DPNCheck®

Sural Nerve Conduction FAQs

Medical Professional Use Only

Clinical Background

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

Is testing of the sural nerve alone sufficient for assessment of DPN?
Sural nerve conduction alone does not diagnose DPN. The diagnosis of DPN 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 DPN in the absence of signs and symptoms, (2) confirm clinically evident DPN, and (3) stage DPN 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 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 (SNAP) 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 most susceptible to the microvascular damage of diabetes.

What is the physiological and pathological significance of the sural SNAP amplitude?
The SNAP 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 SNAP amplitude.

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, diabetic neuropathy tends to involve both large and small nerve fibers. Furthermore, foot ulcer risk is primarily associated with large fiber dysfunction.[7] Epidermal nerve fiber density (ENFD) testing is an invasive diagnostic method that may be used to assess for the presence of small fiber neuropathy. Neither nerve conduction nor ENFD should used in lieu of one another as they assess different nerve fibers. Nerve conduction assesses the large nerve fibers, whereas, ENFD assesses the small nerve fibers.

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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.

Do peripheral neuropathies other than DPN alter sural nerve conduction?
Most forms of peripheral neuropathy (e.g., due to chemotherapy, alcohol, HIV, uremia) lead to abnormal sural nerve conduction.[9]

Testing Protocols

When is bilateral sural nerve conduction testing indicated?
Sural nerve conduction studies are generally symmetrical in DPN and therefore unilateral testing is usually adequate.[10] 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 DPN detection sensitivity?
Sensitivity is maximized by performing bilateral testing and accepting an abnormal result in either limb as an indication of DPN.

What testing protocol maximizes DPN detection specificity?
Specificity is maximized by performing bilateral testing and defining DPN 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.[11] 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 SNAP amplitude is low?
When the SNAP amplitude is low, such as ≤ 4 microvolts, the exact onset of the SNAP may be difficult to discern. As a result, the conduction velocity, which is calculated from the SNAP onset time, may vary more from test to test, than for nerves with larger SNAP 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 SNAP 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.[6,12] This is indicative of more severe neuropathy[5] and increased foot ulcer risk.[13]

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 can not 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.

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 gender?
Gender 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 gender 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,[14,15] while others have not found an association.[16,17] Most studies confirm that sural SNAP amplitude decreases with age, particularly when comparing elderly and younger patients.[17,18]

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.

Is sural nerve conduction correlated to hemoglobin A1c (HbA1c)?
Sural nerve conduction velocity and SNAP amplitude are negatively correlated with HbA1c.[19] As HbA1c increases, both nerve conduction parameters decrease.

*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.

References

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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.