Surgical and medical management of a diabetic foot infection in a community setting

Robert Morley, Francis Webb, Sarah Maxwell

The management of complex diabetic foot infections is multifaceted and expensive, often requiring onward referral for admission to acute care. It requires the input and expertise of a multidisciplinary team with access to specialist facilities often resulting in prolonged stays in hospital. The case study outlined in this article demonstrates how adhering to protocols to support referral, assessment and management, as well as multidisciplinary working, can be optimised to treat an urgent diabetic foot infection requiring surgical intervention in a community setting.

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Article points

1. Inpatient care for diabetic foot infections result in increased bed occupancy, prolonged stays in hospital and risk of hospital acquired complications.
2. Managing diabetic foot disease is a financial burden on the NHS and the most common reason for diabetes-specific admission.
3. Effective outpatient care of complex diabetic foot infection requires adherence to protocols, multidisciplinary working and access to specialist facilities.
4. Understanding when to refer on to acute care should underpin the management of diabetic foot complications in the community.
5. The authors present a case study of how a diabetic foot complication requiring surgery can be managed in the community.

Key words

- Diabetic foot infection
- Foot surgery
- Outpatient care

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The financial cost of treating diabetes is great, incorporating the need for structured patient education, blood glucose control and insulin therapy, management of complications and hospital admissions (NICE, 2011a). This costs the NHS £13.8 billion per year, £9 billion of which is attributed to inpatient care (Kanavos et al, 2012) of a total budget of £121 billion (HM Treasury, 2011).

Inpatient care to treat short- and long-term diabetic complications is estimated to cost between £1 800 and £2 500 per patient (Kanavos et al, 2012) with 47% of diabetes-specific admissions due to foot disease (NHS, 2011). This contrasts with outpatient costs, estimated at between £300 and £370 per patient (Kanavos et al, 2012).

The case study illustrated here demonstrates how multidisciplinary working can be optimised to treat a diabetic foot infection requiring surgical intervention in a community setting.

Case report

A 64-year-old man was referred to the authors' podiatric surgery team from a health centre with a 6-week history of right foot plantar second metatarsophalangeal joint (MTPJ) ulceration. The referring podiatrist had requested intervention for the provision of a removable soft cast to aid pressure redistribution, as well as an X-ray to rule out osteomyelitis. The ulcer measured 2 cm × 3 cm and the second toe was dorsally dislocated at the MTPJ. He had undergone surgery 6 years earlier in an acute hospital setting to amputate the third toe at the MTPJ, following an infection.

The patient had been diagnosed with type 2 diabetes more than 30 years earlier. He had previously had two myocardial infarctions and presented with controlled hypertension and asthma, renal disease following an infection 2 years earlier, and an ileostomy following surgery for rectal adenocarcinoma. He had also previously undergone an angioplasty to the contralateral leg for vascular insufficiency and was currently seeing a vascular consultant.

His drug history included insulin (Novorapid®; Novo Nordisk), anti-hypertensives (furosemide, ramipril, nicorandil, and bisoprolol), a beta 2 adrenoceptor agonist inhaler (Ventolin® HFA), and an antimotility drug (loperamide), along with low-dose aspirin and isosorbide mononitrate. Documenting drug history is paramount in understanding the effects they have on the presenting condition, and for reducing the risk of interactions, should antimicrobial therapy be indicated. In addition, it enabled the clinicians to have confidence that the patient's other comorbidities – commonly seen in those with diabetes – were being adequately addressed.

Figure 1. The patient's foot infection demonstrating marked erythema, swelling, and abscess formation.

Figure 2. Intraoperative image of pus being released from the base of the second toe.

No blood tests or blood monitoring were indicated at the initial appointment since there was no clinical evidence of infection, the patient was not on any antimicrobial therapy and a HbA_{1c} (7.4%; 57 mmol/mol), as well as other blood tests, had recently been conducted to provide a baseline.

Vascular assessment demonstrated strong pedal but weak digital pulses following Doppler ultrasound and the pole test (Smith et al, 1994), which confirmed that pulses were still evident at an elevation of 95 cm. Neurological assessment detected widespread diabetic peripheral neuropathy and X-rays were negative for osteomyelitis. A replaceable soft slipper cast was subsequently made to aid pressure redistribution and a 7-day follow-up appointment arranged. Advice was given to the patient to check the foot regularly to ensure the cast was not causing any abrasions or blistering.

At follow-up, the ulcer had reduced in size with no evidence of any complications from the cast. The patient was due to return in a further 3 weeks, following a camping trip, and was advised to monitor his feet closely for clinical changes.

Surgical intervention

On returning from his trip, the patient attended immediately with a 6-day history of an erythemic, oedematous foot with cellulitis extending to the level of the ankle and a palpable swelling on the dorsal aspect of the forefoot (*Figure 1*). He informed the clinician that his blood glucose levels had recently been erratic (14–16 mmol/L), but reported he did not feel unwell.

Observations revealed slight pyrexia (37.9°C) with pulse and blood pressure within normal limits. Deep swabs were taken from the ulcer site and were then placed in charcoal and sent for microbiological culture and sensitivity testing. X-rays demonstrated gas in the soft tissues with no evidence at this stage of osteomyelitis. Bloods were taken including full blood count (FBC), erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), urea and electrolytes (U&Es), liver profile, and HbA_{1c}. The patient was supplied with oral clindamycin (300 mg, four times a day) and ciprofloxacin (750 mg, twice daily), based on the authors' antibiotic protocol algorithm and supplied under a Patient Group Direction (PGD).

A follow-up appointment was arranged for the next day. The patient was advised that if his symptoms deteriorated or he began to feel systemically unwell he should contact a member of the podiatry team via the 24-hour, on-call phone number.

In addition, the consultant diabetologist was informed and prepared to accept the patient via A&E during the night if required. A typed letter was given to the patient to present at A&E, incorporating a full patient and treatment history.

At 24-hour follow-up no improvement was seen in the patient's clinical symptoms and, consequently, the consultant podiatrist decided to perform an incision and drainage procedure in the theatre under local anaesthesia to release the suspected abscess on the dorsal aspect of the forefoot (*Figure 2*). The patient was fully informed and gave his consent.

A dorsal incision over the forefoot was performed to release the pus, which was found to be tracking around the head of the second metatarsal. Subsequently, the second toe and second metatarsal head were excised with other necrotic tissue removed as necessary with tissue samples sent for microbiological culture and sensitivity testing. The plantar ulcer was reduced with sharp debridement and further "milking" of pus was followed by a thorough examination of all the tissues to determine the extent of the infection (*Figure 3*). This was followed by copious irrigation using a total of 1.5 litres of fluid comprising 50% saline and 50% betadine solution.

The dorsal wound was packed using 30 gentamicin beads (Mohanty et al, 2003) followed by loose closure with 4.0 prolene sutures to oppose skin edges. Both the dorsal wound and plantar ulcer were dressed with an alginate, sterile gauze, and a crepe bandage and the patient was given a postoperative shoe to enable limited partial weight-bearing. The patient was advised to continue on oral clindamycin and ciprofloxacin, and was required to attend daily for redressing, observations, and blood monitoring.

Postoperative phase

Twenty-four hours following surgery, the patient had his wound redressed. Erythema and oedema had reduced, there was still no evidence of systemic infection, and observations and blood glucose levels were within normal limits. Blood tests were taken

to determine inflammatory marker levels (CRP and ESR) and district nurses arranged to attend to the patient over the weekend to redress the wound.

The patient was seen on a daily basis for the first 14 days postoperatively for wound redressing. Within this period, inflammation reduced significantly, as did the inflammatory markers CRP (*Figure 4*) and ESR, and blood glucose remained within normal limits. Simultaneously, close liaison was maintained with the microbiology department, which confirmed *Staphylococcus aureus* and *Proteus Sp* infection following culture and sensitivity testing. An increase in oral clindamycin (450 mg, four times a day) was recommended to help ensure bone penetration and oral ciprofloxacin (750 mg, twice daily) for a minimum of 6 weeks.

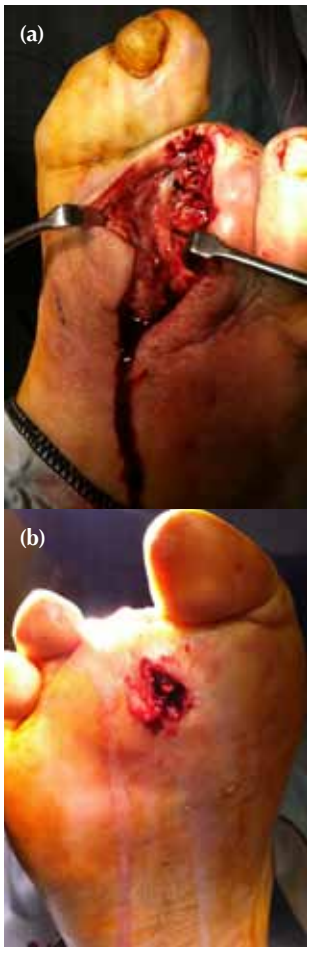
At 1-week postoperatively, however, the patient presented with a mild, but widespread, pruritic rash with subsequent antihistamines arranged via the GP, which proved to be effective. Mild diarrhoea was also evident and a decision was made to change the clindamycin regimen from 450 mg, four times a day, to 600 mg three times a day to help improve tolerance. The patient was also advised on the daily intake of probiotic yoghurts to help augment gastrointestinal flora (McFarland, 2006). The extent of diarrhoea was monitored closely and it ultimately subsided. Had this been more severe, a stool sample would have been taken to rule out the presence of *Clostridium difficile*.

Two weeks following the incision and drainage procedure, six of the 30 gentamicin beads were removed to encourage further healing of the dorsal wound (*Figure 5*). An appointment was also arranged with the diabetologist to ensure close monitoring of blood glucose levels. At 3 weeks post-surgery, both dorsal and plantar wounds continued to reduce in size with granulation was apparent. A further eight gentamicin beads were removed and X-rays showed no evidence of osteomyelitis. At this point, wound redressing was reduced to three times per week. Two of these appointments at his local GP surgery with the practice nurse and the third appointment was at the authors' community hospital. This meant blood monitoring of inflammatory markers and hepatic and renal function testing for adverse antibiotic effects could be conducted on a weekly basis. X-rays continued to be taken every 2–3 weeks to determine any osseous changes.

Four weeks post-surgery, the patient had the remaining gentamicin beads removed. However, he presented with widespread joint pain and swelling affecting the left wrist, fourth finger, hip, and knee, which was believed to have been triggered by the ciprofloxacin. Myalgia and arthralgia have previously been associated with this drug (British National Formulary, 2012) and were considered to have been the contributing factors in this case. However, bloods demonstrated serum urate levels of 795 mol/L (200–430 mol/L) suggesting a gout flare-up. CRP spiked to 300 mg/L (*Figure 4*), while creatinine was 230 mol/L (*Figure 6*) and eGFR was 25 mL/min (*Figure 7*) indicative of stage four acute renal failure, which was attributed to a self-directed course of naproxen to help minimise joint pain. Weekly blood tests had all been unremarkable.

Consequently, the diabetologist was contacted urgently and a decision made to admit the patient to acute care to stabilise renal function and reduce serum urate levels. The patient subsequently spent

Figure 3. Intraoperative image (a) following amputation of the second toe with examination of adjacent tissues, and (b) plantar ulceration following surgical debridement.



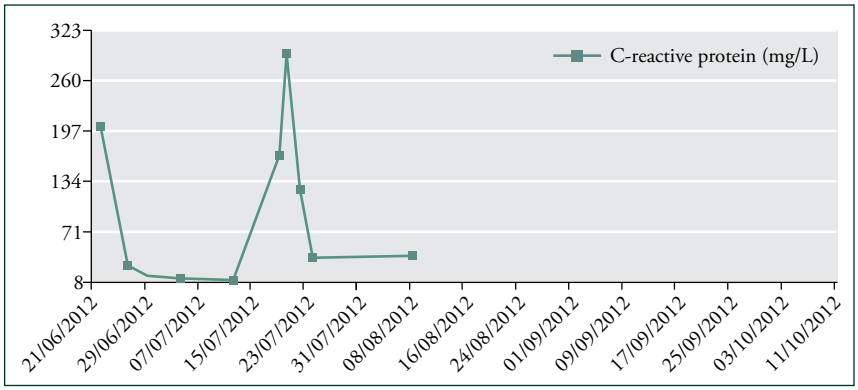


Figure 4. The patient's c-reactive protein (CRP) levels. An initial spike in CRP was caused by original foot infection, with the second spike a consequence of gouty arthritis.

Figure 5. Gentamicin-impregnated beads within the wound 2-weeks post-surgery.

Figure 6. The patient's serum creatinine levels. The large spike is indicative of reduced renal function. The initial spike may have been caused by ciprofloxacin.

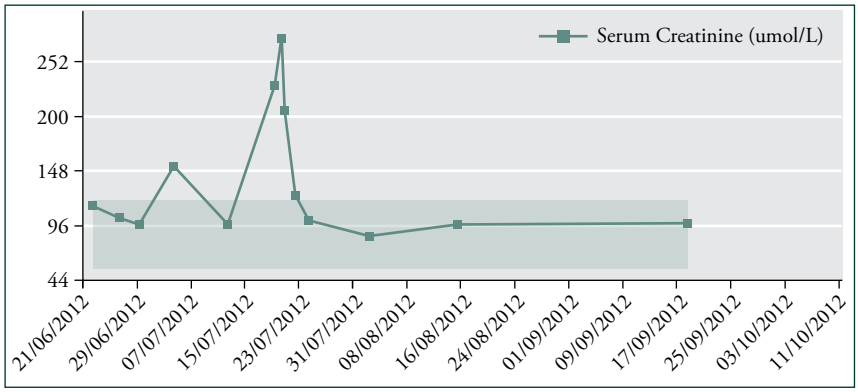


Figure 7. The patient's estimated glomerular filtration rate (eGFR). The large inverted spike is indicative of reduced renal function. The initial inverted spike may be caused by ciprofloxacin.

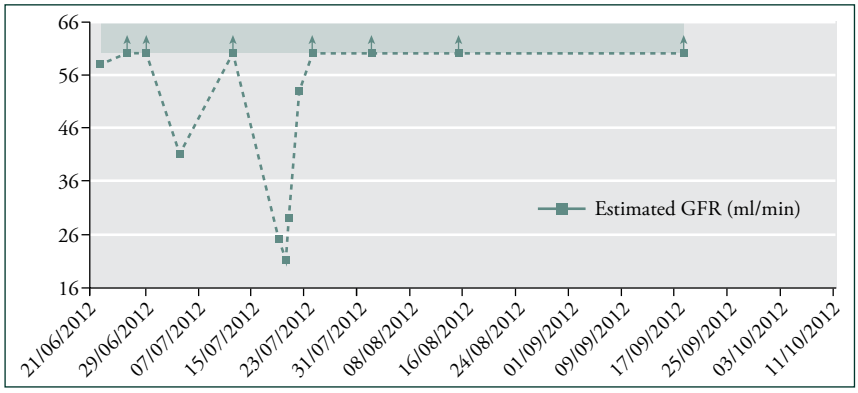


Figure 8. The patient's foot prior to discharge demonstrating a healthy superficial wound with no evidence of infection.

3 days in hospital where he was given low-dose colchicine. Ciprofloxacin was reduced from 750 mg twice daily to 500 mg twice daily and his ramipril and frusomide were temporarily withheld. A referral to rheumatology was also made with a view to stabilising the gout in the long term.

At 5 weeks postoperatively, serum urate remained elevated (738 µmol/L) and joint pain was still evident. Further low-dose colchicine was arranged via the GP. The foot continued to make excellent progress with further reduction of wound dimensions. At 6 weeks, the rheumatologist had commenced the patient on oral allopurinol 100 mg once a day to help reduce hyperuricaemia and joint pain had subsided. In week 7, X-rays showed no osseous abnormality and following a telephone consultation with the diabetologist, a decision was made to discontinue the antibiotics. The patient was monitored closely for any recurrence of infection.

The wound continued to be dressed on a biweekly basis, once by the practice nurse and once by the team in the community hospital until complete healing of both the dorsal incision and plantar ulceration occurred in the 17th week after the initial incision and drainage procedure (*Figure 8*).

Discussion

This case successfully demonstrated the surgical and medical management of a complex diabetic foot infection in a community setting, but it could only have been achieved under certain circumstances. Timely access to a member of the team, as well as having specific protocols and strategies in place to support referral, assessment, and management, was vital. These protocols could be used to determine diagnosis and extent of disease, and to supply appropriate antimicrobial therapy under previously agreed PGDs and/or through supplementary prescribing.

Certain facilities were also of paramount importance and are also recognised in NICE Clinical Guideline 10 (2004), which states that a multidisciplinary foot care team must have unhindered access to specialist services, including suites for managing major wounds, urgent inpatient facilities, antibiotic administration, community nursing, microbiology diagnostic and advisory services, vascular surgery, radiology, orthotics, and orthopaedic or podiatric surgery.

Multidisciplinary working is also a crucial strategy for managing diabetic foot infections in the community. The individual in this case required regular contact with consultants from different disciplines, including the diabetologist who not only provides optimised blood glucose control but served as the linchpin in the medical management of diabetic complications. Input was required from microbiology to confirm appropriate antibiotic therapy, duration of treatment, and advice on associated complications in the presence of abnormal blood results. The rheumatologist was instrumental in controlling the patient's hyperuricaemia and joint pain, while the radiologist's opinion was sought to rule out the presence of osteomyelitis. Finally, keeping the GP well-informed – and using their independent prescribing rights to prescribe drugs recommended by other consultants where supplementary prescribing was inadequate or in the absence of a specific PGD – was paramount, as was input provided by the practice and district nursing teams.

Regardless of effective multidisciplinary working, recognising when a patient requires admitting to acute care and understanding when to refer on should underpin the community management of diabetic foot complications. This was exemplified in this case when blood testing demonstrated stage four acute renal failure. Advice was sought from the diabetologist and a decision made to admit the patient to acute care to stabilise renal function. It was only through regular clinical assessment and blood testing as part of protocol that this was detected and, therefore, could be acted upon.

Managing diabetic foot complications in a community setting has some distinct advantages. These include less time spent in hospital and less hospital acquired complications such as infection, venous thromboembolism, medication errors and pressure ulcers (Department of Health, 2010). Inpatient care also results in increased bed occupancy, prolonged stays in hospital (NICE, 2011b) and is considerably more expensive (Kanavos et al, 2012). Finally, anecdotal evidence suggests that many patients would much rather receive treatment in an outpatient setting.

However, there is a paucity of podiatric surgery departments in the NHS and even fewer offer diabetic specialist foot care services. This is unfortunate bearing in mind the unique and extensive knowledge the podiatrist has, not only in the anatomy and mechanics of the foot, but also in understanding the pathogenesis and overall impact of diabetes in the lower limb.

The authors also accept there is no likelihood of commissioning podiatric surgeons as part of a diabetes service on a national basis due to their scarcity and believe more people should be encouraged to enter this complex and rewarding field. NICE clinical guideline 10 (NICE, 2004) reinforces the need for podiatric surgery in diabetic foot care. It states that the multidisciplinary team should consist of an orthopaedic or podiatric surgeon with relevant expertise in managing diabetic foot problems. Although the podiatrist working in the community setting may seem to be disadvantaged in their ability to commence intravenous (IV) antibiotics, good multidisciplinary working can ensure timely access to IVs under the supervision of the diabetologist.

Future developments within our podiatric surgery department include the setting up of a weekly multidisciplinary clinic to treat at-risk and ulcerated patients involving a diabetologist, a diabetes specialist podiatrist, a podiatric surgeon with relevant expertise and a diabetes specialist nurse. An on-call podiatric surgery service already in place adheres to the Diabetes in Adults Quality Standards Programme (NICE, 2011c), which states that people with diabetes who have a foot problem requiring urgent medical attention should be seen by a multidisciplinary foot care team within 24 hours of referral. In addition, the authors have recently helped to initiate the use of IV antibiotics in the community where, previously, those patients requiring IVs were admitted to acute care as inpatients. The authors hope to further this initiative negating the need in some cases for admission to acute care.

Conclusion

Effective surgical and medical management of complex diabetic foot infections can be achieved in a community setting. Protocols and strategies must be devised and access must be made available to relevant facilities and cohesive multidisciplinary working. Most importantly, the clinician must have the confidence to identify when a patient requires further medical management and referral to acute care. ■

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