

Preventive Treatment Reduces the Number of Major Amputations in Diabetic Patients

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INTRODUCTION

In 1989 the World Health Organisation (WHO) and the International Diabetes Federation (IDF) launched a programme aimed at improving the quality of diabetes care in Europe which was embodied in the St Vincent Declaration. Particular importance was placed on reducing the impact of serious diabetic complications over a five-year-period. One of these aims was to reduce the number of major leg amputations in-patients with diabetes by half.

An up-to-date registration programme is essential in order to accurately assess the number of amputations in a given population. Hospital registers in Sweden are currently not adequate for this as they often omit the diagnosis of diabetes, particularly in patients with non-insulin-dependent diabetes treated by diet alone. The diagnosis is also often not recorded in patients undergoing amputation while in-patients of another department (for example, a patient from a department of geriatrics with diabetes undergoing amputation by the orthopaedic department may fail to have the diagnosis of diabetes registered by the operating surgeon (1). Furthermore, this also applies to the registration of diagnostic codes of other complications associated with diabetes, and this makes demographic and epidemiological data based on such diagnostic codes impossible (2).

The prevalence of diabetes in patients undergoing major amputations has been estimated at between 40 and 70% (1, 3, 4, 5, 6, 7). Costs for the treatment of foot ulcers and amputations are high. Most of amputations in diabetic patients are preceded by a foot ulcer (1, 4, 7, 8, 9, 10). The mean cost of treatment for diabetic foot ulcers from diagnosis until healing in Sweden in 1990 were US\$ 14, 527, including the costs of rehabilitation, while that for major amputations was US\$ 73, 627 (11). These figures does not include social costs. Ulcers at amputations sites took considerable time to heal; the mean healing time was over 2 months in 90% of patients. Thus amputation is an expensive treatment for diabetic foot ulcers.

Preventive and medical foot care together with a team approach to the care of serious diabetic foot problems, including ulcers, may dramatically decrease the numbers of major amputation (1, 12, 14, 16, Table 1). Studying how these results were achieved provides

insight into ways in which similar programmes may be started.

Why do diabetic patients develop foot lesions?

The most important condition related to the development of foot lesions in diabetic patients is neuropathy which is evident in 70-100 per cent of these patients (17). Three groups of diabetic patients with a high probability for amputation can be identified: a) patients with neuropathy and with no signs of peripheral vascular disease (PVD), patients with neuropathy and PVD, and c) patients with PVD and no signs of neuropathy. The proportions between varies, probably due to selection of patients and demographic differences. In the developing countries, the first group is by far the most common (18).

Preventive Foot Care Reduces the Number of Amputations

Only about one quarter of foot ulcers in diabetic patients are caused by arterial insufficiency (19). The majority are caused by other factors including neuropathy and infection. These are either preventable or treatable by conservative wound therapy. Six reports have shown that the preventive care may reduce the number of amputations in diabetic patients by 50% or more (Table 1). Three of these come from Sweden (1, 13, 16) where co-operation between primary care hospital teams is the norm. Two of the remaining studies are from Arizona and Kentucky (14, 15), while the sixth is from London, UK (12). In the studies from outside Sweden, patients were treated in referral centres which reported clinic- based results, suggesting at least some degree of patient selection.

Table 1

Education and treatment modalities used at various centres to reduce the number of major amputations by 50% or more.

	Education	Foot Exam	Foot clinic	Prim care	Amputation reduction (%)
Umea	+	+	+	+	68
London	+	+	+	+	50
Kisa	+	+	+	+	78
Lund	+	+	+	+	56
Tucson	+	+	+	+	66
Louisville	+	+	+	+	53

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During a 10-year period the incidence of major amputation in Umea, Sweden was reduced compared to that in other parts of Sweden (1). The number of major amputations in diabetic patients was in Umea city 3.1/100,000 inhabitants per year. The corresponding figures for Umea county and Gotland county was 6.5 and 20.5/100,000 inhabitants per year, respectively. This was probably due to the fact that almost all diabetic patients visiting the department of medicine underwent foot examination, at which risk factors for the development of ulcers were identified and prodromal symptoms as well as ulcers were treated. This took place in a specialised out-patient clinic for diabetic foot care with a multidisciplinary staff including a podiatrist, diabetologist, an orthopaedic surgeon and a shoemaker. The clinic co-operated closely with primary care teams and this was considered to be the most important factor in preventing amputations. The number of amputations in diabetic patients attending the primary care centre in Kisa, Sweden was reduced from 18 between 1979 and 1983 to four during 1984 and 1989 (13). This was achieved by systematic identification of "problem patients", education, improvement in metabolic control and follow-up of the risk patients. The team consisted of a podiatrist, a nurse, a dietician and a general practitioner. In Lund, Sweden, the number of major amputations in diabetic patients were reduced from 16.1 / 100,000 inhabitants to 3.6 / 100,000. The probable cause of this reduction was co-operation between the primary health care teams and the departments of medicine, orthopaedics and vascular surgery (16).

At a specialised clinic for diabetic patients with foot ulcers at King's College Hospital in London staffed by a podiatrist, a nurse, a shoemaker, a diabetologist and a surgeon, the number of amputations was reduced by 50% over a 3-year-period (12).

In Tucson, USA, diabetic patients who had previously had foot ulcers, or who had undergone major amputations, attended an education programme that included a one-hour lecture. A matched group of patients who did not receive the intensive education was also followed-up and was found to undergo three times more amputations than those in the group who received education (14). Systematic foot examinations were made in all diabetic patients attending the University Hospital in Louisville, Kentucky, USA, and they received education in foot care.

Patients who received this preventive care were compared with a group of patients who did not, and these had twice the incidence of major amputations

(19% compared with 9% as those receiving education) (15).

Signs of Risk Factors for Diabetic Foot Ulcers

The incidence and prevalence of diabetic foot ulcers have been reported to be 3-5% and 8-17%, respectively (20, 21, 22, 23). Factors involved in the causation of amputations in diabetic patients include atherosclerosis, neuropathy, infection, hypertension, hyperglycaemia, smoking, oedema, lack of knowledge and inadequate help from the medical service (3, 8, 16). Diabetic ulcers usually have a multifactorial background and patients at risk need to be identified.

History and Examination

The interview and physical examination include signs of vascular and neurological as well as other important concomitant diseases. The examination of both feet should be performed with shoes and stockings removed. The gait pattern should be assessed for abnormal foot positions and deformities. Different symptoms and signs are listed (Table 2 and 4).

Table 2

Medical history in diabetic patients with foot lesions-Important factors

- Type, duration and treatment of diabetes mellitus. Other complications. Concomitant diseases, smoking, previous thromboembolic disease and previous foot ulceration.
- Social conditions. Knowledge of podiatric problems. Compliance.

Table 3

Local symptoms and signs in diabetic patients with foot lesions and peripheral vascular disease

- Intermittent claudication.
- Nocturnal pain, rest pain that may be relieved by dependency.
- Blanching on elevation. Dependent redness.
- Peripheral cold. Absence of pulses (25). Gangrene.
- Loss of hair on feet and toes.

Arterial insufficiency and ankle pressure measurement

Early prevention is essential in the most serious diabetic foot ulcers, that is due to arterial insufficiency. However, prevention is difficult and no reports of its successful use have been published.

Early and aggressive treatment of hypertension, optimal control of diabetes, lipid-lowering therapy, haemorrhologically active treatments and stopping smoking are all important preventive measures. Vascular surgeons, or those experienced in transluminal angioplasty, should be consulted when patients have symptoms of ischaemia. Recently, a group of Danish vascular surgeons reported reducing the number of lower limb amputations by half over a ten-year-period in a large group of patients. The reduction occurred parallel with the increasing use of arterial bypass to crural and pedal arteries, as well as an overall 100% increase in vascular reconstruction and angioplasty (24).

Diagnosis of Peripheral Arterial Insufficiency

Peripheral arterial insufficiency is diagnosed by palpation of the foot pulses. When these pulses are palpable, significant arterial insufficiency does not exist (25). Measurement of systolic blood pressure at the ankle is a simple and readily available screening examination for the degree of arterial insufficiency. The ankle systolic pressure is generally slightly higher than the brachial artery pressure. If it is lower, it usually signifies peripheral arterial insufficiency. An ankle systolic blood pressure < 50 indicates critical ischaemia in non-diabetic patients (26) while a pressure of < 80 mm Hg indicates critical ischaemia in patients with diabetes (8). However, measurements of systolic ankle pressures are limited in patients with rigid arterial walls (26). However; this condition is least likely to have any impact on the blood pressure level (8, 27).

Neuropathic Foot Lesions

The most common precipitating cause for foot ulcers in patients with diabetic neuropathy is pressure from tight shoes (11, 28). Other deformities which can cause foot ulcer are pes cavus, hallux valgus, hallux rigidus and diabetic osteopathy (11, 29).

The type or severity of foot lesions are similar in patients with either Type 1 or Type 2 diabetes aged 15-50 years (20). The only exception is necrobiosis lipoidica, which is more common in women with Type 1 diabetes. Sixty percent of patients in this age group have signs of fallen fore foot arches, 50% hammer toes, 30% dry feet, 50% callosities, 7% fissures and 3% foot ulcers (20).

While such deformities as fallen fore foot arches and hammer toes may be noted at an early age, and may cause impaired function of the foot, they are seldom felt to require treatment. These deformities, with or without callosities, are found in one quarter of healthy

subjects (20) and are probably the result of poor shoe culture. These foot problems seldom cause foot ulcers in healthy people while they do in diabetic patients (2830) probably because diabetic skin is more sensitive (31). As recent studies have shown, these deformities should be preventable by early education and well-fitting shoes. Plantar callosities should be examined and any identifiable causes treated. Efforts should be made to eliminate them as this decreases the pressure on the tissues in the foot, reducing the risk of development of an ulcer (32). Ulcers under the fore foot arch are found in 10 per cent in population-based patients materials (28, 33).

Plaster cast treatment is one of the mainstays in the treatment of diabetic foot ulcers (34).

It is important to realise that poor awareness of disease may be conducive to the development of diabetic foot ulcers, and in particular those likely to recur (35).

Oedema as A Cause of Diabetic Foot Ulcers

Oedema of any cause is a common underlying cause of foot ulcers in diabetic patients. Oedema probably affects the microcirculation in the foot. The commonest cause of distal oedema is the heart failure (11, 36, 37) and as blood pressure may be lowered in cardiac failure, there may be a reduction in distal perfusion pressure. The warning sign of an impending ulcer in the oedematous foot is erythema, more or less widespread, in which a central necrosis develops (37).

Thus oedema in diabetic patients should be aggressively treated. Diuretic drugs alone are seldom sufficient and elastic bandages or stockings should be used with them.

Teamwork is Essential

Thus recommendations can be generated from the results of these reports which may drastically reduce the number of major amputations in diabetic patients. The reports mentioned satisfy the requirements of the St. Vincent Declaration and used remarkably similar methods to achieve the results (Table 1). Thus all centers used education as the basis of their programmes. Co-operation is essential between members of the diabetic care team in primary care. These include the general practitioner, nurse, dietician and podiatrist. There should be easy communication with the diabetes team at their referral hospital where an inter-departmental team, made up of a diabetologist, surgeon, podiatrist and shoemaker should be available to assess foot problems, educate

at-risk patients and initiate treatment of foot abnormalities.

Table 4
Local signs in diabetic patients with foot lesions with neuropathy

- Burning pain in calves. Paraesthesia. Decreased temperature sensation. Decreased / absent vibratory sensation (20, 38). Numbness.
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- Cold feet. Dry feet.
- Absence of deep tendon reflexes. Muscle wasting. Foot deformities (20).
- Limited joint mobility (39).

CONCLUSIONS

Prevention is better than cure. But when they develop, diabetic foot ulcers are eminently treatable, and successful treatment may avoid amputation. Teamwork has developed between hospital departments and primary care teams in order to reduce the number of major amputation in diabetic patients. Patient education has been shown to cause a significant reduction in foot problems (1, 11-15).

Diabetic foot problems have a multifactorial aetiology, and are due to neuropathy, macro-microangiopathy and impaired metabolism. This explains the efficacy of the team approach to prevention and treatment of diabetic foot problems. Prevention of foot is time consuming and requires continuous vigilance if it is to succeed in achieving a long-term reduction in the number of major amputations in diabetic patients.

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