The Pathway to Foot Ulceration in Diabetes

Andrew J.M. Boulton

At any one time 2% to 4% of the diabetic population is likely to have an active foot ulcer. Peripheral neuropathy, foot deformity, and trauma (often from ill-fitting footwear) represent the commonest causal pathway to foot ulceration. All patients with diabetes require an annual foot screen, and those found to be at risk require specialist foot care and preventive foot-care education. Identification of the high-risk foot can be achieved without the need for expensive equipment. Understanding the implications of loss of protective sensation is essential in reducing the all too high incidence of foot problems in diabetes.

Epidemiology of Foot Ulceration and Amputation: Can Global Variation be Explained?

David J. Margolis and William Jeffcoate

There is considerable apparent variation in the incidence of amputation for diabetes, both between countries and within them. Very many factors contribute to such variation and some of these relate to details of how relevant data are obtained and analysed, while others include race, social deprivation, and access to effective health care services. The rapidly increasing prevalence of known diabetes, as well as increasingly inclusive criteria for its diagnosis, will also result in an apparent variability in incidence, especially when diabetes-related amputation is expressed in terms of the total, as opposed to the "at risk", population. The complexity of the interactions which may impact on the calculated incidence of amputation means that great care must be exercised before meaningful conclusions can be drawn from comparisons made between different countries. On the other hand, reports from the USA and UK of up to ten-fold variation in amputation incidence within the same country require more urgent consideration. While race, social deprivation and restricted access to effective health care are important, there is increasing evidence that a major explanation for observed variation may lie in differences in the structure of medical services available for people at risk of, or who develop, disease of the foot in diabetes, as well as differences in the skills and beliefs of those who care for them. One of the strongest pieces of evidence for the importance of the professional performance is the marked decline in incidence of amputation reported from an increasing number of centres and achieved simply by altering the way in which local foot care services are provided. It must be remembered that amputation is a treatment, and not a direct marker of the natural history of disease, and treatments are selected by patients on the advice of their caregivers.
Preventing the First or Recurrent Ulcers 807
Lawrence A. Lavery, Javier La Fontaine, and Paul J. Kim

This article reviews the current evidence to prevent diabetic foot ulceration. Prevention is an ongoing process that requires a team approach including educators, physical therapists, physicians, podiatrists, nurses, pedorthists, and prosthetists. Screening, risk stratification, education, regular foot care, and protective shoes and insoles are the mainstay of the prevention process. Diabetic foot prevention can prevent reulceration in high-risk patients by 50%.

Peripheral Arterial Disease and Bypass Surgery in the Diabetic Lower Limb 821
Mostafa A. Albayati and Clifford P. Shearman

By 2030 it is estimated that there will be 439 million people in the world living with diabetes. Diabetes is a major risk factor for the development of atherosclerotic peripheral arterial disease (PAD). One of the commonest and most costly causes of admission to hospital for a person with diabetes is foot and lower limb complications, which often lead to amputation. The number of people with diabetes who develop foot complications and have PAD will increase and they are at significant risk of poor ulcer healing and limb loss. This article examines the role of surgical revascularisation in these patients.

Interventional Radiology in the Diabetic Lower Extremity 835
Jim A. Reekers

This article discusses the important new role of interventional radiology and endovascular treatment for arterial diabetic foot disease. Endovascular treatment is currently the first treatment option in many institutions. The role of new drug-eluting technologies remains to be investigated.

The Charcot Foot 847
Lee C. Rogers and Robert G. Frykberg

The Charcot foot or Charcot neuroarthropathy (CN) is a rare, but complex and often misdiagnosed complication of diseases causing peripheral neuropathy, like diabetes. Early recognition and treatment can prevent complications like ulcers and amputations. This article provides a review of the current evidence base and offers a pathway for treatment.

Pathogenesis and Medical Management of Diabetic Charcot Neuroarthropathy 857
Janice V. Mascarenhas and Edward B. Jude

The Charcot foot is an acute clinical emergency that warrants immediate management in order to prevent irreversible joint destruction. Offloading remains the mainstay of treatment of Charcot foot; however, adjunctive therapy with antiresorptive agents may facilitate retardation and early recovery from the inflammatory destructive process. This article discusses the medical management of the ever-challenging complication affecting the diabetic foot.
Orthopaedic Surgery and the Diabetic Charcot Foot

Wei Shen and Dane Wukich

Over the past two decades, a gradual trend toward more aggressive management of diabetic Charcot neuroarthropathy has occurred, mainly due to improved understanding of the pathophysiology and advances in surgical techniques. Although the mainstay of diabetic Charcot foot management is still nonoperative, surgical reconstruction using internal and external fixation techniques is indicated in patients with progressive deformity, instability, recurrent ulceration, and impending compromise of the soft tissue envelope. The ultimate goal of treatment, whether nonsurgical or surgical, is to achieve a stable, plantigrade foot that can be accommodated with appropriate shoe wear and orthotics. Various surgical procedures are described.

Topical and Biologic Therapies for Diabetic Foot Ulcers

Nicholas A. Richmond, Alejandra C. Vivas, and Robert S. Kirsner

Achieving healing in diabetic foot ulcers (DFUs) can be difficult, and despite the implementation of standard of care measures, healing rates remain unsatisfactory. The best management strategy to achieve more successful outcomes and avoid amputations is to perform a systematic approach. This includes offloading of the affected foot, infection control, correction of arterial disease and good wound care. Here the different topical and biologic therapies used in the management of DFUs to achieve a balanced, healthy, and pro-healing state, prevent limb loss, and improve quality of life for patients are reviewed.

Negative Pressure Wound Therapy and Other New Therapies for Diabetic Foot Ulceration: The Current State of Play

Adam L. Isaac and David G. Armstrong

Up to 25% of people with diabetes will develop a foot ulcer, with 1 in 5 ulcers requiring an amputation. An interdisciplinary team approach to limb salvage, combined with a vertical and horizontal strategy for wound healing, may help to systematically simplify what is a complex process. The organization and integration of care, with an emphasis placed on identifying key diagnostic points in healing and warning signs for recurrence, will be instrumental in improving outcomes in patients with diabetes and complicated foot wounds.

Diagnosis and Management of Infection in the Diabetic Foot

Edgar J.G. Peters and Benjamin A. Lipsky

Foot infections are common in persons with diabetes mellitus. Most diabetic foot infections occur in a foot ulcer, which serves as a point of entry for pathogens. Unchecked, infection can spread contiguously to involve underlying tissues, including bone. A diabetic foot infection is often the pivotal event leading to lower extremity amputation, which account for about 60% of all amputations in developed countries. Given the crucial role infections play in the cascade toward amputation, all clinicians who see diabetic patients should have at least a basic understanding of how to diagnose and treat this problem.
Osteomyelitis of the foot in diabetes is common and frequently undiagnosed. Diagnosis should be clinical and based on signs of infection, the size of the lesion, and the visibility of bone in the first instance but supported by the results of radiologic examination. The gold standard for diagnosis is histologic and microbiological examination of bone, which is not possible or necessary in all patients. There is no consensus as to whether management should be primarily medical or surgical; the pros and cons of each approach must be taken into account on an individual basis and after discussion with patients.

Hyperbaric oxygen therapy (HBO) is a short-term, high-dose oxygen inhalation and diffusion therapy, delivered systemically through airways and blood under high pressure using hyperbaric chambers. HBO stimulates angiogenesis, reduces edema, augments granulation tissue formation by enhancing fibroblasts, and improves leukocyte function by elevating the partial pressure of oxygen in tissue. The number of clinical trials evaluating the effect of HBO on the healing of diabetic foot ulcers is increasing, and to date two double-blind randomized controlled trials have been published, both showing improved long-term healing after HBO.