DIAGNOSIS OF DIABETIC NEUROPATHY

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DIAGRAM OF CASUAL PATHWAYS TO FOOT ULCERATION

- Diabetes mellitus
  - Somatic sensory neuropathy: Decreased pain, temperature, and proprioception
  - Somatic motor neuropathy: Small muscle wasting
  - Autonomic neuropathy: Decreased sweating, Altered blood flow
    - Hyperhidrosis: Dry skin
    - Altered blood flow: Distended foot veins, "warm feet"

- Foot deformities
  - Increased foot pressures
    - Callus
      - At-risk neuropathic foot
        - Repetitive trauma: e.g., ill-fitting shoes
          - Neuropathic foot ulcer
DIABETIC PERIPHERAL NEUROPATHY

- the M/C complication of diabetes
- Prevalence: 28% (UK); 66% (Rochester, Minn., USA)
- the burden in health care costs
- up to 70% of all leg amputations
- 26%, painful diabetic neuropathy; 13%, no Sxs; 39%, no treatment
- prediabetes or IGT: rates of neuropathy; a 2-3 fold in neuropathic pain
CHANGES OF SIGNS

Asymptomatic peripheral nerve dysfunction
NCS, RR interval

- Decreased sensation toes
- Pan-modality stocking sensory loss of the toes, feet, distal legs
- Abnormal tendon reflexes
- Clinical autonomic abnormalities
- Weakness of small foot muscles and of ankle DF

Early
Latency
Late

Bril V. Diabetic neuropathy. 2010 AANEM Annual meeting
2013 KSDF Foundation Congress
SENSORY CHANGES
DEFINITION OF DIABETIC PERIPHERAL NEUROPATHY

Somatic and/or autonomic neuropathy that is attributed solely to diabetes mellitus

Generalized symmetric polyneuropathies
- Acute sensory
- Chronic sensorimotor
- Autonomic

Focal and multifocal neuropathies
- Cranial
- Truncal
- Focal limb
- Proximal motor (amyotrophy)
- Coexisting CIDP
CLASSIFICATION OF DIABETIC PERIPHERAL NEUROPATHY

Generalized polyneuropathies
- Typical DPN (diabetic sensorimotor polyneuropathy)
- Atypical DPN

Focal & multifocal neuropathies
- Focal neuropathy: median, ulnar, peroneal nerves
- Multifocal neuropathies: multiple mononeuropathies, radiculoplexus neuropathies
ASSESSMENT OF DIABETIC PERIPHERAL NEUROPATHY

1. Clinical symptoms & signs
2. Electrodiagnostic studies
3. Quantitative sensation testing
4. Autonomic function testing

cf) nerve biopsy,
    skin biopsy: small fiber neuropathy
ASSESSMENT OF DIABETIC PERIPHERAL NEUROPATHY

cf) nerve biopsy,
skin biopsy: small fiber neuropathy

Diabetes Care 1996;19:S72-S92
PERIPHERAL NERVOUS SYSTEM

Motor | Sensory | Autonomic

Myelinated | Myelinated | Thinly myelinated | Un-myelinated | Thinly myelinated | Un-myelinated

A alpha | A alpha/beta | A delta | C | C

Large | Small

Muscle control | Touch, vibration, position perception | Cold perception, pain | Warm perception, pain | Heart rate, blood pressure, sweating, GIT, GUT function

Casellini & Vinik. Endocr Pract 200713:550-566
2013 KSDF Foundation Congress
PERIPHERAL NERVOUS SYSTEM

Motor  Sensory  Autonomic

Myelinated  Myelinated  Thinline  Unmyelinated  Thinline  Unmyelinated

A alpha  A alpha/beta  A delta  C  C

Large  Small

1. Neve conduction study
2. Vibration detection threshold
1. Cold detection threshold
2. Heat-pain threshold
3. Confocal cornea microscopy
4. Intraepidermal nerve fiber density
1. Sympathetic skin response
2. Heart rate during deep breathing
3. QSART
CONSENSUS FOR DIABETIC PERIPHERAL NEUROPATHY

- The 1988 San Antonio Conference on Diabetic Neuropathy
  (Diabetes Care 1988;11:592-597)

- Boulton et al.
  (Diabetes Care 2005;28:956-962)

- AAN, AANEM, and AAPM&R
  (Neurology 2005;64:199-207)

- The 2009 Toronto Conference on Diabetic neuropathy
  (Diabetes Care 2010;33:2285-2293)

**Diabetic Neuropathies**
A statement by the American Diabetes Association

**Distal symmetric polyneuropathy: A definition for clinical research**
Report of the American Academy of Neurology, the American Association of Electrodiagnostic Medicine, and the American Academy of Physical Medicine and Rehabilitation

**Diabetic Neuropathies: Update on Definitions, Diagnostic Criteria, Estimation of Severity, and Treatments**
<table>
<thead>
<tr>
<th>Neuropathic symptoms</th>
<th>Decreased or absent ankle reflex</th>
<th>Decreased distal sense</th>
<th>Distal m. weakness or atrophy</th>
<th>NCSs</th>
<th>Ordinal likelihood</th>
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MAKING THE DIAGNOSIS OF DIABETIC PERIPHERAL NEUROPATHY

The Gold Standard of Diagnosis

Symptoms + Signs + Abnormal NCS


The most reliable diagnosis and selection of patients for research studies

DEFINITIONS OF MINIMAL CRITERIA FOR DIABETIC PERIPHERAL NEUROPATHY

1. PossibleDSPN: symptoms or signs of DSPN
2. ProbableDSPN: symptoms & signs of DSPN
3. ConfirmedDSPN: abnormal NCs + a symptom or symptoms, or a sign or signs
4. SubclinicalDSPN: abnormal NCs or a validated measure of SFN with no signs or symptoms
GUIDELINES FOR DIABETIC PERIPHERAL NEUROPATHY

1. Studies of the epidemiology of peripheral and autonomic diabetic neuropathy

2. Conduct of clinical trials in diabetic neuropathy

3. Management of diabetic peripheral neuropathy by practising clinicians


Neurodiab of EASD, 1995
SCREENING FOR DIABETIC PERIPHERAL NEUROPATHY

- The International Guidelines for Diagnosis and Outpatient Management of Diabetic Peripheral Neuropathy
  (The neuropathy study group [Neurodiab] of the European Association for the Study of Diabetes [EASD], 1995)

- Guidelines for diagnosis and outpatient management of diabetic peripheral neuropathy. European Association for the Study of Diabetes, Neurodiab.
  (Boulton AJ. Diabetes Metab. 1998;24 Suppl 3:55-65)

- International consensus on the diabetic foot

- The Clinical Practice Guidelines of the Canadian Diabetes Mellitus
  (Canadian J Diabetes, 2008)
2013 ADA RECOMMENDATIONS FOR NEUROPATHY SCREENING

● All patients should be screened for distal symmetric polyneuropathy (DPN) starting at diagnosis of type 2 diabetes and 5 years after the diagnosis of type 1 diabetes and at least annually thereafter, using simple clinical tests. (B)

● Electrophysiological testing is rarely needed, except in situations where the clinical features are atypical. (E)

● Screening for signs and symptoms of cardiovascular autonomic neuropathy (CAN) should be instituted at diagnosis of type 2 diabetes and 5 years after the diagnosis of type 1 diabetes. Special testing is rarely needed and may not affect management or outcomes. (E)
SCREENING NEUROLOGICAL TESTS FOR DIABETIC PERIPHERAL NEUROPATHY

- **Pinprick sensation**: a disposable dressmaker’s pin
- **Vibration perception**: a 128-Hz tuning fork
- **Pressure sensation**: 10-g Semmes-Weinstein monofilament
- **Ankle reflex**: reflex hammer
SCREENING NEUROLOGICAL TESTS FOR DIABETIC PERIPHERAL NEUROPATHY

• Pinprick sensation: a disposable dressmaker’s pin
  - Ask “Is it painful?” not “Can you feel it?"
  - Sites: dorsum of great toe ot
    the plantar aspect of the distal 1st, 3rd, and 5th toes
  - highly subjective, poorly reproducible
Vibration perception: a 128-Hz tuning fork
- wrist (or elbow or clavicle) → 1st toes
- two true application + one “mock” application
→ a highly subjective and poorly reproducible,
but significantly associated with development of foot ulcers
SCREENING NEUROLOGICAL TESTS FOR DIABETIC PERIPHERAL NEUROPATHY

**Pressure sensation:** 10-g Semmes-Weinstein monofilament
- hands (or elbow or forehead) → three sites (1st toe, forefoot)
- two true application + one “mock” application (yes or no)

→ the best correlate to the presence or history of an ulcer

forefoot: moderate reproducibility (κ=0.38-0.54)
Ankle reflex: reflex hammer
- both ankles, sitting or kneeling
- no reflex → repeat with reinforcement
- grade: 0, absent; 1, present but decreased;
  2, normal; 3, increased; 4, increased with clonus
- a poor predictor of ulceration
<table>
<thead>
<tr>
<th>Neuropathy Disability Score (NDS)</th>
<th>Right</th>
<th>Left</th>
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<tbody>
<tr>
<td><strong>Vibration Perception Threshold</strong></td>
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<td>128-Hz tuning fork; apex of big toe: normal = can distinguish vibrating/not vibrating</td>
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<tr>
<td><strong>Temperature Perception on Dorsum of the Foot</strong></td>
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<tr>
<td>Use tuning fork with beaker of ice/warm water</td>
<td>Normal = 0</td>
<td></td>
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<tr>
<td>Abnormal = 1</td>
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<tr>
<td><strong>Pin-Prick</strong></td>
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<tr>
<td>Apply pin proximal to big toe nail just enough to deform the skin; trial pair = sharp, blunt; normal = can distinguish sharp/not sharp</td>
<td>Present = 0</td>
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<tr>
<td>Present with reinforcement = 1</td>
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<tr>
<td>Absent = 2</td>
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<td><strong>Achilles Reflex</strong></td>
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<td>Present = 0</td>
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<td>Absent = 2</td>
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<tr>
<td><strong>NDS Total out of 10</strong></td>
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</table>

Boulton AJM. Clinical Diabetes 2005;23:9-14

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SCREENING NEUROLOGICAL TESTS FOR DIABETIC PERIPHERAL NEUROPATHY

- Combinations of more than one test have 87% sensitivity in detecting DPN.

- Loss of 10-g monofilament perception and reduced vibration perception predict foot ulcers.
EARLY RECOGNITION AND MANAGEMENT OF NEUROPATHY

- Nondiabetic neuropathy... treatable
- a number of treatment option
- up to 50% of diabetic peripheral neuropathy... asymptomatic
  ➔ at risk for insensate injury to feet
- autonomic neuropathy and cardiac autonomic neuropathy
  ... substantial morbidity and even mortality
Thank You for Your Attention