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Sural Nerve Conduction FAQs

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Clinical Background

Why test the sural nerve when evaluating distal symmetrical peripheral neuropathy (DSPN)*?
The sural nerve is a distal sensory nerve that reliably exhibits nerve conduction changes in DSPN.[1-5] Furthermore, sural nerve conduction is highly correlated to the morphological severity of peripheral neuropathy as assessed by biopsy.[6]

* References below to peripheral neuropathy are to DSPN, which is the most common type of peripheral neuropathy.

What forms of peripheral neuropathy alter sural neve conduction?
Most forms or peripheral neuropathy, for example, due to chemotherapy (CIPN), chronic alcohol use, HIV, uremia, and diabetes (DPN) can be identified by abnormal sural nerve conduction.

Is testing of the sural nerve alone sufficient for assessment of peripheral neuropathy?
Sural nerve conduction alone does not diagnose peripheral neuropathy. The diagnosis of peripheral neuropathy is made on the basis of the patient's history, physical examination, and objective test results. Sural nerve conduction is a quantitative biomarker that helps (1) identify peripheral neuropathy in the absence of signs and symptoms, (2) confirm clinically evident peripheral neuropathy, and (3) stage peripheral neuropathy severity.

When are more extensive electrodiagnostic studies indicated?
If the sural nerve conduction results are inconsistent with the patient's clinical presentation, the patient has substantial weakness, or the neuropathic symptoms are acute and rapidly progressing, then a more extensive evaluation may be beneficial.

Nerve Conduction Measurements

What sural nerve conduction parameters are typically measured and reported?
The two most commonly reported parameters are the nerve conduction velocity and the sensory nerve action potential amplitude.

What is the physiological and pathological significance of the sural nerve conduction velocity?
The conduction velocity represents the action potential propagation velocity of the "fastest" sural nerve axons (also called "nerve fibers"). Any pathological process that adversely impacts action potential propagation, such as demyelination, will lead to conduction velocity slowing. Another reason for decreased conduction velocity is degeneration of the fastest axons, which are usually most susceptible to pathological processes.

What is the physiological and pathological significance of the sural amplitude?
The sural amplitude represents the number of large myelinated axons that are conducting action potentials. Degeneration of axons, such as due to diabetes, will lead to a decrease in amplitude.

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Differential Diagnosis

Does sural nerve conduction detect small fiber neuropathies?
Nerve conduction measures the function of large myelinated nerve fibers, therefore sural nerve conduction will not directly identify small fiber neuropathies. However, most peripheral neuropathies, such as diabetic neuropathy, involve both large and small nerve fibers. Furthermore, the risks of falling and development of foot ulcers are primarily associated with large fiber dysfunction.[7]

Can abnormal sural nerve conduction be indicative of a focal nerve lesion?
Abnormal sural nerve conduction may be caused by focal nerve lesions in the sural nerve or more proximally, such as in the sciatic nerve.[8] However, these lesions are rare and usually evident from the patient's medical history. Furthermore, most of these lesions are unilateral and therefore asymmetrical sural nerve conduction is likely.

Is sural nerve conduction abnormal in lumbosacral radiculopathies?
The cell bodies giving rise to the axons making up the sural nerve are located in dorsal root ganglia located outside the spinal cord and vertebrae. Compression of the sensory nerve roots, such as due to disc herniation and spinal stenosis, do not mechanically disrupt the axons and therefore sural nerve conduction is generally unaffected in lumbosacral radiculopathies.

Testing Protocols

When is bilateral sural nerve conduction testing indicated?
Sural nerve conduction studies are generally symmetrical in peripheral neuropathy and therefore unilateral testing is usually adequate.[9] Bilateral testing may be useful when the results on the first limb tested are inconclusive or the patient has an asymmetrical clinical presentation.

What testing protocol maximizes peripheral neuropathy detection sensitivity?
Sensitivity is maximized by performing bilateral testing and accepting an abnormal result in either limb as an indication of peripheral neuropathy.

What testing protocol maximizes peripheral neuropathy detection specificity?
Specificity is maximized by performing bilateral testing and defining peripheral neuropathy as abnormal sural nerve conduction in both limbs.

Understanding Results

How much does sural nerve conduction vary test to test?
Like other physiological measurements such as heart rate and blood pressure, sural nerve conduction velocity and amplitude will vary from test to test. The reasons for variability include true underlying variation in the measurements, small differences in test setup (e.g., exact placement of device on leg), and random electrical interference such as from nearby computer and medical equipment. The variation should be less than 5% for conduction velocity and 25% for amplitude.[10] If you obtain a result that is on the border between normal and abnormal and are concerned about reliability, the test can be repeated to confirm the finding.

Does the variability of sural nerve conduction velocity increase when the amplitude is low?
When the amplitude is low, such as ≤ 4 microvolts, the exact onset of the nerve response may be difficult to discern. As a result, the conduction velocity, which is calculated from the response onset time, may vary more from test to test than for nerves with larger amplitudes.

What is an undetectable sural nerve response and what usually causes it?
An undetectable sural nerve response indicates that despite maximal stimulation of the nerve, the amplitude is less than 1.5 microvolts. The most likely explanation is that the nerve has undergone substantial axonal degeneration and too few axons remain to conduct an electrically measurable signal.[6,11] Readings indicating an undetectable response are a valid result, and are indicative of severe neuropathy[5] and increased foot ulcer risk in people with diabetes.[12]

Are there non-clinical causes of an undetectable sural nerve response?
Excessive tissue between the device's stimulating probes and the patient's sural nerve, such as due to severe edema or adipose tissue, may prevent adequate stimulation of the sural nerve and may thereby lead to an undetectable response. Another non-clinical cause could be misplacement of the testing device such that the nerve is not stimulated. If you are unsure about the reliability of an undetectable response, the test should be repeated.

Is there a correlation between feeling nerve stimulation and sural nerve conduction results?
If the patient cannot feel the electrical stimulation, then an undetectable sural response is likely. By contrast, undetectable responses are possible even if the patient can feel the electrical stimulation. Although there may be too few nerve fibers to conduct a nerve conduction response, some sensation may be preserved. This is one reason why assessments based solely on self-reported sensation can be unreliable.

Factors Influencing Nerve Conduction

How does temperature affect sural nerve conduction?
Sural nerve conduction velocity varies with the temperature around the nerve, which is often estimated by the skin surface temperature. The velocity decreases with colder temperatures and increases with warmer temperatures. In practice, the nerve is either warmed to a minimum temperature (e.g., 30°C) or the velocity is mathematically adjusted for temperatures below this minimum. It is important to compensate for temperature effects in order to avoid false positive results.

Does sural nerve conduction depend on the patient's sex?
Sex has not been shown to have a consistent and independent influence on sural conduction velocity or amplitude. In general, apparent differences in nerve conduction due to Sex are accounted for by height differences.

Does sural nerve conduction depend on the patient's age or height?
Some studies have shown that sural conduction velocity decreases with age and height,[13,14] while others have not found an association.[15,16] Most studies confirm that sural response amplitude decreases with age, particularly when comparing elderly and younger patients.[16,17]

Do patient age and height influence interpretation of sural nerve conduction results?
Sural nerve conduction results are judged against reference values (i.e., "normal limits," "cutoffs") obtained in control subjects.* Although these reference values may be age and height dependent, in typical clinical practice fixed reference values are used. As a result, the sensitivity and specificity of the results may vary somewhat with the patient's age and height. In particular, the test will have maximal specificity in younger, shorter† subjects and maximal sensitivity in older taller‡ subjects. What this means in practice is that borderline results in patients at demographic limits should be cautiously interpreted. For example, mild abnormalities in older, taller patients may be false positives. Conversely, results at the lower limit of normal in younger, shorter patients may be false negatives.

**Individuals without diabetes, risk of peripheral neuropathy, or clinical evidence of peripheral neuropathy.*
†For example, less than 5 feet tall and younger than 30. ‡For example, more than 6 feet tall and older than 60.

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This information is intended as a resource only and is not a substitute for professional medical judgment. The ordering and interpretation of electrodiagnostic studies is always the responsibility of the physician.