## The Diabetic Foot

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## Prevalence of Diabetes

- 422 million diabetic – 2016  
  - 382 million -2013  
  - 8.5% adult population  
  - 90% Type II

## Prevalence of Diabetes United States

<table>
<thead>
<tr>
<th>CDC</th>
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</table>
| 29.1 million diabetic – 2014  
  - ¼ undiagnosed |  
| 86 million prediabetic  
  - 15-30% developing diabetes within 5 years |

## Symptoms

- Increased thirst  
- Frequent urination  
- Extreme hunger  
- Unexplained weight loss  
- Fatigue  
- Irritability  
- Blurred vision  
- Slow-healing sores  
- Frequent infections
### Economic Strain

- **American Diabetes Association**
  - $327 billion in 2017 from $245 billion in 2012
    - Medical cost and lost wages
      - 26% increase
  - **$237 billion in direct medical costs**
    - hospital inpatient care (30%)
    - prescription medications (30%),
    - diabetes supplies (15%),
    - physician office visits (13%).

- **$90 billion indirectly**
  - increased absents ($3.3 billion)
  - reduced productivity while at work ($29.2 billion)
  - inability to work as a result of disease-related disability ($37.5 billion)
  - lost productive capacity due to early mortality ($19.9 billion).

### Mortality

- **8th leading cause of death:**
  - World Health Organization
  - 1.5 – 5 million deaths a year – 2012
    - International Diabetes Federation
      - Directly or indirectly

- **2-fold higher rate for death middle-aged people with diabetes**
### Complications of Diabetes

- Cardiovascular disease
- Neuropathy
- Retinopathy
- Nephropathy
- Neuroarthropathy

### The diabetic foot

- Cardiovascular disease
  - PAD
    - 1 out of 3 diabetics over the age of 50
- Risk Factors
  - DM
  - Smoking
  - High blood pressure
  - Abnormal blood cholesterol
  - Overweight
  - Not physically active
  - Over age 50
  - History of heart disease: heart attack or a stroke
  - Family history of heart disease, heart attacks, or strokes

### Signs of PAD

- Absent pedal pulses
- Leg pain, walking or exercising, which improves with rest
- Numbness, tingling, or coldness
- Sores or infections heal slowly

### Diagnosis of PAD

- ABIs
- Ultrasound: Arterial Wave flow
- MRI/CTA
- Angiogram
### Concern for PAD

- Impact on healing

### The diabetic foot

- Neuropathy
  - Peripheral Neuropathy
  - Autonomic Neuropathy

### Peripheral Neuropathy

- Numbness
  - Do not feel pain or temp changes

- Burning
  - Increased sensitivity:
    - Sensation hot or cold

- Tingling
  - Pins and needles

### Peripheral Neuropathy

- Diagnosis
  - Monofilament
  - EMG
  - Tuning fork
  - Biopsy
**Peripheral Neuropathy**

- Concern
  - ulceration

**Autonomic Neuropathy**

- Affects the nerves that control your body systems
  - digestive system
  - urinary tract
  - sex organs
  - heart and blood vessels
  - sweat glands
  - eyes

**Autonomic Neuropathy**

- Impact on feet
  - Integrity of the skin
  - Dry cracking

**The diabetic foot**

- Retinopathy
  - Visual impairments
    - Issues with proper foot care
    - Issues with visualizing foot concerns
The diabetic foot

- Nephropathy
  - Complications
    - Fluid retention, swelling
    - Damage to the blood vessels
    - Anemia
    - Non-enzymatic glycation → structural changes

Nephropathy

- Irreversible damage to your kidneys (end-stage kidney disease)
  - dialysis
  - kidney transplant for survival
- Antibiotic usage

The diabetic foot

- Neuroarthropathy
  - Charcot
    - chronic, progressive, and destructive arthropathy
  - Pathogenesis
    - Multifactorial
      - mechanical and vascular factors
      - peripheral and autonomic neuropathy
      - metabolic abnormalities of bone

Charcot

- Structural changes
  - Increase peak pressure
    - ulcerations
<table>
<thead>
<tr>
<th>The diabetic foot</th>
<th>Why</th>
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</thead>
</table>
| • Preventative care  
  – Circulation  
  – Sensation  
  – Structural changes  
    • Non-enzymatic glycation → contractures  
    • increased plantar pressures  
  – Skin integrety  
  – Nail Care | • Foot complications: leading cause of hospitalization for patients with diabetes |
| | • 15% to 20%: foot ulcer during their lifetime |

<table>
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<tr>
<th>Why</th>
<th>Routine examination of the foot in diabetic patients</th>
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<tbody>
<tr>
<td>• Hospitalized diabetic foot ulcer patients can expect a 59% longer length of stay</td>
<td></td>
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</table>
| • Patient with diabetes are 15 times more likely to require a major amputation  
  – 14% to 24% DM ulcers will result in an amputation | |
When to refer to a podiatrist?

“Diabetic foot” variety of pathological conditions that might affect the feet in patients with diabetes (Boulton 2002)

Diabetic Foot

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• Prevalence
  – 29.1 Million people 9.3% of the US 2012
    • CDC
  – 2.8% Worldwide 2000 (171 million)
    • WHO

Amputations
  – 73,000 non-traumatic amputations in diabetics 2010
    • CDC

• Cost
  – $4,595 per ulcer and $28,000 >2 years
  – $5 billion per year annually
    – Clin Ther 1998
  – $30-50k amputation according to president
Foot Infections

- Any infra-malleolar infection in a person with diabetes
- Common and costly problem
  - DM related amputation cost 3B per year
    • *Diabetes Care 2003*
- Most common reason for a diabetic to be admitted
  - *National Hospital Discharge Data*
- Most common non-traumatic cause of amputation
  - 60% of LEA
  - Most common cause of nontraumatic lower extremity amputation
    • *Lancet 2005*

Importance of Diabetic Wound care

- Diabetic foot ulcers present >4 weeks have a 5 fold higher risk of infection
- Infection in a foot ulcer increases the risk for hospitalization 55.7 times and risk for amputation 155 times
- 5 year mortality after limb amputation is 68%
  • *NIH publication 1995*

Wound Care is Easy

The FDA defines a healed wound as reepithelialized skin without drainage or dressing requirements confirmed at 2 consecutive visits 2 weeks apart.

Guidance for Industry

Chronic Cutaneous Ulcer and Burn Wounds — Developing Products for Treatment
Clinical Practice Guidelines

- Management of etiologic factors
  - Adequate perfusion
    - PAD (Twice as common in DM)
    - Gregg et al 2004
    - Rarely lead to ulcer directly
    - Contributes to 50% of ulcers
      - Diabetes Metab 2008
  - Debridement
    - Sharp debridement of infection
    - Urgent for gas/necrotizing infection
    - Infection Control
      - IDSA guidelines
  - Pressure Mitigation
    - Offloading
    - Total contact cast

The management of diabetic foot: A clinical practice guideline by the Society for Vascular Surgery in collaboration with the American Podiatric Medical Association and the Society for Vascular Medicine

Joel H. Wright, MD, Cara E. LaBie, MD, Dennis D. Mardis, MD, David W. Seltzer, MD, John M. Marzullo, MD, Andrew D. M. Artinian, MD, Paul B. Lesar, MD, PhD, Robert J. Kunelis, MD, and Kevin M. Tierney, MD, FRCP
Frequency

- Category 0 (Normal Risk)
  - Annual
- Category 1 (Neuropathy)
  - Semiannual
- Category 2 (Neuropathy/PAD/Deformity)
  - Quarterly
- Category 3 (Previous ulcer/amputation)
  - Monthly/Quarterly

Basic evaluation and treatment of foot diabetic foot ulcers

- Neurologic status
  - Monofilament
  - Vibratory sensation
  - Questionnaire
    - Patient may not realize loss of sensation
- Vascular status
  - Pedal pulses
  - ABI’s with waveforms and toe pressures
  - TcO2

Vascular work up

- ADA recommendations:
  - ABI >50 y DM
  - <50 y with risk factors
    - Smoking
    - HTN
    - Hyperlipidemia
  - >10 years DM
  - Anyone with PAD symptoms
- Dependent rubor
- Pallor on elevation
- Absence of hair growth
- Dystrophic nails
- Cool/Dry/Fissured skin
  - Diabetes Care 2003
The majority of foot ulcers appear to result from minor trauma in the presence of sensory neuropathy. McNeely

Critical Triad: (65% of diabetic foot ulcers)

- Neuropathy
- Deformity
- Trauma
Wound Evaluation

- **Size**
  - % reduction early predictor of outcome

- **Location**
  - WB surface
  - Digits
  - Heel
  - Legs

- **Shape**
  - Margolins

- **Depth**
  - Deep tissue involvement

- **Base**
  - Necrotic/Fibrotic/Granular

- **Border**
  - Abnormal

- **Probe**
  - 89% Probe to bone

- **Xrays**
  - Free air/foreign body

- **Infection**
  - Advanced imaging work up

Diagnostics

- **Inflammatory markers**
  - Lack specificity
  - Neuropathy/vascular disease mimic/diminish inflammatory findings

- **CBC**

- **Culture**
  - All open wounds are colonized

- **Bone biopsy**
  - Invasive
  - Guide antibiotic

- **Imaging**
  - Radiographs
  - MRI
  - CT
  - White blood cell scan
  - FDG-PET

Table 1

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
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<tbody>
<tr>
<td>Stage A</td>
<td>No infection or ischemia</td>
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<tr>
<td>Stage B</td>
<td>Infection present</td>
</tr>
<tr>
<td>Stage C</td>
<td>Ischemia present</td>
</tr>
<tr>
<td>Stage D</td>
<td>Infection and ischemia present</td>
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</table>

Grading

- Grade 0: Epithelialized wound
- Grade 1: Superficial wound
- Grade 2: Wound penetrates to tendon or capsule
- Grade 3: Wound penetrates to bone or joint

Grade 2 ulcers
Grade 3 D ulcers

Osteomyelitis

- Hindfoot and leg osteomyelitis is often met with few options for salvage
- Often move into a major amputation – BKA/AKA
- Limb preservation often not an option but should be examined in each case
- Mortality after non-traumatic BKA/AKA (4+ comorbidities)
  - 30 day: 16%
  - 1 year: 25/43 (37)%
  - 5 year: 66/83 (70)%


Osteomyelitis

- Osteomyelitis – a challenge met by all those treating the foot and ankle
- Osteomyelitis secondary to diabetic foot ulceration is an unfortunate complication that may require
  - Long term intravenous antibiotics
  - Operative debridement
  - Amputation, and commonly a combination of these.
- Debridement/comple se excision of infected bone
  - Soft tissue coverage
  - Compliance of patients

Amputation Healing

- Transfer Lesion
- Abnormal tendon pull
- Rotation in various planes
- Dehiscence
- Optimal healing
- Shoe filler

Amputation Recovery

- Amputation
- Appropriate Orthoses
- Instability
- Plantigrade foot
- History of ulcer

Amputation

- Hallux
- Digit amputation
- Metatarsal Amputation
- Transmetatarsal
- Lisfranc Amputation
- Chopart Amputation
- Syme’s Amputation
Grade 3D

Charcot Neuroarthropathy/Abnormal pressure
Thank You