CASE REPORT

Conservative treatment in a patient with diabetic osteomyelitis: antibiotic treatment is sufficient for complete bone regeneration in selected cases

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SUMMARY

Diabetic foot ulcers are commonly complicated by bone involvement and osteomyelitis. Diagnosing diabetic osteomyelitis can be problematic. However, positive findings at clinical examination and X-ray may set the diagnosis. Recent guidelines suggest that selected cases of diabetic osteomyelitis can be treated conservatively with antibiotics. We report on the successful treatment of a 52-year-old man with diabetes with osteomyelitis in the distal phalanx of a toe. On X-ray, the affected phalanx appeared completely eroded. However, regeneration of the bone tissue was observed following outpatient treatment with antibiotics. We therefore encourage doctors to provide conservative treatment for selected cases of diabetic osteomyelitis.

INVESTIGATIONS

General examination revealed the presence of sensory neuropathy in both feet, as detected by a 10 g monofilament (Semmes-Weinstein) test. Examination of the toe revealed the presence of oedema, calor and desquamation of the skin around the ulcer (figure 1), and probe-to-bone test was positive. Ankle and toe blood pressure, determined by strain-gauge technique, were within the normal range (ie, ankle-brachial index 1.17 and toe-brachial index 0.78 on the right side). No blood samples were taken. Routine screening for methicillin-resistant *Staphylococcus aureus* (MRSA) was negative. *S. aureus* infection was detected from a swab culture, and osteomyelitis diagnosis was confirmed by X-ray showing complete erosion of the distal phalanx of the third toe (figure 2).

BACKGROUND

Osteomyelitis affects 15–20% of patients presenting with a diabetic foot ulcer.^{1 2} Bone biopsy is the gold standard for diagnosis, although this modality is not without problems regarding specificity and sensitivity.¹ However, osteomyelitis can also be diagnosed by a combination of clinical examination (infectious ulcer, visible bone, positive probe-to-bone) and presence of characteristic signs on plain radiograph.¹ In medical centres encountering high prevalence of osteomyelitis, these simple and non-expensive investigations can be used to establish or exclude osteomyelitis in non-acute wounds, with excellent positive and negative predictive values.³ Traditionally, treatment of diabetic osteomyelitis involves surgical removal of infected and necrotic bone.² We demonstrate that selected cases of diabetic osteomyelitis can be treated conservatively with antibiotics to achieve complete bone regeneration and functional recovery.

DIFFERENTIAL DIAGNOSIS

Cellulitis, gouty arthritis, malignancy and cholesterol embolism could be considered as differential diagnoses. However, the patient had no record of gout and cholesterol embolism was considered less likely. Bone contact at ulcer base and X-ray examination confirmed that bone was involved by the infection. The patient responded adequately to antibiotic treatment and there was no suspicion of malignancy.

CASE PRESENTATION

A 52-year-old man with type 2 diabetes mellitus presented with a painful ulcer on the right third toe, of 1-month duration. We obtained a full medical history in which the patient reported general well-being and no symptoms except a history of fever, 2 weeks earlier, with a maximum temperature of 38°C. However, the fever had resolved spontaneously and the patient had not experienced fever within the past week. At the visit to our clinic, the patient showed no clinical signs of systemic inflammatory response.

Figure 1 Clinical presentation of the patient's foot ulcer with underlying osteomyelitis.

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Figure 2 Left picture: no cortical bone of the distal phalanx on the right third toe is visible on X-ray prior to antibiotic treatment. Right picture: following 3 months antibiotic (flucloxacillin) treatment, the distal phalanx of the third toe is completely regenerated.

TREATMENT

The patient received outpatient-based conservative treatment, which included locally administered gentamicin and oral flucloxacillin.

OUTCOME AND FOLLOW-UP

At 1 week, there was no bone contact at the ulcer base and the patient reported pain relief. Local administration of gentamicin was discontinued but the patient agreed to continue oral antibiotics for 12 weeks. At 3-month follow-up, the patient reported complete functional recovery and, on clinical examination, the ulcer had completely healed and no signs of residual infection were detectable. Follow-up X-ray revealed regeneration of the distal phalanx of the third toe and complete resolution of bone erosions (figure 2).

DISCUSSION

The present patient fulfils all clinical and radiographic criteria of osteomyelitis. Our choice of antibiotics may be criticised as being guided exclusively by a swab culture since concordance between swab and bone culture is <50%.⁴ However, as reported by Malone *et al*,⁵ performing a deep wound swap with contact to bone surface can improve concordance and is an alternative in cases where bone biopsy is not available. Using a deep sampling technique, we established a high probability for a relevant microbiological agent in our patient.

We combined oral antibiotics with locally administered gentamicin and this could have had additional influence on resolving the infection. Local gentamicin was applied for provisional safety as long as the microbiological agent's sensitivity to flucloxacillin was undetermined and as long as the ulcer stayed connected to bone tissue (ie, the first week of therapy). Our choice of antibiotic regimen was based on previous experience and, in Denmark, flucloxacillin is considered the drug of choice for empirical treatment of infected diabetic foot ulcers. This might not be in accordance with the recommendations in other countries and attention should be brought to this issue when

interpreting the result of this case report. In areas with a high frequency of MRSA, long-term antibiotic therapy could become a more complex matter.

It is important to note that sepsis was not suspected in this patient. Oral antibiotic treatment would never have been considered in an individual with systemic manifestations, and under such circumstances the patient would have been hospitalised. International guidelines recommend taking blood samples in patients with suspected osteomyelitis and it could be considered a weakness in our approach that this was not performed.

We found sensory neuropathy in the patient, as detected by a monofilament test. Nonetheless, the patient reported ulcer-related pain and, seemingly, sensibility was not completely absent. In patients with diabetes with insensitive feet, it is a well-known fact that the development of Charcot arthropathy can lead to pain of variable degree. We suggest that the influence of diabetic neuropathy on A- β fibres (touch), A- δ fibres (pain) and C fibres (pain) is heterogeneous, explaining the discrepancy between sensation of light touch and sensation of pain in the present patient.

Our conservative approach was sufficient to resolve infection. There is, however, a lack of consensus on whether patients with osteomyelitis may benefit from conservative treatment in contrast to surgery. Recent literature corroborates our finding of antibiotics as first-line treatment—especially for small forefoot lesions and in cases where surgery leads to destabilisation of foot mechanics.² To further substantiate this, Tone *et al*⁶ found 6 and 12 weeks of antibiotic therapy to be equally effective in osteomyelitis.

One remarkable aspect of our case story is the complete regeneration of the distal phalanx of the third toe. Several mechanisms of staphylococcal osteomyelitis explain the loss of mineralisation.⁷ Infiltrating inflammatory leucocytes release a large number of proteolytic enzymes dissolving bone mineral. *S. aureus* infection leads to increased production of inflammatory cytokines, altering the balance between osteoblastic and osteoclastic cell functions, thus inhibiting bone formation and enhancing bone resorption.⁷ Subsequent to antibiotic treatment, our patient regenerated the distal phalanx with regular shape and

full mineralisation. It is plausible that surviving quiescent osteoblastic stem cells have initiated bone formation and mineralisation. Our results demonstrate that, in cases of diabetic osteomyelitis, bone destruction may be reversible. One previous report has suggested possible bone tissue regeneration following treatment of osteomyelitis in children.⁸ Our case report extends these findings to adults and demonstrates that relevant antibiotic therapy and wound care can be sufficient for bone tissue regeneration.

Learning points

- Combination of clinical examination and X-ray yields a high positive predictive value for the diagnosis of diabetic osteomyelitis.
- Perception of pain can be triggered in diabetic sensory neuropathy, suggesting various levels of the disease entity and sparing of A- δ and/or C fibres.
- Selected cases of diabetic osteomyelitis can be treated conservatively with antibiotics.
- Bone tissue may regenerate following antibiotic treatment of diabetic osteomyelitis.

Contributors All the authors contributed to writing the case report. KY and JF cared for the patient.

Competing interests None declared.

Patient consent Obtained.

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