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Review

Dermatological and musculoskeletal assessment of diabetic foot: A narrative review

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ABSTRACT

Aims: Diabetic Foot Syndrome (DFS) is the most costly and devastating complication of diabetes mellitus (DM), which early effective assessment can reduce the severity of complications including ulceration and amputations. This study aimed to review dermatological and musculoskeletal assessment of diabetic foot.

Materials and methods: In this review article, we searched for articles published between March 1, 1980 and July 28, 2015 in PubMed, Science Direct, Embase, Web of Science, and Scopus, for both English and non-English language articles with the following keywords: “Diabetic foot syndrome”, “Ulceration”, “Amputation”, “Foot assessment”, “Skin disorders” and “Musculoskeletal deformities”.

Results: In dermatological dimension, most studies focused on elucidated changes in skin temperature, color, hardness and turgor as well as common skin disorders such as Diabetic Dermopathy (DD), Necrobiosis Lipoidica Diabeticorum (NLD) and Diabetic Bullae (DB), which are common in diabetic patients and have high potential for leading to limb-threatening problems such as ulceration and infection. In musculoskeletal dimension, most studies focused on range of motion and muscle strength, gait patterns and as well as foot deformities especially Charcot osteoarthropathy (COA), which is the most destructive musculoskeletal complication of diabetes.

Conclusion: DFS as a common condition in DM patients lead to ulceration and lower limb amputation frequently unless a prompt and comprehensive assessment was taken. So that dermatological and musculoskeletal assessments are usually neglected in primary health care, these assessments should be done frequently to reduce the high risk of serious complications.

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Abbreviations: DM, diabetes mellitus; IDF, International Diabetes Federation; DFS, Diabetic Foot Syndrome; DD, Diabetic Dermopathy; NLD, Necrobiosis Lipoidica Diabeticorum; DB, Diabetic Bullae; IRT, Infrared Thermometer; LCT, Liquid Crystal Thermography; DMI, Diabetic Muscle Infarction; DD, Dupuytren's Disease; CTS, Carpal Tunnel Syndrome; ROM, Range of Motion; COA, Charcot osteoarthropathy.

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1. Introduction

Diabetes mellitus (DM) is one of the most prevalent metabolic disorders, characterized by elevated levels of plasma glucose, results from the absence or scantiness of insulin secretion with or without concurrent impairment of insulin action [1,2]. This disease is considered as one of the main problems in health systems, and a global public health threat, which its prevalence has increased dramatically over the past 2 decades [3,4]. The latest estimate from the International Diabetes Federation (IDF) indicates a global prevalence rate of 8.4% in adults, and 382 million cases of diabetes in 2013 [5]. Based on current tendencies, it is estimated that this rate will be doubled by 2050 [6].

DM is responsible for significant mortality and morbidity in human populations worldwide [2]. This ailment is considered as the sixth and seventh leading cause of death in Canada and the United States, respectively [7,8]. In addition, DM as one of the most cost demanding health conditions imposes a large economic burden to the healthcare system, most of which is the monetary value associated with disability and loss of life as a result of the disease itself and its related complications [9].

Long-standing DM can lead to permanent and irreversible functional changes and damage the cells of the body, thereby leading to various complications such as: blindness, cardiovascular diseases, end stage renal diseases, hypertension, stroke, neuropathy, premature death and Diabetic Foot Syndrome (DFS) [8,10,11].

DFS defined as the foot of a diabetic patient that has the potential risk of pathologic consequences including infection, ulceration, and/or destruction of deep tissues associated with neurologic abnormalities, various degrees of peripheral vascular disease, and/or metabolic complications of diabetes in the lower limb [11,12]. DFS is one of the most common complications of DM which involve more than half of these patients during their life [13]. Currently, DFS is considered as key contributors to medical costs, as 50% of all inpatient admissions in diabetes clinics are due to foot complications such as ulceration and amputation [14]. This syndrome is the principal reason of non-injury legs amputations, and accounts for most of diabetes-related hospitalizations in developed countries [12].

1.1. Etiology of diabetic foot syndrome

The three main important factors related to the development of DFS are neuropathy, peripheral arterial disease and infection [12,15]. The most common pathway to foot problems is peripheral sensorimotor and autonomic neuropathy, leading to loss of sensitivity, foot deformities, high foot pressure and dry skin. Furthermore, peripheral arterial disease, which is more frequent and more serious in the diabetic population, delays cicatrization and causes gangrene and finally amputation [16,17]. Infection is also a major factor for foot problems because of its risk of spreading into deep tissue and bone, which increases the risk of amputation [12].

Beside the three main factors, recent studies have shown another risk factors associated with DFS development [18,19]. Investigations have indicated that diabetes foot complications are associated with smoking, elevated systolic blood pressure, dyslipidaemia, lack of physical activity, limited joint mobility, trauma, improperly fitted shoes, history of prior ulcers and amputations as well as impaired visual acuity [11,20,21].

2. Evidence acquisition

In this review article, we searched for articles published between March 1, 1980 and July 28, 2015 in the following five electronic databases: PubMed, Science Direct, Embase, Web of Science, and Scopus, for both English and non-English language articles with the following keywords: “Diabetic foot syndrome”, “Ulceration”, “Amputation”, “Foot assessment”, “Skin disorders” and “Musculoskeletal deformities” as the medical subject heading (MeSH). Study designs that were included were randomized controlled trials (RCTs), case-control studies, cohort studies, prospective and retrospective uncontrolled studies, cross-sectional studies, and review studies. Case reports and case series were excluded. We searched bibliographies for all retrieved and relevant publications to identify other studies.

3. Review

3.1. Assessment of diabetic foot

Despite the frequency of complications involving diabetic patient’s lower limbs, the assessment of their feet is neglected in primary health care frequently [22]. Studies have demonstrated that fewer than 50% of diabetic patients received appropriate foot assessment as part of their annual medical checkups by medical staffs [20,23–25]. In one study, lhaka et al. with a modified classification tool of foot risk status determined that 60% of DM patients have not received regular podiatric screening [26]. Furthermore, since neuropathy removes the pain that would normally alert diabetic patients, they are often unaware of serious foot problems and ignore regular checkup. It is reported that patients with diabetic foot ulcers do not know that they had ulcers until they were advised by physicians [22]. So, it is so important for DM patients to assess their feet regularly.

Today, studies have indicated that good screening and assessment of patients at high risk of foot complications is associated with a 25–60% reduction in lower extremity amputations [27]. Although there have been no randomized clinical trials that can provide ideal frequency of foot examinations, current international guidelines recommend that in order to prevent major foot complications, all people living with type 2 diabetes should receive at least on time comprehensive annual foot examination [21]. Generally, the approach to assess diabetic foot varies from one hospital to another and is determined by the health care professional’s own preferences and the availability of some techniques. Totally, assessment of the lower extremity of diabetic patients includes dermatological, vascular, neurologic and musculoskeletal assessments, which due to most studies focus on vascular and neurologic assessments, this article aimed to provide an overview of dermatological and musculoskeletal assessments of diabetic foot.

3.2. Dermatological assessment

Studies have demonstrated that approximately 70% of patients with DM had pathologic skin changes [28], and 30–91% of them experience at least one dermatologic complication during the course of their disease [29]. The main mechanism for the skin changes seen in DM is thought to be non-enzymatic glycosylation

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