MANAGEMENT OF DIABETIC FOOT COMPLICATIONS WITH ULCERATION

Establishing an interdisciplinary approach is an optimal way to improve clinical outcomes of prophylaxis and treatment of all types of problem wounds. The complex and multifaceted nature of wounds in an individual with diabetes requires a coordinated interdisciplinary approach. The wound treatment team may include some or any of the following disciplines: family physicians, diabetologists, nurses, dietitians, vascular surgeons, podiatrists, wound resource nurse, diabetes educators, and orthotists. (See Appendix 1 for list of professionals).

Additional information pertaining to wound healing and factors that affect healing and the prevention and control of infections is provided in Appendices 6 and 7 respectively.

The following guidelines may be utilized to provide an optimum wound environment for healing:

1. **Wound Cleansing**
   - Do not use skin cleansers or antiseptic agents (e.g. povidone iodine, iodophor, sodium hypochlorite solution (Dakin’s), hydrogen peroxide, acetic acid) to clean wounds with healthy, granulating tissue.
   - Use normal saline, sterile water or non-cytotoxic wound cleansers to clean wounds.
   - Fluid used for cleansing should be warmed to at least room temperature.
   - Cleanse wounds initially and at each dressing change.
   - To reduce surface bacteria and tissue trauma, the wound should be gently irrigated with 100 to 150 mls. of solution.
   - Use enough irrigation pressure to enhance wound cleansing without causing trauma to the wound bed. Safe and effective ulcer irrigation pressures range from 4 to 15 p.s.i. Pressure of 4 to 15 p.s.i. is achieved by using the following held 4-6 inches from the wound:
     - 35 ml syringe with a 19 gauge angiocath or blunt needle, or
     - Single-use, 100 ml. saline squeeze bottle

2. **Wound Dressings**
Consider what you are replacing when you think about selecting a dressing. The skin’s functions are: maintenance of body temperature, protection and immunity, sensory perception, absorption, synthesis of Vitamin D, excretion of waste products, maintenance of body pH and provision of a waterproof layer. The dressing replaces the skin for the time the wound is in situ and so must attempt to manage many of these functions. Additional information is provided in Appendix 8.
There are four guidelines for selecting a wound dressing:

- Function (learn about dressings by function)
- Consider safety, effectiveness, user-friendliness and cost effectiveness
- Change dressings based on an assessment of the patient, the wound and the dressing, not on standardized routines
- Adapt the wound treatment to optimize healing throughout the phases of the healing

Moisture retentive dressings optimize the wound environment and promote healing, provided there is sufficient arterial blood flow to support healing.

Dry dressings are indicated for individuals with insufficient blood flow for wound healing when there is a stable dry eschar in situ or dry gangrene of the toe. In these individuals wounds need to be kept dry, using betadine or Cicatrin powder and gauze dressing.

Did You Know?
Interactive dressings are only recommended when the expected outcome of treatment is healing based on the assessment that there is adequate blood supply to the area.

Consider the following criteria for selecting an interactive dressing:

- Maintains a moist environment
- Controls wound exudate, keeping the wound bed moist and the surrounding intact skin dry
- Provides thermal insulation
- Protects from contamination of outside micro-organisms
- Maintains its integrity and does not leave fibers or foreign substances within the wound
- Does not cause trauma to the wound bed on removal
- Is simple to handle, and is economical of costs and time

Use clinical judgment to select the type of moist wound dressing suitable for the ulcer, considering:

- Etiology of the wound,
- Individual’s general health status, goals of care, and individual choice;
- Individual’s living environment;
- Location of the wound;
- Size of the wound, including depth and undermining;
- Pain;
- A packing that will loosely fill the wound cavity;
- Exudate: type and amount;
- Risk of infection;
- Type of tissue involved;
- Phase of the wound healing process;
• Frequency of the dressing change;
• Comfort and cosmetic appearance;
• Where and by whom the dressing will be changed; and
• Dressing availability, cost and cost effectiveness

Dressing treatments should be done for a few dressing changes before changing products in order to evaluate optimal outcomes. Use clinical judgment to decide when a dressing is not effective for the wound and seek further assistance. 23

3. Management of Wound Infection
Diabetic foot infections should be described in terms of severity of infection (local and systemic signs) and wound location and appearance. This will assist in classifying diabetic foot infections into two categories:

- Mild to moderate or non-limb threatening infections; and,
- Severe or limb threatening infections

The above classification will generally facilitate management.

a) Mild to moderate or non-limb threatening infections
These infections are characterized by:

- No evidence of systemic toxicity/infection;
- Superficial ulceration, skin fissure or puncture wound;
- Less than 2 cm of surrounding skin cellulitis;
- No significant vascular disease or ischemia;
- No bone or joint involvement

Most non-limb threatening infections are caused by gram-positive bacteria, but anaerobic bacteria should be considered if there is a foul smell or necrotic tissue. These infections can usually be managed in the outpatient setting, with close medical follow-up.

Management includes:

- Optimal diabetic therapy;
- Rest and elevation of the affected limb;
- Appropriate wound care (debridement if indicated) and dressings;
- Empiric oral antibiotic therapy as per Canadian guidelines, taking into account recent use of any antibiotics by the individual and local antimicrobial resistance patterns. 24, 25 Topical antimicrobials in isolation are not recommended in the treatment of diabetic foot infection;
Follow-up by the physician and wound care nurse within 48 to 72 hours is required. Most of these infections will respond to appropriate antibiotic therapy within 3 days;

If the cellulitis is slow to respond, worsens, or recurs while on antibiotic therapy the wound should be cultured (deep wound culture from base of ulcer/wound), and admission to hospital for intravenous antibiotic therapy and other investigations should be considered.  

**Did You Know?**

Two centimeters of erythema around a diabetic lower limb wound may be indicative of limb-threatening infection.

### b) Severe or limb-threatening infections

These infections are characterized by:

- Evidence of systemic toxicity (fever, tachycardia, hyperglycemia, leukocytosis);
- Cellulitis extending >2cm beyond the ulcer or skin lesion; edema or deep tissue involvement such as abscess formation;
- Foul odor; lymphangitis;
- Severe vascular disease and ischemia;
- Bone or joint involvement; gangrene;
- Increasing pain (may indicate osteomyelitis). Palpation of bone by probing diabetic pedal ulcers is strongly correlated (90% positive predictive value) with the presence of underlying osteomyelitis.

Most limb threatening infections are polymicrobial, involving gram-positive and gram-negative bacteria and anaerobes. If the foot wound is chronic and if the individual has been on antibiotics recently, resistant bacteria and Pseudomonas must be considered.

**Management:**

Management of severe diabetic foot infections requires emergent hospital admission. A complete evaluation of the patient is required, as there are usually other complications of diabetes such as renal disease, hypertension, peripheral arterial disease and neuropathy which will influence overall management. Initial investigations of the foot infection involves:

- A deep wound culture to assess bacterial etiology and antibiotic sensitivities;
- Blood culture; CBC; ESR;
- X-rays to assess for soft tissue gas and osteomyelitis

Initial management of the wound infection should include appropriate wound care and debridement, and empiric use of broad-spectrum IV antibiotics. Antimicrobial therapy will be influenced by the patient’s prior antibiotic use, the nature of the wound and the patient’s kidney function, and will be modified according to wound
culture results and initial response to treatment. If the patient does not respond dramatically to initial therapy within 48 hours, consultations to Infectious Diseases and Vascular Surgery may be required.

4. **Ulcer Management: Debridement**

Vascular assessment is recommended for ulcers in lower extremities prior to debridement to rule out vascular compromise. 

Foot ulcers with dry eschar need not be debrided if they are stable/unchanging. Monitor these wounds routinely for evidence of complications that would require debridement. 

Provide local wound care considering debridement, infection control and a moist wound environment.

Select the method of debridement most appropriate to:

- Patient’s condition and goals of treatment
- Type, quantity and location of necrotic tissue; and
- Depth and amount of fluid

**Sharp debridement** should be used if there is an urgent need for debridement, as with advancing cellulitis or sepsis.

**Surgical debridement** for diabetic foot ulcers should include resection of bone and joint resection when these structures are involved. This procedure must be followed by culture-directed antibiotic therapy. Surgical debridement is considered the cornerstone of management of diabetic foot ulcers. Necrotic tissue removed on a regular basis can expedite the rate at which a wound heals and has been shown to increase the probability of attaining full secondary closure. Joint resection or partial amputation of the foot is necessary if osteomyelitis, joint infection, or gangrene is present.

**Enzymatic debridement** involves the topical application of commercially prepared enzymes to necrotic tissue to break it down.

**Autolytic debridement** involves using dressings that maintain moisture within the wound bed supporting the body’s own ability to cleanse itself. The action of enzymes present in wound fluids will break down necrotic tissue.
Mechanical debridement involves the use of force to remove nonviable tissue or debris. Common methods are:
- Forceful wound irrigation;
- Wet-to-dry dressings changes that remove debris adhered to the dressing; and,
- Whirlpool treatment.23

5. Pain Management

Assess all patients for pain related to the wound or its treatment. Consider analgesics prior to dressing changes and/or wound debridement. Refer to the client’s physician for management as indicated.

Did You Know?
The presence of pain in a previously insensate foot can be one of the first and most important indicators of infection.

6. Prevention of Wound Trauma

Pressure offloading is essential for wound healing to occur, especially if there is loss of protective sensation in the foot.

The following options may be considered and provided by a podiatrist or orthopedic specialist:18

- Accommodative dressings - felt, foam, deflective padding
- Total contact orthoses - custom walking braces
- Shoe cut-outs
- Healing sandal/surgical shoe with molded insole
- Half shoes or wedge shoes
- Removable walking braces with rocker bottom soles
- Foot casts or boots
- Total contact casting
- Patellar tendon bearing braces
- Assistive devices - crutches, walker, cane, etc.
- Total non-weightbearing - crutches, bed, wheelchair

Did You Know?
Scar tissue is at increased risk of re-ulceration because it will not achieve greater than 80% of the pre-injury tensile strength and has reduced vascularity. Close monitoring and prevention measures will help protect these at risk areas.
7. **Diabetes Management**

All patients with diabetic foot ulcers and their caregivers should have an understanding of their condition and the resources available to optimize their general health, diabetes management and ulcer care.  

Diabetes education is essential as an empowerment strategy for diabetes self-management and prevention or reduction of complications such as foot ulcers.

Components that should be included in the Diabetes Education Programs are:

- Why People with Diabetes Need to Take Care of Their Feet (Brochure produced by Saskatchewan Health)
- How to achieve the recommended glycemic targets through regular exercise, healthy eating and lifestyle and medical management of diabetes with medications and/or insulin. Additional information from the CDA is provided in Appendix 9 “Staying Healthy with Diabetes”.

<table>
<thead>
<tr>
<th>Recommended targets for glycemic control as per the 2003 Clinical Practice Guidelines</th>
<th>A1C %</th>
<th>FPG/preprandial PG (mmol/l)</th>
<th>2-hr postprandial PG (mmol/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target for most patients</td>
<td>≤ 7.0</td>
<td>4.0-7.0</td>
<td>5.0-10.0</td>
</tr>
<tr>
<td>Normal range (consider for patients in whom it can be achieved safely)</td>
<td>≤6.0</td>
<td>4.0-6.0</td>
<td>5.0-8.0</td>
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**Did You Know?**  
Poor glycemic control is a factor contributing to poor healing outcomes.

8. **Nutrition Management**

Prevent clinical nutrient deficiencies by ensuring that the patient is provided with optimal nutrition. Nutritional management includes adequate protein, energy and micronutrient intake to support healing while still optimizing blood glucose, blood lipid and blood pressure management. Some individuals may benefit from the use of special nutritional products and supplements. A referral to a registered dietitian for assessment is recommended.
9. **Adjunctive Therapies**

These therapies may not be readily available in all regions of the province. Recalcitrant diabetic foot ulcers may be treated by alternative therapies when they have proved unresponsive to optimal conventional treatment. Some of these options are:

- Electrical stimulation
- Hyperbaric oxygen
- Negative pressure wound therapy\(^2^8\)

If healing is delayed despite best practice and the above adjunctive therapies are unavailable, biological agents may be a consideration. A wound care specialist should be contacted.

10. **Traditional Therapies**

Practitioners need to be aware of, and respectful of traditional therapies used by various cultures in our province.

The Regina Qu’Appelle Health Region’s (RQHR) Diabetes Foot Care Working Group has developed some additional materials regarding the unique needs of First Nations and Métis people and the numerous barriers to prevention and care. The materials reflect a holistic approach and contain recommendations from community members and care providers. Contact the RQHR Regional Diabetes Initiative (306-766-4774) for additional information.