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Type 2 diabetes mellitus and disability

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Diabetes mellitus is one of the commonest chronic diseases and was estimated to affect 4% of the world's population in 1995. The prevalence is increasing and could reach 5.4% by 2025 (King et al., 1998). Type 2 diabetes accounts for more than 90% of cases and is often considered a condition of affluence because of its strong association with obesity and physical inactivity. Yet the majority of affected people (more than 70%) live in low or middle income countries. In low income countries type 2 diabetes tends to be most prevalent in the wealthiest parts of the population whereas in high income countries the poor are most commonly affected. These social gradients only tell part of the story however and diabetes is increasingly seen in the urban poor in all countries.

The underlying causes of type 2 diabetes are similar worldwide. Access to relatively cheap energy-rich diets coupled with obesogenic environments lead to low physical activity levels and result in metabolic changes that predispose to obesity and diabetes. The genetic basis of type 2 diabetes is mostly polygenic in origin and a family history of diabetes confers a substantially increased lifetime risk of developing the condition. This increased heritability may be due to either familial behavioural effects or through genetic and epigenetic mechanisms but it suggests the alarming possibility that a positive feedback loop could increase the susceptibility to diabetes of future generations (Fetita et al., 2006).

In predisposed individuals, various body tissues and organs become resistant to the effects of circulating insulin levels and this insulin resistance causes a range of metabolic abnormalities. Diabetes develops in insulin resistant individuals when pancreatic insulin secretion fails to compensate adequately leading to an inability to maintain normal blood glucose levels (Stumvoll et al., 2005). Hyperglycemia, i.e. chronically elevated blood glucose levels, defines diabetes and is also the cause of many of the adverse consequences that result from the disease. Established type 2 diabetes is generally irreversible and is usually progressive because pancreatic beta cells continue to lose their ability to manufacture and secrete insulin. Consequently a progressive increase in the intensity of medical therapies is required and many patients need to take multiple medications including insulin injections to control blood glucose levels. The pathological consequences of prolonged hyperglycemia include disease of the small arteries that supply the retina, kidney and the peripheral nervous system and this leads to the 'typical' complications of diabetes: retinopathy, nephropathy and peripheral neuropathy.

Many patients with type 2 diabetes also have hypertension and hyperlipidemia. This clustering of conditions, often termed the metabolic syndrome, carries a very high risk of atherosclerosis. Consequently, coronary heart disease, peripheral arterial disease and cerebrovascular conditions are also highly prevalent in type 2 diabetes and these

often carry a worse prognosis than when they occur in non-diabetic people. The combination of peripheral neuropathy (causing reduced sensation in the feet) and peripheral arterial disease (leading to reduced blood supply to the lower legs) is particularly serious and patients can develop serious lower limb or foot problems related to foot ulceration, sepsis or gangrene. The morbidity of type 2 diabetes therefore includes a wide range of serious conditions including coronary heart disease (the major cause of death), vision loss, kidney failure, lower limb amputation, painful peripheral neuropathy and strokes.

There are many effective preventive and treatment options available to those with access to good health care. However the management is complex and requires patients to take on healthy lifestyle measures and self-management practices and to engage in regular and life-long monitoring of blood glucose, lipid and blood pressure levels and in medical screening designed to detect treatable diabetic complications at an early stage. Patients may be required to use glucose and blood pressure measuring devices, self-administer insulin, take complex medication regimes, engage in daily foot care and attend for regular medical checks (family doctor, diabetes physician, ophthalmologist). In many countries, specialist educators (nurses, dieticians) run clinics for patient education and support. There have been many technical improvements with new medications including newer insulin variants, devices for easier administration of insulin, the emergence of point-of-care biochemical monitoring and wearable technologies for continuous glucose monitoring. Costs of care are enormous and beyond the capacities of many health care systems and the poor. Diabetes prevention appears to be feasible but the challenges at the individual and public health level are also immense (Simmons et al., 2010).

Disabling conditions in type 2 diabetes

It is not surprising that individuals with type 2 diabetes have an increased risk of suffering from chronic disability. Many diabetic complications are inherently disabling as are the predisposing conditions, obesity and low activity levels. Recent research suggests that the diabetic state itself may be independently associated with disability i.e. not directly explained by diabetic complications. Several studies have shown that patients with type 2 diabetes have greater impairments in mobility and more difficulties performing basic activities of daily living (ADL) than similarly aged non-diabetic people (Lu et al., 2009). In addition, type 2 diabetes has been associated with an increased risk of falls, fractures, depression and cognitive impairment. Most studies have focused on single topics and few provide an overall assessment of the impact of diabetes. In a recent Australian study, we reported on 223 diabetic subjects aged 70 years or over (Bruce et al., 2003). In this community-living group, ADL disability was seen in 53%, urinary incontinence in 27%, fecal incontinence in 11%, major depression in 14% and 15% had dementia and only 36% of the sample were free from such problems.

The disablement process is complex and involves social and economic factors, lifestyle-related risk factors (e.g. poor nutrition, obesity, smoking, sedentary preference), psychological factors (personality type, coping strategies), psychiatric conditions (mood disorders, changes in cognition) and a range of disabling medical conditions (arthritis, cardio-pulmonary disease, cancer, stroke) (Verbrugge and Jette, 1994). Most of these factors that contribute to disability are also important in the development of type 2 diabetes and its complications.

The extent to which disability in diabetes is gradually progressive or catastrophic, i.e. following on from a major event such as stroke or amputation, is unknown. Studies in the general population show that an impairment in mobility is often an early step in the progression to future disability. In our own study of middle-aged patients with type 2 diabetes, 18% developed new problems with basic ADL after 4.8 years follow-up (Bruce et al., 2005). There were multiple independent risk-factors for disability in this cohort including a history of stroke, peripheral arterial disease or depression, being a smoker and taking low levels of physical exercise. However, the strongest independent risk factor was mobility limitation at baseline consistent with the general literature. Reports of mobility impairment may be a useful early marker for preventative and rehabilitation efforts in diabetes. We also studied diabetic patients with normal mobility to identify possible causes of mobility limitation. Almost a third of our patients developed some degree of limitation after 5 years and again there were multiple independent causative factors that included the presence of peripheral neuropathy, arthritis and history of stroke (Bruce et al., 2005).

Falls and fractures

Prospective studies have shown that older women with diabetes have an increased risk of falls (Lu et al., 2009). The risk of falling is probably explained by the presence of peripheral neuropathy causing balance problems and gait abnormalities (reduced speed, shorter stride length and greater step to step variability) because of sensory and motor impairments (Allet et al., 2008). Other factors are also likely to be relevant including all the causes of mobility limitation listed above. Recent brain imaging studies have demonstrated that deep cerebral white matter lesions, common in diabetes and thought to represent chronic vascular ischemic damage, also increase the risk of falls (Blahak et al., 2009). In addition, diabetes has been shown to cause a more rapid loss of skeletal muscle mass than seen with normal aging (Park et al., 2009). In the limited studies currently available, sarcopenia occurs independently of neuropathy suggesting that this is yet another diabetic complication. Not surprisingly perhaps, the increased risk of falling is associated with a higher risk of fractures, especially at the hip. Yet, patients with type 2 diabetes do not seem to have an increased risk of osteoporosis (Khazai et al., 2009).

Dementia and cognitive impairment

Longitudinal studies have demonstrated that diabetes increases the risk of dementia, mild cognitive impairment and decline in a number of cognitive abilities (Cukierman et al., 2005). This problem appears to be confined to older patients in the main and may be due to the increased incidence of cerebrovascular disease. There is a current debate over whether there is also an increased risk of Alzheimer-related pathology in diabetes as clinical Alzheimer's disease appears to be more common. Some older diabetic patients have relatively subtle deficits in cognitive function that do not meet the criteria for dementia. Commonly, deficits in frontal-executive function are found, possibly caused by microvascular disease of the frontal lobes of the brain. Importantly, such deficits can be difficult to detect, yet are likely to have adverse effects on patients' abilities to self-manage complex diabetes management regimes. This possibility is worth considering whenever older patients appear to be getting into difficulties with their diabetes.

Depression and diabetes

Major depression occurs more commonly than expected in patients with type 2 diabetes. However the relationship between the two conditions is complex. Whilst patients with diabetes have an increased risk of becoming depressed, depression has also been shown to be a risk factor for the development of type 2 diabetes. It is likely that both situations occur, diabetes is a risk factor for depression and vice versa. Importantly, the combination of the two conditions carries a particularly poor prognosis and affected individuals generally have poor diabetic control and develop more or earlier diabetic complications (Egede, 2006; Black et al., 2003). Depression in diabetes appears to be amenable to conventional therapy but patients require an integrated approach that addresses both their physical and mental health problems (Egede, 2006).

Rehabilitation

There is relatively little evidence on the effectiveness or otherwise of standard rehabilitation therapy in patients with diabetes. However there is little to suggest that they do not benefit as well as their nondiabetic counterparts from standard approaches to assessment and rehabilitation. What is clear however from clinical experience is the complexity of problems that need to be dealt with. For example, the rehabilitation team may have to consider how to conduct stroke rehabilitation in a patient with chronic kidney failure who needs to spend considerable time periods undergoing renal dialysis. They may have to consider a patient with a recent amputation who also has visual or cognitive impairment (or both). Rehabilitating a patient with diabetic foot problems can be challenging as frequently the 'good' leg is also at-risk or already showing evidence of ischemia or impaired wound healing.

Diabetic patients undergoing rehabilitation require careful assessment, goal setting and good teamwork that will often involve multiple teams. The management of the underlying diabetes frequently requires modification. For instance, some patients require a simpler regime to enable a family caregiver to administer regular medications. In other cases, improved control of blood glucose levels may assist with wound healing or pain control (high glucose levels lower pain thresholds). It is not uncommon that the goal of achieving and maintaining close to normal blood glucose levels is no longer appropriate. In such cases, the advice of the diabetes treating team is often invaluable.

Exercise is one of the mainstays of treatment for type 2 diabetes and public health guidelines frequently update recommended frequencies, duration and type of exercise. Generally, trials of exercise have focussed on effects on control of blood glucose levels or cardiovascular risk (Bronas et al., 2009) and there is little published evidence on how to treat, prevent or limit disability in diabetic patients. Some interventions that have been demonstrated to be effective in older adults may be less effective in diabetes. For example, Tai Chi improves balance, gait speed and muscle strength in older adults but appears to be less effective in diabetes (Orr et al., 2006). On the other hand, a physiotherapist-supervised group training program was shown to be effective and resulted in improved balance and reduced fear of falling in patients with neuropathy (Allet et al., 2010). Given the increased focus on disability in type 2 diabetes evident in the recent literature, more treatment trials are to be expected in the near future.

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