## History Taking

| | |
|---|---|
| *Chief complaint* | Ask patient why they're here and take HPI (NLDOCAT) |
| *Review Medications* | Ask if they are any changes. Ask about their taking behaviour and any side effects they may be experiencing. Ask about complimentary or alternative medications. |
| *Review Allergies* | Ask if they have any new allergies |
| *Active Practitioners* | Ask about any recent visits to specialists, including dental eyes, endrocrine, nephron, neuro). |
| *Medical History* | Inquire about their conditions. Are they any new diagnoses? |
| | Diabetes specific questions: date of diagnosis, FBG levels, A1C levels, recent hypoglycemia episodes, history of ulcers (if they are in for wound care, is this their first wound or have they had multiple?) |
| *Social History* | Inquire about their activity level. Are they working? Do they exercise? Do they live alone? Ask about smoking, alcohol and drug use. |

Remember it is important to get a full picture of the patient as this will impact the treatment plan. Will they and are they able to change dressings? What may be impeding wound healing? Will the patient be compliant with the tx plan including offloading. What is their financial situation? Can they afford appropriate footwear or orthotics?

## Wound Assessment

| | |
|---|---|
| *Vascular Testing* | Inquire the last time they have had any vascular testing. This should be done once a year if they have circulatory insufficiencies or are high risk. Check pulses, cap refill. Skin/hair assessment for venous or arterial insufficiency, assess for swelling- Does the patient wear compression stockings? Inquire about IC night or rest pain. Do we need to take temperature or use doppler. Conclude their overall vascular status and what this means regarding wound healing. |
| *Neurological Testing* | Monofilament, vibration, proprioception and assess small diameter fibres. Inquire about any pain or sensation (burning, tingling, etc). Conclude neurological status, does this contribute to the cause or wound healing? |



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| Wound Assessment (cont) | |
|---|---|
| *Examination of Wound* | Duration of the wound, change in size/appearance, change in number of wounds, pain or altered sensation with wound. Does the patient know the cause of the wound? Ask about systemic signs as well (lethargy, flu, malaise, etc). Look for signs of infection. Note the periphery of the wound is it callused or macerated? Look for exudate. Inspect the wound bed for granulation tissue, note the colour of the base. Note the depth-PTB? Take temperature! Compare to contralateral side. |
| *Deformity* | Look for any deformities or areas of pressure |
| *Skin* | Look for evidence of skin breakdown. More areas at risk for ulceration? |
| *Footwear* | Assess footwear. |

Use Diabetic inlow's screening tool. Decide how often the patient needs to be screened. If they are diabetic and have history of ulcer/amputation, need to screen every 1-3 months. LOPS w/wout PAD/deformity/onychomycosis/evidence of pressure need to be screened every 3-6 months. If low risk needs to be screened once yearly.

## PEDIS Wound Classification

| Clinical Manifestations | Infection Severity | PEDIS Grade |
|---|---|---|
| Wound lacking purulence or any manifestations of inflammation | Uninfected | 1 |
| Presence of more than or equal to two manifestations of inflammation (purulence or erythema, tenderness, warmth, or induration), but any cellulitis/erythema extends ≤2 cm around the ulcer, and infection is limited to the skin or superficial subcutaneous tissues; no other local complications or systemic illness | Mild | 2 |
| Infection (as above) in a patient who is systemically well and metabolically stable but that has more than or equal to one of the following characteristics: cellulitis extending >2 cm, lymphangitic streaking, spread beneath the superficial fascia, deep-tissue abscess, gangrene, and involvement of muscle, tendon, joint, or bone | Moderate | 3 |
| Infection in a patient with systemic toxicity or metabolic instability (eg, fever, chills, tachycardia, hypotension, confusion, vomiting, leukocytosis, acidosis, severe hyperglycaemia, or azotaemia) | Severe | 4 |

PEDIS- Perfusion, Extent, Depth, Infection, Sensation

## Wound Types

| Feature | Neuropathic | Ischemic | Neuroischemic |
|---|---|---|---|
| Sensation | sensory loss | pain | degree of sensory loss |
| Callus/necrosis | callus present and often thick | necrosis common | minimal callus; prone to necrosis |
| Wound bed | pink and granulating, surrounded by callus | pale and sloughy with poor granulation | poor granulation |
| Foot temperature and pulses | warm with bounding pulses | cool with absent pulses | cool with absent pulses |
| Other | dry skin and fissuring | delayed healing | high risk of infection |
| Typical location | weight-bearing areas of the foot, such as metatarsal heads, the heel and over the dorsum of clawed toes | tips of toes, nail edges and between the toes and lateral borders of the foot | margins of the foot and toes |
| Prevalence[45] | 35% | 15% | 50% |

**Healing**: Causes and co-factors that can interfere with healing have been removed. Wound healing occurs in a predictable fashion. Wound may be acute or chronic.
**Non-healing**: Wound has healing potential, but causes and co-factors that can interfere with healing have not yet been removed.
**Non-healable**: Causes and co-factors that can interfere with healing cannot be removed (e.g., in cases of terminal disease or end-of-life care).

## Texas Wound Classifcation

University of Texas Diabetic Wound Classification System

| Stage | Grade | | | |
|---|---|---|---|---|
| | 0 | I | II | III |
| A (no infection or ischemia) | Pre- or post-ulcerative lesion completely epithelialized | Superficial wound not involving tendon, capsule, or bone | Wound penetrating to tendon or capsule | Wound penetrating to bone or joint |
| B | Infection | Infection | Infection | Infection |
| C | Ischemia | Ischemia | Ischemia | Ischemia |
| D | Infection and ischemia | Infection and ischemia | Infection and ischemia | Infection and ischemia |

## Diagnostic Tests

| | |
|---|---|
| Swab Technique | 1. Rinse wound with normal saline. 2. Do not swab pus. exudate, hard eschar or necrotic tissue. Rotate the swab tip (sterile cotton tip) in an area of clean granulation tissue for 5 seconds, using enough pressure to release tissue exudate. Warn patient for pain. 3. Remove protective cap from culture medium and insert cotton tipped applicator into the culture medium. 4. Transport to lab within 24 hours. |
| Culture & Sensitivity | Entire petri dish surface is inoculated with test organism and an antibiotic impregnated disc containing a range of abx is paced on the surface. Inhibition of the growth around the disc indicates sensitivity of the organism to the abx. |
| Cellulitis | CBC W/diff, ESR/CRP, C&S, biopsy, x-rays, bone scans, MRI/CT/ultrasound |

## Osteomyelitis in Diabetics

| | |
|---|---|
| Contiguous Focus OM | Soft tissue infection directly extends into adjacent bone. Most common OM in LE. |

## Osteomyelitis in Diabetics (cont)

| | |
|---|---|
| | X-rays- shows swelling, gas bubbles, mottled bony osteolysis and sclerotic areas (late finding) |
| Direct Extension | Puncture wounds, retained foreign body, puncture through shoe (s.aurea, p.aeruginosa) |
| OM Secondary to Vascular Insuff-ciency | Caused by arteriosclerosis, diabetics with arterial disease or frostbite |
| Physical Examin-ation | Focus on locating a nidus of infection, assessing PVD and sensory function and exploring ulcer of bone. |
| Diagnosis | X-ray (need 30-50% of mineral content loss to show on image). First sign is gas in tissue, if gas, then x-ray alone is enough for diagnosis. Also see soft tissue swelling. |
| | MRI. Gold standard as it is most sensitive and specific. Can detect change in composition of bone marrow early on. |

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## Osteomyelitis in Diabetics (cont)

| | |
|---|---|
| | Bone biopsy with bacterial culture is gold standard for OM in diabetic patients. |
| Diagnostic Criteria | Exposed bone, persistent sinus tract, tissue necrosis overlying bone, chronic wound over hardware or fracture. |
| Treatment | Many will need surgery and prolonged abx. |
| | Oral therapy may be just as effective as IV therapy. Ciprofloxacin is most used. |
| | Immediate referral to hospital. (Infectious disease specialist, IV abx and maybe surgical intervention). |

Ask patient about systemic symptoms (lethargy, malaise, back pain, fever). Think about predisposing factors (diabetes, PVD, trauma, IV drug use).

## Wagner Wound Classification

Table 2. Diabetic Foot classification according to Wagner

| Grade | Denomination | Description |
|---|---|---|
| 0 | Foot at risk | Thick calluses, bone deformities, clawed toes, and prominent metatarsian heads |
| 1 | Superficial ulcers | Total destruction of the thickness of the skin |
| 2 | Deep ulcers | Penetrates through skin, fat and ligaments, but not affect bone. Infected |
| 3 | Abscessed deep ulcers | Limited necrosis in toes or the foot |
| 4 | Limited gangrene | Limited necrosis in toes or the foot |
| 5 | Extensive gangrene | Necrosis of the complete foot, with systemic effects |

## Adjunctive Therapies for Wound Healing

| | |
|---|---|
| **Negative Pressure Wound Therapy** | Controlled negative pressure over the wound surface |
| | Facilitates the drainage of the fluid and debris, reducing bacterial counts and edema and increasing capillary blood flow and granulation tissue formation. |
| | Considered for healable wounds that are stalled and the exudate is greater than what can be managed with conventional advanced dressing modalities |
| **Hyperbaric Oxygen Therapy** | Administration of 100% O2 at an increased atmospheric pressure to a wound |
| | Improves tissue oxygenation, down regulates inflammatory cytokines, up-regulates growth factors, antibacterial and leukocyte effects |
| **Topical Wound Oxygen Therapy** | Administration of pressurized oxygen topically to the wound bed |
| | Supplies continuous or cyclical diffusion of pure oxygen over the surface wound |

## Adjunctive Therapies for Wound Healing (cont)

| | |
|---|---|
| | Increase vascular endothelial growth factor expression and blood vessel density |
| **Electrical Stimulation** | Application of capacitive coupled electrical current to transfer energy to a wound. |
| | Increased blood flow and oxygenation, edema and pain reduction, debridement, thrombolysis, bactericidal, faster wound closure, improved scar formation |
| **Ultrasound** | Application of ultrasound waves to the wound/per-wound to induce cellular activity |
| | Increases the release of growth factors/fribroblasts, accelerates the inflammatory phase and wound contraction, increases vascularity, improves wound tensile strength and elasticity, reduces pain and edema, reduces bruises and hematoma, bactericidal |

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## Adjunctive Therapies for Wound Healing (cont)

| | |
|---|---|
| **Shock Wave** | Shock waves targeted directly to the wound area to speed healing. Promotes the generation of new connective tissue, has an analgesic effect for pain reduction and facilitates blood flow to the area. |

International best practice guidelines identifies adjunctive treatments such as negative pressure wound therapy and hyperbaric oxygen therapy may be considered if appropriate but requires advanced clinical decision-making skills.

## Popular Wound Dressings

| | |
|---|---|
| Promogran Prisma | Maintains a physiologically moist environment at the wound surface that is conducive to granulation tissue formation, epithelialization and optimal wound healing. |
| | Contains silver and antimicrobial agents |
| | Sterile, freeze dried composite of oxidized regenerated cellulose, collagen and silver |
| | In the presence of exudate, the prisma transforms into a soft and conformable biodegradable gel allowing contact with all areas of the wound |
| | ORC helps with tissue repair, cell growth and control bacteria growth |
| Silvercel | Non-adherent antimicrobial alginate dressing |

## Popular Wound Dressings (cont)

| | |
|---|---|
| | Has carboxy methylcellulose & silver. Easy to lift technology |
| | Sustained release of silver ions up to 7 days-> effective barrier protection. Good exudate management, maintains moist environment. |
| Acticoat | Antimicrobial barrier dressing consists of three layers: an absorbent rayon/polyester inner core sandwiched between outer layers of silver coated, low adherent polyethylene net. |
| | Helps maintain moist environment at the wound surface and has barrier protection for at least 3 days. |
| Inadine | Impregnated with polyethylenge base containing 10% Povidone iodine that has a broad spectrum of antimicrobial action. |

Biofilms are complex microbial communities, containing bacteria and sometimes also fungi, which are embedded in a protective polysaccharide matrix. The matrix attaches the biofilm to a surface, such as a wound bed, and protects the microorganisms from the host's immune system and from antimicrobial agents such as antiseptics and antibiotics. Biofilms are commonly present in chronic wounds, and are thought to contribute to, and perpetuate, a chronic inflammatory state that prevents healing

## Wound Dressings

| | |
|---|---|
| **Conventional** | Gauze. Non woven better than woven as it is more absorptive. Does have strike through, adherence and incorporation into wound surface |
| **Transparent films** | Semipermeable adhesive films- Opsite, Tegaderm. Permeable to gas and water vapour but not to water, no fibres, transparent, non absorbent |
| **Low Adherent Wound Contact Layers** | Non medicated: Adaptic or Mepitel. Medicated: Bactrigras tulle which contains chlorhexidine acetate, Inadine |
| **Low Adherent Absorbent Dressings** | Melolite (highly absorbent cotton and acrylic fibre pad and polyester film). Has rapid drainage of exudate, reduces trauma to healing tissue, very absorbent, comfortable, minimizes pain on removal. |
| **Semipermeable Hydrogels** | Intrasite gel. Contains carboxymethylcellulose. |



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## Wound Dressings (cont)

| | |
|---|---|
| **Hydrocolloids** | Tegasorb, comfeel, duoderm. Form a gel when in contact with wound surface. Semi liquid produced provides moisture and insulated environment, occlusive. Contraindicated in infected wounds. Not good for diabetic ulcers. |
| **Hydrofiber Wound Dressings** | Aquacel. Moderate to heavily exudating wounds. |
| **Alginate Dressings** | Kaltostat-Calcium Sodium Alginate. Calcium and sodium salts of alginic acid, derived from seaweed. When in contact with blood or exudate, alginate fibers convert into a hydrophilic gel. Gel is absorbent, protective moist interface with the wound. Indicated for moderately to highly exuding chronic and acute wounds and for wounds with minor bleeding. |
| **Polyurethane Foams** | Allevyn- moderate amounts of exudate. Allows adequate hydration of the wound surface and has effective thermal insulation. |

## Wound Dressings (cont)

| | |
|---|---|
| **Charcoal Dressing** | Malodorous exudating wounds. Deodorant dressing with activated charcoa. |
| **Silver agents** | Antibacterial. Acticoat and silvercel. Usually a combination dressing. |
| **Desloughing Agents** | Iodosorb. Exerts hydrophillic action, acting as an absorbent, also helps remove debris and bacteria from wound surface by capillary action, beads swell under the influence of exudate and the release of iodine. Intrasite gel, products with enzymes, sterile larvae can also be used for slough. |

## Offloading

| | |
|---|---|
| **Total Contact Cast** | Gold standard! Contraindicated for infected or ischemia wounds. |
| **Removable Cast Walker** | Not for heel ulcers. Can be used for infected wounds. Not good for those with poor balance |
| **Instant Total Contact Cast** | Not for heel ulcers. May not be tolerable |
| **Half shoe (Rearfoot or forefoot)** | Either good for heel or toe/forefoot ulcers. Very unstable |

## Offloading (cont)

| | |
|---|---|
| **Surgical Shoe** | Best for forefoot but can be used for all locations. Low cost. Use with orthotic. Good for edema. Only for short term. |
| **OTC or custom orthotics/footwear** | Distributes pressures evenly but expensive |
| **Padding** | Low cost but offloading property limited. |
| **Surgical Offloading** | Achilles tendon lengthening, joint arthroplasty met head resection or osteotomy can support healing and prevent future ulcer if conservative treatment fails |
| | Cannot be done in ischemia patients or uncontrolled infection |
| | Digital flexor tenotomy used to prevent or support healing of toe ulcer when conservative tx fails |

When choosing offloading device, consider- disease, pressures, ulcer location, type and dressing, physical activity, finances, patient behaviour (ability to adhere to plan/mental capabilities)

## Surgeries- Amputations and Revascularization

| | |
|---|---|
| **Revascularization**: | Angioplasty- Using a ballon and/or stent to widen the artery |
| | Athrectomy - Clear out the plaque that is causing the occlusion |



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## Surgeries- Amputations and Revascularization (cont)

| | |
|---|---|
| | Bypass Surgery- Surgeon uses a graft of a blood vessel to reroute blood flow around a blockage. |
| | Endarterectomy- Surgeon opens artery to remove plaque buildup inside. |
| **Amputation**: | Causes: trauma, ulcers (persistent, decreasing quality of life, necrosis), infection, vascular, deformity |
| | Digital- Performed due to extensive ulceration. OM or gangrene. Semi-elliptical incisions carried down to bone. Cartilage on met head better barrier to infection so we don't cut bone in middle. Auto amputation (2-6 months) good for those who shouldn't have surgery |
| | Ray amputations- central, 1st or 5th. Performed for abscess, OM, or necrotizing fasciitis. Converging semi elliptical incisions around base of toe. Met is exposed and resected at point where bone does not appear infected. May have transfer lesions. |
| | Midfoot amputations- Transmet (will do TAL to decrease FF pressures). Lisfranc (less stable, equinovarus) |
| | BKA better than doing syme or chopart amputations. |

## Factors that affect Wound Healing

| | |
|---|---|
| **Glycemic level** | **Trauma** |
| **Activity** | **Neuropathy** |
| **Smoking** | **Bony deformity** |
| **Footwear** | **PAD** |
| **History of wounds** | **Amputations** |
| **Age** | **Other infections in body** |

## Smoking and Diabetes

-Smoking alters blood glucose homeostasis-> increases blood glucose

-Smoking can decrease insulin action and impairs measures of B cell function

- Exposure to cigarette smoke is associated with vascular damage, endothelial dysfunction and activation of the blood-clotting cascade.

-Cigarette smoking increases risk of micro and macrovascular complications in diabetes

-Smoking cessation should improve glycemic control but cessation often worsens glycemic control, possibly due to weight gain that often occurs after smoking abstinence. Emphasize the importance of both exercise and smoking cessation together!

## Short-Term Management Plan

| | |
|---|---|
| **Assessment and Classifications** | Do appropriate assessments and classify wounds. Is this mild/moderate or severe and needs hospitalization right away? Do we need to refer to vascular studies right away? Consider doing ABI and TBI. |

## Short-Term Management Plan (cont)

| | |
|---|---|
| **Treatment** | Cleanse. (chlorohexidine gluconate 2%), providone iodone, wound cleanser, sterile saline) |
| | Sharps debridement. Tissue nippers are great to use for undermined edges and it doesn't hurt the patient. |
| | Cleanse again. Use antiseptic, mostly like sterile saline. Pat dry. |
| | Apply antiseptic. Betadine most commonly used. |
| | Dressing. Choose appropriate dressing that will remove exudate and maintain humidity. Want it to have low adherence and maintain a good temp. Maintain suitable pH and be permeable to gases NOT microorganisms. Think about the comfort and ease for patients. |
| **Advice** | Dressing instructions, activity reduction, protecting wound from trauma and while showering. Instruct how to monitor for signs of infection. Tips to keep skin overall healthy. |



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## Short-Term Management Plan (cont)

| | |
|---|---|
| **Social History** | Understand any underlying factors that may put patient at risk for infections. Such as, UTI, age, mobility, psychosocial factors, self-care ability |

## Mid-Term/Short-term Management Plan

| | |
|---|---|
| **Reassessment** | Reassess wound along with dressing and offloading- do we need to make changes?. Abx? culture & sensitivity? imaging? |
| | Asking the patient what they're doing at home. Decreasing or increasing activity? Home care? Do they feel the wound is getting better? Are they wearing offloading devices? |
| | Re-checking vascular status |
| | Assessing medications, is it impairing wound healing? (ie steroids) |
| **Advanced Therapies** | Think about adjunctive therapies and dressings that may be beneficial for the patient. |
| **Surgical Referral** | Foot reconstruction, tenotomy, arthroplasty, etc, vascular surgeries |
| **Other Referrals** | Nutritionist for nutrition screening, endocrinologist, etc) |

Most of these we would implement in the short-term. Mid-term should focus on preventing infection/reducing risk factors for infection.

## Long-Term Management Plan

Long term goals: PREVENTION! If the wound is closed, how do we ensure we are preventing it from occurring again? Strengthening our circle of care. Referrals for smoking cessation, nutrition management and psychosocial should be made.
Including the patient in the long-term plan. What can THEY do to prevent reulceration. When should they be concerned? Advise joining support groups.

If the wound isn't closing, consider referring to infectious disease specialist. Start from the basics (short-term plan)

## Antibiotics

Cephalexin or TMP/SMX is 1st line of treatment for cellulitis seen in the diabetic foot. 2nd line is cloxacillin.

Even though most DFU infections are caused by staph and step. Look for signs of pseudomonas (Green ring or odour). In this case, prescribe Ciprofloxacin.

If there is a penicillin allergy or renal insufficiency, consider clindamycin

Foul smell or presence of necrotic tissue may indicate anaerobes - use clindamycin or amoxicillin/clavulanate.

When you have doubt regarding the probable organism, go with cephalexin!
If CA-MRSA is cultured, go with TMP/SMX.



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