

## FULMINANT SKELETAL FAILURE IN A CENTENARIAN: THE IMPACT OF NUTRITION AND IMMOBILITY

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**Abstract:** This case describes a 103-year-old lady who presented from home with an incidental diagnosis of a left femoral fracture. She had no history of trauma and denied pain. She had a known diagnosis of osteoporosis, and sustained a fracture of the contralateral femur aged 93 which was managed conservatively. She was bed-bound with fixed contractures, poor oral intake and was non-compliant with prescribed calcium/vitamin D supplementation. Clinical biochemical measurements showed severe vitamin D deficiency and mild hypocalcaemia. Secondary hyperparathyroidism in the setting of an inappropriately normal phosphate suggested concurrent renal bone disease. Biomarkers of bone turnover were also consistent with bone remodelling. The history of prior fragility fractures, severe vitamin D deficiency and immobility supports a diagnosis of osteoporotic fracture, however other causes of spontaneous fracture were also considered. This case highlights the complexity of interpreting clinical biochemistry results in the setting of multi-morbidity and addresses the challenges of bone health management in the frail older person.

**Key words:** Spontaneous fracture, malnutrition, osteoporosis.

### Background

Osteoporosis is a serious public health concern affecting over 200 million people worldwide and 30% of post-menopausal women with an impending projected rise of 240% in hip fractures (1, 2). The risk of a major fragility fracture increases with age, independent of corresponding bone mineral density scores (3). We present an interesting case of spontaneous fracture in a centenarian which highlights the challenges of osteoporosis management and the impact of nutrition and immobility on bone health.

### Case presentation

A 103-year-old lady presented to the emergency department with a six-day history of incidental left thigh deformity. There was no history of falls or trauma. She had a background history of visual impairment, dementia and osteoporosis. She sustained a right femoral fracture ten years previously which was managed conservatively. Calcium and vitamin D supplementation were prescribed for secondary prevention. She lived with her daughter and was bed and house-bound for the previous two years. She was non-adherent with medications due to a dislike of the taste and moderate dysphagia. She thus had severely impaired caloric intake for years. On examination, there was significant muscle wasting and fixed flexion contractures of both lower limbs. Ecchymosis and oedema were noted around the left distal femur.

Plain radiographs of the left femur reported an oblique fracture through the metaphysis with angulation shortening and heavy arterial calcification, (see Figure 1). Additional radiographs of the right femur reported a previous healed femoral fracture and loss of cortical continuity potentially

representing another fracture, (see Figure 2).

Serum biochemistry results were consistent with chronic kidney disease (CKD) with urea 22.3mmol/L (Reference Interval (RI): 2.9-8.2mmol/L), creatinine 122µmol/L (RI:49-90µmol/L), calcium 1.88mmol/L (RI:2.15-2.55 mmol/L) and albumin 31g/L (RI:39-51g/L) resulting in an adjusted calcium of 2.07mmol/L (RI:2.17-2.51 mmol/L). Alkaline phosphatase (ALP), phosphate and magnesium were within the normal range at 86 U/L (RI:35-104 U/L), 1.40 mmol/L (RI: 0.87-1.45 mmol/L) and 0.80 mmol/L (RI:0.65-1.05mmol/L) respectively. C-reactive protein was elevated at 147mg/L (RI: <5mg/L). Intact parathyroid hormone was significantly raised at 290 ng/L (RI: 15-65ng/L) and Vitamin D (25OHD) 17nmol/L, indicative of severe deficiency. The bone resorption marker, C-terminal telopeptide of type 1 collagen (CTX 1) was elevated at 1.770ug/L (Postmenopausal RI: 0.104-1.008 µg/L) while the formation marker, Procollagen type I N-terminal propeptide (PINP) was 33.1µg/L and within the normal range (RI: 16.3-73.9 µg/L).

Spontaneous fractures occur in presumably normal bone without any history of blunt force trauma (4). In our case, given the history of prior fracture, severe vitamin D deficiency and immobility, an osteoporotic fracture is the most likely aetiology. Other differential diagnoses include pathological fracture, multiple myeloma, and 'pseudo-spontaneous' fractures in elder abuse.

The orthopaedic team advised conservative management of the fracture. Following discussions with her family, she was discharged with community palliative medicine support and died peacefully in her home.

**Figure 1**

Radiograph of left femur: Oblique fracture through the metaphysis of the left femur. Angulated with shortening of the distal segment



osteoclasts and/or reduced bone deposition by osteoblasts results in bone loss and osteoporosis which is exacerbated in the context of vitamin D and calcium deficiency (7). Immobilisation hypercalcaemia in this case may also be a contributor to raising serum calcium levels to a near normal value (8). The normal ALP level is unexpected but is likely consequent to severe zinc deficiency. ALP is a metalloenzyme which requires a divalent ion including magnesium and zinc for its activity.

**Figure 2**

Radiograph of right femur: Old healed fracture of the right femoral diaphysis



### Discussion

The impact of nutrition and immobility on bone health and bone metabolism is pertinent to this case. Reduced calcium and vitamin D intake are consistent with malnutrition compounded by non-adherence to prescribed supplements and a total lack of exposure to sunlight due to her housebound status. Additionally, the severity of secondary hyperparathyroidism, inappropriately normal phosphate level (also masking severe malnutrition) and elevated serum creatinine concentration suggest concurrent renal bone disease secondary to CKD (5). Additional biochemical parameters that may assist with the assessment of the degree of malnutrition are magnesium, which was normal, and zinc which is not measured routinely (6). Biomarkers of bone turnover are consistent with the clinical picture. The CTX1 level was almost double the concentration expected in health, while PINP was normal indicating uncoupling in bone remodelling. Increased resorption by

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Adherence to calcium/vitamin D is sub-optimal in the osteoporotic population with reported rates of 20-50% (9, 10). Reasons for non-adherence include forgetfulness, tablet burden, improvement in bone markers, a perceived lack of benefit, costs and side effects (11).

A conservative approach was adopted following the initial fracture 10 years previously and anti-resorptive therapy was not commenced. Recent systematic reviews and research suggest a poorer prognosis with non-operative management (12-15). Oral bisphosphonates would not have been appropriate given her frailty and CKD (16). If Vitamin D levels were optimised, alternative therapies such as denosumab, teriparatide or intravenous zoledronic acid every 18 months would merit consideration (17).

### Conclusion

In summary, this interesting case highlights the complex interplay of nutrition, immobility, and clinical biochemical markers on the diagnosis and management of fracture. Optimising nutrition, promoting mobility and appropriate secondary prevention are key to maintaining bone health.

*Disclosure Statement:* All authors have nothing to declare.

*Ethical standard:* The case report was approved by the Clinical Research Ethics Committee and informed consent was given by the late patient's next of kin.

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