Journal of Pre-Clinical and Clinical Research 2024, Vol 18, No 2, 124-127
www.jpccr.eu

CASE REPORT

Painless stress fractures of the foot in the course of poorly controlled type 1 diabetes – case report

Karolina Rogowska[1,A–F]✉, Katarzyna Pochodowicz[1,A,D], Julia Zawistowska[2,D–E], Angelina Lęgas[3,D], Joanna Smalira[1,D], Weronika Rogala[1,D], Bartosz Przybysz[4,D], Jakub Kawalec[5,D], Weronika Rutkowska-Kawalec[6,D], Tomasz Gromotowicz[1,A,D,F]

[1] *Praski Hospital, Warsaw, Poland*
[2] *Voivodeship Hospital in Bialystok, Poland*
[3] *University Clinical Centre, Medical University, Warsaw, Poland*
[4] *Bielański Hospital in Warsaw, Poland*
[5] *Specialist Hospital for Pulmonary Diseases, Zakopane, Poland*
[6] *Tytus Chałubiński Regional Hospital, Zakopane, Poland*
A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation, D – Writing the article, E – Critical revision of the article, F – Final approval of the article

Rogowska K, Pochodowicz K, Zawistowska J, Lęgas A, Smalira J, Rogala W, Przybysz B, Kawalec J, Rutkowska-Kawalec W, Gromotowicz T. Painless stress fractures of the foot in the course of poorly controlled type 1 diabetes – case report. J Pre-Clin Clin Res. 2024; 18(2): 124–127. doi: 10.26444/jpccr/188213

Abstract

This case report describes a 33-year-old woman with type 1 diabetes mellitus complicated by peripheral neuropathy, who developed recurrent painless stress fractures in both feet. The patient's poorly controlled blood glucose levels likely contributed to severe neuropathy and increased fracture risk. While fractures in diabetics are often associated with Charcot's foot (painful), this case highlights the possibility of painless stress fractures due to sensory neuropathy. The case also addresses the issue of skeletal abnormalities that can occur in the course of type 1 diabetes. Understanding the relationship between painless stress fractures of the foot and poorly controlled diabetes underscores the importance of early diagnosis and proper glycaemic control of type 1 diabetes mellitus to prevent such complications.

Key words

diabetic neuropathy, type 1 diabetes mellitus, complications of diabetes, uncontrolled diabetes, stress fractures

INTRODUCTION

Diabetes is a metabolic disease that is becoming increasingly prevalent and is now one of the most common chronic health problems. Its incidence is constantly rising, leading to a growing number of people struggling with complications related to it. Neuropathy is one of the most common chronic complications of diabetes, caused by high blood glucose levels, and can affect up to 70% of patients with metabolic disorders of glucose regulation. Diabetes is most frequently associated with distal, symmetrical sensory-motor polyneuropathy [1].

Mid-foot deformations can result from fractures caused by Charcot neuropathy, which is a typical consequence of poorly managed diabetes and peripheral neuropathy [2]. The soft tissues, joints, and bones of the foot are all impacted by the sterile inflammatory process known as Charcot's disease. If left untreated, the damage to these structures can progress to fractures and dislocations, ultimately leading to foot deformities [3].

Type 1 diabetes can be a cause of osteoporosis because it is associated with low bone mineral density [4, 5]. Therefore, it is important to remember that people suffering from it have an increased risk of bone fractures. Risk factors include glycosylated haemoglobin (HbA1c) levels above 8% and diabetes duration exceeding 10 years [6]. Development of optimal bone density, structure, and strength in paediatric patients with T1D is impaired [7]. As a result, there is a higher chance of incident fracture that start in childhood and lasts throughout the entire lifetime. Individuals diagnosed with type 1 diabetes experienced a significantly higher incidence of fractures to their lower extremities [8].

Foot fractures in the course of diabetes are usually associated with Charcot's disease, and are most commonly painful, despite advanced neuropathy [1].

Stress fractures are small cracks in bones caused by repetitive, low-impact forces. While often associated with athletes, stress fractures can also occur in individuals with underlying medical conditions, such as diabetes mellitus. Diabetic neuropathy and microvascular insufficiency can contribute to impaired bone health and increased susceptibility to stress fractures [9].

Although painful fractures related to Charcot's foot are the most common type of fracture in diabetes, stress fractures, which might be painless, should always be considered in patients with diabetes complicated by sensory neuropathy [1].

The case study discusses a patient diagnosed with type 1 diabetes mellitus and peripheral neuropathy, who experienced recurrent painless stress fractures in both feet.

✉ Address for correspondence: Karolina Rogowska, Praski Hospital, Warsaw, Poland
E-mail: karokarolina.rogowska@gmail.com

Received: 08.04.2024; accepted: 25.04.2024; first published: 16.05.2024

CASE REPORT

A 33-year old female patient presented to the orthopaedic clinic with painless swelling in her left foot. Months prior, she received a diagnosis of stress fractures in the fourth and fifth metatarsals of the same foot. Her medical history included type 1 diabetes mellitus (poorly controlled with insulin injections), which she has had for approximately 14 years, complicated by simple retinopathy, gastropathy and neuropathy. The patient takes Insulin NovoRapid 14 units before main meals and Insulin Toujeo 18–20 units at 22:00. Six months earlier, she had been hospitalized for decompensation of type 1 diabetes with a blood glucose level of 2020 mg/dL, glycated haemoglobin of 14, renal failure, metabolic acidosis, and microcytic anaemia. In her medical history, there had earlier been increased glucose blood levels (500mg/dL). The patient's BMI is within the normal range. The patient has confirmed gastric ulcers and has experienced gastric ulcer bleeding. Additionally, she is diagnosed with depression. There are no other known medical conditions, and she is not taking any medications other than insulin and vitamin D3 supplementation.

Neuropathy was diagnosed based on a clinical examination. The patient exhibits diminished pain sensation as well as decreased superficial sensation in both feet. She is not currently on any neuropathy medications. Vitamin D levels are normal. Her profession requires extensive walking. Physical examination in the clinic revealed swelling and redness of the left foot. X-ray imaging revealed a recently formed fracture of the second metatarsal bone of the left foot (Fig. 1).

Figure 1. Left foot, new fracture of the second metatarsal bone and healing fractures of the fourth and fifth metatarsal bones

Two months later, the patient returned with swelling in both feet. Sensory testing revealed impaired pain and touch sensation in both feet. No other abnormalities were identified. The patient reported no pain. X-ray imaging showed healing of the previously fractured second, fourth, and fifth metatarsals of the left foot, a new fracture in the third metatarsal bone (without significant

Figure 2. Left foot, new fracture of the third metatarsal bone

Figure 3. Right foot, new fracture of the fourth metatarsal bone and healing fractures of the second, fourth, and fifth metatarsal bones

Figure 4. Left foot, healing fractures of the second, third, fourth, and fifth metatarsal bones

Figure 5. Right foot, new subcapital fracture of the third metatarsal bone, healing fracture of the fourth metatarsal bone

displacement) of the left foot (Fig. 2), and a fracture of the fourth metatarsal bone in the right foot (Fig. 3). Off-loading of the foot and use of a Walker ankle-foot orthosis were recommended. One month later, follow up X-ray imaging revealed healing of multiple fractures at various stages, and complete resolution of the swelling. During the follow-up visit, in addition to the previously mentioned healed fractures in the left foot (second, third, fourth, and fifth metatarsals) and the healed fourth metatarsal fracture in the right foot, an X-ray showed a new fracture – a subcapital fracture of the third metatarsal bone in the right foot (Fig. 4, 5). Examination showed swelling in the right foot, normal blood flow in the lower limbs, and persistently impaired superficial sensation in both feet. The fracture was asymptomatic. The patient did not undergo the ordered follow-up laboratory tests. All fractures, classified as stress fractures, healed without the formation of any foot deformities.

DISCUSSION

The rising prevalence of diabetes and prediabetes is associated with an increasing number of complications related to these conditions. One of the most common complications is neuropathy. Distal symmetric polyneuropathy, the most common type of diabetic neuropathy, is characterized by a particular distribution of symptoms that mimic wearing 'socks and gloves', with the hands and lower extremities being most commonly affected [10]. Sensory axons are afflicted more commonly than motor axons [1].

The presence of at least one non-sensory region in both feet indicated the existence of peripheral neuropathy [11]. Factors that influence the development of diabetic neuropathies include poorly controlled blood glucose levels resulting in persistent hyperglycaemia, microvascular dysfunction, oxidative and nitrosative stress, flawed neurotropism, and immune-mediated neuropathies [12]. The main symptoms are pain and a tingling sensation in the affected area; feelings of burning and numbness can also occur. In the final stages, patients develop weaker reflexes, muscle atrophy, and decreased sensation [1]. While many patients with documented diabetic neuropathy may be clinically asymptomatic, there is a risk of damage to their feet caused by the lack of feeling [13]. Due to the increased fall risk caused by diabetic neuropathy, it is a substantial risk factor for the incidence of fractures in both males and females [8, 10].

In addition, reduced bone mineral density is a characteristic of type 1 diabetes, and it has a greater detrimental effect on the bones than type 2 diabetes. Skeletal abnormalities can also arise, with varying changes in indicators of bone resorption and decreasing markers of bone production. All those factors result in an increased risk of bone fractures throughout life [4, 8].

The patient described above had several risk factors associated with fractures, including late diagnosed, poorly controlled, and prolonged type 1 diabetes, which led to many complications, such as diabetic neuropathy. The patient's glycated haemoglobin level was 14%. A 1% increase in HbA1c is associated with a 5% and 11% higher risk of fracture in men and women, respectively [8]. Both the length of time someone has diabetes and their HbA1c levels are strong indicators of increased risk of developing diabetic neuropathy. This highlights the importance of achieving good glycaemic control in type 1 diabetes mellitus, as it can effectively prevent or slow down nerve damage [10, 14].

Charcot neuroarthropathy (CN), a specific form of diabetic foot, is a chronic complication of diabetes which occurs in patients with sensory neuropathy, and manifests as bone and joint destruction [15, 16]. Swelling, warmth, and redness of the foot are characteristic symptoms that indicate that active Charcot neuroarthropathy should be considered. Diagnosis is based on clinical features, medical imaging, and excluding other potential causes [3]. Compared to diabetic individuals without Charcot joint disease, those with Charcot neuroarthropathy are more likely to experience fractures and osteoporosis [15]. However, in the absence of the Charcot foot, people with type 1 diabetes may also experience significant bone changes, increasing the risk of fractures [7].

Stress fractures are most common in athletes and present with severe pain and swelling. They result from repetitive microtraumas leading to progressive bone damage until a fracture occurs. This typically happens to individuals who regularly engage in intense physical activity without allowing for adequate rest and recovery. Low bone mineral density (BMD) increases the risk of stress fractures, which most commonly affect the metatarsals [9].

In the presented patient, no diagnosis was made of Charcot neuroarthropathy. Although her employment required intensive walking for many hours daily, the only symptom of the fractures was swelling and she experienced painless stress fractures due to severe sensory neuropathy.

In diabetic patients with advanced sensory neuropathy, stress fractures should always be considered in the differential diagnosis of painless foot swelling, in addition to Charcot neuroarthropathy [1].

CONCLUSION

Maintaining proper blood glucose levels is the most important element of diabetes treatment, as proper glycaemic control reduces the risk of complications. It is important to consider

that fractures can occur in patients with diabetes, especially in type 1 diabetes, where the risk is increased due to bone disorders.

Foot fractures are often associated with a specific form of diabetic foot syndrome called Charcot's foot, which is characterized by pain. On the other hand, painless fractures in patients with advanced sensory neuropathy may suggest stress fractures. The presence of non-painful swelling of the foot in the absence of a history of injury, especially in a patient with poorly controlled type 1 diabetes, should always be an indication for X-ray imaging of the affected joint to rule out a stress fracture that occurred in the course of severe sensory neuropathy, without coexisting Charcot's neuroarthropathy.

REFERENCES

1. Oleszko M, Fularska K, Kuźniar A, Szawica D, Wąsiewicz E, Bernacki R, Bernacki P, Dutka M, Zardzewiały W. Neuropathy and neuroarthropathy as a complication of diabetes and other diseases, with particular emphasis on painless fractures – a review of the literature. Journal of Education, Health and Sport. 2023;25(1):75–82. eISSN 2391-8306. doi:10.12775/JEHS.2023.25.01.007
2. Davis BL, Tiell SM, McMillan GR, Goss LP, Crafton JW. Simple model of arch support: Relevance to Charcot Neuroarthropathy. Clin Biomech (Bristol, Avon). 2021 Jul;87:105403. doi:10.1016/j.clinbiomech.2021.105403. Epub 2021 May 29. PMID: 34091194; PMCID: PMC8316300
3. Schaper NC, van Netten JJ, Apelqvist J, Bus SA, Fitridge R, Game F, Monteiro-Soares M, Senneville E; IWGDF Editorial Board. Practical guidelines on the prevention and management of diabetes-related foot disease (IWGDF 2023 update). Diabetes Metab Res Rev. 2024 Mar;40(3):e3657. doi:10.1002/dmrr.3657. Epub 2023 May 27. PMID: 37243927
4. Schwartz AV, Lane NE. Bone and Joint Complications in Diabetes. In: Cowie CC, Casagrande SS, Menke A, Cissell MA, Eberhardt MS, Meigs JB, Gregg EW, Knowler WC, Barrett-Connor E, Becker DJ, Brancati FL, Boyko EJ, Herman WH, Howard BV, Narayan KMV, Rewers M, Fradkin JE, editors. Diabetes in America. 3rd ed. Bethesda (MD): National Institute of Diabetes and Digestive and Kidney Diseases (US); 2018 Aug. CHAPTER 32. PMID: 33651567
5. Zerikly R, Demetriou EW. Use of Fracture Risk Assessment Tool in clinical practice and Fracture Risk Assessment Tool future directions. Womens Health (Lond). 2024 Jan-Dec;20:17455057241231387. doi:10.1177/17455057241231387. PMID: 38529935; PMCID: PMC10966972
6. American Diabetes Association Professional Practice Committee. 4. Comprehensive Medical Evaluation and Assessment of Comorbidities: Standards of Care in Diabetes-2024. Diabetes Care. 2024 Jan 1;47(Suppl 1):S52–S76. doi:10.2337/dc24-S004. PMID: 38078591; PMCID: PMC10725809
7. Beeve AT, Brazill JM, Scheller EL. Peripheral Neuropathy as a Component of Skeletal Disease in Diabetes. Curr Osteoporos Rep. 2019 Oct;17(5):256–269. doi:10.1007/s11914-019-00528-8. PMID: 31392667; PMCID: PMC6817763
8. Weber DR, Haynes K, Leonard MB, Willi SM, Denburg MR. Type 1 diabetes is associated with an increased risk of fracture across the life span: a population-based cohort study using The Health Improvement Network (THIN). Diabetes Care. 2015 Oct;38(10):1913–20. doi:10.2337/dc15-0783. Epub 2015 Jul 27. PMID: 26216874; PMCID: PMC4580610
9. Paavana T, Rammohan R, Hariharan K. Stress fractures of the foot – current evidence on management. J Clin Orthop Trauma. 2024 Feb 22;50:102381. doi:10.1016/j.jcot.2024.102381. PMID: 38435398; PMCID: PMC10904895
10. Feldman EL, Callaghan BC, Pop-Busui R, Zochodne DW, Wright DE, Bennett DL, Bril V, Russell JW, Viswanathan V. Diabetic neuropathy. Nat Rev Dis Primers. 2019 Jun 13;5(1):41. doi:10.1038/s41572-019-0092-1. PMID: 31197153
11. Wu C, Wu Z, Chen Y, Xu H, Li K. The relationship between dietary phosphorus and peripheral neuropathy in the general population of the United States: A preliminary research. PLoS One. 2024 Mar 15;19(3):e0299566. doi:10.1371/journal.pone.0299566. PMID: 38489279; PMCID: PMC10942028
12. Galiero R, Caturano A, Vetrano E, Beccia D, Brin C, Alfano M, Di Salvo J, Epifani R, Piacevole A, Tagliaferri G, Rocco M, Iadicicco I, Docimo G, Rinaldi L, Sardu C, Salvatore T, Marfella R, Sasso FC. Peripheral Neuropathy in Diabetes Mellitus: Pathogenetic Mechanisms and Diagnostic Options. Int J Mol Sci. 2023 Feb 10;24(4):3554. doi:10.3390/ijms24043554. PMID: 36834971; PMCID: PMC9967934
13. Pop-Busui R, Boulton AJ, Feldman EL, Bril V, Freeman R, Malik RA, Sosenko JM, Ziegler D. Diabetic Neuropathy: A Position Statement by the American Diabetes Association. Diabetes Care. 2017 Jan;40(1):136–154. doi:10.2337/dc16-2042. PMID: 27999003; PMCID: PMC6977405
14. Hicks CW, Selvin E. Epidemiology of Peripheral Neuropathy and Lower Extremity Disease in Diabetes. Curr Diab Rep. 2019 Aug 27;19(10):86. doi: 10.1007/s11892-019-1212-8. PMID: 31456118; PMCID: PMC6755905
15. Rabe OC, Winther-Jensen M, Allin KH, Svendsen OL. Fractures and Osteoporosis in Patients With Diabetes With Charcot Foot. Diabetes Care. 2021 Sep;44(9):2033–2038. doi:10.2337/dc21-0369. Epub 2021 Jul 27. PMID: 34315699
16. Dardari D. An overview of Charcot's neuroarthropathy. J Clin Transl Endocrinol. 2020 Oct 28;22:100239. doi:10.1016/j.jcte.2020.100239. PMID: 33251117; PMCID: PMC7677697