LAb

Contractions in the GIT

Tonic contractions (at the sites of sphincters)

Rythmic/phasic contraction.

- slow waves → Not true action potentials, they are only undulating (موجة) changes of membrane potential (Don't cause contraction by themselves), it is slow.
  - These waves are maintained by ICC (cells of Cajal) → the electrical pacemaker for smooth muscle cells.
  - they set the frequency at which contraction can happen
  - they are different depending on :- 1. The part of GIT. 2. The species. (بتختلف بين الكائنات)
  - slow waves frequence → Duodenum = 12/minute, terminal ileum = 8-9/minute
  - in rats it can rech upto 25 - 30/minute.
- rhythmic contractions occur by having the always happening changes of resting potential without reaching the threshold.
- spike potentials → true action potential that happen on top of a slow wave causing a contraction, it is initiated by 1. strech 2. chemicals (Ach, hormones like motilin)

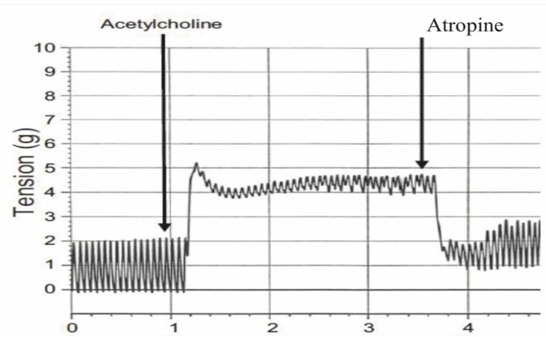
The experiment

* Investigate the contraction of smooth muscle in small intestine by obsarving the occurance of rhythmical contractions and by the modification of these contractions by Ach and atropin.

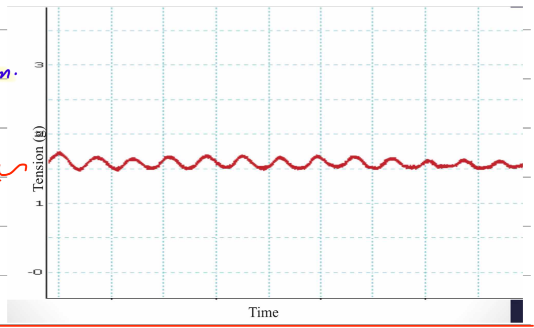
→ Method :- small spieces (2-3 cm) of rat's small intestine are hanged vertically by a thread to a glass hook in an organ bath that contains warm oxygenated buffer (37c°), After hanging the tissue it is allowed to rest for 15-20 minuts to allow the muscle to recover nomal function, The SI connected by a thread to a tension transducer which will convert the mechanical signal generated by the contraction to an electric signal and conveys (وينقل) it into special software, the software is capable of displaying a simple graph of tension versus time → The tension created by the SI is recorded → Ach is added → Atropin is Added.

→ Organ bath :- a solution that contains certain nutrins and salts, used to maintain the viability of the tissue for a time.

→ Certain amount of strech is applied on the piece to start the contraction.



The contractile force. →



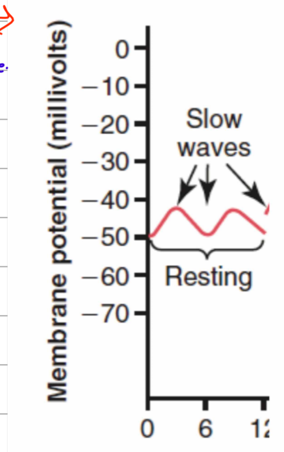
- Ach is secreted by enteric and parasympathetic neurons.
- its effect on intestinal smooth muscle cells is mediated by M receptors.
- Ach → ↑↑ the tension (Asch is the major excitatory neurotransmitter in the SI)
- Any competitive antagonist of Ach → ↓↓ the tension.
- epinephrine and norepinephrin will have the same effect of Atropin (→ comparetive antagonist of Ach) → ↓↓ the tension.
  - No effect on rats, but in other species (rabbit) it did the same as atropin.

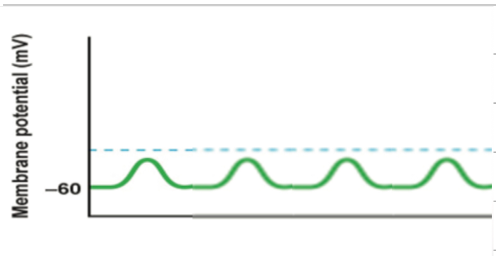
↳ the increas in contractile force is due to an increase in the number of spiks nor the frequency of slow waves.

↳ Most GI contractions occur rhythmically.

↳ Phasic (Rhythmical) contractions ↝ periodic contractions and relaxation, it is determined mainly by the frequency of the slow waves in the absence of neural or hormonal stimulation. →

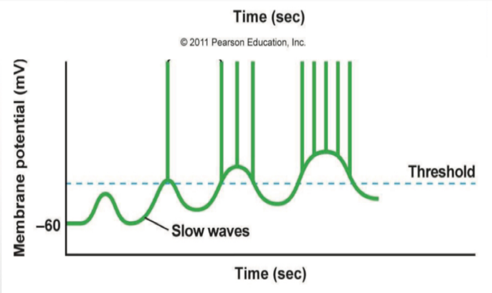
↳ slow waves set the maximum frequency at whic contraction can occur at a particular site.



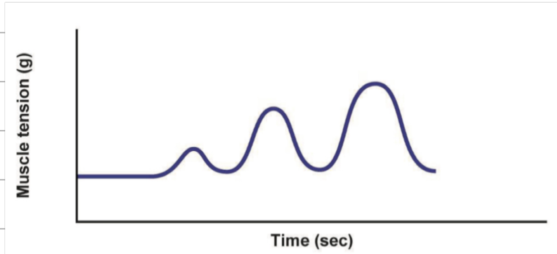


↝

↳ No tension by slow waves.



↝



↳ when spike potetial is generated ↝ contraction occurs.

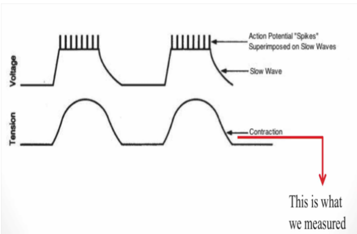
↳ the spike potential is seen transint membrane depolarization superimposed on the peak of slow wave.

↳ stimulated by stretch, Ach and some GI hormones.

↳ slow waves are allway fixed.

↳ slow waves determine the rate contraction.

↳ Number of spike potential determine the strength of the contraction.



↝ out experiment is to masure the actual contraction Nor the slow waves.

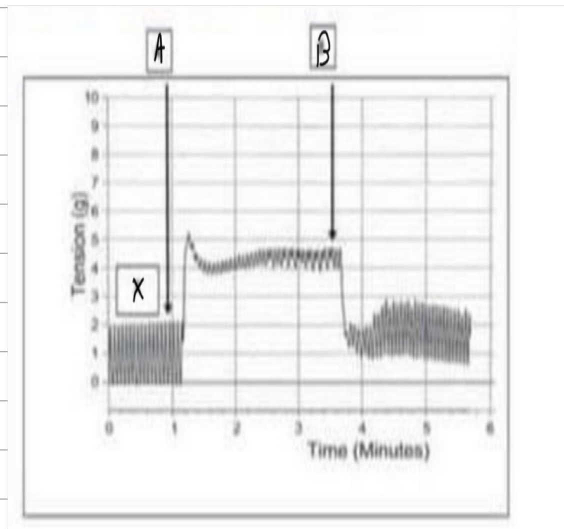
X ↝ contractions

A ↝ same effect of Ach.

B ↝ competetive antagonist to A.

↳ A ↝ Muscarinic receptor ↝ ↑↑ tonic contraction.

↳ B ↝ M receptor ↝ ↓ tonic contraction.



Mid lecture :-

→ ATP ⇝ Energy ⇝ Body works (Chemical , mechanical , Electrical) ⇝ heat.
Building component, secretions. — Muscle contraction — ↳ Na^+/K^+ pumps.

→ phosphocreatine + ADP ⇄ ATP + Creatine. (↑ Creatine = ↑ storage of energy)
↳ transfere energy to ATP.

→ Most of our body energy is produced in the form of aerobic energy.

→ Glycolysis (Glucose ⇝ pyruvic acid) is a form of anaerobic energy

→ anaerobic reactions ⇝ in case of lack of oxygen (Hypoxia) or high activity (Muscles.) ⇝ leads to accumulation of lactic acid.

→ Aerobic energy ⇝ By enzymatic reaction , it is very well controlled , Final products ⇝ CO_2 and H_2O.

↳ $C_6H_{12}O_6$ (glucose) + $6O_2$ ⇝ $6H_2O$ + $6CO_2$ ⇝ Glucose burning.

→ Respiratory Quotient (RQ) = CO_2 Produced / O_2 Consumed (الـ CO_2 المنتجة بدل O_2 مستهلكة)

↳ RQ in case of :- Glucose = 1 , Fat = 0.7 , protein = 0.8 , Mixed Food = 0.82.

→ we can estimate the respiratory quotient for all the body from the respiratory exchange ratio by the lung ⇝ indicate the mane type of Food stuffs used for metabolism.

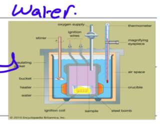
Metabolic rate :-

→ Metabolic rate = The rate of heat production.

→ Metabolic rate under basal conditions ⇝ Basal metabolic rate (The minimal energy expenditure by body to exist)
not in sleep , 12 hours without food , After a nigh of restful sleep , No exercise for one hour (and during the rest) , No exitements and comfortable temperature.

→ Measurements of metabolic rate :- The unit is calory C.

1. Direct Calorimetry :- using direct methods by Calorimeter whic measure the heat taken by the flow of water.



2. Indirect Calorimetry :-

A. Closed circuit method ⇝

↳ From the amount of oxygen consumed (95% of energy)

↳ 4.825 Calories / on liter of Oxygen onsumption (Energy eqhivalent of oxygen)

↳ we use pirometer as a metabolator by filling it with pure oxygen and adding in the way of expired air a substance to adsorb the CO_2 produced ⇝ Measure O_2 consumption.

↳ Heat produced = Amount of heat / m^2 surface body / hour (Cal . $hour^{-1}$ / m^2)

Example :- Oxygen consumption of 100 ml of oxygen / 5 minuts.

1. Calculate Oxygen consumed / 1 hour ⇒ $\frac{1 \text{ Liter } (100 \text{ ml})}{5 \text{ minuts}} \times \frac{60 \text{ minut}}{1 \text{ hour}}$ = 12 liters / hour

2. Calculate the the energy produced (heat) ⇒ 1 O_2 liter = 4.825 cal ; 12 O_2 liter = ?? ⇒ Heat = 57 C / hour

3. Know the surface area of the body ⇒ 1.7 m^2 in our question

4. Heat produced = $\frac{57 \text{ Cal / hour}}{1.7 \text{ m}^2}$ = 34 Cal . $hour^{-1}$ / m^2

↳ The metabolic rate can be related to the ideal basal metabolic rate (% increased or decreased)

A. opened circuit method :-

↳ A bag is used for collection of expired air during the physical activity.

↳ By knowing the concentration of O_2 in the atmospher and in collected air ⇝ know O_2 that was consumed ⇝ calculate the metabolic rate.

⇝ Factors effect metabolic rate :-

Exercis (↑) , Daily activities (lie in bed all day ⇝ 1600 cal/day , Eating process ⇝ ↑ the rate by 200 Cal.)

Age (↓) , sleep (↓) , Fever (↑) , Malnutration (↓) , thyroid hormones (↑) , Male sex hormones (↑ the basal metabolic rate by 10-15%)
GH (↑ by 15-20%) , Sympathetic stimulation (↑) , Climate ⇝ The metabolic rate of people living in tropical regions is less.