

A Recent Overview of Diabetic Foot Diseases

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Abstract

Diabetes Mellitus (D.M) is a chronic metabolic disorder that elevates blood glucose levels, leading to severe systemic and organ damage over time. The global prevalence of D.M exceeds 400 million individuals, with significant impacts on healthcare systems worldwide. In Saudi Arabia, approximately 30% of the population is affected, with 15% of these patients suffering from Diabetic Foot Ulceration (DFU), a severe complication of D.M that can lead to amputations and increased mortality. This paper reviews the diagnosis, classification, management, and prevention strategies for Diabetic Foot Disease (DFD), emphasizing the role of a multi-disciplinary team in enhancing patient outcomes and reducing treatment costs.

Challenges include a lack of double-blinded randomized trials and the need for more robust treatment protocols. Future research should focus on evidence-based practices and patient engagement to improve prevention and management outcomes. This review underscores the critical need for continued advancements in treatment strategies and heightened awareness to mitigate the devastating effects of DFD on patients and healthcare systems

Introduction

Diabetes Mellitus (D.M) is a chronic, metabolic disease that is characterized by increasing the blood glucose level in the blood, resulting with serious damage overtime for the body's system and organs. It's estimated that more than 400 million persons in the world have D.M (World Health Organization, 2019) and about 30% of the Saudi population (Alrashed et al., 2017) and it's considered to be one of the leading cause for death (World Health Organization, 2019).

By 2017, it is estimated that DFD will cost the healthcare system in the United stated more than 327 billion Dollars with a 33% increase compared to the 2007 estimate (Joret et al., 2019).

The aim of this paper is to explore the major methods used to diagnose, classify, management, protection and prevention of DFU and the role of multi-disciplinary team management in increasing the quality of patient's life and reduce the cost of treatment.

Overview and Background

Epidemiology

One of the major and most serious complication of D.M is the Diabetic Foot Disease (DFD) that include ulceration or a full thickness wounds in the distal part of the lower limbs and below the ankle level (Amin & Doupis, 2016), when it was introduced in the 19th century, Diabetic Foot Ulceration (DFU) management was primary consist of prolonged bed rest, until Dr. Frederick Treves (1853–1923) introduced a new methods of treatment that are still being used to date that is consist of : Debridement, Off-Loading and Patient Education (Everett & Mathioudakis, 2018).

It is estimated that 12% to 25% of diabetic patients has DFU, with a slow rate of healing and rehospitalization, DFU is responsible for 40% to 60% of non-traumatic amputation with recurrence rate of 35% within 3 years (Eraydin & Avsar, 2018), and mortality rate associated with DFU estimated to be 5% in the first 12 months and 42% in five years (Everett & Mathioudakis, 2018).

Diabetes Mellitus in Saudi Arabia

It is estimated that up to 30% of the Saudi population are diagnosed with D.M which has a devastating effect in all of the body's organs including the lower limbs, 15% of the Diabetic patient are suffering from DFU, D.M will increase the chance of these patient to have gangrene with up to 40 folds of risk compared to patient with no ulceration. Within 5 years of having an ulcer, patient's survival rates drop to 50% (Alrashed et al., 2017).

Al-Rubeaan et al., reported (as cited by Alrashed, 2017) in his retrospective study that in his survey that include over 62 thousand participant all diagnosed with D.M, only 3.3% had a complication related to their diagnosis as follow: Foot ulcers 2.05%, gangrene 0.19% and amputation in 1.06%.

One of the complications of D.M is the Diabetic Peripheral Neuropath (DPN) which is a leading cause for non-traumatic amputation, 20% of the Saudi diabetic patient were conformed to have DPN, due to that 3970 Saudi patient lose a limb yearly (Alrashed et al., 2017). Alrashed et al., also reported that diabetic Saudi patient suffer from lack of knowledge about the seriousness of their diagnosis and they are not adequately educated despite the major awareness campaign that the health provider organizes.

Diabetic Foot Disease

Ranging from a numbness in the lower limb to a below knee amputation, DFD has a dramatic effect on any patient's quality of life. Apart from ulceration several other complications were identified such as the Peripheral Neuropathy, peripheral vascular disease, loss of sensation and vibration, limited joint mobility, foot deformities and limb loss, this in addition to the clinical manifestation of D.M in the other organs such as visual and kidney impairment (Amin & Doupis, 2016).

Diabetic Foot Ulceration is rapidly increasing wound that will keep growing in depth till sometimes it reaches the bones of the foot if not treated properly, it is estimated that 19% to 34% of diabetic patient will be affected by ulceration during their life time. DFU is responsible for the mortality rate by 5% in the next 12 Month of the happening and 42% within 5 years (Everett & Mathioudakis, 2018).

Peripheral Diabetic Neuropath (PDN) is defined as abnormalities in the peripheral nerve function in diabetic patient and can be diagnosed after excluding other factors that might cause this abnormality. It is considered as one of the most common complication that will last for a long time and might be reversable. Even with minor trauma, the presence of PDN is a major factor to start ulceration of the foot, as it is increasing the chance of ulceration by seven times compared to other diabetic patients. and it is also estimated it is the reason of 45% to 60% of ulceration and cause of 45% in combination with other ischemic factors (Everett & Mathioudakis, 2018).

There are several other complications that is directly related to DFD such as formulation of gangrenous tissue, amputation that can be happened at the level of the foot, ankle, below the knee joint or above the knee joint depend on the severity of the infection and gangrenous tissues. But even if it was treated properly, the recurrence rate is about 40% within the next year (Amin & Doupis, 2016)

Management of Diabetic Foot Disease

At the time of the first discovery of the DFU, the only solution was a prolonged bed rest, however, Dr. Frederick Treves (1853–1923) established what can be considered now as the corner stone of DFU treatment and it was based on three major principle: extensive vigorous debridement, offloading the affect limb and patient awareness and education (Everett & Mathioudakis, 2018).

Identifying the problems and classifying it is essential for any therapeutic intervention to succeed by increasing the knowledge of which modalities serves better at each stage. Wagner-Meggitt classification is the widest in use and it is also one of the earliest classification systems in use currently, it is a 6 stages system that classify based on the depth of the wound: (1) Grade 0: The skin is intact; (2) Grade 1: Presence of ulcer which is superficial; (3) Grade 2: Presence of ulcer which is deep; (4) Grade 3: Deep ulcer with abscess, bone involvement or osteomyelitis;

(5) Grade 4: Gangrene in the forefoot; and (6) Grade 5: Whole foot gangrene (Amin & Doupis, 2016).

Currently there are several ways to manage DFD that ranges from conservative treatment to more aggressive surgical intervention.

Surgical Intervention also known as surgical debridement which is the surgical removal of the dead necrotic gangrenous tissues, tissues that partially affected and adjacent soft tissue that might be compromised. Thus promoting more healthier tissue to grow and decrease the level of infections by building a barrier that allow antibiotics times to take effect. All debridement procedure should take in consideration the possible preservation of the limb function and prevent deformities (Amin & Doupis, 2016).

Medical Intervention is a conservative way to promote healing of viable tissue and using medication to prevent the spread of the infection and maintain health blood supply, all in combination of dressing of the wound and prevent further injuries.

Antibiotics: A well-known factor of poor healing the presence of infectious agent in the wound, the ability to identify and recognize the infectious agent is essential to choosing the appropriate antibiotics medication thus improving the outcome, as choosing the inappropriate medication has an adverse effect. It is recommended the use of antibiotic with the presence of two or more clinical signs of infection such as erythema tenderness and pain and to be used after deep cleaning of the wound and removal of any infectious tissue as recommended by the Infectious Disease Society of America (IDSA) (Tchero et al., 2018).

Dressing: With the goal of providing a wet environment to promote granulation of healthy tissues, there is no fit for all types dressing, the use of collagen materials in DFUs showed a rapid and full healing in the wound management (Hwan Park et al., 2019).

Team approach: It is estimated that in 2017, the cost of treating DFD is 327 billion dollars compared to 174 billion on 2007, and it cost about 23 thousand dollars to treat a single case from discovery to the end of the treatment protocol. In other chronic disease management, the move from doctor-centric approach to a patient centric approach showed to be beneficial both on patient care and on cost effectiveness. Similar in treating DFD, the multi-disciplinary approach has been proven to be both effective and reduce the treatment cost (Joret et al., 2019).

Conservative Intervention with the advance in the medical field, the need for immediate surgical intervention is not indicated in DFD as study have shown the successfulness of other methods.

Negative pressure With new generation of the Vacuum-Assisted closure (VAC) now we can offer a consistence and portable continuous negative pressure to aid woundhealing, increase blood flow and fight infection. VAC compared to conventional dressing only treatment has been proven to be superior and recommended to be used in parallel with other modalities such as antibiotics (Bayoumi, Al-Sayed, & Al-Mallah, 2018).

Ultrasound: In particular a low frequency non-contact airborne ultrasound is now recommended to be utilized in a multi-disciplinary team approach as it provide safe way to be applied to the wound without the

risk of contamination and it does not produce any heat that will cause tissue or vascular damage (Rastogi, Bhansali, & Ramachandran, 2019).

Physical therapy: The amount of blood supply that reach the distal part of the foot as well as the level of blood flow improve the chance of formation of new healthy tissues by also providing the need nutrient and oxygen, as it will improve the blood flow and joint mobility, promoting a healthy life style and prevention of recurrence of foot ulceration and reducing the depth and size of the current DFU, it is recommended that diabetic patient engage in a regular exercise program (Eraydin & Avsar, 2018).

In addition to exercise, patient must maintain a proper medical footwear equipped with rigid rocker sole and appropriate size to prevent any DFU and the recurrence if the patient is at risk (López-Moral et al., 2019). In addition, due to the nature of the ground forces that affect the foot both vertically and horizontally as shear force, shoe medication or the use of walkers that lessen the load on the foot in relation to the location of the wound has been proven to be of value in the treatment protocol of DFU (Everett & Mathioudakis, 2018).

Limitation

The current treatment protocols for DFD and DFU are proven to be successful in treating the complication of D.M, However, there are a obvious shortage of double blinded Randomized studies and establishment of protocol guidelines for both the healthcare worker and the patient and his family. And despite all the awareness campaigns about D.M, the rate of occurrence is keep going up.

Future studies should focus on providing substantial evidence on successful protocols and how we can incorporate the patients and their families in the treatment program.

Conclusion

Diabetes Mellites and its complication on the foot and the rest of the body comes with a devastating effect on the patient's quality of life, the healthcare system and on the economy. The current level of treatment protocol is still short compared to the desired final result. To fill the gap between what we have and what we want, the current medical team should work in a multi-disciplinary approach to properly choose the best current evidence-based practice that will keep the functional level of the patient and maintain the quality of life.

The current literature provides a variety of intervention based on the patient condition and level of injury, however a keen eye must be kept to provide the best and suitable intervention.

With the current level of incidence, the medical community should improve the patient participation and improve the community awareness to prevent the occurrence of foot ulceration and its catastrophic consequences.

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