Fundamentals in the Diabetic Foot Exam - What to Look For?

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Diabetic Examination

Objectives

- Dermatological
  Tinea Pedis, Onychomycosis, Hyperkeratotic Lesions, Fissures

- Neurological
  Sharp-dull, Two-Point Discrimination, Deep tendon reflexes, Vibratory, Babinski, Fine Touch, Diabetic Neuropathy

- Biomechanical
  Structure, Charcot Arthropathy
Who is at Risk for Diabetic Foot Ulceration?

- Diabetic foot complications are the single most common cause of non-traumatic lower extremity amputations in the industrialized world.
- Individuals with diabetes have a 15 to 46 fold greater risk of high level lower extremity amputation than those without diabetes.
- The most common component in the pathway to amputation is the diabetic neuropathic foot ulcer.

Risk Factors for Diabetic Foot Ulceration - Intrinsic

- Peripheral sensory neuropathy
  - Sensorimotor
  - Autonomic
- Previous ulceration/amputation
- Poor glycemic control
- Duration of diabetes
- Vascular disease
  - Macrovascular
  - Microvascular
- Immunopathy/susceptibility to infection
- Structural foot deformity
- Biomechanical dysfunction
- Limited joint mobility
- Advanced age
- Blindness/partial sight
- Callus
“I skate to where the puck is going to be, not where it is.”

Wayne Gretzky
Autonomic Neuropathy and the Patient with Diabetes

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NCVH 2015 New Orleans
Neurological Examination

Diabetic Peripheral Neuropathy
Defining Pain

“An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.”

International Association for the Study of Pain (IASP)

Acute vs Chronic Pain States

**Acute**
- Associated with tissue damage
- Increased autonomic nervous activity
- Resolves with healing of injury
- Serves protective function

**Chronic**
- Extends beyond expected period of healing
- No protective function
- Degrades health and functioning
- Contributes to depressed mood

Nociceptive vs Neuropathic Pain States

**Nociceptive**
- Arises from stimulus outside of nervous system
- Proportionate to receptor stimulation
- When acute, serves protective function

**Neuropathic**
- Arises from primary lesion or dysfunction in nervous system
- No nociceptive stimulation required
- Disproportionate to receptor stimulation
- Other evidence of nerve damage

Examples of Nociceptive and Neuropathic Pain

Nociceptive
Caused by tissue damage
- Arthritis
- Mechanical low back pain
- Sports/exercise injuries
- Postoperative pain

Mixed
Caused by combination of primary injury and secondary effects
- Low back pain
- Fibromyalgia
- Neck pain
- Cancer pain

Neuropathic
Caused by lesion or dysfunction in the nervous system
- Painful DPN
- PHN
- Neuropathic low back pain
- Trigeminal neuralgia
- Central poststroke pain
- Complex regional pain syndrome
- Distal HIV polyneuropathy
DPN and PHN Produce Positive and Negative Symptoms

Positive Sensory Symptoms
- Spontaneous pain
- Dysesthesias
- Paresthesias
- Evoked pain

Negative Sensory Symptoms
- Loss/impairment of sensory quality
- Numbness, reduced sensation

# Spontaneous Symptoms

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Description</th>
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<tbody>
<tr>
<td>Spontaneous pain</td>
<td>Persistent burning pain, shocklike pain</td>
</tr>
<tr>
<td>Dysesthesias</td>
<td>Abnormal, unpleasant sensations (eg, shooting, lancinating, burning)</td>
</tr>
<tr>
<td>Paresthesias</td>
<td>Abnormal, not unpleasant sensations (eg, tingling)</td>
</tr>
</tbody>
</table>

DPN: What Is It?

• Nerve damage and dysfunction secondary to diabetes mellitus type 1 or 2
   Consensus definition: “the presence of symptoms and/or signs of peripheral nerve dysfunction in people with diabetes after exclusion of other causes”
• A very common complication of diabetes
• A leading cause of neuropathic pain

Prevalence of Painful DPN


Approximately 18.2 million people in the US have diabetes. Approximately 2.7 million Americans experience approximately 15% pain from painful diabetic peripheral neuropathy (DPN). The prevalence of DPN ranges from 4% to 5.9% to ≥6%.

Diabetes prevalence:
- 4% to 4.9%
- 5% to 5.9%
- ≥6%
DPN:

How Diabetes May Lead to Nerve Damage
Potential Mechanisms of Nerve Damage in Diabetes

• Hyperglycemia
  − Toxic/reactive metabolites from increased glucose metabolism

• Microangiopathy and ischemia

• Cell signaling abnormalities*
  − Diacylglycerol, protein kinase C

• Na⁺ channel dysregulation*

• Demyelination

*Based on animal models.

DPN Classification Based on Clinical Features

• Hyperglycemic neuropathy
• Hypoglycemic neuropathy
• Generalized neuropathies
  - Sensorimotor polyneuropathy
  - Acute painful sensory neuropathy
  - Autonomic neuropathy
  - Acute motor neuropathy
• Focal and multifocal neuropathies
  - Cranial neuropathy
  - Thoracolumbar radiculoneuropathy
  - Proximal diabetic neuropathy
• Focal limb neuropathy
• Superimposed chronic inflammatory demyelinating neuropathy

Distal Symmetric Polyneuropathy

- Result of sensory nerve damage
  - Large (Aα/β) fibers
  - Small (Aδ and C) fibers
- Most patients have mixed neuropathy
  - Large- and small-fiber symptoms
- Sock-and-glove distribution very common

Distal Symmetric Polyneuropathy: Small Fiber

- First: pain and hyperalgesia
- Later: loss of sensitivity
  - Heat/Cold
  - Light touch/pinprick
- Autonomic symptoms
- Predisposes to diabetic foot disease
- Electrophysiology may not detect nerve damage

Distal Polyneuropathy - Small Fiber
Distal Symmetric Polyneuropathy: Large Fiber

- Sensory and/or motor nerves
- Feet usually affected first
  - Vibration perception
  - Position sense (proprioception)
  - Deep-seated gnawing/aching pain
  - Muscle wasting (hammertoes)
- May interfere with activities of daily living
- Abnormalities readily detected by electromyography

Distal Polyneuropathy - Large Fiber
JCAHO Recognizes Pain as Fifth Vital Sign

1) Temperature
2) Respiration
3) Pulse
4) Blood pressure
5) Pain

Pain is now the **Fifth Vital Sign**

JCAHO = Joint Commission on Accreditation of Healthcare Organizations.

### Examples of Tests Used in a Clinical Examination for DPN or PHN

<table>
<thead>
<tr>
<th>Domain</th>
<th>Assessment</th>
<th>Detects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory</td>
<td>Pinprick, Brush or swab</td>
<td>Hyperalgesia, Dynamic allodynia</td>
</tr>
<tr>
<td>Motor</td>
<td>Reflexes, strength, balance, Muscle tenderness, Joint mobility, Tremor</td>
<td>------------------------------</td>
</tr>
</tbody>
</table>
Foot Screen for Loss of Protective Sensation in Patients with Diabetes
Current Therapies for Painful DPN or PHN

• Antidepressants
  − Tricyclics
  − Serotonin-norepinephrine reuptake inhibitors (SNRIs)
• Anticonvulsants
  − First generation
  − Second generation
• Opioid analgesics
• Dermal and topical treatments
Painful DPN and PHN: Summary

• Comprise 2 of the most common types of neuropathic pain
• Substantial burden on patients
• Nerve damage leads to inappropriate pain signal transmission
• Calcium channel modulation is a promising strategy for controlling neuropathic pain
• Good clinical management of neuropathic pain involves
  − Thorough workup
  − Control of underlying disease, if possible
  − Multiple treatment approaches
Bust of the Greek physician Hippocrates. Much of what is known about Greek medicine comes to us from his collection of medical writings (The Hippocratic Collection).
Biomechanical - Predicting Plantar Pressure
Risk Factors for Charcot Disease

- Duration of diabetes
- Peripheral sensory neuropathy in presence of normal circulation
- History of trauma, often minor
- Foot deformity
- Prior surgery or amputation
Diabetic Neuropathic Osteoarthropathy (Charcot Foot)

- Charcot foot (neuropathic osteoarthropathy) is a progressive condition characterized by joint dislocation, pathologic fractures, debilitating deformity, and possible need for amputation.
- Diabetes mellitus and associated neuropathy is the most common etiology.
Locomotor Ataxia (Tabes Dorsalis)
Charcot’s Observations

- Fulgurant (lacinating pain)
- Sudden and unexpected arthropathy
- Generalized tumefaction
- Rapid joint changes with enormous wear and tear
- Extensive looseness of ligaments
- Disturbance of gait
“With tabes, the foot deformity relates to an erosion of the tarsal bones, with a resultant flat foot, and especially marked protrusions of the medial tarsal components. In such cases, the flat foot seems enlarged, and a footprint would show an impression of the entire foot.”

J.M. Charcot
Diabetic Neuropathic Osteoarthropathy (Charcot Foot)

- Trauma superimposed on a severely neuropathic Extremity may precipitate development of Charcot foot.
- The sensory-deprived patient is often unaware of osseous destruction in progress
Clinical Diagnosis of Acute Charcot Arthropathy

- **Initial Findings:**
- Profound unilateral swelling of foot, but skin intact
- Increased skin temperature over affected areas
- Erythema
- Joint effusion bone resorption in an insensate foot
- Pain described by some but not all patients
- Coexisting ulceration may complicate diagnosis
Classification of Charcot Arthropathy

- The most common classification is based upon radiographic appearance.
- Developmental stage: Significant soft-tissue swelling. Osteochondral fragmentation or joint dislocation of varying degrees.
- Coalescent stage: Reduction in soft-tissue swelling, bone callus proliferation, consolidation of fractures.
- Reconstructive stage: Bony ankylosis, hypertrophic proliferation.
# Recognizing Foot Deformities

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<tbody>
<tr>
<td><strong>1. Limited Hallux Motion</strong></td>
<td>When the hallux will not bend dorsally, risk for ulcer on its plantar surface because of high pressure is increased.</td>
</tr>
<tr>
<td><strong>2. Limited Ankle Joint Range of Motion</strong></td>
<td>When the ankle will not dorsiflex, pressure under the forefoot is likely to be increased.</td>
</tr>
<tr>
<td><strong>3. Prominent Metatarsal Heads</strong></td>
<td>When one or more metatarsal heads are prominent or easily palpable with or without calluses, pressure under these locations is likely to be increased.</td>
</tr>
<tr>
<td><strong>4. Toe Deformity</strong></td>
<td>Clinically evident clawed or hammer toes or unusual angulation of the toes increases risk for ulceration, both dorsally and at the tips of the toes.</td>
</tr>
<tr>
<td><strong>5. Charcot Foot</strong></td>
<td>Charcot fracture is a significant structural deformity that may present with flattened arches or a more obvious deformity. Charcot foot or fracture is an emergency problem and should be referred to a specialist. Charcot fractures are associated with both plantar and dorsal prominences.</td>
</tr>
<tr>
<td><strong>6. Callus</strong></td>
<td>Calluses have been shown to increase plantar pressure.</td>
</tr>
</tbody>
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Tabetic Arthropathies

TREATMENT

OFF-LOADING
Tabetic Arthropathies—Treatments

Non-pharmacologic Therapy

- Bed Rest
- Firm bandage support
- Physical rehabilitation therapy
- Electrotherapy—continuous (galvanic) electric currents
- Bone stimulation
Shoe Considerations - Rx for the Pedorthist/Orthotist

Complications from diabetes are the leading cause of non-traumatic amputation. Timely conservative measures and daily care are the best ways to prevent serious, debilitating complications from diabetes.

The Therapeutic shoe bill, a Medicare program, provides 'at-risk' patients with protective footwear and shoes inserts. The use of these products has been proven to reduce diabetic foot injuries. Ask your doctor if you qualify.

Benefit Therapeutic Footwear Network a division of Lange Distribution Services, Inc.
Footwear Therapy
For The Diabetic Patient

Can Proper Shoes Prevent
New lesions?
Therapeutic Footwear: Is there Evidence of Effectiveness?

- Intuitive assumption corroborated by several studies (and unproven in others)
- Several reviews question the validity of studies purporting a reduction in incidence of recurrent ulcers/foot lesions
- Design issues may confound effect noted (poor internal validity)

Maciejewski et al: Diabetes Care 2004
Boulton and Jude: Diabetes Care 2004
Spencer: Cochran Review 2002
Litzleman: Diabetes Care 2002
Reducing Plantar in the Neuropathic Foot: A Comparison of Footwear

- Compared pressure reduction under forefoot
- Extra-depth, athletic, and comfort shoes vs. canvas
- With and without unmodified viscoelastic insoles
- With special insole, all shoe types significantly reduce peak plantar pressure by 5.4-20%.
- Comfort and (SAS) and athletic shoes are equally or more effective than extra-depth shoes.
Effectiveness of Therapeutic Footwear in Preventing Ulcers

- Edmonds et al (1986)
  - 26% vs. 83% ulcer recurrence in regular shoes

- Chantelau (1994)
  - 8% relapse vs. 38% at 2 yrs when worn >60% daily

- Uccioli (1995)
  - At one year 28% vs. 58% ulcer relapse, P= 0.009
Osteomyelitis vs Charcot
- ACUTE -

? Clinical Evidence of Infection?
( Local - Systemic - Lab.)

? Is Bone Destruction Present?

? Further Confirmation Needed?

YES

Triphasic Bone Scan + Indium Scan

- Bone Scan
- Indium Scan

SEEK ANOTHER DIAGNOSIS

NO

+ Bone Scan
- Indium Scan

ACUTE CHARCOT ARTHROPATHY

+ Bone Scan
+ Indium Scan

ACUTE OSTEOMYELITIS

NOTE: A Positive In111 Scan = Positive @ 24 or 24 hours. Not less.
Osteomyelitis vs Charcot - CHRONIC -

? Is Further Confirmation Needed?

YES

In111 @ 24-46 Hrs
NOT 4-6 hours

Indium Scan & Bone Scan

POSITIVE

? Is Further Confirmation Desired?

YES

Bone Bx: Culture & Histology

? MISMATCH?

- Culture - Histo

+ Culture + Histo

NO

In111 @ 4-6 &/or 24 hours

NEGATIVE

CHRONIC CHARCOT ARTHROPATHY

NO

OSTEOMYELITIS - With or Without -
CHARCOT ARTHROPATHY
Bust of the Greek physician Hippocrates. Much of what is known about Greek medicine comes to us from his collection of medical writings (The Hippocratic Collection).
Thank You!