Dynamic Chiropractic

CHRONIC / ACUTE CONDITIONS

Diabetic Peripheral Neuropathy

Marco Lopez, DC, CCEP

Diabetes mellitus (DM) is the most common acquired cause of peripheral neuropathy in developed Western countries.[1] According to the WHO, it is the most common neuropathy worldwide, with 10 million cases in the U.S. alone.[2] Approximately 45-60 percent of patients with diabetes will develop manifestations of peripheral neuropathy. More importantly, several studies document clinical and subclinical signs of diabetic neuropathy even before neurological impairment and symptom development).[1-9] These cases substantiate the importance of early and intensive glycemic control as the most important preventable risk factor in the development of neuropathy.[1-9] Prevention and early detection is crucial, especially in light of the estimated increase in worldwide diabetes to approximately 366 million by 2030.[10]

Diabetic Neuropathy

A frequent microvascular complication of diabetes is diabetic neuropathy. The most common type is distal symmetric neuropathy or polyneuropathy (diabetic peripheral neuropathy - DPN), which results in significant disability and morbidity.[1,10] Complications of DPN include severe pain, loss of ambulation from foot deformities and increased risk of foot ulceration, infection, and ensuing amputation.[10-11] Sadly, lifetime risk of foot amputation is 15 percent in patients with diabetic polyneuropathy.[11]

While the most common pattern of diabetic neuropathy is DPN, other patterns of neuropathy exist. These include autonomic neuropathy, small-fiber neuropathy, polyradiculopathy, diabetic amyotrophy, and focal mononeuropathies.[1-2] DPN involves the distal lower extremities with sensory involvement greater than motor and autonomic involvement.[1,12,14,15] Generally, involvement of motor nerves occurs later in the development of the disease.

Early motor involvement increases the diagnostic severity of DPN.[12,15] Other pathophysiologic processes associated with diabetic neuropathies include a predisposition to compression and repetitive injury.[1] Superimposed mononeuropathies or entrapment neuropathies, like carpal tunnel syndrome, commonly occur in patients with DPN.[1,14]

Signs of Nerve Injury

Polyneuropathy has been reported in 10-50 percent of patients with diabetes.[11] At the time of diagnosis, neuropathy is already present in 10 percent of diabetic patients. Many studies show that early signs of neuropathy often predate an official diagnosis of diabetes.

In the Rochester Diabetic Neuropathy Study, 45 percent of type 2 patients had quantitative changes, clinical and electrophysiologic studies, although only 13 percent had neuropathic symptoms.[1] In another report, prevalence of neuropathy early in diabetes increased to 50 percent, but only with quantitative sensory testing and nerve conduction studies.[2] This occurs in part because a majority of diabetics can have objective sensation loss without accompanying symptoms.[2]

Nerve conduction can play an important role in diagnosis because electrophysiologic signs of neuropathy are detectable despite clinical symptoms.[4,6] Kimura noted that when both abnormal nerve conduction attributes and/or delayed F waves were involved, evidence of neuropathy existed in 60 percent of patients without clinical signs and in 96 percent with clinical signs.[3] Lee, et al., noted that children with IDDM [insulin-dependent diabetes mellitus] frequently have nerve conduction abnormalities without clinical neuropathy at initial diagnosis.[8]

These studies support the common notion that early detectable evidence of nerve injury can be found regardless of the patient's complaints. Changes in nerve function represent a normal and often unavoidable consequence of diabetes. However, not all patients necessarily develop ensuing complications. The more important question attempts to make sense of the findings to determine the type of intervention.

Electrodiagnostics

The sural nerve provides a good diagnostic starting point.[2,5,13,16] Amplitude and velocity changes early in the course of the disease help note glycemic control and the development of neurological impairment. Including the medial plantar sensory nerve increases the sensitivity up to 70 percent in the detection of neuropathy and allows earlier diagnosis, especially when routine nerve conduction studies are normal.[5]

Attributes of the peroneal motor nerve also predict the progression of diabetic neuropathy and the development of neurological impairment, especially when considered with increased triglycerides early in the course of disease.[2,16] In general, conduction slowing and respective neuropathy correlates with disease duration.4 Alone, this is not an indicator of neurological progression, but rather an expression of glucose metabolism and microvascular changes. When the velocity of the fastest conducting fibers is maintained, the prognosis is favorable. Neurological impairment is less likely in this instance.

The integrity of axons,the smaller components or fibers that make up a nerve, plays a larger role in determining impairment. This tends to occur more with time and/or disease severity. More axonal loss equates to increased neurological impairment. If axonal regeneration does keep pace with degeneration, denervation can be seen and heard during EMG.[1]

In extreme cases, chronic denervation can lead to atrophy.[12,15] Also small detectable changes in nerve conduction are a sensitive indicator of progressive nerve dysfunction and response to treatment, even when lab testing is normal[2,4,13]. In this respect, electrodiagnostic evaluation can help gauge the severity of neuropathy and provide a prognosis as to neurological impairment.

Other Considerations

Of course, every test has its limitations. Electrophysiologic findings do not always translate to clinical impairment. For this reason, a diagnostic test should never be used alone. Clinically, contrasting loss of sharp touch and temperature with subjective increased pain is common.[1,2, 7,9,12] Decreased vibration and position sense occur frequently, but are less sensitive.[2, 7,9,12] Decreased ankle reflexes are also common, as well as the electrodiagnostic equivalent, H reflexes. Distal small muscle weakness and atrophy may occur in chronic or uncontrolled cases.[1,2,7,9] While clinical findings help diagnose DPN, nerve conduction studies provide a more powerful tool that can helps identify subclinical cases for early intervention.[7,9]

Nerve conduction studies are also insensitive to the function of small C fibers and autonomic B fibers. These are often impaired early with poor glycemic control despite normal NCV. However, there are other electrodiagnostic tests that can evaluate these nerves.

Combining laboratory studies with information gained from the history, examination, and electrodiagnostic testing usually identifies 74-82 percent of cases.[1] For example, nerve conduction study abnormalities in subclinical DPN are highly correlated to HbA1c levels over 7 percent.[6] In a previously undiagnosed population with documented neuropathy, an impaired glucose tolerance test was more sensitive than fasting blood sugar in diagnosing glycemic control, more so than HbA1c elevations.[2]

HbA1c seems to be more linked to small-fiber neuropathy and autonomic dysfunction, especially in type 1 diabetics.[1-2] Hypertension and elevated triglycerides are also predictive factors in the development of neuropathy with diabetes.[2] In type 1 DM, long-term glycemic control, diabetes duration and HbA1c are associated with low nerve conduction velocity and amplitude response.[17]

People rarely have one issue at a time. An electrodiagnostic evaluation helps differentiate the diagnosis and note co-morbidities. In the past month, I have seen several diabetic patients with varying degrees of neuropathy and neurological impairment. These cases caught my attention:

- An early case of diabetic amyotrophy with positive EMG findings, thigh weakness and a history of mild spinal stenosis.
- A case of apparently well-controlled diabetes, hypothyroidism and leg cramping, with thyroidism proving more of an issue than diabetes.
- A case of moderate to severe peripheral vascular changes, distal muscle atrophy, and denervation due to uncontrolled diabetes. (This case was complicated by history of disc herniation with radiculopathy.)
- A diabetic with constant cramping in the feet who was thought to have plantar fascitis and showed electrodiagnostic evidence of selective involvement of sensory-motor fibers in the peroneal nerve bilaterally. He was recommended for further lab testing to rule out hereditary sensorimotor neuropathies.

Here are three other interesting case studies worth taking the time to review:

- Tracy JA, Engelstad JK, Dyck PJ. Microvasculitis in diabetic lumbosacral radiculoplexus

neuropathy. *J Clin Neuromuscul Dis*, 2009 Sep;11(1):44-8. FREE
- Tavee J, Zhou L. Small fiber neuropathy: a burning problem. *Cleve Clin J Med*, 2009 May;76(5):297-305. FREE
- Cho KT, Kim NH. Diabetic amyotrophy coexisting with lumbar disk herniation and stenosis: a case report. *Surg Neurol*, 2009 Apr;71(4):496-9.

The Chiropractor's Role

From a chiropractic standpoint, consider diabetes as a contributing factor in patient treatment. When patients show objective clinical changes despite subjective complaints, explore the issue further, especially if they tell you they are pre-diabetic or you suspect they might be diabetic. Perform a brief distal motor-sensory-reflex exam on diabetic and pre-diabetic patients a couple of times a year to keep tabs on early objective changes.

If patients have had an NCV / EMG, look beyond confirmed radiculopathy or entrapment neuropathies. If neuropathic signs are evident on NCV / EMG without clinical symptoms of neuropathy and these patients have no history of diabetes, request lab work or refer to the primary care physician and/or endocrinologist for evaluation of glucose tolerance, elevated H1bAc, and triglyceride levels. If they have a history of diabetes, send a copy of the test to the primary care physician and/or endocrinologist, as this can provide useful information on glycemic control and ensuing neuropathies.

Remember, diabetic neuropathy and more importantly, neurological impairment, can be prevented when treated early. Treatment of diabetic neuropathy focuses on maintaining normal blood sugar levels. This helps to prevent progression of the neuropathy and neurological impairment.[1-9] Glycemic control has proven to be a greater risk factor over five years in the progression of subclinical neuropathy.8 With intensive treatment to optimize glycemic control, there is a 64 percent risk reduction in the development of neuropathy after five years. Even in treatment-naive type 1 diabetic patients with confirmed clinical neuropathy, optimal glycemic control can reduce symptoms of peripheral neuropathy.[1-2]

References

1. Vavra MW, Rubin DI. The peripheral neuropathy evaluation in an office-based neurology setting. *Semin Neurol*, 2011;31:102-114.
2. Habib A, Brannagan TH. Therapeutic strategies for diabetic neuropathy. *Curr Neurol Neurosci Rep*;10:92-100.
3. Kimura J. Motor Neuron Excitability and Late Responses. 19th Annual Course & Symposium. Basic and Advanced Techniques in Electrodiagnosis. Columbia University. June 2010.
4. Gilchrist JM, Sachs G. Electrodiagnostic studies in the management and prognosis of neuromuscular disorders. *Muscle Nerve*;29:165-190.
5. Uluc K, Isak B, Borucu D, Temucin CM, Cetinkaya Y, Koytak PK, Tanridag T, Us O. Medial plantar and dorsal sural nerve conduction studies increase the sensitivity in the detection of neuropathy in diabetic patients. *Clin Neurophysiol*, 2008 Apr;119(4):880-5.
6. El-Salem K, Ammari F, Khader Y, Dhaimat O. Elevated glycosylated hemoglobin is associated with subclinical neuropathy in neurologically asymptomatic diabetic patients: a prospective study. *J Clin Neurophysiol,* 2009 Feb;26(1):50-3.
7. Asad A, Hameed MA, Khan UA, Butt MU, Ahmed N, Nadeem A. Comparison of nerve conduction studies with diabetic neuropathy symptom score and diabetic neuropathy examination score in type-2 diabetics for detection of sensorimotor polyneuropathy. *J Pak Med Assoc,* 2009

Sep;59(9):594-8.
8. Lee SS, Han HS, Kim H. A 5-yr follow-up nerve conduction study for the detection of subclinical diabetic neuropathy in children with newly diagnosed insulin-dependent diabetes mellitus. *Pediatr Diabetes*, 2010 Dec;11(8):521-8.
9. Feldman EL, et al. A practical two-step quantitative clinical and electrophysiological assessment for the diagnosis and staging of diabetic neuropathy. *Diabetes Care*, 1994 Nov;17(11):1281-9.
10. Kosinski, MA, Lipsky BA. Current medical management of diabetic foot infections. *Expert Rev Anti Infect Ther*, 2010;8(11):1293-1305.
11. Booya F, Bandarian F, Larijani B, Pajouhi M, Nooraei M, Lotfi J. Potential risk factors for diabetic neuropathy: a case control study. *BMC Neurology,* 2005,5:24.
12. Said G, Baudoin D, Toyooka K. Sensory loss, pains, motor deficit and axonal regeneration in length-dependent diabetic polyneuropathy. *J Neurol*, 2008 Nov;255(11):1693-702.
13. Brown MJ, et al. Natural progression of diabetic peripheral neuropathy in the Zenaresta study population. *Diabetes Care,* 2004;27:1153-1159.
14. Johnson EW. Sixteenth annual AAEM Edward H. Lambert lecture. Electrodiagnostic aspects of diabetic neuropathies: Entrapments. *Muscle & Nerve*, 1993;16:127-134.
15. Andersen H, Stålberg E, Gjerstad MD, Jakobsen J. Association of muscle strength and electrophysiological measures of reinnervation in diabetic neuropathy. *Muscle & Nerve*, 1998;21:1647-1654.
16. Charles M, Soedamah-Muthu SS, Tesfaye S, Fuller JH, Arezzo JC, Chaturvedi N, Witte DR. Low peripheral nerve conduction velocities and amplitudes are strongly related to diabetic microvascular complications in type 1 diabetes: the EURODIAB Prospective Complications Study. *Diabetes Care*, 2010 Dec;33(12):2648-53.

APRIL 2011