



PASSION ACADEMIC TEAM



Sheet# 4

YU - MEDICINE

GASTROINTESTINAL SYSTEM

Lec. Title : Basic Mechanisms
of GI Motility

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Basic mechanisms of GI motility

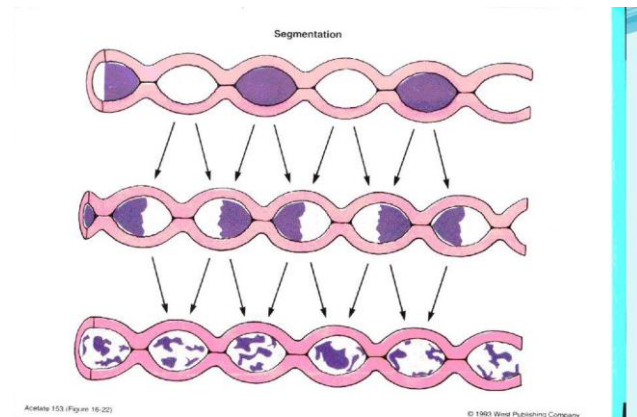
How the motility of GI system regulated and initiated?

-The regulation mechanism of the motility is very important in order to achieve optimal digestion and absorption

What is the primary role of GI system?? 1) Digestion 2) absorption

GI Motility

- Refers to contraction and relaxation of walls and sphincters of gastrointestinal tract
- GI Motility helps propel digested material through the alimentary tract
- GI Motility helps mix and grind digested material



GI Motility mechanisms

What is the physical basis of all motility within the GI tract??

The Physical basis of all GI motility is the : motor activity of smooth muscles ((contraction and relaxation))

These activity regulated by:

1) Enteric nervous system (Myenteric plexus) 2) Autonomic nervous system

Muscular subtypes:

There are two types of muscles in GIT (smooth muscles and skeletal muscles), and both of them contribute to GI motility.

Skeletal muscles regulated by voluntary motor neuron: this type of muscles are located in the both ends of GIT (oral cavity, Anus ,pharynx, upper 3rd of esophagus).

Where the remain parts of GI is **smooth muscles** which regulated by Enteric nervous system and Autonomic nervous system.

Muscular Geometry of smooth muscles:

- ✚ Contraction of smooth muscle of GI tract can lead to different result: it could be lead to reduce either the diameter or the length of GI tube wall ,and the outcome of the contraction depends on the arrangement of muscles within the GI tract ,when the **longitudinal** muscles contraction reducing in the length. Where the **circular** muscles contractions leads to reducing in the diameter.
- ✚ In swallowing, the contraction leads to a reduction in both the diameter and the length of the GI tract.

There are two type of contraction :

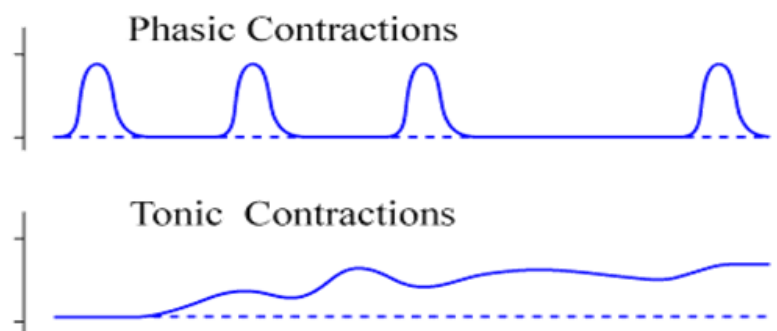
1) **Tonic contraction** maintain a constant level of contraction, without regular periods of relaxation . and this type of contraction seen in sphincters.

Q:what is the mechanism that can lead to tonic contraction ?

Hormonal stimulation (it is one of the mechanism that can lead to continuous contraction.

2) **phasic contraction (rhythmic)** : **cyclical** periods of contraction and relaxation . This type of contraction is seen in most segments of GI.

Phasic contraction responsible for mixing and propulsion movement.



Slow waves and Spike

The activity of GI smooth muscles is continuously stimulated by: electrical activity

• There are two type of electrical activity :

1) **slow waves:**

It is very important to know that the slow waves are not true action potentials, so can't produce contraction, it sometimes lead to contraction in stomach.

Q : why the slow waves can't produce true action potentials ?

Because the calcium influx during depolarization is not enough to cause contraction.

- Slow waves can just cause electrical change in resting membrane potential of smooth muscles.
- In other wordsslow waves which contribute to the basic electrical rhythm (BER)

In this figure we can see a slow wave with cyclic depolarization and repolarization in resting membrane potential.

The mechanism of the slow waves is not completely understood, but there is theory suggests that there is a complex interaction between smooth muscle and interstitial of cajal.

Q :what is the interstitial of cajal? it is a cell that act as a pacemaker of smooth muscles , can change the resting membrane potential without any external stimulation of smooth muscles.

In the slow waves : the depolarization caused by Ca^{2+} entrance and the repolarization caused by K^{+} reflux.

If the membrane potential of slow waves exceeds the threshold (-40 mv), slow waves become spike.

There are many factor can lead to increase the magnitude of membrane potential, which caused converting the slow waves to spike..... **These factors include:**

- 1) stretching
- 2) Acetylcholine
- 3)parasympathetic

Another factor can stimulate hyperpolarization, to prevent the converting of slow waves to spike: **these factor include:**

- 1) Norepinephrine
- 2) sympathetic

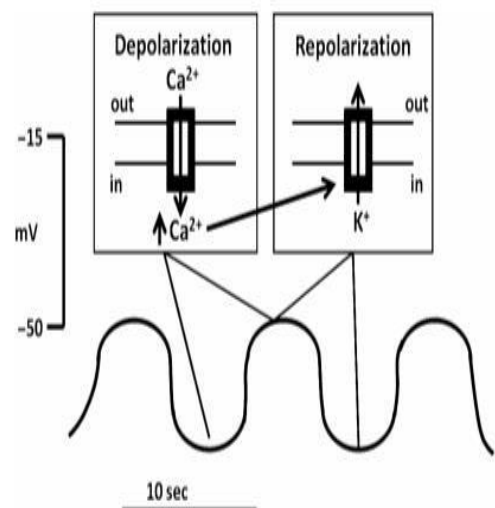
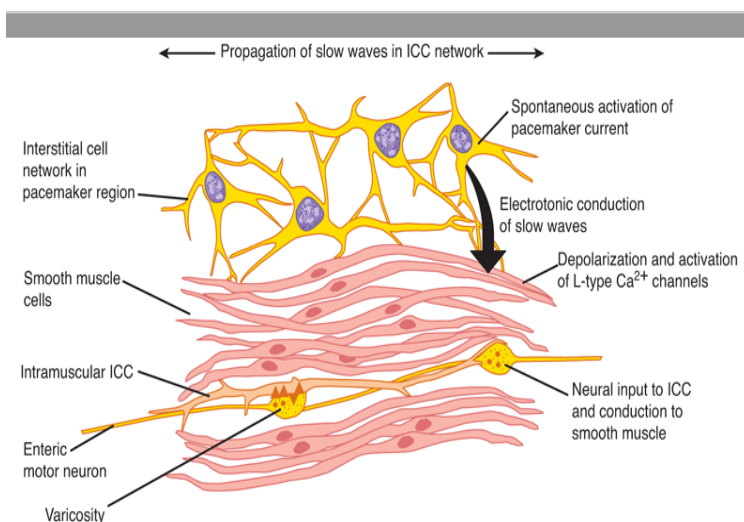
oThe rate of slow wave (BER):

- Stomach -3/min
- Duodenum ~ 12/min
- Jejunum ~ 10/min
- Ileum ~ 8/min

2) spike : (the second type of electrical activity)

There are direct relationship between Spike frequency and contraction

The channel which is responsible for generating spikes is the $Ca^{2+} - Na^{+}$ channel : allow the influx of large number of Ca^{2+} and smaller number of Na^{+} ,so the Ca^{2+} have very important role in contraction.



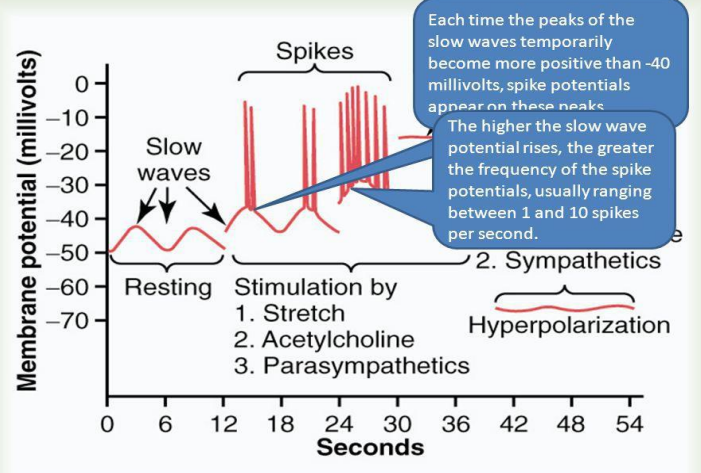
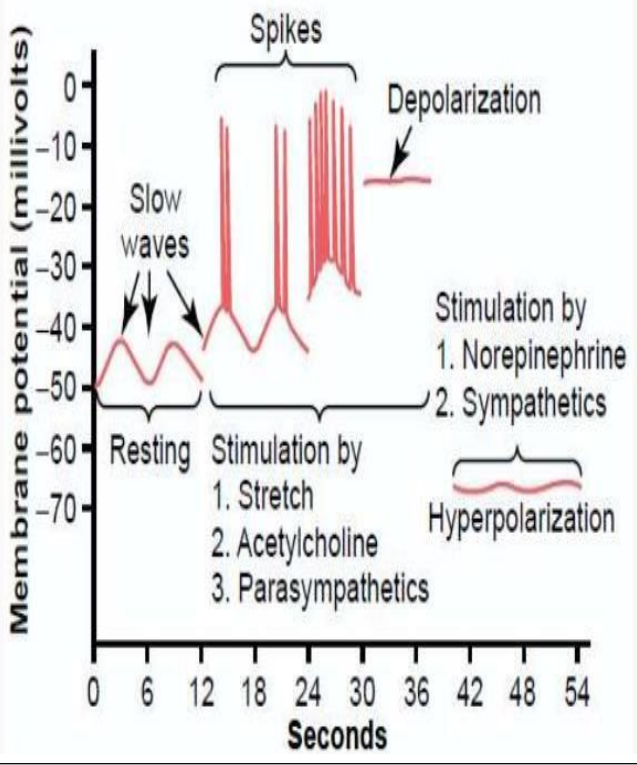
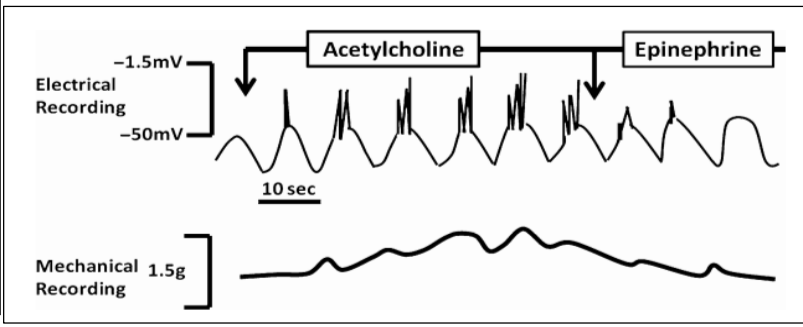
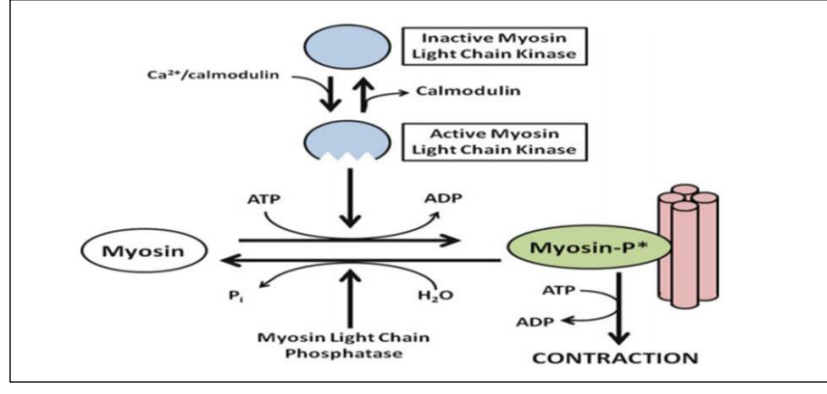
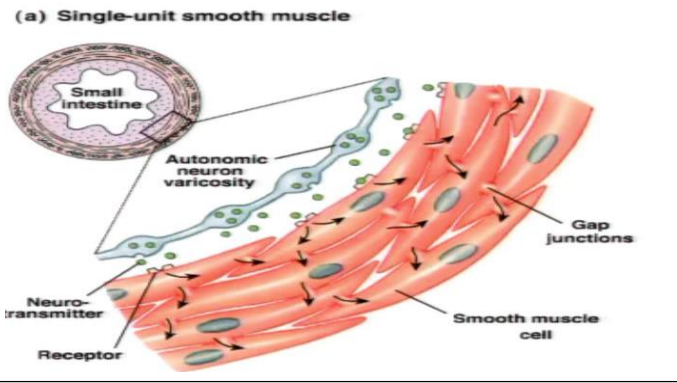


Figure 62-3; Guyton & Hall



ال action potential في ال spike يستغرق وقت اكثر من 10 الى 40 مره من الوقت المستغرق بال action potential الذي ينتج بالاعصاب ما هي الاسباب؟؟؟؟؟؟؟؟؟ بنحتاج الى وقت طويل حتى يصير عملية هضم كامله و فعاله ،اما في الاعصاب نحتاج الى ردة فعل سريعه والسبب هو القنوات الموجوده بالاعصاب تختلف عن الموجوده في ال smooth muscles اللي في ال GIبينما في الاعصاب عنا قنوات صوديوم بتفتح و بتسكر بشكل سريع جدا لهيك الاستجابه سريعه و الوقت المستغرق قليل..... اما في ال smooth muscles لل GI عنا قنوات كاسيوم (L type) بتسمح بدخول الكالسيوم و الصوديوم و بتفتح و بتسكر ببطيء شديد ،لهيك الفتره الزمنيه المستغرقه طويله و هذا اشي كويس و مناسب لل GI حتى نحصل على عملية هضم كامله.

Electrical Basic of GI Rhythmic contraction



Types of Gut Motility

Elapsed Time	Segmentation	Tonic Contraction	Peristalsis
Function	Mixing	Separation (Sphincter)	Propulsion