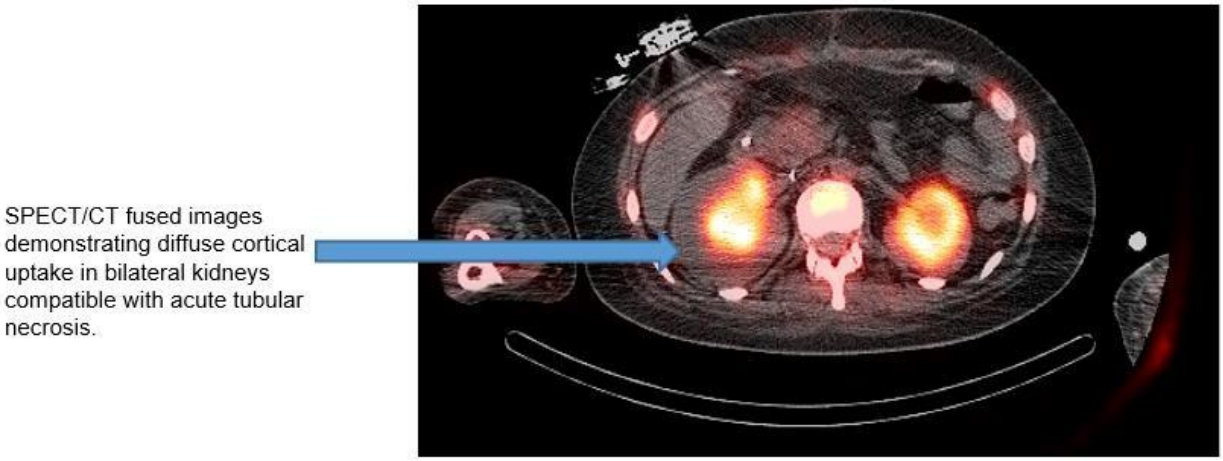

Image 5: Fused SPECT/CT images demonstrating abnormal cortical retention of radiotracer in bilateral kidneys corresponding to acute tubular necrosis.

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