3rd Congress of the European Academy of Neurology
Amsterdam, The Netherlands, June 24 - 27, 2017

Hands-on Course 2

Assessment of peripheral nerves function and structure in suspected peripheral neuropathies - Level 1

Motor and sensory nerve conduction studies

Simon Podnar
Ljubljana, Slovenia

Email: simon.podnar@kclj.si
Conflict of interest:
The author has no conflict of interest in relation to this manuscript

The key learning objectives:
To see a demonstration of motor and sensory nerve conduction studies
Try nerve conduction studies individually
To interpret basic patterns obtained by nerve conduction studies

Essential knowledge:
Motor and sensory nerve conduction studies (NCSs) are usually the first step in electrodiagnostic evaluation of a patient with suspected peripheral neuropathy. Together with needle EMG, they are regarded as a continuation of clinical neurologic examination.
The basic idea of NCSs is electrical excitation of all thick fibres in the peripheral nerve, and recording response at some distance either from the nerve itself (mixed nerve or sensory nerve action potential - SNAP) or from the innervating muscle (compound muscle action potential - CMAP). Responses are then quantitatively described using NCS parameters:

- **Latency (ms)** measures time delay between the electrical stimulus and beginning of the response.
- **Amplitude (mV or µV)** measures voltage difference between the baseline and the peak of response.
- **Area (msmV or msµV)** surface between the baseline and the response curve, and provides similar information as amplitude.
- **Conduction velocity (m/s)** can be calculated by dividing distance by latency (difference).

On comparison to reference values these parameters provide often relevant information on the studied nerve and sometimes also muscle. Increased latency and reduced conduction velocity usually indicate myelin disorder. Diminished amplitude of the response on proximal stimulation (conduction block) or response dispersion usually point to a non-uniform demyelination typical of acquired demyelinating polyneuropathies and focal neuropathies. By contrast, low amplitude and area on distal stimulation usually mean axonal disorders, although disease of neurons, or muscles is also possibility.

During motor NCSs we fix “active” electrode (E1) on muscle motor point, and “reference” electrode (E2) on a distal bone. Typically 8 cm proximal to the middle of “active” electrode we stimulate the nerve using “supramaximal” nerve stimuli (i.e., stimulus strength evoking maximum
amplitude CMAP increased by 20%). Distance should be always measured along the anatomic course of the studied nerve (e.g., median nerve at the wrist). In order to asses more proximal segments of the nerve and to calculate conduction velocity, additional proximal stimulations are used. During sensory NCSs we typically measure 14 cm distance along the anatomic course of the nerve. We can then stimulate the nerve either proximally and record distally (antidromic study) or stimulate distally and record proximally (orthodromic study).

Following please find few hints for better NCSs:

- All CMAPs should start from the straight baseline;
- Distal motor distance measurement for the median nerve should follow the anatomic course of the motor branch passing through the middle of the palm;
- Minimal changes in “active” electrode position on the thenar may significantly change the response
- Be cautious with median nerve stimulation proximal to the elbow with thenar eminence recording due to danger of the ulnar nerve co-stimulation;
- For precise localization of the ulnar nerve lesion at the elbow 2-cm studies are best used from 4 cm distally to 4 cm proximally to medial epicondyle;
- To reduce artefacts SNAP recording from fingers is best from the distal part of the proximal phalanxes;
- In case of low amplitude response on stimulation of the tibial nerve in the popliteal fossa maximum stimulus strength (including stimulus duration of 0.5 or 1 ms) should be applied somewhat laterally;
Suggested reading: