Guidelines for Repetitive Nerve Stimulation recording (decrement study)

RNS recordings are performed in patients with muscular fatigue symptoms such as Myastenia Gravis (MG) or Myastenic syndromes (MyS eller Lambert Eaton Myastenic Syndrome = LEMS, cong MG syndromes)

A peripheral nerve is electrically stimulated, and the amplitude of the CMAP is recorded at rest and after a short voluntary activation. The stimulation frequency is 3 Hz, the number of stimuli 10. The result is reported as the difference in amplitude of the CMAP between stimulation one and four (in %). The area value changes typically in parallel, but is not reported. If there is a major difference between ampl and area decrement, technical factors should be considered.

Muscles to examine (in decreasing sensitivity for the MG diagnosis) are:
- Deltoid muscle (axillary nerve)
- Trapezius muscle (accessory nerve)
- Anconeus muscle (radial nerve)
- Nasalis muscle (facial nerve)
- ADM muscle (ulnar nerve)

Depending on symptoms other muscles e.g. in lower limbs may be tested.

In LEMS distal muscles can be tested with the same sensitivity as proximal. A typical finding in LEMS is a low initial amplitude (< 2mV), with an increment (a rise in amplitude from 1st to 4th stimulation) of at least 60% immediately after activation.

Recording

Preparations:
The patients should be off anticholinesterase treatment for at least 12 hours if the condition allows.
Let the patient rest for 10 minutes before the recording (important for follow up studies). In LEMS 15 minutes rest is required.
The patient's hands and arms must be warm, if not - warm them up! Less decrement in low temp.
Surface electrodes for recording and stimulation. Same position as used for NCS.

Recording protocol:
1. Recording at rest
2. Immediately after activation (20 s activation default, 10 s in severe cases)
3. 1 minute after activation
4. 3 minutes after activation
5. 5 minutes after activation (may not be necessary, particularly if SFEMG will be performed)

**Practical comments to the protocol:**

*Fixation:* in principle the muscle shall be immobilized. See individual muscles

*Recording at rest:*
A pathological decrement has a typical appearance; a successive decrease in CMAP amplitude from 1st to 4th stimulation, then a slight recovery (facilitation) towards the 10th stimuli (“saddle shaped” response).
If the amplitude varies up and down during the recording, a technical problem can be the explanation (e.g. movements, electrode artefacts).

*Activation:*
Loudspeakers ON to give the patient and the operator sound feedback when activating maximally for 20 s (10 s if the patient is weak!).
Put the limb down in rest and prepare for an immediate new recording (within a few seconds).

*After activation:*
A pathological decrement (> -5%) will get back close to normal when recording immediately after activation (facilitation). At the recording 1 minute after activation the pathology will return and even increase (exhaustion). At 3 minutes the exhaustion can be more pronounced and at 5 minutes, the decrement is back to the resting value.

In LEMS there is a very low amplitude in rest that facilitates more than 60% immediately after a short exercise. This is called increment.
In these patients a high frequency stimulation (20 Hz in 3 sec) can be performed to demonstrate this, but strong voluntary activation is equally effective, and not painful.
**Note!** If a recording for some reason fails immediately after activation, the patient must rest at least 3 minutes before a new activation test can be done.

Example of a recording in a patient with MG.
Muscles to examine

The Deltoid muscle
Type of recording electrode: surface plate electrodes.
Position of recording electrode: at the Deltoid muscle
Position of reference electrode: at the shoulder bone.
Type of stimulating electrode: surface electrodes on a fixed bar.
Stimulation site: over the plexus, proximal to the clavicular bone. Look for the best stimulation site.
Fixation: manual at elbow
Recording procedure: Rest: Increase the stimulation intensity in a low frequency until a maximal CMAP amplitude is recorded. Add another 25% in stimulation intensity. When a technically good recording quality is obtained, wait for 30 s before the recording is performed. Record 2 RNS studies to confirm the result at rest.
Activation: ask the patient to press his elbow in a lateral direction. The examiner must work against this movement, but not too much – or fixate the lower arm. Listen to the sound from the loudspeakers – both patient and examiner.

The Trapezius muscle
Type of recording electrode: surface plate electrodes.
Position of recording electrode: over the proximal part of the Trapezius muscle.
Position of reference electrode: at the shoulder bone
Type of stimulating electrode: surface electrodes on a fixed bar.
Stimulation site: over the accessory nerve, just behind the sternocleido mastoid muscle.
Fixation: Press the shoulders downwards
Recording procedure: Rest: see the Deltoid muscle
Activation: ask the patient to pull his shoulder upwards.
Listen to the sound from the loudspeakers – both patient and examiner.

The Anconeus muscle
Type of recording electrode: Surface plate electrodes.
Position of recording electrode: At the Anconeus muscle (distal head of the Triceps muscle).
Complete a triangle between olecranon, lateral epicondyle and the muscle.
Position of reference electrode: at the ulnar styloid at the wrist.
Type of stimulating electrode: surface electrodes on a fixed bar.
Stimulation site: at the upper arm, over the radial groove.
Fixation: Manual fixation of lower arm

**Recording procedure:**

- **Rest:** see the Deltoid muscle.
- **Activation:** ask the patient to make and attempt to stretch his elbow strongly but fixate the forearm to avoid large movements. Listen to the sound from the loudspeakers – both patient and examiner.

### The Nasalis muscle

**Type of recording electrode:** Surface plate electrodes.

**Position of recording electrode:** At the Nasalis muscle

**Position of reference electrode:** at the tip of the nose.

**Type of stimulating electrode:** surface electrodes on a fixed bar.

**Stimulation site:** over the facial nerve

**Fixation:** No

**Recording procedure:**

- **Rest:** see the Deltoid muscle.
- **Activation:** ask the patient to wrinkle the nose maximally. Listen to the sound from the loudspeakers – both patient and examiner.

### The ADM muscle

**Type of recording electrode:** Surface plate electrodes.

**Position of recording electrode:** At the ADM muscle.

**Position of reference electrode:** at the distal phalanx of digit V.

**Type of stimulating electrode:** surface electrodes on a fixed bar.

**Stimulation site:** at the wrist, the hand resting with the dorsal side facing upwards.

**Fixation:** Wrap a tape around all digits.

**Recording procedure:**

- **Rest:** see the Deltoid muscle.
- **Activation:** ask the patient to spread his fingers maximally. Listen to the sound from the loudspeakers – both patient and examiner.