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Review Article

Diabetic Foot Infections and Problems in Guyana

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Abstract

Diabetes mellitus (DM) is a major global metabolic disorder currently affecting more than 465 million people. If diagnosed late or left untreated, DM can induce a number of long-term complications which are due to DM-induced hyperglycaemia leading to nephropathy, cardiomyopathy, neuropathy, retinopathy, impotence, foot ulcers and amputations. Diabetic foot problems (DFP) are major concerns for the patients as they affect their quality of life and exert great financial burden on them, especially for people from a low income developing country as Guyana. In 2019, it was estimated that the expenditure for diagnosis, treatment and care for diabetic foot patients was USAD$75 million in Guyana. Both obesity and diabetes are on the increase in Guyana with almost 11 - 12% of the adult population have DM, due to obesity (diabesity) and more women compared to men. Moreover, there is an unacceptable high rate of amputations due to lack of organised foot-care programme and the absence of national guidelines in its management. There are various aspects of good diabetic foot care and this article reviews what has been achieved and what needs prioritisation to improve the management of diabetic foot problems in Guyana among patients with diabetes mellitus. 'The Guyana Diabetes and Foot Care Project" has made significant improvement in this area but the lack of specialist vascular surgical service is obvious.

Keywords: *Diabetes Mellitus; Guyana; Diabetic Foot Infection; Ulcer; Amputation; Foot Care*

Introduction

Diabetes mellitus (DM) is one of the oldest disorders to inflict humans and it is due to elevated blood glucose (hyperglycaemia) level because of either the lack of insulin or insulin resistance (IR). The metabolic hormone, insulin plays a major physiological role in the body to regulate blood glucose level. Currently, over 465 million people have DM worldwide and this number is expected to rise to 700 million by 2040 [1] and 90% have T2DM and 10% have T1DM and gestational diabetes [1]. Another 200 million people are undiagnosed and 1 billion people have pre-diabetes. Globally, it costs almost $1 trillion USAD to diagnose, treat and care for diabetic patients so that they can enjoy a better quality of life [1]. Diabetes mellitus is now diagnosed by a well reliable test called HBA1c and value of 6.5% or 48 - 50 mol/mol and above confirms diabetes. If diagnosed late, left untreated or patients do not take their medications regularly or non-pharmacological treatment including regular exercise, diet modification and complementary medicine, then DM can lead to a number of long-term complications including retinopathy, nephropathy, neuropathy, cardiomyopathy and many other complications such as foot ulcers and amputations. The review is related to diabetic foot infections and related ulcers and amputations in Guyana, a low income developing country in South America.

Diabetic foot infections and ulcers

Diabetic foot infections and ulcers are associated with a number of risk factors including poorly fitted or poor quality shoes, poor hygiene, not washing the feet regularly, improper trimming of toe nails, excess alcohol consumption, nerve damage, partial blindness [2]. People with diabetes are susceptible to develop an ulcer or pre-ulcerative lesion (fissures, blisters and subcutaneous haemorrhage), trauma (trivial or major), foot deformity, previous lower extremity amputation or healed ulcer, chronic kidney disease (CKD) and peripheral arterial disease (PAD). Additional risk factors for infection include barefoot walking, constant scratching of skin at the lower shin and foot, and dermatophytosis (nail/interdigital) [2-4].

Diabetic foot ulcer (DFU) and amputation are the two most debilitating complications of DM. The incidence of DFU is about 6.0% and lower extremity amputation about 0.5% in the US population [2]. Diabetic foot ulcer syndrome (DFUS) is defined as infection, ulceration or destruction of tissues of the foot of a person with currently or previously diagnosed DM, usually accompanied by neuropathy and/or PAD in the lower extremity [3]. There is wide variation in clinical outcome of diabetic foot problems within various geographical areas suggesting that some people are being managed considerably less well than others. Among the many possible reasons is the lack of emphasis placed on basic training and continuing education of doctors and nurses [4]. National Institute of Clinical Excellence (NICE) has published guidance on standard of foot care in the UK [5]. Similarly, International Working Group on the Diabetic Foot (IWGDF) has made many recommendations on prevention and treatment of diabetic foot. Diabetic foot ulcer remain a major health care problem in Guyana, a low income developing country in South America. Until 2008, diabetic foot complications were the most common diagnosis on admission to the Georgetown Public Hospital Cooperation (GPHC) in Guyana, with 42% of cases resulting in amputations [6]. It causes undue suffering due to its frequent recurrences. It is associated with high mortality, as well as considerable health care costs and a reduction in the quality of life of the patients [7]. This review article investigated the problems encountered in patients with diabetic foot ulcers and its treatment in Guyana.

Methods

For this review, all studies selected were in English language, have a primary focus on Caribbean and Guyana that have been published from 2000 to 2020. The following electronic health databases were searched: MEDLINE, EMBASE, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Cochrane Library and Evidence-Based Nursing. An additional search was performed on subject gateways (Research-gate, National Library for Health and Google Scholar) and bibliographies of all relevant retrieved studies relevant to the research questions. Literature searches were carried out by the researchers and conflicts over inclusion are resolved throughout the discussion. The key terms used to extract articles were diabetes, amputation, adult, Guyana, Caribbean, diabetic foot, education. All articles published in English language were included in the study. Experimental animal based study if any, were excluded.

Diabetes prevalence

Guyana is one of the developing and low income countries in South America with a population of 786,552 and 26.9 % of the population live in urban areas of the country [8]. The largest two ethnic groups are the Indo-Guyanese (39.8%), the descendants of indentured labourers from India and Afro-Guyanese (29.3%), who are the descendants of slave labourers from mainly West Africa. Guyanese of mixed heritage make up 19.9% while the indigenous peoples make up only 10.5% with rest of other origins [9]. Both Indian and African migrant populations are particularly affected by type 2 diabetes (T2DM) at a younger age and as such, they are highly associated with morbidity and mortality due to related diabetes-induced long-term–complications, especially kidney and heart failures [10, 11]. As per the official figure of International Diabetes Federation, prevalence of diabetes mellitus in Guyana in adults is 11.5% with the total cases of diabetes estimated to be around 60,400 [1]. However, population survey showed the national prevalence to be 18.1% with a high prevalence among women in rural areas [12]. Approximately, 74% of all people with diabetes are in their productive working years i.e. under 65 years. Each year, an average of over 7,000 new cases of diabetes are diagnosed across Guyana [13].

Infrastructure of diabetes health and social care system in Guyana

The health and social care system in Guyana consists of both the public and private sectors. The public service is generally free, but the local standard is far from the international standard due to underfunding, lack of resources and qualified and experienced staff. The private sector is responsible for their own financing and staff recruitment and patients are required to pay for any services rendered. People living in rural areas have limited or no access to physicians and hospital treatments. There is a shortage of health care professionals in Guyana, especially, in rural locations [14].

Diabetic foot screening

The International Working Group on the Diabetic Foot (IWGDF) and National Institute for Health and Clinical Excellence (NICE) recommend that a person with diabetes at low risk of foot ulceration should be examined every year for signs or symptoms of loss of protective sensation and peripheral artery disease (PAD). This is done in order to determine if they are at increased risk for foot ulceration and more so to examine more frequently if they are of higher risk [15]. Foot screening needs detail history, assessment of circulation, sensation and deformity [16]. This is not always practical, so a simplified 60-second screening tool was developed in Guyana and implemented to screen 3,452 persons. During screening, it was found that 48% had at least one abnormality and were classified as high-risk Guyana [17]. This was adopted by the Government of Guyana to be used throughout the country routinely as a part of preventive health examination in primary care settings through "Wellness Centres of Excellence" [13].

Foot care education management

The education of diabetic patients on self-care management is considered very important and in turn this can improve the knowledge of the patients of diabetes-related foot problems and foot-care [18]. They should be educated in wearing adequately protective footwear, self-foot checks, practice proper foot hygiene and seeking professional help in a timely manner after identifying a foot problem [15]. Guyana has a reading literacy rate at 85.6% for the population over age 15 years and 49.9% for people above the age of 65 years [19]. Despite this, there is a lack of Foot Care Education (FCE), which can easily be incorporated during foot screening. Recently, "The Guyana Diabetes and Foot Care Project" community awareness was enhanced by the use of media such as radio and television. This include the Ministry of Public Health and Social Care program called "Your Health, The Nation's Wealth" that helped to increase awareness of diabetic foot complications by outlining signs of danger to the feet [20].

Multi-disciplinary diabetic foot clinic

Multi-Disciplinary Foot Clinics (MDFC) have been established all over the world to provide holistic care to patients with diabetic foot problems [21]. There is a wide variation in the availability of a range of professional skills in the MDFC in different health economy [21]. Based on outcome data in specialized MDFC in Europe, approximately 77% of diabetic foot ulcers heal within 1 year [18]. In Guyana, a multi-disciplinary foot clinic has been established in the national Diabetic Foot Centre at the Georgetown Public Hospital Cooperation and the foot care program has been expanded to various Guyanese administrative regions [20]. This is a step in the right direction to improve foot care and health. Following establishment of MDFC at GPHC, the mean monthly number of amputations has reduced significantly from 7.95 to 3.89 [17].

Referral pathway for diabetic foot

NICE guideline recommends for all diabetic foot problems and referral should be made within 1 working day to the multidisciplinary foot care service [5]. There should be rapid access to podiatry for assessment of patients and if required, referral to MDFC at by the podiatrists without the need to involve anyone else [16]. In developing countries, various models of pathway have been tried such as 'Step

by Step', in India, Pakistan, Congo, Tanzania and Mali [22]. Similarly, in Guyana, "The Guyana Diabetes and Foot Care Project" has been successfully implemented to improve pathway of care [20].

Offloading of foot with ulcers

Offloading is one of the most important interventions needed to heal a neuropathic plantar foot ulcer [23]. This can be non-removable as total contact cast [24] or other removable casts [25]. In Guyana, the foot clinic at GPHC and other regional centres encourages the adaptation of more cost effective wound-care offloading practices using commercially available (Darco) wound care sandals at a fraction of the price. Casting is also used with the training to cast room technicians [20].

Diabetic foot infection management

Diabetic foot infection is the most frequent diabetic foot complication which requires hospitalization and the most common precipitant for lower extremity amputation. Outcomes for patients presenting with an infected diabetic foot ulcer are poor. As such, it should be treated promptly with an antibiotic agent based on the likely or proven causative pathogens and their antibiotic susceptibilities and the clinical severity of the infection. The choice depends upon drug allergy, agent availability and financial costs. Some agents to consider include penicillin, cephalosporin, carbapenem, metronidazole, clindamycin, linezolid, fluoro-quinolones either alone or in combinations. Antibiotic therapy should initially be given by the parenteral route for a severe diabetic foot infection [26]. In a prospective cross-sectional study in Guyana, out among 102 diabetic foot ulcer swabbed, *Pseudomonas aeruginosa* (18.8%) was the most common isolated, followed by *Escherichia coli* (13.9%) among gram negatives, and Methicillin-resistant *Staphylococcus aureus* (MRSA) (12.1%) followed by Methicillin-sensitive *Staphylococcus aureus* (MSSA) (7.9%) were dominant among gram positive group. Almost 42.1% (95% CI 34.8 - 49.6) of the infections were caused by poly-microbial and 38.2% had multiple drug resistance [7]. This is suggestive of previous antimicrobial use in this group of patients. Therefore, it is important to follow strict guidelines involving multidisciplinary foot teams to improve outcomes of diabetic foot infections.

Debridement of ulcers

Debridement involves the removal of surface debris, slough, and necrotic tissue and leave the viable tissue to support healing. This will lower the burden of bacterial load and stimulate the release of various growth factors. The different techniques to undertake debridement include mostly surgical, but occasionally, biological using larvae or other agents such as hydrogels or enzymes [27]. Previously in Guyana, the implementation of "The Guyana Diabetes and Foot Care Project" surgical debridement took place in poorly lit and unsanitary wards. Moreover, it had to compete with other surgical emergencies in the operating rooms [17]. This procedure has now been improved at the foot clinic at GPHC.

Dressing of ulcers

Dressings are almost always used in ulcer care for the provision of comfort, protection of the ulcer, and exudate control. Basic contact dressings are often used but advanced dressings such as alginate, hydrogel, films, hydrocolloid and foam are increasingly used in most developed countries. Some dressings contain agents with antimicrobial properties (honey, iodine, silver, poly-hexamethylene) and some contain agents designed to alter the biology of the chronic wound, for example influencing surface protease activity. There is currently no robust evidence for differences between wound dressings for any outcome in foot ulcers in people with diabetes [28]. There is emerging evidence of newer types of dressing which can modulate wound environment and promote healing [29]. There are no data available on the use of dressing materials in Guyana for the treatment of diabetic foot. Practitioners need to consider the unit cost of dressings, their management properties and patient preference when choosing dressings [28].

Access to vascular service

It is estimated that in middle- and high-income countries, up to 50% of patients with diabetes and foot ulceration have underlying peripheral artery disease (PAD), whereas neuropathic ulcers are possibly more prevalent in low-income countries. In patients with diabetes, PAD may remain undiagnosed until late as many patients may lack the classic symptoms of PAD such as claudication or rest pain [30]. Simple diagnostic tests, as Doppler, may be less reliable due to the presence of medial arterial calcification and peripheral oedema. However, it is important to identify PAD in patients with diabetic foot ulceration at the earliest possible stage, as the presence of PAD is associated with increased risk of non-healing ulcers, infection, and major limb amputation [31]. NICE guideline suggests duplex ultrasound followed by contrast-enhanced magnetic resonance angiography or computed tomography angiography to assess PAD [32]. Patients with diabetic foot ulcer and PAD have critical limb ischaemia and should be offered all options for revascularisation such as angioplasty or bypass surgery by a vascular multidisciplinary team before major amputation is considered [32]. The majority of ulcers in developing countries are neuropathic with good peripheral circulation. However, the access to vascular service is limited with public claiming that there are no vascular surgeons in Guyana [33]. There is an urgent need to recruit and train vascular surgeon to develop this service in order to reduce amputations. A recent study conducted at GPHC in Guyana showed the presence of PAD to be 48.6% amongst patients with diabetic foot ulcer [34]. Interestingly, one of the main risk factors for PAD is smoking which was present in 38.6% of these subjects [34].

Access to therapeutic footwear

The International Working Group on Diabetic Foot (IWGDF) recommends therapeutic footwear which can relieve pressure to a diabetic person who has healed from foot ulcer or is at moderate risk for foot ulceration [15]. There are no data on the access to custom made footwear in Guyana. Regular debridement of callus and use of trainers should be encouraged for high-risk diabetic foot. In the presence of recurrence of ulcer, professional Orthotists should be trained to measure and make the shoes for diabetic foot patients.

Research and audit

Most of the research in diabetic foot have been conducted in developed countries using expensive therapeutic interventions. They also have good system of monitoring outcome [35]. This is not always applicable in a low income developing countries like Guyana where the population is different, and the affordability of expensive intervention is limited. Conducting any research in diabetic foot problem is difficult as there are many pathological processes involved, variation amongst various population, difference in outcome reported and multiple disciplines involved in the management of diabetic foot disease. However, good quality research studies addressing local issues are important to understand the best suitable treatment for Guyanese people with diabetic foot problems [36]. In addition, a robust audit is necessary to establish if these research recommendations and guidelines are implemented at the local level.

Affordability

The direct cost of treating diabetic foot complications are extremely high. In the United States, a total of $176 billion is spent annually on direct costs for diabetes care. Moreover, as much as one third of this expenditure is lower-extremity–related, constituting a substantial cost to society [18]. The latest data from the U.K. estimate that the total annual cost of management of diabetic foot ulcers exceeds $1.32 billion and represents almost 1% of the total National Health Service budget [4]. The total cost of treating diabetic foot ulcer patients are five times higher when compared to patients without foot ulcers. In Trinidad and Tobago, a Caribbean nation next to Guyana, the Government spends USAD $85 million/year, or 0.4% of their gross domestic product, exclusively to treat patients hospitalized for diabetic foot infections [37]. Currently, there are no data available on the cost of treating diabetic foot problems in Guyana but if we extrapolate the data of the expenditure in diabetic foot with Trinidad and Tobago then it will be around USAD$75 million annually.

Conclusion

Generally, diabetic foot infections and ulcers can be easily treated and improved once the treatment is appropriate thereby allowing the patients with diabetes to live longer and enjoying a better quality of life. In the Guyanese population, as its health and social care improve, the foot problem is expected to decrease. The cost of active diabetic foot ulcer management can be very high, so it is essential that health care professionals and patients are educated in self-care management and the prevention and early diagnosis and treatment of this debilitating condition. Smoking and excess alcohol consumption, which are widely prevalent in this population should be actively discouraged. It is essential that the professionals must agree on guidelines for management of diabetic foot problems in Guyana, which is updated with new research findings that are applicable to local population. In addition, a robust method of data collection should be established so that appropriate intervention can be directed to those health economy areas where there is an urgent need.

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