The Diabetic Foot Ulcer — Can Diet Make a Difference?

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The statistics are shocking: 25.8 million Americans, or 8.3% of the population of the US, has been diagnosed with diabetes.1 Among the complications of the disease are diabetic foot ulcers (DFUs), which affect as many as 20% of patients with diabetes during their lifetime.2 DFUs can significantly impair a patient’s quality of life, require prolonged hospitalization, involve infection and gangrene, and may ultimately result in amputation.

The National Pressure Ulcer Advisory Panel (NPUAP) has established evidence-based nutrition recommendations for the prevention and treatment of pressure ulcers. These guidelines focus on increasing micro- and macronutrients to promote wound healing.3 Unfortunately, no such guidelines exist for treating DFUs, and it is unclear if recommendations for pressure ulcers can be extrapolated to DFUs. However, it appears that nutrition does play an important role. A poor diet can result in altered immune function, malnutrition, and poor glycemic control, all of which are risk factors for poor healing.4,5 Achieving and maintaining a healthy body weight can help maximize wound healing because glycemic control can be negatively affected by obesity.6 Healthcare professionals (HCPs) should encourage patients with DFUs to consume a healthy diet that contains nutrient-dense foods. A registered dietitian (RD) skilled in medical nutrition therapy for diabetes can assess, treat, and monitor patients with DFUs to help them meet their complex nutritional needs.

Immune Function and Malnutrition

Compromised immune function is one factor associated with nonhealing wounds; it affects wound healing in a number of ways.7 Protein-energy malnutrition is associated with impaired immuno competence, including depressed cell-mediated immunity and phagocyte dysfunction.7 Malnutrition also makes a person more susceptible to infection.8 Infection, whether systemic or localized in a DFU, can have an impact on wound healing because of the stress it places on the body. A diet that provides adequate protein, calories, vitamins, and minerals can help maximize immune function.

Nutrient deficiencies can affect the complex process of wound healing in a multitude of ways.9 Malnutrition and/or nutrient deficiencies can impair collagen synthesis, prolong inflammation, decrease phagocytosis (causing dysfunction of B and T cells), and decrease the mechanical strength of the skin.4 Many patients with chronic skin ulcers have altered nutritional status; in one study, malnutrition was identified in 62% of persons with a DFU and was a predictor of poor outcome.10 To maximize pressure ulcer healing and meet nutritional needs, the NPUAP recommends 30 to 35 calories per kilogram of body weight per day, and enough vitamins and minerals in the daily diet to meet the Dietary Reference Intakes for vitamins and minerals.7 Micronutrients involved in wound healing include vitamin A, vitamin C, magnesium, copper, and zinc.9 Supplements of these or other nutrients may be recommended if a deficiency is confirmed or suspected.11 The NPUAP guidelines may be a useful starting point for treatment of the DFU but may need to be adjusted, especially in the presence of impaired kidney function or poor glycemic control.

Glycemic Control

High blood glucose can lead to defective white blood cell function and render a DFU susceptible to infection.2,11 High blood glucose also can affect the production of inflammatory molecules, interfere with collagen synthesis, and change cellular morphology.2 In a recent study at Johns Hopkins, elevated A1c was significantly associated with a poor wound healing rate.12 Food choices, including the timing and carbohydrate content of meals and snacks, can impact glycemic control. Any form of carbohydrate when eaten in excess (including whole grains and not just simple sugars) can affect blood sugars, so portion control of all carbohydrates is important. Choosing whole grain breads and cereals instead of refined grains will provide added fiber, vitamins, and minerals. HCPs can encourage patients to use portions that are outlined by ChooseMyPlate, the US Department of Agriculture (USDA) food guide available at www.choosemyplate.gov/food-groups/. Medical nutrition therapy should include helping patients choose appropriate carbohydrate portions and balance food with oral medication and insulin to help optimize glycemic control.

Weight Loss

All overweight or obese individuals who have or are at risk for diabetes should consider weight loss as part of their treatment plan.6 Studies show that moderate weight loss (5% of body weight) is associated with decreased insulin resistance, improved measures of glycemic and blood lipid control, and...
reduced blood pressure. Unfortunately, many patients attempt to lose weight by restricting calories and/or protein. This practice could result in impaired wound healing because nutrient needs, particularly calories and protein, are elevated in the presence of a wound.

Experts don’t know the optimal mix of protein, carbohydrate, and fat in the diet needed for successful weight loss, but low-carbohydrate diets could have a negative effect on health. The body needs at least 130 g of carbohydrate per day to provide enough glucose for normal bodily functioning. Low-carb diets can limit other nutrients, including dietary fiber, vitamins, and minerals. For safe and effective weight loss for persons with a DFU, a moderate calorie restriction combined with regular physical activity (if feasible) will usually have a positive effect. Patients can be advised to use the Dietary Guidelines for Americans (www.health.gov/dietaryguidelines) (see Table 1) and ChooseMyPlate.gov for guidance on appropriate food choices and portion sizes to help facilitate weight loss.

**Specialized Nutrition Interventions**

**Oral nutrition supplements.** High-protein, high-calorie, nutrient-enriched supplements (referred to as oral nutrition supplements, or ONS) may be recommended between meals if food intake doesn’t meet a patient’s needs for wound healing. ONS can help meet basic needs for weight maintenance in patients with chronic disease and/or those who are experiencing unintended weight loss. They provide additional calories and are a source of carbohydrate and should be recommended in the overall context of a patient’s eating pattern and medications. The effect of high-protein ONS on blood sugars and renal function should be evaluated frequently.

**Amino acids.** Arginine and glutamine are two amino acids that have been studied extensively for their role in wound healing. In addition, beta-hydroxymethylbuterate, which is a metabolite of the amino acid leucine, has been linked with improved wound healing and tissue regrowth. Results of studies of ONS containing these nutrients are mixed, some showing promising benefit and others showing little benefit. Currently, no evidence-based guidelines are available for addressing the safe use and appropriate dosage of these supplements. However, ONS containing these ingredients are available as an option to promote wound healing and often are used successfully with patients with chronic wounds.

**Practice Points**

Nutrition is a critical component of the healing of DFUs, particularly as it relates to immune function, malnutrition, glycemic control, and weight loss and weight maintenance. Recommendations for a healthful eating pattern (following the Dietary Guidelines for Americans and ChooseMyPlate) should be individualized based on protein, calorie and carbohydrate needs, blood sugars, and weight. Nutrition assessment and intervention by a RD can help patients with a DFU maximize their nutritional status to promote wound healing. Long-term randomized trials of individual nutrients and clinically relevant endpoints are needed to show the benefits of nutritional supplementation and dietary interventions. Until they are available, the best evidence suggests the importance of screening every patient for malnutrition, estimating caloric needs, and monitoring dietary intake of essential nutrients to ensure those needs are met.

**References**

Table 1. Dietary guidelines for Americans: 2010 key recommendations

- Maintain calorie balance over time to achieve and sustain a healthy weight
  - Prevent and/or reduce overweight and obesity through improved eating and physical activity behaviors
  - Control total calorie intake to manage body weight
  - Increase physical activity and reduce time spent in sedentary behaviors
  - Maintain appropriate calorie balance during each stage of life

- Focus on consuming nutrient-rich foods and beverages
  - Increase fruit and vegetable intake
  - Eat a variety of vegetables, especially dark-green, red, and orange vegetables and beans and peas
  - Consume at least half of all grains as whole grains
  - Increase intake of low-fat and fat-free milk products
  - Choose a variety of protein foods, which include seafood, lean meat and poultry, eggs, beans and peas, soy products, and unsalted nuts and seeds
  - Increase the amount and variety of seafood consumed by choosing seafood in place of some meat and poultry
  - Replace protein foods that are higher in solid fats with choices that are lower in solid fats and calories and/or are sources of oils
  - Use oils to replace solid fats where possible
  - Choose foods that provide more potassium, dietary fiber, calcium, and vitamin D, which are nutrients of concern in American diets. These foods include vegetables, fruits, whole grains, and milk and milk products