PERIPHERAL NERVE COMPLICATIONS

Disorders of the peripheral and autonomic nervous systems are some of the most common complications of diabetes mellitus. (See specific organs like the stomach or the genitourinary tract for a discussion of autonomic neuropathy.) Although there are many different clinical manifestations of peripheral neuropathy, the most common in people with diabetes is distal symmetrical polyneuropathy (DSPN). This disorder is characterized by a progressive loss of distal sensation in a classic "stocking-glove" distribution (due to the loss of sensory axons). In severe cases, sensory loss can be followed by damage to the motor axons and the patient may develop weakness. Because a major characteristic of this disorder is loss of sensation in one’s feet, it is critical for patients to visually inspect their feet everyday. Since patients cannot otherwise sense minor cuts or areas of excess pressure from poorly fitting shoes, visual inspection is critical to detect early problems before they develop into pressure ulcers and infections (see an example of an ulcer in the figure below). It is estimated that 20% of hospitalizations for people with diabetes are related to foot problems, so the importance of detecting ulcers and/or infections early cannot be overstated.

The severity and duration of hyperglycemia appears to be the most important risk factor for peripheral neuropathy, as evidenced by the fact that tight glycemic control can both limit the progression of peripheral neuropathy, or prevent it altogether. Although there are several theories about the cause of peripheral neuropathy, hyperglycemia is implicated in two different ways: excess glucose damages the small blood vessels supplying the neuron, causing the neuron to become ischemic; in addition, hyperglycemia induces deleterious metabolic changes in the neuron itself.

More information about the peripheral nerve complications of diabetes is discussed in the following articles:

History:
Even if the patient has not suffered from foot ulcerations or infection, there are many other complaints that will cause him or her to present to a physician. The most typical presentation will be a patient who complains of numbness and tingling in the feet, which gradually progresses up the lower leg in a characteristic stocking distribution. The upper extremities will also be affected, in a glove distribution (see figure). Some patients may complain of a burning pain. At more advanced stages, DSPN can also involve damage to the motor nerves, so patients may complain of distal weakness and foot drop.

Physical Exam:
The hallmark of DSPN is loss of sensation in a “stocking-glove” distribution (pain and temperature sensation are the first to go, followed by vibration, proprioception, and two-point discrimination). The device used to measure pressure sensation is the microfilament, an example of which is shown in the figure. Vibration sensation is also tested on the dorsum of the foot, typically with the use of a 128-Hz tuning fork. Inspection in a patient with DSTP is also quite valuable, as it may reveal atrophy of the distal muscles (if motor neurons are damaged) in both the upper and lower extremities, as well as joint deformities (which can further predispose the patient to pressure ulcers). Inspection is also critical for detecting the presence of ulcers, clawed toes, Charcot’s arthropathy (characterized by collapse of the midfoot arch and replacement with bony prominences), or infection. If there is purulent discharge from an ulcer combined with erythema, warmth, swelling, and tenderness (all signs of cellulitis), infection should be suspected and further evaluation of the foot should be performed; this includes checking for fluctuance and expression of pus from sinus tracts (indicates deep tissue infection), as well as looking for purple/black discoloration (indicates a necrotizing infection).

Strength testing may reveal symmetrical distal weakness, which contributes to a “steppage gait” as a compensation for foot drop (so as not to drag one’s toes on the ground when walking). Both tone and deep tendon reflexes can be reduced.
More information about the physical examination of the diabetic foot is discussed in the following articles:

- Feldman EL; Stevens MJ; Thomas PK; Brown MB; Canal N; Greene DA. "A practical two-step quantitative clinical and electrophysiological assessment for the diagnosis and staging of diabetic neuropathy." Diabetes Care 1994; 11:1281-9.

Tests:
Several scoring rubrics have been designed that appear to have good predictability for DSPN. These take into account the patient’s numbness, pain, and tingling, as well as measurements of the patient’s sensation (using a monofilament), ankle reflexes, and appearance of the feet. At the end of the first paragraph, added on the following sentences: One generally accepted quantitative scoring system (Michigan) is as follows: 2 points in each foot for an absent Achilles tendon reflex, 1 point in each foot for absent or reduced vibration sense, 1 point in each foot for absent or reduced pressure sensation, and 1 point for reduced temperature sensation. When combining all of these facets of the neurologic examination, a total score of 0-2 is considered normal, 3-5 is mild, 6-8 is moderate, and 9-10 is severe peripheral neuropathy.

Note, if soft tissue infection is present (as indicated erythema, warmth, swelling, tenderness, and potentially fluctuance and/or expression of pus from sinus tracts), a plain radiograph or MRI of the affected foot to rule out osteomyelitis may be indicated. It is also possible that curettage of the ulcer base or deep tissue culture may be indicated to guide the choice of antibiotics.

In the event that one’s diabetes status is not already known (peripheral neuropathy may be a presenting feature of type 2 diabetes), a fasting blood glucose test should be obtained.

Treatment:
The doctor and patient must work together to optimize glycemic control. In addition, the patient should be counseled about the importance of visually inspecting his or her feet every day. Patients at high risk (loss of sensation by monofilament testing, foot deformities, or prior foot ulcer) should be referred to a podiatrist.

Diabetic foot infection is a serious condition that can ultimately lead to foot or even above-knee amputation if severe deep tissue infection or osteomyelitis should develop. In non-limb threatening situations, a course of antibiotics and close monitoring is usually sufficient. However, if a patient has a limb-threatening infection (as indicated by the presence of gangrene, severe ischemia, or tissue necrosis), hospitalization with surgical debridement and parenteral antibiotics may be required; this is especially true in the case of osteomyelitis.

More information about the treatment of diabetic foot infections is discussed in the following articles:


Self Assessments:
Which of the following is MOST CORRECT in a patient with diabetic peripheral neuropathy?

A. Numbness and tingling will be present in a truncal distribution
B. Deep tendon reflexes will be increased
C. Muscle tone may be reduced
D. Weakness will primarily affect one side over the other

Explanations:
A. Incorrect. The hallmark of distal symmetrical polyneuropathy (DSPN) is the loss of sensation in a stocking-glove distribution.
B. Incorrect. As is common with lower motor neuron disease, deep tendon reflexes will be reduced.
C. Correct! If the neuropathy affects lower motor neurons, tone (as well as strength and reflexes) is reduced.
D. Incorrect. The weakness in distal symmetrical polyneuropathy (DSPN) is typically symmetrical.

Which of the following is critical to the management of diabetic peripheral neuropathy?

A. Strict glycemic control
B. Daily visual inspection of one’s feet
C. Seeking immediate medical attention for foot ulcers
D. All of the above

Explanations:
A. Incorrect.
B. Incorrect.
C. Incorrect.
D. Correct! Each of these strategies is critical to the management of diabetic peripheral neuropathy.