EMG

INTRODUCTION

- Electromyography is the study of electrical activity of muscle at rest and during muscle contraction. It involve detection and recording of electrical potential from the skeletal muscle fibers. It is used to diagnose the neuromuscular diseases or trauma.
- Motor units are composed of an anterior horn cell, one axon, its neuromuscular junction & all the muscle fibers innervated by that axon.

- A single axon conducts an impulse to all its muscle fibers causing them to depolarize at relatively the same time . This depolarization produces electrical activity that is motor unit action potentials (MUAP) and recorded graphically as the EMG.

Components of EMG

- The EMG instruments needs electrodes, amplifier and a display system. Recording of the EMG require three phases system:
- 1. An input phase that include electrode to pickup the electrical potentials from contracting muscles.
- 2. A processor phase during which small electrical signal is amplified and
- 3. An output phase in which electrical signals are converted into visible and audible signals, so that the data can be displayed and analyzed.

- When a normal muscle contract all the individual muscle fiber of motor unit depolarize at the same time causing a local electrical disturbances in the muscle.

- This electrical disturbances can be recorded either by a surface electrode or by a coaxial needle electrode inserted into the selected muscle.

- Electrical disturbances recorded is sum of the potential due to all the muscle fibers activated.

Clinical EMG examination

- An EMG examination assess the integrity of the neuromuscular system including upper and lower motor neuron, the neuromuscular junction and muscle fibers, This usually involves observation of muscle action potential from several muscles in different stages contraction. EMG examination of skeletal muscle performed in four stages:

1. Insertional activity:

- Initially the patient is asked to relax the muscle to be examined during insertion of the needle electrode. At this time you will observe a spontaneous bursts of potentials which is possibly caused by the needle breaking through the muscle fibers membranes. This is called insertional activity & usually last for less than 300ms. It usually stops when the needle stops moving.

- The insertional activity can be described as normal, decreased or increased, depending on the magnitude and speed of movement of needle in the muscle. It may be markedly reduced in fibrotic muscle or exaggerated when denervation or inflammation is present.

2. The muscle at rest:

- If the needle is stationary and muscle at rest no electrical activity is detected in normal subjects except when the needle is in the end plate region irritating the small intramuscular nerve terminals. Electrical potential arising during this rest period are significant abnormal findings.

3. Normal motor unit action potential (MUAP):

- After observing the muscles at rest the patient is asked to contract the muscle minimally. This weak voluntary effort should cause individual motor unit to fire. These motor unit potentials are assessed with respect to amplitude, duration, shape, sound and frequency. These five parameters are the essential characteristics that will distinguish normal and abnormal potential.

4. Recruitment pattern or interference pattern:

- Finally the patient is asked to increase the level of contraction progressively to a strong effort allowing assessment of recruitment pattern.

Abnormal potential

Spontaneous activity:

- A normal muscle at rest exhibits electrical silence any activity seen during the relaxed state can be considered abnormal. Such activity is termed spontaneous activity.
- Four types of spontaneous activity have been identified::

1. Fibrillation potentials:

- These are bi or tri-phasic of 1-2 ms 50-300 micro volt amplitude. They are due to spontaneous excitation of individual muscle fiber and appear 10-20 days after nerve degeneration.

2. Positive sharp wave:

- It gives a sharp initial +ve deflection followed by a prolonged –ve phase. The amplitude varies between 50-2000 micro volt. These indicates denervation of the muscle.

3. Fasciculation potential:

- These are spontaneous discharges from motor unit not under voluntary control.
- They consist of potential repeating at a lower rate than fibrillation.
- They are usually from 0.5-3 micro volt in amplitude and 7-20 ms in duration.
- Fasciculation occur in benign myokymia particularly in the extensors muscles of the forearm but is usually an indication of pathology at spinal cord or root level.

- **4. High frequency discharges or repetitive discharges:**

- They occur in myotonia especially and occasionally in polymyositis. They give a characteristic dive bomber sound the loudspeaker.

INDICATIONS

- Disorders of peripheral nerves.
- Polyneuropathies .
- Motor neuron diseases.
- Myopathies.
- Myotonia.
- Myasthenia gravis.
- Radiculopathy.
- Facial nerve palsy.
- Spinal cord compression.

References:

- Forster & Palastanga, (2004), Clayton's Electrotherapy; Theory & Practice, Bailliere Tindall, U.K.

- John Low and Ann Reed, (2008), Electrotherapy Explained, Principles and Practice, Elsvier, India.