Meeting report

5th International Symposium on The Diabetic Foot

Noordwijkerhout, The Netherlands, 9–12 May 2007

Of the many complications that affect people with diabetes, those of the foot can have the greatest impact. Up to 70 % of all leg amputations are performed on people with diabetes, and this population has a 25 times greater chance of losing a leg than people without the condition.

In order to discuss the problems associated with the diabetic foot and the implications of the most recent treatment discoveries, the 5th International Symposium on the Diabetic Foot was held on 9–12 May, 2007 in Noordwijkerhout, The Netherlands.

This quadrennial symposium began in 1991 with 400 delegates and has gained worldwide support over the years. On this occasion, more than 70 countries were represented by over 1000 participants.

The conference began with an insightful overview of the pathogenesis and epidemiology of diabetic foot ulcers by Andrew Boulton, Professor of Medicine in Manchester and Miami. More than 5 % of people with diabetes have a history of foot ulcers, while the cumulative lifetime risk of ulceration may be as high as 25 %. Despite the fact that most neuropathic foot ulcers should be treatable and not result in amputations, owing to infections, amputations remain common throughout the world (especially in developing countries).

Neuropathy, trauma and deformity are the most common causes of foot ulcers and therefore, preventative measures must be taken where possible. These include visiting a healthcare professional on a regular basis for examination. Increasing global awareness and education is imperative.

As discussed by Benjamin Lipsky, Associate Professor, University of Washington, perhaps the most important advance in treating diabetic foot infections has been the launch and widespread use of guidelines, developed by the International Working Group on the Diabetic Foot and the Infectious Diseases Society of America.

Major studies have shown that almost 60 % of diabetic foot ulcers are infected and this leads to hospitalisation in approximately 80 % of cases. Controversy exists on the usefulness of quantitative microbiology in distinguishing an infected from an uninfected wound, especially since the emergence of MRSA. However, antibiotics such as linezolid and ertapanem have been approved recently and newer topical silver and iodide preparations are used widely for mildly infected foot wounds, although evidence of their efficacy is limited.

The future of the Charcot foot

A major issue discussed at the conference was Charcot arthropathy, a condition that should be diagnosed as early as possible. With early intervention, many Charcot feet can be healed and further deformity prevented. Charcot's osteoarthropathy can be divided into an acute active phase (characterised by unilateral erythema, oedema and increased temperature) and a chronic stable phase.

For the acute phase, following an X-ray, a technetium bone scan should be performed to detect evidence of bone damage. If this is present, an MRI is used to describe the damage in more detail. Treatment is immobilisation in a plaster cast until bone damage can no longer be detected and temperature is within 2°C of the contralateral foot.

In the chronic phase, there may still be oedema but the foot is no longer warm and red. The X-ray shows fracture healing, sclerosis and bone remodelling. The cast is removed and the individual must wear suitable supportive footwear. During rehabilitation, it is very important to monitor the individual constantly for signs of relapse; for instance, swelling and heat in the foot.

William Jeffcoate, Consultant Diabetologist, Nottingham, presented the theory that expression of RANKL, a cytokine involved in bone metabolism, is increased in diabetes and an inflammatory episode may be sufficient to trigger the onset of bone collapse and dislocation. This raises the possibility of new therapies, including antagonists to RANKL and pro-inflammatory cytokines.

The developing world

Diabetes predominantly affects people in developing countries, with 80 % of all cases being recorded in such countries. In addition, the majority of complications in developing countries are neuropathic in origin while there is a lower prevalence of vascular disease compared with more developed countries.

The challenges of providing care in these areas are huge; health centres are often poorly organised and are not accessible by all people with diabetes. The fact that most cases of diabetic foot are neuropathic in origin suggests that relatively simple measures to reduce the risk of trauma and treat lesions earlier could be very effective in preventing serious foot problems. Despite some recent interventions to improve diabetes care in developing countries, there remains the urgent need for well-powered studies with hard outcome measures in such settings. These would provide evidence to policy makers and a guide for healthcare planners.

In Senegal, cultural and religious reasons often explain the late presentation and advanced state of foot ulcers; for example, walking barefoot, poor footwear, traditional healing techniques and perilous aesthetic foot treatments. There are also insufficient treatment facilities for diabetes and diabetic foot ulcers. The

lack of specialised podiatry services and the geographic spread of these facilities make an interdisciplinary approach very difficult.

In the Middle East, peripheral arterial disease was found to be 3.1 % lower compared with the West, while a higher incidence of foot deformities, skin and nail pathology (54.7 %) and inappropriate footwear (61.6 %) was reported. There is also a low awareness of the value of preventative medicine, a high illiteracy level, a lack of structured footcare education programmes and a lack of infrastructure, referral systems and communications. Almost all countries in the Middle East share this lack of structured diabetic foot services.

With an estimated 38 million people with diabetes, India leads the world in terms of the size of its diabetes population. In this country alone, 40 000 leg amputations are performed annually, 75 % of which are potentially preventable. Trivial foot lesions precede 85 % of leg amputations and the training of nurses and doctors may help them to take care of such lesions and offer advice about appropriate footwear.

In response to these issues, the 'Step by Step' project was conceived 3 years ago by five international authorities on the diabetic foot. In total, 115 teams of doctors and nurses from India, Tanzania, Bangladesh, Sri Lanka and Nepal were selected for training in diabetes foot care and offered a basic course in 2004 and an advanced course in 2005. The participants learnt principles of diabetes foot care and management with an emphasis on preventative foot care.

An adjunct project was initiated by a group of German diabetic foot specialists, intending to offer selected participants from the Indian Step by Step centres the opportunity to visit German diabetic foot clinics for a period of 2 weeks. Patient education in the diabetic foot context and structured amputation prevention were among the most important issues reported by Indian visitors. German teams also travelled to India to raise awareness in the region, advertise new structures of foot care and improve the acceptance of hosts in their own settings in order to launch the necessary interdisciplinary collaborations.

Surgery on the foot

David Armstrong, Professor of Surgery, Rosalind Franklin Medical School, Chicago, presented information on indications for surgery and the consequences. Classification of diabetic foot surgery in the absence of critical limb ischaemia is centred on three fundamental variables: the presence or absence of neuropathy; the presence or absence of an open wound; and the presence or absence of acute limb-threatening infection. This allows the definition of distinct classes of surgery in an order of theoretically increasing risk for high-level amputation. These classes are as follows.

- Class I: Elective diabetic foot surgery (treats a painful deformity without loss of protective sensation).
- Class II: Prophylactic (reduces risk of ulceration or re-ulceration in a person with loss of protective sensation but without an open wound).
- Class III: Curative (assists in healing open wound).
- Class IV: Emergency (limits progression of acute infection).

The presence of critical ischaemia in any of these classes of surgery should prompt a vascular evaluation. Professor Armstrong hopes that this system will begin a dialogue among physicians and surgeons that can ultimately facilitate communication, enhance perspective and improve care.

Appropriate footwear

The mechanical pressures applied to the plantar surface of the foot during walking are known to be elevated in people with neuropathic diabetes and these excessive pressures are a major risk factor for plantar ulceration in the neuropathic foot. The presence of deformity in the neuropathic foot is often a reason to prescribe custom-made footwear, especially when a prior ulcer has been present in the foot.

Following surgery to control infection, different specialised footwear is required depending on the position and severity of the treated ulcer.

In the case of non-severe deformity of the forefoot, the foot can be placed in a deep shoe with a rocker bottom sole and moulded insole that allows reduction of forefoot plantar pressure during walking. When there are dorsal foot deformities like hammer toes, the shoe must be wide enough to contain the protrusion of the bone.

Deformity and joint instability of the midfoot, which characterises the Charcot foot, creates several problems in choosing the appropriate footwear. The shoe should be prepared by the footwear technician starting from a plaster cast of the foot that permits constructing protective footwear characterised by a rigid rocker sole and a medial and lateral counterfort able to support the ankle during walking. A moulded insole is also prepared to redistribute the plantar peak of pressure secondary to foot deformity.

Ankle instability should be supported by an ankle arthrodesis until a solid bone union has been achieved. In the case of bone malunion, a boot, such as the aircast pneumatic walker or castboot, is strongly indicated.

It is also worth considering the effect the shoe will have on balance. It is conceivable that footwear, orthotics, casts and braces used for treatment or prevention of plantar ulceration through offloading of the injured area can exacerbate the postural instability and risk of falling. Evidence has suggested that people wearing such devices demonstrate markedly reduced activity levels. Footwear should therefore be very carefully considered and specific to each individual.

Neuropathy

At least one in four people with diabetes is affected by distal symmetric polyneuropathy. This presents a major health problem as it may cause excruciating pain and is responsible for substantial morbidity and increased mortality. The treatment is based on multifactorial intervention aimed at normoglycaemia and reduced cardiovascular risk factors; pathogenetic mechanisms; symptomatic treatment; and avoidance of risk factors and complications.

Among the centrally-acting analgesic drugs, the tricyclic antidepressants carbamazepine and gabapentin have been used for many years to treat neuropathic pain. More recent trials have reported using agents such as the selective serotonin norepinephrine reuptake inhibitor (SSRI) duloxetine and the anticonvulsant pregabalin. In the future, drug combinations might aim at symptomatic pain relief and quality

of life improvement by addressing the progression of the underlying neuropathic processes.

Biology of the chronic wound

The prevalence of foot ulcers in people with diabetes is 25 % with a 2–3 % annual incidence. Wound care must address several biochemical and cellular abnormalities that may delay or prevent wound healing. The clinician must determine if the wound has the ability to heal. The three local wound care components are debridement, treatment of local inflammation and infection and moisture balance.

Surface infection requires treatment with antibacterial dressings, while deeper infections necessitate systemic antimicrobial therapies. The key signs to categorise the superficial and deep levels of bacterial damage or infection are represented by the acronyms NERDS (Non-healing wound, increased Exudation, Red friable tissue, Debris and Smell) and STONES (Size, Temperature, Os for bone, New areas of breakdown, Exudate, Erythema, Edema and Smell), respectively.

Debridement

The treatment of diabetic foot ulcers includes a number of different approaches including glycaemic control, revascularisation, surgical intervention, local wound treatment, offloading and other non-surgical treatments.

In a review of five randomised, controlled trials of debridement, different methods of debridement were assessed by Magnus Eneroth, Lund University, Sweden.

Results suggested that hydrogels are significantly more effective than gauze or standard care in healing diabetic foot ulcers. Surgical debridement and larval therapy demonstrated no significant benefit. Other methods such as enzyme preparations or polysaccharide beads have not been evaluated in randomised, controlled trials of people with diabetes.

Topical negative pressure wound therapy seems to be a safe and effective treatment for complex diabetic foot wounds and could lead to a higher proportion of healed wounds, faster healing rates and potentially fewer re-amputations than standard care.

Although debridement of ulcers is considered a prerequisite for the healing of diabetic foot ulcers, there is little evidence of its efficacy. More research into the pros and cons of each treatment is needed.

Conclusions and future perspectives

Large clinical studies describing the typical clinical presentation of diabetic foot ulcers and factors related to outcome were limited before 2000.

In recent mixed cohort studies, primary healing rates of 65–85 %, amputation rates of 10–20 % and mortality rates of 10–20 % have been presented. Signs of peripheral arterial disease can be found in more than half of people with a foot ulcer.

Studies suggest there has been improvement in the intervention and healing rates of neuroischaemic and ischaemic ulcers. However, there is still a limited number of interventional studies on this compared with wound treatment in neuropathic ulcers.

Infection is seldom the direct cause of an ulcer. However, when present, the risk for subsequent amputation is greatly increased. In studies, the outcome is related to the extent of tissue involved, comorbidity and coexisting peripheral vascular disease.

In a recent study, more than 50% of people with a foot ulcer received antibiotics prior to admission to a diabetic foot centre or clinic and 25–75 % of individuals at various centres were considered to have a wound infection at the time of admission. This finding is disturbing in a time of MRSA, multi-resistant microbes and debate over bioburden and biofilms.

In the prevention, management and outcome of diabetic foot ulcers, it is important to consider psychological factors and quality of life. Perceptions of their own risk based on symptoms, their own beliefs in the efficacy of self care and beliefs in health and illness can affect footcare practice and concordance by an individual.

It is extremely important to recognise the diabetic foot ulcer as a sign of multiple organ disease.

There is therefore a complexity of factors related to outcome of foot ulcers in people with diabetes and evaluating and recognising these factors with a holistic management approach is of utmost importance, both for successful management and outcome.

The conference was concluded with a view of the future from Peter Cavanagh, Professor of Biomechanics, Cleveland.

He anticipates that although the prevalence of diabetes is expected to increase rapidly over the next 25 years, complete individual genome sequences will be accessible by 2032 and this may allow the identification of genetic predispositions to complications. Early application of prevention programmes and targeted intervention should follow.

It is also likely that the current open-loop extrinsic glycaemic control using injection or an insulin pump will be replaced by closed-loop systems that will further reduce the effects of complications.

Advances in information technology could have a major impact on diabetic foot care. Implantable wound-healing sensors and in vivo molecular imaging techniques will allow personalised, data-driven wound management. Stem cell therapy is likely to be a routine aspect of wound care.

There will be more telemetric access to physiological data and shoes with embedded activity monitors and radiofrequency identification will also be available to improve compliance. Footwear will be manufactured based on biochemical data rather than opinion and mathematical modelling will have provided guidelines for the design of custom insoles in many foot types and conditions. Smart footwear will enable instantaneous modification of the foot–shoe interface to meet altered conditions and foot status. A risk detection system will also be a feature of custom footwear.

Robotic rehabilitation systems are a possibility to optimise physical therapy after amputation.

Success of these various advances will be apparent from the dramatically reduced rates of ulceration, reulceration and amputation.

The 5th International Symposium on the Diabetic Foot was an extremely valuable opportunity for experts from around the world to unite and share their knowledge in an bid to improve the care of people with diabetic foot complications. Given the increasing popularity of the conference, an even greater event is predicted when the diabetic foot conference reunites in 2011.