CASE REPORT

A rare case of a non-traumatic neck of femur fracture in a 17-year-old boy associated with vitamin D deficiency

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SUMMARY

Hip fractures in the young, healthy population are rare and often the result of high-energy trauma. A previously healthy 17-year-old patient presented to our institution with a 5-week history of left hip and knee pain in the absence of any trauma. Pelvic radiograph revealed a subacute left femoral neck fracture. He subsequently underwent surgical fixation and made an uneventful recovery. Further endocrine evaluation revealed isolated vitamin D deficiency to be the likely underlying cause for this fracture. Multiple previous opportunities were missed to identify the cause for this patient's symptoms. An intracapsular fracture in a young adult requires early recognition and prompt anatomical reduction. This case emphasises the need to maintain a high index of suspicion for atraumatic fractures in healthy adolescents with unexplained joint pain. Further endocrine and metabolic investigations are warranted, and isolated vitamin D deficiency must be considered as a potential causative factor.

BACKGROUND

Femoral neck fractures are commonly seen in the elderly population following a fall.¹ However, hip fractures in the young, healthy population are rare and often the result of high-energy trauma.^{2,3} Such fractures in the absence of trauma are uncommon and should raise concern for an altered metabolic bone state necessitating further investigations. Vitamin D deficiency is more common in the general population than was previously thought.⁴ It can lead to bone fragility thus predisposing individuals to fractures.⁵ We identified three case reports of hip fractures associated with vitamin D deficiency in middle-aged adults, two of which were preceded by minimal trauma.^{6–8} To our knowledge, there are no previous reports of femoral neck fractures involving healthy adolescents in the absence of trauma.

CASE PRESENTATION

A 17-year-old man of Southeast Asian origin presented to our institution with a 5-week history of left hip and knee pain of insidious onset, first noticed while he was walking to school. He was otherwise fit and well, and there was no history of constitutional symptoms and no history of trauma. He was previously independent and mobile but had been unable to attend college for 4 weeks

due to pain. There was no significant medical or drug history and no personal or family history of previous fractures. He did not smoke or drink alcohol and was not involved in any extra-curricular sporting activities. His body mass index was 24 (height 1.85 m, weight 83 kg). Examination findings revealed tenderness over the left hip and knee with range of movement in the hip limited by pain. There was no deformity, leg length discrepancy or distal neurovascular deficit. He was noted to be mobilising with a limp. He had two prior visits to the general practitioner (GP) and one prior visit to the emergency department where he was discharged with analgesia. Due to ongoing symptoms, radiographs were requested by the GP, and the patient was referred to our surgical assessment unit.

INVESTIGATIONS

Pelvic radiographs revealed a displaced left intracapsular neck of femur fracture with no signs of osteopaenia or Looser's zones (figure 1). As advised by the radiologist and in order to guide surgery, a pelvic MRI scan was performed, which confirmed the diagnosis of a subacute insufficiency fracture with associated oedema and small joint effusion (figure 2A,B). No abnormalities were found in the contralateral hip. Further investigations were performed to identify the underlying cause for the fracture. Blood tests showed normal corrected calcium level at 2.41 (reference range 2.2–2.6 mmol/L) and normal phosphate and parathyroid hormone levels. The alkaline phosphatase level was 165 (reference range for adolescents 60–360 U/L). Full blood count, renal function and liver function including albumin levels were also normal. C reactive protein was mildly raised (16 mg/L). Endocrine evaluation revealed low total vitamin D at 16 (reference range 50–220 nmol/L) and mildly low thyroid stimulating hormone (TSH) levels at 0.25 (reference range 0.35–4.94 mU/L) but normal free thyroxine (T4) level. Serum testosterone level was 7.5 (reference range 1–27.8 nmol/L), and sex hormone binding globulin level was 6 (reference range 14–71 nmol/L). Serum tissue transglutaminase antibody level was normal at 3.3 (reference range <20 CU). He awaits an outpatient dual energy X-ray absorptiometry scan to check bone mineral density.

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Figure 1 Antero-posterior pelvic radiograph at presentation showing subacute displaced left intracapsular neck of femur fracture.

DIFFERENTIAL DIAGNOSIS

Important differential diagnoses that were initially considered for subacute joint pain in an adolescent included infection (septic arthritis, osteomyelitis, pelvic or psoas abscess), inflammatory (systemic arthritis), mechanical (stress fracture, slipped capital femoral epiphysis, Perthes disease and muscular strain) and neoplastic (leukaemia, primary or metastatic tumour). In our patient, the pelvic radiograph confirmed the diagnosis of a neck of femur fracture, and initial laboratory investigations showed no evidence of underlying infection, inflammation or neoplasia.

TREATMENT

The patient subsequently underwent surgical fixation with dynamic hip screw and antirotation screw (figure 3A,B). Histology from the intraoperative bone specimens showed normal bone structure with no evidence of inflammation or malignancy. There was also no evidence of osteomalacia such as increased osteoid or decreased bone forming surfaces. He was started on vitamin D supplementation and rehabilitative physiotherapy. Appropriate orthopaedic and endocrine follow-up was arranged.

OUTCOME AND FOLLOW-UP

At 6 weeks' follow-up, he was pain free and mobilising well with minimal assistance. Repeat pelvic radiograph showed a well-healing fracture with no evidence of avascular necrosis (figure 4).

Figure 2 (A) Axial and (B) coronal MRI T2 images at presentation showing the subacute left intracapsular neck of femur fracture.

Figure 3 (A) Antero-posterior and (B) lateral views of intraoperative radiographs showing dynamic hip screw fixation.

The patient is currently being jointly followed up by the orthopaedic and endocrine teams.

DISCUSSION

Hip fractures in the young, healthy population are extremely rare and often the result of high-energy trauma such as road traffic accidents or fall from a height.^{2,3} They can also result from repetitive microtrauma, otherwise known as stress fractures, which usually occur in athletes or servicemen/women.⁹ Hip fractures involving no or minimal trauma are uncommon and usually involve an underlying pathology. Causes identified in the literature include epilepsy,¹⁰ osteoporosis¹¹ and metabolic bone disease such as osteomalacia,¹²⁻¹⁴ hyperparathyroidism^{15,16} and renal osteodystrophy.¹⁷

In the present case, we found no evidence of these conditions from the history, examination or investigations performed. Several cases have reported spontaneous hip fractures secondary to vitamin D deficiency-associated osteomalacia,¹²⁻¹⁴ a disorder of impaired bone mineralisation. In our patient's case, laboratory investigations did not reveal any abnormality in serum calcium, phosphate or parathyroid hormone levels, except for a very low vitamin D level. Furthermore, there were no radiological features of osteomalacia on the pelvic radiographs or MRI scan. This was in keeping with isolated vitamin D deficiency as the potential underlying cause for the fracture.

We have identified only three reported cases of spontaneous femoral neck fractures in otherwise healthy individuals with low vitamin D in the absence of features of osteomalacia. These cases were reported in middle-aged adults, two of which involved minimal trauma. The first case was in a 36-year-old man with irregular dietary and lifestyle habits and high alcohol intake who

Figure 4 Pelvic radiograph at 6 weeks postsurgical fixation showing the dynamic hip screws and antirotation screw in good position with no evidence of avascular necrosis.

sustained bilateral femoral neck fractures after missing a step while walking down a flight of stairs.⁶ The second case was reported in a 39-year-old healthy active military personnel who fell while cycling.⁷ Paralicci *et al* reported a case of 46-year-old woman with a bilateral hip fractures with no associated trauma.⁸ To our knowledge, this is the first case of femoral neck fracture in a healthy teenager associated with vitamin D deficiency in the absence of any trauma.

The role of vitamin D in the metabolism of bone and prevention of fractures has been well described in the literature.⁵ Its deficiency was previously thought to be less prevalent in developed countries due to fortification of milk and dietary supplement use; however, recent literature appears to contradict this assumption.⁴ Common risk factors for deficiency include suboptimal nutrition, inadequate sun exposure, dark skin (our patient had dark skin tone in keeping with Fitzpatrick skin type V),¹⁸ malabsorption syndromes, chronic kidney disease and antiepileptic medication use.¹⁹ Currently, the National Institute for Health and Care Excellence guidelines advise vitamin D supplementation in at-risk individuals.²⁰

In the present case, in addition to low vitamin D, blood tests showed low TSH levels in the absence of low T4. These findings suggest a subclinical hyperthyroid state. Although overt hyperthyroidism has been linked to increased bone resorption and increased fracture risk, the effect of subclinical hyperthyroidism on bone health is not yet clear.²¹ The levels were only mildly deranged, and the patient's TSH levels were previously normal 2 months prior to the fracture, implying it is unlikely to be of high clinical significance in our patient.

In young patients, the principal aim of treatment is to preserve the bone; therefore, internal fixation with either cannulated screws or dynamic hip screw is preferred over arthroplasty.²² Delayed diagnosis and treatment can be associated with increased risk of complications such as avascular necrosis of the femoral head and non-union resulting in significant morbidity and the need for arthroplasty.²² Given their rare occurrence, hip fractures in the absence of trauma are often diagnosed late. It is therefore essential to have a high index of suspicion and perform early radiological

investigations to allow prompt identification and surgical treatment.

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Learning points

- ▶ High index of suspicion for a fracture is needed in young patients presenting with unexplained joint pain even in the absence of trauma.
- ▶ Early recognition and treatment of femoral neck fractures is essential for a good functional outcome, therefore low threshold for imaging is advised.
- ▶ Prompt metabolic and endocrine work-up following initial management is necessary to identify the underlying cause.
- ▶ Vitamin D deficiency is a potential causative factor in unexplained fractures.
- ▶ The prevalence of vitamin D deficiency among the general population is underestimated, and the National Institute for Health and Care Excellence guidelines advise supplementation in at-risk groups.

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