



Case report

Calcium sulphate as a drug delivery system in a deep diabetic foot infection



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HIGHLIGHTS

- Calcium sulphate as a drug delivery system is an effective adjunct in deep diabetic foot infection.
- Local application produces high antimicrobial concentration at the site of infection.
- When given in isolation local application reduces potential toxicity compared to other routes.
- This method of administration can reduce costs and reduce reliance on patient adherence.

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ABSTRACT

Treating diabetic foot infection is costly, time consuming and challenging for the patient and clinician alike. It requires a multidisciplinary approach to provide a favourable outcome but all too often results in amputation.

We present a patient with Type 2 diabetes who attended clinic with a limb threatening foot infection complicated by osteomyelitis and requiring emergency surgery and antibiotic administration.

Our patient underwent surgery by means of an incision and drainage procedure with local antibiotic administration to augment systemic antibiotics. The wound was packed with calcium sulphate (Stimulan® Biocomposites Ltd.) impregnated with gentamicin and vancomycin to enable high antibiotic concentrations at the site of infection. The patient made a full recovery at four months requiring only minimal bone excision to maintain a functional foot.

This case demonstrates an alternative route for antibiotic administration to overcome some of the limitations of systemic administration including penetration at the site of infection, systemic toxicity, prolonged hospital admission and cost. This route of administration is being increasingly used as an alternative to systemic antibiotics at our centre.

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1. Introduction

Osteomyelitis is an infective process in bone accompanied by bone destruction [1] and characterised by substantial morbidity [2]. It presents significant therapeutic difficulties [3] usually requiring a multidisciplinary approach [4] with the goal of treatment to eradicate infection, promote repair of skeletal defects, heal offending wounds and restore function [3,5,6]. Treatment usually requires combined surgical debridement and appropriate antimicrobial therapy [3,7].

Systemic antibiotics however are often ineffective [8] even after prolonged intravenous treatment and recurrence of infection is not

uncommon [6]. Efficacy of systemic antibiotics may be limited by impaired blood flow of infected bone [7] and bacterial strains forming biofilms leading to actual or apparent resistance [5,6]. Long term duration and high doses of antibiotics whether parenteral or oral are also associated with severe adverse effects [5,6,9] including systemic toxicity with liver and renal impairment [10]. Furthermore increased costs and lack of patient adherence are further disadvantages to long term antimicrobial therapy [6]. Surgical debridement meanwhile of non-viable infected bone and soft tissue can leave large defects resulting in dead space [7] with loss of function.

Local administration of antibiotics have been used as an adjunctive therapy to oral and parenteral antibiotics [4] and in some cases as a viable alternative [5,6]. Drug delivery systems in the form of bone void fillers have been shown to produce prolonged high concentrations at the site of infection, minimise systemic levels [5,7], eliminate concerns with regards to antibiotic penetration [6] and fill dead space [7].

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Fig. 1. Plantar ulcer and source of infection.

In this case study we demonstrated the use of a synthetic, biodegradable and biocompatible form of calcium sulphate (CS) as a drug delivery system to treat a deep diabetic foot infection complicated by osteomyelitis.

2. Case report

A 52 year old male patient with Type 2 diabetes of 19 years duration with controlled hypertension and hypercholesterolaemia was referred from the diabetes specialist podiatrist for immediate assessment due to a limb threatening foot infection. The diabetologist had counselled the patient with regards to the likelihood of amputation.

The patient presented with an eight month history of recurrent plantar ulceration to left foot (Fig. 1) measuring 8 mm × 6 mm and probing to the third metatarsophalangeal joint. The lesion had deteriorated significantly in the last few days with abscess formation evident both clinically (Fig. 2) and sonographically (Fig. 3). Plain radiographs demonstrated osteomyelitis of the third metatarsal head and base of the proximal phalanx (Fig. 4).

The patient felt generally well, there was no pyrexia. However, further observations demonstrated tachycardia with an elevated pulse of 106 (60–100) along with elevated random blood glucose levels of 11 mmols/L. Vascular status revealed bounding biphasic posterior tibial and dorsalis pedis pulses while neurological testing demonstrated profound peripheral neuropathy with no ability to appreciate a 10 g monofilament or vibration sensation within the foot.

Drug history revealed ramipril, doxazosin, simvastatin and exenatide to control comorbidities. The patient was further prescribed oral ciprofloxacin 750 mg twice daily and clindamycin 600 mg three times daily for the infection based on previous microbiology results which identified a polymicrobial infection including *Staphylococcus aureus*, group B *Streptococcus*, *Enterococcus faecalis* and *Pasteurella multocida*.



Fig. 2. Formation of abscess on dorsal surface of the foot.

Based on clinical and radiographic examination a decision was made to operate immediately under local anaesthesia via ankle blockade. This would involve an incision and drainage, thorough suction irrigation and packing with CS beads impregnated with vancomycin and gentamicin.

A longitudinal incision over the second intermetatarsal space of the left foot was performed to drain the large abscess of copious pus (Fig. 5). This was followed by sharp and blunt dissection to the third metatarsal and proximal phalanx. This revealed soft brown bone consistent with devitalised tissue. The base of the proximal phalanx and 3 cm of the distal aspect of the third metatarsal were excised back to healthy looking tissue. Soft tissues were examined in the operative area and excised as necessary and sent to microbiology for culture and sensitivity testing. The plantar ulcer was curetted and a sinus was removed which extended dorsally to the abscess.



Fig. 3. Ultrasound demonstrating large collection of pus.

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