An Evidence Based Approach to Treating Diabetic Foot Ulcerations in a Veteran Population

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Abstract:

With the advent of evidence based medicine, some physicians have decided to change their practice patterns. At our facility including both residents and students, an evidence-based algorithm for treating diabetic foot ulcers has been developed incorporating published data. Patients are initially assessed and are assigned to a low, moderate, or high risk category. Basic wound care principles are followed (off-loading , moist wound environment, debridement, and control of infection). Vascular assessment is made and if ankle-brachial indices are <0.8, an appropriate vascular referral is made. In the low risk patient, wounds are assessed and measured. If there are minimal changes after 2 weeks, therapy is changed. After 4 weeks, if the ulcer has not decreased more than 50%, a living skin equivalent, such as a single layered dermal equivalent is used. For the moderate to high risk patients, a living skin equivalent is used initially. Expeditious and complete wound healing is the definitive goal in treating DFUs. The longer the ulcer is open, the greater the chance for infection and amputation. Using an evidence based approach helps determine which patients are best suited for Advanced Therapies (Living Skin Equivalents), thereby allowing the clinician to facilitate improved outcomes in healing chronic ulcers in patients with diabetes.

Key words: Ulcer, Algorithm, Diabetes

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Introduction

Data reported as recently as 2007 by the Centers for Disease Control (CDC), has estimated that nearly 7.8% of the US population or about 23.6 million Americans are diabetic, with the population growing at alarming rates leading to severe impacts on American society[1]. According to the CDC National Diabetes Fact Sheet, there were a reported 1.5 million new cases of diabetes in 2006 among individuals 20 years or greater, and diabetes was the 7th leading cause of death listed on 2006 US death certificates[1]. It has been further estimated that by the year 2025 nearly 300 million people worldwide will be diagnosed with diabetes[2], showing that the population of diabetic persons is expected to greatly increase over the next 15 years. Among this population, the lifetime incidence of developing a diabetic foot ulcer (DFU) has been estimated to be as high as 15%[3].

Despite the numerous available treatments, these ulcerations commonly become chronic wounds. This presents a huge burden to patients with diabetes as well as to the healthcare system, with costs estimated at nearly $13,200 per ulcer-related episode[4].

Hospitalization for ulcer care as the reason for hospital admission is $3000 a day and amputations at over $50,000 not considering the collateral risk of revision and mortality.

The most cost effective way to minimize complications is to attain wound closure as expeditiously as possible. Therefore, as the population of diabetic persons continues to rise in the future, finding a method to quickly and adequately close and/or prevent ulcerations will be of the utmost importance.

Based on the 1999 American Diabetes Association[5] consensus statement on DFU care, it is generally believed that foot ulcerations in patients with diabetes become chronic wounds due to the numerous co-morbidities compared to the average patient. Co-morbidities commonly encountered in the diabetic patient include abnormal biomechanics, vascular and/or arterial compromise, diminished protective sensation, renal disease, and altered nutritional status. These factors not only put the diabetic patient at risk for the development of ulcerations, but also impede the effectiveness of treatments.

Typically, conventional care techniques for the treatment of DFUs have focused on four major concepts: debridement of necrotic or devitalized tissue, controlling infection, offloading, and maintaining a moist wound environment. Although there may be variations as to the exact means employed, these concepts have been the basis of several published DFU treatment guidelines. In 2003, Sheehan and colleagues noted that an ulcer that fails to reduce in size by at least 50% at the 4 week mark has less than a 10% chance of closing by 12 weeks with good conventional care.[6]

The authors of this study therefore felt that achieving at least a 50% reduction in wound size in 4 weeks time could strongly predict whether a wound will go on to closure. In 2006, the Wound Healing Society published evidence-based treatment guidelines supporting the re-evaluation of wound treatment for chronic wounds that have shown less than 50% reduction in area after 4 weeks of treatment with standard care methods alone.[7] This was based on data collected in a prospective multicenter study of 203 patients with DFU's, which suggested that the four week mark is a good point to evaluate wound healing. It is at this juncture, the failure of a wound to reduce in size by 50% in 4 weeks, that Boulton et al suggested the use of additional advanced wound care products[8]. Such products include Pre-market approval (PMA) approved products, negative pressure, hyperbaric oxygen (HBO) and pulsed radio frequency therapies. Such advanced therapies could therefore be considered to achieve wound closure in a timely manner, and thus prevent any further morbidity so commonly associated with chronic DFUs.

Aims

With the advent of Evidence-Based Medicine (EBM) and the importance that this evidence has in directing patient care, many physicians have begun to take a step back and revaluate their practice patterns. Therefore, the aim of this work is to provide a reference and guidance (algorithm) to what the data indicate regarding timeliness and treatment options, realizing that no two patients are the same and all care should be individualized to the patient

Methods

Utilizing the evidence that has been published, our algorithm (Figure 1) has been developed and is currently being used for the treatment of numerous DFUs. The systematic approach begins with initial patient assessment in which patients are classified, based on clinical criteria, as being either low risk or moderate to high risk DFU patients. Low risk DFU patients are generally patients who develop new foot ulcerations, without a previous history of ulcerations, show no evidence infection being present, and who have documented palpable pedal pulses. Patients that fall into the moderate to high risk category tend to be patients with wounds probing to bone, ulcerations greater than 30 days duration, or patients with additional co-morbidities including renal disease, a previous history of ulceration or amputation, an elevated HbA1c, and decreased albumin/prealbumin levels.

Anyone with one or a combination of these factors is someone who may be at a higher risk for experiencing a non-healing ulceration and therefore, may have a greater chance of developing a serious complication.

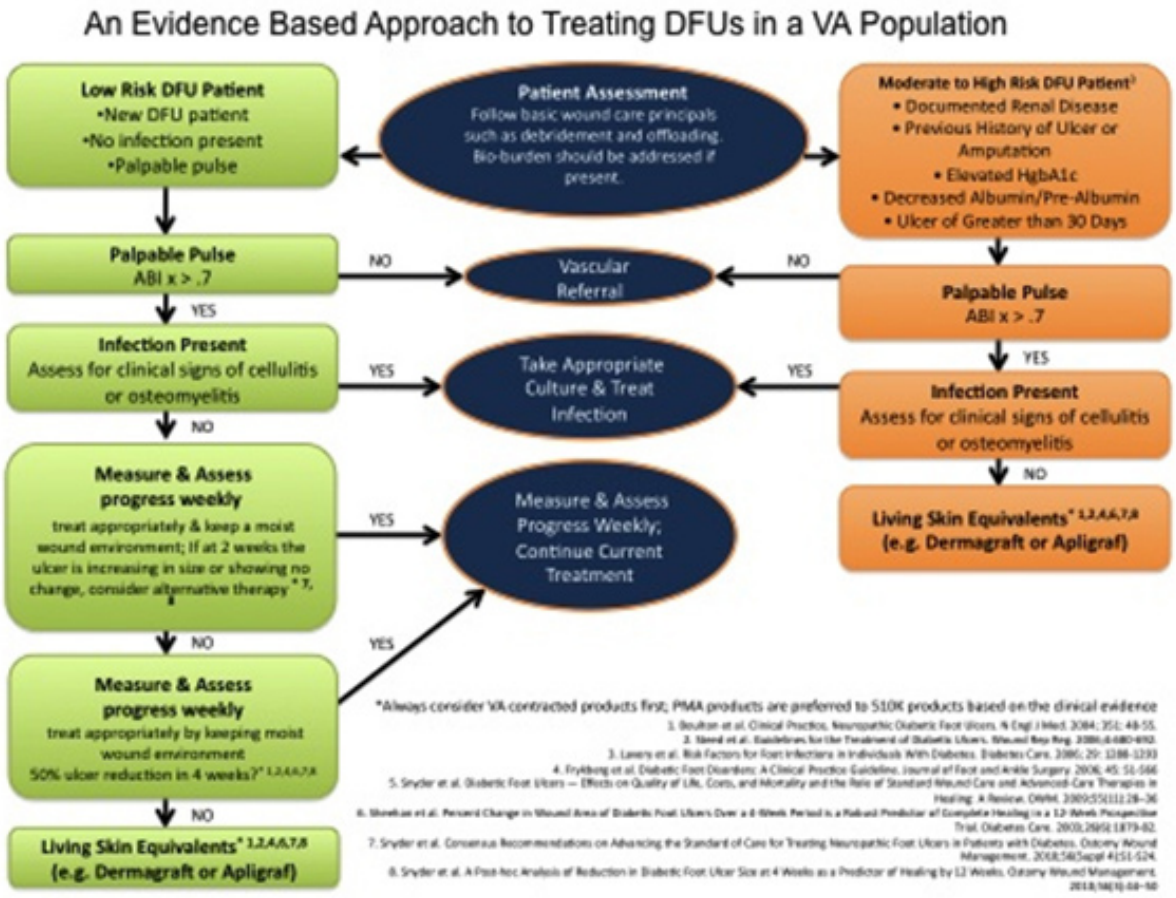

Figure 1: Evidence Based Approach Algorithm to treating DFUs

After the initial patient assessment, a complete medical history and exam along with a comprehensive lower extremity exam is performed. The lower extremity exam includes a visual assessment of the lower extremity, vascular assessment with a Doppler probe, and a neurological exam, including 10-G monofilament assessment, vibratory sensation, proprioception, and reflex testing. , The orthopedic exam includes testing of muscle strength, gait analysis, range of motion of the foot and ankle, as well as visual inspection for any structural deformities, such as bunions or hammertoes. From this history and physical assessment, patients can be assigned a risk category which will direct what treatment path to follow. Basic wound care principles are followed for both groups and include debridement of necrotic and devitalized tissue, infection control, offloading of the ulceration, and maintenance of a moist wound environment. Throughout the treatment, vascular assessment is made and monitored. For any patient with an ankle brachial index (ABI) measurement of less than 0.8, an

appropriate vascular referral is made. Infection is also closely monitored and patients are assessed at each visit for signs of cellulitis or osteomyelitis. Controlling infection is extremely important as several studies have found infection to be strongly correlated with increased risk of amputation[9]. In fact, a large cohort study conducted by Lavery and colleagues (2006) found that an infected DFU increased the risk of hospitalization by nearly 56 times and amputation by nearly 155 times.[10] Interestingly, all independent risk factors for infection identified in the study mirror the at-risk comorbidities or patient history (ulcer probing to bone, ulcer history of greater than 30 days, peripheral vascular disease, recurrent ulcer and traumatic etiology) that place our Veterans in a moderate to high risk category. One thing that also needs to be considered is that many of our patients present with multiple risk factors that multiply their risk for complications. Signs or symptoms of infection that most commonly present with DFUs include: increased redness, increased warmth, swelling, purulent exudate, increased pain or tenderness, and constitutional symptoms (nausea, vomiting, fever, chills). With the development of these symptoms, wound cultures are taken and confirmed infections are treated with appropriate measures.

For low risk patients, the algorithm specifies that wounds are measured and progress is assessed weekly. Wounds are treated appropriately following conventional wound care guidelines, and, if at 2 weeks the ulcer is increasing in size or showing no change, an alternate form of therapy may be considered. As long as the wound continues to show weekly progress, the current form of treatment is continued. At 4 weeks, if the wound does not show at least 50% reduction in ulcer area, an advanced form of therapy, such as a living skin equivalent (LSE; i.e. Dermagraft® or Apligraf®), is recommended due to the stagnant nature of the wound. Again, as long as the wound shows at least 50% reduction in area in 4 weeks, the wound is measured or assessed weekly and the current modality of treatment is continued. For moderate to high risk patients, the algorithm outlines that in these patients an advanced form of therapy, such as an LSE, should be used initially as long as infection is controlled and appropriate vascular status is present. While these moderate to high risk patients are often excluded from Food and Drug Administration (FDA) clinical trials, we have seen good success with a human fibroblast derived dermal substitute (i.e. Dermagraft®) at closing ulcers and reducing complications.

The typical requirement for FDA approval is to demonstrate a 12-week closure mark significantly faster than conventional wound care. The LSEs have demonstrated faster closure when used weekly per FDA approvals to treat DFUs. They have also proven to reduce the complications such as infection and amputation. Negative pressure and pulsed radio frequency are not approved under the PMA process because they are not intended to provide direct closure. There is also reported clinical experience in using the human fibroblast-derived dermal substitute in combination with both therapies to promote closure in patients with exposed bone and deep wounds.[11,12] Collagen-based products and extracellular matrix products are considered alternative dressings because they provide collagen to the wound. While they can be beneficial to some patients they have not demonstrated faster closure than wet-dry dressings in FDA approved trials.

Results

Within our clinic, we have noticed that by employing this evidence based algorithm, we have been able to significantly reduce our closure time of chronic DFUs. By expediting the rate of closure, we have been able to reduce the infection rate, decrease the level of hospitalizations due to complications of chronicity, and reduce the overall number of clinic visits in our diabetic patient population.

Conclusion

Expeditious and complete wound healing is the definitive goal in the treatment of DFUs. The longer a wound remains open, the greater the risk of complications, such as infection and subsequent amputation. Using an evidence-based approach helps determine which patients and when those patients are best suited for advanced therapies such as LSEs. This therefore allows the clinician to facilitate improved outcomes in healing chronic ulcers in patients with diabetes. By following this algorithm it is possible to increase closure rate of DFU's, decrease complications associated with chronic ulcers, as well as prevent future amputations which often are the result of longstanding DFUs.

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