Unit VII – Problem 4 – Physiology: Electromyography (EMG)

- **Use**: to detect muscle activity in patients with neuropathy.
- **Patient presented to your clinic with muscle weakness (what is the cause?)**
  - **Motor**: cortex defect (e.g. the problem is in the brain) or pathway defect.
  - **Spinal cord injury/defect.**
  - **Peripheral nerve disease**, which can be:
    - ✓ Demyelination (occurring in multiple sclerosis): resulting in conduction block (no action potentials will be transmitted through the nerve fiber!).
    - ✓ Axonal degeneration.
  - **Neuromuscular junction defect, which can be:**
    - ✓ Lambert-Eaton Myesthenic Syndrome: production of autoantibodies against calcium-channels in terminal ends of nerve fibers → there will be no influx of calcium and no release of neurotransmitters which are stored in the vesicles of nerve endings/terminals.
    - ✓ Myashtenia Gravis: production of autoantibodies against acetylcholine-receptors which are present on the muscle membrane.
  - **Muscle defects (myopathies)**: examples include the following:
    - ✓ Myositis (inflammation of muscle fibers).
    - ✓ Duchenne/ Becker muscular dystrophy.
    - ✓ Amyloid myopathy.
- **Motor unit:**
  - **Definition**: one neuron and the muscle fibers innervated by this neuron.
  - **One neuron can innervate:**
    - ✓ One muscle fiber: aiming for fine movements (e.g. ocular muscles).
    - ✓ 300 muscle fibers: aiming for strength (e.g. hamstrings).
      Therefore, innervations of a muscle depends on how precise is the muscle fiber.
  - **The same muscle might have many motor units (why?)** → because if there is only one motor command to the muscle, it will have the same tone and this will not change depending on the function (e.g. when more tone is needed, it will not change!).
- **Peripheral nerve injuries:**
  - **Any disease with muscle weakness (e.g. atrophy of the muscle) indicates → lower motor neuron disease:**
    - ✓ Normally, motor neurons secrete trophic factors to the muscle (in addition to neurotransmitters), so when these neurons are defected, trophic factors will not be secreted and the muscle will atrophy.
- **Myesthenia Gravis:**
  - **An autoimmune disease**: auto-antibodies against Ach-receptors present on the muscle membrane.
  - Usually associated with thymus tumor or hyperplasia.
  - **There is gradual development of weakness** → from proximal to distal portions of the body.
  - **Myeshtenia crisis**: respiration is compromised.
- **Skeletal muscle problems:**
  - **Normally, there are skeletal proteins keeping actin and myosin filaments in their normal positions against each other:**
    - ✓ If they are not present (such as dystrophin) → actin and myosin are pulled away and they cannot slide against each other to cause contraction.

- **Introducing the needle of EMG:**
  - The needle will produce high action potentials due to hyperexcitability of the muscle fiber (especially after the nerve injury has occurred)
- **When there is neuropathy, the following can be detected:**
  - **Fibrillations:**
    - ✓ Not visible.
    - ✓ Causing no movement.
    - ✓ Spontaneous.
    - ✓ Only detected by EMG.
  - **Fasciculations**: they occur due to:
    - ✓ Lower motor neuron disease.
    - ✓ Fatigue (benign condition).

	Lesion / EMG Steps	Normal	Neurogenic Lesion		Myogenic Lesion	
			Lower Motor	Upper Motor	Myopathy	Polymyositis
1	Insertional Activity	Normal	Increased	Normal	Normal	Increased
2	Spontaneous Activity		Fibrillation, Positive Wave			Fibrillation, Positive Wave
3	Motor Unit Potential	0.5-1.0 mv, 5-10 msec.	Large Unit, Limited Recruitment	Normal	Small Unit, Early Recruitment	Small Unit, Early Recruitment
4	Interference Pattern	Full	Reduced, Fast Firing Rate	Reduced, Slow Firing Rate	Full, Low Amplitude	Full, Low Amplitude

- **Myesthenia Gravis:**
  - Normally, patients with this disease have no signs or symptoms in the morning. These will develop gradually throughout the day (progressive weakness of muscles).
  - When EMG is performed, repetitive stimulation will be sent to the muscles of these patients. The amplitude will be higher at the beginning but then it will start to decrease progressively.

- **Lambert-Eaton Myesthenic Syndrome:**
  - It is associated with para-neoplastic syndrome especially in small-cell carcinoma of the lung.
  - When EMG is performed, repetitive stimulation will be sent to the muscles of these patients. The amplitude will progressively become higher as there will be a build-up of Ach in the neuromuscular junction.