Physio lab summary
Intestinal Motility Experiment

➢ Remember, there are 2 types of contraction: tonic and phasic (rhythmic) contractions.
➢ Most gastrointestinal contractions occur rhythmically.

❖ Method:

• we use small pieces (2-3cm) of small intestine (SI) of the rat.

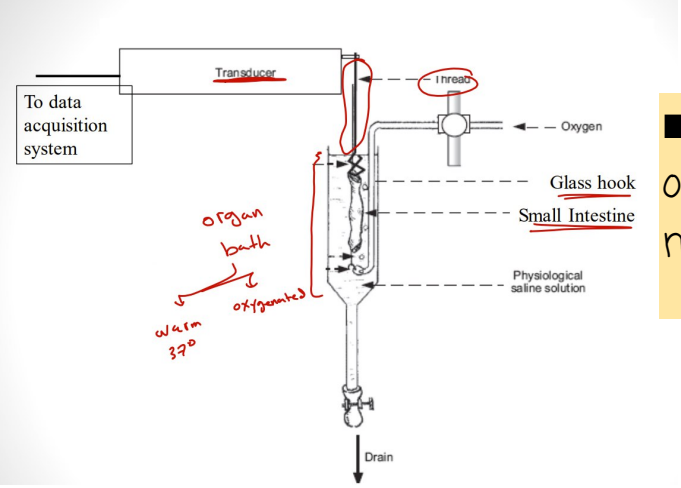
• The SI are hanged vertically by a thread to a glass hook in an organ bath, and the SI is connected by a thread to a tension transducer.

• The tension transducer converts the mechanical signal generated by the contraction of the small intestine to an electric signal and conveys it to a special software (simple graph of tension versus time).

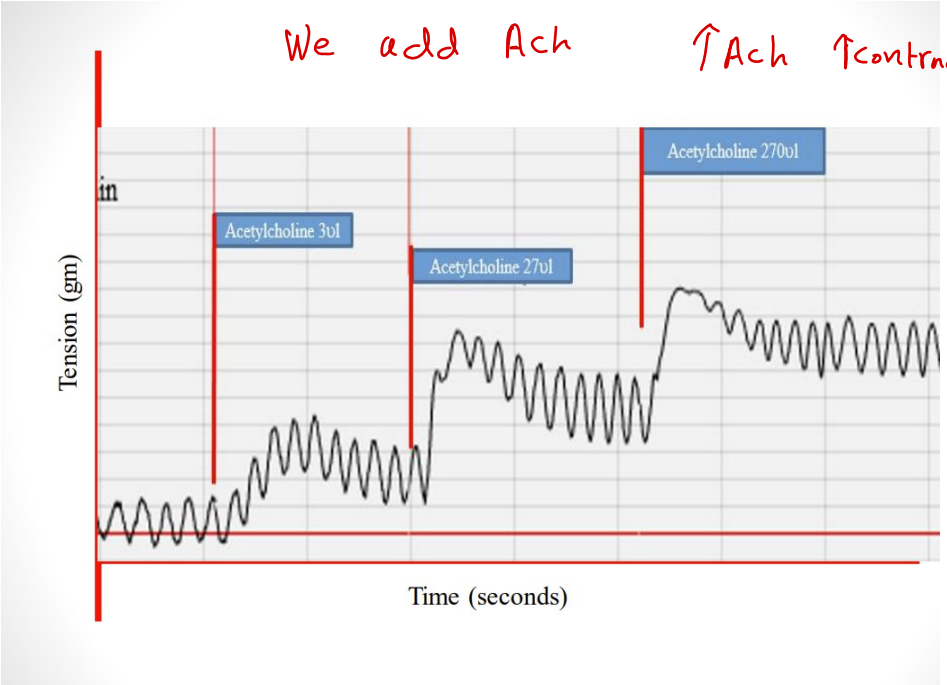
• After hanging the tissue, it is allowed to rest for 15-20.

• The tension created by the small intestinal segment is recorded.

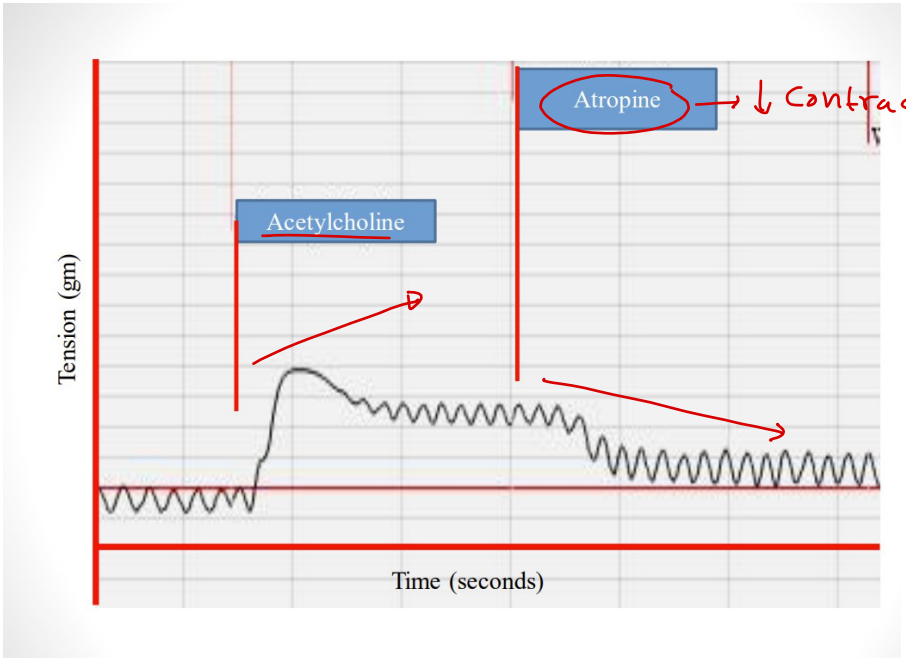
• Then acetylcholine is added to the organ bath. Finally Atropine is added to the organ bath.



■ The organ bath contains a warm (37°C) oxygenated buffer. This is essential to maintain the viability of the tissue.



• Ach is the major excitatory neurotransmitter in the small intestine. (through muscarinic receptors).
• Secreted by enteric neurons and parasympathetic neurons.
• Acetylcholine promotes increased contractile force due to an increase in the number of spikes, not in the frequency of slow waves.



• Inhibition of the contractile effect of ACh is mediated by adding atropine; a competitive antagonist of Ach at the muscarinic receptor.

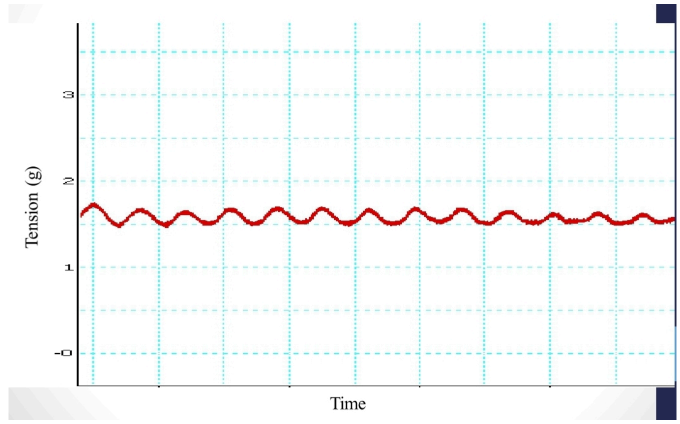
❖ Results:

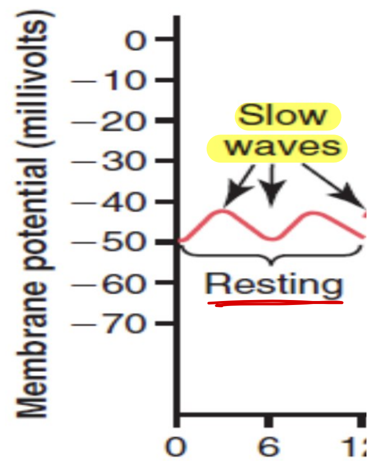
- Smooth muscle fibers in the small intestine contracts rhythmically in the absence of neuronal or hormonal stimulation.

- The rhythm is determined mainly by the frequency of the "slow waves".

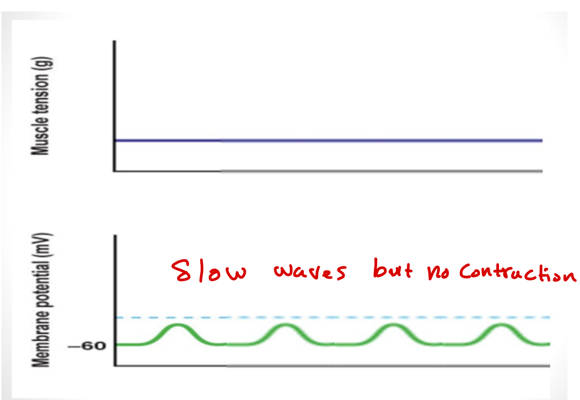
- The slow waves are generated by the interstitial cells of Cajal (ICC), which are believed to act as electrical pacemakers for smooth muscle cells.

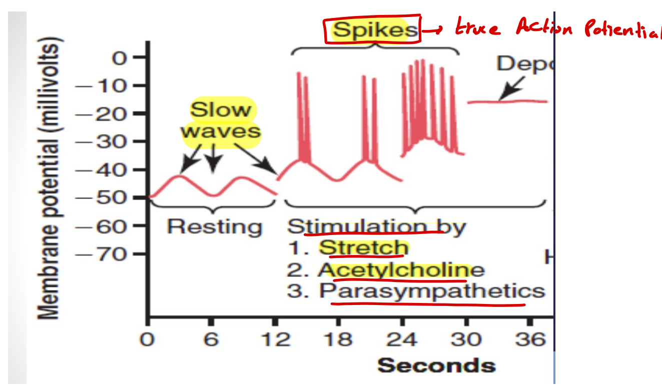
- Phasic (Rhythmical)contractions: periodic contractions and relaxations.

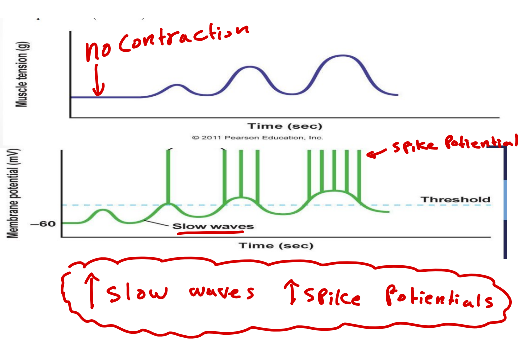




- Slow waves are slow, undulating changes in the resting membrane potential.
- Slow waves set the maximum frequency at which contraction can occur at a particular site.

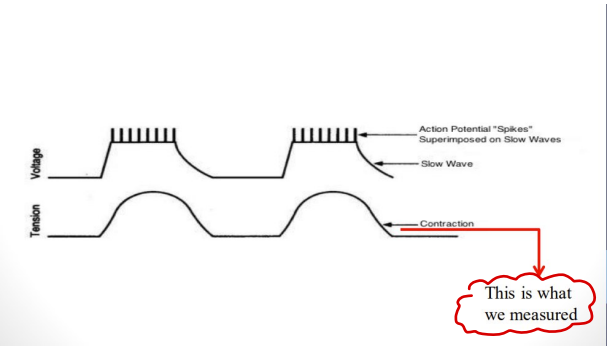






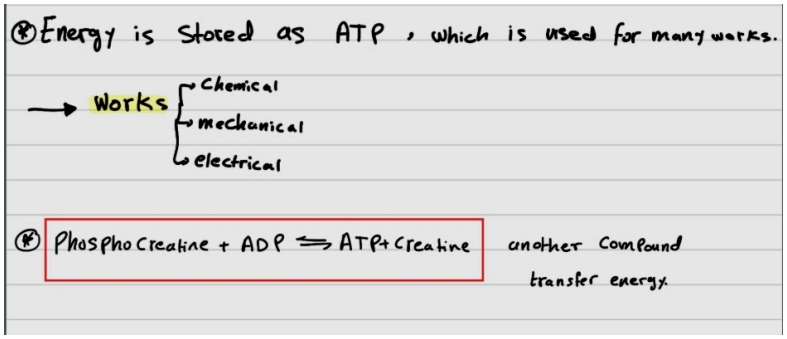
(Contraction)

- a spike potential must be generated by smooth muscle cells on the peak of the slow wave.
- They are true action potentials.
- Stimulated by stretch, acetylcholine, and some GI hormones.
- Appear when the peaks of the slow waves temporarily become more positive than −40mV.



■ Remember that in our experiment we measured the actual contraction of the small intestine NOT the slow waves .

Mid material



• ATP formation by chemical reactions in the body:
1. Aerobic energy (need): Most of the energy produced in our body is in the form of aerobic energy.
▪ The final products of complete breakdown of food stuff will result in the formation of H2O and CO2
2. Anaerobic energy (no oxygen needed) : Some ATP molecules can be produced by reactions such as glycolysis (break down of glucose into pyruvic acid).
▪ result in the accumulation of lactic acid in the muscle.

▪ From this reaction, we can calculate "Respiratory Quotient" (RQ) (CO2 produced/O2 consumed) when glucose is used as a source of energy.

(RQ) = CO2/O2 = 1.0 >> glucose
RQ = 0.7. >> fat
RQ = 0.8 >> protein
RQ = 0.82 >> mixed

▪ respiratory quotient for all body to indicate the main type of food stuffs used for metabolism in the body

▪ METABOLIC RATE:

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• Metabolism refers to all chemical reactions in our body.
• The rate of heat production is known as the metabolic rate. The heat produced can be measured to reflect the metabolic activities in the human body.

▪ Basal metabolic rate : metabolic rate under basal conditions.
▪ The metabolic rate under these conditions refers to the minimal energy expenditure by a body to exist.

□ Basal conditions: The person to whom we intend to measure the metabolic rate is not in sleep, and the following basal conditions must be met: (سؤال بامتحان)

1. No eaten food for at least 12 hours.
2. measurement after a night of restful sleep.
3. No exercise and physical activities in at least one hour prior to and during the test.
4. Elimination of all factors that may cause excitement.
5. comfortable temperature during measurement.

■ Measurements of metabolic rate : • The Calorie is the used unit for measuring heat produced by the body. Calorie spelled with C capital to mean 1 kilocarie (1000 calories).

1. Direct calorimetry: Measuring the heat produced with direct methods by calorimeter (an insulated chamber constructed with a constant rate of water flow (in and out) to measure the heat taken by the flow of water).

2.Indirect calorimetry:(O2 consumption)

A. Closed circuit method: More than 95% of the energy is produced by oxygen consuming chemical reactions.

▪ The rate of heat production can be calculated from the amount of oxygen consumed , by using the spirometer as a metabolator by equipping it (filling it with pure oxygen and adding in the way of expired air a substance to adsorb the CO2 produced), we can measure O2 consumption.

* 1 liter O_2 ⟶ 4.825 Cal

▪ The heat produced is calculated as the amount of heat/m2 surface body/hour.

o There is an example for calculation of metabolic rate:
If we measure in 5 minutes, oxygen consumption of 1000ml (1L) of pure oxygen/ 5 minutes

① The oxygen consumed Per hour

5 min ⟶ 1 L of O_2
60min ⟶ ??

O_2 consumed = 12 L/hr

② The energy produced for that amount of oxygen consumed

1 L of O_2 ⟶ 4.825 Cal
12 L/hr ⟶ ??

heat = 57 Cal/hr

- We can have the surface area of the body from tables designed to have the surface area by knowing the weight and height of a person.

- If we have it as 1.7m2. Then the amount of heat produced is: 57 Cal. hour-1/1.7 m2 = 34 Cal. hour-1/m2 .

B. Opened Circuit method : other indirect methods by using opened circuit methods. In these methods, a bag is used for the collection of expired air during physical activity. By knowing the concentration of oxygen in the atmosphere and in collected air. We can know how much oxygen was consumed, and then we can calculate oxygen consumption and the metabolic rate in the same way as above.

■ Factors affecting metabolic rate: (مهم مهم مهم)

1. Exercise: increases metabolic rate. This increase is well related to the strength of the exercise.

2. Daily activities: The metabolic rate depends on the daily activities. For a lie in bed all day, the metabolic rate is about 1600 Cal/day. The eating process increases the rate by 200 Cal. Etc.

3. Age: The metabolic rate calculated for the surface is of the body decreases with age. It is higher in children and less in old people.

4. Sleep: decreases the metabolic rate.

5. Climate: The metabolic rate for people living in tropical regions is less.

6. Fever: During infection, there is an increase in metabolic rate.

7. Malnutrition: Decreases metabolic rate (سؤال باست)

8. Effect of hormones:

Thyroid hormones , Male sex hormones, and Growth hormones increase the metabolic rate.

9. Sympathetic stimulation: increases metabolic rate. (سؤال باست)

- Slow waves occur at different frequencies at various points along the gastrointestinal tract. In humans, their frequency is 12/minute in the duodenum, 8-9/minute in the ileum.

نسيت هاي الحلوة بجزئية الاب ☺

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بالتوفيق