

Fundamentals of Electrodiagnostic Procedures: Physiological Basis and Clinical Applications

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Abstract:

Nerve Conduction Studies (NCS) play a vital role in diagnosing various neuromuscular disorders. The success of these studies hinges on careful planning, which should be guided by a thorough patient history and clinical examination. This process ensures that the appropriate nerves are tested and relevant findings are accurately interpreted.

A detailed patient history is the first crucial step in planning NCS. The history should focus on several key areas. Firstly, the nature, duration, and progression of symptoms such as numbness, tingling, weakness, pain, or muscle atrophy should be identified. For instance, symptoms localized to the hand with worsening at night might suggest Carpal Tunnel Syndrome. The onset and course of symptoms, whether acute, subacute, or chronic, can point to different conditions. Sudden onset may indicate trauma or acute nerve compression, while a gradual onset may suggest a chronic condition like diabetic neuropathy. Previous medical conditions, such as diabetes, thyroid disorders, or autoimmune diseases, can predispose to neuropathies and guide the clinician on which nerves to study. Occupational and lifestyle factors are also important, as activities involving repetitive motions or prolonged pressure on certain body parts can suggest specific entrapment neuropathies, such as Ulnar Neuropathy from prolonged elbow flexion.

The clinical examination is equally crucial for localizing the lesion and planning the NCS. It includes a comprehensive motor examination to assess muscle strength, atrophy, and fasciculations. Weakness in specific muscle groups can help localize the nerve involved. For example, weakness in the abductor pollicis brevis points to Median Nerve involvement. The sensory examination tests light touch, pain, temperature, and vibration sense. Sensory loss in a specific dermatomal pattern can indicate which nerves or nerve roots are affected. Reflex testing is also important, as hyperreflexia or hyporeflexia can provide clues about upper versus lower motor neuron lesions, respectively. Absent reflexes in certain areas may help localize nerve damage. Special tests such as Tinel's sign and Phalen's test can support clinical suspicion of nerve entrapment and guide the selection of nerves for NCS.

Based on the history and examination, the planning of Nerve Conduction Studies can proceed. This involves selecting the nerves to be studied based on the suspected diagnosis. For instance, in suspected Carpal Tunnel Syndrome, the focus would be on the Median Nerve, including both sensory and motor studies. The study design should decide whether to perform motor NCS, sensory NCS, or both, depending on the presenting symptoms. Motor NCS is indicated when motor weakness is present, while sensory NCS is useful for sensory loss. It's often helpful to study both the affected and unaffected sides to compare results, especially in unilateral symptoms. Additional tests such as F-Waves or H-Reflexes may be considered for proximal nerve segments or root-level lesions, and repetitive nerve stimulation for suspected neuromuscular junction disorders.

The interpretation of NCS findings aids in differentiating between neuropathies, myopathies, and neuromuscular junction disorders, localizing lesions within the peripheral nervous system, and assessing the severity and chronicity of conditions. Specific patterns associated with various

disorders can be identified, including axonal versus demyelinating neuropathies, radiculopathies and plexopathies, myopathic versus neurogenic changes, and neuromuscular junction transmission defects.

NCS have wide clinical applications in the diagnosis and management of various neurological conditions. These include Carpal Tunnel Syndrome and other entrapment neuropathies, Guillain-Barré Syndrome, Chronic Inflammatory Demyelinating Polyneuropathy (CIDP), diabetic neuropathy, Amyotrophic Lateral Sclerosis (ALS), Charcot-Marie-Tooth disease, and peripheral nerve injuries. After conducting NCS, it's important to compare the findings with the clinical history and examination. Consistent results across history, examination, and NCS support the diagnosis, while discrepancies may suggest the need for further testing or re-evaluation of the clinical picture.

In conclusion, the planning of Nerve Conduction Studies should be a structured process, rooted in a detailed patient history and thorough clinical examination. This approach ensures that the NCS is tailored to the patient's specific condition, leading to accurate diagnosis and effective management. By following these principles, clinicians can maximize the utility of NCS in diagnosing and treating neuromuscular disorders.