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GAVIN PUBLISHERS

Journal of Surgery

van der Sijp MPL, et al. J Surg: JSUR-1115.

Case Report

DOI: 10.29011/2575-9760. 001115

Low Energy Hip Fractures in Young Adults: A Case-Series

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Citation: van der Sijp MPL, Geertsema D, Niggebrugge AHP (2018) Low Energy Hip Fractures in Young Adults: A Case-Series. J Surg: JSUR-1115. DOI: 10.29011/2575-9760. 001115

Received Date: 07 March, 2018; **Accepted Date:** 13 March, 2018; **Published Date:** 20 March, 2018

Abstract

Introduction: Proximal femoral fractures are amongst the most common type of fractures in elderly patients. Osteoporosis is the main underlying cause of these low-energetic fractures. Patients younger than 50 accounts for less than 5% of the total fracture incidence and low-energetic fractures in children and young adults are extremely rare. We report three cases of young patients with a low-energetic hip fracture and review the pathogenesis of these fractures.

Case Series: A 19-year-old woman with a history of psychosocial disorders including severe anorexia nervosa was treated for an extracapsular femoral neck fracture. A 25-year-old man was treated for a dislocated extracapsular femoral neck fracture. He was diagnosed with a heterozygote Collagen Type I Alpha 1 Chain (COL1A1) mutation resulting in osteogenesis imperfecta type I. a 22-year-old man with a left-sided hemiparesis caused by laminectomies was admitted with an un-displaced femoral neck fracture. One year earlier he had an unsuccessful surgery of his left knee followed by a lengthy period of immobilization.

Discussion: Our hospital treated 490 patients in 2017 and recorded only these three cases of young adults with a low-energy proximal femoral fracture. Known causes of osteoporosis in young adults include chronic inflammatory, endocrinal, neuromuscular, metabolic, and genetic diseases. Amongst these are anorexia nervosa, osteogenesis imperfecta and reserved load-bearing physical activity present in the reported cases.

Why should an emergency physician be aware of this?: These extreme and rare cases stress the importance of taking a thorough medical history and perform additional diagnostics for underlying causes for atypical fractures.

Keywords: Anorexia; Hip Fracture; Low Energy Fractures; Osteoporosis; Osteogenesis Imperfecta; Paresis; Proximal Femoral Fracture; Young Adults

Introduction

Proximal femoral fractures are amongst the most common type of fractures in elderly patients with lifetime risks of 12% for women and 5% for men [1]. These risks almost double above the age of 50 [2] and the overall risk increase ten-fold with every 20 years of age [3]. In 90% of cases the trauma mechanism is a simple fall from standing position on the ipsilateral trochanter major [4]. The main underlying cause for these low-energetic fractures is osteoporosis in 51% of all cases for women and 24% in men [5]. Osteoporosis is defined as a low Bone Mineral Density (BMD, <2.5 SD) according to the World Health Organization (WHO) [6]. It is most commonly associated with postmenopausal women and increasing age. Decline in oestrogen levels at menopause interferes with osteoclast activity and shifts the calcium homeostasis leading to increased calcium requirement and reduced absorption [6]. Additionally, the prevalence of multiple comorbidities and sarcopenia associated with age, often referred to as frailty, leads to a higher tendency to fall. Osteoporosis and frailty combined results in the exponential increase in the risk for hip fractures as age progresses [7].

Proximal femoral fractures in patients younger than 50 account for less than 5% of the total incidence and in paediatric

patients the incidence of hip fractures is below 1%(8). These fractures are most commonly caused by high-energy traumas in male patients involving vehicles or falls from height [8]. Low-energetic fractures in children and young adults are extremely rare and often associated with severe bone disorders [9]. We report three distinct cases of young patients with a low-energetic hip fracture and review the pathogenesis of these fractures.

Case Reports

Patient A

In May 2017, a 19-year-old woman was admitted to the Emergency Department (ED) with an extracapsular femoral neck fracture after she had tripped over a doorstep and fallen on her left hip two days earlier. She had no prescription drugs and no (family) history of fractures. Her medical history revealed psychosocial disorders including severe anorexia nervosa between the age of 14 and 18 years with a Body Mass Index (BMI) as low as 12.11 kg/m^2. Her BMI upon admission was 19.03 kg/m^2. The blood results showed a vitamin-D level of 45 nmol/L (normal: 70-250nmol/L). She was operated the following day with closed anatomic reduction and internal fixation with a dynamic hip screw. After three days she was discharged on crutches with home care and continued physiotherapy. Osteoporosis (T-score -2.5) was diagnosed during outpatient follow-ups with Dual-energy X-ray Absorptiometry (DEXA).

Patient B

In July 2017, a 25-year-old man was admitted with a dislocated extracapsular femoral neck fracture after he slipped on a wet floor and fell on his side. He had a notable slender physique, arachnodactyly and blue sclera. His medical history was obtained from a local hospital and revealed Morbus Behçet with multiple episodes of thrombosis, Stickler Syndrome and previous severe musculoskeletal injuries of the knee, shoulder and elbow. Blood results showed a vitamin-D level of 50 nmol/L. He was operated the same night with closed anatomic reduction and internal fixation with a dynamic hip screw. The DEXA scan indicated osteoporosis (T-score -3.2). He was referred to an academic hospital with a clinical suspicion for a congenital connective tissue disorder. DNA-diagnostics revealed a heterozygote Collagen Type I Alpha 1 Chain (COL1A1) mutation resulting in osteogenesis imperfecta type I. Vitamin D supplements and colchicine were prescribed, and the patient was referred to the clinical geneticist for genetic genealogy.

Patient C

In October 2017, a 22-year-old man was admitted with an undisplaced femoral neck fracture two days after his legs gave way and he dropped to the floor from an upright position, landing on his left side. His medical history revealed a left-sided hemiparesis caused by a spinal pilocytic astrocytoma and resected via laminectomies in 2007 and 2012. One year earlier he had an unsuccessful surgery of his left knee followed by a lengthy period of immobilization after a severe distortion with a rupture of his cruciate ligaments. Blood results showed a vitamin-D level of 36 nmol/L. He was surgically treated using 3 cannulated screws. The diagnostic hip and pelvic X-rays indicated a decreased bone-density of the left femur compared to the contralateral hip. No DEXA-scan was performed due to the patients' incompliance of the follow-up.

Results and Discussion

Low-energetic hip fractures in young adults have hardly been described in literature. Our high-volume specialised hip fracture hospital treated 490 patients in 2017 and recorded only these three cases. We estimate the incidence of low-energy hip fractures in young-adults (age 18-30) at 0.6%. The incidence of osteoporosis in young (female) adults is estimated at 0.5% [10]. Known causes of osteoporosis in young adults include chronic inflammatory, endocrinal, neuromuscular, metabolic, and genetic diseases [10]. Amongst these are poor nutrient intake associated with the anorexia nervosa of patient A [11], osteogenesis imperfecta as diagnosed in patient B and reserved load-bearing physical activity associated with patient C.

Anorexia nervosa

Osteoporosis is a known complication of anorexia nervosa. Similar cases have previously been described in literature, but never before of a hip fracture in a teenager [12]. Chronic malnourishment can lead to multiaxial hormonal disturbances, increased reabsorption and insufficient mineralization of bone, causing loss of BMD [13]. Strength of bones also depends on mechanical strain and loading. Consequently, anorexic patients may have insufficient weight to maintain a sufficient bone density [12]. More than half of all women with anorexia nervosa have a severely low BMD. Less than one year exposure to anorexia nervosa may lead to a relevant loss of bone density [14]. Several studies have demonstrated the long-term effect of anorexia nervosa with elevated fracture risks even decades after recovery [15].

Osteogenesis Imperfecta

Osteogenesis Imperfecta (OI), also known as brittle bone disease, is the most common heritable connective tissue disorder with an incidence of approximately 1/20,000 births. Type I collagen is the most abundant protein fibre in bone tissue which forms a matrix and provides resilience. Mutations in the genes coding for these collagen fibers cause qualitative and/or quantitative abnormalities in the collagen, causing a disruptive matrix and leading to bone deformities or fractures. COL1A1 mutations are the mildest form of OI and includes 90% of all collagen mutations [16]. The incidence for hip fractures in younger male OI patients (<50 years old) was estimated to be 24 times higher compared to

the standard population [17]. Treatment options are limited and mimics treatment of osteoporosis with medication [16].

Paresis

The prevalence of osteoporosis in spinal cord injury patients is well-studied and present in virtually all patients with paralyzed limbs [18]. The main mechanism is based on decreased physical exercise and mechanical strain of the extremity, known as unloading. This leads to altered osteoblast and osteoclast activity which causes reduced bone deposition and mineralization and increased bone resorption. The effect is strengthened by the sympathetic denervation of the limb and local vascular dysfunction. Fracture risks are twice as high compared to the standard population and up to 50% of all patients sustain a low-energy fracture of the lower extremities [18]. Multiple hip fractures in patients with spinal cord injuries have previously been described [19]. The effects of bisphosphonates seems limited as it reduces bone resorption but has little effect on bone formation. Physical exercise programs increasing the limbs' mechanical loading has been shown to promote osteogenesis and improve bone formation in these patients [18,20].

These extreme and rare cases stress the importance of taking a thorough medical history and perform additional diagnostics to diagnose underlying causes for atypical fractures, especially in young patients with an inadequate trauma mechanism. Osteoporosis screening should be considered routine for all proximal femoral fracture patients as well as all atypical low-energy fractures.

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