



THE UNIVERSITY *of* TEXAS

MEDICAL SCHOOL AT HOUSTON

A part of The University of Texas Health Science Center at Houston

Gastrointestinal Physiology

Chapter 2


12/17/2009

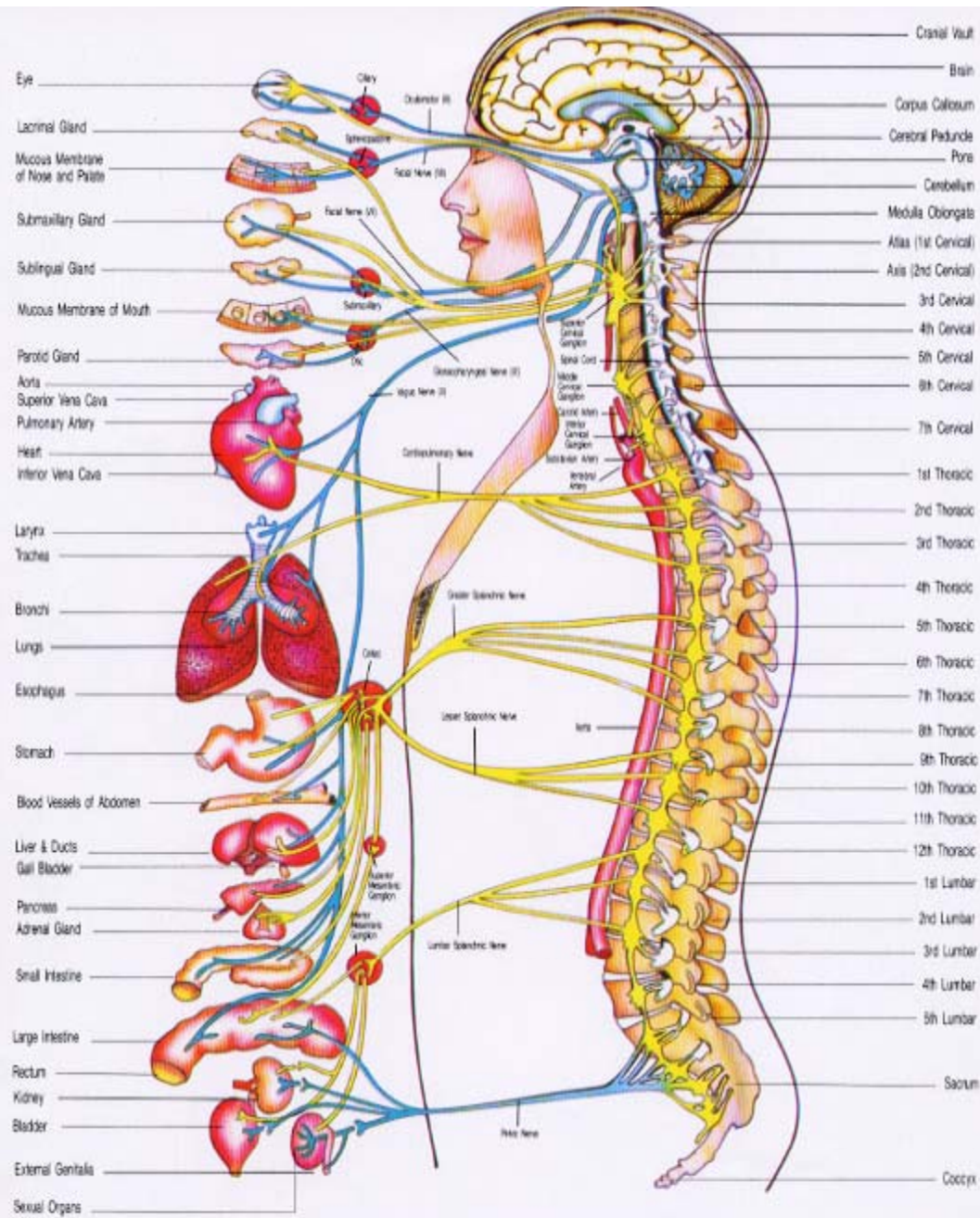
Gerald Mank, MD

Introduction

- Secretory, motility and absorptive functions must be integrated
- Mediated by regulatory systems
- Mediated through the actions of specific chemicals on target cells in the GI tract
- Most regulatory systems contain intrinsic activities
- Basic properties/intrinsic activities of smooth muscle

Anatomy of the Autonomic Nervous System

- GI tract
- Extrinsic and Intrinsic (enteric)
- Extrinsic 
 - Parasympathetic
 - Sympathetic

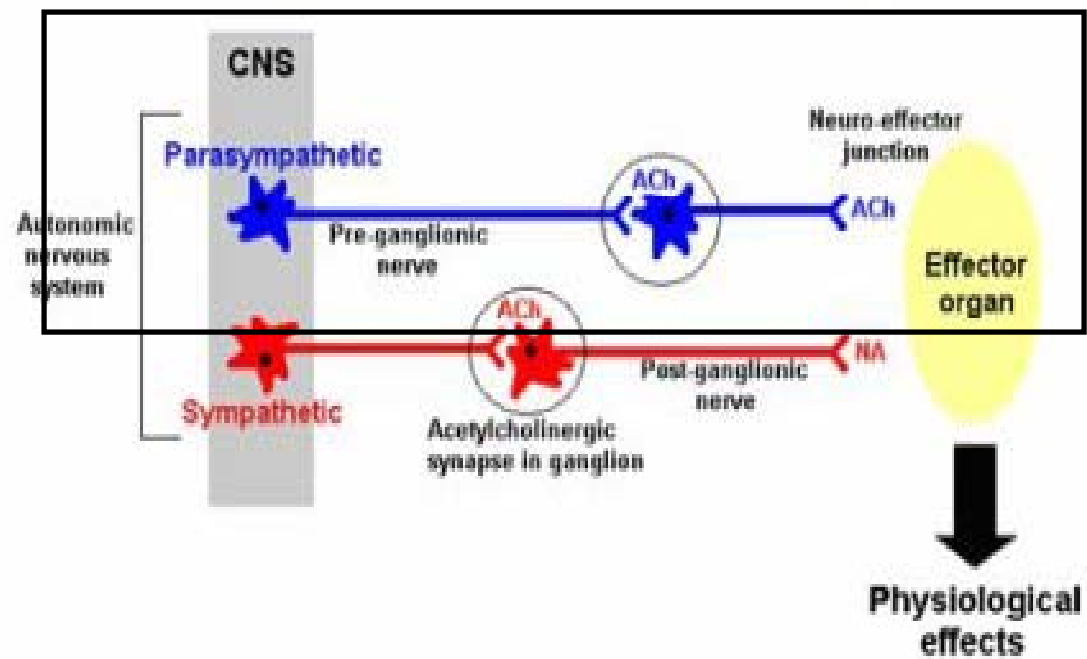


AUTONOMIC NERVOUS SYSTEM
 Sympathetic — Yellow Parasympathetic — Green

Parasympathetic

- Primarily supplied by Vagus and Pelvic Nerves
- Long preganglionic axons → Medulla
→ Spinal Cord
- Synapse with cells of the enteric nervous system
- Many afferent nerves

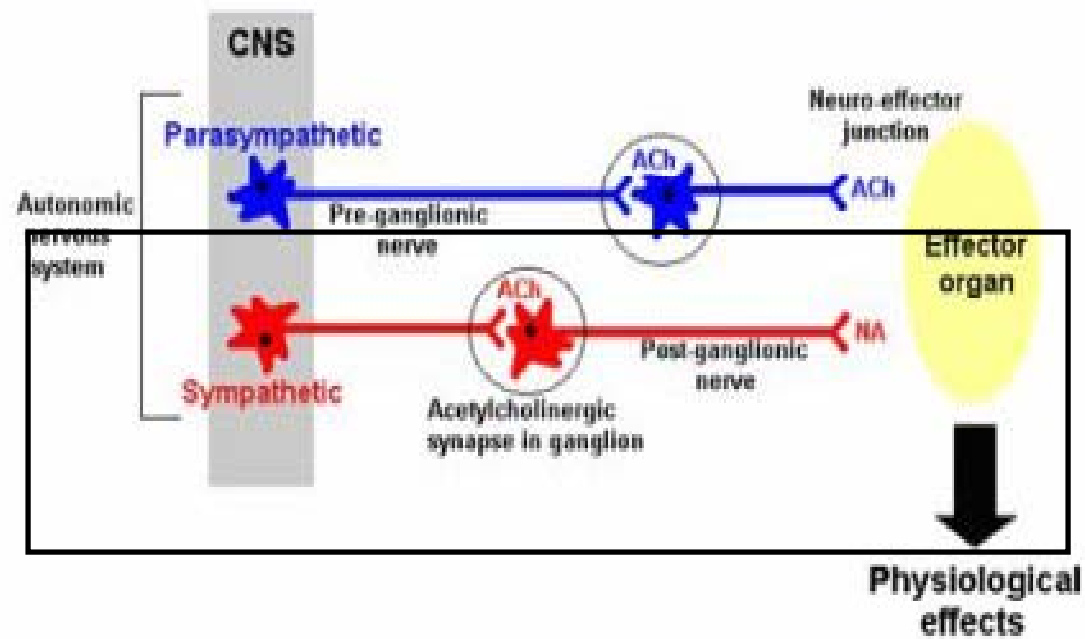
The main components of the autonomic nervous system.....



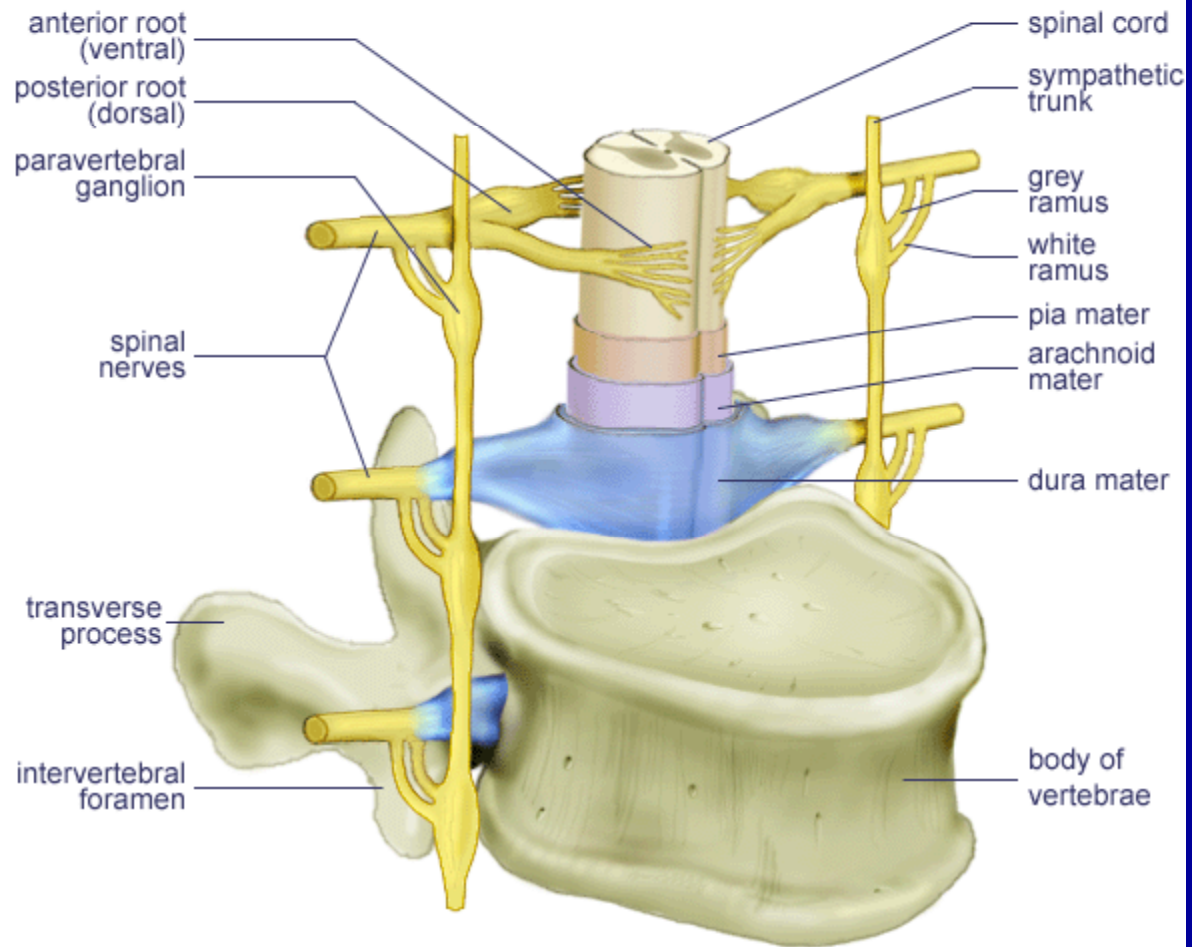
Sympathetic

- Spinal cord and prevertebral ganglia
- Preganglionic: Efferent fibers arise within the spinal cord to the ganglion
- Postganglionic fibers innervate primarily the enteric system, organs of the gut
- Few fibers innervate
 - Secretory
 - Absorptive
 - Muscle
- Afferent fibers, provide sensory input for integration

The main components of the autonomic nervous system.....

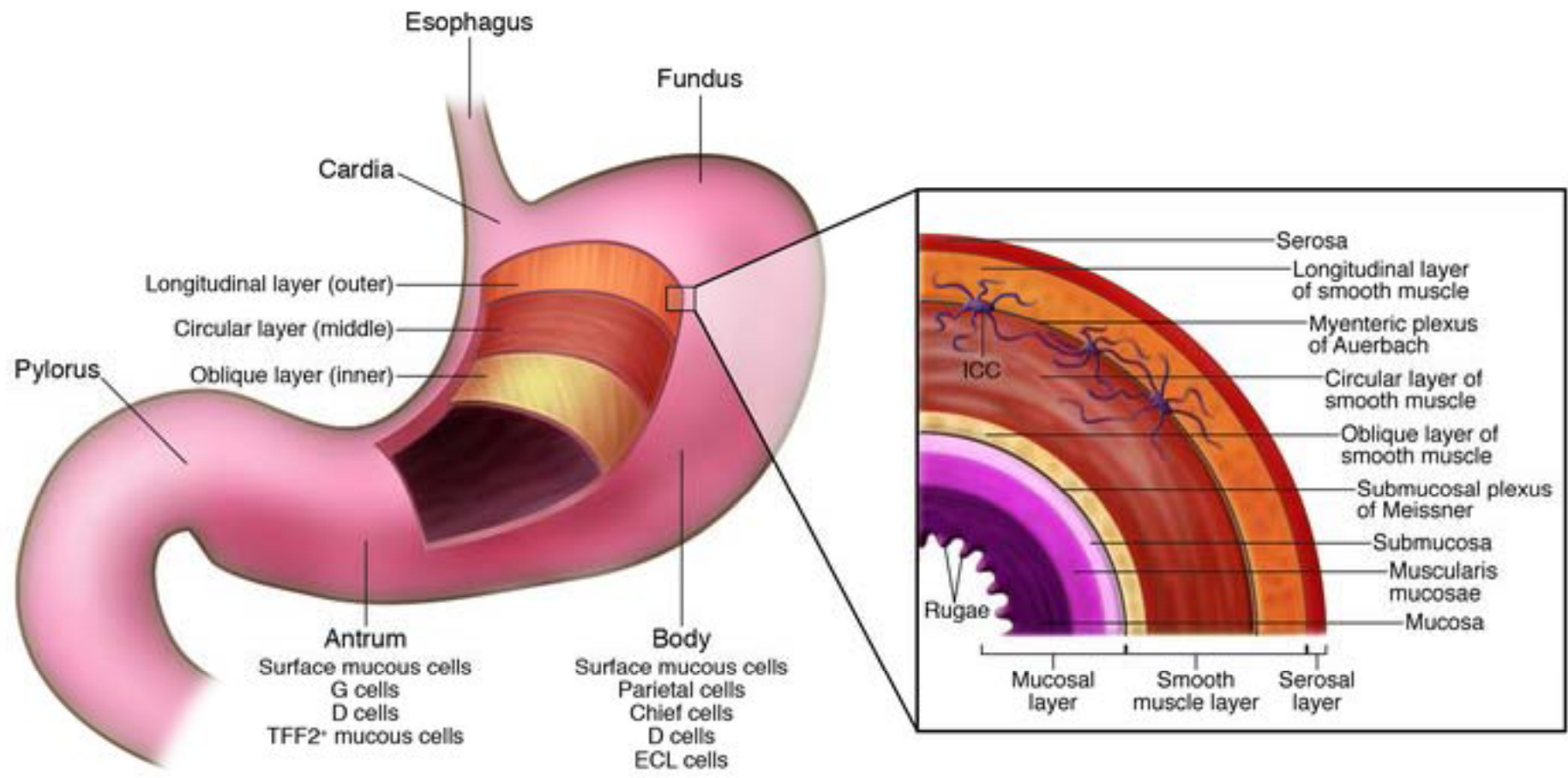


Autonomic Nervous System



Intrinsic/Enteric Nervous System

- Several anatomically distinct networks
- Myenteric and Submucosal most prominent
- Consist of Nerve Cell Bodies, Axons, Dendrites and nerve endings
- Not only innervate target cells (smooth muscle, secretory cells and absorptive)
- Also connect to sensory receptors
- Interdigitate with processes from other neurons located both inside and outside the plexus



Neurocrines within ANS

- ACh
- NE
- Serotonin
- VIP
- NO
- Somatostatin
- Substance P

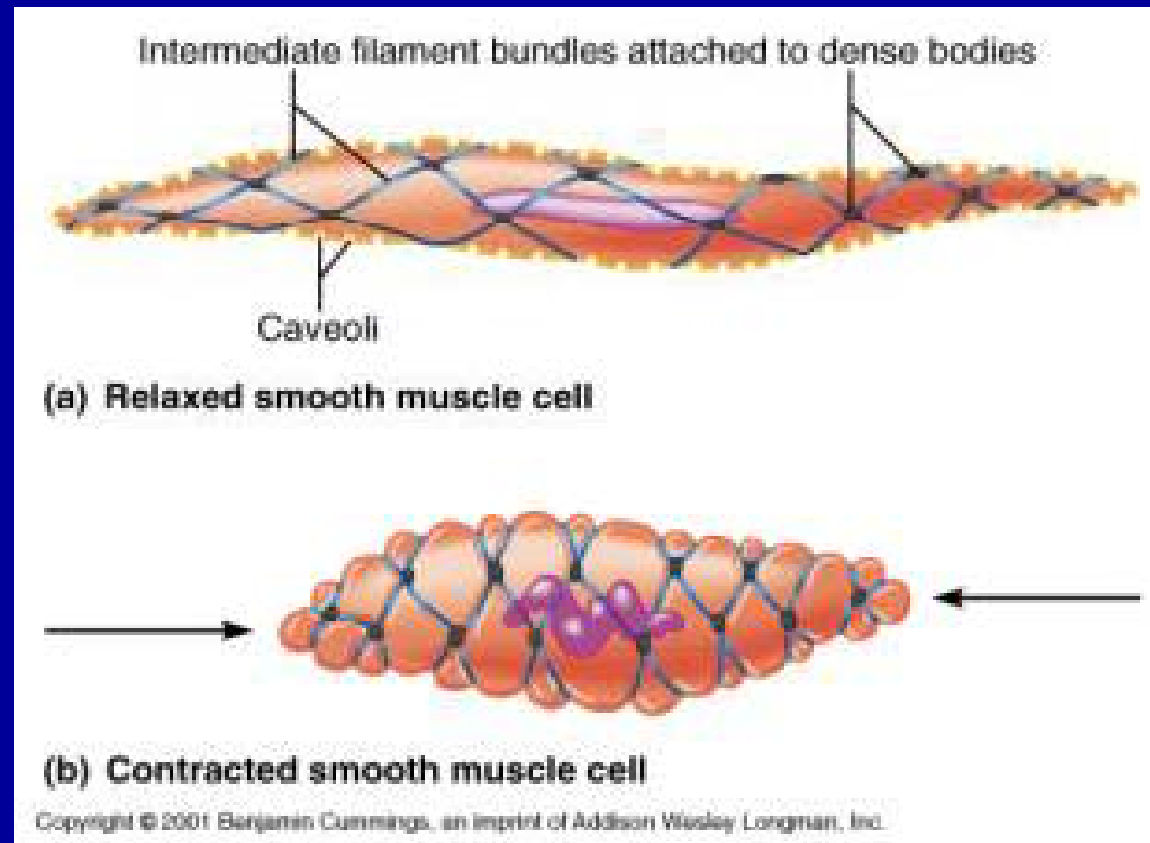
Neurohumoral Regulation of GI Function

- ANS-Endocrine / Paracrine interact to control secretion, absorption and motility
- Resting output modulated by combination of the 2 systems
- Smell
- Products of Digestion

Anatomy of the Smooth Muscle Cell

- GI tract except Oral third of Esophagus, Pharynx and External Anal Sphincter
- Basic Properties
 - Smaller than skeletal muscle cells
 - Contractile elements are not orderly like sarcomeres
 - Similar contractile proteins
 - Thin Filaments: Actin / Topomyosin
 - Thick Filaments: Myosin
 - Ratio 15:1 thin/thick
 - Skeletal muscle 2:1
 - Intermediate Filaments

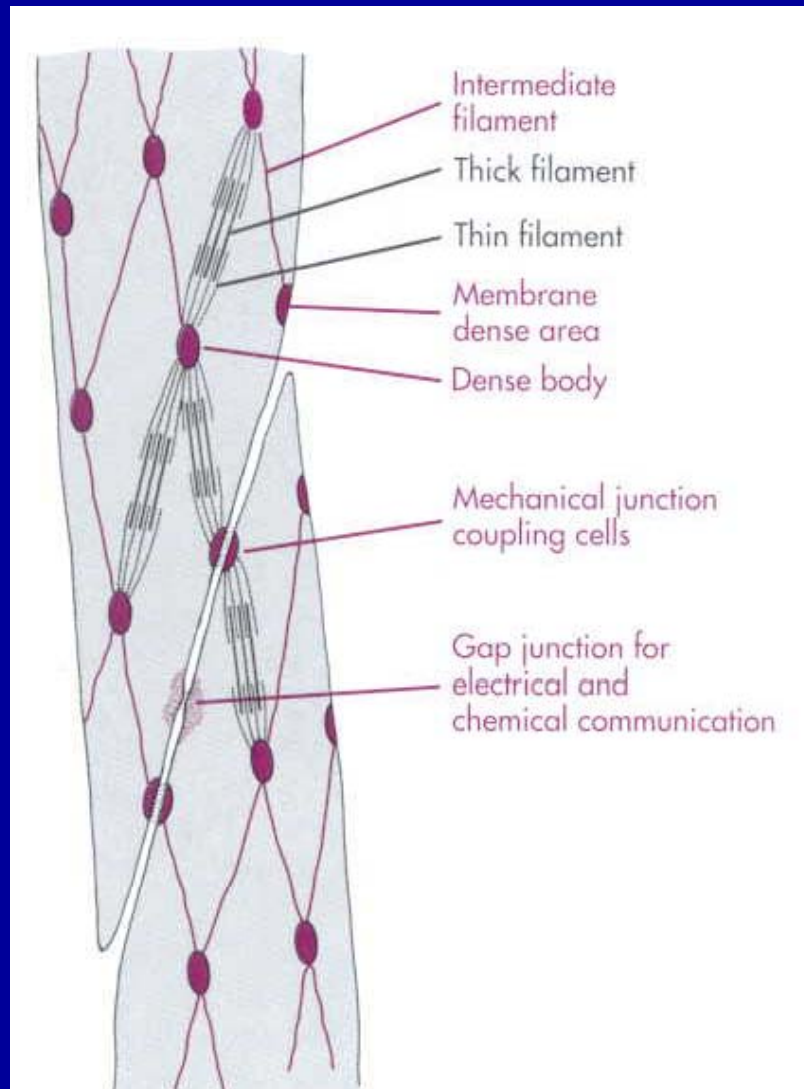
Anatomy of the Smooth Muscle Cell



Anatomy of the Smooth Muscle Cell

- Smooth muscle cells are grouped into branching bundles, or fasciae
- Surrounded by connective tissue sheets
- Smooth muscles of the guts are “Unitary” type
- Gap junctions/Nexuses

Anatomy of the Smooth Muscle Cell



Smooth Muscle Contraction

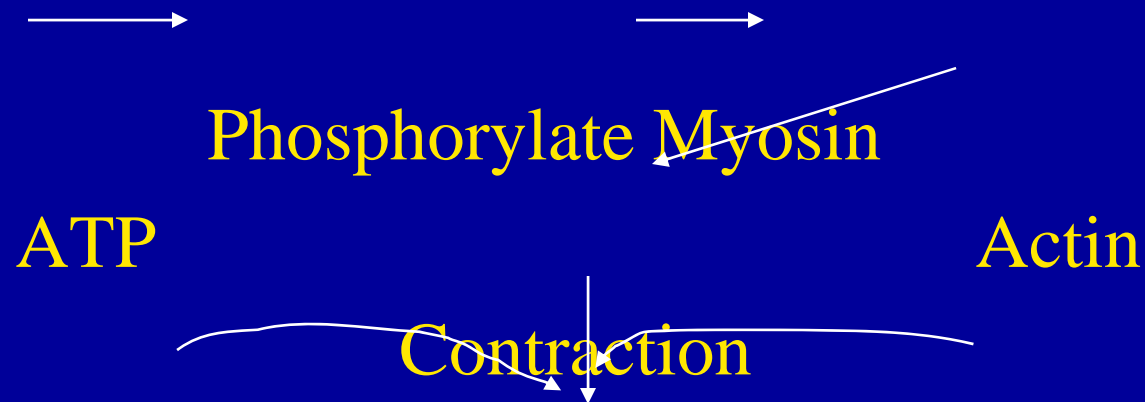
- Remarkable heterogeneity in time course
- Phasic Contractions (seconds)
 - Body of the esophagus
 - Small bowel
 - Gastric Antrum
- Tonic Contractions (minutes to hours)
 - LES
 - Ileocecal Sphincter
 - Internal Anal Sphincter

Smooth Muscle Contraction

- Type depends on the muscle cell itself or by the Interstitial Cells of Cajal (ICC)
- Does not depend on Neural or Hormonal Input
- Neurocrines/Endocrines and Paracrines modulate
- Amplitude of Phasic Contractions
- Tone of Tonic Contractions

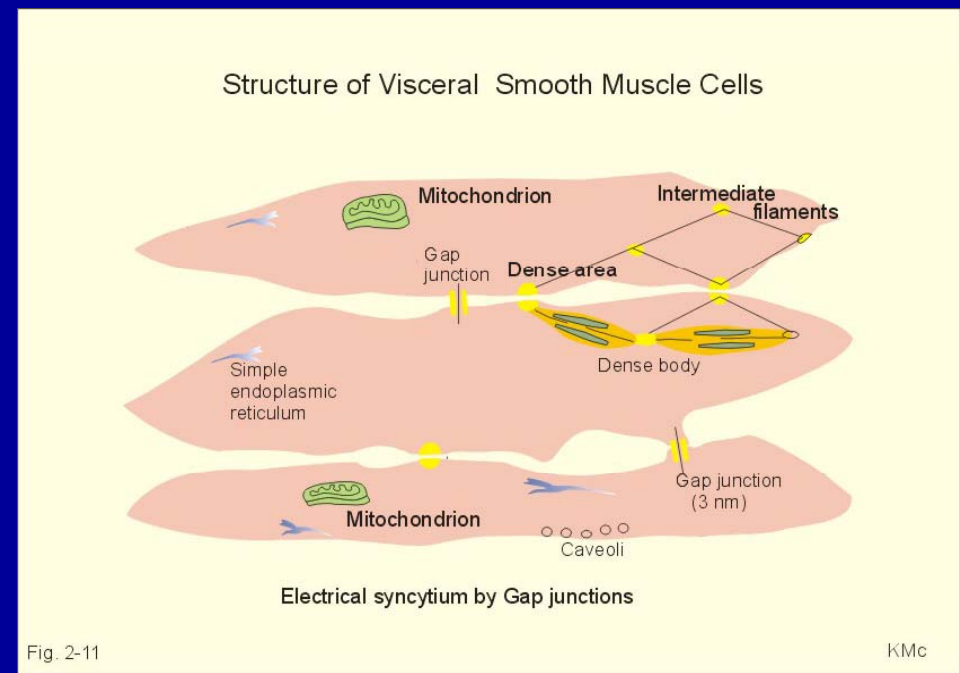
Smooth Muscle Contraction

- Similar to Striated Muscle – Calcium is the Key
- Low Levels – no contractions
- High Levels- contractions
- Calcium Calmodulin Protein Kinase



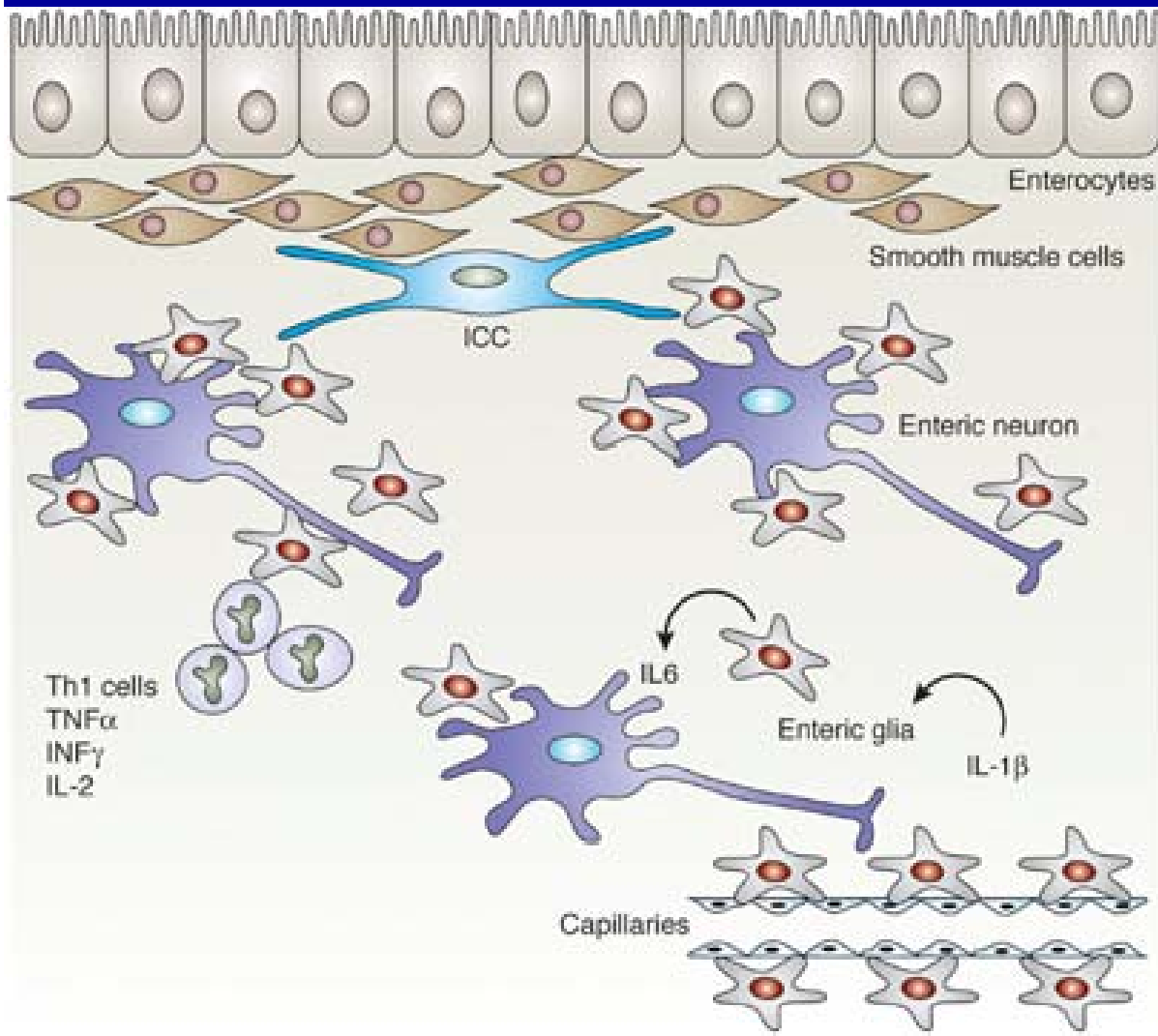
Smooth Muscle Contraction

- Where does the Calcium come from?
- Caveolae (Body of the esophagus)
- SR (LES)
 - Electrical events of the plasma membrane
 - Inositol Triphosphate



Smooth Muscle Contraction

- Action or Spike potentials
- Superimposed on a resting potential (slow waves)
- Genesis of the slow waves come from ICC
- ICC's are found throughout the GI tract where slow waves are found and they are interconnected with each other and via gap junctions with the muscle cells



1852-1934

Summary

- Neural and Humoral influences GI Function
- ANS has intrinsic and extrinsic
- Extrinsic – Parasympathetic and Sympathetic
- Ach- excitatory
- NO and VIP are inhibitory
- Phasically active muscles
- Periodic membrane depolarization