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Review article

Charcot Foot Screening Algorithm in Type 2 Diabetic Patients

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Abstract

Diabetic neuropathy is the most prevalent complication of type 2 diabetes, affecting up to 50% of all diabetic patients. Peripheral neuropathy, meaning peripheral nerve damage, causes significant issues such as nonhealing wounds, major infections, and amputations. Another consequence of peripheral neuropathy can be Charcot Neuropathic Osteoarthropathy (CN), commonly referred to as Charcot foot, which involves the soft tissue and bones of the foot and ankle and leads to permanent deformities. This condition may ensue if the bones in the feet suffer fractures and the foot becomes misaligned. According to the World Health Organization, up to 50% of type 2 diabetic patients develop neuropathy, which may cause infections, amputation, and Charcot foot. Early recognition and care are essential for treatment of Charcot foot and prevention of further injury. Due to the complexity of this potentially life-threatening complication, assessment is challenging, especially when practitioners who treat adult diabetic patients may not be familiar with Charcot foot. The purpose of this article is to discuss the use of monofilament testing for diabetic neuropathy, increase awareness of Charcot foot and introduce a Charcot foot-screening algorithm.

Introduction

Peripheral Nerve Damage Prevalence and Incidence

The American Diabetes Association reports that approximately 60–70% of people with diabetes will develop peripheral nerve damage, which can lead to Charcot foot with an estimated 0.5% of those patients actually developing the condition. In most cases, the onset occurs after the age of 50 and in those patients diagnosed for more than 15 to 20 years [1]. Despite the fact that uncontrolled diabetes and loss of proprioception is the main contributing factor leading to Charcot, other predisposing elements may increase the risk such as widespread atherosclerosis, inflammation caused by minor injury, infection, ulceration, or any other disorder in which blood flow is impeded [2].

Therefore, discovering the underlying etiology is a crucial aspect in successful treatment. The incidence and prevalence of Charcot is not known exactly but is estimated that approximately 0.8-8% of the diabetic population are affected. Diabetic patients are demonstrating a diagnosis with radiographic studies in 10% of cases. In addition, studies have shown men and women are equally affected and typically have had diabetes for at least 10 years and are between the ages of 50-70 [3]. Despite the fact that uncontrolled diabetes and loss of proprioception is the main contributing factor leading to Charcot, researchers now believe other predisposing elements may increase the risk such as widespread atherosclerosis, inflammation caused by minor injury, infection, ulceration, or any other disorder in which blood flow is impeded [2]. Discovering the underlying etiology is a crucial aspect in successful treatment.

Impact of Charcot Foot

Charcot is a devastating complication of diabetic peripheral neuropathy and not only may affect a person's physical appearance and their ability to work; it also has the potential of having a significant effect on their mental capabilities. Patients may have feelings of depression, guilt from financial strains, and isolation. In addition, patients suffering from Charcot experience a high rate of depression and anxiety due to physical mobility restraints and chronic pain. Male patients are even more at risk of complications due to an inability to work and provide for their families financially [4]. Finally, studies show that mortality rates of individuals with Charcot foot are significantly higher than those who have simple

diabetic foot ulcerations and those with type 2 diabetes not suffering foot complications at all. The comparable rates are 28.3, 37.0, and 18.8% [5].

Risk Factors

There are varieties of risks factors associated with the development of Charcot arthropathy and occur in patients with peripheral neuropathy resulting from diverse conditions including diabetes mellitus, leprosy, syphilis, poliomyelitis, chronic alcoholism or syringomyelia. Repetitive microtrauma that exceeds the rate of healing may also cause fractures and dislocations as well as changes in circulation causing resorption of bone, weakening the bone and increasing susceptibility to fracture and dislocation" [6]. Other contributing factors may consist of sprains or other injury, which goes unnoticed because of sensory impairment. Continued pressure on the foot while walking may worsen the extent of the injury with subsequent dislocation or fractures in one or more bones of the foot or ankle.

Signs and Symptoms

In 1966, orthopedic surgeon Sidney Eichenholtz identified three stages of Charcot arthropathy [7]. Progression through these stages can range from a few weeks to many years. The three stages are: development (I), coalescence (II), and reconstruction and reconstitution (III). Stage I clinical findings include swelling, erythema, warmth, and ligamentous laxity. Stage II findings include decreased warmth, swelling and erythema. Stage III findings include absence of warmth, swelling and erythema, and may include a fixed joint deformity [8]. People living with Charcot foot may be untouched with symptoms at first development (Development stage I). Symptoms of further development may include: foot deformity with elevated arch; foot drop, which is an inability to hold the foot horizontal); "Slapping" gait (feet slap on the floor when walking due to foot drop); muscle atrophy in the lower extremities, leading to thin calves; numbness in the feet; balance or gait instability. Advanced development may include joint dislocation; heat insensitivity in the foot; joint instability; erythema; bounding pulses; edema of the foot and ankle (caused by leakage of synovial fluid from the joint capsule); and subluxation (bone misalignment from a joint).

Complications

Charcot foot in patients left untreated or misdiagnosed may develop serious complications including the following: ulcerations, especially if foot deformity is present or if there is a delay in diagnosis during early stages, calluses, bony protrusions (These have a greater risk of infection if friction persists for an extended period on the inner portion of the shoe). Compression of blood vessels and/or nerves, osteomyelitis (Bone infection), impaired or loss of sensation in the foot, and loss of foot function may also develop if no treatment is started.

Prevention

To prevent the formation of Charcot, patients in the diabetic population, or any person with peripheral neuropathy, should follow a strict foot regimen including daily inspection in an effort to reduce the incidence of foot, metatarsal, and lower extremity amputation. This regimen consists of daily foot self-exams, wearing closed toed shoes at all times, avoid going barefoot (Even indoors), seeking medical attention immediately if any open sores, injury, or changes to the appearance of the foot or ankle, keeping feet clean and dry, and avoiding moisture. Referral is also a key component in preventing Charcot. Patients considered being at high risk for developing ulceration, infection, and Charcot arthropathy deformities need referral to a group of specialists who focus on mechanical, medical, and surgical intervention in the treatment of the diabetic foot and lower extremity [9].

Treatment

Presently, there are numerous treatment methods available for treatment of Charcot foot with the primary goal being joint stabilization. Although there are currently no known treatments to stop or slow the progression of Charcot foot, research efforts continue in hopes of finding a solution. Recovery period may extend upwards of eight weeks or longer in the acute stage, during which time patients will be required to be non-weight-bearing. Treatment options for non-surgical interventions include:

- Immobilization
- Custom shoes and bracing
- Use of crutches, casts, and wheelchair used to protect foot
- Limiting activities that cause the condition

Although surgical treatment is an option, treatment is primarily non-operative due to the added factor of diabetes associated poor wound healing. Conservative treatment of Charcot foot relies on halting the destructive phase of progression, and then protecting and supporting the joints throughout the healing process. Other activities to assist in maintaining muscle strength include physical and occupational therapy, as well as physical activity directed toward improving independent functioning. Treatment plans can be broken into two phases, acute and post-acute. Charcot foot is inactive in the acute treatment phase, usually three to six months. In addition, immobilization will help to prevent further destruction. The goal in the treatment of Charcot foot is offloading the foot, treat bone disease, and prevent further injury. An offloading cast will help reduce pressure on the foot, improve healing foot ulcers, and reduce deformity during the active stage.

American Diabetes Association Recommendations

Since Charcot foot in the diabetic patient poses many clinical diagnosis and management challenges, the American

Diabetes Association [ADA] task force met in 2011 and created recommendations for appropriately managing this devastating lower extremity complication of diabetes, which is serious and potentially limb-threatening. Rogers, et al. [10] lists the ADA recommendations.

Diagnostic Recommendations for Active Charcot Foot

- Clinical assessment and patient history allow for diagnosis of active Charcot foot, but imaging will confirm this diagnosis.
- The earliest clinical manifestation is inflammation, which is an important aspect in the pathophysiology of Charcot foot.
- Due to the inflammatory process of bone healing, Charcot foot may be in the acute phase despite the absence of deformity.
- Healthcare providers should observe for subtle fractures or subluxations with radiologic imaging.
- Confirm clinical suspicions with Magnetic Resonance imaging (MRI) or nuclear imaging in the presence of normal-appearing radiographs.
- Recommendations for Medical Therapy
- Foot offloading and immobilization are the most vital treatment recommendations in active Charcot foot and have the potential of preventing further destruction.
- Little evidence is available to guide in the use of available pharmacological therapies to promote healing of Charcot foot.
- Weight-bearing devices such as braces, prescription shoes, boots, or other protective measures are required post-active occurrence
- Lifetime monitoring for diabetic foot complications, recurrence, or new signs of Charcot foot.

Charcot Foot Screening Algorithm

The clinical algorithm (Flow chart) is a text format that is specifically suited for representing a sequence of clinical decisions, for teaching clinical decision making, and for guiding patient care [11]. The Charcot Foot Screening Algorithm, which provides a clear guidance of treatment recommendations based on assessment findings. The algorithm guides practitioners in the care and treatment of patients based on assessment findings.

Relevance to Nursing Practice

Because type 2 diabetic patients are at risk for numerous multisystem complications, all healthcare personnel, including nurse practitioners, have a responsibility to patients to be knowledgeable and competent in advanced assessment skills in hopes of preventing further complications. According to Rogers, et al. [10], "The Charcot foot in diabetes poses many clinical challenges in its diagnosis and management. Despite the time that has passed since the first publication on pedal osteoarthropathy in 1883, we have much to learn about the pathophysiology, and little evidence exists on treatments of this disorder." Identification of Charcot foot in its early stages is crucial to successful treatment. Refer patients to a podiatric specialist at the first indication or onset of symptoms. Diagnosis may often be challenging, mimicking other major conditions such as cellulitis or deep venous thrombosis since definitive diagnosis of a Charcot fracture cannot be made until bone changes occur. The initial clinical manifestations of Charcot foot are frequently mild in nature; however, they can become more pronounced with repetitive trauma. Worsening usually occurs slowly with age and rapid progression is rare but warrants a prompt re-evaluation. Since undiagnosed Charcot can lead to serious complications including infection, deformity, amputations, disability, loss of employment, financial and mental strains, and life-long devastating effects, it is crucial for practitioners to be knowledgeable and skilled in assessment and treatment methods.

Implications for Change of Practice

Accurate assessment of the diabetic foot is a complex process requiring skill, experience, and knowledge of not only the disease but also signs and symptoms of potential complications. The loss of sensation due to peripheral nerve damage makes it difficult for patients to help providers diagnose developing problems. Patients often present with vague symptoms or non-healing wounds and often unaware of the nature of the initial injury. Consistent and close monitoring of patients with diabetes is crucial. Patient education of Charcot foot symptoms should be included in daily healthcare. According to Meyers [12], by decreasing the incidence of amputations and improving quality of life through education and close monitoring, the result will be a decrease for funds spent long-term for care of the patient with diabetes. However, many clinicians lack experience in the area of Charcot foot assessment and often consider it as simply "A diabetic foot."

Summary

Charcot foot is a devastating and potential life-threatening complication of diabetes and those suffering from peripheral neuropathy. As stated previously, many patients suffering from peripheral neuropathy or impaired sensory perception may experience injuries that are unaware until they begin to see visible signs of trauma such as edema, discoloration, or deformity. For these reasons, patients often times delay-seeking treatment or are treated by healthcare providers with little or no knowledge on the clinical manifestations of diabetic foot complications.

If left untreated, Charcot foot may progress to permanent disfigurement or amputations. Early detection and intervention are the key to preventing this serious condition. The development of an

assessment-screening tool and following ADA recommendations will assist nurse practitioners and benefit the diabetic population. Currently, advanced multiple assessment tools available to specialists in areas such as orthopedics and podiatry. A simple screening tool, along with screening algorithm, assessment and treatment practice guidelines will help identify patients at risk. The goal is for immediate intervention, treatment, and referral to podiatry specialty and prevent further damage or injury. The use of an algorithm to guide the assessment of the foot in a patient with diabetes will guide practitioners in the care and treatment of patients based on assessment findings.

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