Diabetes: Effect on Wounds

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Disclosures

- On the Board of Directors for the Wound Ostomy Continence Certification Board
- No financial interest or gain in anything presented today
- Adjunct Faculty for Nebraska Methodist College DNP program

Presentation Objectives

1.Define Diabetic Foot Ulcer (DFU) including pathophysiology.
2. Identify common comorbidities in patients with DFUs.
3. Recall diagnosis and management of DFUs.
4. Discuss prevention of DFUs.
5. Define how diabetes affects wound healing.

DFU: Prevalence

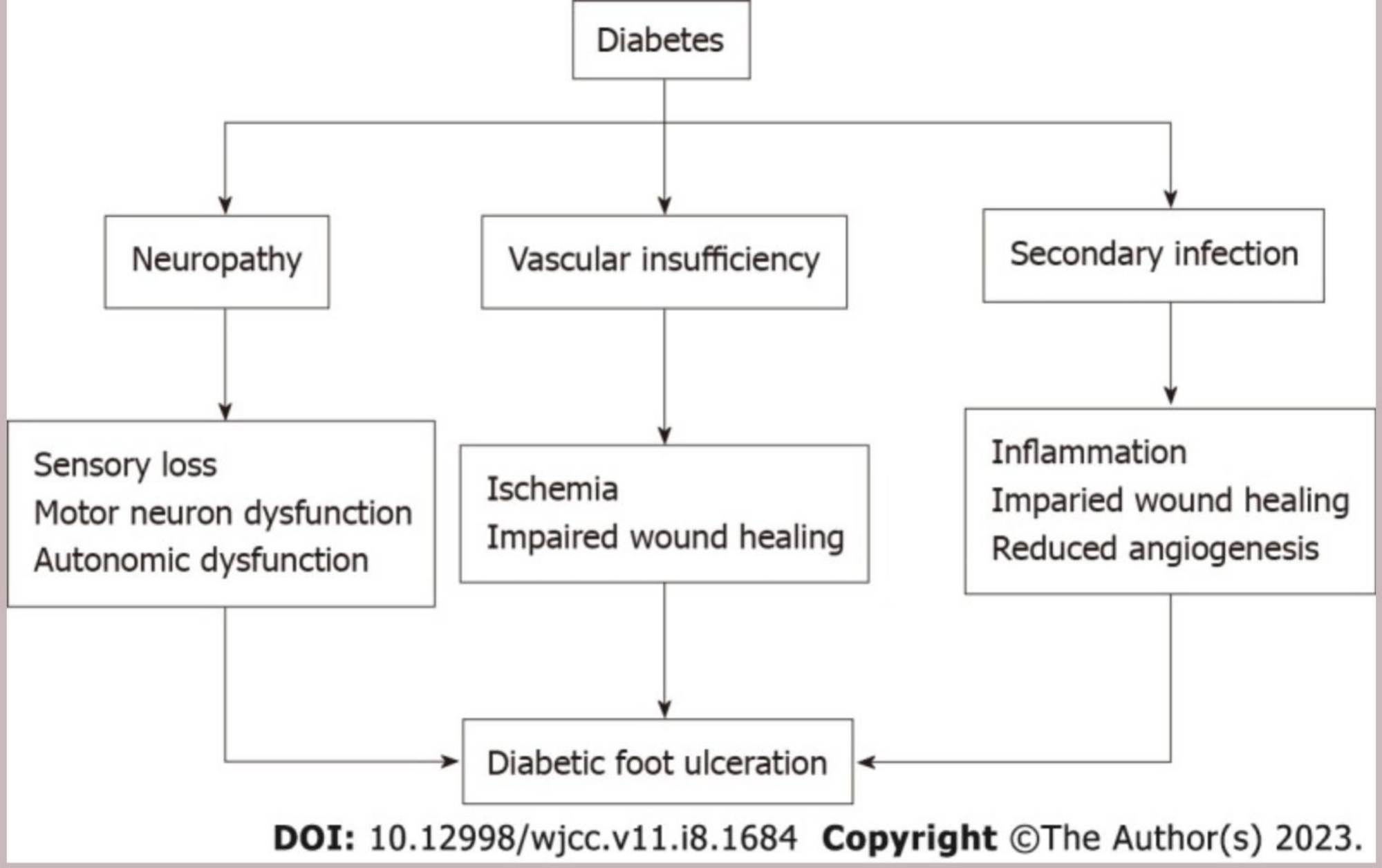
- 19-34% of patients with Diabetes will develop a DFU in their lifetime.
- 14-25% of those patients will require amputation of the foot due to infection or other complications
- Estimated that between 9.1 million to 26.1 million individuals with diabetes develop foot ulcers every year (global number)
- The annual incidence of foot ulceration is between 1.9% and 4.0% of the population with diabetes.
- Even higher incidence of diabetic foot ulcerations when PAD and neuropathy are comorbidities.

Diabetic Foot Ulcer (DFU): Pathophysiology

-Develops at the level of the ankle or below.
-Most common in patients with uncontrolled or longstanding Diabetes.
-Caused by a traid of complications

1. Neuropathy
2. Peripheral Arterial Disease
3. Infection





Raja, J. M., Maturana, M. A., Kayali, S., Khouzam, A., & Efeovbokhan, N. (2023). Figure 1. National Library of Medicine. https://pmc.ncbi.nlm.nih.gov/articles/PMC10037283/

DFU: Neuropathy

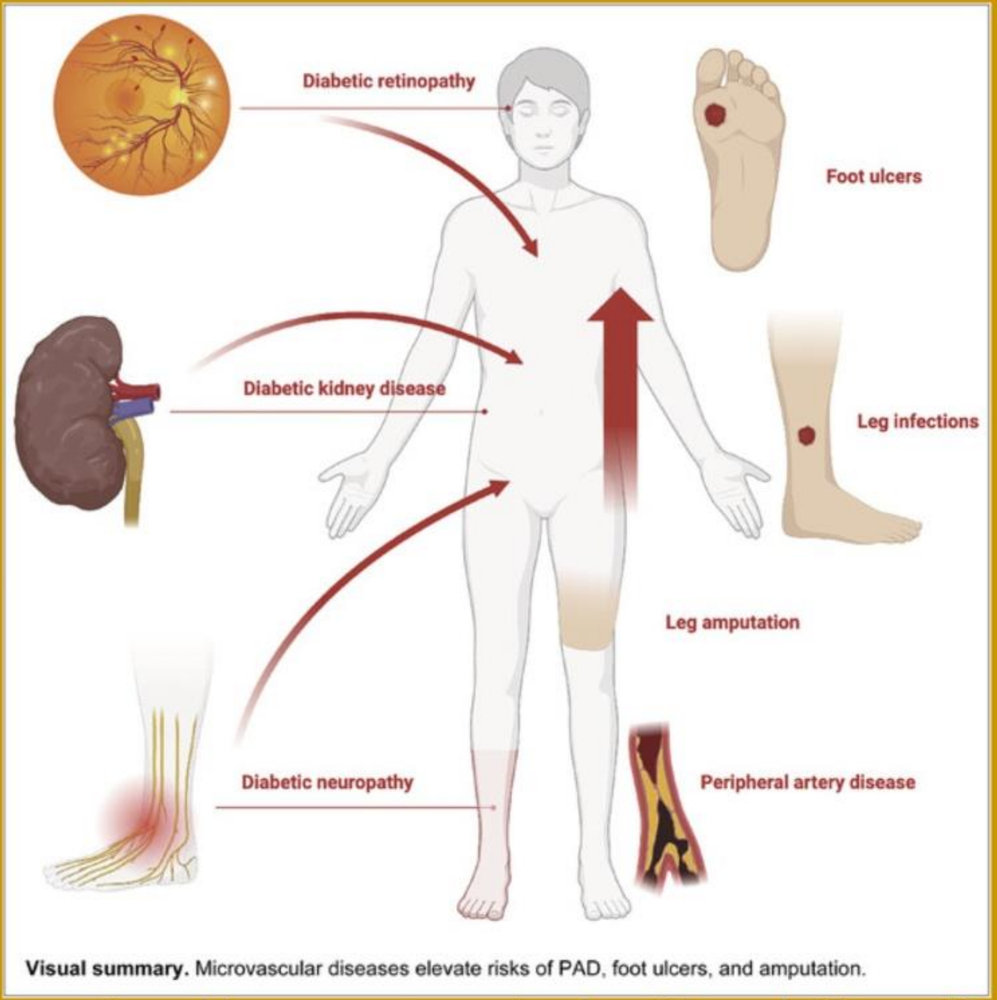
- Loss of protective senses -> trauma, friction, pressure
- Loss of sweat production -> dry skin, friction, fissures
- Muscle wasting and structural abnormalities -> Charcot Neuroarthropathy

Assessing Diabetic Neuropathy

- 10-gram Monofilament Test: Detects loss of protective sensation.
- Vibration Perception Threshold: Assessed with a 128-Hz tuning fork.
- Ankle Reflexes: Evaluation of motor nerve function.
- Nerve Conduction Studies: Electrophysiological assessment of nerve health.

Diabetes and Vascular Disease

- Diabetes increases risk of macrovascular and microvascular disease.
- Estimated macrovascular complication rate of 32.2% among 4,549,481 diabetic patients.
- Diabetes leads to atherosclerosis of large vessels leading to PAD.
- Diabetes leads to microvascular disease which leads to neuropathy.



Visual summary. Microvascular diseases elevate risks of PAD, foot ulcers, and amputation.

https://www.thieme-connect.com/products/ejournals/abstract/10.1055/a-2661-2537

Signs of Vascular Compromise



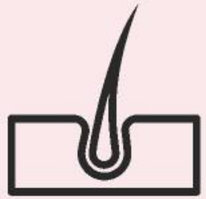
Coolness or pallor in the affected limb, indicating reduced blood flow.



Absent or diminished pedal pulses, claudication symptoms, edema.



Dependent rubor (redness when limb is lowered) or prolonged capillary refill time.



Absent/altered hair growth pattern, dry skin, thickened/brittle toenails.

Vascular Evaluation and Testing

- Clinical assessment: Palpation of pulses, skin temperature, capillary refill.
- Ankle-Brachial Index (ABI): Non-invasive screening for peripheral artery disease.
- Arterial Ultrasound: Detailed imaging of blood flow and vessel morphology.
- Angiography (CT/MR/Catheter-based): Definitive imaging for intervention planning.

DFU: Secondary Infection

https://www.unmc.edu/intmed/_documents/id/asp/clinicalpath-dfi_institutional_guideline_final.pdf

- Infectious Disease Society of America (IDSA) has published wound infection treatment recommendations from The International Working Group on the Diabetic Foot (IWGDF) published with key recommendations as follows:

- In patients with PAD and a DFU who have evidence of gangrene or infection obtain surgical and cardiovascular consult for treatment
- Consider antibiotics and early surgery within 24-28 hours for severe Diabetic Foot Infections to remove necrotic/infection tissue.
- Urgent surgical consultation is needed in cases of severe infection or moderate foot infection complicated by extensive gangrene, necrotising infection, signs suggesting deep abscess, or severe lower limb ischaemia.
- Do not treat clinically uninfected DFUs with systemic or local antibiotic therapy.
- In patients with suspected Diabetic Foot Infection a culture is recommended to guide therapy and should be obtained as a tissue culture, not a topical swab culture.
- In patients with suspected Diabetic Foot Infection a CRP, Sed Rate, and Procalcitonin should be obtained.
- Recommend against using HBOT as a means for treating Diabetic Foot Infection only.

Wagner's Classification of Diabetic Foot Ulcer

Grade	Characteristic
Wagner grade 1	Partial- or full-thickness ulcer (superficial)
Wagner grade 2	Deep ulcer extending to ligament, tendon, joint capsule, bone, or deep fascia without abscess or OM
Wagner grade 3	Deep abscess, OM, or joint sepsis
Wagner grade 4	Partial-foot gangrene

DFU: Treatment

Treatment must utilize a multidisciplinary approach including the following:

- wound care
- metabolic management
- infection control
- vascular management
- surgical treament if indicated

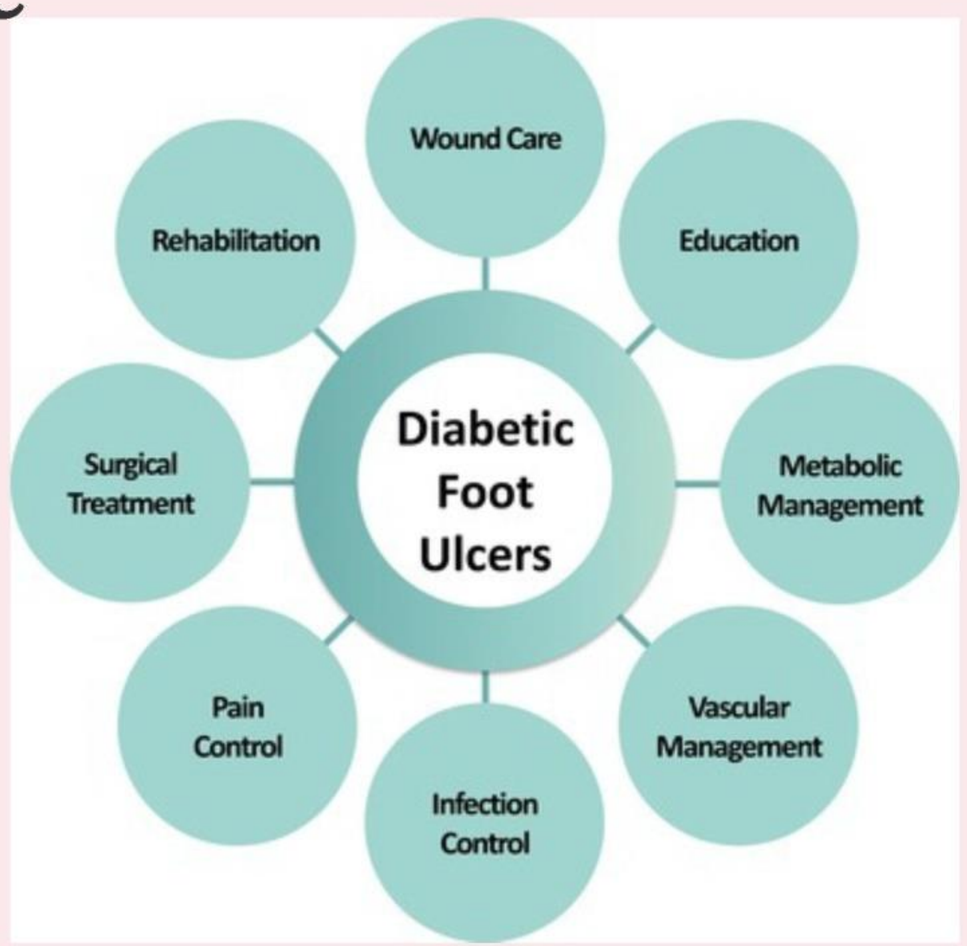


Image from reference 5.

Interdisciplinary Treatment Strategies



- Revascularization: Restoring adequate blood supply to the limb.
- Aggressive Wound Debridement: Removing non-viable tissue to promote healing.
- Offloading and Pressure Relief: Protecting wounds from further trauma.
- Infection Control: Prompt diagnosis and treatment of infections.
- Nutritional Optimization: Supporting systemic healing and recovery.

DFU: Amputation Prevention

Key steps to safeguard limb health in diabetic patients

Early Detection & Screening

Patients should undergo regular foot exams, ABI, and neuropathy screening to identify risks routinely.

Aggressive Diabetes Management

Strict glycemic control, lipid management, and blood pressure optimization.

Prompt Wound Treatment

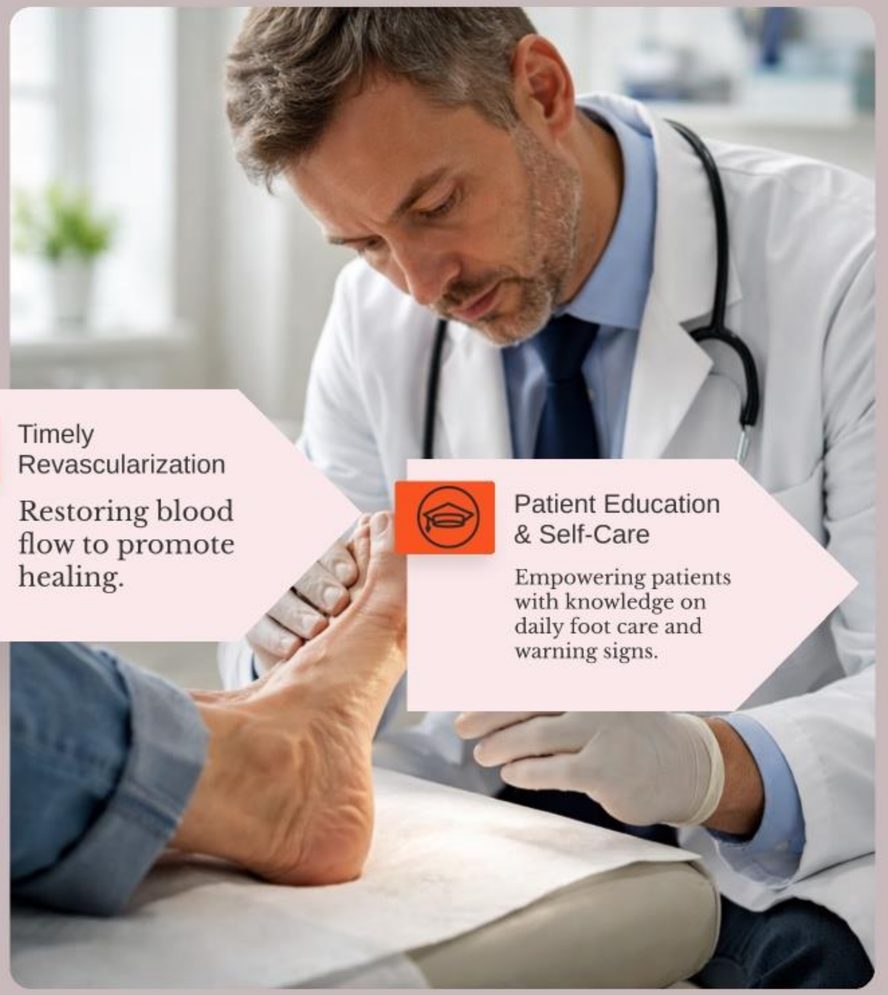
Immediate and specialized care for any wounds or infections.

Timely Revascularization

Restoring blood flow to promote healing.

Patient Education & Self-Care

Empowering patients with knowledge on daily foot care and warning signs.



Diabetes and General Wound Repair

Hyperglycemia disrupts the essential inflammatory response, delaying the transition from the initial injury phase to tissue repair. Elevated glucose levels impair leukocyte chemotaxis, phagocytosis, and bactericidal activity, leaving the wound site vulnerable to prolonged infection and persistent inflammation.

Diabetes hinders the proliferative phase by inhibiting fibroblast migration and reducing collagen cross-linking. Furthermore, impaired vascular endothelial growth factor expression leads to defective angiogenesis, resulting in poor perfusion and an inadequate scaffold for effective wound closure.

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