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## THE REFLEX ACTION

The reflex action is the physiological (functional) unit of the nervous system.

The nervous pathway of the reflex action is called the Reflex arc which consists of:

- ×-Receptors
- ×-Afferent neuron
- × Center
- ×-Efferent neuron
- ×-Effector organs.

# **REFLEX ARC**



# **TYPES OF REFLEXES**

- According to the number of synapses the reflex arcs are classified into:
- 1- Monosynaptic reflex arc:
- The afferent neuron synapses with the efferent neuron without interneuron in between. e.g., stretch reflex.
- 2- Polysynaptic reflex arc:
- In which interneurons are present between the afferent and efferent neurons.

## **TYPES OF REFLEXES**



## \*PROPERTIES OF THE NERVOUS REFLEXES:

### **1-UNIDIRECTIONAL:**

The nerve impulse runs from the afferent to the efferent neuron and never in the opposite direction due to the presence of the synapse in which transmission occurs from the presynaptic to the postsynaptic neuron.
 This is called the law of forward direction.



## 2-LOCALIZATION (SPECIFICITY):

- A specific stimulus at a certain receptor leads to specific response of the effector organs included in the reflex arc. For example
- A pin prick on the outer, surface of the arm produces reflex flexion and adduction of the arm.
- b) If the stimulus is applied to the inner surface of the arm extension and abduction of the arm occur.

## **3- TOTAL REFLEX TIME:**

It varies from one reflex to another according to the number of synapses as it is very short in the stretch reflex, but it is long in the light reflex <u>It includes:</u>

- \* a) Time taken in the conduction in afferent nerve.
- × b) Central delay (time taken to cross C.N.S.).
- c) Time taken to be conducted in the efferent nerve.
- d) Latent period of the muscle.

## **CENTRAL DELAY**

- Transmission through a synapse takes 0.5
   millisecond
- If the central delay within this range, the reflex is monosynaptic, while if more than this (polysynaptic).
- The central delay = total reflex time time taken in the afferent and in the efferent and the latent period of the muscle.

The extent of the reflex response depends on the intensity of the stimulus, thus the stronger the stimulus the more the activated neurons inside the C.N.S. and the more the extent of the response.

### **Examples:**

\* a) weak painful stimulus of the sole of foot produces reflex flexion of the big toe only. \* c) Crossed extensor reflex: Very strong stimulus also to the sole of the foot leads to withdrawal reflex in the stimulated limb and the other limb extends by irradiating the impulse, to support the body weight on the extended limb while the stimulated one is elevated.

### Flexor (Withdrawal) Reflex



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It is defined as the decline in response after repetition of the reflex due to exhaustion of the chemical transmitter at the synapse.

## **6-RECIPROCAL INNERVATION:**

 Reflex contraction of one group of muscles are accompanied by reflex inhibition (relaxation) of its antagonistic group of muscles to facilitate movement.

 <u>Example</u>: Withdrawal reflex leads to contraction of the flexors and inhibition of the extensors.

### ANTAGONISTIC MUSCLE PAIRS

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# RECIPROCAL INNERVATION



- EXPLANATION:
- × As the afferent neuron enters the spinal cord, it activates two sets of interneurons.
- One is excitatory to stimulate the motor neurons of the flexor muscles.
- ★ The other is inhibitory to inhibit the motor neurons of the antagonistic extensor muscles.
- There is one exception, the positive supporting reflex:
   Pressure on the sole of foot by body weight produces
   contraction of both extensors and flexors of the limb to
   support the body.



## 7- RECRUITMENT AND AFTER DISCHARGE:

- \* This property can be studied by recording the reflex tetanus and the motor tetanus
- **Reflex tetanus**:
- produced by maximal repetitive stimulation of the afferent nerve

### Motor tetanus:

\* produced by maximal repetitive stimulation of the efferent nerve

### **Reflex tetanus**

1-the latent period is longer,(conduction in afferent & efferentnerves and central delay).

2-Gradual rise of muscle contraction to maximum, due to gradual stimulation of the motor units in the muscle (recruitment). 1-the latent period is short(motor end plate delay) whichresemble single synaptic delay.

Motor tetanus

2- Rapid rise of contraction to a maximum, because all motor units of the muscle are simultaneously excited
(No recruitment).

## **Reflex tetanus**

3- limited power of contraction.As not all motor cells are stimulated.

4-After stoppage of the stimulation there is gradual relaxation (after discharge),

5-Fatigue occurs early (synaptic fatigue).

### Motor tetanus

3-Higher power of musclecontraction , due to stimulationof all motor fibers to the muscle.

4- When the motor stimulation is stopped the muscle rapidly relaxes.

5- delayed fatigue.

# **RECRUITMENT:**

✗ It is a gradual activation of AHCs on stimulating the afferent nerve due to difference in number of interneurons

### After discharge:

 It means persistent discharge from efferent neurons after stoppage of stimulation of the afferent one connected to it. Due to impulses arriving to them through interneuronal circuits.



# **CLASSIFICATION OF HUMAN REFLEXES**

### A. Peripheral reflexes:

- Center outside CNS. Most of these reflexes are found in the GIT.
- × 1) Local enteric reflex.
- × 2) Local ganglionic reflex.
- × 3) Local axon reflex.

#### **× B. Central reflexes:**

1-

Center inside CNS. They are further subdivided into:

## <u>Conditioned or Cortical reflexes</u>

They are so called because they need:

- 1. Previous education or training (learning).
- 2. Intact cerebral <u>Cortex</u> (<u>Consciousness</u>).
- 3. Specific stimulus must be present.

They are not essential for life Needed for <u>C</u>ivilization.



- Inborn reflexes are classified according to the site of CENTER into:
- 1) Spinal reflexes: their centers lie in the spinal cord.
- 2) Brain stem reflexes: their centers lie in the brain stem.
- As vomiting, deglutition, cough reflexes (centers in medulla).
- Herring Breuer, righting reflexes (centers in pons or midbrain).
- **3) Hypothalamic reflexes:** their centers lie in the hypothalamus.

