Loss of Sural Responses Estimated by a Rapid and Easily Administered Technique Identifies Greater Neuropathy Severity and Risk in a General Diabetes Population

Aaron I. Vinik, MD, PhD and Shai N. Gozani, MD, PhD
Diabetes Research Institutes, Eastern Virginia Medical School, Norfolk, VA and NeuroMetrix, Inc., Waltham, MA

Background

Annual monitoring of diabetic peripheral neuropathy (DPN) is recommended for early detection of this microvascular complication and to track its progression. The most widely utilized testing method is the 5.07/10-g monofilament. Nerve conduction studies (NCS) are the most accurate and reproducible test for DPN. However, they are not used for routine monitoring due to their expense, limited availability, and complexity. In response, we developed a fast, low-cost, point-of-care device capable of measuring sural nerve conduction velocity (CV) and sensory nerve action potential (SNAP) amplitude.

The sural SNAP amplitude is often dichotomized as detectable or undetectable. A detectable sural has been used as a marker for less severe DPN in clinical trials (Vinik et al. 2005). More severe neuropathy is associated with foot ulcers (Kizilitan et al. 2007) and risk of falling and fractures. In this study we evaluated whether the dichotomous sural SNAP amplitude identifies this at-risk population in a general diabetes population using a rapid, easily administered, quantitative point-of-care test.

Methods

This study was a retrospective multi-site observational analysis of 10,000 consecutive point-of-care NCS for evaluation of DPN uploaded to the NC-stat® database. The NC-stat is a rapid, point-of-care nerve conduction measurement device that is capable of testing 6 different nerves, including the sural nerve. Recently, a version of this device called NC-stat® DPNCheck™ has been developed to test just the sural nerve.

The studies were performed at approximately 100 US community based endocrinology and primary care clinics. Each study included data from at least 1 median, peroneal, and sural nerve. The studies were grouped according to the dichotomous sural response (detectable SNAP > 2 μV), with group differences evaluated by the two-group t-test.

Results

1872 (18.7%) studies had an undetectable sural response. The Table below shows nerve conduction parameters stratified by the sural response.

All electrophysiological parameters exhibited statistically significant differences between the two cohorts. Patients with detectable surals had motor amplitudes that were 0.7–1.1 mV larger than those with undetectable surals. F-wave latencies were longer and sensory amplitudes smaller in the undetectable cohort.

	Detectable	Undetectable	Diff.
Peroneal n.			
Motor Latency (msec)	3.9 (0.7)	4.2 (0.8)	+0.3, p<0.001
Motor Amplitude (mV)	3.0 (1.7)	1.9 (1.5)	-1.1, p<0.001
F-wave Latency (msec)	55.0 (6.5)	58.7 (7.1)	+3.7, p<0.001
Median n.			
Motor Amplitude (mV)	4.7 (1.9)	4.0 (1.9)	-0.7, p<0.001
Sensory Amplitude (μV)	20.7 (15)	13.0 (12)	-7.7, p<0.001

Discussion

In a general diabetes population, patients with an undetectable sural response had significantly worse nerve conduction than those with a detectable sural. The lower motor and sensory amplitudes suggest that an undetectable sural response is associated with widespread motor and sensory loss, therefore indicating disease that is more severe. In fact, prior studies have demonstrated that amplitude differences of this magnitude are clinically meaningful in DPN (Albers et al. 2007).

Summary

The results of this study support use of this easily administrated evaluation of the sural response as an indicator of neuropathy severity in patients with diabetes. Patients with an undetectable sural had substantially lower motor and sensory amplitudes suggesting greater axon loss and more severe neuropathy. These patients are candidates for more aggressive management of their neuropathy and its consequent risk.

References

Vinik, et al. *Muscle Nerve.* 2005;32.
Kiziltan, et al. *J Neurol Sci.* 2007;258.
Albers, et al. *Diabetes Care.* 2007;30.