

# **STRATEGIES IN ELECTRODIAGNOSTIC MEDICINE**

EXPECTED FINDINGS, PROCEDURES AND DIFFERENTIAL DIAGNOSIS

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Electroneuromyography (ENMG) is a diagnostic tool used in the diagnosis of neuromuscular disorders. Today other tests like sensory thresholds, somatosensory evoked potentials (SEPs) and tests of the autonomic nervous system are also used. Although ENMG is the backbone of the examination the importance of the other tests is increasing. Therefore, we prefer to call this a neurophysiologic evaluation. The examination is not just a number of laboratory tests, like blood samples, that are prescribed by the referring doctor. The examination is a series of logical steps that are tailored to the problem at hand. The American Association of Electrodiagnostic Medicine uses the term *electrodiagnostic consultation*, which we find appropriate. Usually, the patient is referred to a specialist for a neurophysiological investigation. In the Scandinavian countries and some other European countries the examination is performed by a specialist in clinical neurophysiology. In other countries the ENMG examination is done by neurologists or specialists in rehabilitation medicine.

The starting point of the examination is based on the background information by the referring doctor, the information provided by the patient and clinical findings. The electromyographer forms a list of possible disorders that could underlie the patients problems. Based on this list he plans the details of the examination; which muscles and nerves will be studied and what tests should be performed. The plan may be modified according to findings obtained during the examination.

There are numerous ways to arrive at the correct diagnosis, some of which may be simple, while others may be complex. However, it is not feasible to study all nerves and muscles (neuromuscular mapping), this would be too time consuming and uncomfortable for the patient. The findings during the examination often modify the differential diagnostic alternatives. Some findings may rule out one diagnostic alternative, while other unexpected findings may add new alternatives to the list of possible diagnoses.

The **strategy** is the plan for the investigation which aims at a correct diagnosis with the available methods and skills. With an optimal strategy the goal is reached with a minimum number of muscles and nerves tested. This is to save the patient from unnecessary discomfort and to reduce the time the doctor and technician need for the investigation.

The strategy of an EMG examination depends on several factors and no single approach applicable to all situations can be established. The contents of this document have emerged from the clinical practice in our laboratory. This document is meant to be used in the educational dialogue. We hope it will stimulate thinking about electrodiagnostic procedures and so help rationalize and improve the quality of EMG examinations.

This document consists of three parts. In the first part the *individual diseases* and the expected neurophysiologic findings are described. In the second part we describe the *differential diagnostic alternatives of commonly encountered symptoms*. Here the differential diagnostic alternatives in a patient with drop foot, myotonia or muscle fatigue, are presented. The third part describes the *neuromuscular abnormalities that may be associated with different hereditary, metabolic, infectious, autoimmune or toxic disorders*.

**Part 1 "Individual neuromuscular disorders"**. This section describes the individual disorders. At first the **etiology** of the disorder is given. In hereditary disorders we have attempted to outline the exact genetic features. Secondly, the typical **clinical features** of the disorder are outlined. This includes typical symptoms, age of onset and course of the disease. The main **strategy**, the overall goal of the examination, is described. The essential findings, both **expected abnormal findings** and **expected normal findings** are given. Only neurophysiological findings have been included here. We believe that EMG should provide independent information to the diagnosis and the clinician should clearly see to what extent the conclusions are based on neurophysiological findings. These expected findings are by no means rigid diagnostic criteria, which are very difficult to define. The findings may vary from one patient to another depending on the severity and duration of the disorder. The purpose of this first section is to give guidelines for electrophysiological findings in each disorder. The **procedure** is the recommended tests that should be performed in each disorder. The **procedure** is in most instances a *fixed set of tests* that should be done if that disorder is suspected. We have tried to keep the number of tests as small as possible. In some situations, as for instance in myasthenia gravis, the **procedure** is a *decision tree* (a flow chart) where each step is determined by the result of the previous test. Finally, there are **notes**, special details that are pertinent to a diagnosis.

We have tried to include every possible disorder that could be encountered with a reasonable frequency in an EMG laboratory. Obviously there are a number of rare disorders that could not be included.

**Part 2. "Electrodiagnostic differential diagnosis of common symptoms"**. Most patients are referred an EMG examination because of pain, paresthesia or weakness. For instance paresthesias in digits 4 and 5. This may be due to an ulnar neuropathy at the elbow or wrist and sometimes also a lesion in the plexus brachialis or a C8 radiculopathy. Part 2 gives the differential diagnostic alternatives that should be considered in a given situation. Of course relevant background information must be taken into consideration, the age of the patient may exclude some of the diagnostic alternatives given. For instance, one does not suspect Duchenne muscular dystrophy in a 80 year old lady with proximal muscle weakness. Referral pattern and prevalence of disorders are also often included in the process of ranking possible diagnoses.

**Part 3. Neuromuscular abnormalities associated with systemic disorders, treatment and toxic substances.** Many systemic diseases are associated with various neuromuscular abnormalities that are quite typical of that disease. Patients with rheumatoid arthritis have carpal tunnel syndrome, axonal polyneuropathy and myasthenia gravis more often than others. Part 3 lists the disorders that may be encountered in various endocrine disorders, collagen vascular disorders, injuries etc.

This document has been under development for two years, there are still many parts that are not finished yet. Some things we have worked with in great detail. There are certainly points that you will not agree with. We would be very happy to hear from you about your comments.

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**Abbreviations**

ACh	acetylcholine
AChR	acetylcholine receptor
AIDP	acute inflammatory demyelinating polyneuropathy
ALS	amyotrophic lateral sclerosis
AMPL	amplitude of motor and sensory responses
BMD	Becker muscular dystrophy
CIDP	chronic inflammatory demyelinating polyneuropathy
CMAP	compound motor action potential (M wave)
CTS	carpal tunnel syndrome
CV	conduction velocity
DISP	dispersion of conduction velocities in motor nerves
DLAT	distal motor latency
DM	dermatomyositis
DMD	Duchenne muscular dystrophy
EMG	electromyography
EPP	end-plate potential
FSHD	facio-scapulo-humeral muscular dystrophy
GBS	Guillan-Barré syndrome
HMSN	hereditary motor and sensory polyneuropathy
HNNP	hereditary liability to pressure neuropathies
IBM	inclusion body myositis
LEMS	Lambert-Eaton myasthenic syndrome
MCS	motor nerve conduction study
MCV	motor conduction velocity
MEPP	miniature endplate potential
MG	myasthenia gravis
MMN	motor neuropathy with multifocal conduction block
NMJ	neuromuscular junction
PM	polymyositis
SCS	sensory nerve conduction study
SFEMG	single fiber EMG
SLE	systemic lupus erythematosus
SMA	spinal muscular atrophy