Neurometer® CPT®

Sensory Nerve Conduction Threshold (sNCT®)
Electrodiagnostic Evaluation

Overview and References

Appendix B. General Utilization Guidelines

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Contents

Professional Responsibilities

The clinical judgement of a licensed physician is required and appropriate to determine if a patient's symptoms and physical examination merit an sNCT evaluation. The physician must prescribe the evaluation, including the body sites to be tested, according to his/her differential diagnosis. A clinician's impression should accompany the software generated analysis of the sNCT study results and the neurophysiologic data from the tests should be maintained in the patient's medical record.

The manufacturer's recommended procedural guidelines must be followed to allow reproducible automated sNCT generated CPT values to be obtained in a standardized double blind fashion with a resolution of +/- 20 μAmperes ($p<0.006$).

The recommended procedural guidelines must be followed to allow reproducible automated sNCT generated CPT values to be obtained is according to the *Generic Description* of the sNCT/CPT evaluation as follows:

> "Automated double-blind sensory nerve conduction threshold measures obtained using constant alternating current sinusoid waveform stimuli presented at 2000 Hz, 250 Hz and 5 Hz frequencies with durations of 1.65 second, 1.65 seconds and 2.88 seconds respectively obtained with a resolution of +/- 20 microAmperes, $p<0.006$."

Utilization of this procedure further assists in the detection of patient non-compliance.

The clinician must document why the sNCT/CPT evaluation is indicated, the interpretation of the sNCT/CPT test results and how the sNCT/CPT findings will affect the patient's management. Reasons for a new study, including a comparison with the previous test results, must also be documented.

This examination is a prescription study that may only be preformed by or on the order of a licenced physician. The sNCT/CPT evaluation provides the clinician with a means to obtain an objective quantitative differential diagnosis of sensory nerve impairments and to assess and document the efficacy of therapeutic intervention.

Prerequisites for Clinical Use of Electrodiagnostic Studies

Clinical sensory electrodiagnostic procedures are appropriate only when a patient's history and physical examination have documented a suspected sensory impairment that must be confirmed, quantified or ruled out in order to diagnose or

treat an illness or injury, or to evaluate an equivocal response to a therapeutic intervention. Prescribing the test for an excessive number of sites beyond those necessary to determine a differential diagnosis or repeating the test on a patient without an examination and documentation of a change in sensory abnormalities or an equivocal response to a therapeutic intervention are not appropriate.

Minimum Criteria for sNCT evaluations to be considered reasonable and necessary are listed below. The information provided by the sNCT/CPT or any electrodiagnostic evaluation requires the physician's impression based upon a clinical correlation of all pertinent findings in order for a diagnosis to be achieved.

1. The testing must provide information necessary to direct patient management.
2. The patient must be able to communicate and willing to cooperate.
3. The health care provider conducting the patients physical evaluation prescribes the sNCT/CPT examination.
4. The appropriate number of nerves to be evaluated for each condition are discussed in the section of this document titled "sNCT Pathology Specific Evaluation Guidelines".

Exclusion Criteria of other sensory electrodiagnostic tests

There is no known indication for conducting other sensory electrodiagnostic tests, such as the sensory nerve conduction velocity test, in combination with the sNCT/CPT test.

Peripheral Neuropathy

Various types of commonly detectable peripheral neuropathies by sNCT/CPT evaluation are discussed in this section The following is a list of the various types of peripheral neuropathy discussed:

1. Distal symmetrical polyneuropathy
2. Asymmetric polyneuropathy
3. Radiculopathy
4. Compressive and focal lesions

This classification of these conditions is consistent with the classic medical pathology approach as described in the pathology textbook by Robbins et. al.[1]. This textbook also includes addition detail to assist in distinguishing the sNCT study

[1] Pathologic Basis of Disease. Edited by Robbins, S.L., Cotran, R.S. and Kumar, V. W.B. Saunders Co., Philly. , pages 1428-1431, 1984. The second paragraph (page 1429) discusses "both diffuse demyelination and axonal degeneration" neuropathy. The axonal degeneration neuropathy results in a distal symmetrical dying back polyneuropathy as illustrated in Fig. 29-44. Diffuse demyelination, also shown in this illustration, may occur anywhere along the length of the nerve and present clinically with an asymmetric distribution. The text reports that acute demyelinating polyneuropathies show "some predilection for the proximal nerve trunks" (page 1430). The text also reports that focal nerve lesions would include radiculopathy and compressive lesions (page 1429).

from the sensory nerve conduction velocity (NCV) study. For example, the diagnostic applications of the sNCT study for specific small and or large fiber neuropathy, regeneration, radiculopathy and proximal lesions has been reported in numerous publications however these conditions are not capable of being evaluated by the sensory NCV study.

The following is a list of the top following top eight conditions appropriately evaluated by the sNCT/CPT evaluation:

1. Axonal polyneuropathy
2. Demyelinating polyneuropathy
3. Entrapment Neuropathy (eg. Carpal Tunnel Syndrome)
4. Focal nerve lesion
5. Radiculopathy
6. Myelopathy
7. Metabolic neuropathy
8. Toxic neuropathy

Evaluation of Specific Neuropathological Conditions

Sensory Nerve Conduction Threshold (sNCT) evaluations are conducted at symptomatic and asymptomatic sites to assess, localize and document abnormal distributions of sensory nerve function and assist in the diagnostic work up. Diagnoses commonly include the following pathological conditions: radiculopathy, compressive/focal lesions and polyneuropathy. The following sections present guidelines for the reasonable and appropriate use of the sNCT electrodiagnostic study for the evaluation of these major categories of neuropathological conditions. Electrodiagnostic testing is considered to be a dynamic process however, so the results of any one test in a planned series may determine if additional testing is indicated.

Distal Symmetrical Polyneuropathy

Distal symmetrical polyneuropathy first effects the longest nerve fibers impairing sensory function at the tips or distal phalanges of the toes and then, if untreated, progresses proximally to effect the feet and the fingers. Diagnostic sNCT studies are first conducted from the distal phalanges of the great toes (Superficial/Deep Peroneal Nerves, L4/L5 dermatomes) to permit the earliest possible evaluation of this condition. Further evaluation from the distal phalanges of the ring fingers (Median/Ulnar, C6/C7 dermatomes) may be indicated when abnormal measures are obtained from the tests on the great toes to evaluate for the presence of polyneuropathy in the upper extremity. If sNCT findings from these sites are normal, then no further testing is required. If sNCT findings are uniformly anesthetic at a site, then more proximal testing on a site where sNCT measures are obtainable is appropriate. Proximal testing localizes the extent of the neuropathy, aids in performing a differential diagnosis and enables the physician to quantify changes in the patient's

condition at a follow-up evaluation.

Asymmetric Polyneuropathy

Asymmetric polyneuropathy is diagnosed through bilateral, proximal and distal sNCT evaluations. Sites evaluated include the peroneal nerve (distal limb nerve), lateral antebrachial cutaneous (mid-limb nerve) and the lessor occipital (proximal segment nerve). Asymmetric polyneuropathies are often immune mediated and are associated with conditions such as Chronic Inflammatory Demyelinating Polyneuropathy.

Radiculopathy

Radiculopathic sensory impairments are evaluated by testing two different nerves within the same dermatome or testing the same nerve in two different dermatomes. Unless a distal polyneuropathy is suspected, proximal testing within the same dermatome distribution is generally unnecessary.

Upper extremity cervical radiculopathy is diagnosed through bilateral sNCT evaluations at the following distal finger/dermatome test sites: thumb (C6), index finger (C7), and the little finger (C8). Lower extremity lumbar/sacral radiculopathy is diagnosed through bilateral sNCT evaluations at sites including the following distal toe/dermatome test sites: medial great toe (L4), dorsal middle toe (L5) and lateral little toe (S1). Infrequently, radiculopathies may involve upper cervical (neck, cervical) or thoracic (mid-back) dermatomes. sNCT evaluation of these types of radiculopathies typically includes bilateral testing of affected and adjacent dermatome test sites.

Compressive and Focal Nerve Lesions

Focal nerve lesions, such as those caused by a traumatic injury, are evaluated and confirmed by determining normal sensory function proximal to the suspected lesion and abnormal function distally. The sNCT evaluation may be performed immediately following an acute nerve injury.

The evaluation of carpal tunnel syndrome, for example, is performed by testing the median nerve proximal and distal to the carpal tunnel - at the palmar cutaneous branch of the median nerve and the distal digital branches of the median nerve, respectively. Upon obtaining measures consistent with the suspected condition, the distal digital branches of the ulnar nerve at the little finger are evaluated to rule out a distal polyneuropathy mimicking or co-existing with carpal tunnel syndrome. Appendix F Report 3 provides an example of a report generated for the evaluation of carpal tunnel syndrome.

Professional Organization Guidelines: Indications for Electrodiagnostic Evaluations

The Recommended Policy For Electrodiagnostic Medicine by the American

Association of Electrodiagnostic Medicine, American Academy of Neurology and the American Academy of Physical Medicine and Rehabilitation reports that electrodiagnostic (EDX) testing has the following indications [2]:

"Indications

EDX testing is used to evaluate the integrity and function of the peripheral nervous system (most cranial nerves, spinal roots, plexi, and nerves), NMJ, muscles, and the central nervous system (brain and spinal cord). EDX testing is performed as part of an EDX consultation for diagnosis or as follow-up of an existing condition. EDX studies can provide information to:

1. Identify normal and abnormal nerve, muscle, motor or sensory neuron, and NMJ functioning.
2. Localize region(s) of abnormal function.
3. Define the type of abnormal function.
4. Determine the distribution of abnormalities.
5. Determine the severity of abnormalities.
6. Estimate the date of a specific nerve injury.
7. Estimate the duration of the disease.
8. Determine the progression of abnormalities or of recovery from abnormal function.
9. Aid in diagnosis and prognosis of disease.
10. Aid in selecting treatment options.
11. Aid in following response to treatment by providing objective evidence of change in neuromuscular function.
12. Localize correct locations for injection of intramuscular agents (e.g., botulinum toxin)."

The sensory electrodiagnostic evaluations the sNCT/CPT evaluation meets or exceeds the accuracy and capabilities of the sensory nerve conduction velocity evaluation in the cooperative patient for the above indications.

Specific Patient Management Considerations Table

The ability of the sNCT/CPT procedure to evaluate and document various types of sensory dysfunction is the basis of its utility in specific patient populations. Conditions such as myelopathies, radiculopathies, plexopathies, entrapment

[2]From the following URL: http://www.aaem.net

neuropathies and axonal and demyelinating, diffuse and multi focal polyneuropathies occur in the patient population. Pain resulting from non-neuropathic conditions such as vascular pathology, sprain/strain injury, arthropathies or visceral referred pain can mimic the pain from neuropathic conditions. An objective sensory electrodiagnostic evaluation is often required to assist in selecting the most appropriate therapeutic intervention. The sNCT/CPT evaluation permits differentiation of non-neuropathic from neuropathic conditions and differentiates the various types of nerve dysfunction cited above. The sNCT/CPT evaluation is also capable of evaluating the severity of each of these conditions as they may differentially effect the functioning of the three major subpopulations of sensory nerve fibers. The following table indicates specific patient management considerations for various pain conditions with the differential diagnosis obtained using the sNCT/CPT electrodiagnostic evaluation:

Specific Patient Management Considerations Neuropathic Pain	
sNCT/CPT Diagnosis	**Management**
Myelopathy	Neurological Management
Radiculopathy	Objective sNCT/CPT evaluation assists in determination whether surgical consult or medical management may be indicated.
Brachial Plexopathy	Typically rehabilitation medical management is indicated.
Entrapment Neuropathy	Early stage conservative management, splinting, NSAIDs, steroid injection. Advanced stage surgery.
Focal Lesion	Evaluation differentiates neuropraxia, axonotmesis or neurotmesis (with surgical intervention).
Distal Axonopathy	Determine etiology and treat the diabetes, alcoholism thyroid disorder, cancer, nutritional, toxic.
Non-neuropathic Pain	
sNCT/CPT Diagnosis	**Management**
No sensory impairment	No further sensory electrodiagnostic testing is required. Management based upon the premise that sensory function is intact.
Demyelinating Disease	Steroid, IVIg, Plasmapheresis, anti-HIV therapy may be indicated.

ICD-9-CM Codes for the sNCT Evaluation

Professional association Recommended Policy For Electrodiagnostic Medicine [41] also states the following regarding electrodiagnostic elected ICD-9-CM Codes:

> "At a minimum, any list of acceptable diagnoses should include all the diagnoses in Selected ICD-9-CM Codes: By Diagnosis with a note that additional diagnoses may be considered with accompanying documentation. Because EDX testing in some patients does not establish an etiologic diagnosis, any list of ICD-9-CM codes for electrodiagnostic testing must include symptom codes (such as weakness, pain, or altered sensation), as well as codes for defined diseases."

Neurotron, Inc. agrees with this above policy statement with respect to the sNCT/CPT electrodiagnostic evaluation. A listing of related ICD-9-CM codes may be found in endnote [1] of this Appendix.

Criteria for the sNCT/CPT Evaluation
Specific Neuropathological Conditions

Criteria for the Evaluation of Radiating Back/Neck Pain

Progressive Radiculopathy - radiating back/neck pain: Typically radiculopathy or spine sprain/strain injuries once clinically diagnosed are treated conservatively for 2-4 weeks and electrodiagnostic testing is not required. There are always exceptions and the health care provider's impression is key for management decisions. More severe presentations are treated more aggressively.

Symptoms of a radiculopathy where the sNCT/CPT evaluation may be indicated when the clinical sensory evaluation findings are equivocal include the following:

1. The pain radiates in a dermatome(s) distribution.
2. Pain is reproducible using provocative orthopedic maneuvers.
3. Cervical: pain limiting use of upper extremity.
4. Low back: pain limiting weight bearing.
5. Symptoms same or worse after 2-4 weeks of conservative therapy.

The sNCT/CPT electrodiagnostic evaluation may be indicated for a radiculopathic injury if:

1. The severity of a sensory nerve injury, if present, requires objective evaluation because the clinical neurological findings although present are equivocal as to the severity of the nerve dysfunction in the three individual sub-populations nerve fibers being evaluated. This information is needed for the appropriate intervention to be selected.
2. The distribution of a sensory nerve impairment, if present, requires objective

evaluation because clinical neurological findings although present are equivocal as to actual distribution of dysfunction. This information is needed for the appropriate intervention to be selected.

3. The information is necessary to determine if and where an imaging study or motor electrodiagnostic study may be required.
4. Surgical intervention is being considered and objective evaluation of sensory function is required because clinical findings are not diagnostic, eg. Radiculopathy vs Plexopathy.
5. Imaging studies are not diagnostic of the sensory impairment, eg., multiple disc herniations are visualized, sNCT/CPT is indicated to determine functional significance of each.

Note:

1. Pain associated with radiculopathy can interfere with accurate strength assessments distorting clinical measures of motor nerve function.

2. A radiculopathy may be motor, sensory or mixed. Most often sensory dysfunction precedes motor dysfunction (which appears in the more advanced stages). Motor dysfunction may be assessed by needle EMG evaluation but only approximately 5 weeks after the radiculopathic injury occurs. The delay for the needle EMG diagnostic test is necessary to allow for the paraspinal muscles to become denervated. The sensory sNCT/CPT evaluation is immediately sensitive to radiculopathy and no waiting period is required after a radiculopathic injury to conduct a sNCT/CPT evaluation of sensory nerve function.

3. Occasionally a myelopathy may be detected during the course of a sNCT/CPT evaluation of a suspected radiculopathy. The management of myelopathy is different than the management of radiculopathy.

Criteria for the Evaluation of Sensory Polyneuropathy

Sensory polyneuropathy may be the presenting symptom of a variety of metabolic, toxic, neoplastic, infectious, digestive and connective tissue disorders. The symptomatology may exhibit a range of presentations as exemplified by the following three conditions:

1. Asymptomatic, yet polyneuropathy findings upon clinical evaluation.
2. Symptomatic consistent with clinical evaluation findings of polyneuropathy.
3. Symptoms of pain or numbness, but no findings on clinical evaluation.

The distribution of sensory impairments associated with such pathology is generally either diffuse or distal. The clinical evaluation of sensory polyneuropathy may sometimes yield equivocal results. The primary differential diagnosis of sensory polyneuropathy is axonal versus demyelinating. The objective assessment of the severity of such conditions may also be critical for determining appropriate

patient management. The automated double blinded sNCT/CPT evaluation is indicated for the differential diagnosis of these two types of polyneuropathy or the evaluation of their severity. There are always exceptions and the health care provider's impression is key for management decisions.

Progressive polyneuropathy is often characterized by diffuse sensory abnormalities including pain and numbness. Typically a distal axonopathy appears at the tips of the toes first. When distal axonal polyneuropathy is overt, it is often clearly delineated and its etiology is often associated with a known metabolic or toxic condition (eg. alcoholism, diabetes, chemotherapy), HIV infection or paraneoplastic syndrome. The electrodiagnostic sNCT/CPT evaluation of such neuropathies when clearly discernable is not indicated.

In accordance with current prevailing USA CMS coverage rules, sensory electrodiagnostic evaluations are not indicated for screening for the polyneuropathy of diabetes or end-stage renal disease (ESRD).

The sNCT/CPT electrodiagnostic evaluation may be indicated for a sensory polyneuropathy if:

1. The severity of a sensory neuropathy, if present, requires objective evaluation because neurological findings although present are equivocal as to the actual severity of the pathology in all 3 individual subpopulations of sensory nerve fibers being evaluated. This information is needed ascertain the etiology of the symptoms and to select the appropriate intervention.
2. The distribution of a sensory neuropathy, if present, requires objective evaluation because even with neurological findings their actual distribution is equivocal for permitting the differential diagnosis between axonal versus demyelinating polyneuropathy. This information is needed ascertain the etiology of the symptoms and to select the appropriate intervention.
3. The information is necessary to determine if and where an imaging or motor electrodiagnostic study may be required.
4. Despite significant sensory complaints consistent with polyneuropathy, the clinical findings are normal.

Note:

1. Pain associated with polyneuropathy can interfere with accurate strength assessments distorting clinical measures of motor nerve function.
2. A polyneuropathy may be motor, sensory or mixed. Most often sensory dysfunction precedes motor dysfunction (which appears in the more advanced stages).

Criteria for the Evaluation of Nerve Compression Syndromes

Typically, the evaluation of a focal compressive neuropathy is clinically straight forward, i.e. there is normal nerve function proximal to the lesion with abnormal function distal to the lesion. Conditions such as sprains, strains, Carpal Tunnel

Syndrome (CTS), Guyons Canal Syndrome, Vibration Neuropathy, Pronator Syndrome, Cubital Tunnel Syndrome and Tarsal Tunnel Syndrome can often be clinically diagnosed and respond effectively to conservative management (NSAID therapy, splinting, physical therapy for two to three weeks). Patients may present with a poor association between symptoms and physical findings and an objective electrodiagnostic evaluation is required. Compression syndromes, when obvious, do not require electrodiagnostic sNCT/CPT evaluations. There are always exceptions and the health care provider's impression is key for management decisions. More severe presentations are treated more aggressively.

Occasionally, confounding variables such as arthralgias, vascular insufficiency, radiculopathy, plexopathy and referred pain can result in misleading or questionable clinical findings with respect to the actual sensory impairment. Under such circumstances, an electrodiagnostic evaluation may assist in selecting the most appropriate patient management. The sNCT/CPT electrodiagnostic evaluation may be indicated for the evaluation of sensory nerve compression syndromes if:

1. The severity of a sensory impairment, if present, requires objective evaluation because the neurological findings, although present, are equivocal as to actual severity of the pathology in all 3 individual subpopulations of sensory nerve fibers being evaluated. This information is needed ascertain the etiology of the symptoms and to select the appropriate intervention.
2. The distribution of a sensory neuropathy, if present, requires objective evaluation because the distribution of the neurological findings is equivocal and impairs the differential diagnosis between a distal focal compressive neuropathy versus a more proximal focal compressive neuropathy or an axonal versus demyelinating polyneuropathy. Occasionally a compressive neuropathy such as Carpal Tunnel Syndrome (CTS) may be superimposed upon a systemic polyneuropathy (eg, uremia as discussed in Appendix E, Reference 13). Electrodiagnostic information is necessary to ascertain the etiology of the symptoms and to select the appropriate intervention.
3. The information is necessary to determine if and where an imaging or motor electrodiagnostic study may be required.
4. Despite significant sensory complaints consistent with a focal compressive , the clinical findings are normal.

Note:

1. Pain associated with focal compressive neuropathy can interfere with accurate strength assessments distorting clinical measures of motor nerve function.
2. A focal compressive neuropathy may be motor, sensory or mixed. Most often sensory dysfunction precedes motor dysfunction (which appears in the more advanced stages).

Criteria for the Evaluation of Plexopathy

Plexopathies are primarily traumatic, eg. brachial plexopathy caused by a direct blow to the shoulder in a motor vehicle accident. Most plexopathies may be diagnosed by clinical evaluation findings. Typically plexopathy injuries are treated conservatively for 2-4 weeks and no electrodiagnostic testing is required. There are always exceptions and the health care provider's impression is key for management decisions, more severe presentations are treated more aggressively:

Symptoms of a plexopathy where the sNCT/CPT evaluation may be indicated when the clinical sensory evaluation findings are equivocal include the following:

1. The pain is not consistent with a peripheral nerve or dermatomal distribution.
2. Pain is reproducible using provocative orthopedic maneuvers.
3. Cervical: pain limiting use of upper extremity.
4. Low back: pain limiting weight bearing.
5. Symptoms same or worse after 2-4 weeks of conservative therapy.

The sNCT/CPT evaluation may be indicated for a plexopathy injury if:

1. The severity of a sensory nerve injury, if present, requires objective evaluation because the clinical neurological findings although present are equivocal as to the severity of the nerve dysfunction in the three individual sub-populations nerve fibers being evaluated. This information is needed ascertain the etiology of the symptoms and to select the appropriate intervention.
2. The distribution of a sensory nerve impairment, if present, requires objective evaluation because even with neurological findings their actual distribution of dysfunction is equivocal. This information is needed ascertain the etiology of the symptoms and to select the appropriate intervention.
3. The information is necessary to determine if and where an imaging study or motor electrodiagnostic study may be required.
4. Surgical intervention is being considered and objective evaluation of sensory function is required because clinical findings are not diagnostic, eg. Radiculo-pathy vs Plexopathy.
5. Imaging studies are not diagnostic of the sensory impairment, eg., multiple disc herniations are visualized, sNCT/CPT is indicated to determine functional significance of each.

Note:

1. Pain associated with plexopathy can interfere with accurate strength assessments distorting clinical measures of motor nerve function.
2. A plexopathy may be motor, sensory or mixed. Most often sensory dysfunction precedes motor dysfunction (which appears in the more advanced stages). Motor dysfunction may be assessed by needle EMG evaluation which requires approximately 5 weeks after the plexopathy injury occurs. This delay is necessary to permit the affected muscles to become denervated. The sensory sNCT/CPT evaluation is immediately sensitive to plexopathy and no

waiting period is required after a plexopathy injury to conduct a sNCT/CPT evaluation of sensory nerve function.

Criteria for the Evaluation of Therapeutic Intervention of Nerve Recovery (eg., recovery from toxin exposure, nerve regeneration, medication).

Occasionally a therapeutic intervention of a sensory neuropathological condition will yield equivocal clinical findings of the response to the intervention. Rather than continue with potentially ineffective, toxic and very expensive intervention it is more efficient to conduct an objective electrodiagnostic sNCT/CPT evaluation to gage the patients sensory nervous function in response to the therapy. A few examples follow:

1. Evaluate the efficacy of steroid or IVIg therapy of a demyelinating polyneuropathy.
2. Evaluate possible recovery of nerve function following nerve repair to rule out the need for follow-up surgery to remove a possible neuroma formation interfering with nerve regeneration.[3].
3. To evaluate the efficacy of therapeutic intervention of diabetic neuropathy [4].
4. To monitor for the toxicity of cancer chemotherapy [5].
5. To evaluate the efficacy of therapeutic intervention of pain. The sNCT/PTT Pain Tolerance Threshold (PTT) test would be a useful measure for this assessment[6].

Criteria for the sNCT/CPT Evaluation of Direct Sensory Nerve Trauma

Sensory nerve trauma is often an acute event that is most frequently caused by laceration, contusion or a vascular accident. It is when there is a laceration of a nerve with associated sensory symptomatology that the differential diagnostic question occurs as to whether the condition represents a neuropraxia, axonotmesis or neurotmesis. The prognosis for neuropraxia and axonotmesis is favorable, however when there is neurotmesis, a surgical repair may be indicated. If a nerve is obviously completely transected then a sensory electrodiagnostic evaluation would not be indicated. It is only when the extent of the nerve damage is not clear clinically and the clinical evaluation yields equivocal findings that the sNCT/CPT evaluation may be considered.

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[3]Chu, N.S. Current Perception Thresholds in Toe-To-Digit Transplantation and Digit-To-Digit Replantation. Muscle & Nerve, Volume 19(2):183-186, 1996.

[4]Winkler, G., Pal, B., Nagybeganyi, E., Ory, I., Porochnavec, M., Kempler, P. Effectiveness of different benfotiamine dosage regimens in the treatment of painful diabetic neuropathy. Arzneim.-Forsch./Drug Reseach, Volume 49:220-224, 1999.

[5]New, P. Neuro-selective Current Perception Threshold (CPT) quantitative sensory test: A re-evaluation, Neurology, Volume 49(5):1482, 1997.)

[6]Angst, M.S., Drover, D.R., Lötsch, J., Ramaswamy, B., Naidu, S., Wada, D.R., Stanski, D.R. The pharmacodynamics of orally administered sustained release hydromorphone in humans. Anesthesiology, Volume 94:63-73, 2001.

Frequency of Testing

The Kansas Medicare Carrier in the year 2002 has suggested that the frequency of sensory and motor electrodiagnostic testing be the following [7]:

> "Frequency of testing is a difficult issue to answer. Clinical justification, rather than an algorithm, should be the determinant in these instances. While this removes any recipe-style limits, it also calls for clear, responsible and evidence-based documentation for any repeat study. Such a guideline applies to all studies including those for patients (i) under medical, surgical or rehabilitative treatment, (ii) for neuropathy and (iii) for patients with chronic renal failure and/or dialysis."

Inappropriate sNCT Evaluations

Prescribing the test for an excessive number of sites beyond those necessary to determine a differential diagnosis or repeating the test on a patient without an examination and documentation of a change in sensory abnormalities or an equivocal response to a therapeutic intervention are not appropriate.

Specific Patient Sub-population Based Upon Category of Symptomatology and Impact on Patient management

The sNCT electrodiagnostic evaluation of specific patient subpopulations will be categorized according to their symptomatology as described in the following vignettes. The impact of the evaluation findings on patient management is discussed.

Subjective, Objective, Assessment and Planning (SOAP) Progress Note Vignettes With Comments on the Effects of the sNCT/CPT Evaluation on Patient Management

More than thirty years ago, Dr. Lawrence L. Weed developed the concept of subjective, objective, assessment and planning (SOAP) progress notes, which serve as the core of documentation education in major medical institutions in the Unites States, Asia and Europe and are used by countless health care practitioners[8]. Neurotron, Inc. has chosen this SOAP format to provide examples the role of the sNCT/CPT evaluation in the management of Specific patient sub-populations. This choice is based on part by standard American Medical Association (AMA) Relative

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[7] From the following URL on March 7, 2002: http://www.kansasmedicare.com:80/part_B/lmrp/NerveConductionStudiesandElectromyography.htm

[8] Additional information is available at the following URL: http://www.pkc.com/about/larry_weed.html

Value Scale (RVS) Speciality society communications provided to The Centers for Medicare and Medicaid Services (CMS) as well as related AMA Internet postings [9, 10]. This information is provided by the AMA to the CMS to assist in the valuation of procedures such as sensory electrodiagnostic evaluations.

The following SOAPS list of specific subpopulations of patients based upon symptomatology for whom the results of a sNCT/CPT electrodiagnostic evaluation is indicated because it is necessary to direct patient management.

1. **Weakness and numbness in extremities - Proximal Demyelinating Radiculo-neuropathy:** Based on an AMA vignette[9]. The quoted text below is from the vignette. This vignette states it is describing the "Typical patient" with proximal demyelinating radiculoneuropathy.

Subjective: "A 50-year-old woman complains of weakness and numbness of her arms and legs for three months." This condition was not related to be associated to any specific event.

Objective: "Physical examination shows weakness of distal upper and lower limb muscles, areflexia and stocking-glove sensory loss."

Assessment: "Differential diagnostic considerations included axonal or demyelinating polyneuropathies."..."Both of these conditions have different etiologies and treatments."

Plan: "Most primarily demyelinating neuropathies are diagnosable only by electro-diagnostic techniques, not blood or imaging tests." The AMA plan is that sensory electro-diagnostic testing is required. SNCT/CPT studies are indicated.

Effect of the sNCT/CPT Evaluation on Patient Management
The health care provider in this case determined that the differential diagnosis of the patient's neurological condition includes either a distal axonal or a demyelinating type of polyneuropathy. The sNCT/CPT electrodiagnostic evaluation is capable of differentiating these two conditions. The sNCT/CPT findings, in this case, permit the confirmation of the diagnosis of a demyelinating type of polyneuropathy as well as effectively ruling out a possible distal axonal polyneuropathy. The sNCT/CPT findings assist the health care provider in selecting the most appropriate therapeutic intervention for this condition (eg. either steroid, human immune globulin or plasmapheresis).

The sNCT/CPT test helps to attenuate morbidity and associated expenses of this disease's progression. Without the sNCT evaluation of this disease, patients have prolonged suffering, disease progression and may have unnecessary ineffective additional diagnostic invasive testing such as a MRI, blood tests or a bone marrow biopsy.

2. **Numbness in extremity - Cervical Transverse Myelitis:** Based on an AMA

[9]This AMA vignette is from the Internet at the following URL: http://www.ama-assn.org/ama/pub/article/3866-3863.html.)

This AMA document is based upon research of hundreds of professionals belonging to the American Academy of Neurology (AAN), American Association of Electrodiagnostic Medicine (AAEM), American Academy of Physical Medicine and Rehabilitation (AAPM&R) and the American Physical Therapy Association (APTA).

vignette [10]. The quoted text below is from the vignette.

Subjective: "A 35-year-old woman complains of numbness in the right arm."

Objective: "Physical examination studies...Studies are normal."

Assessment: Differential diagnostic considerations include sensory neurological impairment somewhere between the periphery and the brain or some non-sensory neurological condition including a possible psychiatric or vascular condition. Neuropathic and non-neuropathic conditions effecting sensory nerve function have different etiologies and treatments.

Plan: The management of this a patient with significant sensory complaints and normal physical examinations findings requires that an objective sensory electrodiagnostic test be conducted that evaluates sensory nerve function from the periphery to the brain. The sNCT/CPT evaluation is indicated.

Effect of the sNCT/CPT Evaluation on Patient Management
The health care provider in this case is unable to objectively determine if the patient actually has some type of impairment in sensory nerve function in her right arm. The sNCT/CPT evaluation documents a segmental distribution of sensory impairment consistent with spinal cord pathology. It effectively rules out a mono-radiculopathy, focal peripheral nerve lesions or a distal axonal polyneuropathy. The sNCT/CPT evaluation benefitted the management of the patient by informing the health care provider of the neuropathic condition and its severity. This information was crucial in assisting the health care provider to formulate the decision that a MRI of the cervical spine was the next indicated test in ultimately diagnosing the patients condition and selecting the appropriate therapeutic intervention (eg. steroid therapy).

3. **Back Pain - Thoracic Disc Herniation:** Based on an AMA vignette [12]. The quoted text below is from the vignette.

Subjective: "A 40-year-old man reports back pain in the thoracic lumbar region."

Objective: Clinical findings are equivocal."Imaging studies reveal disc herniations at the T6-7 and T10-11 regions, both impinging without the thecal sac."

Assessment: Differential diagnostic considerations consider that one or both of the disc herniations is responsible for the patients symptoms. These are conditions with different etiologies and treatments.

Plan: The effects of disc herniation on sensory nerve function may be evaluated by electrodiagnostic sNCT/CPT the evaluation. The sNCT/CPT evaluation is indicated.

Effect of the sNCT/CPT Evaluation on Patient Management
The measures from the sNCT evaluation indicated to the health care provider that the patients sensory impairment is a result of the T10-11 herniation and not the T6-7 herniation. "These findings direct the surgeon to operate at this level. He recovers uneventfully." The ability of the sNCT evaluation to result in more effective spinal cord

[10]This vignette is discussed in an AMA / Speciality Society RVS Update. This AMA document is based upon input from 23 members of the American Association of Electrodiagnostic Medicine, 60 members of the American Academy of Neurology 100 members of the American Academy of Physical and Rehabilitation Medicine and 120 members of the American Physical Therapy Association.

related surgery is the topic of an in press publication in the Journal of Neurosurgery[11].

4. **Progressive sensory, motor dysfunction - Thoracic Disc Herniation:** Based on an AMA vignette [12]. The quoted text below is from the vignette.)

Subjective: "Over the last two months, a 40-year-old man has noted progressive difficulty in gait, urinary urgency, and numbness in his feet."

Objective: "Physical exam is remarkable for diffuse mild (4/5) weakness in the lower limbs (right side worse), hyperactive knee and ankle stretch reflexes with a right Babinski sign and equivocal loss of vibration sense in the feet."

Assessment: The differential "diagnoses include cervical spondylosis, motor neuron disease or intracranial pathology (e.g. hydrocephalus or stroke)." These are conditions with different etiologies and treatments.

Plan: The AMA plan includes sensory electrodiagnostic testing. The sNCT/CPT evaluation is indicated.

Effect of the sNCT/CPT Evaluation on Patient Management
The sNCT findings shows abnormalities consistent the clinical impression of myelopathy with a mid thoracic myelopathy. The findings demonstrate involvement of the somatosensory pathways (arguing against motor neuron disease) and suggest spinal cord impairment at the mid thoracic level. "Combined with the clinical picture," the sNCT/CPT findings suggest conducting imaging studies to be focused on the mid-thoracic spinal regions. "Imaging studies suggest a large thoracic disc herniation. He undergoes surgery and recovers completely."

5. **Radiating Pain - S1 Radiculopathy:** Based on an AMA vignette [12]. The quoted text below is from the vignette.

Subjective: "A 65-year-old man complains of right leg pain an some back discomfort."

Objective: Physical examination, lumbar spine X-rays... are all normal."

Assessment: Differential diagnosis considerations include radiculopathy or an axonal or demyelinating polyneuropathy or a focal mononeuropathy or some type of non-neuropathic condition (e.g. sprain, vascular disease or arthropathy). These are conditions with different etiologies and treatments.

Plan: The AMA plan includes sensory electrodiagnostic testing. The sNCT/CPT evaluation is indicated.

Effect of the sNCT/CPT Evaluation on Patient Management
The sNCT/CPT findings are consistent with a moderate right S1 radiculopathy. These electrodiagnostic findings are the first objective evidence obtained of nervous system dys-function. The sNCT findings effectively rule out any systemic axonal or demyelinating polyneuropathy or a focal peripheral mononeuropathy. The health care provider obtains an MRI indicating a disc herniation at L5-S1. "After a trial of conservative therapy fails, he

[11]Falci, S.P., Best, L.G, Bayles, R., Cown, C. Dorsal Root Entry Zone (DREZ) microcoagulation for central pain of spinal cord injury: operative intramedullary electrophysiological guidance and clinical outcome. Journal of Neurosurgery (Spine 2), Volume 97:193-200, 2002.

undergoes laminectomy and L5-S1 discectomy and recovers completely."

6. **Radiating Pain - C7 Radiculopathy: Based on an AMA vignette** [12]: The quoted text below is from the vignette.

Subjective: "A 65 year-old man complains of right arm pain and some neck discomfort."

Objective: "Physical examination, cervical spine X-rays...are all normal."

Assessment: Differential diagnosis considerations include radiculopathy or an axonal or demyelinating polyneuropathy or a focal mononeuropathy or some type of non-neuropathic condition (e.g. metabolic, neoplastic, toxic). These are conditions with different etiologies and treatments.

Plan: The management of this patient with significant sensory complaints and normal physical examinations findings requires that an objective sensory electrodiagnostic test be conducted that evaluates sensory nerve function from the periphery to the brain. The sNCT/CPT evaluation is indicated.

Effect of the sNCT/CPT Evaluation on Patient Management
The sNCT/CPT findings are consistent with a moderate C7 radiculopathy. The sNCT/CPT findings effectively rule out an distal axonal polyneuropathy or a diffuse demyelinating polyneuropathy. These electrodiagnostic findings are the first objective evidence obtained of nervous system dysfunction.

7. **Radiating Pain - Acute Inflammatory Demyelinating Polyneuropathy (AIDP):** Based on an AMA vignette [12]. The quoted text below is from the vignette.

Subjective: A 67-year-old woman complains of an acute onset of burning pain in all of her limbs for 3 weeks resulting in the need to use a wheel chair.

Objective: Physical examination shows pain limited range of motion, allodynia in upper and lower extremities sensory and motor findings were otherwise intact. The patient was referred by a rheumatologist who conducted the initial work-up. Blood studies were negative.

Assessment: "Differential diagnostic considerations included axonal or demyelinating polyneuropathies."..."Both of these conditions have different etiologies and treatments."

Plan: sNCT/CPT studies are indicated.

Effect of the sNCT/CPT Evaluation on Patient Management
The health care provider determined that the differential diagnosis of the patient's neurological condition includes either a distal axonal or a demyelinating type of polyneuropathy. The sNCT/CPT electrodiagnostic evaluation is capable of differentiating these two conditions. The sNCT/CPT findings permit the confirmation of the diagnosis of a demyelinating type of polyneuropathy as well as effectively ruling out a possible distal axonal polyneuropathy. A spinal tap was then conducted and a protein of 400 was noted with no cells. The correct diagnosis of Acute Inflammatory Demyelinating Polyneuropathy (AIDP) was made. One dose of intravenous immunoglobulin rendered this patient pain free. If she had not been administered the sNCT/CPT evaluation she might have never received the appropriate therapy.

The sNCT/CPT test helps to attenuate morbidity and associated expenses of this disease's progression. Without the sNCT electrodiagnostic evaluation of this disease, patients have prolonged suffering, disease progression and may have unnecessary ineffective additional diagnostic invasive testing such as a MRI, blood tests or a bone marrow biopsy.

8. Radiating Pain - Small Fiber Neuropathy:

Subjective: A 46-year-old man presents with complaints of episodic excruciating burning pain all over his body, but primarily in his lower extremities, over the past 3 years.

Objective: The physical examination was unremarkable. Cephalic MRI and standard blood chemistry tests were all negative.

Assessment: Differential diagnostic considerations included axonal or demyelinating polyneuropathies or some type of non-neuropathic condition (e.g. metabolic, endocrine, neoplastic, toxic, connective tissue disorder). These are conditions with different etiologies and treatments.

Plan: sNCT/CPT studies are indicated.

Effect of the sNCT/CPT Evaluation on Patient Management
The health care provider determined that the differential diagnosis of the patient's neurological condition includes a possible neuropathic condition. The sNCT/CPT findings, in this case, permit the confirmation of the diagnosis of a diffuse small fiber polyneuropathy and effectively rule out a demyelinating or distal axonal polyneuropathy. These electro-diagnostic findings are the first objective evidence obtained of nervous system dysfunction. Appropriate blood biochemical tests were then performed and a diagnosis of Fabry's disease was confirmed.

The sNCT/CPT test helps to attenuate morbidity and associated expenses of this disease's progression. Without the sNCT electrodiagnostic evaluation of this disease, patients have prolonged suffering, and may have unnecessary ineffective additional diagnostic invasive testing such as a MRI, blood tests or a bone marrow biopsy.

9. Pain in forearm and hand - Carpal Tunnel Syndrome (CTS):

Subjective: A 67-year-old woman with complaints of pain in the right hand and forearm. The pain is described as intermittent and occurs at rest as well as with movement and wakes her up at night. It has become progressively worse over the past two months and it did not respond to her self prescribed NSAID therapy over the past three weeks.

Objective: Physical examination shows a kyphotic slightly obese patient. Both hands reveal early osteoarthritic joints, notably the interphalangeal joints and the base of the thumb. There is a slight bony crepitus in both wrist joints. There is a positive Phalen's and Tinel's signs in both hands. A slight tenderness to palpation was noted over the anterior superior aspect of the right forearm.

Assessment: Differential diagnostic considerations include non-neuropathic pain secondary to osteoarthritis and its related complications or neuropathic pain from Carpal Tunnel Syndrome (CTS) and/or cervical radiculopathy. These are conditions with different etiologies and treatments.

Plan: The sNCT/CPT sensory electrodiagnostic evaluation is indicated.

Effect of the sNCT/CPT Evaluation on Patient Management
The sNCT evaluation measured a moderate sensory impairment of large myelinated fiber function in the distribution of the right median nerve innervation distal to but not proximal to the carpal tunnel. These electrodiagnostic findings are the first objective evidence obtained of nervous system dysfunction. A diagnosis of moderate Carpal Tunnel Syndrome (CTS) was made. The stage of the CTS was determined to be non-surgical so no surgical consultation was required. The sNCT/CPT evaluation effectively ruled out a polyneuropathy (either axonal or demyelinating) or a cervical radiculopathy. The patient was treated with a wrist splint and NSAID medication. Within two weeks there was a complete resolution of the symptoms.

10. Radiating Back Pain into Feet -Diabetic Neuropathy:

Subjective: A 72-year-old "healthy" woman represents with complaints of worsening pain in her back and feet radiating up the legs. It has been becoming progressively more painful over the past two weeks. No precipitating events were noted.

Objective: This patient had been seen in the clinic a week before with similar but less severe complaints and had been prescribed with NSAID therapy. Clinical evaluation findings included positive straight leg raising sign (also observed the previous week). No sensory asymmetries were detected with the tuning fork or pin wheel. Routine blood tests and urine analysis were normal.

Assessment: The clinical evaluation findings of positive straight leg raising sign is consistent with lumbar strain and possible radiculopathy. The differential diagnostic considerations included low back strain versus radiculopathy (lumbar or sacral) or polyneuropathy. These are conditions with different etiologies and treatments.

Plan: The sNCT/CPT evaluation is indicated.

Effect of the sNCT/CPT Evaluation on Patient Management
The sNCT evaluation measured a moderate sensory impairment impairments in the distal phalanges of the toes with normal sensory functioning proximally (i.e. proximal sNCT/CPT measures were within established normative parameters). These findings were consistent with a distal axonal polyneuropathy. The sNCT measures ruled out the possibility of radiculopathy or a diffuse demyelinating polyneuropathy. These electrodiagnostic findings are the first objective evidence obtained of nervous system dysfunction.

A fasting blood glucose and HbA1c was then obtained which yielded abnormalities consistent with diabetes. Diabetic management was instituted immediately and the sensory impairments resolved in three months. If the diabetic condition had remained undetected until the sensory neuropathy was allowed to progress to the proximal location (ankle), the patient's neuropathy would have advanced to the stage where it would have required years of tight glucose control to possibly reverse.

11. Radiating Back Pain into Legs - Rule-out Radiculopathy combined with Alcoholic Neuropathy:

Subjective: A 65-year-old male with a history of alcoholic polyneuropathy of 5 years duration presents with complaints of low back pain radiating to the medial aspect of the right lower extremity for two weeks.

Objective: Clinical evaluation findings included positive straight leg raising sign. A mild loss of vibratory and pinwheel sensation was noted in the toes. No other sensory asymmetries were detected. A low back MRI revealed several bulging lower lumbar discs of questionable clinical significance.

Assessment: The clinical evaluation findings of positive straight leg raising sign is consistent with lumbar strain and possible radiculopathy. The differential diagnostic considerations included low back strain versus radiculopathy (lumbar or sacral) or exacerbation of the alcoholic polyneuropathy from distal to diffuse. These are conditions with different etiologies and treatments.

Plan: The sNCT/CPT evaluation is indicated.

Effect of the sNCT/CPT Evaluation on Patient Management
The sNCT evaluation measured a moderate sensory impairment impairments in the distal phalanges of the toes with normal sensory functioning proximally (i.e. proximal sNCT/CPT measures were within established normative parameters) within the L4, L5 and S1 dermatomes. These findings were consistent with a distal axonal polyneuropathy. The sNCT measures ruled out the possibility of radiculopathy or a diffuse demyelinating polyneuropathy.

These electrodiagnostic findings obviate the need for further electrodiagnostic testing or MRI evaluation of the Lumbar/Sacral spine. A surgical consult for possible radiculopathy evaluation is also ruled out. pharmacologic pain management was instituted which successfully alleviated the patients pain and the patient was able to be successfully treated for his alcoholism.

12. Radiating Neck Pain into Arm After Trauma - Brachial Plexopathy:

Subjective: A 68-year-old woman presents with complaints of pain in her neck, right shoulder and arm after falling off a ladder.

Objective: Physical evaluation reveals normal motor strength and tenderness and decreased range of motion in the right neck and shoulder. A diffuse pattern of tenderness was noted in the proximal and distal arm and hand. No sensory asymmetries in the extremities were detected with the tuning fork or pin wheel or reflexes.

Assessment: The clinical evaluation findings are consistent with cervical strain and possible radiculopathy or peripheral plexus and/or focal nerve lesion. These are conditions with different etiologies and treatments.

Plan: The sNCT/CPT evaluation is indicated.

Effect of the sNCT/CPT Evaluation on Patient Management
The sNCT/CPT electrodiagnostic evaluation yielded measures indicating moderate sensory dysfunction with a distribution consistent with a right lower brachial plexus lesion. Appropriate therapeutic intervention including prescription of a sling and physical therapy of modalities was implemented. The sNCT/CPT evaluation effectively ruled out a radiculopathy or focal peripheral nerve injury or any type of metabolic or toxic polyneuropathy. The sNCT/CPT electrodiagnostic findings are the first objective evidence obtained of nervous system dysfunction.

The sNCT/CPT findings guided the therapeutic intervention and negated the need for MRI imaging studies of the neck or surgical consultation for possible radiculopathy.

13. Pain and Numbness in Foot - Tarsal Tunnel Syndrome:

Subjective: A 66-year-old male presents with complaints of numbness and burning in the plantar aspect of his left foot after standing for approximately 30 minutes. The condition had become progressively more painful over the preceding four months and has now prevented the patient from playing golf(his favorite sport). In the past 3 weeks he reports that he has been forced to limit his normal activities of daily living, which included much standing. He complains that he must sit down to obtain relief.

Objective: Physical examination finds no sensory or motor impairments.

Assessment: The differential diagnosis includes vascular complications or some type of neuropathic condition including radiculopathy, polyneuropathy or focal nerve lesion. These are conditions with different etiologies and treatments.

Plan: The sNCT/CPT evaluation is indicated.

Effect of the sNCT/CPT Evaluation on Patient Management
The sNCT/CPT electrodiagnostic evaluation yielded measures indicating severe sensory dysfunction with a distribution consistent with a left tarsal tunnel syndrome. The SNCT evaluation effectively ruled out radiculopathy, or polyneuropathy as the etiology of the patients pain. The sNCT/CPT electrodiagnostic findings are the first objective evidence obtained of nervous system dysfunction.

A surgical consult was requested and a surgical release of the left posterior tibial nerve within the tarsal tunnel was conducted. Subsequent to the surgery the patient became symptom free.

14. Traumatic Nerve Lesion with Impaired Sensory Function - Neuropraxia:

Subjective: A 68-year-old woman had accidentally had her forearm jammed by a car door. She presents with a bandaged painful forearm and complaints of numbness in her little finger.

Objective: A two inch superficial laceration is noted on the medial forearm. The laceration is not deep enough to permit visualization of the ulnar nerve which passes underneath this injury site. Sensation to pinprick and tuning fork is absent from the little finger and hypothenar eminence. Due to the patient's forearm pain it was not possible to accurately assess motor strength in the arm or hand. A hematoma is noted approximately inches three inches long on the posterior forearm.

Assessment: The differential diagnosis of the impaired sensation includes a neuropraxia, axonotmesis or neurotmesis of the ulnar nerve in the forearm. These are conditions with different treatments.

Plan: The sNCT/CPT evaluation is indicated.

Effect of the sNCT/CPT Evaluation on Patient Management
The sNCT/CPT sensory evaluation findings indicated the small fiber CPT measures were

within normative range limits and there was hypoesthesia of the larger fibers. This hypoesthesia corresponds to an axonotmesis of these fibers. These sNCT/CPT measures effectively rule out neurotmesis. By ruling out neurotmesis the treating health care provider determined that surgical exploration/treatment of the ulnar nerve in the injury area was not indicated. The lesion was non-surgically closed by use of steri-strips. Subsequently, the patient fully recovered ulnar nerve function.

15. Progressive Generalized Muscle Weakness - Amyotrophic Lateral Sclerosis (ALS)/Polymyocitis:

Subjective: A 67-year-old male complains of progressive weakness and waking-up in the morning with muscle cramps as well as muscle spasms at night for 2 months.

Objective: Physical evaluation reveals asymmetric weakness, diffuse muscle wasting and atrophy which is predominant in the hands with fasciculation evoked by tapping. Brisk reflexes are also observed. Sensory nerve function appears intact.

Assessment: The differential diagnosis includes Amyotrophic Lateral Sclerosis (ALS) versus other forms of motor neuron disease or muscle disease. Although ALS is incurable and fatal, a number of other causes of motor neuron disease are curable and should be ruled-out in suspected ALS patients. A great number of these other conditions which cause motor neuron disease also can effect sensory nerve function. This would include the following: metabolic disorders (thyroid and parathyroid disorders, Vitamin B12 deficiency, malabsorption, paraneoplastic conditions, autoimmune disease, intoxication (lead and other heavy metals), drugs (eg. strychnine, phenytoin), infection (Lyme, retro viral myelopathy) and structural lesions (eg., syrinx, tumor, spinal cord arteriovenous malformation).

Plan: The sNCT/CPT evaluation is indicated.

Effect of the sNCT/CPT Evaluation on Patient Management
The sNCT/CPT sensory evaluation findings indicated no evidence of sensory impairment. These findings are compatible with the diagnosis of ALS and rule out the above listed neuropathic conditions that result in motor neuron disease as well as sensory nerve dysfunction.

16. Exacerbation of a chronic pain condition - Complex Regional Pain Syndrome:

Subjective: A 62 year old female with a history of chronic pain in the right hand over 3 years that had been previously diagnosed as hypothyroid with CRPS/RSD in the right hand of unknown etiology. She presents with complaints of a progressive worsening of her condition over the past two weeks that has resulted in its disuse. She has been using OTC NSAIDs without success. Patient reportedly dislikes opiates due to their side effects.

Objective: Physical evaluation reveals a patient with allodynia and swelling in the thumb index and middle fingers on the right hand and no evidence of trauma. Motor strength is difficult to evaluate due to the patient's painful condition. The patient is moderately obese. Reflexes are difficult to evaluate and there is mild edema noted around both ankles. Otherwise the neurological history and physical evaluation was unremarkable. Blood test were not remarkable.

Assessment: The differential diagnosis includes an exacerbation of her sympathetic dysfunction, sensory dysfunction including possible Carpal Tunnel Syndrome (CTS), pain

tolerance perception dysfunction, vascular or lymphatic dysfunction.

Plan: The sNCT/CPT evaluation is indicated.

Effect of the sNCT/CPT Evaluation on Patient Management
The sNCT/CPT evaluation reveals normal sensory function but abnormally low sNCT Pain Tolerance Threshold (PTT) measures with the 2000 Hz measures only. These findings are consistent with a large fiber mediated allodynia. Based on these findings the pain clinician rules out initial therapy using selective small fiber analgesics. The patient responds favorably to this treatment. The use of the sNCT evaluation permitted the clinician to rule out any sensory neurological impairment and focus the pain therapy on the large fibers. By avoiding the initial prescribing of narcotics or lidocaine the potentially dangerous and adverse complications associated with these medications is prevented {Endnote 2 of this Appendix cites related publications].

Endnotes

Endnote 1: sNCT/CPT Related ICD-9-CM Diagnosis Codes

Based upon the sNCT evaluation criteria established within this document, specific ICD-9-CM Diagnosis Codes which may be utilized for the sNCT/CPT electrodiagnostic procedure including in the following list:

192.2 Malignant neoplasm of spinal cord
192.3 Malignant neoplasm of spinal meninges
250.60 - Diabetes with neurological manifestations; type II [non-insulin dependent type] [NIDDM type] [adult-onset type] or unspecified type, not stated as uncontrolled
250.61 type I [insulin dependent type] [IDDM] [juvenile type], not stated as uncontrolled
250.62 type II [non-insulin dependent type] [NIDDM] [adult-onset type] or unspecified type, uncontrolled
250.63 type I [insulin dependent type] [IDDM] [juvenile type], uncontrolled
265.1 Other and unspecified manifestations of thiamine deficiency
269.1 Deficiency of other vitamins
335.20-335.29 Motor neuron disease
335.8 Other anterior horn cell diseases
335.9 Anterior horn cell disease, unspecified
336.0-336.9 Other diseases of spinal cord
337.0-337.9 Disorders of the autonomic nervous system (Includes: disorders of peripheral autonomic, sympathetic, parasympathetic, or vegetative system)
344.60 Cauda equina syndrome; without mention of neurogenic bladder
344.61 with neurogenic bladder
344.89 Other specified paralytic syndrome
344.9 Paralysis, unspecified
350.2 Atypical face pain
352.6 Multiple cranial nerve palsies
353.0 Brachial plexus lesions
353.1 Lumbosacral plexus lesions
353.2 Cervical root lesions, not elsewhere classified
353.3 Thoracic root lesions, not elsewhere classified
353.4 Lumbosacral root lesions, not elsewhere classified
353.8 Other nerve root and plexus disorders
353.9 Unspecified nerve root and plexus disorder

354.0-354.9 Mononeuritis of upper limb and mononeuritis multiplex
355.0-355.9 Mononeuritis of lower limb and unspecified site
356.0-356.9 Hereditary and idiopathic peripheral neuropathy
357.0-357.8 Inflammatory and toxic neuropathy
458.0 Orthostatic hypotension
625.6 Stress incontinence, female
710.3 Dermatomyositis
710.4 Polymyositis
710.5 Eosinophilia myalgia syndrome
721.0 Cervical spondylosis without myelopathy
721.1 Cervical spondylosis with myelopathy
721.2 Thoracic spondylosis without myelopathy
721.3 Lumbosacral spondylosis without myelopathy
721.41 Spondylosis with myelopathy, thoracic region
721.42 Spondylosis with myelopathy, lumbar region
722.0-722.11 Displacement of cervical, thoracic, or lumbar intervertebral disc without myelopathy
722.2 Displacement of intervertebral disc, site unspecified, without myelopathy
722.4 Degeneration of cervical intervertebral disc
722.51 Degeneration of thoracic or thoracolumbar intervertebral disc
722.52 Degeneration of lumbar or lumbosacral

intervertebral disc
722.6 Degeneration of intervertebral disc, site unspecified
722.70-722.73 Invertebral disc disorder with myelopathy
722.80-722.83 Postlaminectomy syndrome
722.91-722.93 Other specified disc disorder
723.0 Spinal stenosis in cervical region
723.4 Brachial neuritis or radiculitis NOS
724.00-724.09 Spinal stenosis, other than cervical
724.1 Pain in thoracic spine
724.2 Lumbago
724.3 Sciatica
724.4 Thoracic or lumbosacral neuritis or radiculitis, unspecified
724.5 Backache, unspecified
728.0 Infective myositis
728.9 Weakness, muscle.
729.2 Neuralgia, neuritis, and radiculitis, unspecified
729.5 Pain in limb
736.05 Wrist drop (acquired)
736.06 Claw hand (acquired)
736.09 Other acquired deformities of forearm, excluding fingers
736.79 Other acquired deformities of ankle and foot
781.4 Transient paralysis of limb
781.7 Tetany
782.0 Disturbance of skin sensation
787.6 Incontinence of feces
788.21 Incomplete bladder emptying
788.30-788.39 Incontinence of urine
952.00-952.09 Spinal cord injury without evidence of spinal bone injury- cervical
952.10-952.19 Spinal cord injury without evidence of spinal bone injury-dorsal [thoracic]
952.2 Lumbar spinal cord injury without spinal bone injury
952.3 Sacral spinal cord injury without spinal bone injury
952.4 Cauda equina spinal cord injury without spinal bone injury
952.8 Multiple sites of spinal cord injury without spinal bone injury
952.9 Unspecified site of spinal cord injury without spinal bone injury953.0-953.9 Injury to nerve roots and spinal plexus
954.0-954.9 Injury to other nerve(s) of trunk, excluding shoulder and pelvic girdles
955.0-955.9 Injury to peripheral nerve(s) of shoulder girdle and upper limb
956.0-956.9 Injury to peripheral nerve(s) of pelvic girdle and lower limb
957.0-957.9 Injury to other and unspecified nerves

Endnote 2: Lidocaine Related sNCT/CPT publications

1. Liu, S., Kopacz, D.J., Carpenter, R.L. Quantitative Assessment of Differential Sensory

Nerve Block after Lidocaine Spinal Anesthesia. Anesthesiology, Volume 82(1):60-63, 1995.

2. Wallace, M.S., Dyck, J.B., Rossi, S.S., Yaksh, T.L. Computer Controlled Lidocaine Infusion for the Evaluation of Neuropathic Pain after Peripheral Nerve Injury. Pain, Volume 66:69-77, 1996.
3. Liu, S.S., Gerancher, J.C., Bainton, B.G., Kopacz, D.J., Carpenter, R.L: Effects of Electrical Stimulation at Different Frequencies on Perception and Pain in Human Volunteers: Epidural Versus Intravenous Administration of Fentanyl. Anesthesia & Analgesia, Volume 82:98-102, 1996.
4. Tay, B., Wallace, M.S., Irving, G. Quantitative Assessment of Differential Sensory Blockade after Lumbar Epidural Lidocaine. Anesthesia and Analgesia, Volume 84:1071-1075, 1997.
5. Sakura S, Sumi M, Yamada Y, Saito, Y., Kosaka, Y. Quantitative and Selective Assessment of Sensory Block During Lumbar Epidural Anaesthesia with 1% or 2% lidocaine. British Journal of Anaesthesia, Volume 81:718-22, 1998.
6. Sakura, S., Sumi, M., Kushizaki, H., Saito, Y., Kosaka, Y. Concentration of Lidocaine Affects Intensity of Sensory Block During Lumbar Epidural Anesthesia. Anesthesia and Analgesia, Volume 88(1):123-7, 1998.
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8. Raj, P.P., et al. Painless Electrodiagnostic Current Perception Threshold and Pain Tolerance Threshold Values in CRPS Subjects and Healthy Controls: A Multi-Center Study. Pain Practice, Volume 1(1);53-60, 2001.
9. Kudoh, A., Matsuki, A. Current perception thresholds of epileptic patients treated with valproate. Seizure, Volume 9; Part 7:498-501, 2000.
10. Finkel, J.C., Yang, C.I. Yarvitz, J.L. Patel, K.M. Neuroselective sensory electrodiagnostic evaluation of 4% liposomal lidocaine. Anesthesia & Analgesia, Volume 94:1259-62, 2002.