Foot infection

Prof .Dr.Alaa Al-algawy

2020

Infectious complications of the diabetic foot

By Prof .Dr.Alaa Al-Algawy

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Epidemiology

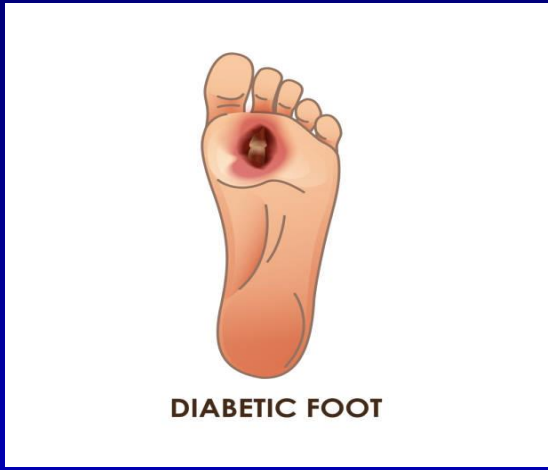
- 15% of diabetics develop ulcers, 6% require hospitalizaitons
- Over half of ulcers become infected
- 20-66% of infected ulcers involve bone

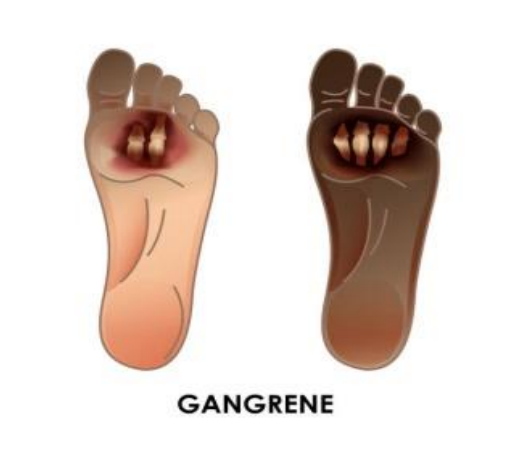
Spectrum of infections

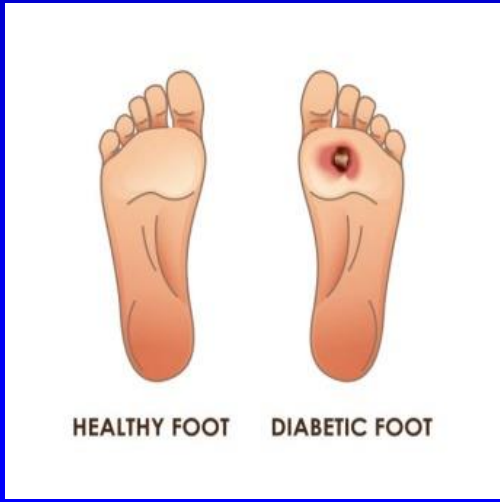
- Cellulitis
- Abscess
- Osteomyelitis

Differential diagnosis

- Non-infected neuropathic ulcer
- Fracture
- Ischemia
- Embolization, vasculitis, stasis ulcer, carcinoma







Pathogenesis

- Sensory neuropathy
  - Trauma, deformity
- Autonomic neuropathy
  - Diminished sweat, dry, cracked skin
- Hyperglycemia
  - Decreased neutrophil function
- Arterial disease

Pathogenesis

Risk factor	Mechanism of injury or impairment
Peripheral motor neuropathy	Abnormal foot anatomy and biomechanics, with clawing of toes, high arch, and subluxed metatarsophalangeal joints, leading to excess pressure, callus formation, and ulcers
Peripheral sensory neuropathy	Lack of protective sensation, leading to unattended minor injuries caused by excess pressure or mechanical or thermal injury
Peripheral autonomic neuropathy	Deficient sweating leading to dry, cracking skin
Neuro-osteoarthropathic deformities (i.e., Charcot disease) or limited joint mobility	Abnormal anatomy and biomechanics, leading to excess pressure, especially in the midplantar area
Vascular (arterial) insufficiency	Impaired tissue viability, wound healing, and delivery of neutrophils
Hyperglycemia and other metabolic derangements	Impaired immunological (especially neutrophil) function and wound healing and excess collagen cross-linking
Patient disabilities	Reduced vision, limited mobility, and previous amputation(s)
Maladaptive patient behaviors	Inadequate adherence to precautionary measures and foot inspection and hygiene procedures, poor compliance with medical care, inappropriate activities, excessive weight-bearing, and poor footwear
Health care system failures	Inadequate patient education and monitoring of glycemic control and foot care

Challenges in Diagnosis of Osteomyelitis

- Neuropathic changes may resemble infection on MRI, other images.
- Superficial cultures correlate poorly with deep organisms, and may not reflect deep infection at all.
- Radiographic signs absent early.
- Bone biopsy invasive, expensive, some times inaccurate !!!

Diagnosis of Osteomyelitis

- Labs: ESR > 70
- Radiology
  - MRI, Labeled wbc, plain film
- Probe to Bone
- Bone biopsy for histopathology, Cx
- Surface cultures
- Wound > 2 cm^2

Plain radiographs

- Cheap and often very helpful
- Moth-eaten necrotic bone is dead and requires surgery

Probe-to-bone

- "On gentle probing, the evaluator detected a rock-hard, often gritty structure without the apparent presence of any intervening soft tissue"
- Gold standard- histo. or clinical + radiology

(Grayson, JAMA 1995. 75 inpatients, 66% with osteomyelitis)

Bone Biopsy

- **Gold standard in most studies**
- **Open Biopsy more accurate than needle**

  For pathological study & C/S.
- **Staph aureus likely pathogen if found.**
- **Superficial cultures is poorly predictive of deep pathogens**

Osteomyelitis Treatment

- **Aerobic Gram +ve M.O are the predominant pathogens in diabetic foot infections**
- **Broad-spectrum empirical therapy is not routinely required but is indicated for severe infections**
- **Acute infections are often monomicrobial (almost always with aerobic GPC)**

Lipsky et al, CID, 2004

Microbiology

Foot-infection syndrome	Pathogens
Cellulitis without an open skin wound	β-Hemolytic streptococcus[a] and *Staphylococcus aureus*
Infected ulcer and antibiotic naive[b]	*S. aureus* and β-hemolytic streptococcus[a]
Infected ulcer that is chronic or was previously treated with antibiotic therapy[c]	*S. aureus*, β-hemolytic streptococcus, and Enterobacteriaceae
Ulcer that is macerated because of soaking[c]	*Pseudomonas aeruginosa* (often in combination with other organisms)
Long duration nonhealing wounds with prolonged, broad-spectrum antibiotic therapy[c,d]	Aerobic gram-positive cocci (*S. aureus* , coagulase-negative staphylococci, and enterococci), diphtheroids, Enterobacteriaceae, *Pseudomonas* species, nonfermentative gram-negative rods, and, possibly, fungi
"Fetid foot": extensive necrosis or gangrene, malodorous[c]	Mixed aerobic gram-positive cocci, including enterococci, Enterobacteriaceae, nonfermentative gram-negative rods, and obligate anaerobes

[a] Groups A, B, C, and G.
[b] Often monomicrobial.
[c] Usually polymicrobial.
[d] Antibiotic-resistant species (e.g., methicillin-resistant *S. aureus,* vancomycin-resistant enterococci, or extended-spectrum β-lactamase producing gram-negative rods) are common.

Lipsky, et al. CID 2004

Antibiotics

- Surgery vs abx vs both.= both
  - ABX can’t sterilize dead bone
- IV vs Oral
  - Easier to monitor therapy with IV, especially with hepatic or renal impairment .
  - Per oral A.B , is also effective when used properly (proper choice , dose & duration)

IV Antibiotics, MRSA

Antibiotic	Pro	Con
Vancomycin	Cheap, safe, active against MRSA	Monitor level. Infusions slow, often twice daily . Poor bone penetration. Weak antibiotic
Daptomycin	Once daily, rapid infusion, good bone penetration	Expensive
Televancin	As for daptomycin	
Ceftaroline	Good tissue penetration, highly active	Twice daily, cost. Spectrum may be overly broad.

IV Antibiotics, MSSA

Antibiotic	Pro	Con
Nafcillin	Most active, narrow spectrum	Q 4 hours
Ceftriaxone	Q day. Covers many gram negatives	Least in vitro activity .
Cefazolin	Activity between nafcillin and ceftriaxone	Q 8 hours

Oral antibiotics

Antibiotic	Pro	Con
Rifampin	Good bone, biofilm penetration. Given with Vanco .	Nausea, LFTs. Resistance, drug interactions
Doxycycline/Mino	Cheap, good bone penetration	GI issues with doxy. Static, not ‘cidal
Fluoroquinolones	Good data when used with rifampin. Good bone penetration	Cipro has poor gram positive activity. Tendinopathy
Linezolid	Bioavailability about 100%.	Up to $100 a tablet. MAOI, low platelets

Duration of therapy

- 4-6 weeks typical, but not based on randomized data
- IV followed by 3 months po if inadequate debridement

Take-homes message

- Diagnosis and management of infected foot ulcers difficult, requires team approach
- Anaerobes, resistant gram negatives not as common as thought . Staph aureus is at least half of infections.
- Swab Cx, probe to bone, X rays useful
- Oral therapy likely as good as IV