Diabetes-Associated Osteoporosis: A Case of Vertebral Compression Fracture in a Middle-Aged Man with Poor Glycemic Control

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ABSTRACT: Diabetes mellitus is associated with an increased risk of osteoporosis and fractures due to impaired bone metabolism and increased fall risk. This case report highlights a 49-year-old Palestinian man with long-standing poorly controlled type 2 diabetes who presented with progressive back pain following a hypoglycemic syncopal episode. Clinical assessment and imaging, including magnetic resonance imaging (MRI) and Dual-Energy X-ray Absorptiometry (DEXA), confirmed a vertebral compression fracture at D12-L1 and severe osteoporosis. Laboratory investigations ruled out secondary causes of osteoporosis. The patient was treated with zoledronic acid, pain management, and improved glycemic control, leading to symptom relief and better metabolic outcomes after 6 months. This case underscores the importance of early osteoporosis screening in diabetic patients and highlights the need for an integrated approach to managing both diabetes and bone health to prevent fractures in high-risk individuals.

PLAIN LANGUAGE SUMMARY

Diabetes-Related Bone Health: A Case of Spine Fracture in a Middle-Aged Man with Poor Blood Sugar Control

This case report describes a 49-year-old man with long-standing diabetes and poor blood sugar control who developed a painful fracture in his spine without any obvious injury. Diabetes can negatively affect bone health, increasing the risk of fractures. In this case, the patient had been living with diabetes for over 20 years and experienced multiple episodes of low blood sugar, which may have contributed to his injury. Tests showed that the patient had severe osteoporosis, a condition where bones become weak and fragile. He was treated with medication to strengthen his bones and to better manage his diabetes. After 6 months, his blood sugar control improved, and his pain subsided. This case highlights the importance of early diagnosis and treatment of osteoporosis in people with diabetes. Diabetes-related complications, such as nerve damage and poor blood sugar control, can increase the risk of falls and fractures. Regular monitoring and proactive treatment can help prevent serious bone injuries in diabetic patients.

KEYWORDS: Diabetes, osteoporosis, vertebral fracture, bone health, case report

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Introduction

Osteoporosis, a chronic skeletal disorder characterized by low bone mass and microarchitectural deterioration of bone tissue, poses a significant health burden globally[1,2] Individuals with diabetes, both type 1 and type 2, have been found to have an increased risk of osteoporotic fractures compared to their non-diabetic counterparts.[3,4] This elevated fracture risk has been attributed to a complex interplay of factors related to the pathophysiology of diabetes and its associated complications.

Diabetes can have detrimental effects on bone health through various mechanisms, including impaired osteoblast function, enhanced osteoclast activity, and disruption of calcium and vitamin D homeostasis.[5,6] The increased risk of falls and diabetes-related complications, such as neuropathy, retinopathy, and cardiovascular disease, further contribute to the elevated fracture risk in this population[5,7]

Early identification and appropriate management of osteoporosis in individuals with diabetes are crucial to mitigate the burden of fractures and associated disabilities. Comprehensive strategies involving regular screening, implementation of preventive measures, and targeted pharmacological interventions are essential to address this significant clinical challenge.[8,9] This case report aims to underscore the importance of early diagnosis and treatment of osteoporosis in individuals with diabetes and such cases.

Case Presentation

A 49-year-old Palestinian man presented to the family medicine clinic with sudden, progressive back pain. The pain was non-radiating, and there was no history of trauma or precipitating factors.

The patient was diagnosed with diabetes 22 years ago and was maintained on Apidra insulin 10 IU 3 times daily and Lantus insulin 30 IU at bedtime. He had experienced recurrent episodes of hypoglycemia, particularly in the early mornings. Two days prior to presentation, the patient had a syncopal episode

characterized by convulsions, jaw locking, and sweating, lasting 2 to 3 minutes. In the subsequent 2 days, he developed worsening back pain and limited arm movement to avoid exacerbating the discomfort.

The physical examination revealed tenderness on palpation of the dorsal vertebrae, while the neurological and cardiovascular examinations were normal. The patient's vital signs were stable, with a blood pressure of 130/82 mmHg, a heart rate of 71 bpm, a temperature of 36.6°C, and a respiratory rate of 16 breaths per minute. The patient's weight was 82 kg, and his height was 1.66 m. Laboratory investigations showed severely elevated fasting blood glucose (410 mg/dL, reference range 65-107 mg/dL), slightly raised urea (53 mg/dL, reference range 15-44 mg/dL), elevated alkaline phosphatase (155 U/L, reference range 30-120 U/L), and hemoglobin A1c of 10.5% (reference range 4.0%-6.5%).

Many laboratory investigations were done to exclude secondary causes of osteoporosis, including assessments of thyroid function (TSH, free T3, and free T4), parathyroid hormone levels, morning cortisol, 25-hydroxy-vitamin D, calcium, and phosphate. All results fell within normal ranges, thereby excluding endocrine or metabolic disorders typically linked to secondary osteoporosis. Furthermore, there was no documented history of chronic corticosteroid use, gastrointestinal malabsorption syndromes, or other systemic diseases recognized as contributing factors to osteoporosis.

The thoracic magnetic resonance imaging (MRI) revealed an acute phase of compression fracture on the D12/L1 vertebrae (Figures 1 and 2).

The patient was treated with a single dose of zoledronic acid (4 mg/mL), bisphosphonate therapy, and pain medication. After 6 months, his HbA1c had improved to 7.3%, and he reported no further back pain, with good overall functional status.

Figure 1. Sagittal magnetic resonance imaging (MRI) of the thoracic spine showing an acute compression fracture at the D12-L1 vertebrae. The imaging highlights vertebral height loss and structural compromise, consistent with osteoporosis-related fragility fractures..The Dual Energy X-ray Absorptiometry (DEXA) scan revealed significant osteoporosis and osteopenia in the hip and lumbar spine (Figure 2). The *T*-scores showed severe osteoporosis and osteopenia in the lumbar spine, with the scores ranging from –3.1 at L1 to –3.5 at L4 and the total lumbar spine. In the hip region, there was moderate osteopenia, with *T*-scores of –1.5 at the femoral neck, –1.1 at the trochanter, and –1.2 for the total hip.

Figure 2. Dual-energy X-ray absorptiometry scan showing significant osteoporosis in the lumbar spine with a *T*-score of –3.5, indicative of severely reduced bone mineral density. These findings highlight the patient's increased susceptibility to fractures, consistent with the diagnosis of diabetes-associated osteoporosis. All these findings support the diagnosis of diabetes-associated osteoporosis as the primary etiology.

Discussion

Vertebral compression fractures (VCFs) are a common complication of osteoporosis, with an estimated 25% of postmenopausal women and 12% of men over the age of 50 affected.[1] In diabetic populations, the prevalence of VCFs is notably higher, ranging from 30% to 40%, depending on glycemic control and associated complications.[10] The occurrence of VCFs in younger individuals, particularly those with uncontrolled diabetes mellitus, is less frequently reported in the literature. This case report provides valuable insights into the pathophysiology, diagnostic approach, and management of VCFs in a middle-aged patient with poorly controlled diabetes.

Diabetes mellitus is a well-established risk factor for the development of osteoporosis and fragility fractures.[2] Chronic hyperglycemia can lead to the formation of advanced glycation end-products (AGEs), which impair the structural and material properties of bone, resulting in decreased bone strength and increased fracture risk.[3] Diabetic neuropathy and retinopathy may contribute to an increased risk of falls, further exacerbating the likelihood of fractures in this patient population.[4]

Diabetes significantly impacts bone metabolism by disrupting the balance between osteoblasts and osteoclasts. Chronic hyperglycemia leads to the formation of advanced glycation

end-products (AGEs), which impair osteoblast activity and promote osteoclast-mediated bone resorption, resulting in weakened bone structure.[10] Additionally, diabetes alters calcium and vitamin D homeostasis, reducing their availability for bone mineralization. Hyperglycemia decreases bone quality by impairing vascularity and collagen integrity, while hypoglycemia increases the risk of falls due to neurocognitive impairment and postural instability. These combined effects heighten fracture susceptibility in individuals with diabetes, emphasizing the need for glycemic control and bone health optimization to mitigate risks.[10]

The recurrent episodes of hypoglycemia experienced by this patient may have also played a role in the development of his vertebral fracture. Hypoglycemia has been associated with an elevated risk of falls and fractures, likely due to the neurocognitive impairment and increased postural instability that can occur during episodes of low blood glucose.[5,6] A study by Schwartz et al found that older adults with diabetes had a higher risk of falls and fractures compared to those without diabetes, and that this risk was further increased in those with poor glycemic control.[5,11] These findings underscore the intricate relationship between glycemic variability and fracture susceptibility, which is particularly relevant in this case. Additionally, long-standing diabetes disrupts the balance of osteoclast and osteoblast activity, further impairing bone metabolism and contributing to osteoporosis.

Emerging evidence highlights the profound impact of diabetes on bone health and fracture outcomes.[11,12] demonstrated that diabetes, particularly in the presence of poor glycemic control, significantly increases fracture risk and adversely affects post-fracture recovery. Elevated HbA1c levels not only impair bone remodeling through reduced osteoblastic activity but also hinder fracture healing due to the accumulation of AGEs, which disrupt bone matrix quality and vascularity. These findings reinforce the importance of optimizing glycemic control as part of a comprehensive approach to fracture prevention and management in diabetic patients.

In this case, the patient's suboptimal glycemic control likely contributed to both the initial fracture risk and the challenges in managing osteoporosis. This underscores the need for a multidisciplinary approach, integrating diabetes management with osteoporosis care to address the multifactorial risks present in such cases. Additionally, maintaining adequate dietary calcium (1000-1200 mg/day) and vitamin D (800-1000 IU/day), as recommended by the Belgian Bone Club and others, plays a crucial role in bone health. Patients should also consume calcium-rich foods such as dairy products and leafy greens, along with weight-bearing exercises to strengthen bones and prevent further fractures.

The use of dual-energy X-ray absorptiometry (DEXA) imaging was crucial in this case, as it revealed significant osteoporosis and osteopenia in the patient's lumbar spine and hip. DEXA remains the gold standard for the diagnosis of osteoporosis and assessment of fracture risk, providing valuable information on bone mineral density (BMD) and *T*-scores.[7] The *T*-scores obtained from the DEXA scan, which ranged from −1.1 to −3.5, clearly demonstrated the patient's compromised bone health and increased susceptibility to fractures.

The management of this patient involved a multidisciplinary approach, including endocrinology, diabetology, and neurology consultations. This comprehensive strategy is in line with the recommended management of patients with osteoporosis and associated comorbidities, as outlined in the American Association of Clinical Endocrinologists (AACE) and American College of Endocrinology (ACE) clinical practice guidelines.[8] The initiation of bisphosphonate therapy, along with adequate pain management and strict glycemic control, was an appropriate treatment strategy.

Bisphosphonates have been shown to be effective in reducing the risk of future vertebral fractures in patients with osteoporosis.[9] The mechanism of action of bisphosphonates involves the inhibition of osteoclast-mediated bone resorption, leading to an overall increase in bone mass and a decrease in fracture risk. Furthermore, the patient's compliance with the prescribed treatment regimen and lifestyle modifications, such as maintaining a healthy diet and engaging in weight-bearing exercises, would have been crucial in improving his overall bone health and reducing the risk of future fractures.[13]

Optimizing glycemic control played a pivotal role in reducing the risk of future fractures in this patient. Strict regulation of blood glucose levels and the prevention of hypoglycemic episodes are essential to mitigating fracture risks in diabetic populations. Moreover, lifestyle modifications, including weight-bearing exercises, a balanced diet rich in calcium and vitamin D, and adherence to the prescribed treatment regimen, are critical for improving long-term outcomes.[14,15] Emerging therapies, such as anabolic agents (eg, teriparatide or romosozumab), may hold promise for managing osteoporosis in patients with diabetes, particularly those with severe bone fragility. Future research should explore the interplay between glycemic control, bone health, and fracture healing to inform more targeted therapeutic strategies.[11,14,15]

Conclusion

Diabetes has a negative impact on bone health, increasing the risk of osteoporotic fractures in those with the illness. Good management, adequate amounts of calcium, & vitamin D, fruits and vegetables that are rich in these elements, as well as bone strengthening exercises are crucial. Comprehensive methods that include routine screening, Comprehensive methods that include routine screening, preventive measures, and targeted pharmaceutical therapies are required to address this substantial clinical challenge and reduce the incidence of fractures and associated disability in the diabetic community.

Declarations

Ethical Considerations

The case report was approved by Palestine Polytechnic University.

Consent for Publication

The participant provided written informed consent for the publication of the case report and any accompanying images.

Author Contributions

Zeina Sheeb: Writing - review & editing. Mays Najjar: Writing - original draft. Neveen Shalalfa: Supervision; Writing - original draft. Saleh Shalalfa: Resources. Ahmad Barakat: Resources.

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Data Availability

All data supporting the findings of this study are readily available within the article. Our patient provided informed, written consent. Palestine polytechnic university gave the ethical approval.

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