Peripheral Neuropathies

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Disclosure

- Nothing to disclose

Learning Objectives

- Describe the pathophysiology of peripheral neuropathies
- Review the anatomy of the nervous system
- Describe the clinical presentation of painful peripheral neuropathies
- Review the diagnostic testing for peripheral neuropathy
- Discuss treatment for painful peripheral neuropathy

PAINWEEK

Peripheral Neuropathy

- General term for a group of disorders
- May involve:
  - Single nerve root (mononeuropathy)
  - Multiple individual nerves (mononeuropathy multiplex)
  - Small fibers that don't conform to dermatomes (peripheral polyneuropathies)
- Prevalence in North America 2-3%
- Up to 10% of the geriatric population

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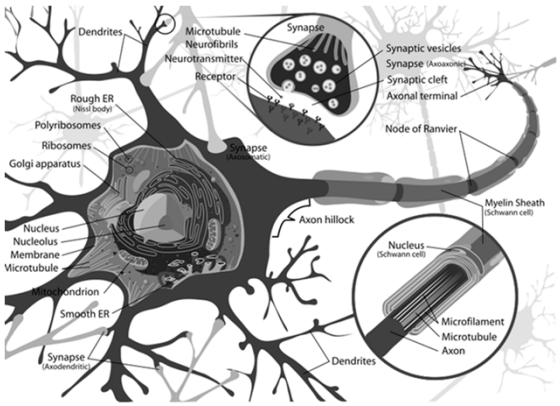
Anatomy of the Nervous System

Neurons:

- Cell body contains nucleus, mitochondria, organelles
- Dendrites pick up signal
- Axons send signals onward to other neurons or effector cells in the body



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3 Basic Classes of Neurons

1. Afferent neurons

- Also known as sensory neurons

- Transmit sensory signals to the central nervous system from receptors in the body

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3 Basic Classes of Neurons

2. Efferent neurons

- Also known as motor neurons
- Transmit signals from the central nervous system to effectors in the body such as muscles and glands

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3 Basic Classes of Neurons

3. Interneurons

- Form complex networks within central nervous system to integrate information received from afferent neurons
- Directs the function of the body through efferent neurons

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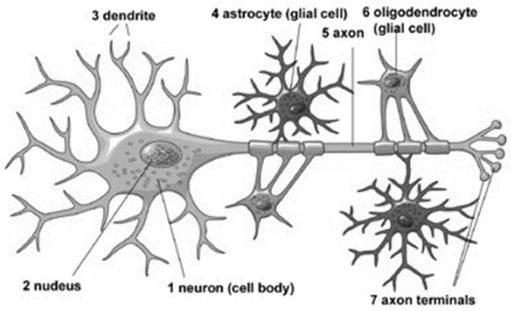
Neuroglia

- Also known as glial cells
- Act as “helper” cells of the nervous system
- Neurons are:
  - surrounded by between 6-60 neuroglia that protect, feed, and insulate the neuron
  - Essential to body function & rarely reproduce
  - Vital to maintain functional nervous system



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Central Nervous System (CNS)

- Seat of higher mental functions:
  - Consciousness
  - Memory
  - Planning
  - Voluntary actions
- Controls lower body functions:
  - The maintenance of respiration
  - Heart rate
  - Blood pressure
  - Digestion

PAINWEEK

Central Nervous System (CNS)

Seat of Higher Mental Functions:

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- Memory
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Controls Lower Body Functions:

- Maintenance of respiration
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- Blood pressure
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The brain has approximately *100 billion* neurons…

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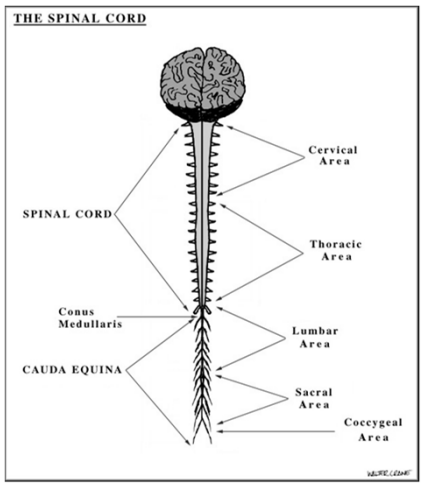
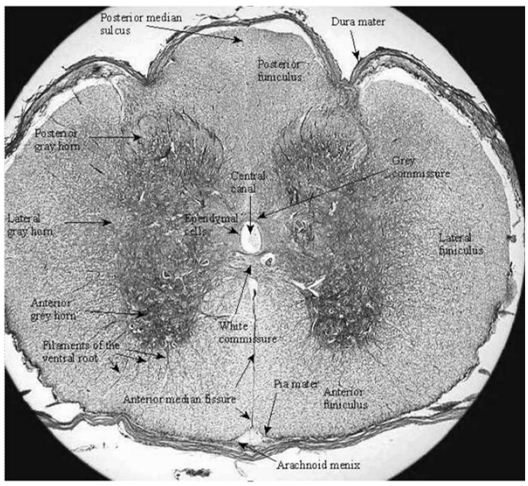
CNS – Spinal Cord





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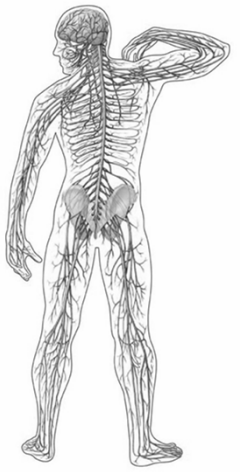
Peripheral Nervous System

- Everything outside of the brain and spinal cord
- Cranial nerves
- Spinal nerves & their roots/branches
- Peripheral nerves
- Neuromuscular junctions



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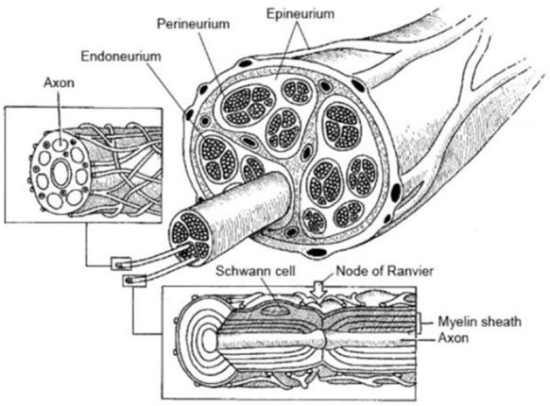
Nerves

- Bundles of axons carry signals to and from the CNS
- Endoneurium: Axon wrapped in connective tissue
- Axons are bundled into groups called fascicles
- Fascicles bundle together to form a nerve



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Nervous System Physiology: 3 Main Functions

1. Sensory

- Collecting information from sensory receptors that monitor the body's internal and external conditions

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Nervous System Physiology: 3 Main Functions (cont'd)

2. Integration

- The processing of the many sensory signals passed into the CNS at any given time
- Signals are evaluated, compared, used for decision making, and discarded or committed to memory as deemed appropriate
- Integration takes place in the gray matter of the brain and spinal cord

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Nervous System Physiology: 3 Main Functions (cont'd)

3. Motor

- Once CNS evaluates sensory information and decides on an action, it stimulates efferent neurons
- Efferent neurons carry signals from the gray matter of the CNS through the nerves of the peripheral nervous system to effector cells
- The effector may be smooth, cardiac, or skeletal muscle tissue or glandular tissue. The effector then releases a hormone, or moves a part of the body, to respond to the stimulus

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PNS: Somatic and Autonomic

Somatic nervous system (SNS)

- Includes all voluntary efferent neurons
- The only consciously controlled part of the PNS
- Is responsible for stimulating skeletal muscles in the body

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PNS: Somatic and Autonomic (cont'd)

Autonomic nervous system (ANS)

- A division of the PNS that includes all of the involuntary efferent neurons
- Controls subconscious effectors such as:
  - Visceral muscle tissue
  - Cardiac muscle tissue
  - Glandular tissue

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Two Divisions of the ANS

1. Sympathetic
   - "Fight or Flight" response
   - Increases respiration and heart rate
   - Releases adrenaline and other stress hormones
   - Decreases digestion

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Two Divisions of the ANS (cont'd)

2. Parasympathetic
   - "Rest and Digest"
   - Decrease respiration and heart rate
   - Increase digestion
   - Permit the elimination of waste

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Peripheral Neuropathy

- More than 100 types of peripheral neuropathy have been identified
  - Motor neuropathy
  - Sensory neuropathy
  - Sensory-motor neuropathy
  - Autonomic neuropathy
  - Combination

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Clinical Features of Peripheral Neuropathies

- Sensory neuropathy
- Numbness
- Loss of sensation or feeling in body parts
- Loss of balance or other functions as a side effect of the loss of feeling in the legs, arms, or other body parts
- Emotional disturbances
- Sleep disruptions
- Loss of pain or sensation that can put you at risk (ie, not feeling an impending heart attack or limb pain)
- Fear of evoked pain can restrict activities

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Clinical Features of Peripheral Neuropathies (cont'd)

- Baseline, spontaneous pain
  - Burning
  - Pins and needles
  - Steady or episodic
  - Lightning, lancinating, crampy

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Clinical Features of Peripheral Neuropathies (cont'd)

- Evoked, stimulus-dependent pain
  - Intense, abnormal responses
    - Hyperalgesia
    - Hyperpathia
    - Allodynia
  - With a crescendo after stimulation of the symptomatic area
  - Can amplify baseline pain qualities
  - Patients often more fearsome of this than baseline pain

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Symptoms of Motor Neuropathies

- Muscle weakness
- Painful cramps
- Fasciculations
- Muscular atrophy
- Changes in skin, hair, or nails

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Autonomic Neuropathy Symptoms

- Inability to sweat properly: leads to heat intolerance
- Loss of bladder control: leads to infection or incontinence
- Dizziness, lightheadedness, or fainting due to loss of control over blood pressure
- Diarrhea, constipation, or incontinence related to nerve damage in the intestines or digestive tract
- Difficulty eating or swallowing
- Life-threatening symptoms, such as difficulty breathing or irregular heartbeat

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Diagnosis

- Medical diagnosis underlying the neuropathy must first be established and managed, when possible
  - Diabetes
  - Hypothyroidism
  - Multiple myeloma
  - Uremia
- Complete history, physical, laboratory examination

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Diagnosis (cont'd)

- Electrodiagnostic studies:
  - Document mononeuropathies, but often fail to reveal small-fiber polyneuropathies
- Quantitative Sensory Testing (QST):
  - More sensitive to demonstrate small-fiber neuropathies
- More testing as indicated:
  - Imaging
  - Rheumatologic screen
  - Thyroid function tests
  - Chest x-ray
  - HIV testing
  - Lyme titers
  - Skeletal survey
  - b12 and folate levels
  - LP
  - Nerve biopsy

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Causes of Peripheral Neuropathy

- Alcoholism
- Autoimmune diseases
  - Sjögren's syndrome
  - Lupus
  - Rheumatoid arthritis
  - Guillain-Barre syndrome
  - Chronic inflammatory demyelinating polyneuropathy and necrotizing vasculitis
- Diabetes
  - Caused by damage to several nerves
  - At least half of all diabetics develop neuropathy
  - Multiple forms of diabetic neuropathy
  - Some occur due to diabetes and others are associated with it

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Causes of Peripheral Neuropathy (cont'd)

- Exposure to poisons
  - May include some toxic substances, such as heavy metals or chemicals
- Medications
  - Certain medications, especially those used to treat cancer (chemotherapy), may cause peripheral neuropathy

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Causes of Peripheral Neuropathy (cont'd)

- Infections: viral or bacterial infections can cause peripheral neuropathy, including:
  - Lyme disease, shingles (varicella-zoster), Epstein-Barr virus, Hepatitis C, leprosy, diphtheria, and HIV
- Inherited disorders
  - Disorders such as Charcot-Marie-Tooth disease are hereditary types of neuropathy

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Causes of Peripheral Neuropathy (cont'd)

- Trauma or pressure on the nerve
  - Motor vehicle accidents, falls or sports injuries, can sever or damage peripheral nerves
  - Nerve pressure can result from using a cast or crutches, spending a long time in an unnatural position, or repeating a motion many times, such as typing

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Causes of Peripheral Neuropathy (cont'd)

- Other diseases
  - Kidney disease
  - Liver disease
  - Connective tissue disorders
  - An underactive thyroid (hypothyroidism)
  - Amyloidosis

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Causes of Peripheral Neuropathy (cont'd)

- Tumors
  - Growths can form directly on the nerves themselves
  - Tumors can put pressure on surrounding nerves
  - Both cancerous (malignant) and noncancerous (benign) tumors can contribute to peripheral neuropathy
  - Paraneoplastic syndromes are associated with cancers and can also cause neuropathy

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Causes of Peripheral Neuropathy (cont'd)

- Vitamin deficiencies
  - B vitamins, including B-1, B-6 and B-12, are particularly important to nerve health
  - Vitamin E and niacin are crucial to nerve health
  - Not having enough of these vitamins in your system may cause peripheral neuropathy

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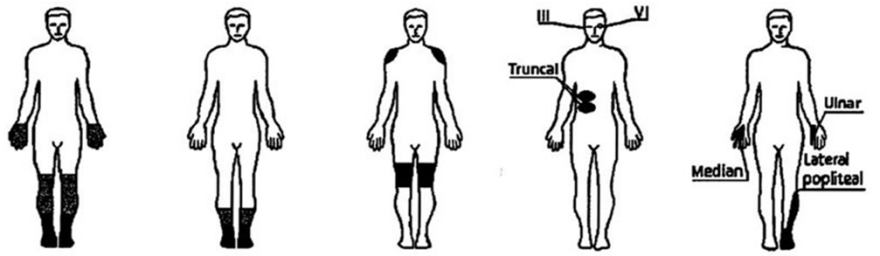

Large fiber Neuropathy	Small fiber Neuropathy	Proximal motor Neuropathy	Acute mono Neuropathies	Pressure Palsies
Sensory loss: 0→ +++ (Touch, vibration) Pain: + → +++ Tendon reflex: N → ↓↓↓ Motor deficit 0 → +++	Sensory loss: 0 → + (thermal , allodynia) Pain: + → +++ Tendon reflex: N → ↓ Motor deficit: 0	Sensory loss: 0 → + Pain: + → +++ Tendon reflex: ↓↓ Proximal Motor deficit: + → +++.	Sensory loss: 0 → + Pain: + → +++ Tendon reflex: N Motor deficit: + → +++	Sensory loss in Nerve distribution: + → +++ Pain: + → ++ Tendon reflex: N Motor deficit: + → +++

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Diabetic Peripheral Neuropathy

- Most common form of diabetic neuropathy
  - Feet and legs often affected first
- Numbness, reduced ability to feel pain or changes in temperature
- A tingling or burning feeling
- Sharp, jabbing pain that may be worse at night
- Extreme sensitivity to the lightest touch
- Muscle weakness and difficulty walking
- Serious foot problems, such as ulcers, infections, deformities, and bone and joint pain

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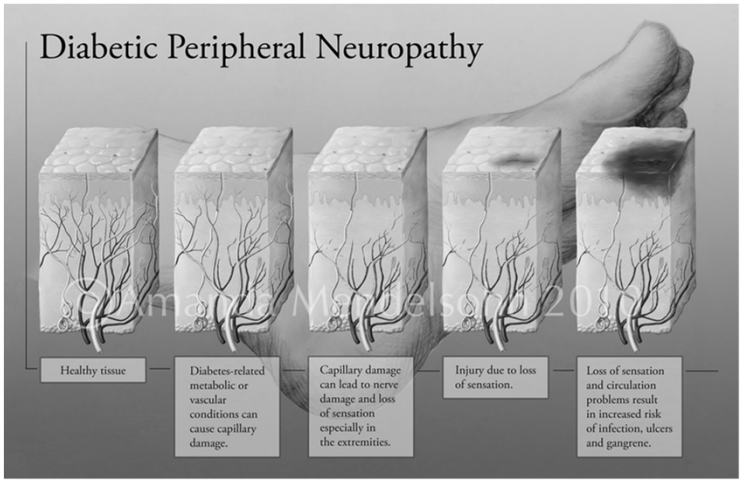
Diabetic Neuropathy



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Causes

- Damage to nerves and blood vessels
  - Prolonged exposure to high blood sugar (glucose) can damage delicate nerve fibers
  - High blood glucose interferes with the ability of the nerves to transmit signals
  - Weakens walls of the small blood vessels (capillaries) that supply nerves with oxygen and nutrients
- Inflammation in the nerves
- Smoking and alcohol abuse

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Risk Factors

- Poor blood sugar control
- Length of time you have diabetes
- Kidney disease
- Smoking
- Genetic predisposition
- Pressure points

- Note that most of these are modifiable

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Complications of Peripheral Neuropathy

- Loss of a limb
  - Lack of feeling in feet, cuts and sores may go unnoticed and eventually become severely infected or ulcerated
  - More than half the nontraumatic lower limb amputations performed every year in the United States are due to diabetes

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Complications of Peripheral Neuropathy (cont'd)

- Charcot joint
  - Occurs when a joint, usually in the foot, deteriorates because of nerve damage
  - Marked by loss of sensation, swelling, instability, and sometimes deformity in the joint

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Complications of Peripheral Neuropathy (cont'd)

- Social isolation
  - Pain, disability, and embarrassment caused by nerve damage can rob people (particularly older adults) of their independence
  - Leaves patients increasingly isolated and depressed

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Diagnostics

- History
- Filament test
  - Sensitivity to touch may be tested using a soft nylon fiber (monofilament)
  - If you're unable to feel the filament on your feet, it's a sign that you've lost sensation in those nerves
- Nerve conduction studies
- Electromyography (EMG)
- Quantitative sensory testing

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Treatment

- Slowing progression
- Relieving pain
- Restoring function

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Slowing Progression of DPN

- Intense glucose control can slow progression, improve current symptoms
- Control blood pressure
- Obtain a healthy weight
- Healthy diet
- Eliminate or reduce alcohol intake
- Quit smoking

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Relieving Pain

- Anti-seizure medications
  - Lyrica
  - Gabapentin
  - Carbamazepine
- Antidepressants
  - Tricyclic antidepressant medications and SNRI
- Lidocaine patch
- Opioids
- Acupuncture

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Lifestyle Remedies

- Blood pressure control
- Dietary changes
- Exercise
  - Improves blood flow and lowers blood sugar
  - 30 minutes / day per ADA
  - Modified for severe: non weight bearing, cycling or swimming
- Stop smoking: circulation problems

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Complementary Medicine

- Capsaicin
  - Capsaicin creams can reduce pain sensations
- Alpha-lipoic acid
  - Alpha-lipoic acid, a powerful antioxidant found in food, may be effective at relieving the symptoms of peripheral neuropathy

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Complementary Medicine (cont'd)

- Transcutaneous electrical nerve stimulation (TENS)
  - Helps prevent pain signals from reaching the brain
- Acupuncture
- Biofeedback
  - Uses a special machine to teach you how to control certain body responses that reduce pain
  - You then learn how to control the same responses yourself
  - Biofeedback often taught in medical centers and hospitals

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The Importance of Support

- Difficulty and frustrations
  - There are often no outward signs, making it hard for people to understand your condition
- Talk to a counselor or therapist
- Join a support group
  - Face-to-face and online groups now available
  - Members understand what you're going through
  - Members offer encouragement, advice about living with diabetic neuropathy
  - The American Diabetes Association offers online support through its website

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Take Home Message

- Know the early signs of DPN
- There are many MODIFIABLE risk factors
- Patients need to know what these are and what they can do to improve their risk profile
- Glycemic control is paramount
  - Know how to help patients connect to the diabetic community to help with motivation

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