Position Statement

American Association of Neuromuscular & Electrodiagnostic Medicine

Proper Performance and Interpretation of Electrodiagnostic Studies

Introduction

The American Association of Neuromuscular & Electrodiagnostic Medicine (AANEM) has developed the following position statement in response to inquiries to address the following two issues:

1) physicians interpreting nerve conduction study (NCS) data without performing a pertinent history and physical examination of the patient, without determining the appropriate NCSs to perform, and without a trained electrodiagnostic (EDX) physician's direct supervision over the technologist performing the NCSs and

2) NCSs being utilized to diagnose patients without a complementary needle electromyography (EMG) study.

The AANEM believes that EDX studies should be performed by physicians properly trained in EDX medicine and that the interpretation of NCS and needle EMG data should be done in real time. If there is not face-face patient interaction by the interpreting physician and control over the process, substandard care is being provided. In addition, the performance of NCSs without needle EMG has the potential of compromising patient care. It is the AANEM's opinion that it is in the best interest of patients, in the majority of situations, for the needle EMG and the NCS examination to be conducted and interpreted on-site in real time.*

Appropriate Performance of Electrodiagnostic Studies

As discussed in more detail below, in most cases, a properly performed EDX evaluation involves using both NCS and needle EMG. The AANEM's *Recommended Policy for Electrodiagnostic Medicine* outlines the necessary steps for an appropriate EDX evaluation as follows:

- Development of a differential diagnosis by a trained EDX physician, based upon an appropriate history and physical examination performed by this physician
- Completion of indicated NCSs
- Completion of indicated needle EMG studies to evaluate the differential diagnosis and to complement the NCSs
- Synthesis by the electrodiagnostic physician of the patient's history and physical examination with the NCS and needle EMG data to reach the diagnosis on-site in real time.[1]

It is the AANEM's position that, in order to perform the steps outlined above, and ensure quality patient care, the individual performing these steps must be a physician with special training in the diagnosis and treatment of neurological and neuromuscular diseases and in the application of particular neurophysiological techniques to study these disorders.[1] The AANEM believes that physicians should receive training in neurology and/or physical medicine and rehabilitation residencies and/or fellowships that

*The use of the term "onsite" indicates that the summary of the patient's history and physical examination, execution of all of the appropriate nerve conduction studies and EMG examinations, analysis of the EDX data, and determination of the diagnoses for the patient are all performed in the same location which is most commonly the EDX laboratory.[2] "Onsite" would preclude the use of telemetry or other technologies to allow the EDX data to be transmitted and interpreted at a location different from where the EDX study is performed.

The use of the term "real time" with regard to nerve conduction studies indicates that information from the history and physical examinations are integrated, the specific and tailored EDX study is performed, and the analysis of the waveforms are all done at the same time and while the patient is present in the EDX laboratory (whether that be in an office, a hospital, or a medical clinic). An EDX study performed in "real time" is more sensitive and accurate since it allows the specific NCS and EMG tests performed to be modified as dictated by the results as they arise and it allows the physician to perform additional NCS or EMG studies, if necessary, after preliminary review and before the patient leaves the EDX laboratory.

provide detailed medical education including anatomy, pathology of muscle and nerve, neuromuscular physiology, electrophysiology, and clinical aspects of neurological and musculoskeletal conditions with particular emphasis on diagnosis and treatment of neuromuscular diseases as they pertain to clinical electrodiagnostic medicine. The AANEM's position statement *Who is Qualified to Perform Electrodiagnostic Medicine?* outlines the AANEM's complete educational requirements for an electrodiagnostic physician. This document is available on the AANEM website at: http://aanem.org/getmedia/f96400ac-6534-4f9f-bddc-21231e241e0c/who_is_qualified.PDF.aspx.

Appropriate Performance of Nerve Conduction Studies

Nerve conduction studies are one diagnostic test used by an electrodiagnostic physician. Nerve conduction studies are performed to assess the integrity and diagnose diseases of the peripheral nervous system. Specifically, they assess the speed (conduction velocity, and/or latency), size (amplitude), and shape of the response. EDX physicians utilize their medical training to determine which nerves to study utilizing NCSs and whether additional diagnostic testing is necessary. It is the AANEM's position that the standard of care in clinical practice dictates that using a predetermined or standardized battery of NCSs for all patients is inappropriate. It is inappropriate in the AANEM's opinion because it may be possible to obtain an accurate diagnosis with a fewer number of studies, and a prespecified battery may not include the appropriate NCSs to determine the diagnosis.

When properly performed, the waveforms from the NCSs should be reviewed as they are obtained (on-site) prior to the patient being dismissed. This is necessary to assess whether further NCSs should be performed, as well as, to determine what other diagnostic tests are necessary. It is also important that the physician review the waveforms to ensure the quality of the waveforms. Before results can be interpreted as normal or abnormal, it is important that the physician consider other factors that could be causing the abnormality such as electrical interference, improper setting, or even if the room was too cold.

Nerve conduction study reports should document the nerves being evaluated, the distance between stimulation and recording sites, the conduction velocity, latency values, and amplitude. The EDX physician interpreting the studies should understand each of these report components. It is important that these measurements are obtainable by the physician and that the physician understand the significance of these components in reaching a diagnosis.[1]

Appropriate Interpretation of NCS Data

The AANEM is concerned about physicians interpreting NCS data without face-to-face patient interaction, without making decisions about the nerves to be tested, and without providing direct oversight over the performance of the NCSs. As described above, to reach a diagnosis based on NCSs it is imperative that the physician has examined the patient, designed the study based on the information obtained, in most circumstances obtain EMG results, and then integrate information from each of the above components. Individuals that interpret NCSs without any patient interaction or individuals that rely on studies that have a delayed interpretation or have the interpretation made off-site, or individuals that interpret NCS results without the complementary information obtained from needle EMG, in the AANEM's opinion, are not meeting the standards outlined in the AANEM's *Recommended Policy for Electrodiagnostic Medicine*. As described more thoroughly below, the interpretation of NCSs separately from that of the needle EMG component of the test should clearly be the exception (e.g. when testing an acute nerve injury) rather than an established practice pattern for a given practitioner.[1]

Performance of Nerve Conduction Studies Without Needle Electromyography

The AANEM is concerned that there has been a significant increase in the number of NCSs performed without a companion needle EMG test. Nerve conduction studies increased by over 30% in 1 year based on Center for Medicare and Medicaid (CMS) information.[2] Nerve conduction studies are only one component of an appropriate EDX consultation.

When NCSs are performed without needle EMG, the additional and complementary information provided by the needle EMG results (except in limited circumstances) is not available. Without the information provided by the needle EMG examination, valuable data that may be essential in establishing an accurate diagnosis is missing. For example, performing both studies together is critically important when evaluating patients with suspected radiculopathy, plexopathy, and motor nerve or motor neuron disease. Quite often, patients with radiculopathy may have normal NCSs.[3] Some reports have indicated that a radiculopathy can be determined by F waves. However, if even a few of the large myelinated motor fibers are intact, the F-wave results will appear normal. Therefore, a patient may have a normal study when, in fact, a radiculopathy is present.[3] Though a few articles may be cited in an attempt to justify F waves in the diagnosis of radiculopathy, the current body of evidence (substantiated by multiple studies published in well respected peer-reviewed medical journals) does not support the use of F waves in isolation to diagnose radiculopathy. The AANEM *Recommended Policy* states that a minimal evaluation for radiculopathy should include one motor and one sensory NCS *and needle EMG* (emphasis added) of the involved limb.[1] Radiculopathy is just one example in which NCSs alone should not be used to reach a diagnosis. Patients with myopathy, plexopathy, or motor neuron disorders may have more widespread abnormalities that are only detectable by needle EMG.

Additionally, patients typically need to have both NCSs and needle EMG to ensure that an underlying medical condition is not missed. For example, in patients with carpal tunnel syndrome (CTS), other disorders can coexist, such as a radiculopathy, brachial plexopathy, or underlying peripheral neuropathy. Alternatively, there may be a problem involving the median nerve but localized at a site more proximal than the wrist. These other problems are far more likely to be misdiagnosed or missed completely if the needle EMG is not performed, and if a physician without the proper skill and training is interpreting the data, making a diagnosis, and establishing a treatment plan. Surgical release of the median nerve at the wrist, a treatment for carpal tunnel, would be an inappropriate and unnecessary procedure if the patient does not have CTS. Additionally, NCSs may be normal, however, the needle EMG examination may demonstrate abnormalities that identify a more proximal nerve lesion that produces symptoms such as numbness in the hand and that may mimic CTS. For this reason, most EDX consultants perform needle EMG in cases of suspected CTS to detect the presence of an underlying radiculopathy or other disease process.

Many patients have variations of normal innervation that cause abnormal nerve conductions values. A physician trained in EDX medicine can recognize situations in which these seemingly abnormal values are due to normal variant innervation and plan other NCSs to confirm the suspicion. These difficult and not uncommon clinical questions are best addressed by thorough and detailed EDX studies that are designed, performed, and interpreted by a physician who is properly trained in EDX medicine. If a physician trained in EDX medicine is physically present, incorrect diagnoses and unnecessary treatments can potentially be avoided.

Importance of a Unified Procedure

It is important that the NCSs and the needle EMG examination be performed together and their results integrated into a unifying diagnostic impression. As stated above, the performance and/or interpretation of NCSs separately from the needle EMG component of the testing should clearly be the exception. In some cases, a NCS

study will be conducted by someone who is not a trained EDX physician (or a trained technician under the direct supervision of a trained EDX physician) and the patient is then referred to a trained EDX physician for assistance in diagnosing the patient. In such cases, the physician trained in EDX medicine will usually need to repeat the NCS prior to performing needle EMG to ensure a quality study. Re-testing will also be necessary to conform to the AANEM policy that only one attending physician should perform or supervise all of the components of the EDX testing (i.e., history taking, physical evaluation, supervision and/or performance of the EDX test and interpretation) for a given patient and that in most cases all testing should occur on the same date of service. This necessary repetition of testing ensures patients receive quality care but wastes scarce health care dollars and subjects the patient to unnecessary discomfort and inconvenience.

Summary

The AANEM strongly recommends that EDX procedures be performed by physicians with comprehensive knowledge of neurological and musculoskeletal disorders to assure accurate interpretation and diagnosis. Individuals without a medical education in neuromuscular disorders and without special training in EDX procedures typically are not qualified to interpret the waveforms generated by NCSs and needle EMGs or to correlate the findings with other clinical information to reach a diagnosis. It is also the AANEM's position that the same physician should directly supervise and interpret the NCSs including those performed by an EDX technician.[1] The AANEM believes that interpreting NCS without performing a focused history and physical and having oversight over the design and performance is inappropriate.

Nerve conduction studies performed independent of needle EMG studies may only provide a portion of the information needed to diagnose muscle, nerve root, and most nerve disorders. For this reason, it is the position of the AANEM that, except in unique situations, NCSs and needle EMG should be performed together in a study design determined by a trained neuromuscular physician.[1]

There are common diagnoses that depend on performing a needle EMG and combining the needle EMG data with the NCS data. Needle EMG studies are a necessary part of the evaluation in the diagnosis of myopathy, radiculopathy, plexopathy, disorders of the motor neuron, peripheral neuropathies and most disorders of the individual peripheral motor nerves. When the NCS is used on its own without integrating needle EMG findings or when an individual relies solely on a review of NCS data, the results can often be misleading, and important diagnoses will likely be missed. Patients may thus be subjected to incorrect, unnecessary, and potentially harmful treatment interventions. The AANEM is concerned that utilizing only NCSs to make health care decisions provides incomplete diagnostic information, leading to inadequate or inappropriate therapy for some patients and may increase health care costs.

Disclaimer

This position statement is provided as an educational service of the American Association of Neuromuscular & Electrodiagnostic Medicine (AANEM) and is provided for informational purposes only. Specific patient care decisions are the prerogative of the patient and the physician caring for the patient, based on the individual facts and circumstances involved in each case. This position statement is not intended to be used as a basis for reimbursement decisions.

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References

1. AANEM Recommended Policy for Electrodiagnostic Medicine Available at: http://www.aanem.org/practiceissues/recPolicy/recommended_policy_2.cfm Accessed September 13, 2005. Approved by the American Association of Neuromuscular & Electrodiagnostic Medicine: September 1997; updated 1998, 1999, 2000, 2001, 2002, and 2004. Endorsed by the American Academy of Neurology: February 1998, February 2002, and June 2004. Endorsed by the American Academy of Physical Medicine & Rehabilitation: June 1998, March 2002, and June 2004.
2. Department of Health and Human Services Office of the Inspector General Work Plan Fiscal Year 2004. Available at http://oig.hhs.gov/reading/workplan/2004/Work%20Plan%202004.pdf Accessed September 13, 2005.
3. Werner RA, Cavender GD: Evaluating radiculopathy: How useful is electrodiagnostic testing? Phys Med Rehabil: State of the Art Review 1999;13(2):251-261.