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Clinical Quiz

Bilateral Fatigue Fractures of the Femur

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Case

An 18-year-old man, a military cadet, presented to the emergency department of the '251' Hellenic Air Force General Hospital of Athens due to bilateral thigh pain and inability to continue his military training, which had begun three months ago. The patient was hemodynamically stable (blood pressure=115/70 mmHg, heart rate=78 beats/min, respiratory rate=13 breaths/min) and afebrile (36.7°C), while his medical history was unremarkable. He complained that 20 days ago, he could not complete his daily training due to pain, while during the last five days, he also experienced pain during walking. Clinical evaluation showed diffuse bilateral thigh pain and mild oedema; hip flexion was slightly weaker bilaterally (grade: 4/5), while the remaining muscle groups of both lower limbs exhibited normal strength (5/5). No neurovascular deficit was present. The ankle-brachial pressure index was 1.2 [normal range (nr):1-1.2].

X-rays revealed bilateral radiolucent lines in the medial cortex of both femurs at the subtrochanteric area (Figure 1A). The serum laboratory examination, including calcium= 9.4 mg/dL (nr= 8.1-10.4 mg/dL), phosphate= 5 mg/dL (nr= 2.5-5 mg/dL), 25-hydroxyvitamin D= 26.4 ng/ml (nr= 20-40 ng/ml) and parathormone= 37.8 pg/ml (nr= 18.5-88 pg/ml), was within normal limits. Dual-energy x-ray absorptiometry (DXA) revealed T-score= -0.5 (proximal femur) and -0.7 (lumbar spine). Furthermore, magnetic resonance imaging (MRI) and bone scintigraphy were performed, showing mild bone oedema and increased radiotracer uptake, respectively, at the medial cortex of the subtrochanteric area of both femurs (Figure 1 B, C, D).

The patient was diagnosed with bilateral fatigue femoral fractures. He was treated conservatively since both fractures were incomplete and non-displaced, with protected weight bearing for 6 weeks and a gradual increase in activities. He could return to his training after 3 months.

Commentary

A wide range of activities causes fatigue fractures; their location is activity-dependent and, therefore, may occur anywhere. For instance, fatigue fractures of the proximal medial posterior surface of the tibia, the distal shaft of the fibula, the navicular bone of the foot and the neck of the femur are common among runners. In contrast, those of the metatarsals, anterior shaft of the tibia and neck and shaft of the femur have been linked with dancing. The lower extremities comprise the majority of the bones affected by fatigue fractures (up to 95%)[1-3]. Less than 10% of fatigue fractures occur in the upper limbs. In terms of frequency, the tibia, tarsal bones, metatarsals, femur, and fibula are mostly affected in that order. Regarding the upper extremities, the most susceptible bone is the ulna[1,3]. The most affected sites for fatigue fractures in military recruits are the calcaneus and metatarsals.

Femoral fractures are typically high-energy-trauma-related injuries. However, lower forces may cause femoral stress fractures (fatigue and insufficiency). Insufficiency

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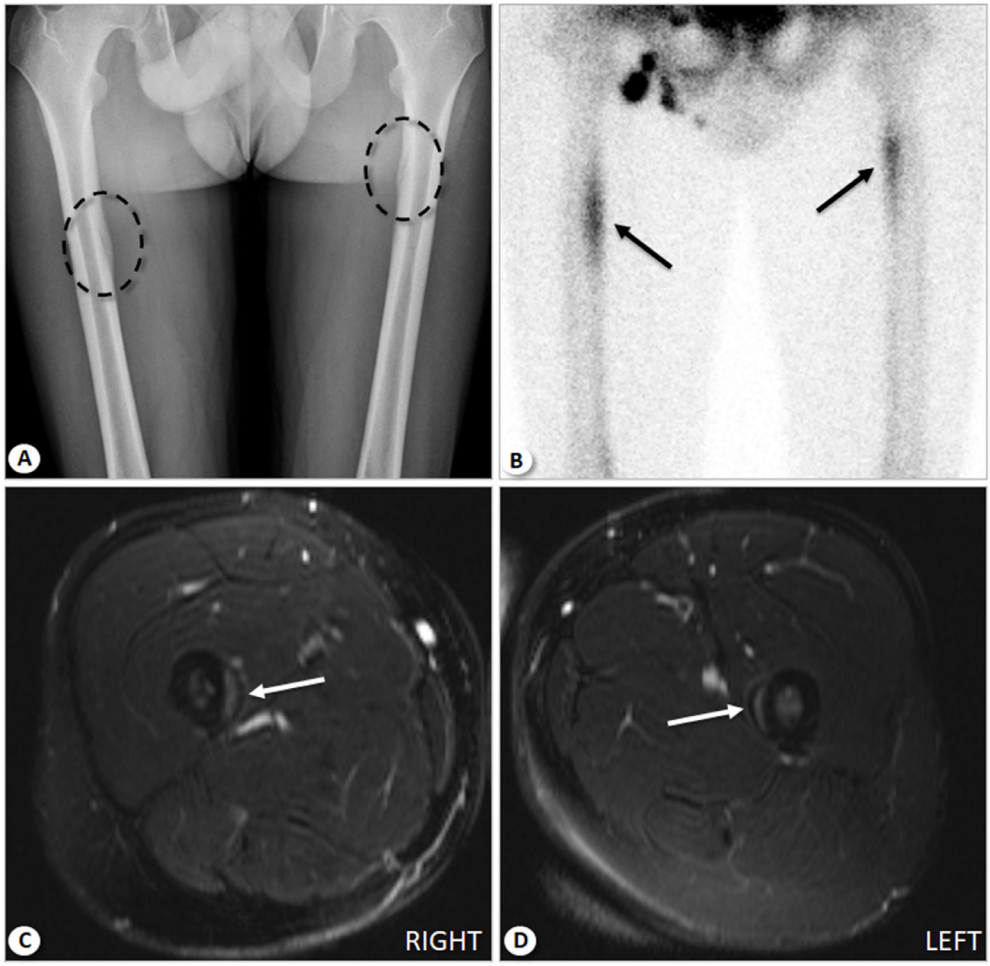

Figure 1. (A) Anteroposterior (AP) X-ray of both femurs displays subtle cortical thickening in the medial aspects of the subtrochanteric area bilaterally. A synchronous thin radiolucent line is also depicted coursing within the thickened cortexes, thus indicating a non-displaced fracture (black dashed oval). (B) Subsequent bone scintigraphy illustrates abnormally increased radiotracer uptake in the aforementioned areas (black arrows). No other regions with pathologic uptake were demonstrated. Axial T2-weighted fat-saturated images of the (C) right and (D) left femurs similarly revealed mild cortical thickening localized in the medial facets of the subtrochanteric area of the femur, with concomitant mild signal hyperintensity also being illustrated due to bone marrow oedema because of the bilateral fractures (white arrows).

fractures occur in unhealthy bones, while fatigue fractures occur in healthy bones with repetitive loading over a long period[1,2]. The femur represents a relatively common anatomical region of fatigue fractures, accounting for approximately 11% of all these injuries[1,3]. However, simultaneous fatigue fractures of both femurs represent an extremely rare clinical entity mainly observed in military recruits and less commonly in athletes and ordinary active individuals[3].

The symptoms of fatigue femoral fractures may vary but typically include pain, tenderness, and swelling in the thigh or groin area. At the same time, since there is no traumatic event, these injuries may be misdiagnosed[1,2]. Due to their low incidence and the lack of a traumatic event, these fractures are often mis-or-under-diagnosed.

Initially, X-rays and computer tomography may not exhibit any abnormalities in fatigue fractures. However, later on, they may reveal periosteal reaction, localized cortical thickening, callus formation and thin fracture lines[4]. MRI represents the most sensitive imaging method for the early detection of fatigue fractures, revealing bone marrow and/or periosteal or soft tissue oedema. In contrast, a hypointense line (fracture) may be depicted in T1 weighted images. Bone scintigraphy may also detect stress fractures as a non-specific increase in activity resulting from bone healing, but it remains less sensitive and specific than MRI[4,5].

In the absence of an appropriate history of repetitive physical activity and especially in the early stages, where

a fracture may not yet be evident, imaging findings may be misinterpreted for bone tumours or infection; therefore, increased suspicion of this condition is advised.

Consent to publish

Written consent for publication was obtained from the patient.

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Questions

1. Fatigue fractures occur due to:
A. High-energy trauma
B. Repetitive stress over a long time-period in a healthy bone
C. Low-energy stress in an unhealthy bone
D. None of the above

Critique

Fractures typically occur due to a high-energy traumatic event. Insufficiency fractures occur in unhealthy bones due to a low force, while fatigue fractures occur in healthy bones with repetitive loading over a long time-period.
The correct answer is B.

2. In a case of suspected fatigue femoral fracture, the initial X-ray views do not reveal any radiolucent line. The most sensitive imaging method for confirming the diagnosis is:
A. Ultrasound sonography
B. Computer Tomography scan
C. Magnetic resonance imaging
D. None of the above

Critique

Initially, X-rays and computer tomography may not exhibit any abnormalities. At the same time, Magnetic Resonance imaging represents the most sensitive technique for the early detection of fatigue fractures since it reveals bone marrow and/or periosteal or soft tissue oedema.
The correct answer is C.

3. Fatigue fractures are more commonly located in the following areas:
A. Lower limbs
B. Upper limbs
C. Spine
D. None of the above

Critique

Fatigue fractures most frequently involve the lower extremities due to weight-bearing stress. In many instances of lower limb fractures, bilateral abnormalities are observable, while in cases of upper limb fractures, they are more commonly unilateral and affect the dominant arm. Spine fatigue fractures typically occur in the pedicle, more commonly in the lumbar spine.
The correct answer is A.