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CH.9. محاضرة Ch-9

Electricity within the body 1/9

(Introduction)

All function in the body , voluntary and involuntary is involved . so all movement are related to electrical movement. Electricity

There are Two aspect of electricity and magnetism in medicine :

1.electrical &magnetic effects generated inside the body

2. we use electricity &magnetism to measure some of body functions .

The electricity generated inside the body serves for the control and operation of nerves ,muscles, and other organs .

The nervous system plays an important rule in every part of body, the brain receive internal and external signals and usually makes proper response.

Nervous System &the Neuron :-

Nervous system can be divided into two parts.

1.Central nervous system: consist of brain, spinal cord and the peripheral nerves.

Nerve fibers (neuron): that transmit sensory information to brain or spinal cord are **"afferent nerves"** .

Nerves fibers : that transmit information from brain or spinal Cord to the appropriate muscles and glands are **"efferent nerves"** .

2. Autonomic nervous system : controls various internal organs such as heart, intestines and glands **((the control here is essentially involuntary)).**

Neuron :is the basic structure unit of nervous system, which is specialized for reception and transmission of electrical signals.

Contents of neuron (nerve cell)

1.cell body : receives electrical massages from another neurons through contacts called **"synapses"**, which are located on the **"dendrites"**.

Dendrites : Are the part of the neuron specialized for receiving information from other cells, (or stimuli).

2.Axon: (or nerve fibers) this carries the electrical signal to muscles, glands, or other neurons. It's usually covered by myelin sheath, except some parts called **"Nodes of Ranvier"** Fig(9-1)

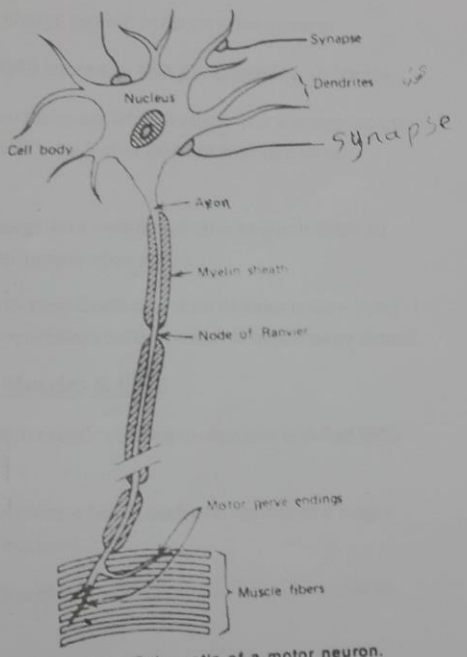


Figure 9.1. Schematic of a motor neuron.

(3 – 9)

When the neuron is simulated ,a momentary charge will happen from positive to negative ,this potential change is called **"Action Potential "** .

Two primary factors affect the velocity of propagation of the action potential:-

1.the Resistance within the core of the membrane.

2.the Capacitance (or the charge stored) across the membrane.

***A decrease in either Will increase the propagation velocity** .

*Internal resistance of axon decrease when its diameter increase so an axon with large diameter will have higher (v) than that of a small diameter.

*the greater the stored charge an a membrane ,the longer it takes to depolarize it .i.e. the slower propagation speed .

*Hence the charge stored in a myelinated section of axon is very small . . e very faster that the unmyelinated section which is high charge stored

Electrical signals from Muscles & EMG

The record of potentials from muscles during movement is called **EMG (electromyogram) .**

*A muscle made up of many motor units, each one consist of a single branching neuron from spinal cord .

* Resting potential across the membrane of muscle fibers is similar to that of a nerve fiber.

Muscle Action: is initiated by an action potential that travels along an axon and is transmitted across the motor and plates into the muscle fiber, causing them contraction.

* single muscle cells are usually not monitored in **EMG** examination because it's difficult to isolated a single fiber. So, there are two methods for obtaining **EMG** :-

1. surface electrode

2. Concentric needle electrode

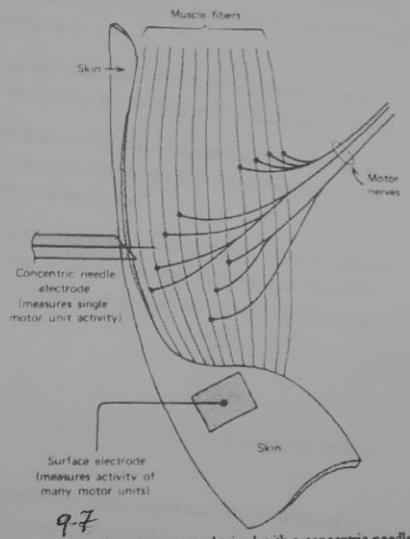
* surface electrode attached to the skin measures the electrical signals from many motor units.

* A concentric needle electrode inserted under the skin measures single motor unit activity.

Action of EMG

1. Action potential appears in **EMG** after a latency period (time between stimulated and the beginning of the response).

2. **EMGs** of symmetrical muscles of the body are compared to each other or to those of normal individuals to determine the action potential and latency periods. As shown in fig.(9-7)



9-7

Fig. Electromyogram obtained with a concentric needle electrode and a surface electrode

(6-9)

3.the conduction velocity of sensory nerves can be measured by simulating of one site and recording at several locations that are known distance from the point of stimulation . many times nerve damage may results in decreased in conduction velocity .

Typical velocities are 40 to 60 % m/sec . velocity blow 10 m/sec Would indicate a problem .

Electrical signal from the heart – ECG

*the action of the heart is controlled by an electrical signal initiated by "sinoatrial (SA) nod " which is spontaneous stimulation of special muscle cells located in the right atrium .

*SA node controls the pulse rate (72pulse per min) , it decreases or increase the pulse rate according to the demands of body to the blood .

*the electrical signal from Sa node intiate depolarization of nerves and muscle of both atria causing the atria to control and pump blood into ventricles . repolarization of atria follow :

*electrical signal passes into arterio ventrical (AV)node , Which initiates de- polarization of right and left ventricle , causing then contract and force blood into the two system (pulmonary and general circulation).

Measuring ECG :-

1.The potentials measured on the surface of the body **depends on the location of the electrodes.**

2.surface electrodes for obtaining ECG are most commonly **located in left arm (LA) , right arm (RA) and left leg (LL).**

3.ECG graphing contains **12** section :-

(6) of them are in the frontal plane , other **(6)** are in the transverse plane in each section an electrode is location .

Electrical signals from the Brain –EEG-

The recording of the signals from the brain is called electroencephalogram or (**EEG**),Which are due to primarily to the electrical activity of the neurons in the cortex of the brain.

* Electrode are small discs made of **AgCl** ,these are attached to the head at location that depend upon the part of brain to be studied.
* these electrodes out on the head at some areas, we record only the potential difference response to that area.

*The reference electrode is attached to the ear (**A**1 and **A**2) . As shown in fig(9.25)exams **8** to **16** channels are recorded.

*Asymmetrical activity is often an indication of brain disease the right signals compared to the left one.

* the amplitude of **EEG** signals is low (**50 μ V**).

* the external noise is controlled ,the potentials of muscle activity ,such as eye movement, can cause artifacts in the record.

* the frequencies of **EEG** signals are depend on the metal activity of the subject .e.g. relaxed person frequency is from **8** to **13 Hz (α wave)**,while frequency of person in action is **>13 Hz (β wave)**.

Various frequency Bands :

Delta **δ** or slow wave	0.5 to 3.5 Hz	deep sleep
Theta **θ** or intermediate	4 to 7 Hz	light sleep
Alpha **α** relaxed	8 to 13 Hz	wake (relax)
Beta **β** fast	>13	in action

EEG

EEG advantages

electrocardiogram

1.it's most useful in diagnosis of epilepsy and its classification.
2.it aids in confirming brain tumors since electrical activity recorded in the region of a tumor
3.it's used to monitor surgery when **ECG** cannot be used.
4.also in surgery for indicating the anesthesia level of the patient during surgery ,single channel is monitored.
5. To study the stage of sleep.

Magnetic Signals from Heart and Brain

1.Magneto cardiogram MCG:- → Magnetocardiography

Magnetic field produced by the current in the during depolarization repolarization .

***MCG** measures the very weak magnetic fields around heart .

* The recording of the heart's magnetic field is **MCG**.

*Magnetic field around heart is**~5*10^{-11}** tesla or **~ 1/10^{6}** of earth' magnetic field . **(tesla=10^{4} gauss)**.

*To measure such small field it's necessary to use : magnetically shi rooms , and very sensitive magnetic detectors.

Total time involved for each **MCG** is usually than 1 min.

MCG advantages:-

1.MCG provides information about heart without the use of electrodes touching the body .

2.It provides information not available in **ECG** , because it magnetic field due to direct current .

2.Magneto encephalogram MEG:-

The recording of magnetic field surrounding brain during α wave magnetic field from brain is **~10^{-3}** tesla.

MEG : can measure fields resulting from direct current , it's impossible to obtain this information from **EEG.**

*Not all measure fields produced within the body are duction current the body can be easily contaminated with magnefterialsl .e.g asbesorwoekts mlale workers asbestos fibers which contain iron oxide particles.

ECG	MCG

(9 ~ 9)