GROUP NO: 2
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Simulated Exercise Joshua Nico Dilig

INTRODUCTION

Nervous influx is the manifestation of the action potential in neurons. The nervous influx is the result of the excitability and the conduction ability of the neuron. Excitability is the ability of the neuron o respond to the action of certain stimuli (electrical, mechanical or chemical, etc.) by generating an action potential. Conduction is the ability of the neuron to propagate the action potential on the full length of its axon.

During the resting periods, the neuronal membrane is polarized having the so called resting membrane potential (RMP). The RMP represents the distribution of the positive charges outside the neuron and the negative charges inside. The process of polarization of the neuronal membrane is active and is maintained by ion pumps of Na^+ and K^+. These are responsible for the simultaneous active transport of 3 Na^+ ions from the interior of the cell into the intercellular space inside the neuron. The result of this process is the prevalent accumulation of positive charges outside the neuron and of negative charges inside the neuron (polarization). Measurement of the RMP can be made by means of a voltmeter whose electrodes are placed in the following way: one outside the neuronal membrane and the other one side of the neuron. The difference of potential recorded by the device will be of -70 mV an average (-40 mV to -90 mV).

If the neuron receives a stimulus of a certain intensity which is higher than the threshold, the RMP is replaced by an action potential (AP). This way, the neuronal membrane becomes hyper-permeable to Na^+ ions and the action of Na^+ and K^+ pumps are useless. A high number of Na^+ ions enter the neuron and suddenly, the distribution of electrical charges along the membrane is reversed. During the process, as the membrane potential approaches 0, Na^+ channels close (entry stops) and K^+ channels open (exit starts). This stops the depolarization of the membrane (at about +30- +35 mV) and initiates repolarization. Repolarization is intense and it determines a membrane potential of -75 mV (hyperpolarization). This makes K^+ channels close and the normal level of membrane polarization is reached.

During the massive influx of Na^+ the neuron is refractory to further stimulation no matte how strong the stimuli is. This period is called the absolute refractory period. During the process of repolarization, there comes a point wherein a strong stimulus can elicit a response (ie. An AP). This period is called the relative refractory period.

The AP which appears in a certain area of the neuron moves toward the extremities of the neuron, obeying the all-or-none principle: it either propagates throughout the full length of the neuron or it does not.

OBJECTIVE

To measure the conduction velocity of the following types of nerves:
a. unmyelinated nerve
b. thin myelinated nerve
c. thick myelinated nerve

PRINCIPLE

Electrical stimuli are applied on different types of nerves and conduction velocity is measured by using two electrodes placed at a known distance from each other. Knowing the distance and measuring the time we can determine the conduction velocity.

The experimental device is made up of:

1. Stimulator: the electrical stimulation machine, which includes:
    - An adjustment device for stimuli intensity
    - An on/off button
    - A device that measures time
2. Signal amplifier
3. A support to fix nerve

TECHNIQUE

1. Turn the stimulator and the amplifier on by pressing the "Network" buttons. It will turn green after you do this.
2. Choose the type of nerve fiber by clicking on the corresponding arrows.
3. Apply an electrical stimulus on the nerve by pressing the "stimulus" button. Increase the stimulus intensity and repeatedly stimulate the nerve until an AP is observed.
4. Measure the time it takes for the AP to reach a specified distance by adjusting the vertical line in the oscillogram screen up to the point where the horizontal line starts to rise. This is done by clicking on the "right arrow' button of the time indicator.
5. Calculate the for the conduction velocity by pressing the 'calculate' button.
6. Press the 'free plate' button to remove the nerve and then press the 'clear screen' button to clear AP recording. Adjust the stimulus intensity back to zero (0 mV).
7. Repeat steps 2 to 6 and record your obse4rvations on the table in the succeeding section of this exercise.

OBSERVATIONS AND DISCUSSION

Table 5.1 Conduction velocity of various types of nerves

	Stimulus Intensity Eliciting AP (mV)	**Time** (sec)	**Conduction Velocity** (m/sec)
Unmyelinated nerve	3	0.13	300
Thin myelnated nerve	3	01	400
Thick myelinated nerve	3	0.06	600

Discussion Questions:

1. How does the presence or absence of myelin, influence the conduction velocity?

Due to the presence of myelin sheath, the conduction velocity of the impulse increases. Myelination is a process in which oligodendrocytes in the CNS wrap the axon in myelin, it is consist of multiple layers of closely opposed glial cells. The time consuming process of action potential occurs only on specific points along the axons, the nodes of Ranvier, where there is a gap in the myelin wrapping. An action potential generated at one node of Ranvier flows passively within the myelinated segment until the next node is reached.

2. Does the thickness of the myelin sheath also influence the conduction velocity? If yes, how?

Yes, the thickness of myelin sheath and the conduction velocity has a direct proportion relationship. The thicker the myelin sheath the greater the velocity of the impulse.

3. Does myelination also influence the excitability of the neuron? If yes, how?

Yes, the conduction speed of is faster in myelinated neuron because of the regeneration of action potential. which is the major time consuming. Due to the myelination, the excitability of the neuron changes.

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Simulated Exercise

INTRODUCTION

Activity of neurons is manifested in two ways: *excitation* - an action that determines the propagation of a nervous influx and a response on the effector organ; and *inhibition* – an action that stops the propagation of a nervous influx and the response on the effector organ.

The breaking of the effector organ's response is made possible by an inhibitory neuron that synapses with the motor neuron of the reflex arch in which the effector organ is included. These synapses are inhibitory, because the hyperpolarization of the membrane of the motor neuron (post-synaptic membrane) stopping the propagation of the excitatatory post-synaptic potential (EPSP).

The inhibitory action manifests in two ways: *peripheral inhibition* and *central inhibition* which is possible through an inhibitory nervous center (generally, a nervous structure that is superior to the inhibited nervous center) which has its axon that synapses with another nervous center which, in turn, it inhibits.

Peripheral inhibition is accomplished by an inhibitory neuron located in the nervous center of an inhibitory reflex arc. This type of inhibition is specific to the vegetative nervous state.

OBJECTIVES

1. Demonstrate the central inhibition.
2. Demonstrate the peripheral inhibition

Principle

Central Inhibition: Apply an electrical stimuli on the leg of an decerebrated frog, before and after apply salt crystals on the optical lobes.

Peripheral Inhibition: Apply an electrical stimuli on an intestinal segment of a decerebrated frog, while following the cardiac activity

TECHNIQUE

Central Inhibition

1. Apply an electrical stimulus on the leg of the decerebrated frog by pressing the stimulus button.
2. Observe the reflex response
3. Apply the salt crystals (which serves as an excitatory factor) on the optical lobes by pressing the arrow below it. Apply another new electrical stimulus.
4. Observe the response
5. Clean the optical lobes with a few drops of Ringer solution.
6. Repeat steps 1 and 2.

Peripheral Inhibition

1. Observe the heart of the decerebrated frog for a few seconds.
2. Apply an electrical stimuli on the exposed intestinal segment. Observe what happens immediately and after a few seconds.
3. Take note of the length of time when changes are observed.

OBSERVATIONS AND DISCUSSIONS

Table 6.1 Effect of central inhibition through ice crystals on a decerebrated frog

Condition	Response
Normal	The legs of the frog moves as an electrical stimulus was applied
With Ice Crystals	No response
Ringer Solution	Same as the reaction in normal state

Table 6.2 Effect of peripheral inhibition through electrical stimulation of an intestine of a decerebrated frog and its effect on the heart

Condition	Response
Normal	Normal speed of heart beat
Initial Stimulation	The heart stops beating for few seconds
Continuous Stimulation	Heart starts to beat slowly, slower than the normal condition
Cessation of stimulation	Heart goes back to its normal condition

Discussion Questions

1. What are the types of inhibition? Briefly discuss each.

Central inhibition-
an active nervous process arising in the central nervous system and leading to the suppression or prevention of excitation. A distinction is made between postsynaptic inhibition, which involves the action of a specific mediator on the postsynaptic membrane of a neuron, and presynaptic inhibition, which is based on the depolarization of a presynaptic nerve ending at the point of contact with another axonal nerve ending.
peripheral inhibition-
which takes place in the synapses and directly affects the muscular and glandular elements.

2. Give at two examples of inhibitory neurotransmitters and briefly discuss the mechanism of action of each.

   Excitatory neurotransmitters are not necessarily exciting, they are what stimulate the brain. Those that calm the brain and help create balance are called inhibitory. Inhibitory neurotransmitters balance mood and are easily depleted when the excitatory neurotransmitters are overactive.

3. What are Renshaw cells? What type of inhibition does it exhibit?

   Renshaw cells are inhibitory interneurons found in the gray matter of the spinal cord, and are associated in two ways with an alpha motor neuron. They receive an excitatory collateral from the alpha neuron's axon as they emerge from the motor root, and are thus "kept informed" of how vigorously that neuron is firing. They send an inhibitory axon to synapse with the cell body of the initial alpha neuron and/or an alpha motor neuron of the same motor pool. In this way, Renshaw cell inhibition represents a negative feedback mechanism. A Renshaw cell may be supplied by more than one alpha motor neuron collateral and it may synapse on multiple motor neurons.

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INTRODUCTION

Pfluger demonstrated the correlation between the intensity of a stimulus and the area on which the response is propagated (the number of muscles which will react to the stimulus). Thus, *the higher the intensity of a stimulus applied to a receptor, the higher the number of medullar nervous centers are implied in a response*. This is possible due to the existence of intermediate neurons, which connect different medullar nervous centers and transmit the information from one to another, amplifying the response.

Principle

Apply electrical stimuli of increasing intensity to a decapitated frog and observe the amplitude of the response.

TECHNIQUE

1. Set the stimulus intensity at 1 by clicking on the right arrow.
2. Apply a stimulus every after adjustment until a response is observed in the frog. Note the stimulus intensity.
3. Also, note the corresponding Pfulger's law that will be flashed on the right side of the set-up.

OBSERVATIONS AND DISCUSSION

Table 7.1 Pfulger's law and the corresponding intensity range of stimuli

Pfulger's Law	Statement	Stimulus Intensity Range
Law of Localization	The principle that specific functions have relatively circumscribed locations in some particular part or organ of the body	5-8
Law of Unilaterality	Mild irritation to sensory nerves produces motor activity on a irritated side only.	9-12
Law of Symmetry	Sufficiently intense levels of stimulation, motor reactions can be observed in similar muscles bilaterally.	13-16

Pfulger's Law	Statement	Stimulus Intensity Range
Law of Longitudinal Irradiation	The pain is directed to the motor nerves higher up in the spinal cord.	17-20
Law of Generalization	The medulla oblangata propagates very intense irritation in one part of the body resulting in an overall increase in muscular tonus.	21-24