Common Lower Extremity Peripheral Neuropathies

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• I have no conflicts of interest to declare.
• The materials used in this presentation were sourced from UpToDate (a medical reference web site), the *Montana Utilization and Treatment Guidelines*, and the Internet via Google searches.
Introduction

• The majority of lower extremity neurological syndromes seen in medical practice are caused by lumbar spine radiculopathies

• Often, practitioners fail to recognize lower extremity peripheral neuropathies because of unfamiliarity

• The purpose of this presentation is to begin the familiarization process
Introduction

• Many causes of lower extremity neuropathies
  – Causes include compression, transection, ischemic infarct, ionizing radiation, degeneration, and inflammation

• Some neuropathies are mistaken for
  – lumbosacral radiculopathy
  – complex regional pain syndrome
  – piriformis syndrome
  – trochanteric bursitis

• In general, this limited discussion will be confined to compression neuropathies
Common causes of neuropathy
Compression

• Compression (e.g., neurapraxia) is the most common problem

• Compression can affect distal nerve segments, as in tarsal tunnel syndrome or peroneal neuropathy at the fibular neck
Compression

• Compression may be intermittent due to positioning, with associated reversible ischemia of the nerve
  – Example: numbness along the lateral shin and top of the foot after crossing the legs caused by compressing the peroneal nerve as it passes across the fibular neck
Compression

• Compression may be chronic causing persistent pain and weakness
• Demyelination occurs as compression grows more persistent and chronic, and nerve conduction velocity slows
• As compression progresses further, the distal nerve segments will no longer function and Wallerian degeneration (i.e., nerve disintegration distal to the compression) may occur
Nerve Transection

- Nerve transection is much less common than chronic nerve compression
- Occurs with leg trauma (e.g., knife and gunshot wounds, amputation) as the distal nerve is completely separated from the proximal portion
- Unlike even severe cases of nerve compression, regrowth of the nerve after transection is impossible without surgical intervention
Nerve ischemia/infarct

- Nerve infarction generally only occurs in relation to vasculitis and atherosclerotic disease, although it is also thought to play a role in diabetic amyotrophy and neuropathy.
- Most common location is the sciatic nerve in the mid-thigh.
- Peroneal and tibial nerve ischemia/infarct also occasionally occurs.
Nerve ischemia/infarct

• Unlike compressive neuropathy, conduction velocity slowing does not occur
• Regrowth of the nerve may occur with control of the underlying disease (e.g., glycemic control in diabetes)
Ionizing radiation

- Exposure usually occurs from radiation therapy for cancer
- Can result in nerve damage that may not appear clinically for years after treatment
- More common in patients who receive axillary radiation therapy for breast cancer
- Can also occur after receiving pelvic irradiation (e.g., prostate cancer)
Inflammation

- Infectious disorders such as herpes simplex, Epstein-Barr virus, and most commonly herpes zoster virus, can produce syndromes of sensory loss and motor dysfunction.

- An inflammatory response associated with diabetes mellitus occasionally occurs, likely playing a role in diabetic radiculopathy, painful diabetic neuropathy and diabetic amyotrophy.
Degeneration

• Distal degeneration of neurons is the hallmark of most axonal polyneuropathies (e.g., diabetic neuropathy, solvent-induced neuropathy)

• Gradual deterioration of neurons occurs in a distal to proximal fashion, with the longest nerves affected first

• Proximal degeneration of neurons also may occur in certain disorders, although this is much less common
Lower Extremity
Peripheral Nervous Anatomy

• Overview of the anatomic origins and courses of the nerves in the lower extremities
• Overview of normal peripheral nervous functions
Lumbosacral plexus and origins of lower extremity peripheral nerves

Image from: http://antranik.org/peripheral-nervous-system-spinal-nerves-and-plexuses/
Major Lower Extremity Peripheral Nerves

Image from: http://antranik.org/peripheral-nervous-system-spinal-nerves-and-plexuses/
### Peripheral Nerve Motor Functions

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<td>Triceps surae (gastrocnemius, soleus)</td>
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<tr>
<td>Foot inversion</td>
<td>Tibialis posterior</td>
<td>Tibial nerve</td>
<td>L4, L5</td>
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Peripheral Nerve Sensory Function

Selected Lower Extremity Peripheral Neuropathies

- Montana Utilization and Treatment Guidelines for Lower Extremity Disorders only covers tarsal tunnel syndrome
- This limited overview will include
  - Sciatic neuropathy
  - Meralgia paresthetica
  - Peroneal neuropathy
  - Tarsal tunnel syndrome
Sciatic neuropathy
Sciatic neuropathy

• Typically caused by compression or trauma of the sciatic nerve in the sciatic notch/gluteal region
Sciatic nerve in the pelvis

Image from: https://www.youtube.com/watch?v=M4_tJbcHc2k
Sciatic nerve in the thigh

Image from: https://www.medicalartlibrary.com/tag/sciatic-nerve/
Causes of sciatic neuropathy

- Yuen and Olney reported on 73 patients who met electrodiagnostic criteria for sciatic neuropathy [Yuen and Olney 1994]
  - hip surgery was the cause in 22 percent
  - acute external compression in 14 percent
  - infarction in 10 percent
  - gunshot wound in 10 percent
  - hip fracture/dislocation in 10 percent
  - femur fracture in 4 percent
  - possible contusion in 4 percent
  - unclear etiology in 16 percent
Causes of sciatic neuropathy

• Srinivasin et al reported on sciatic nerve lesions in 53 children [Srinivasin et al 2011]
  – trauma in 25 percent
  – iatrogenic causes (orthopedic and other surgeries) in 25 percent
  – tumor in 13 percent
  – prolonged external compression and immobilization in 11 percent
  – vascular in 9 percent
  – idiopathic and progressive in 8 percent
  – unknown (presumed viral) in 6 percent
  – infantile and non-progressive in 4 percent
Sciatic neuropathy and piriformis syndrome

• The piriformis syndrome is a controversial condition that may be an occasional contributor to sciatic nerve injury [Kirschner et al 2009, Halpin and Ganju 2009]

• Compression of the sciatic nerve occurs in the region of the sciatic notch as the nerve comes in close contact with an enlarged piriformis muscle

• There is no consensus about diagnostic criteria, and the diagnosis remains one of exclusion

Image from: https://newleafwellnesscentre.com/sciatic-pain-piriformis-syndrome
Symptoms and signs of sciatic neuropathy

- Pain and weakness affecting most of the lower leg musculature, including the hamstrings.
- Hip flexion, extension, abduction and adduction, and knee extension are normal.
- Sensory loss involves the entire peroneal, tibial, and sural territories.

Image from: https://medical-dictionary.thefreedictionary.com/sciatic+neuralgia
Symptoms and signs of sciatic neuropathy

• Sensation in the medial calf and arch of the foot may be spared due to innervation by the saphenous nerve (a branch of the femoral nerve).
• Sensation is spared above the knee both anteriorly and posteriorly
• The patellar reflex is normal, but the Achilles reflex is absent

Image from: https://medical-dictionary.thefreedictionary.com/sciatic+neuralgia
Diagnosis of sciatic neuropathy

• Compression of the sciatic nerve may not produce significant abnormalities on electromyography (EMG) unless it is relatively severe

• If symptoms and signs of sciatic neuropathy are present, referral for electrodiagnostic studies may be appropriate
Prognosis of sciatic neuropathy

• The prognosis of sciatic neuropathy is generally favorable.
• Absence of paralysis in ankle plantar flexion and dorsiflexion at initial evaluation is a favorable prognostic sign.
• Yuen et al observed a 75 percent overall likelihood of good recovery without treatment over a three-year period [Yuen et al 1994].
Meralgia paresthetica
Meralgia paresthetica

• A neuropathy of the lateral femoral cutaneous nerve

• The lateral femoral cutaneous nerve is a small sensory nerve that is a direct branch of the lumbar plexus

• Entrapment of the nerve as it traverses below the inguinal ligament produces the common syndrome of meralgia paresthetica
Meralgia paresthetica

Causes of meralgia paresthetica

• Some people are especially predisposed to developing meralgia paresthetica
  – Obese people
  – Diabetics
  – Elderly people
  – Pregnant women
  – Postpartum women

• In others no obvious cause is identified
Symptoms of meralgia paresthetica

• Patients generally complain of paresthesias and pain that radiates down the lateral aspect of the thigh toward the knee
• The pain can be quite significant
Diagnosis of meralgia paresthetica

• Based primarily upon the unique description of pain in characteristic location
• Sensory loss on examination
• Absence of sensory or motor abnormalities in the lower leg
Diagnosis of meralgia paresthetica

• Electrodiagnostic studies have a limited value
• Studies may be relatively normal in mild cases
• A reduced sensory response amplitude is generally considered evidence for impingement severe enough to produce axon degeneration
Prognosis of meralgia paresthetica

- Meralgia paresthetica is a self-limited, benign disease in most patients
- More than 90 percent of patients respond to conservative measures including weight loss and avoidance of external pressure over the inguinal ligament (e.g., due to supporting heavy materials on the thigh)
Peroneal neuropathy
Peroneal neuropathy

• The most frequent site of injury to the common peroneal nerve is just below the knee as the nerve wraps around the lateral aspect of the fibula, immediately before dividing into its deep and superficial branches.
Peroneal neuropathy

Peroneal neuropathy

• Compression at this site is frequently produced by external pressure on the nerve due to prolonged lying, (e.g., during surgery, prolonged hospitalization)

• Crossing the legs, protracted squatting, and leg casts can also compress this site
Symptoms of peroneal neuropathy

- The typical presentation is acute foot drop (i.e., difficulty dorsiflexing the ankle against resistance or gravity)
- Patients describe the foot as limp; there is a tendency to trip over it unless they compensate by flexing the hip higher when walking, producing what is called a "steppage" gait

Image from: http://teachmeanatomy.info/lower-limb/nerves/common-fibular-nerve/
Steppage Gait - YouTube.mp4
Symptoms of peroneal neuropathy

• Patients may also complain of paresthesias and/or sensory loss over the dorsum of the foot and lateral shin (superficial peroneal nerve territory)

• In one study, 79 percent of 103 patients with common peroneal neuropathy complained of sensory loss; pain was relatively infrequent, affecting only 17 percent [Katirji and Wilbourn 1988]
Signs of peroneal neuropathy

• Examination typically reveals weakness in foot dorsiflexion and foot eversion (deep and superficial peroneal nerve-innervated, respectively), with normal inversion and plantar flexion (posterior tibial nerve innervated)

• Sensory loss is confined to the dorsum of the foot, including the web space between digits 1 and 2 and the lateral shin

• Reflexes are normal
Diagnosis of peroneal neuropathy

- Electromyography and nerve conduction studies (EMG/NCS) are very useful for identifying peroneal neuropathy at the fibular neck
- Conduction block on peroneal nerve motor studies may be identified at the site, even in the acute setting
Prognosis of peroneal neuropathy

- In patients with a peroneal neuropathy at the fibular neck no specific treatment is available
- Prognosis depends upon the degree of dysfunction
Prognosis of peroneal neuropathy

- In one study of 13 patients with idiopathic common peroneal palsy, those presenting with complete lesions (no preserved function in foot dorsiflexion and foot eversion) made no significant recovery, while patients with even mildly preserved strength recovered fully [Pigott and Jefferson 1991]
Tarsal tunnel syndrome
Tarsal tunnel syndrome

• A neuropathy of the posterior tibial nerve
• A tibial nerve compression in the region of the ankle as the nerve passes under the transverse tarsal ligament
• Beneath the retinaculum lies a tunnel containing the tendons of the flexor digitorum longus and flexor hallucis longus muscles, the vascular bundle, the posterior tibial nerve, and the medial and lateral plantar nerves
Tarsal tunnel syndrome

Tarsal Tunnel Syndrome (TTS)

- Tibia
- Talus
- Calcaneus

Posterior Tibial Nerve Compression or Irritation within Tarsal Tunnel

Tarsal Tunnel covered by Flexor Retinaculum (Ligament): Nerve, Artery and Vein Passes Through the Tunnel

Image from: https://www.epainassist.com/sports-injuries/foot-and-heel-injuries/tarsal-tunnel-syndrome-tts-or-posterior-tibial-neuralgia
Causes of tarsal tunnel syndrome

• The most common cause of tarsal tunnel syndrome is a fracture or dislocation involving the talus, calcaneus, or medial malleolus
  – scar tissue, bone or cartilage fragments, or bony spurs may be found compressing the nerve

• Other causes include rheumatoid arthritis, other causes of inflammation, and tumors
Causes of tarsal tunnel syndrome

• In general, true tarsal tunnel syndrome is most commonly diagnosed in patients with a clear history of antecedent foot trauma

• “Idiopathic" (i.e., without trauma) tarsal tunnel syndrome, unlike carpal tunnel syndrome, is quite rare
Symptoms of tarsal tunnel syndrome

• Patients with tarsal tunnel syndrome typically present with aching, burning, numbness, and tingling involving the sole of the foot, the distal foot, the toes, and occasionally the heel
• Pain may radiate up to the calf or higher [Bailie and Kelikian 1998]
• The discomfort is often most irritating at night, may be worse after standing, and sometimes leads to the desire to remove the shoes, even while driving
• Pain and paresthesias occur with weight-bearing activities
Signs of tarsal tunnel syndrome

• Prominent pain radiating distally or proximally with percussion (i.e., Tinel's sign) over the posterior tibial nerve posterior to the medial malleolus
• Sensory loss over the plantar surface of foot
• **No** sensory loss over the dorsal surface of foot
• Atrophy of foot intrinsic muscles will be present only if the nerve compression is severe and/or longstanding
Diagnosis of tarsal tunnel syndrome

- Nerve conduction velocity studies of both sides for comparison to normal side
- EMGs may be needed to rule out radiculopathy
- MRI to rule out space occupying lesions
- Diagnostic injections to confirm the diagnosis

From: Montana Utilization and Treatment Guidelines for Lower Extremity Disorders
Prognosis of tarsal tunnel syndrome

- Decompression of the tibial nerve at the ankle is effective in some patients who truly have a documented entrapment and have failed conservative therapy.

- The most favorable outcomes appear to occur with a short history of illness, the presence of a ganglion, no history of sprains (i.e., ankle instability) and light work demands [Turan et al 1997].
Summary
Summary

- The major mechanisms of lower extremity peripheral nerve injury are compression, transection, ischemia, radiation exposure, inflammation, and neuronal degeneration.
Summary

• Sciatic neuropathy occurs due to a variety of causes; in addition to pain, patients with sciatic nerve injury in the sciatic notch/gluteal region complain of weakness affecting most of the lower leg musculature.

• Lateral femoral cutaneous nerve entrapment as it traverses below the inguinal ligament produces the syndrome of meralgia paresthetica, characterized by paresthesia and pain that radiates down the lateral aspect of the thigh toward the knee.
Summary

• The typical clinical presentation of common peroneal neuropathy at the fibular neck is acute foot drop

• Tarsal tunnel syndrome refers to tibial nerve compression in the region of the medial ankle as the nerve passes under the transverse tarsal ligament; patients typically present with aching, burning, numbness, and tingling involving the sole of the foot, the distal foot, the toes, and occasionally the heel
Conclusion

• Although radiculopathy is the most common cause of leg symptoms, not all lower extremity neurologic conditions result from lumbar radiculopathy

• All the neuropathies reviewed today might be mistaken for lumbar radiculopathy or other disorders
  – Might mistake sciatic neuropathy for piriformis syndrome

• History of pelvic or leg trauma should lead provider to consider a peripheral neuropathy

• If in doubt, referral to an orthopedist or neurologist should be considered
References