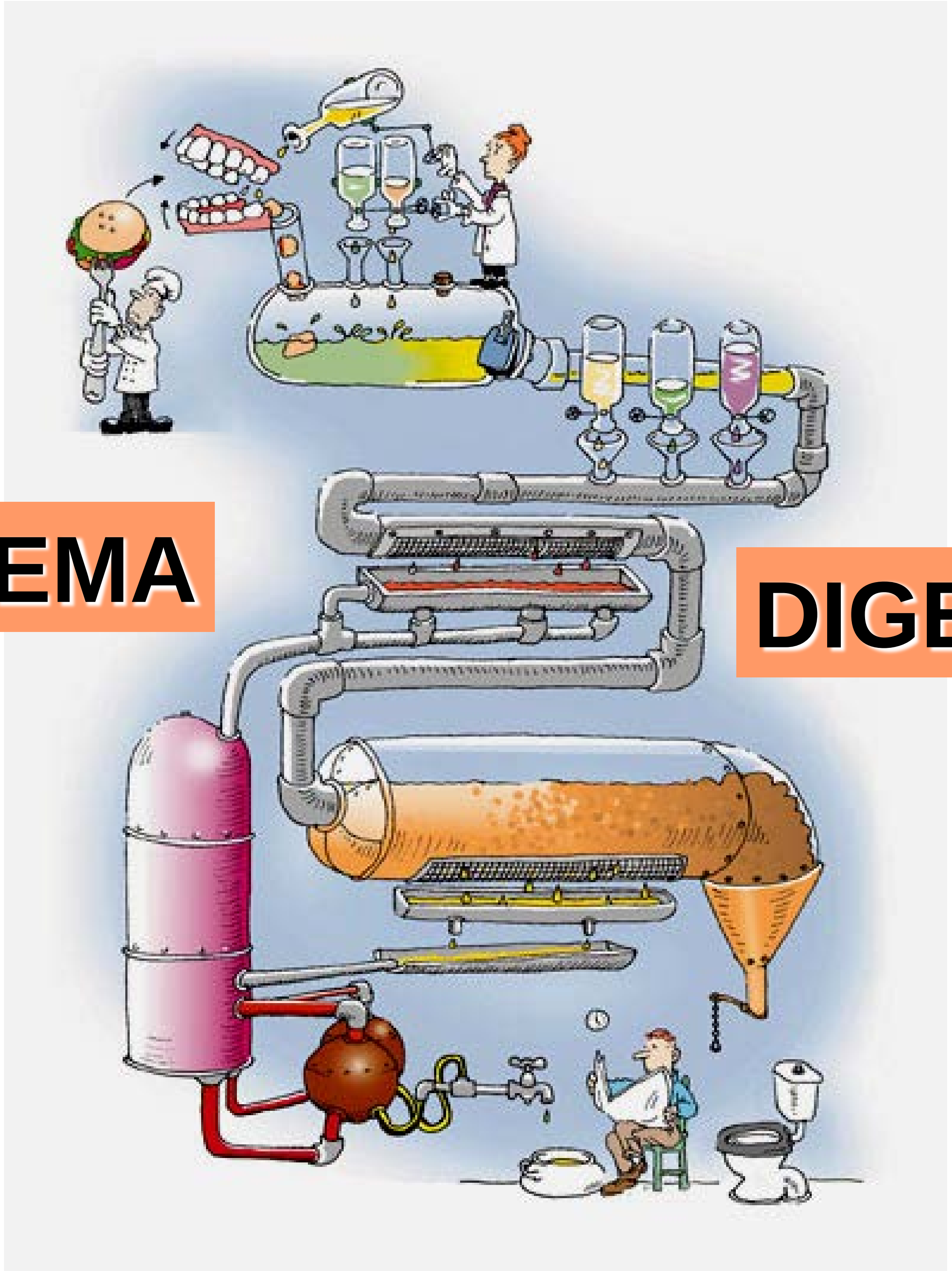


SISTEMA DIGESTÓRIO

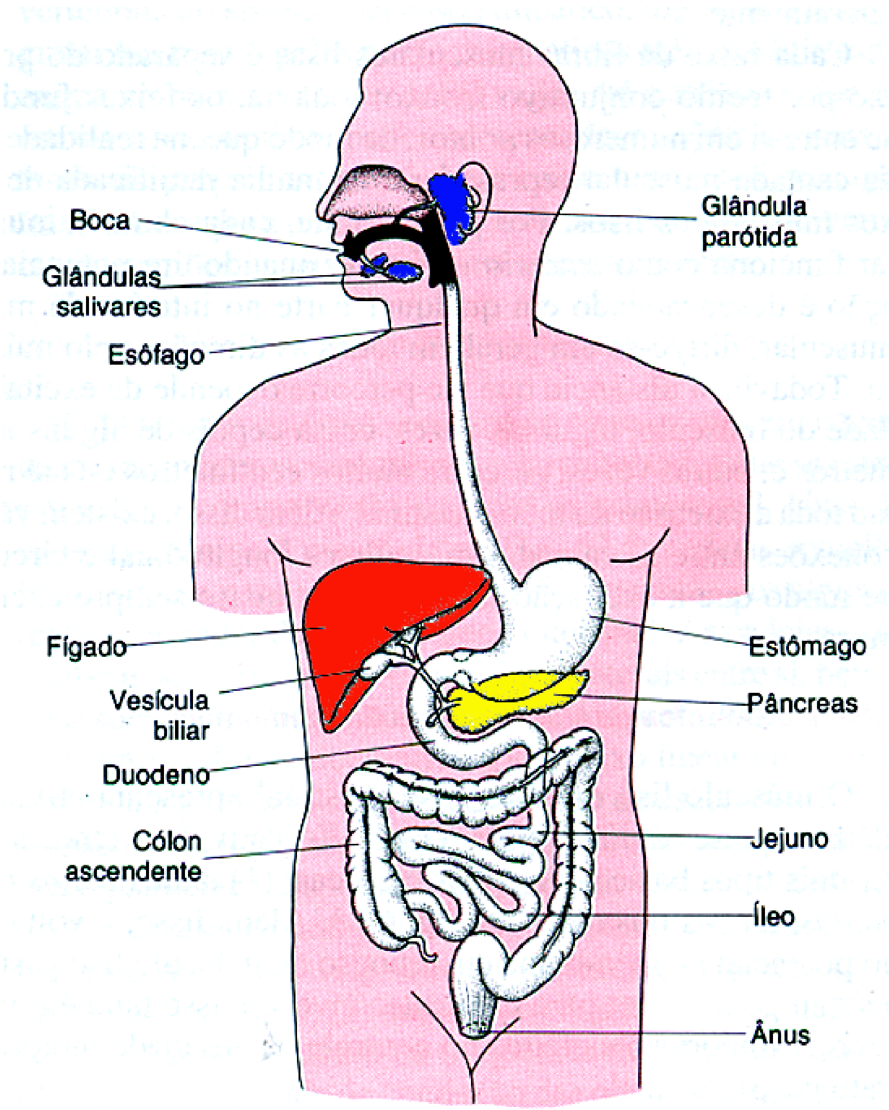
Bibliografia recomendada
Livros-textos:

“Fisiologia” Aires, 2012. Ed. Guanabara.

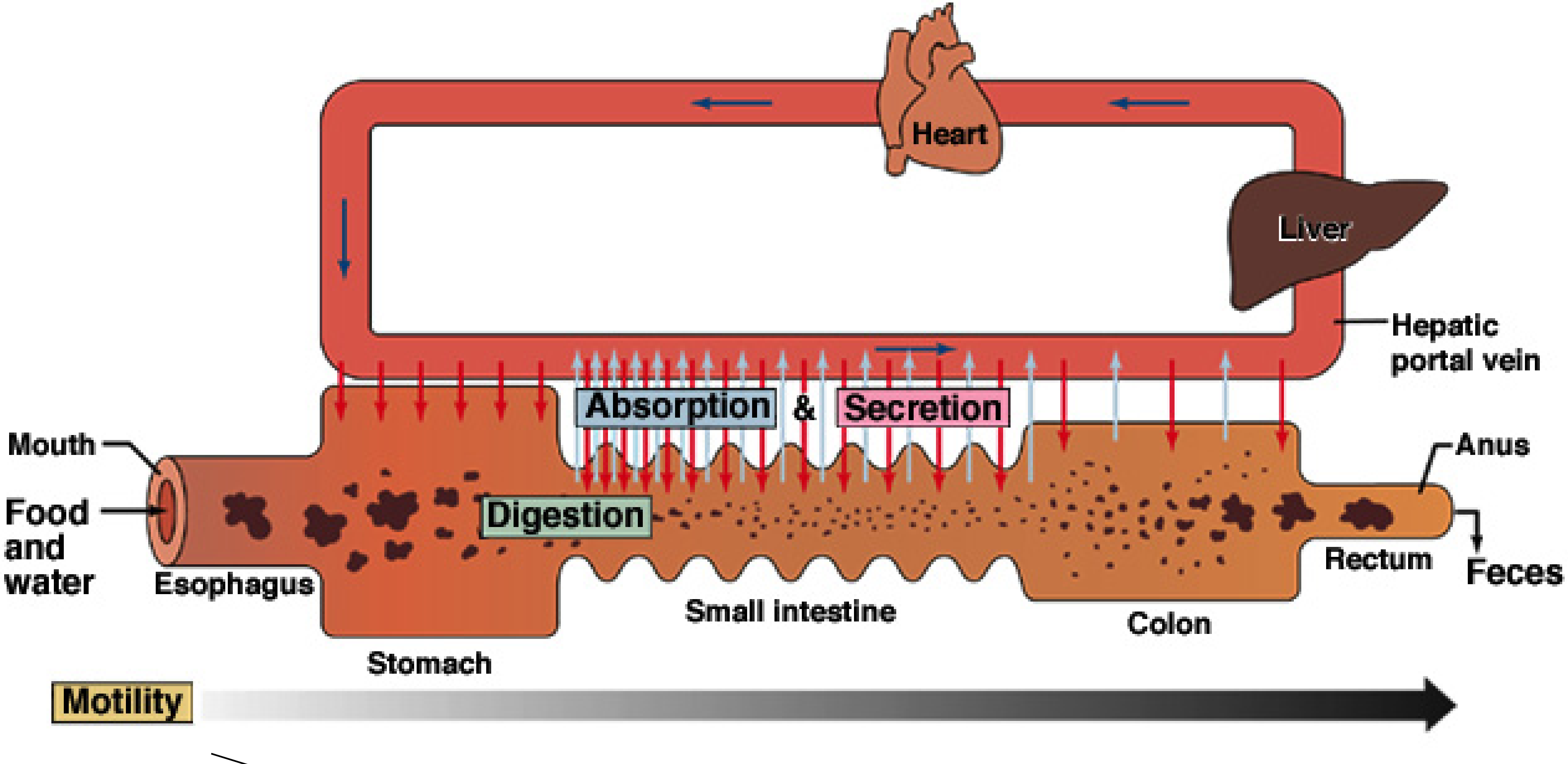
“Fisiologia Básica” Rui Curi & procópio, 2009
Ed. Guanabara Koogan

“Fisiologia” Berne, Levy, Stanton & Koeppen, 2009
Ed. Elsevier

Componentes do TGI

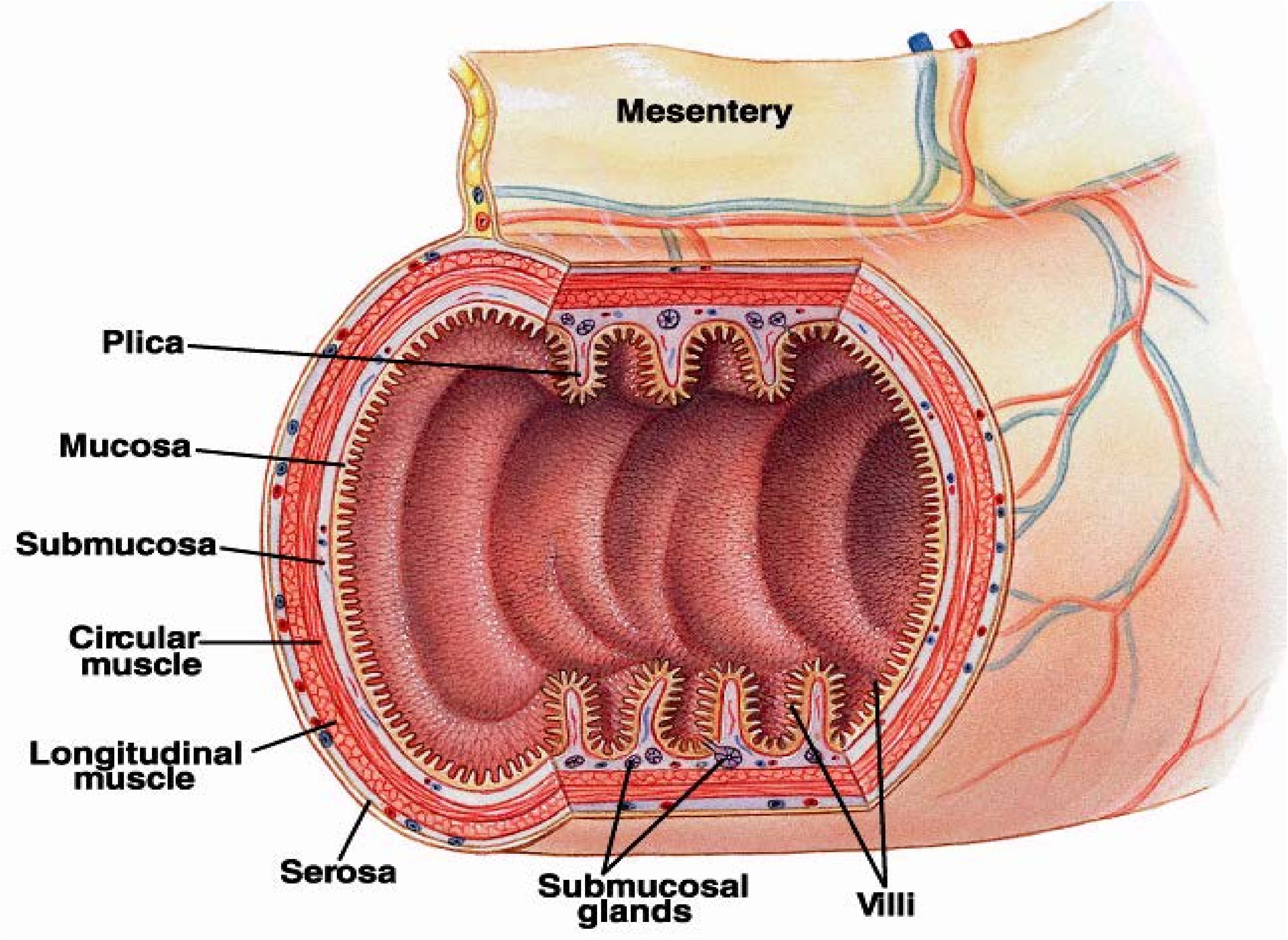


Funções e Regulação do TGI

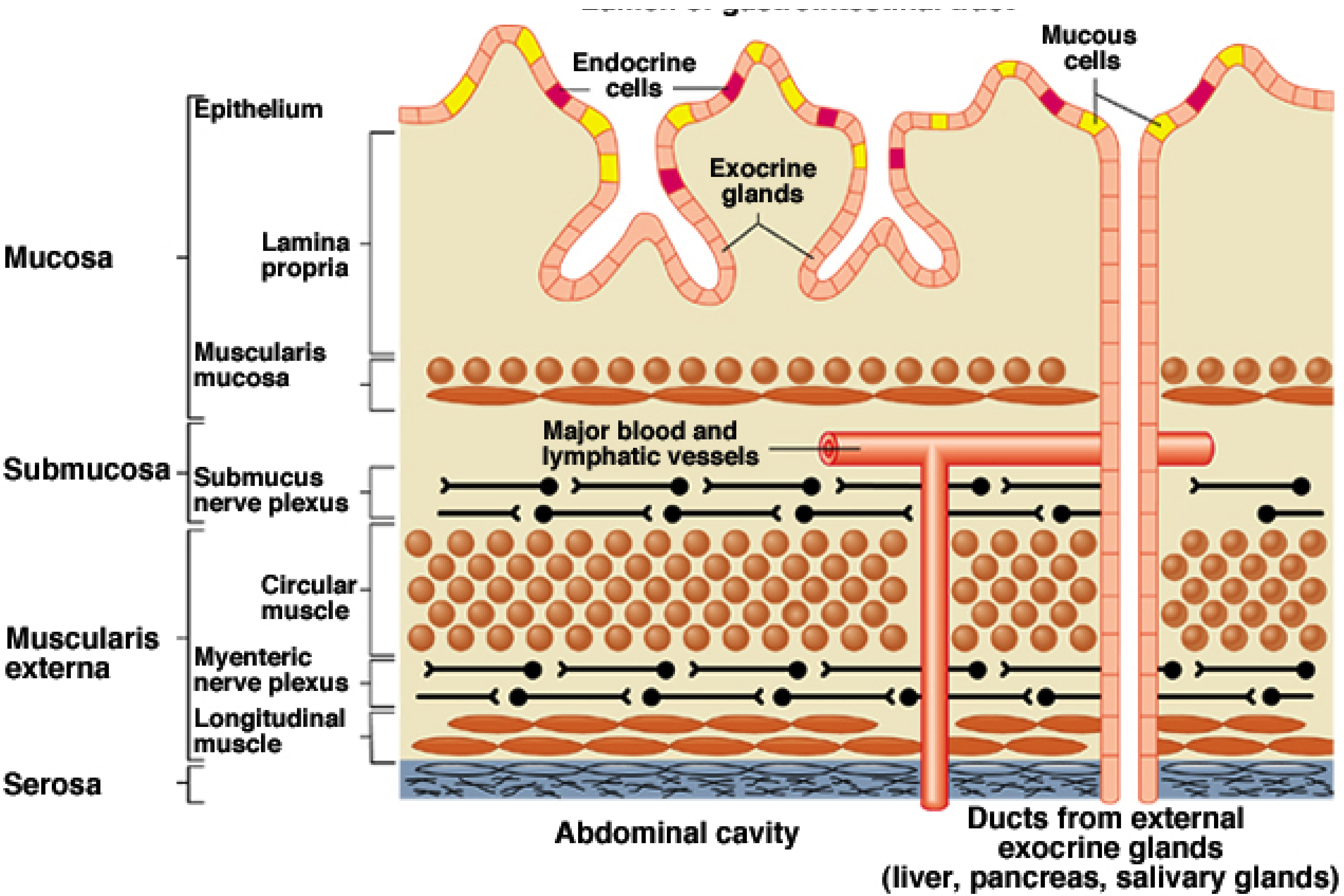


Mistura, trituração, propulsão e excreção

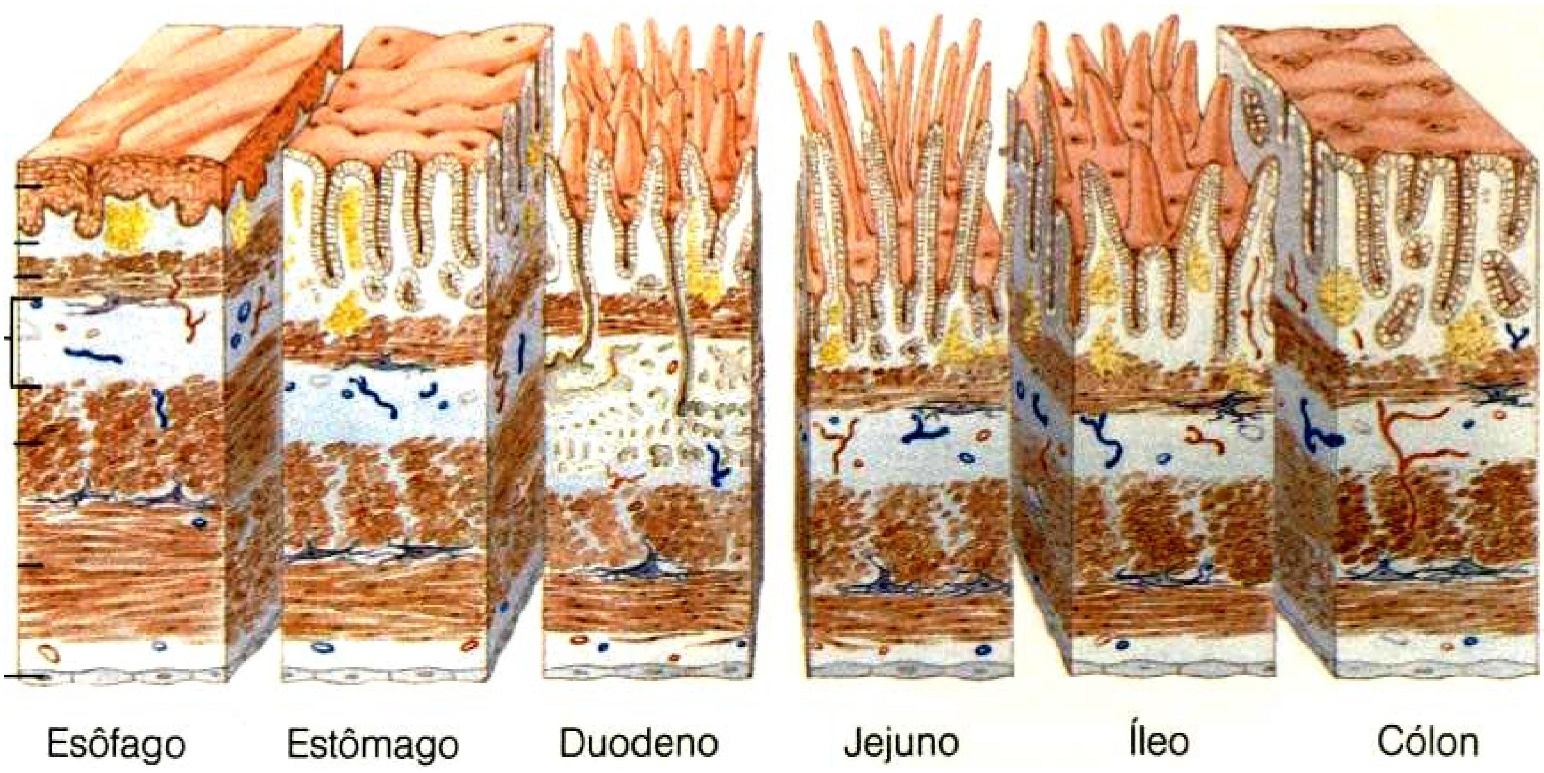
Parede do TGI



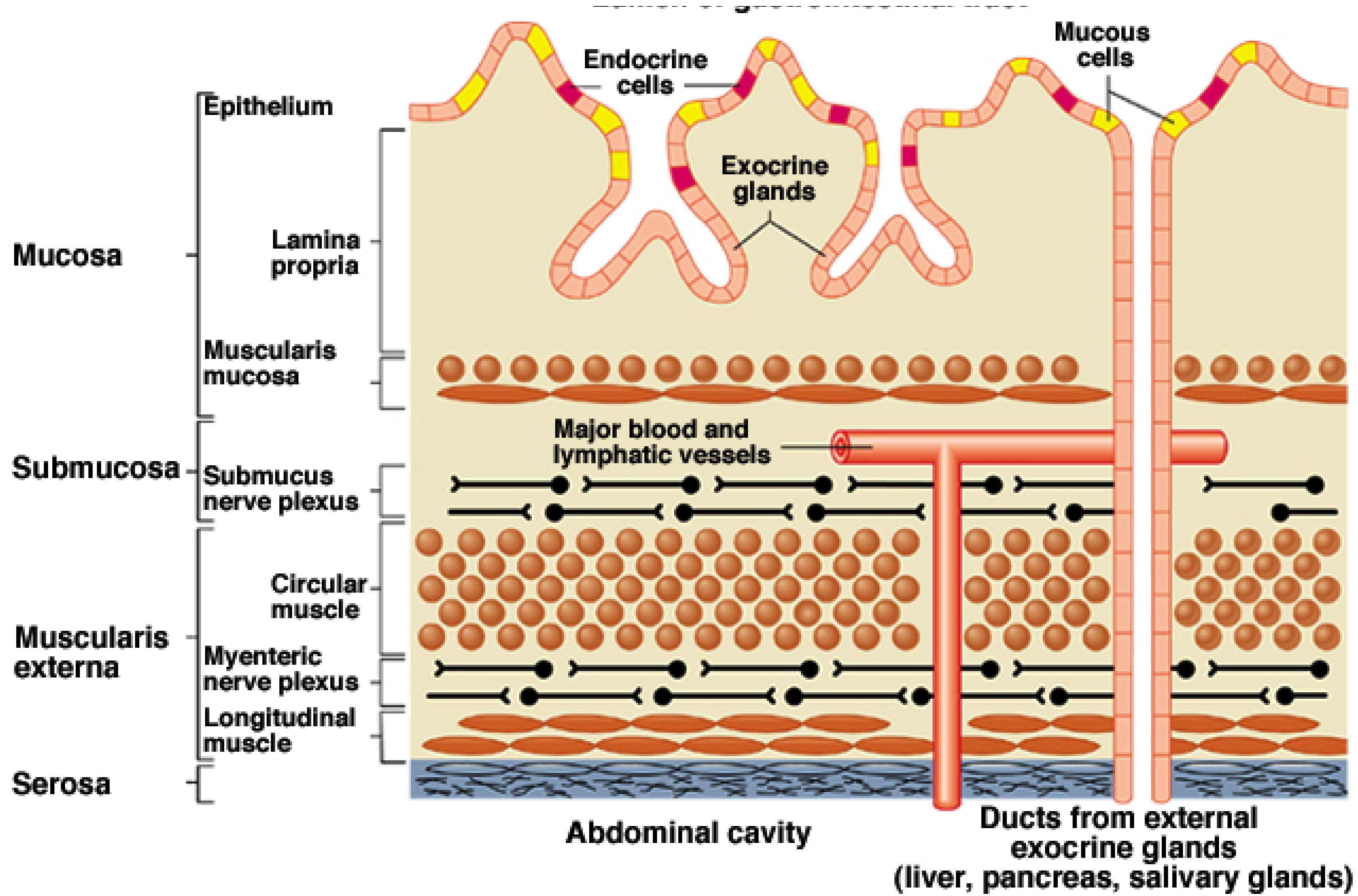
O tubo digestivo e suas principais estruturas



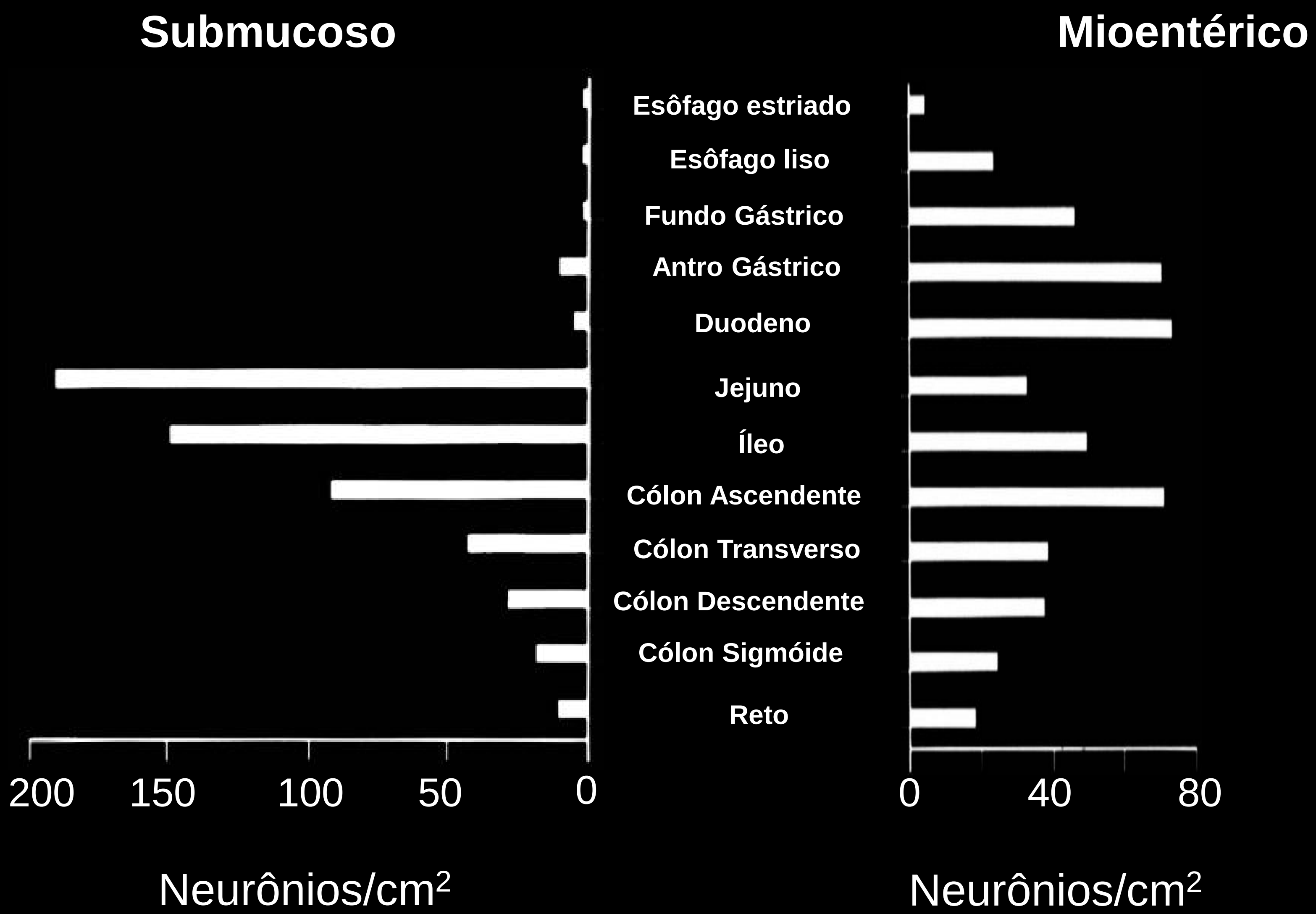
TIPOS DE EPITÉLIO DO TGI



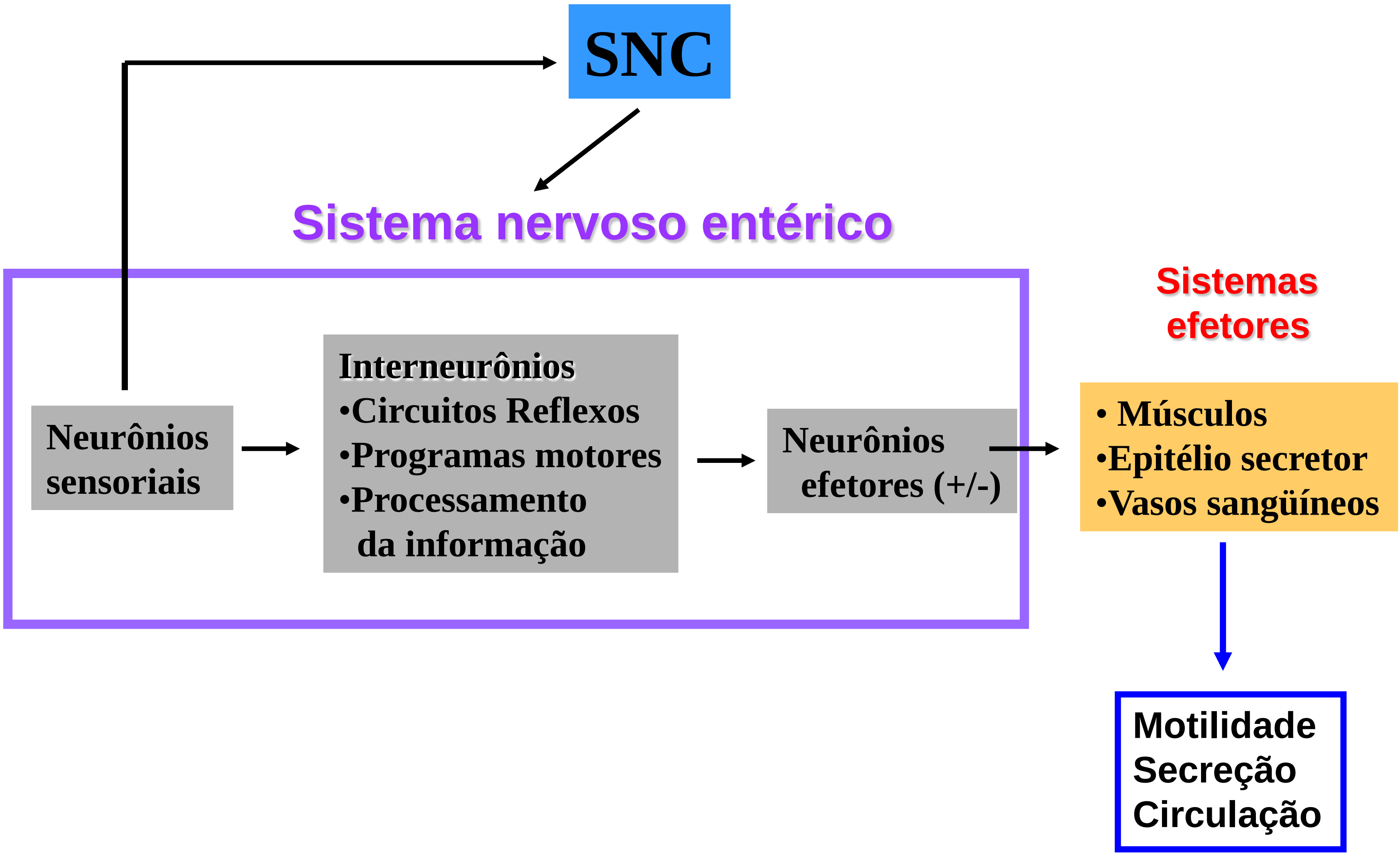
O tubo digestivo e suas principais estruturas



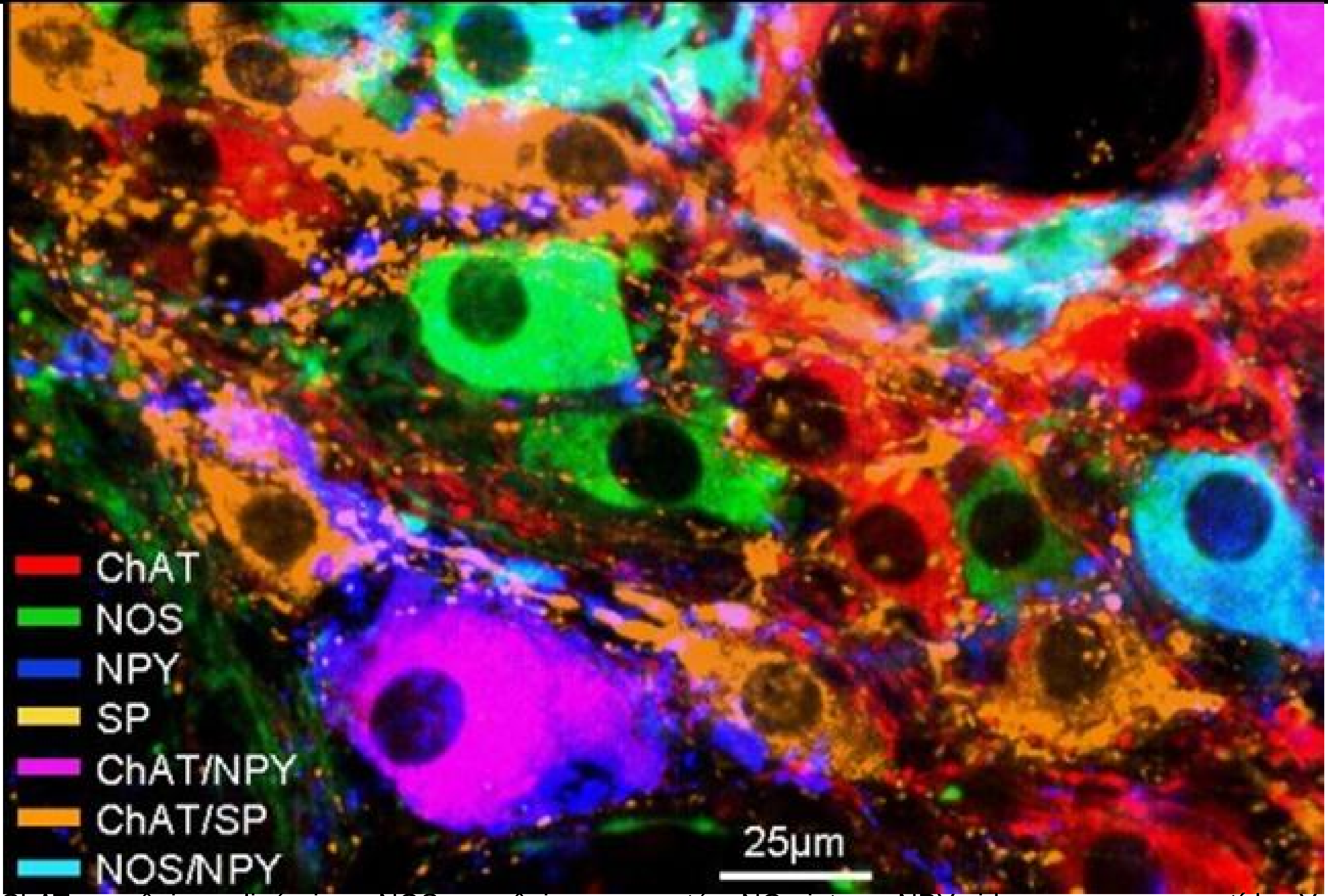
O PEQUENO CÉREBRO



Sistema nervoso entérico



Gânglio do Sistema Nervoso Entérico com neurônios marcados por diferentes técnicas imuno-histoquímicas.



ChAT: neurônios colinérgicos, NOS: neurônios que contém NO-sintase; NPY: idem para neuropeptídeo Y; SP: idem para substância P; ChAT/NPY: neurônio com dupla marcação para ChAT e NPY (colocalização); ChAT/SP: idem para ChAT e SP (colocalização) e NOS/NPY: idem para NO-sintasee NPY (colocalização)

ALGUNS NEUROTRANSMISSORES OU NEUROMODULADORES DO TGI TIPO “NANC” (NÃO-ADRENÉRGICO/NÃO-COLINÉRGICO):

ANS neurotransmitters (NAN`s)	
Transmitter	***Functions***
nitric oxide (NO)	***Enteric neurones*** parasympathetic - important in erection and in gastric emptying. Activates guanylate cyclase.
vasoactive intestinal polypeptide (VIP)	***Enteric neurones*** (throughout the gastrointestinal tract). parasympathetic - co-release with ACh affects salivation; also in sympathetic cholinergic fibres.
neuropeptide Y (NPY)	***Enteric neurones*** Causes prolonged vasoconstriction.
serotonin (5HT)	important in ***enteric neurones*** (peristalsis)
gamma-amino butyric acid (GABA)	***Enteric interneurones***.
dopamine	***Enteric neurones*** May mediate vasodilatation in the kidney
Substance P	**Enteric neurones** sympathetic ganglia,
calcitonin gene related peptide (CGRP)	***Enteric neurones*** contributes to neurogenic inflammation

Megacólon

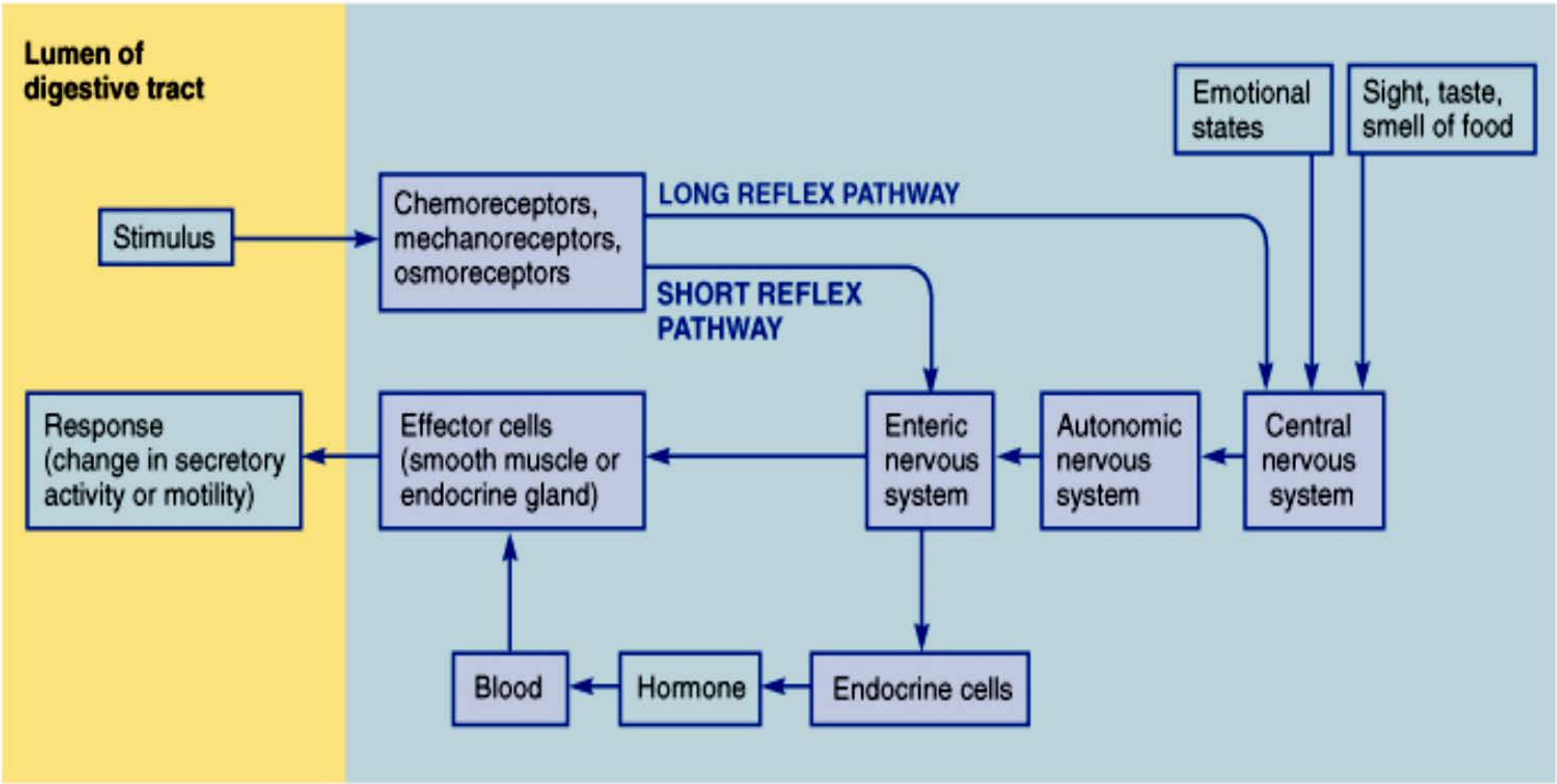
ALTERAÇÕES NEUROQUÍMICAS DO S.N.E. PODEM ESTAR ASSOCIADAS A PATOLOGIAS EM HUMANOS

Patologias	**Alterações do SNE associadas**
Crohn's disease *(doença inflamatória intestinal, DII)*	Increase in submucosal VIP neurones (...) increase in myenteric VIP, NOS and PACAP neurones in afflicted region (...)
Ulcerative colitis *(doença inflamatória intestinal, DII)*	Increase in myenteric SP neurones in inflamed and noninflamed region (...)
Diverticular disease *(cólon)*	Decrease in ChAT activity in fibers of muscle motor neurones
Severe IBS *(Síndrome do intestino irritável)*	neuronal degeneration, increased intraganglionic lymphocytes
Slow transit constipation	increase in myenteric NOS, VIP and PACAP neurones (...)
Achalasia	Decrease of intrinsic nerves including NOS (VIP/PACAP) in constricted and dilated portion of oesophagus (...)
Hirschsprung ***(aganglionose)***	**Loss of enteric neurones**
Hypertrophic pylorus stenosis	Decrease in myenteric NOS, VIP, CGRP and SP nerves
Diabetes	Decrease in NOS, VIP, PACAP fibers and increase in SP fibres in the jejunum
Chagas	**Decreased neurones in rectum and small bowel**
Parkinson	Decrease in myenteric dopamine neurones

The human enteric nervous system. Schemann. & Neunlist, 2004

para uma revisão breve, veja De Giorgio et al., 2004 Neurogastroenterology & Motility, 16, 143-147, 2004

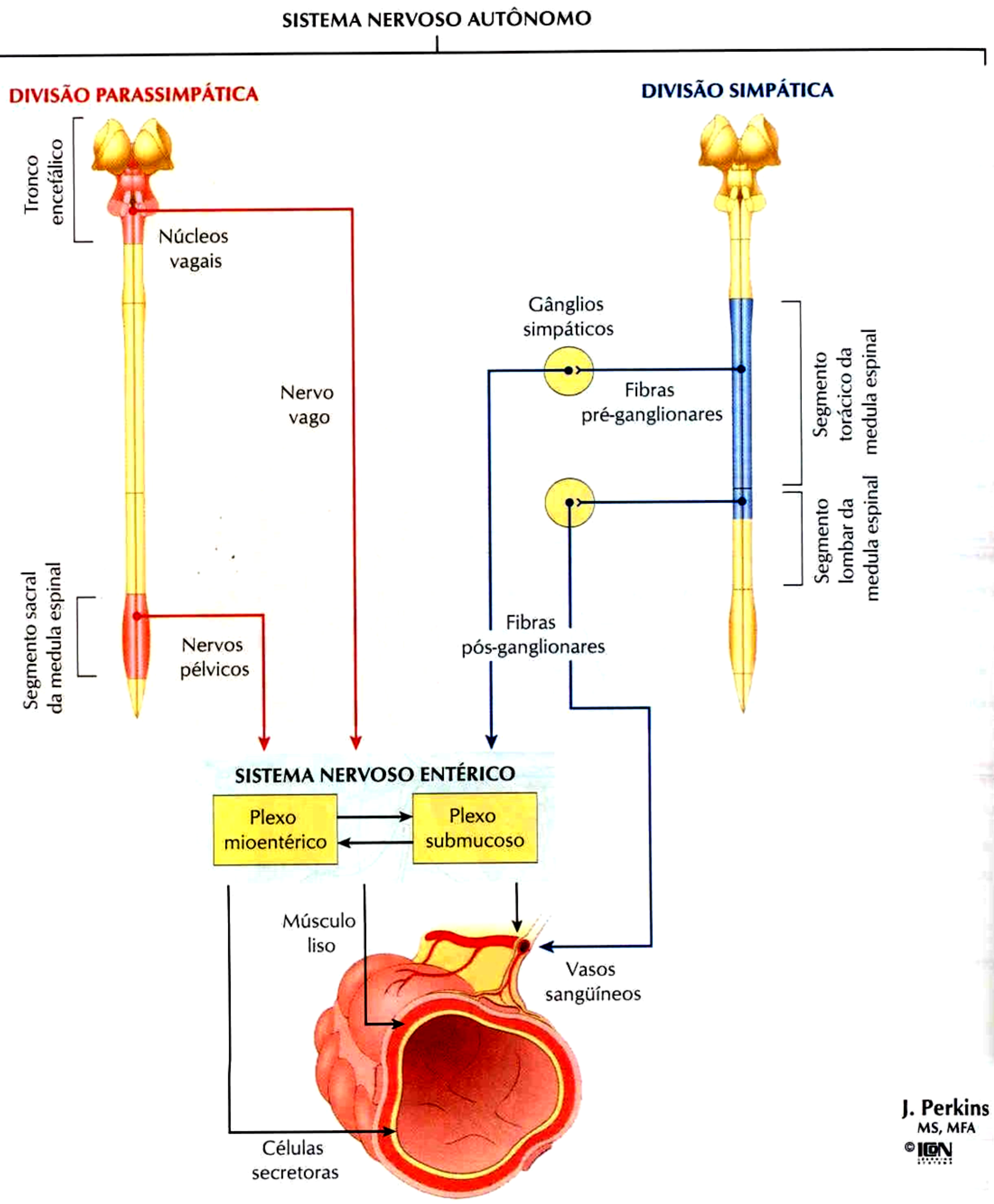
REFLEXOS



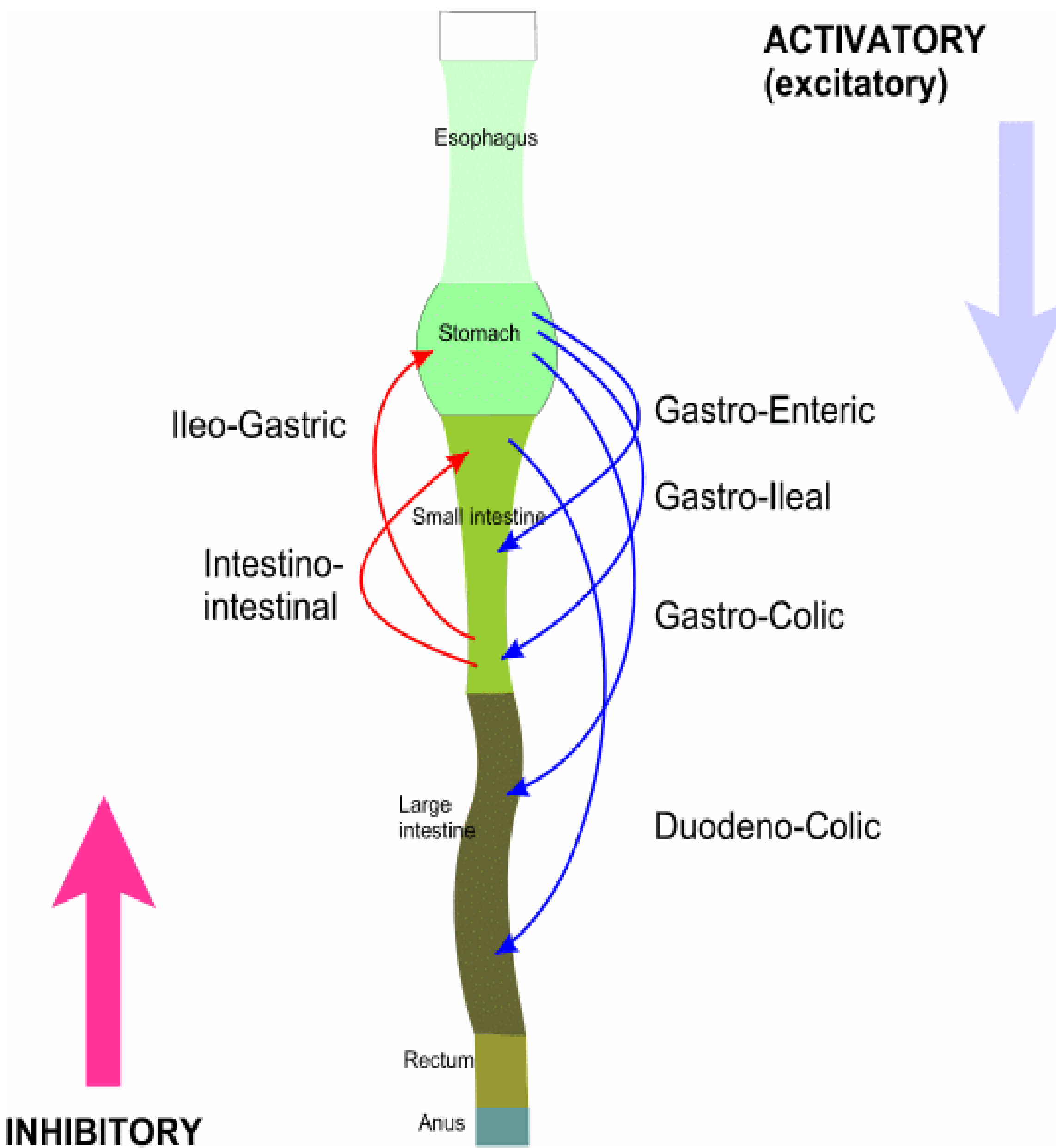
Lumen of digestive tract
Emotional states
Sight, taste, smell of food
Stimulus
Chemoreceptors, mechanoreceptors, osmoreceptors
LONG REFLEX PATHWAY
SHORT REFLEX PATHWAY
Response (change in secretory activity or motility)
Effector cells (smooth muscle or endocrine gland)
Enteric nervous system
Autonomic nervous system
Central nervous system
Blood
Hormone
Endocrine cells

Modulação das atividades do Sistema Digestivo:

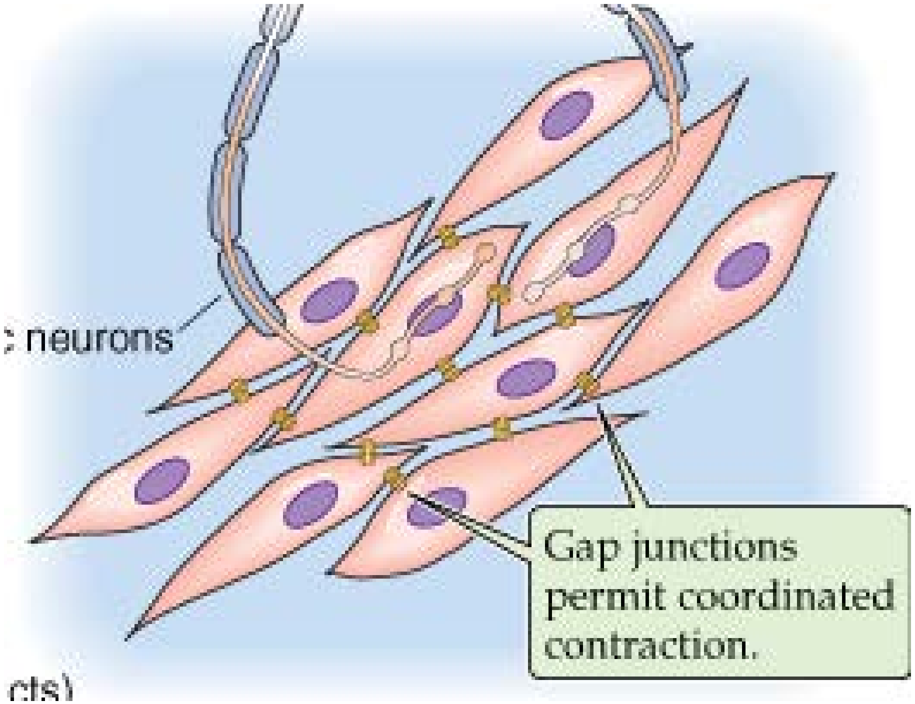
PS e SP



http://www.icb.ufmg.br/%7Efib/Seminario%20Gastro/Fisiologia.htm#um

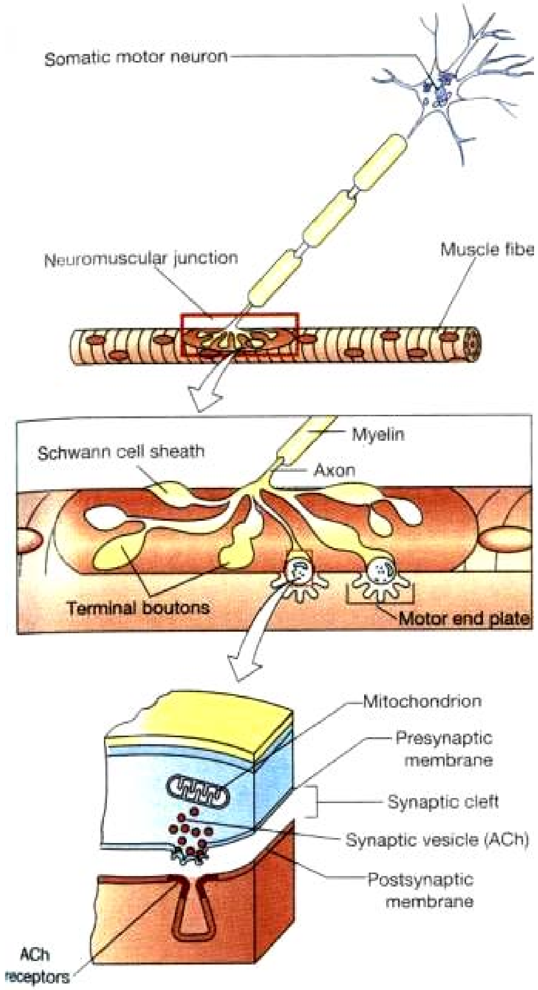

ACTIVATORY
(excitatory)
Esophagus
Stomach
Ileo-Gastric
Gastro-Enteric
Gastro-Ileal
Small intestine
Intestino-
intestinal
Gastro-Colic
Large
intestine
Duodeno-Colic
Rectum
Anus
INHIBITORY

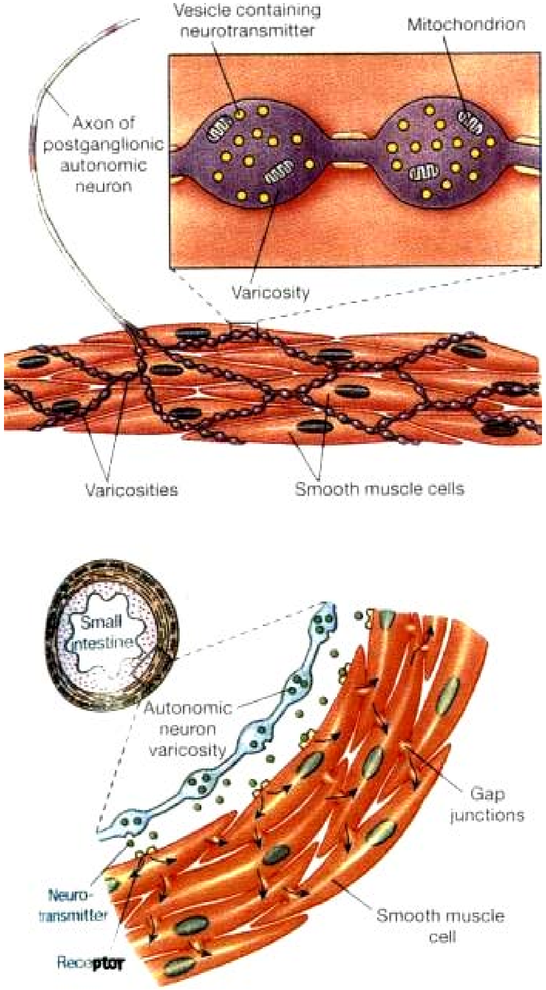
Músculo Lisa Visceral Unitária do TGI



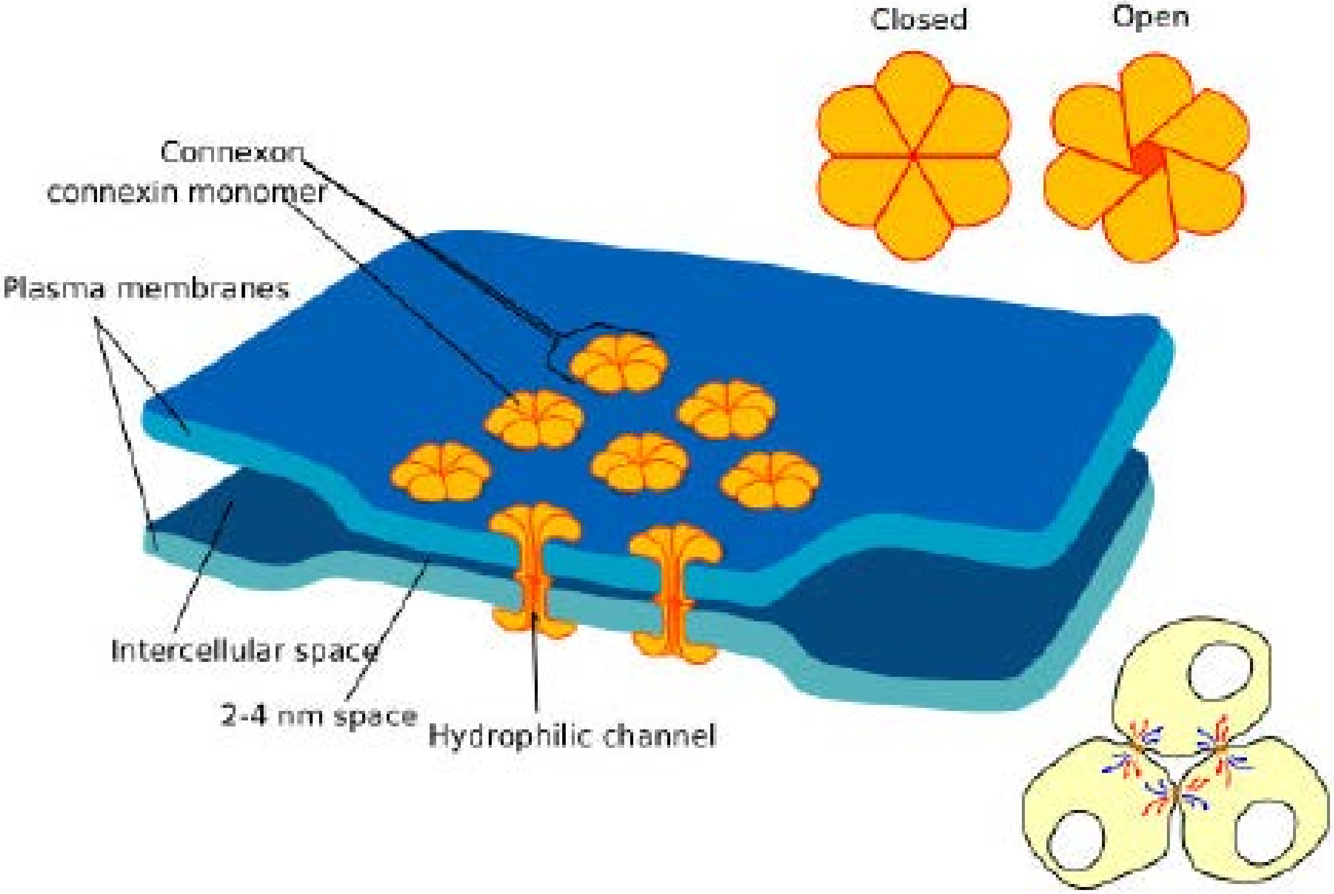
Músculo Esquelético

Músculo Liso

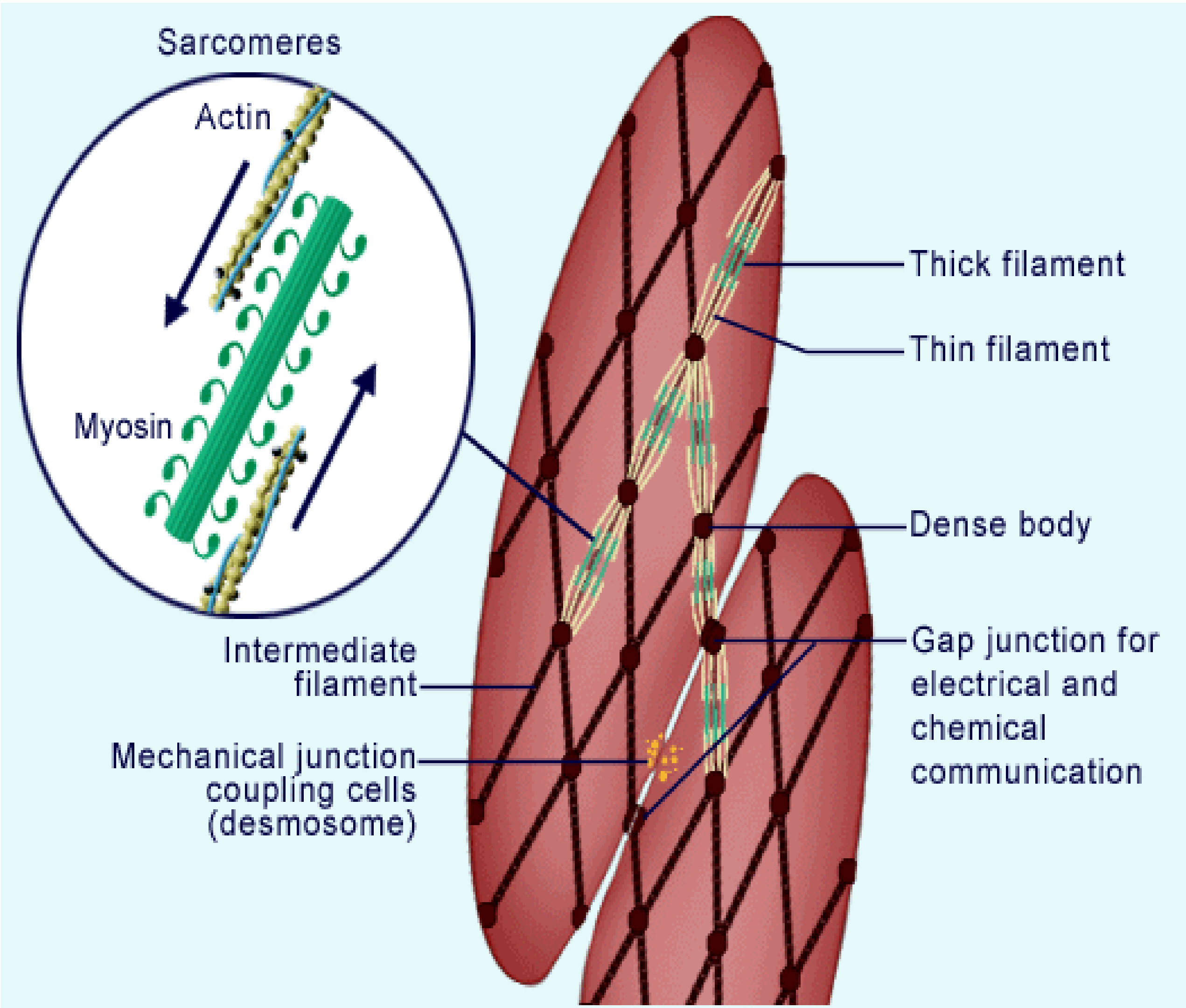


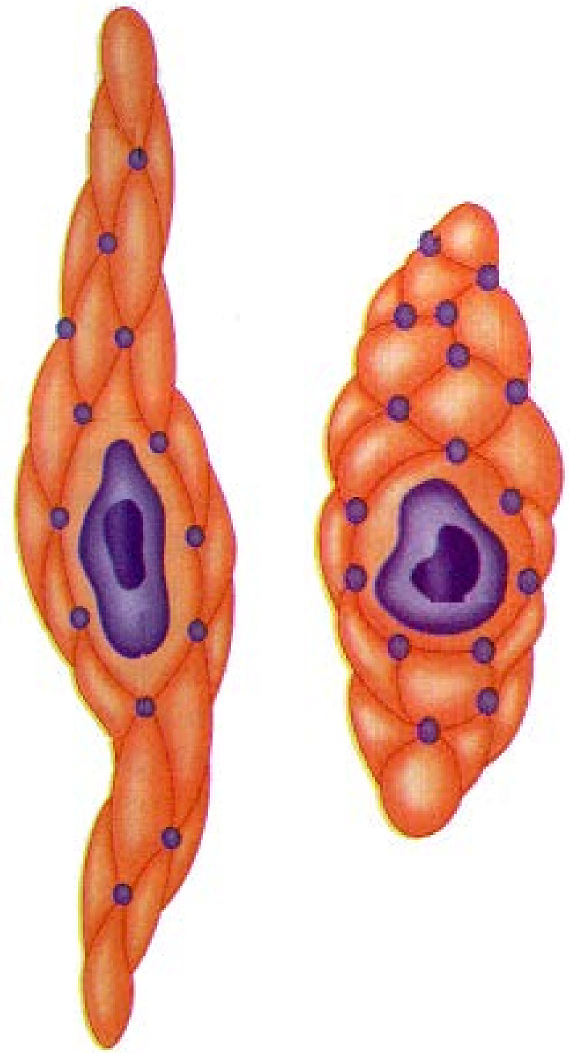


GAP JUNCTIONS



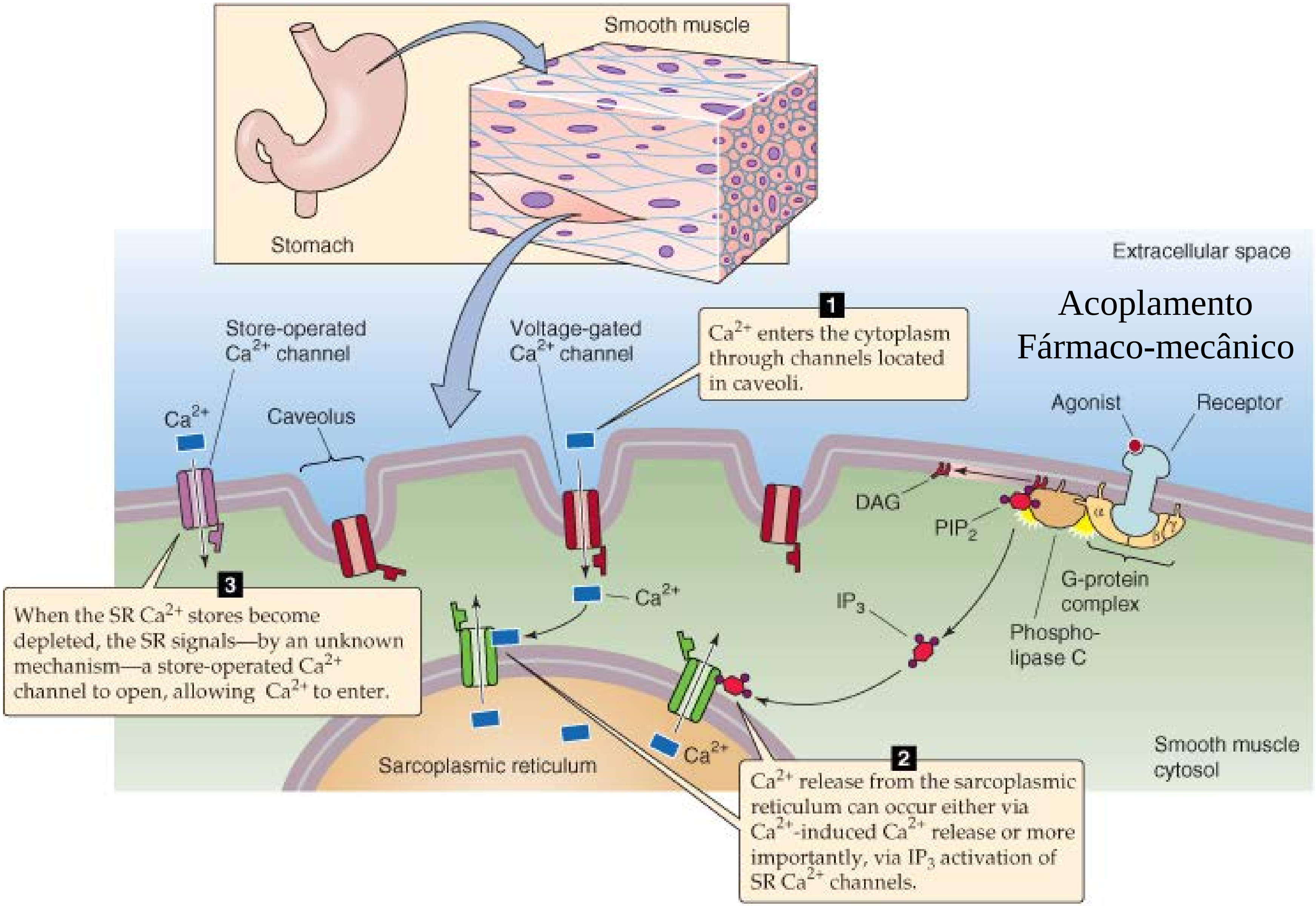
Características do músculo liso



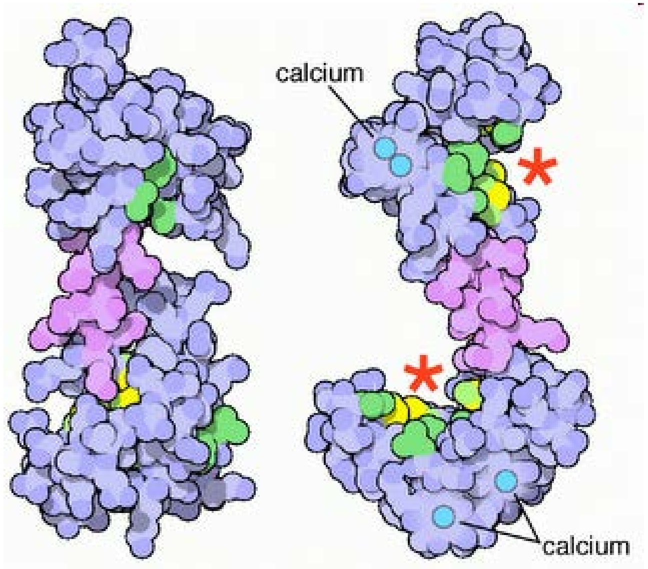


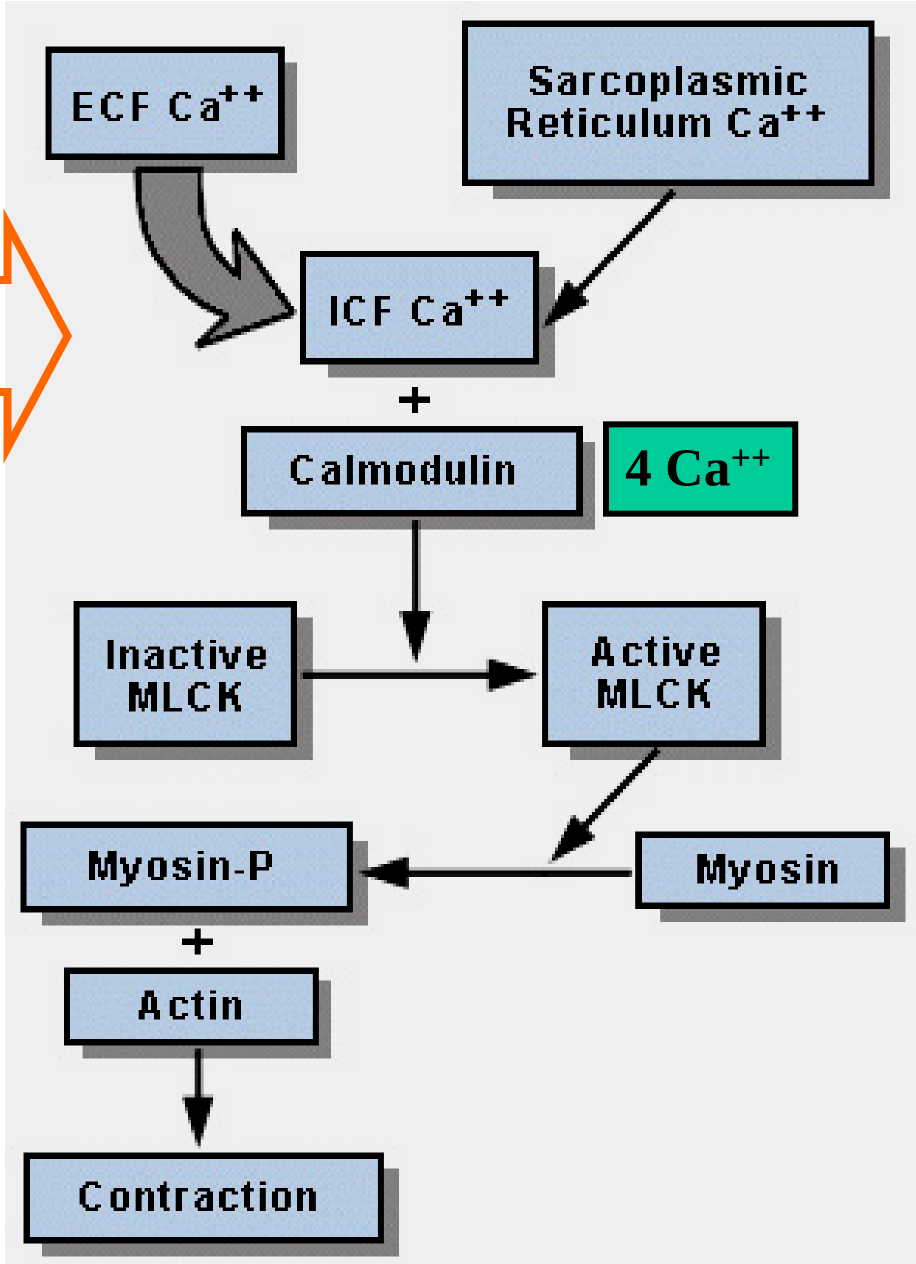
Papel central do Cálcio extracelular na contração da musculatura visceral

Acoplamento Fármaco-mecânico



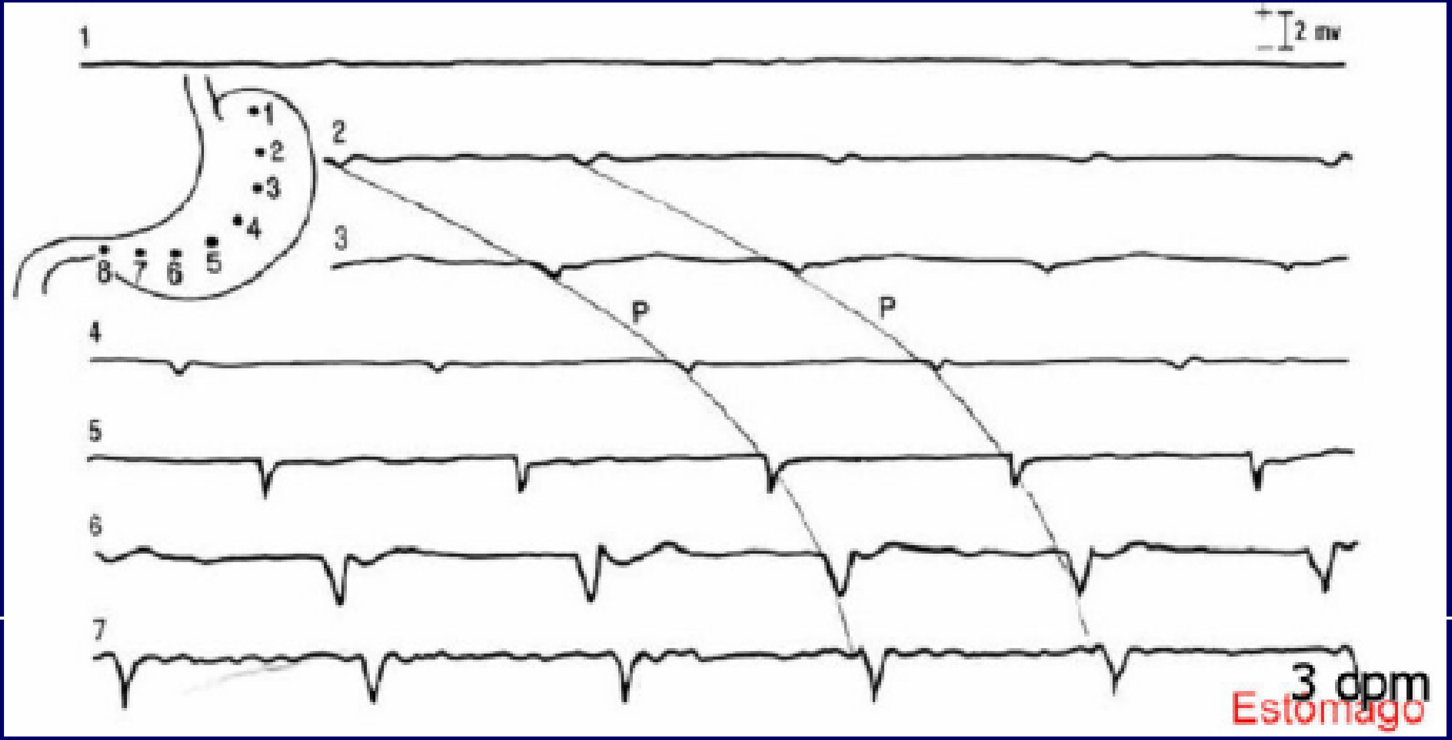
Estímulos: neural, hormonal e de estiramento





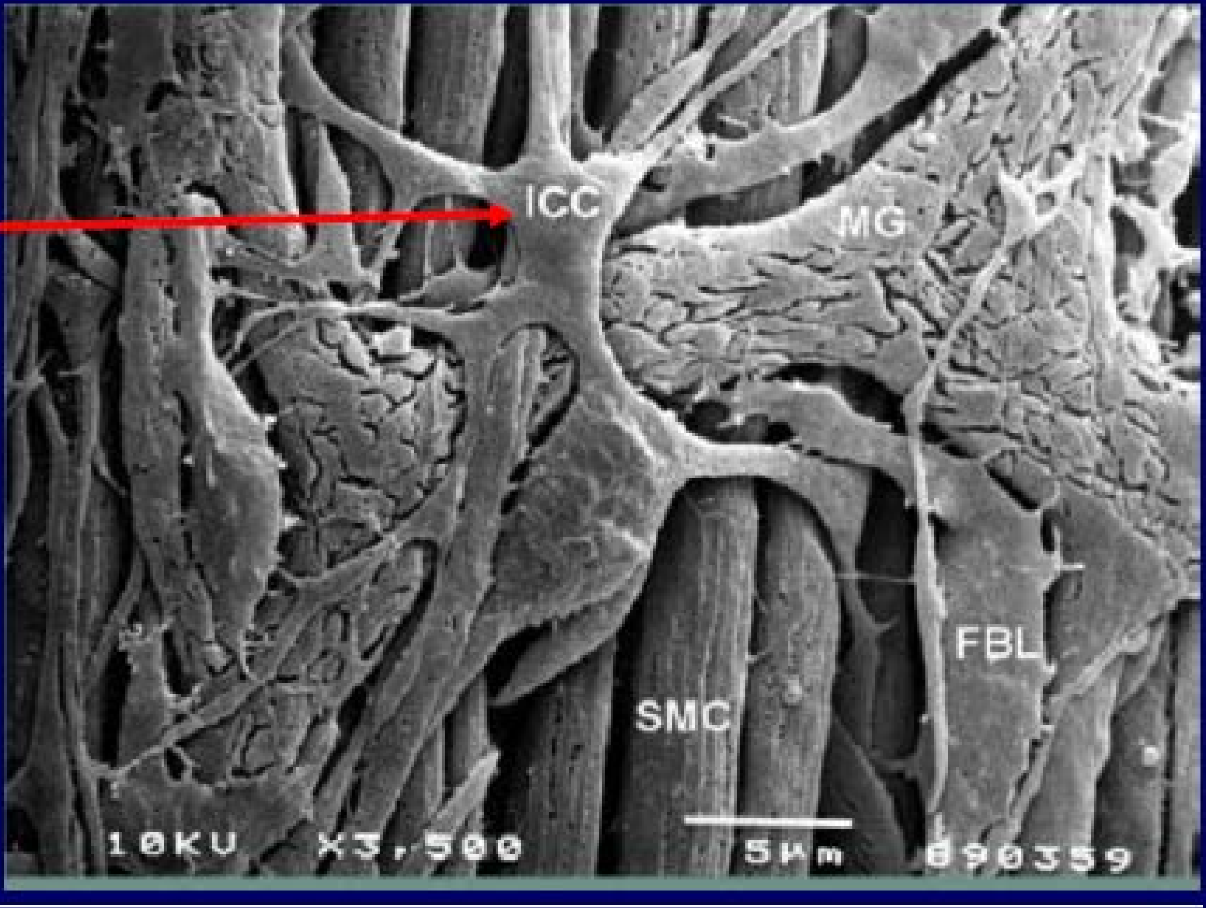
Ondas lentas

- Estão sempre presentes na musculatura gastrintestinal
- Ritmo elétrico básico
- Amplitude de 5 a 15 mV
- Freqüência de 3 a 12 por minuto

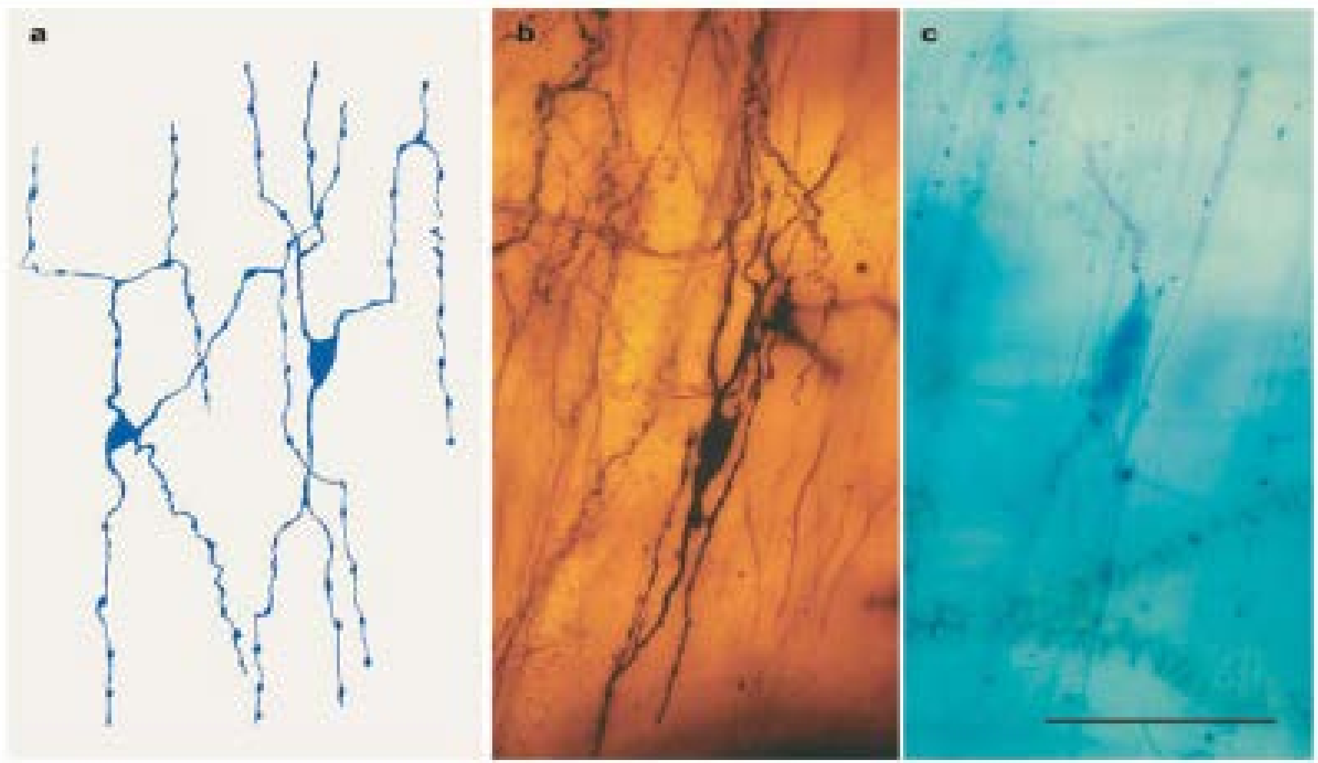


Ondas lentas: origem

Células intersticiais de Cajal



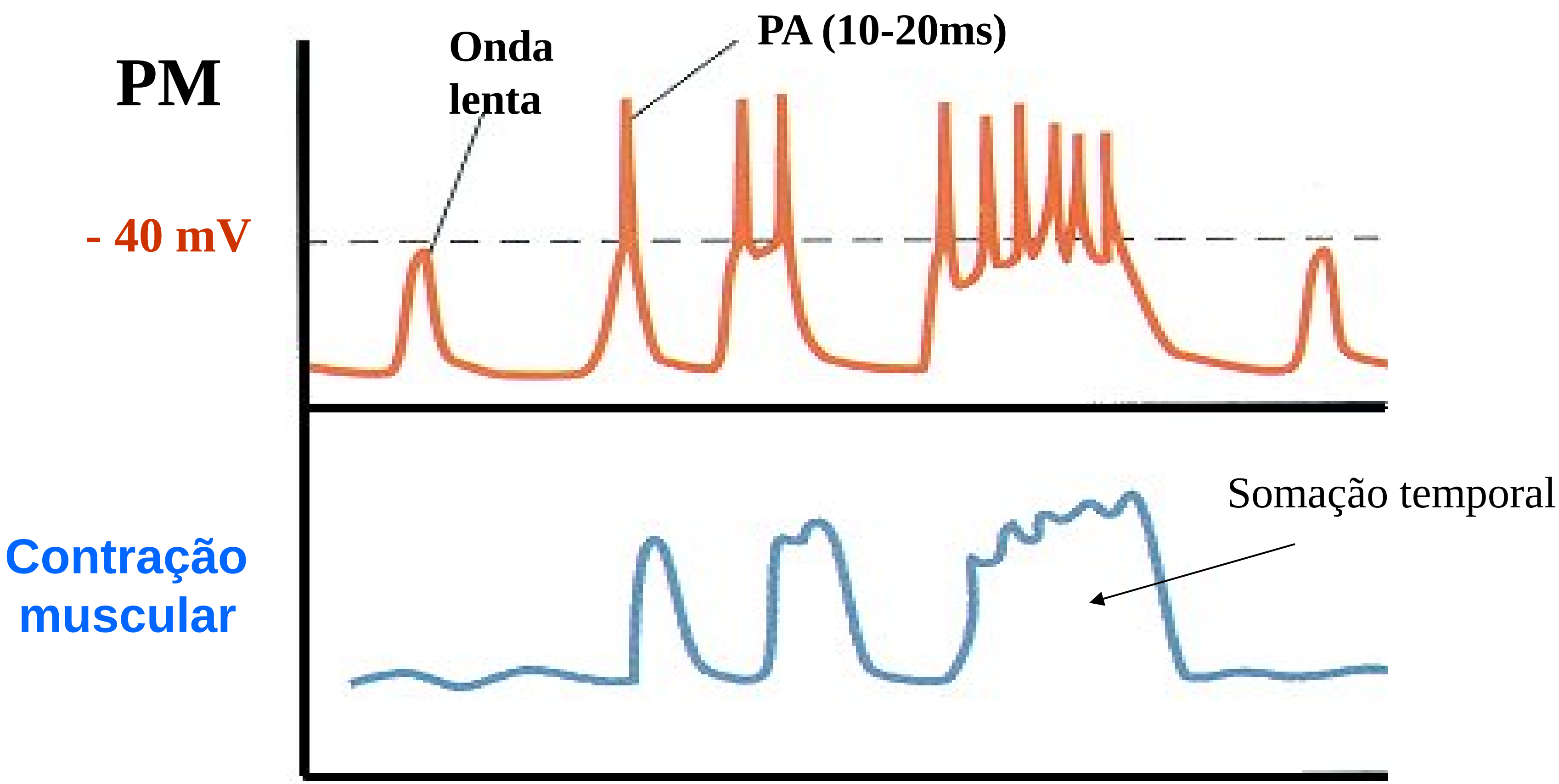
Células intersticiais de Cajal



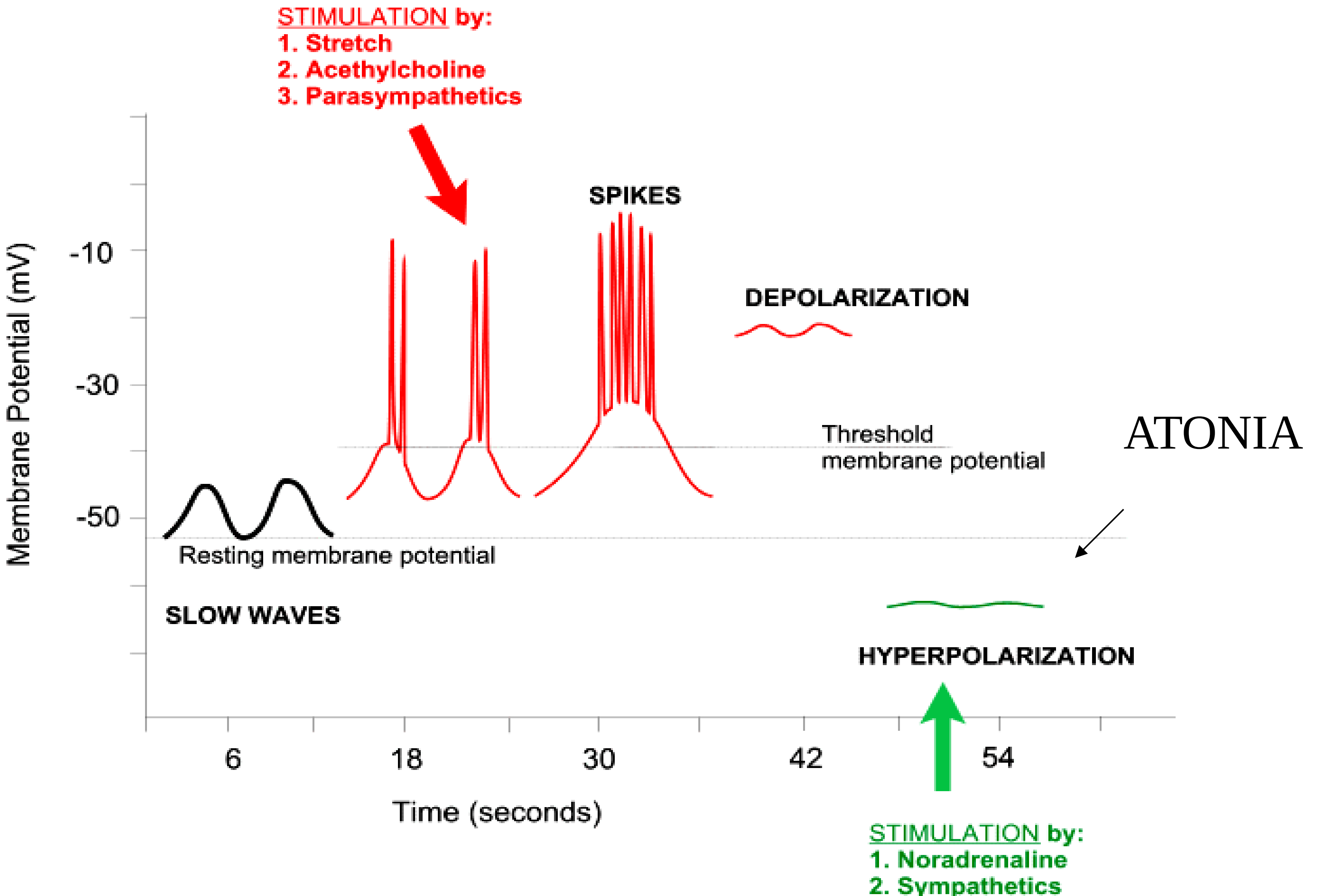
Nature Reviews | Cancer

Tipos de Atividades Elétricas

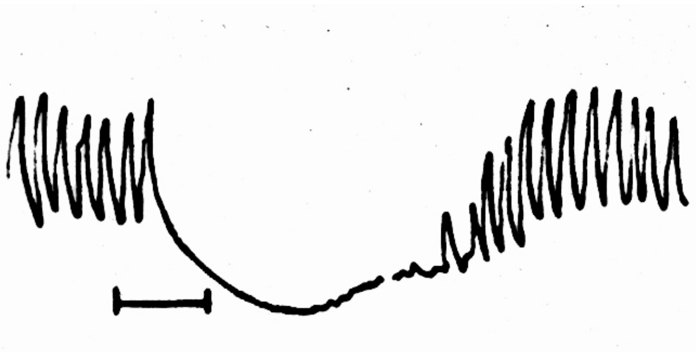
Ritmo elétrico básico (ondas lentas) e potenciais em ponta



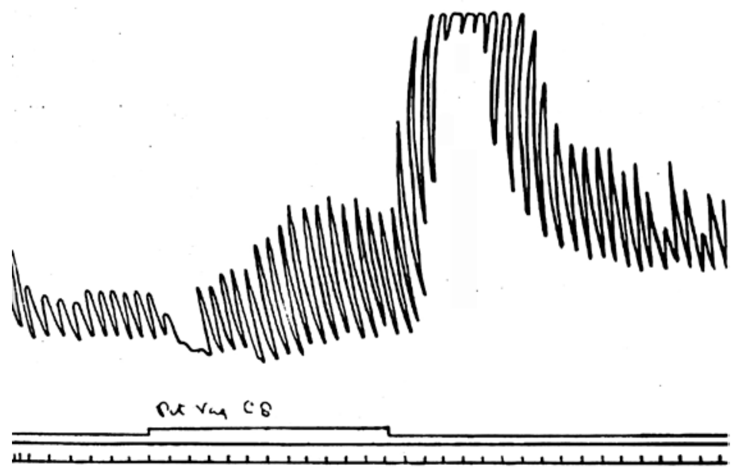
CARACTERÍSTICAS DO TGI



Esplâncnico



Vago



FATORES QUE INFLUENCIAM A ATIVIDADE CONTRÁTIL

- PARASSIMPÁTICO (ACh) (+)
- GASTRINA (+)
- CCK (+)
- INSULINA (+)
- SEROTONINA (+)

- SIMPÁTICO (NOR) (-)
- GLUCAGON (-)
- SECRETINA (-)
- Opiáceos (-)

Ricinus communis

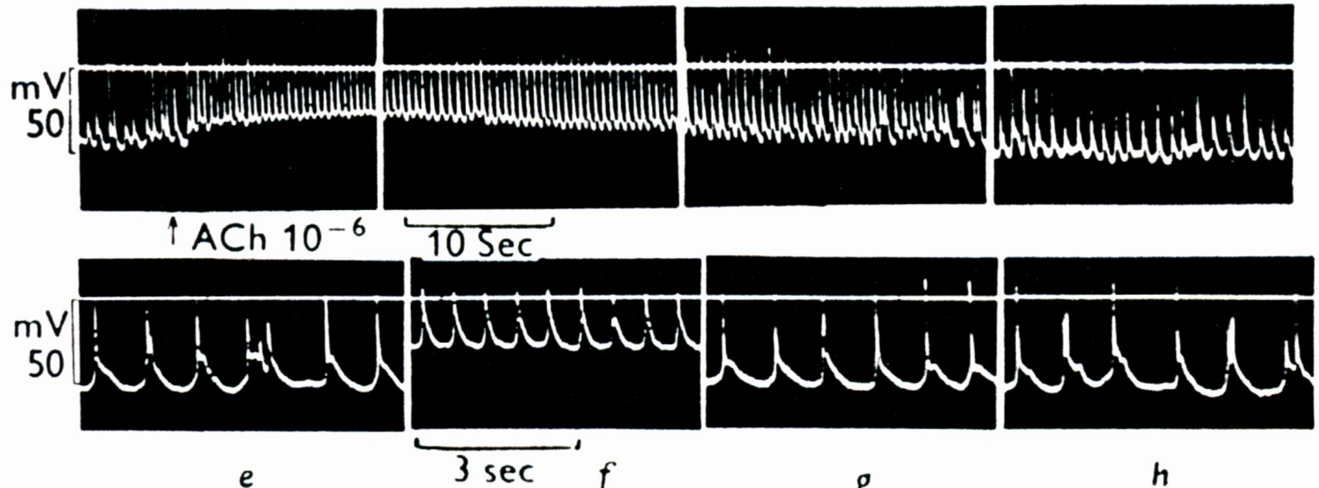


FIG. 453. The effect of acetylcholine on the membrane potential and electrical activity of tænia coli muscle. Top row: slow film speed, *a*, start of exposure to ACh; *b*, end of exposure to ACh; *c*, 70 sec. after removing ACh; *d*, 2 min. later. Bottom row: fast film speed, *e*, before ACh, *f*, at peak, *g*, 80 sec. after removing ACh, *h*, 2 min. later, (Bülbring & Kuriyama. *J. Physiol.*)

FIG. 454. The action of adrenaline on membrane potential, electrical activity and tension (top record) of the guinea pig tænia coli muscle. (Bülbring & Kuriyama. *J. Physiol.*)

PADRÕES DE COMPORTAMENTO MOTOR

MASTIGAÇÃO

DEGLUTIÇÃO

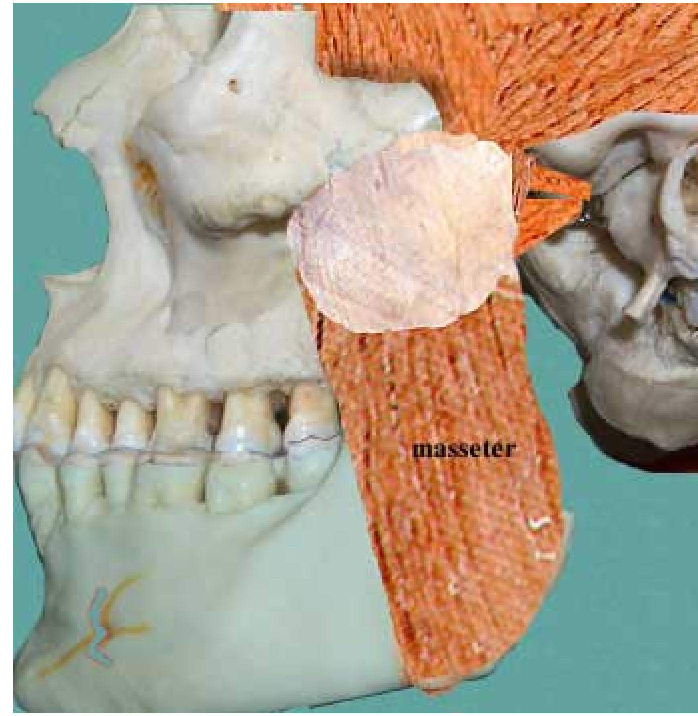
MOTILIDADE GÁSTRICA

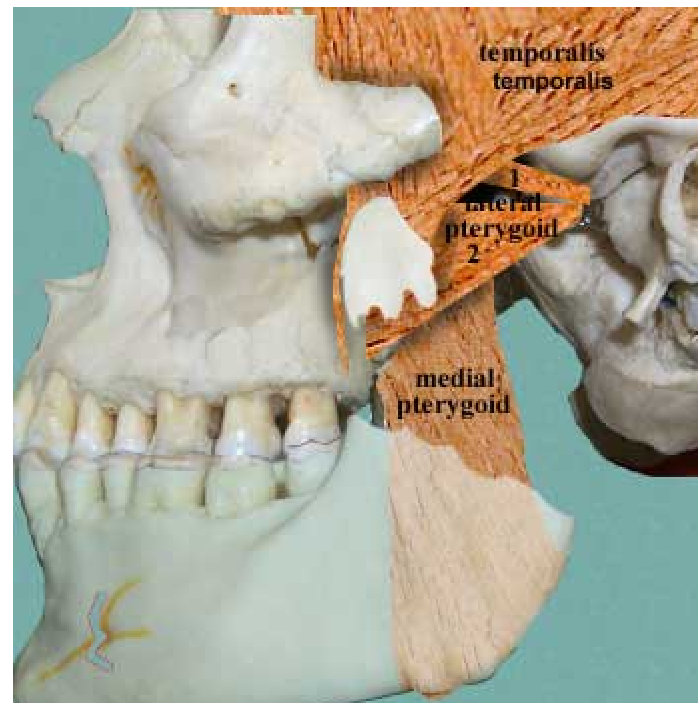
MOTILIDADE DO INTESTINO DELGADO

MOTILIDADE DO INTESTINO GROSSO E DEFECAÇÃO

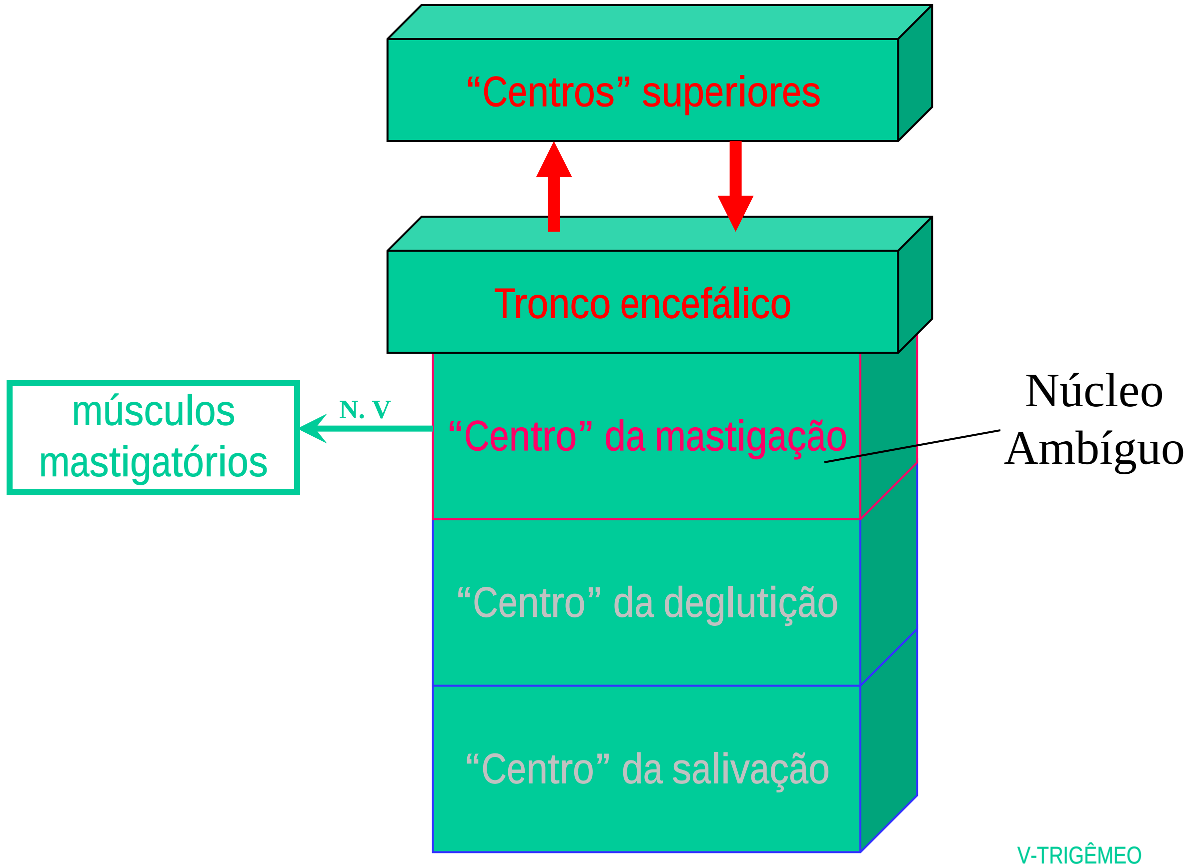
MÚSCULOS ENVOLVIDOS NA MASTIGAÇÃO

-masseter
-pterigoideo medial
-pterigoideo lateral *
-temporalis





http://mywebpages.comcast.net/wnor/lesson4.htm



Pedersen,et al., 2002.

Mastigação: reflexo mastigatório

Bolo alimentar

↓

Pressão contra palato → Inibição músculos de fechamento

↓

Queda mandíbula

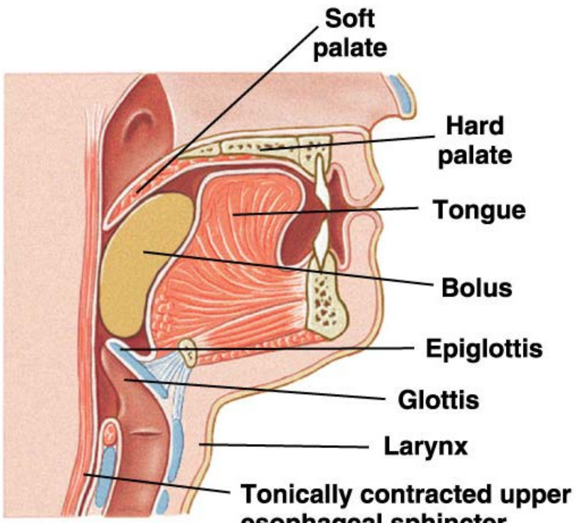
↓

Estiramento muscular → Contração reflexa

↓

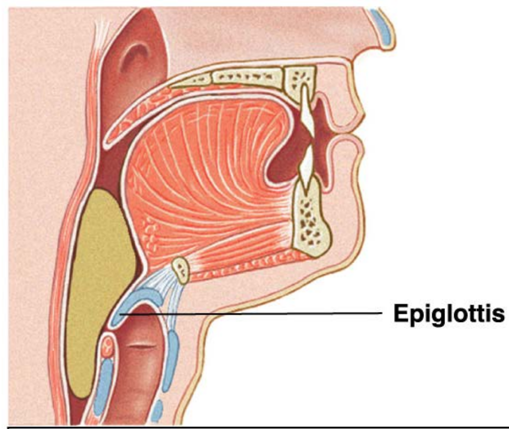
Eleva mandíbula → Pressão contra palato

Principais eventos que participam do reflexo da deglutição



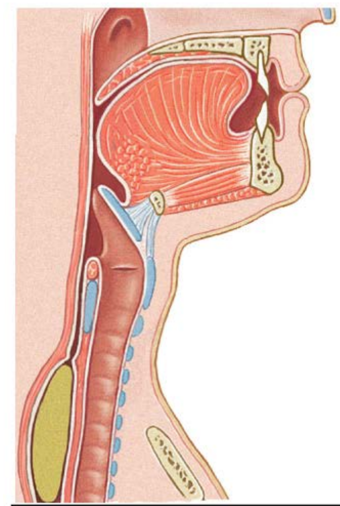
1. Tongue pushes bolus against soft palate and back of mouth, triggering swallowing reflex.

Fase oral (voluntária)



2. Upper esophageal sphincter relaxes while epiglottis closes to keep swallowed material out of the airways.

Fase faríngea (1 seg)



3. Food moves downward into the esophagus, propelled by peristaltic waves and aided by gravity.

Fase esofágica (10seg)

a,

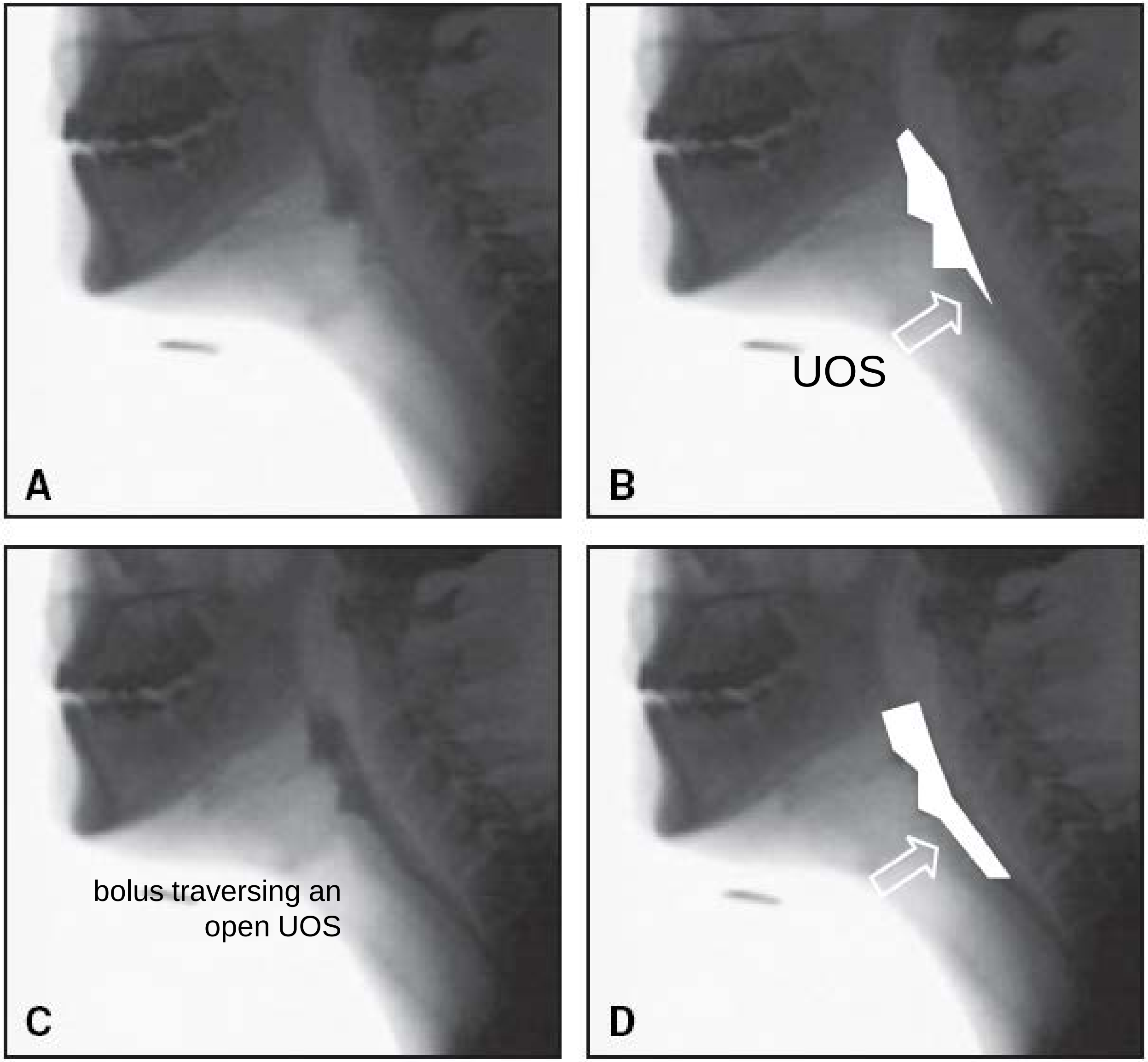
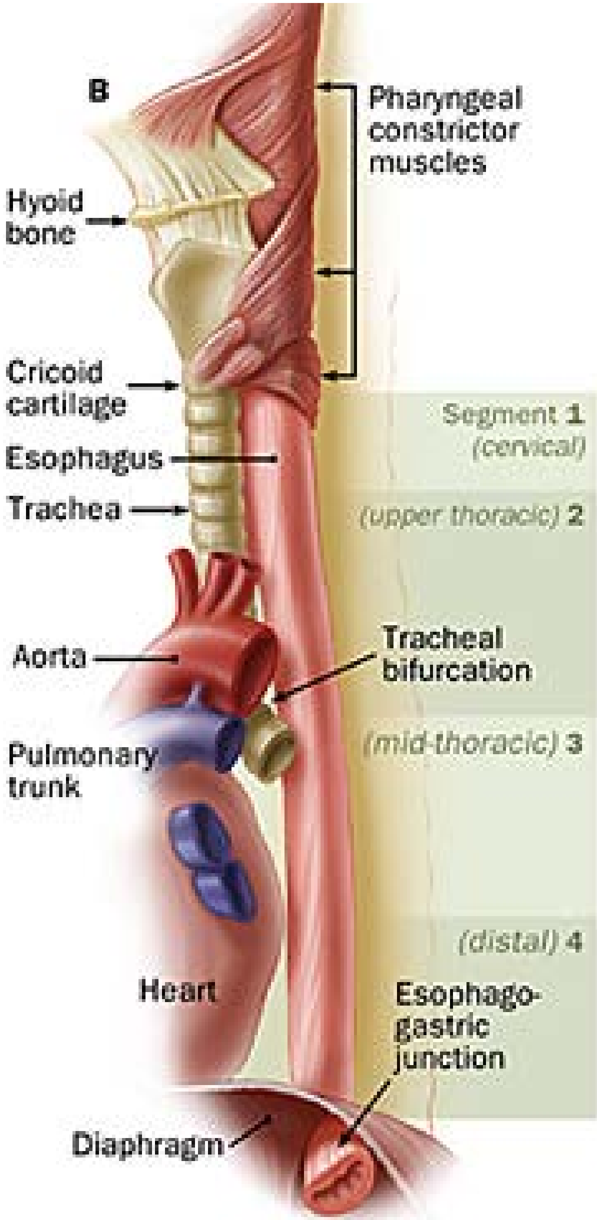


Figure 2 Lateral fluoroscopic images as barium is swallowed.
Image A shows the head of the bolus as it indents the upper oesophageal sphincter (UOS).
Image B is identical but annotated. The barium is highlighted and an arrow indicates the UOS.
Images C and D are also paired to show the bolus traversing an open UOS.

Singh e Hamdy, 2005



O EES complexo esfincteriano superior

-pressão em repouso: 30-200mmHg

http://hopkins-gi.nts.jhu.edu/pages/la id=1

Diminuição transitória do tônus do EES durante a deglutição

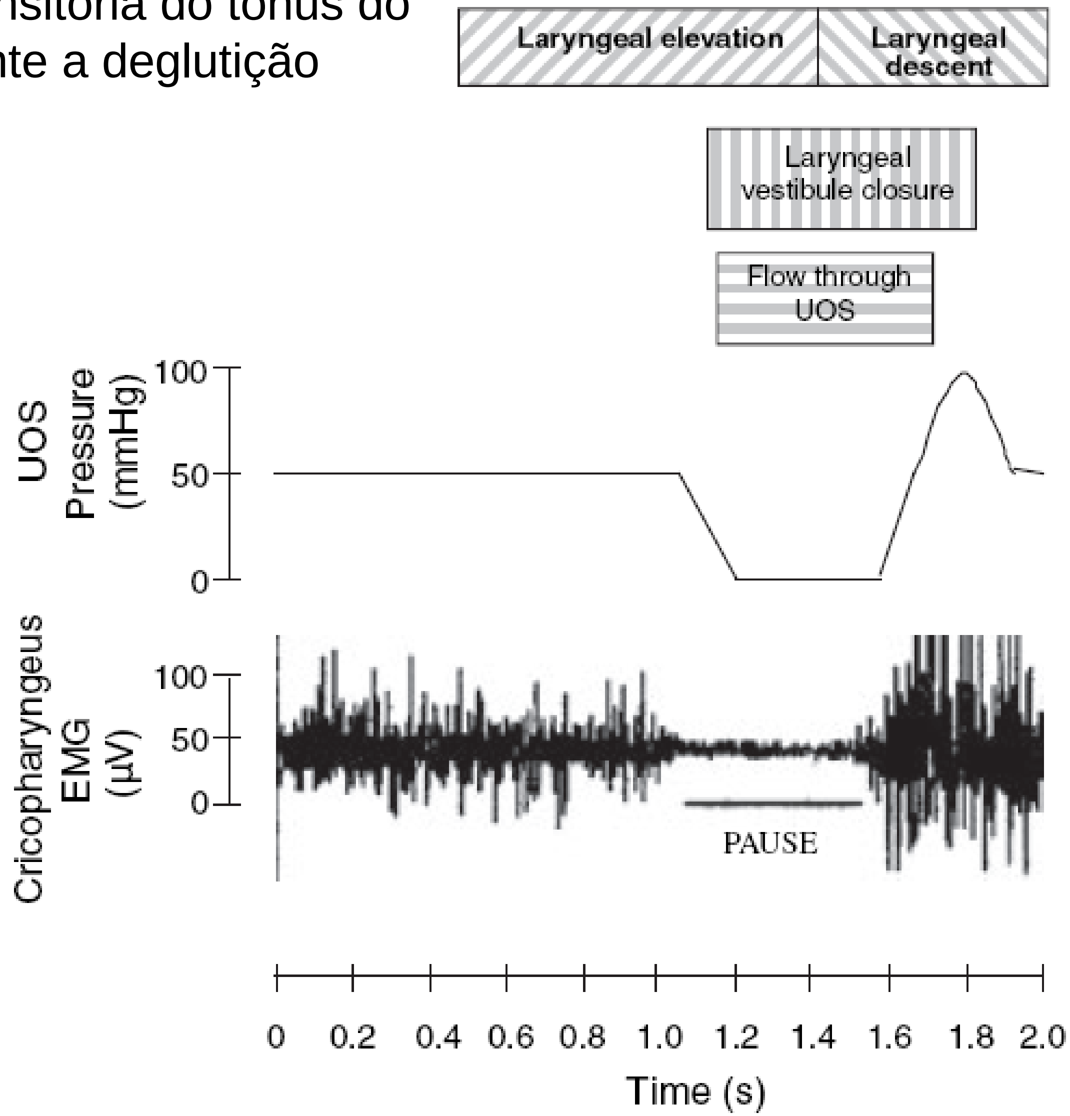
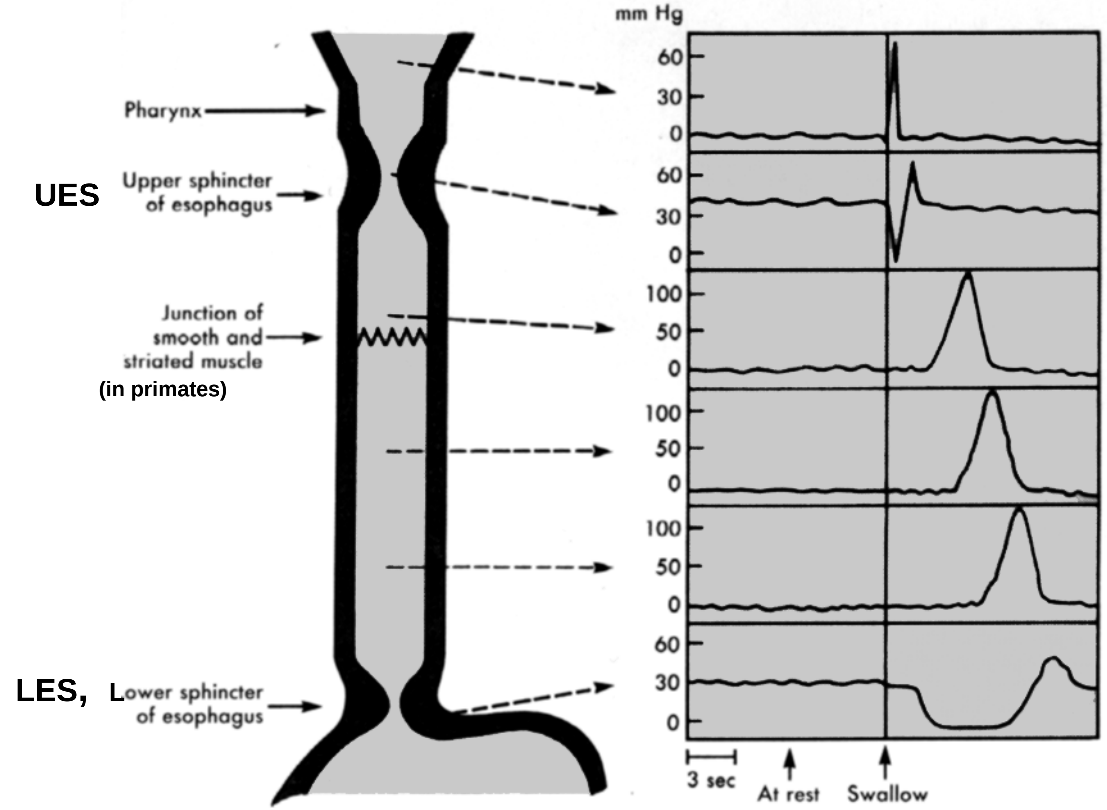
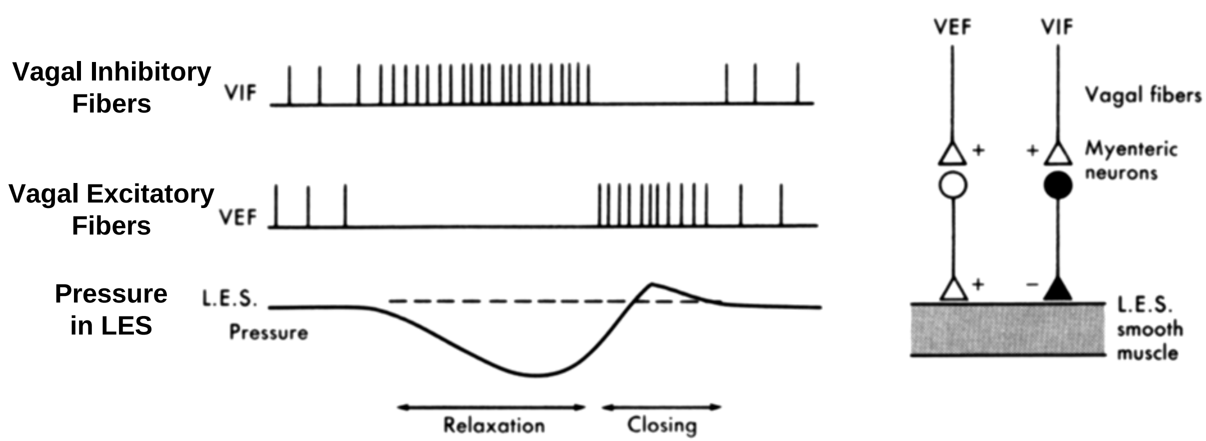


Figure 3 Time line showing the relationship of events during a normal swallow. The exact timings are influenced by factors such as age and bolus size.

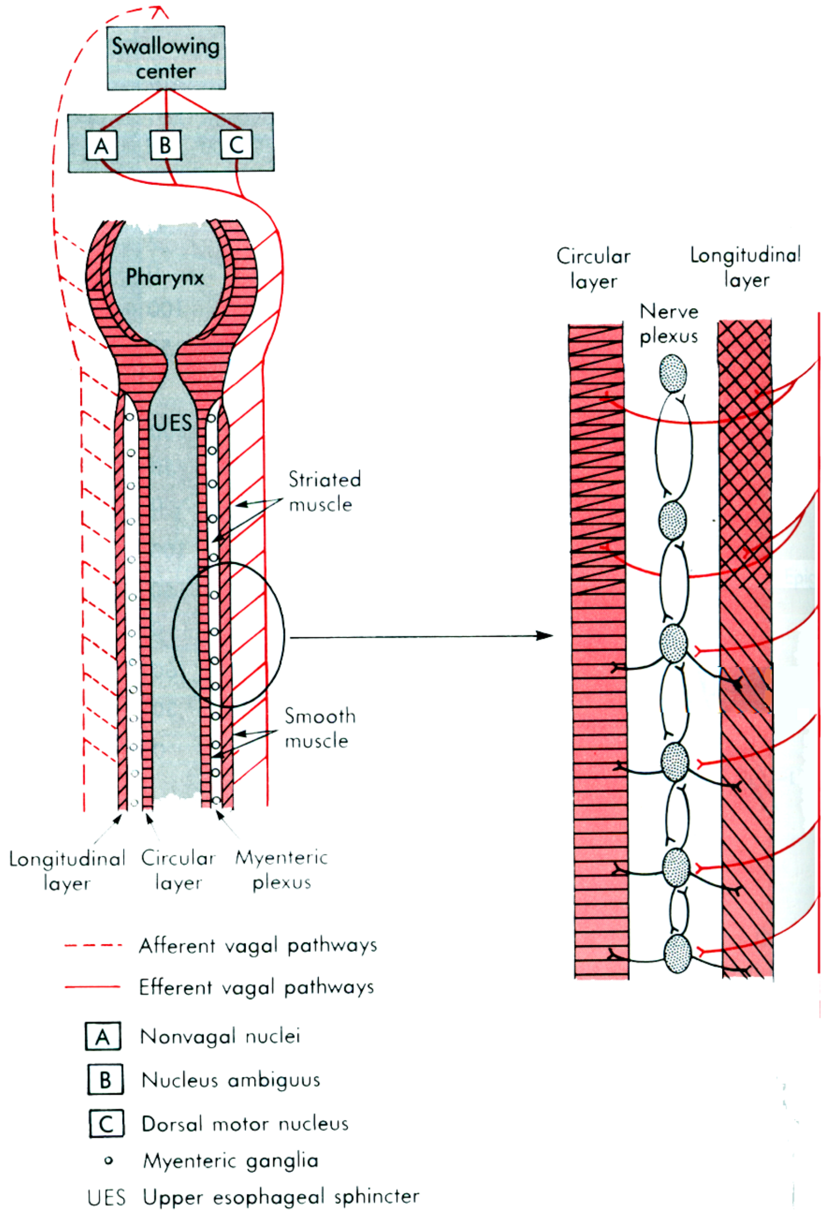
Singh e Hamdy, 2005

Integração do reflexo da deglutição

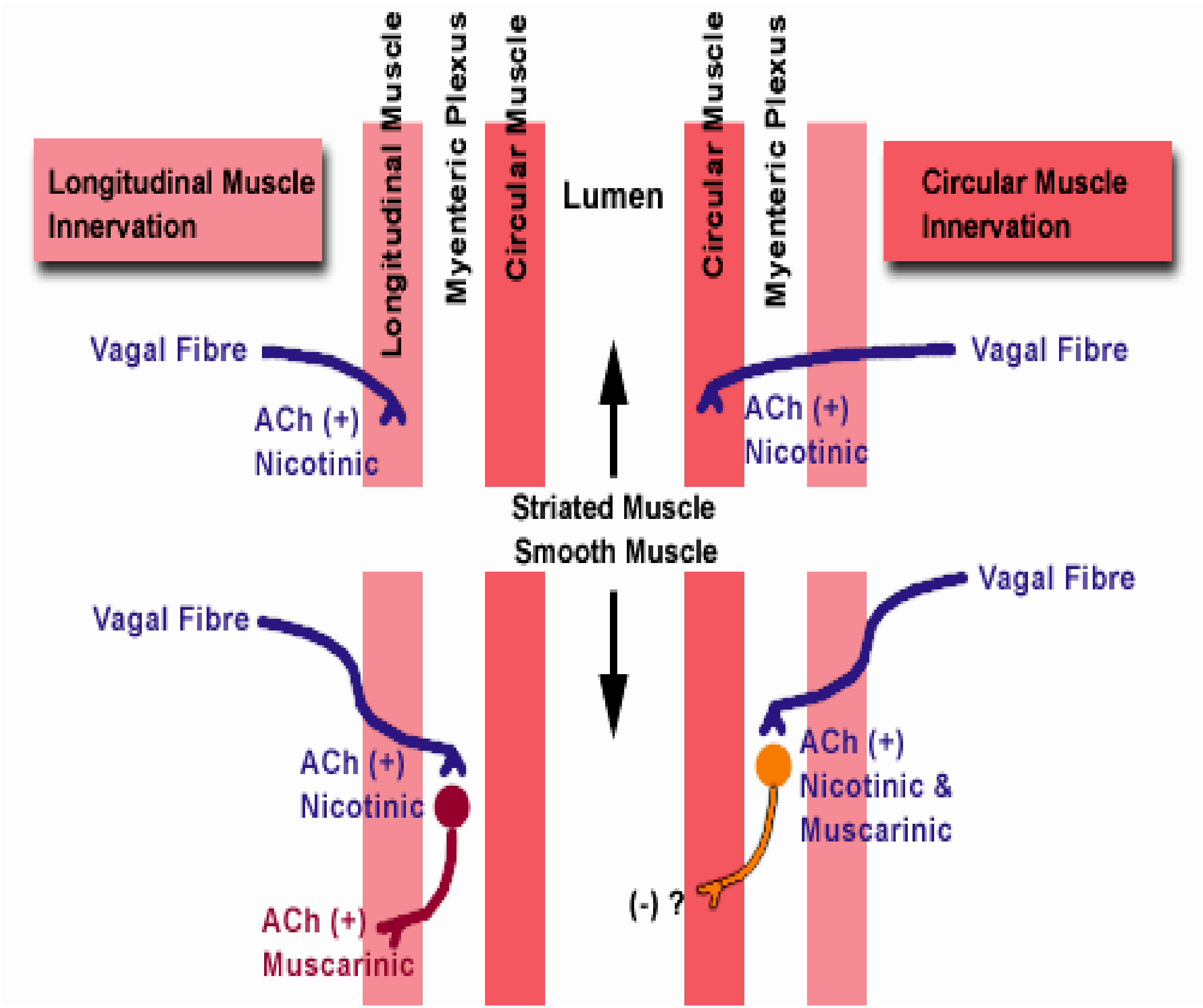




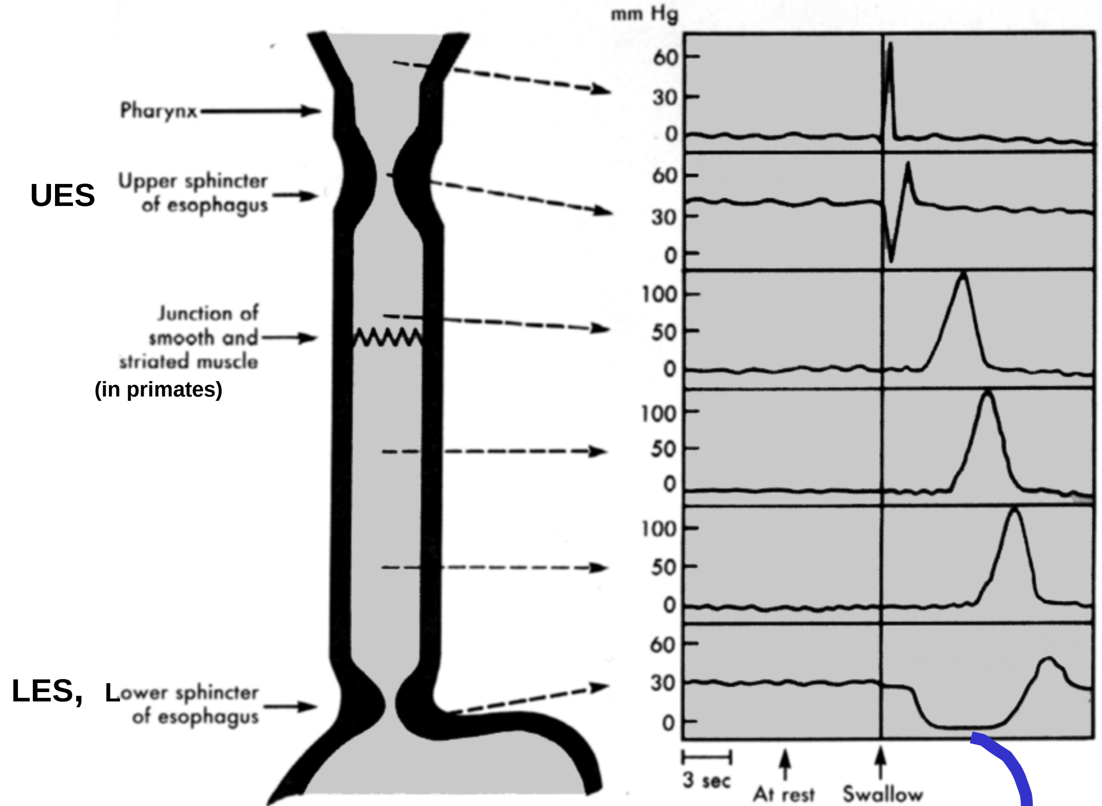
■ **Fig. 38-16** Schematic representation of vagal control of the lower esophageal sphincter *(LES)*. Note that relaxation of the *LES* is associated with an increase in the firing rate in vagal inhibitory fibers *(VIF)* and a decreased frequency of action potentials in vagal excitatory fibers *(VEF)*. Reciprocal changes occur when the sphincter regains its resting tone. (From Miolan, JP, and Roman, C: *J Physiol* [Paris] 74:709, 1978.)


Swallowing center
A
B
C
Pharynx
UES
Striated muscle
Smooth muscle
Longitudinal layer
Circular layer
Myenteric plexus
Circular layer
Longitudinal layer
Nerve plexus
Afferent vagal pathways
Efferent vagal pathways
A Nonvagal nuclei
B Nucleus ambiguus
C Dorsal motor nucleus
Myenteric ganglia
UES Upper esophageal sphincter

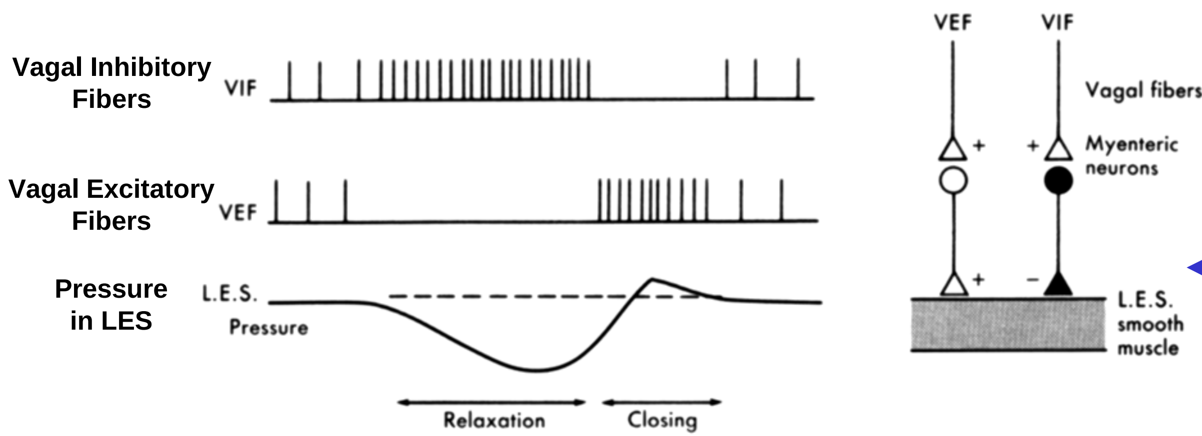
Inervação do esôfago



Integração do reflexo da deglutição



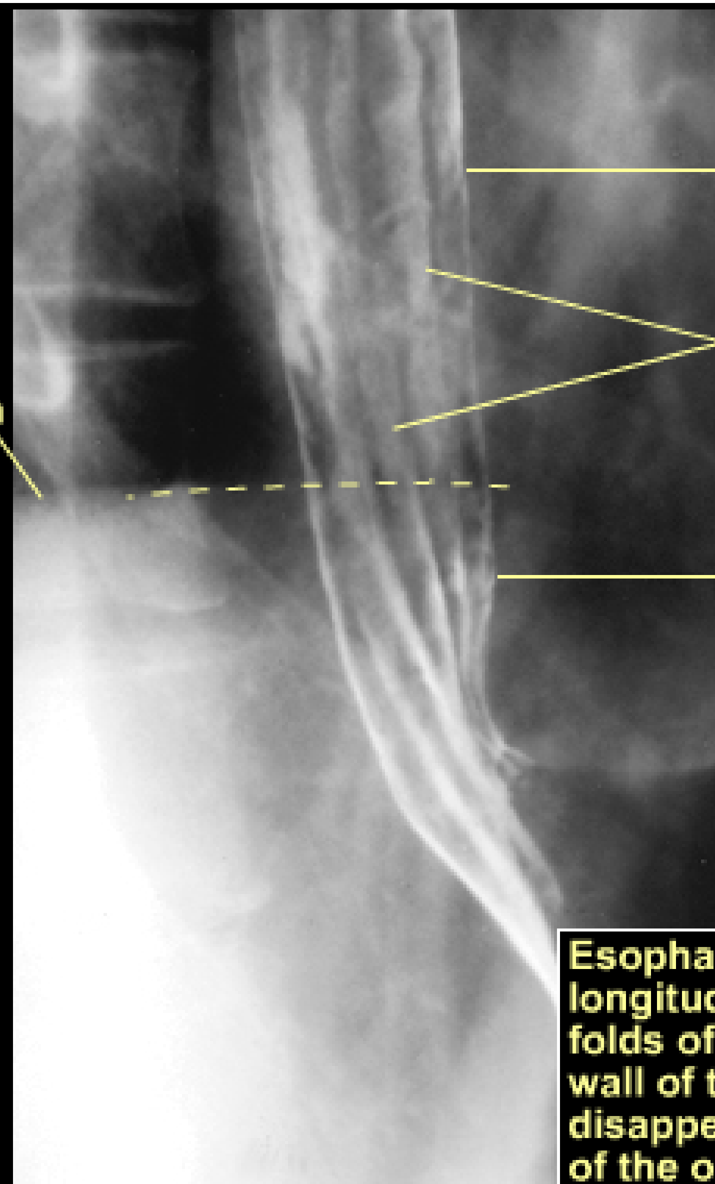
Como o EEI é regulado?



■ **Fig. 38-16** Schematic representation of vagal control of the lower esophageal sphincter *(LES)*. Note that relaxation of the *LES* is associated with an increase in the firing rate in vagal inhibitory fibers *(VIF)* and a decreased frequency of action potentials in vagal excitatory fibers *(VEF)*. Reciprocal changes occur when the sphincter regains its resting tone. (From Miolan, JP, and Roman, C: *J Physiol* [Paris] 74:709, 1978.)

An oblique projection of the esophagogastric junction following air and barium contrast; the patient swallowed thick barium contrast followed by air-producing granules, resulting in an air-contrast relief of the esophagus. Note:

1) The radiograph depicts both thoracic and abdominal portions of the esophagus. The abdominal portion of the adult esophagus is typically about 1.5 cm in length.

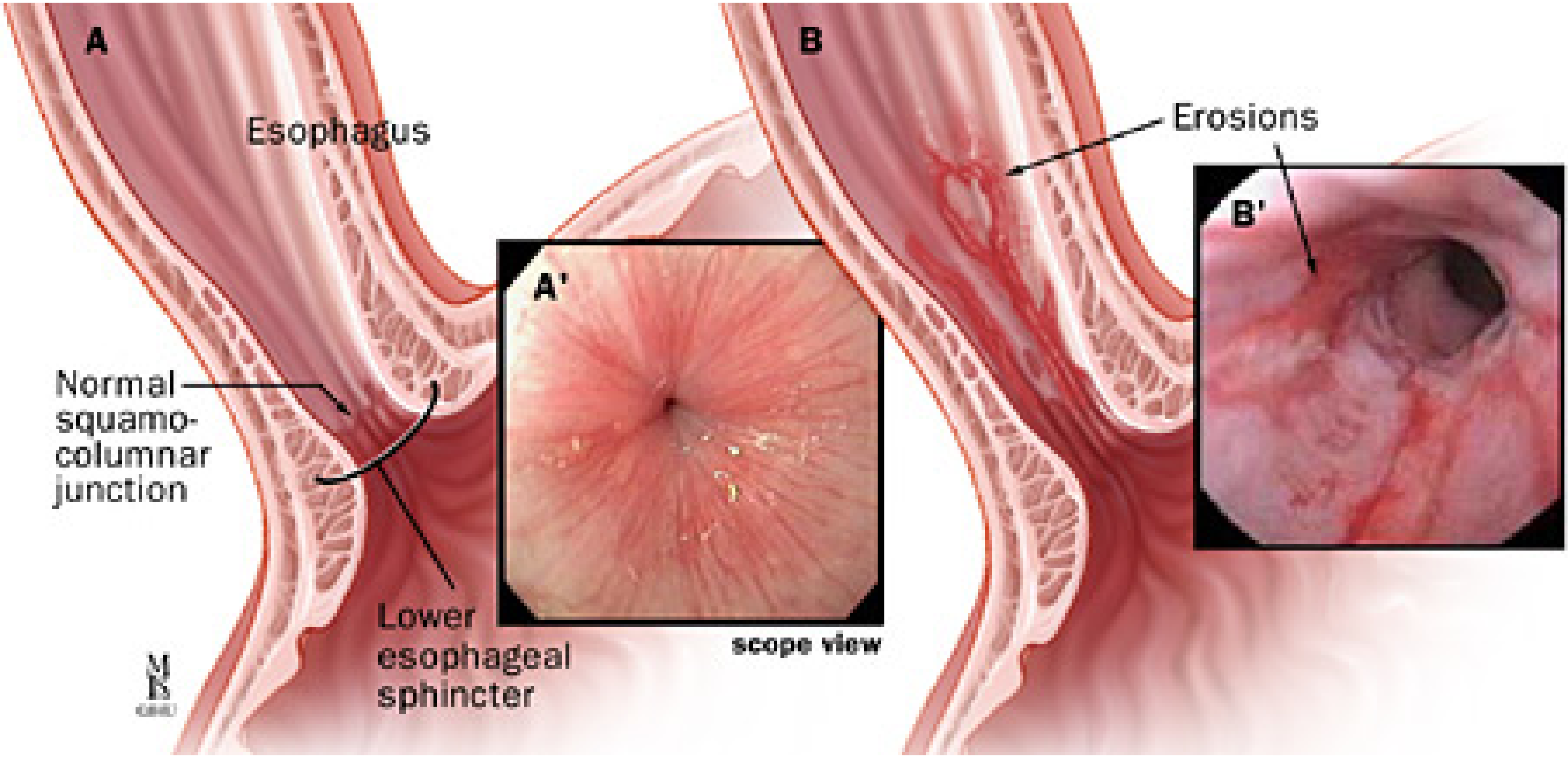


Esophageal folds are longitudinally oriented folds of the inner mucosal wall of the esophagus that disappear upon distention of the organ.

extraído (enquanto disponível) de: http://www.netanatomy.com/nosubscription/notvalidip.htm

Doenças do refluxo gastroesofágico

A inflamação é resultante de contato prolongado da mucosa com o conteúdo gástrico, podendo levar a lesões/úlceras de mucosa.

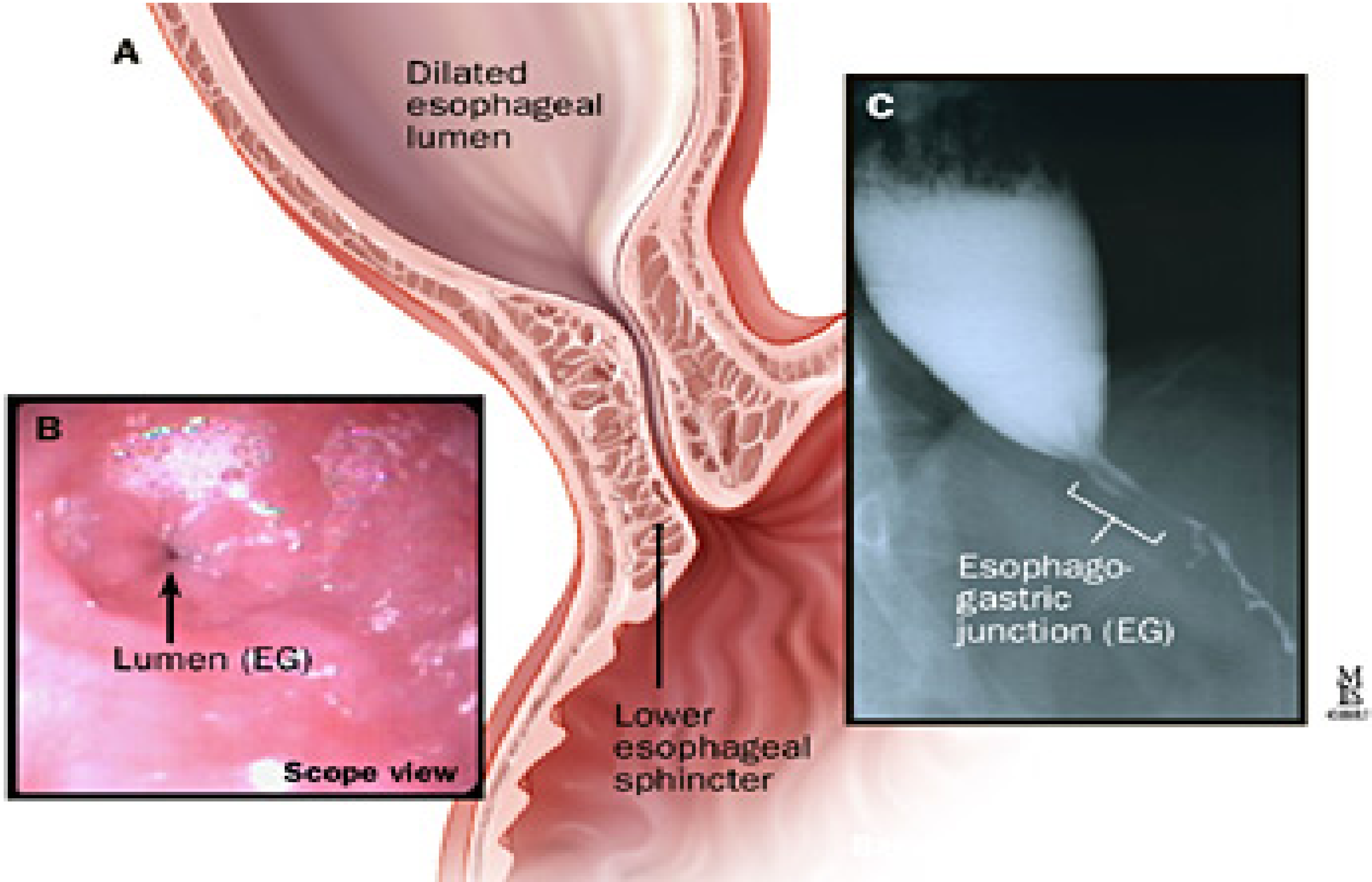


A, **B,** esôfago normal comparado à **esofagite erosiva**.;
A', **B',** visões endoscópicas

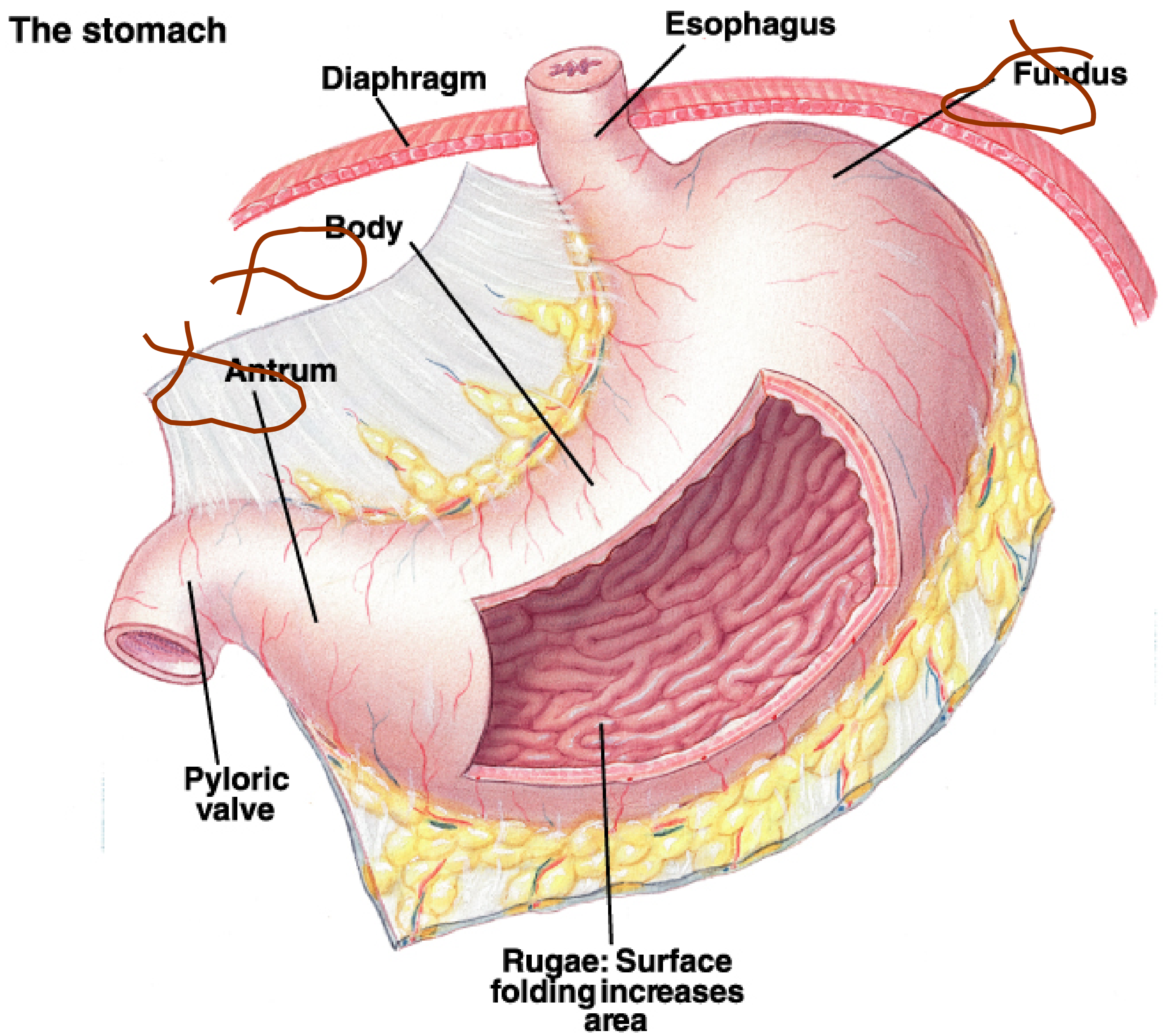
http://hopkins-gi.nts.jhu.edu/pages/latin/templates/?pg=disease3&organ=1&disease=37&pagetype=2&pagenum=588&lang_id=1

Acalasia

- esfíncter não relaxa
- perda neurônios inibitórios
- ausência de peristalse esofágica

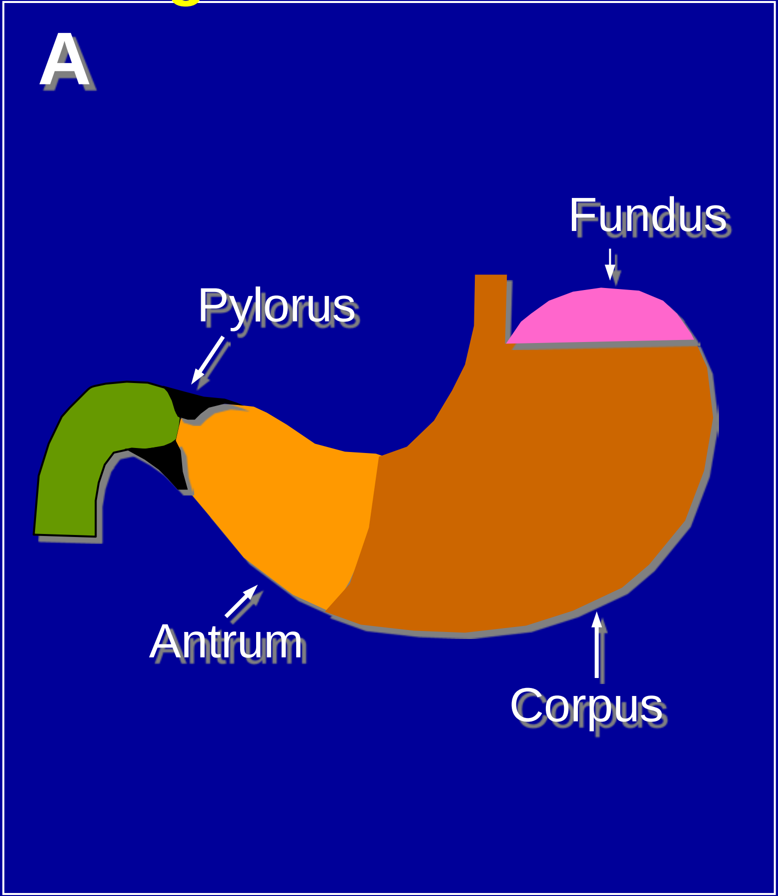


MOTILIDADE GÁSTRICA

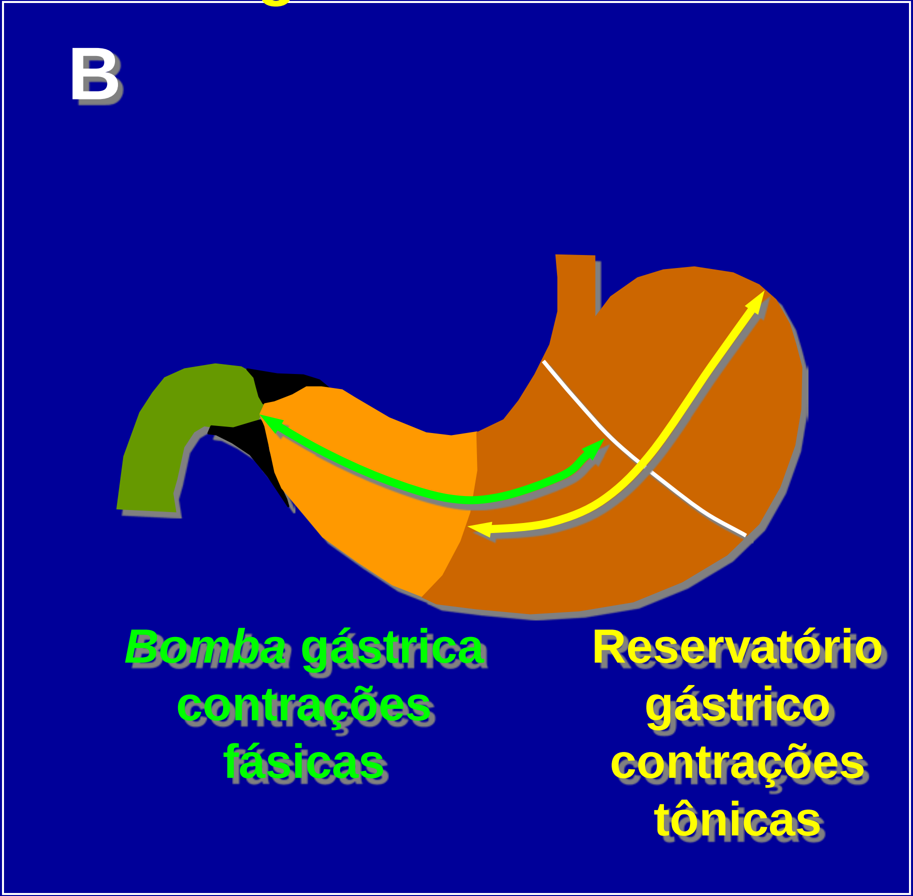


O estômago pode ser dividido em:

3 regiões anatômicas



2 regiões funcionais



website original: *http://www.wzw.tum.de/humanbiology/data/motility/34/?alt=english*

Motilidade Gástrica:

período interdigestivo (jejum):

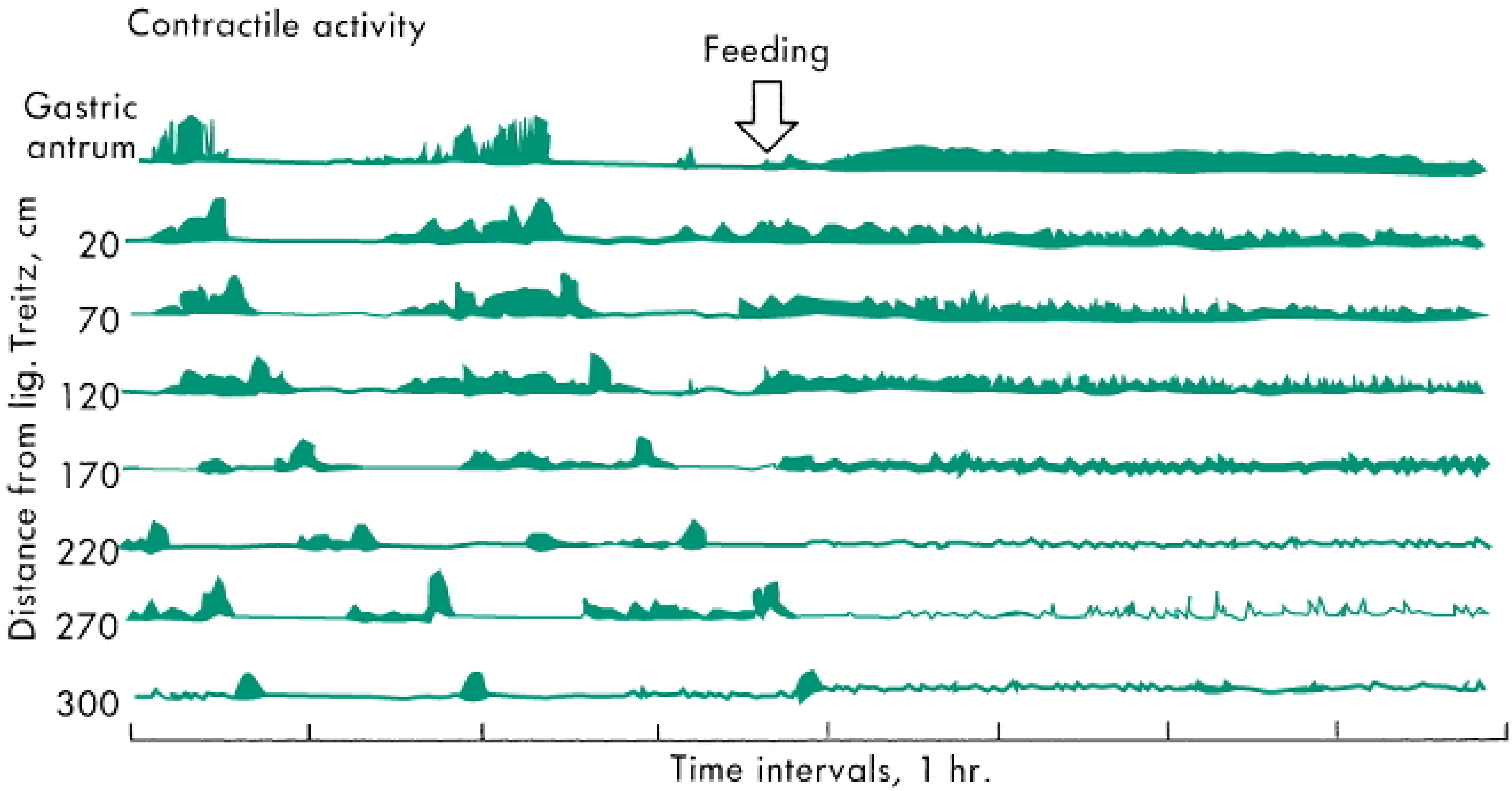
complexo migratório mioelétrico

período digestivo:

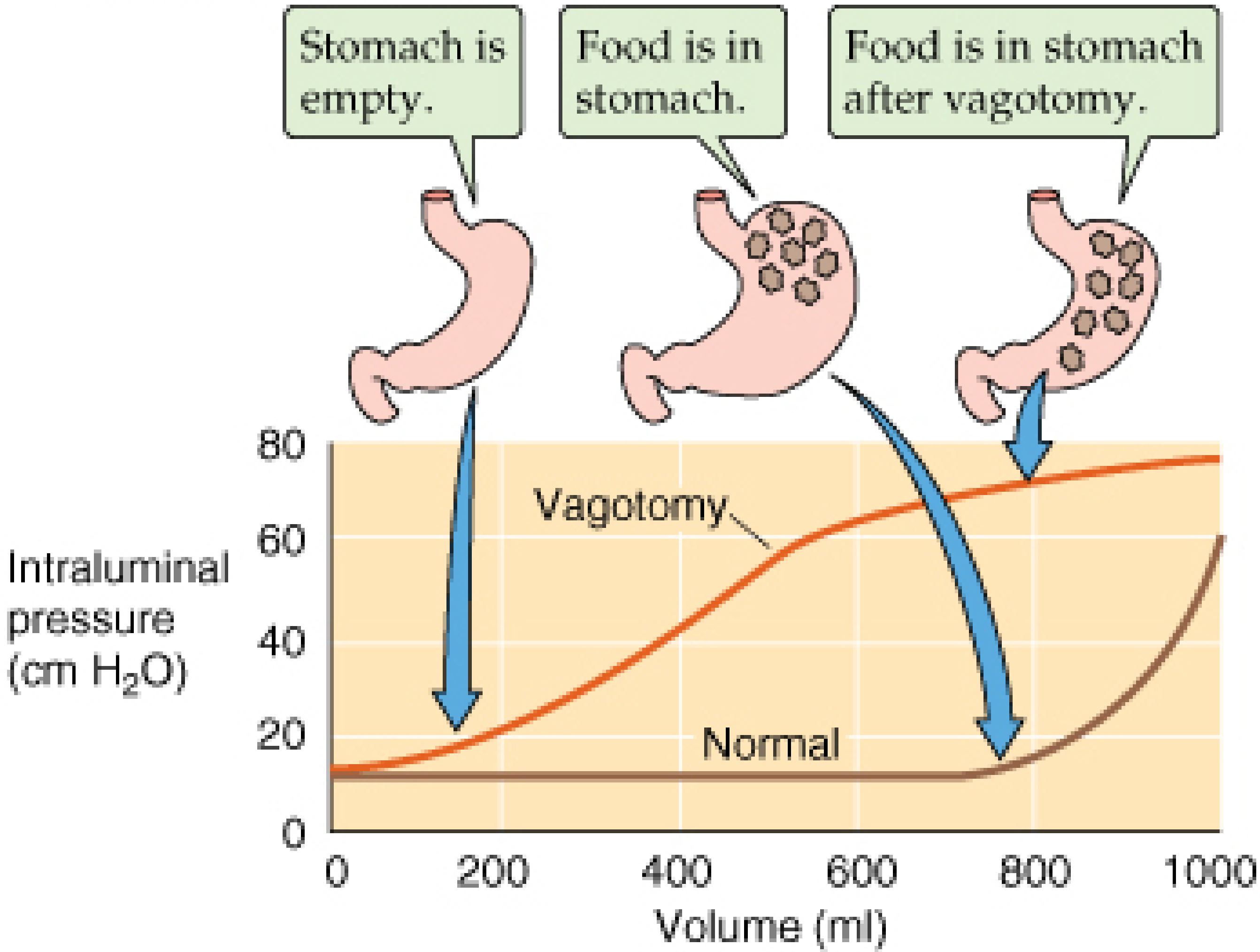
relaxamento, mistura e esvaziamento

Motilidade durante o jejum:

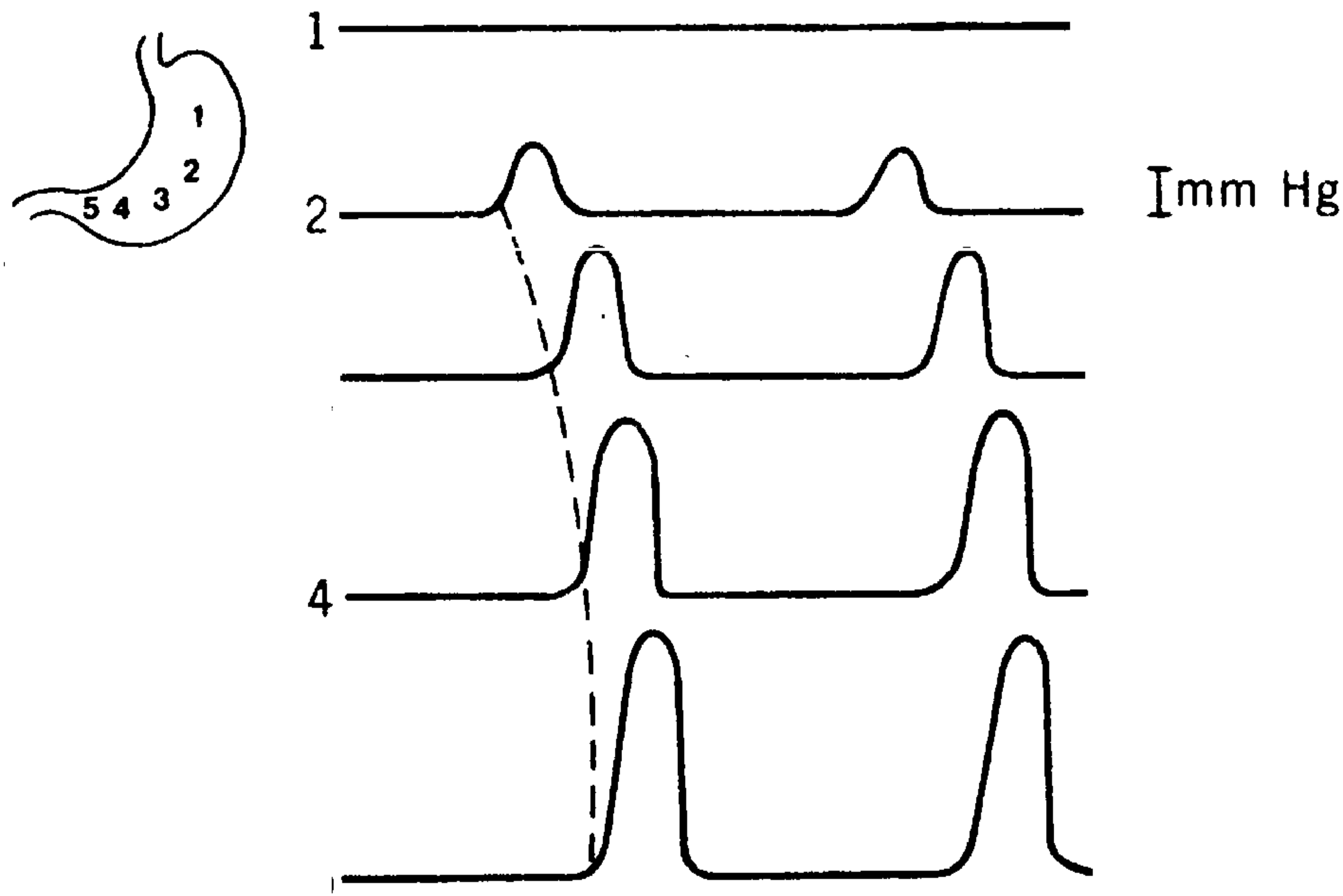
complexo migratório mioelétrico (CMM, estômago ☞ Íleo terminal)



Relaxamento gástrico
(receptivo e adaptativo)



REGISTRO DA ATIVIDADE CONTRÁTIL DO ESTÔMAGO



Antro gástrico: Função de propulsão, esvaziamento e moagem

website original: http://www.wzw.tum.de/humanbiology/data/motility/34/?alt=english

Importância da regulação do esvaziamento gástrico

1-Permitir um esvaziamento regulado dos conteúdos gástricos a uma velocidade consistente com a capacidade de processamento do quimo pelo duodeno.

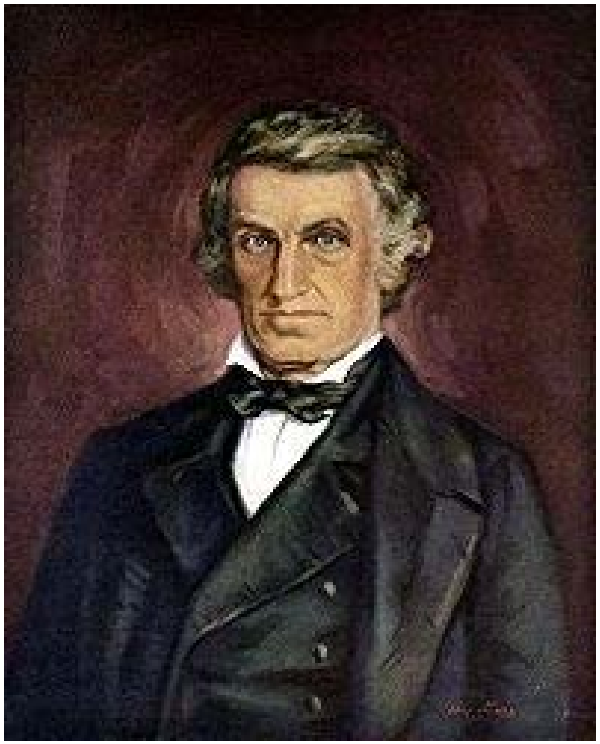
2-Evitar a refluxo dos conteúdos duodenais.

Porque é importante entender como ocorre o controle do esvaziamento gástrico ?

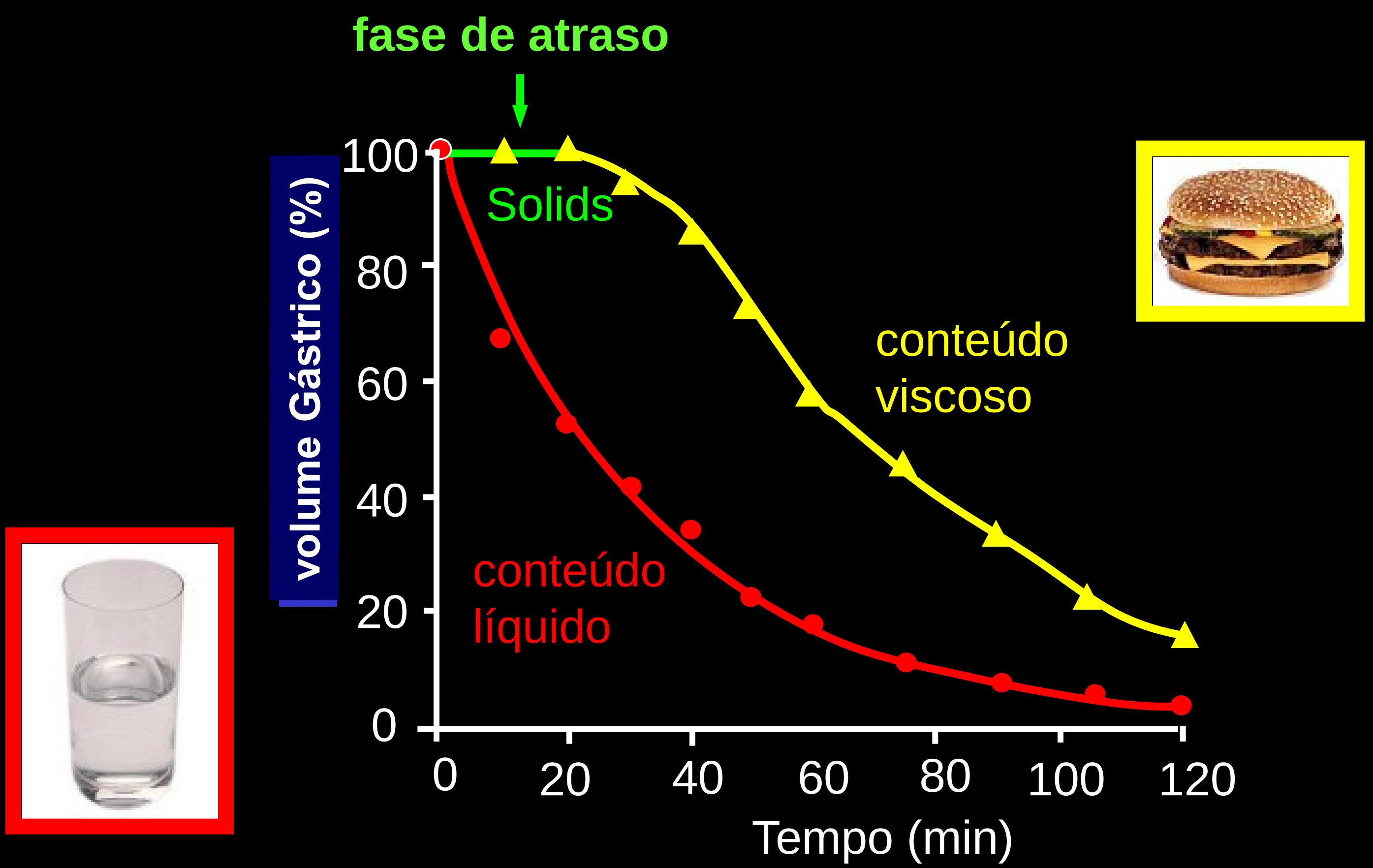
Há correlação direta entre a
taxa de esvaziamento gástrico e
a ocorrência de úlceras duodenais

O pai da Fisiologia Gástrica

Alexis St Martin

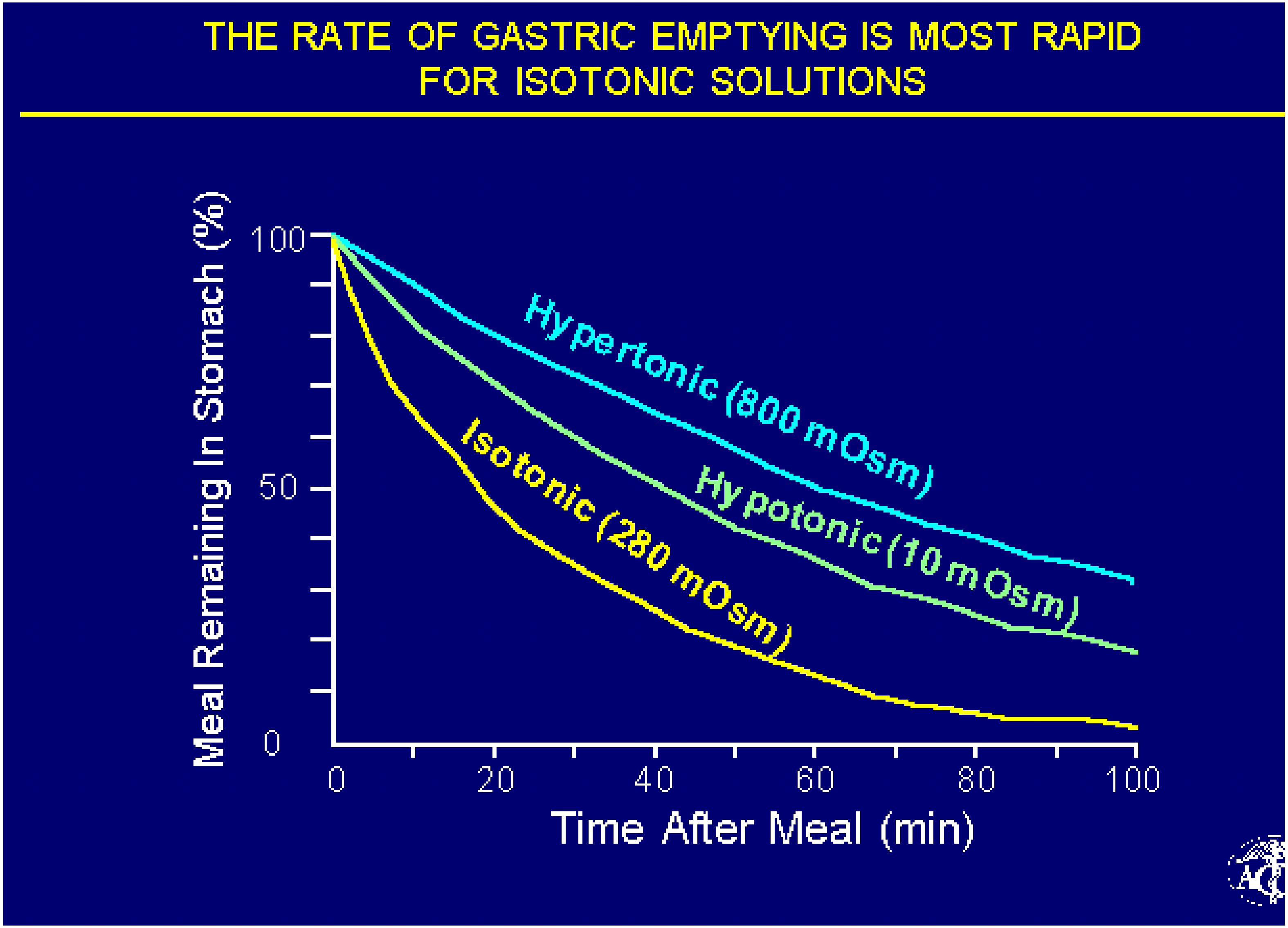


Willian Beaumont

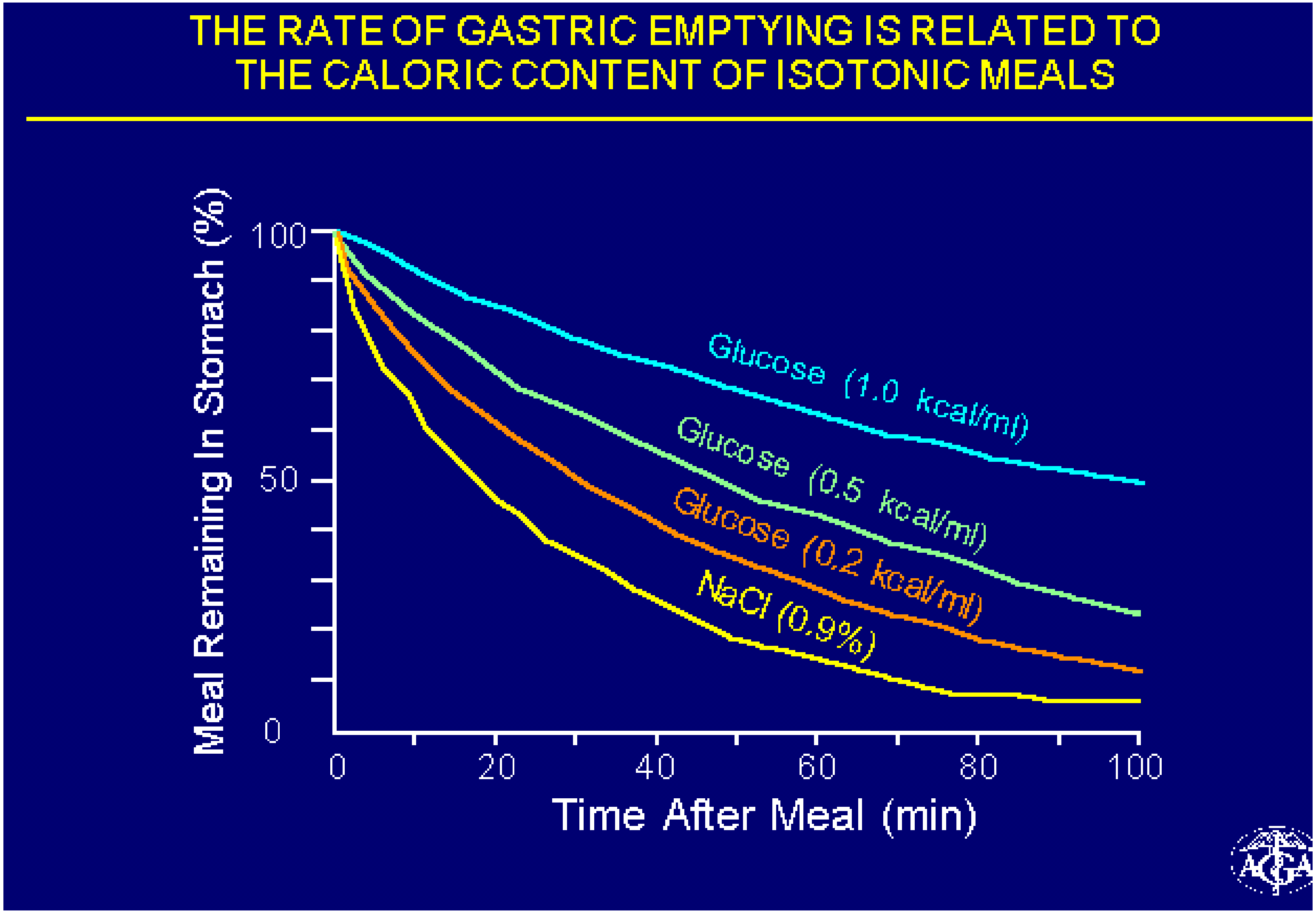


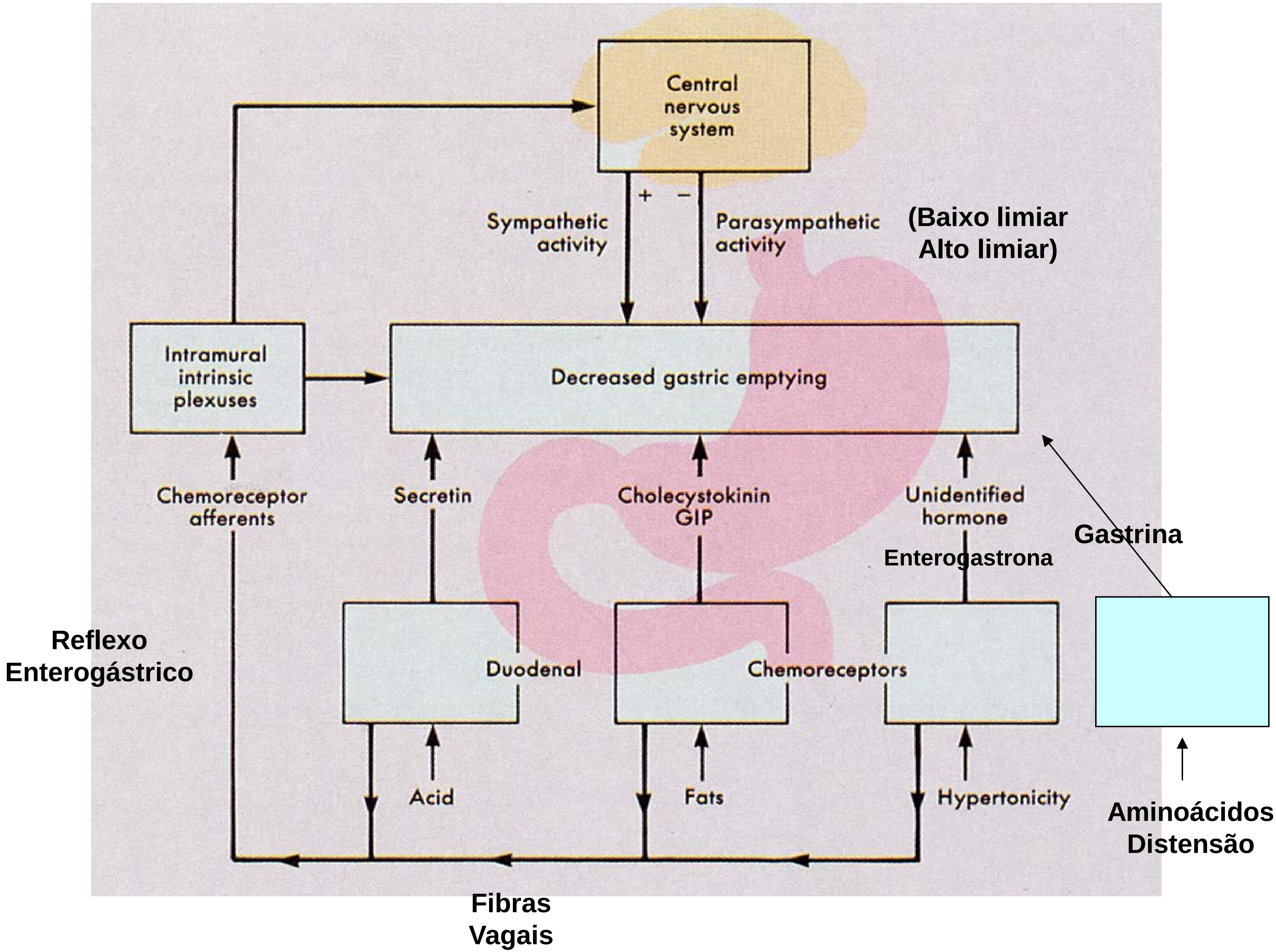
website original: http://www.wzw.tum.de/humanbiology/data/motility/34/?alt=english

Regulação esvaziamento gástrico



Regulação esvaziamento gástrico





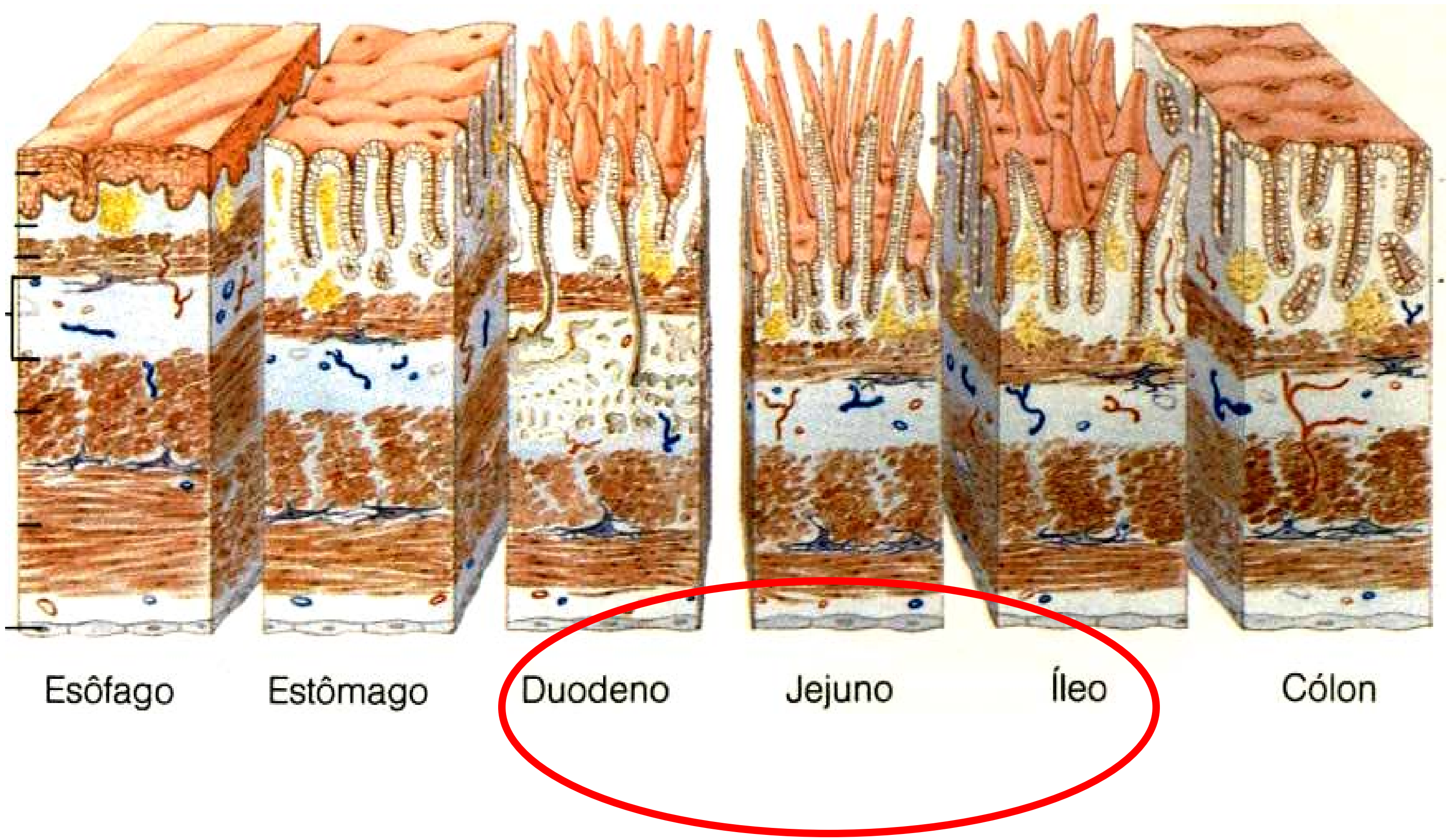
Central nervous system
+
−
Sympathetic activity
Parasympathetic activity
(Baixo limiar
Alto limiar)
Intramural intrinsic plexuses
Decreased gastric emptying
Chemoreceptor afferents
Secretin
Cholecystokinin
GIP
Unidentified hormone
Enterogastrona
Gastrina
Reflexo Enterogástrico
Duodenal
Chemoreceptors
Acid
Fats
Hypertonicity
Aminoácidos
Distensão
Fibras Vagais

MOTILIDADE

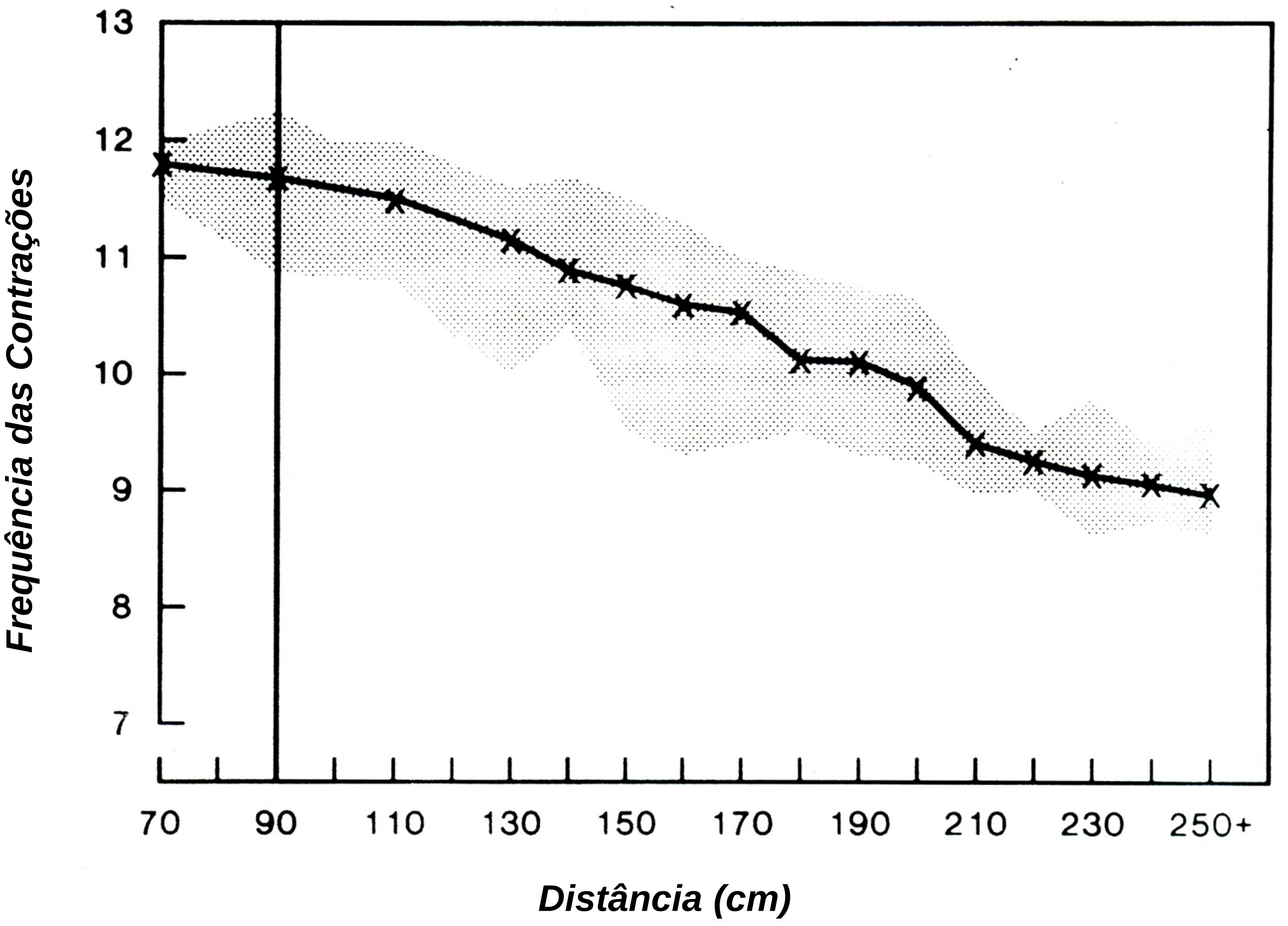
DO

INTESTINO DELGADO

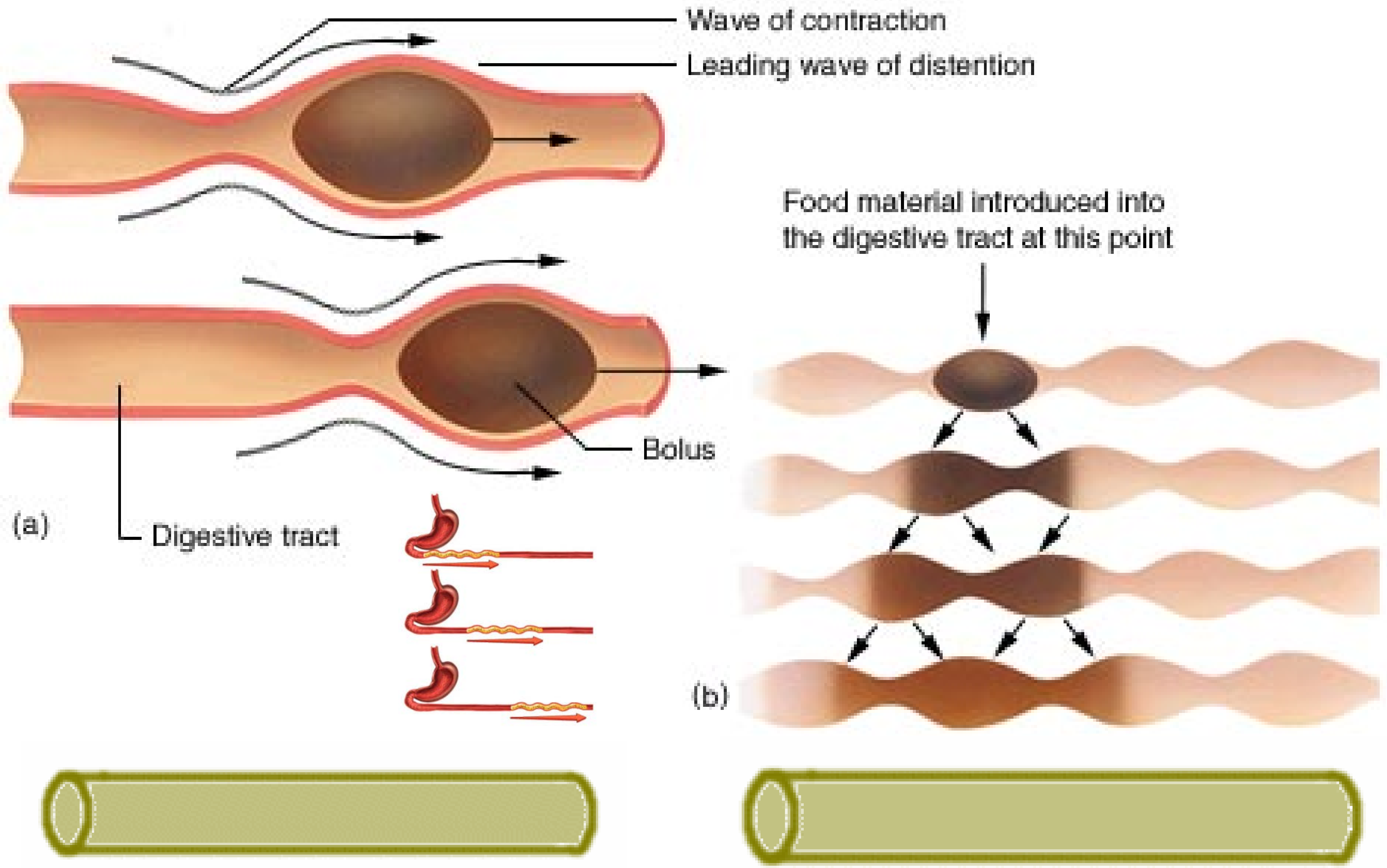
TIPOS DE EPITÉLIO DO TGI



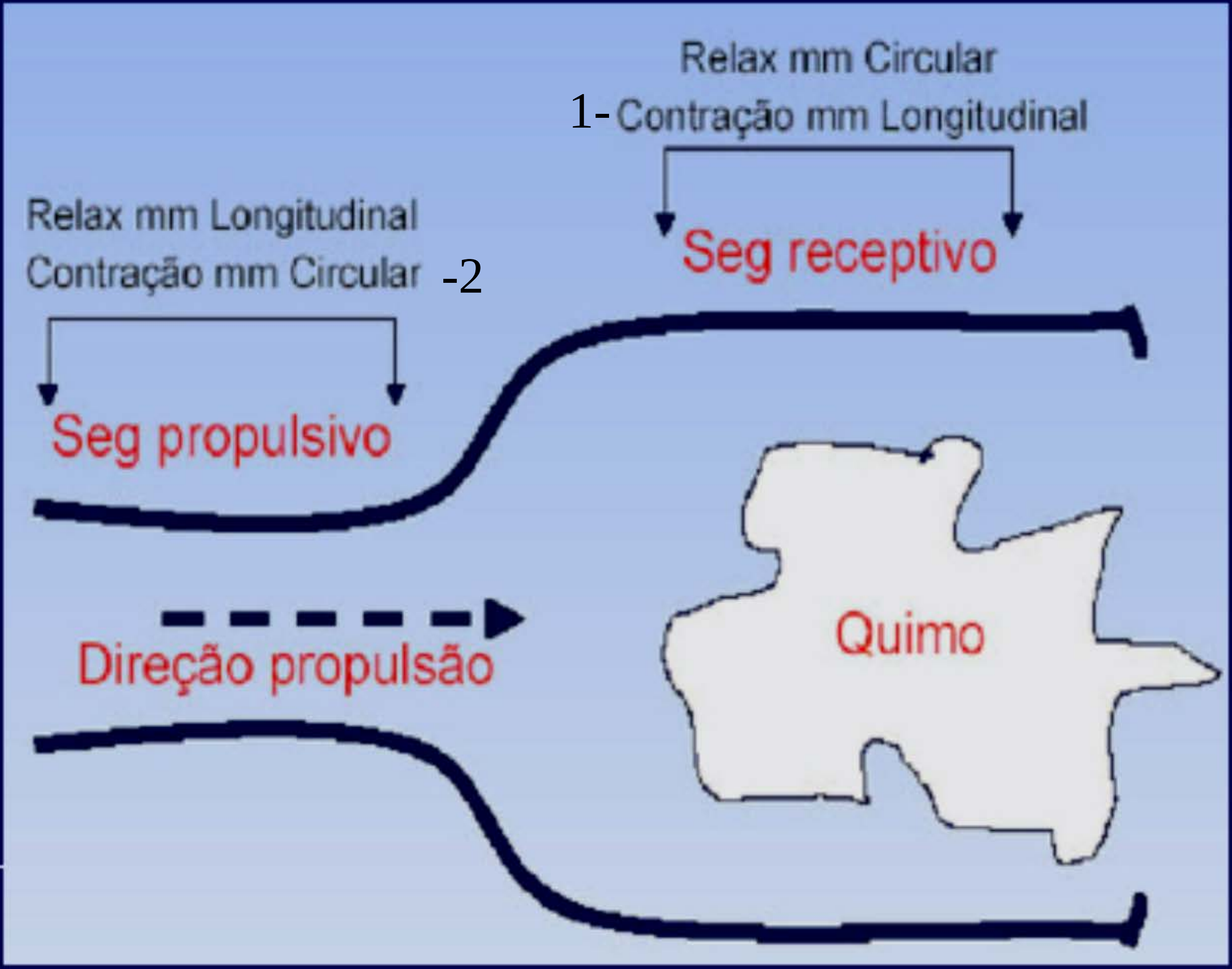
Formação do Gradiente de Atividade



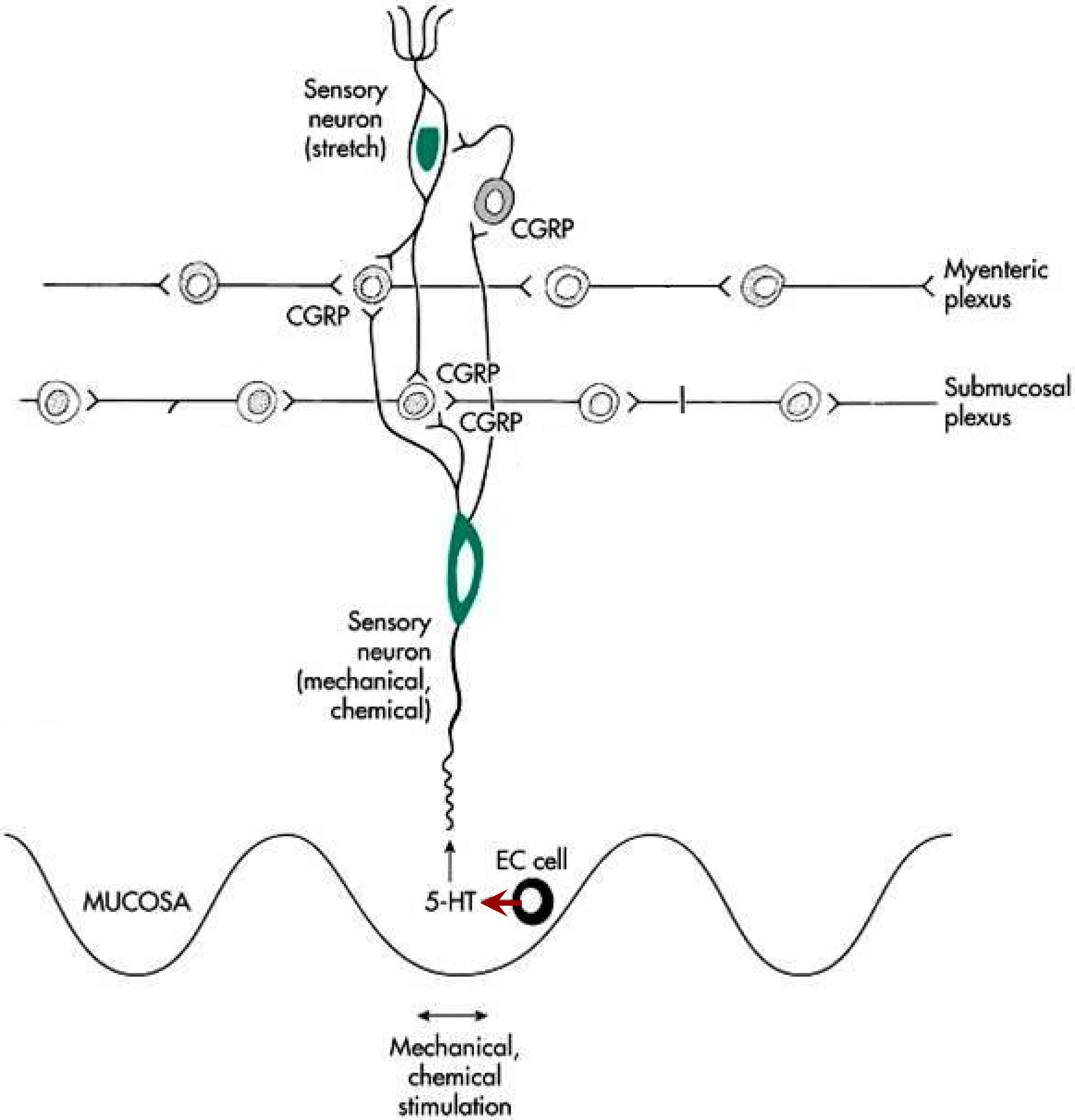
Movimentos do intestino delgado: peristálticos (propulsivos) e de mistura (*segmentares*)



Lei do intestino

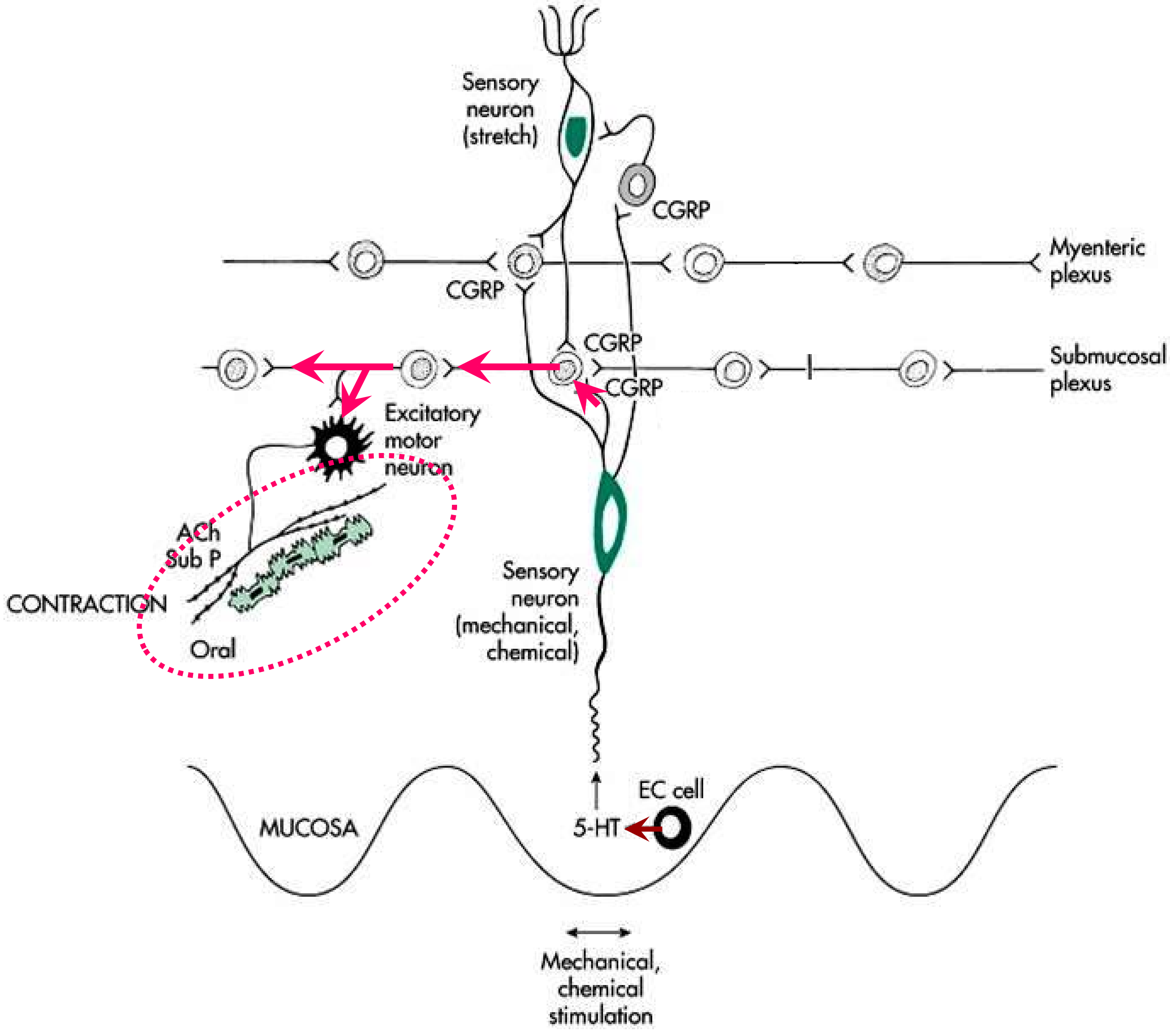


Exemplo de reflexos intrínsecos do sistema nervoso entérico
Movimento peristáltico



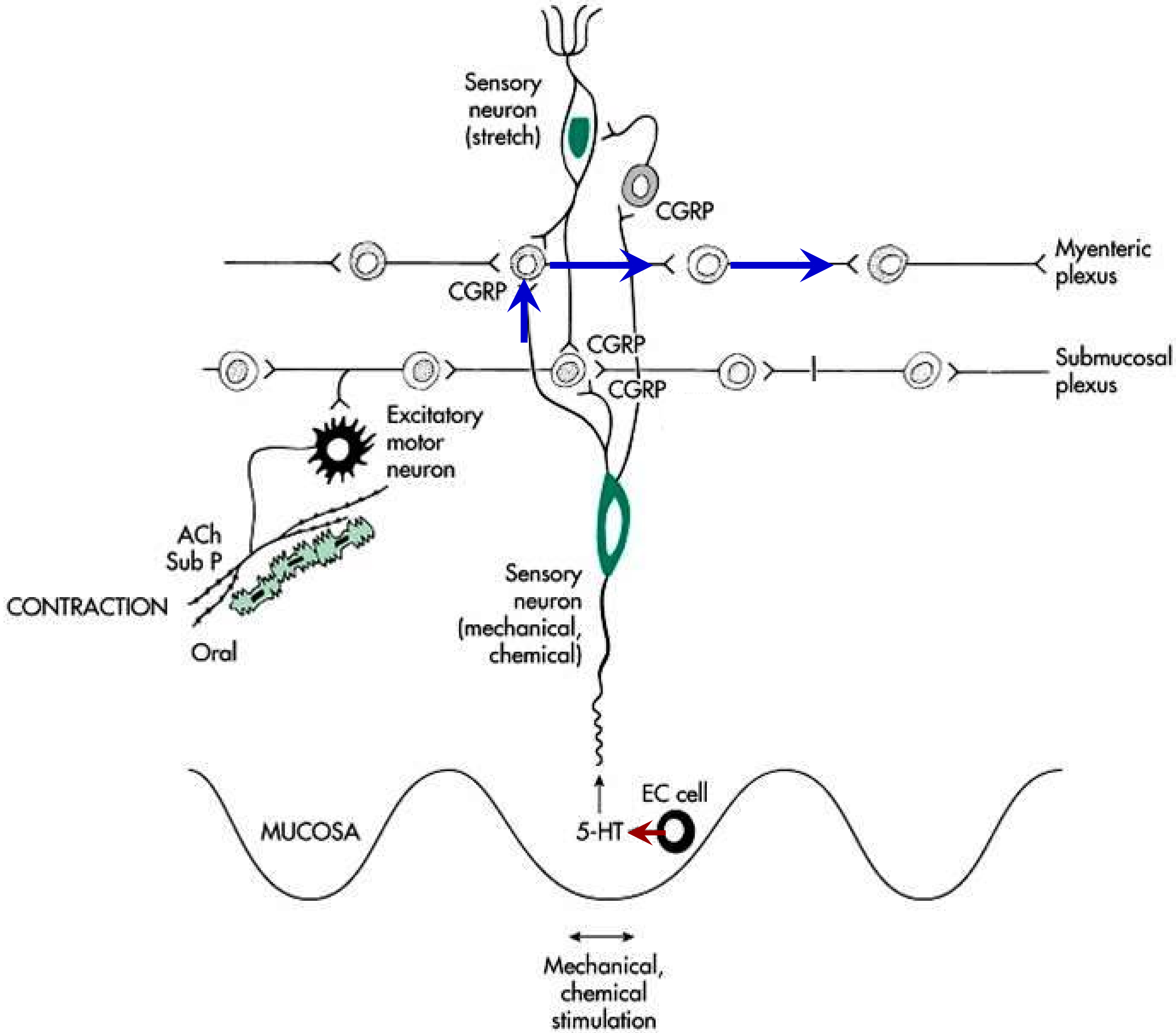
Berne et al., 2004

Exemplo de reflexos intrínsecos do sistema nervoso entérico
Movimento peristáltico



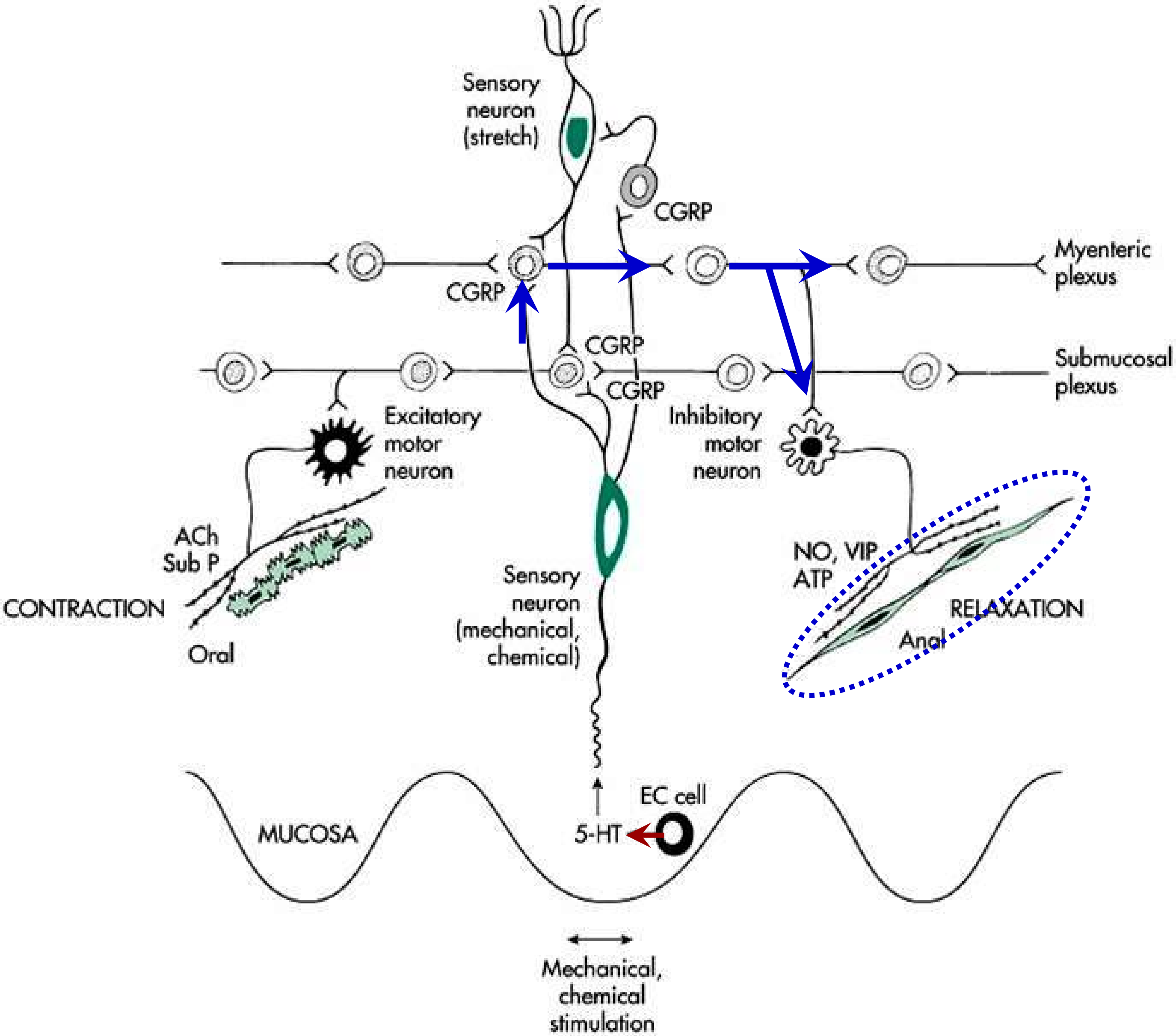
Berne et al., 2004

Exemplo de reflexos intrínsecos do sistema nervoso entérico
Movimento peristáltico



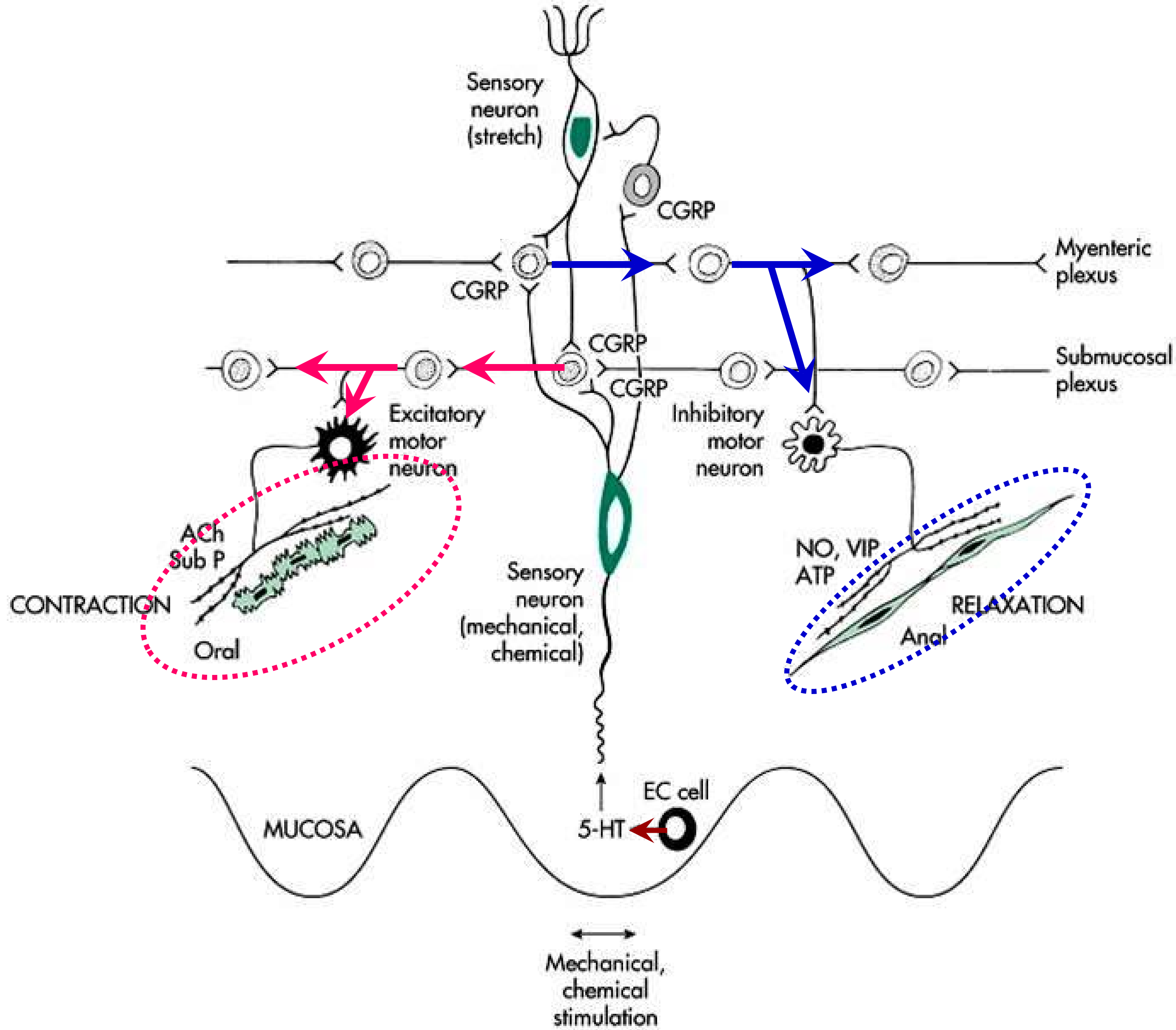
Berne et al., 2004

Exemplo de reflexos intrínsecos do sistema nervoso entérico
Movimento peristáltico



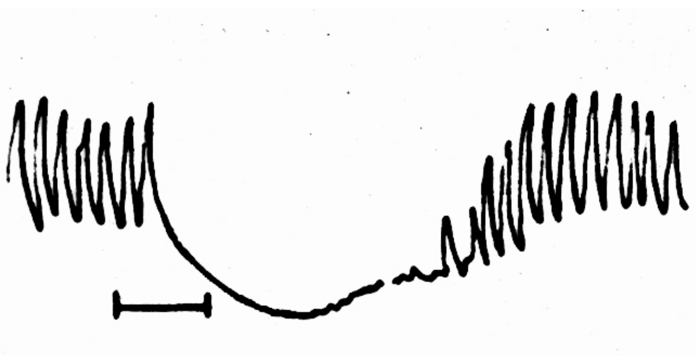
Berne et al., 2004

Exemplo de reflexos intrínsecos do sistema nervoso entérico
Movimento peristáltico

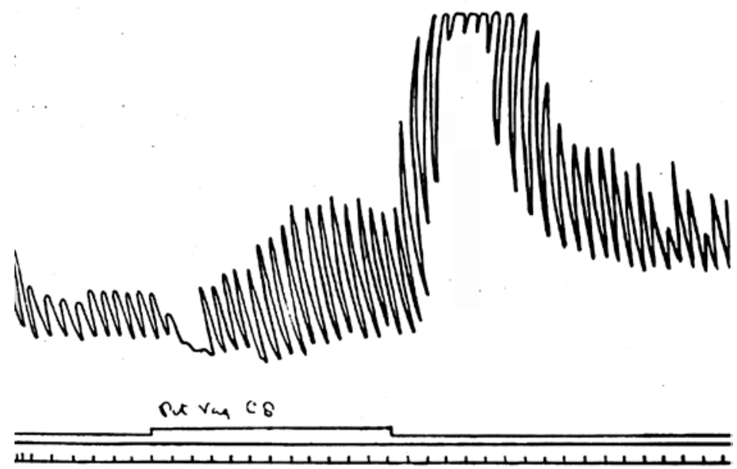


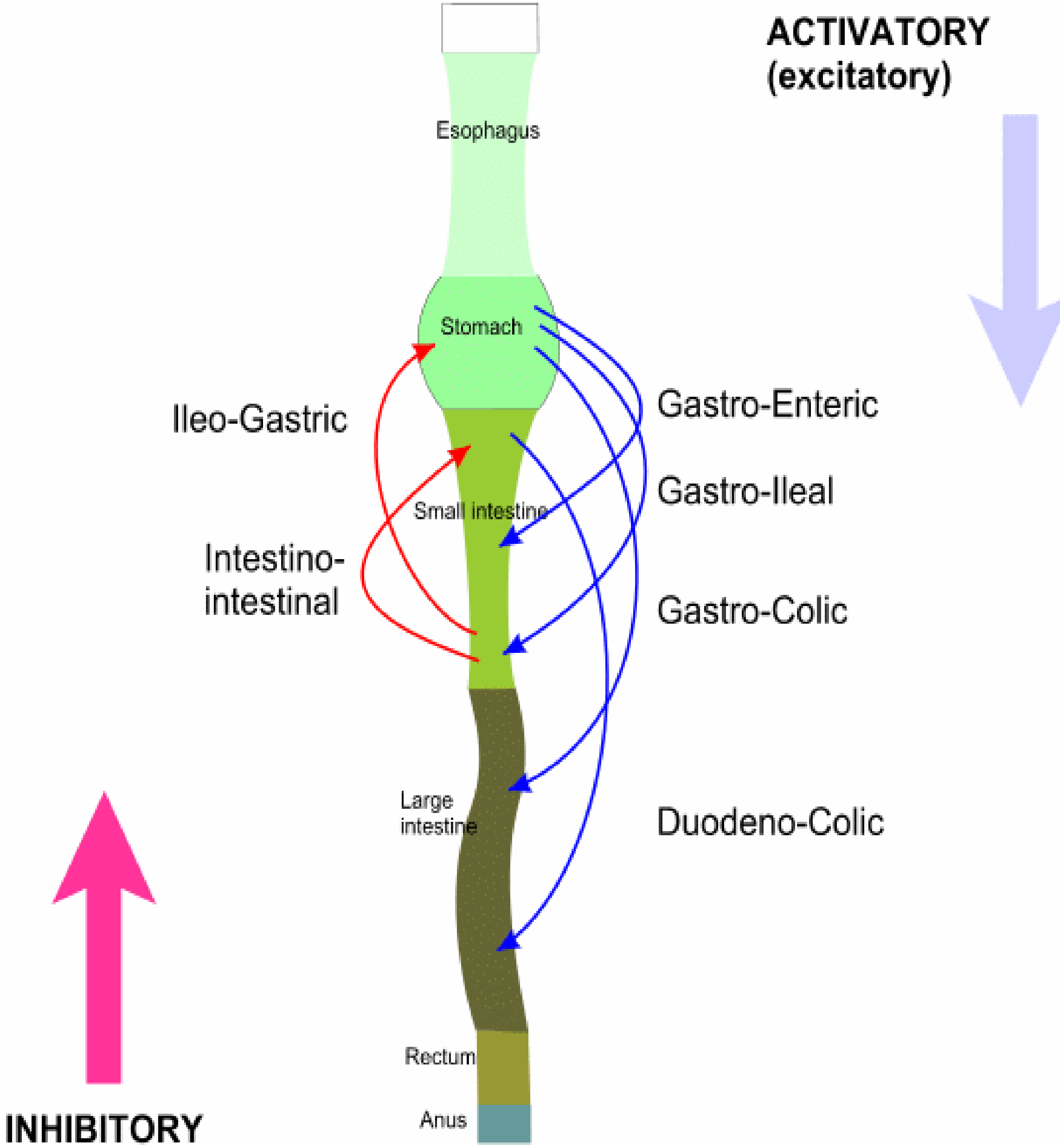
Berne et al., 2004

Esplâncnico



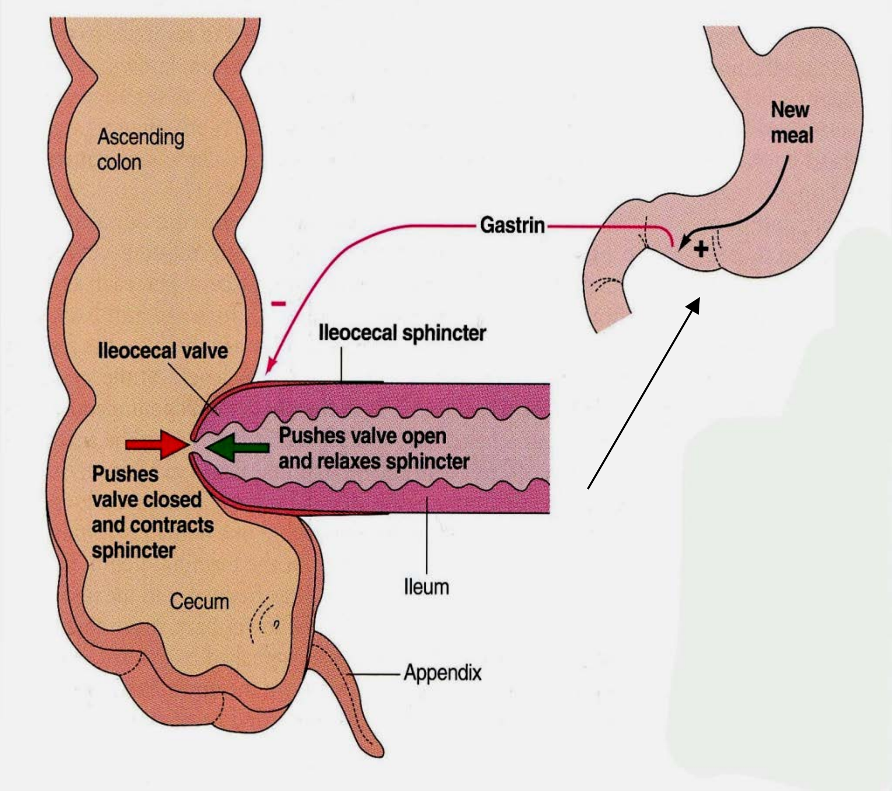
Vago

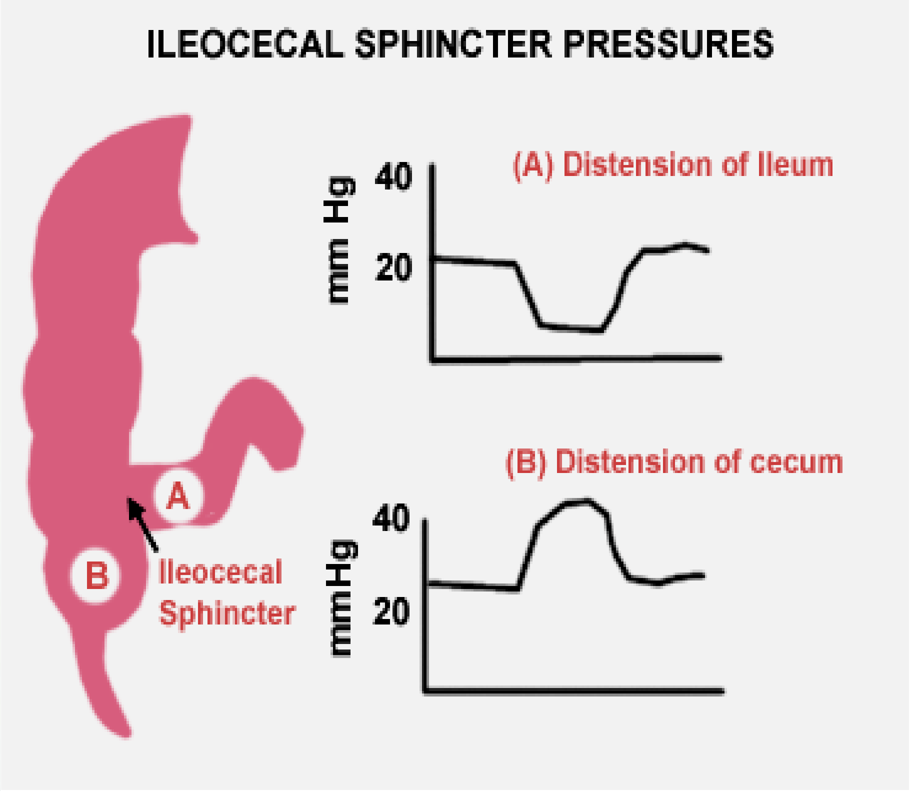




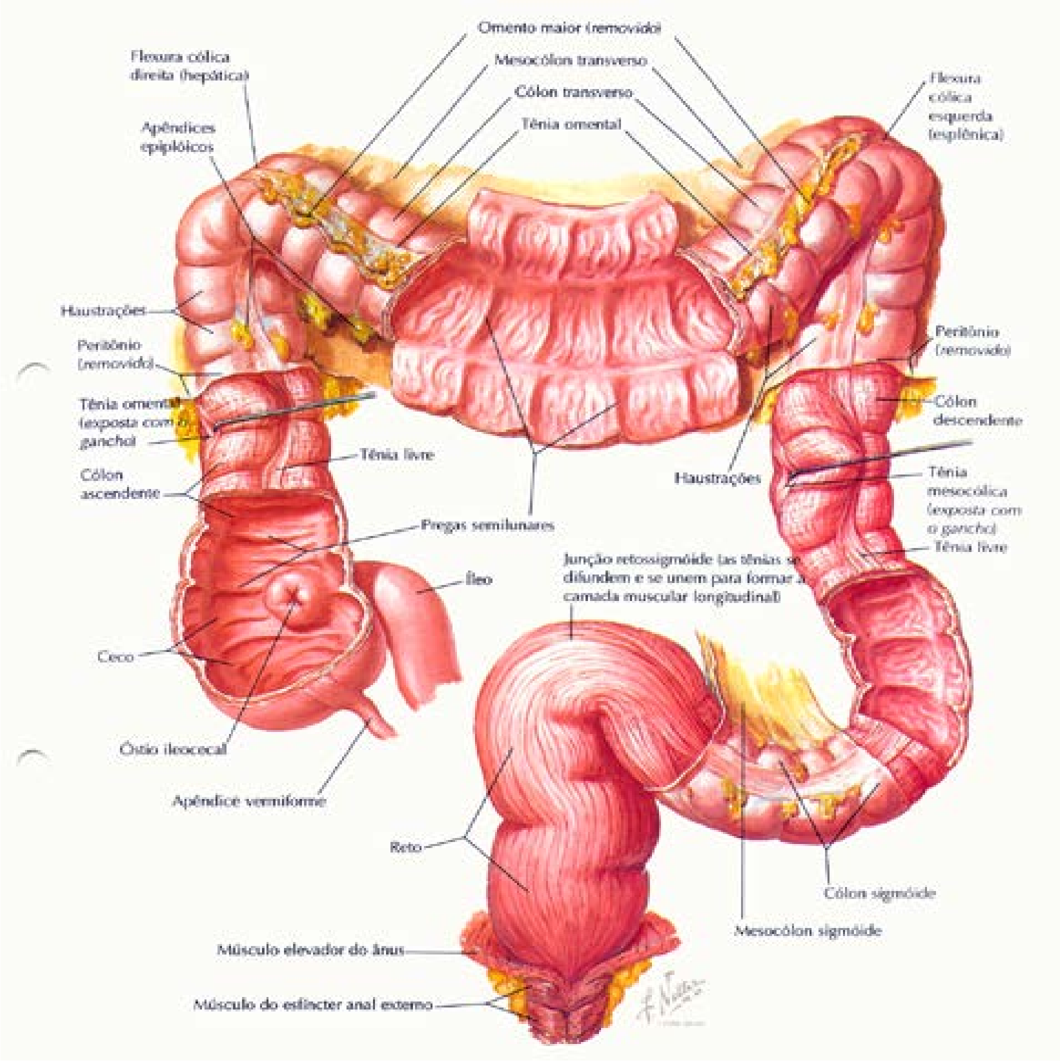
ACTIVATORY
(excitatory)
Esophagus
Stomach
Ileo-Gastric
Gastro-Enteric
Gastro-Ileal
Small intestine
Intestino-
intestinal
Gastro-Colic
Large
intestine
Duodeno-Colic
Rectum
Anus
INHIBITORY

Esfíncter ileocecal e o "Freio ileal" (peptídeo YY)

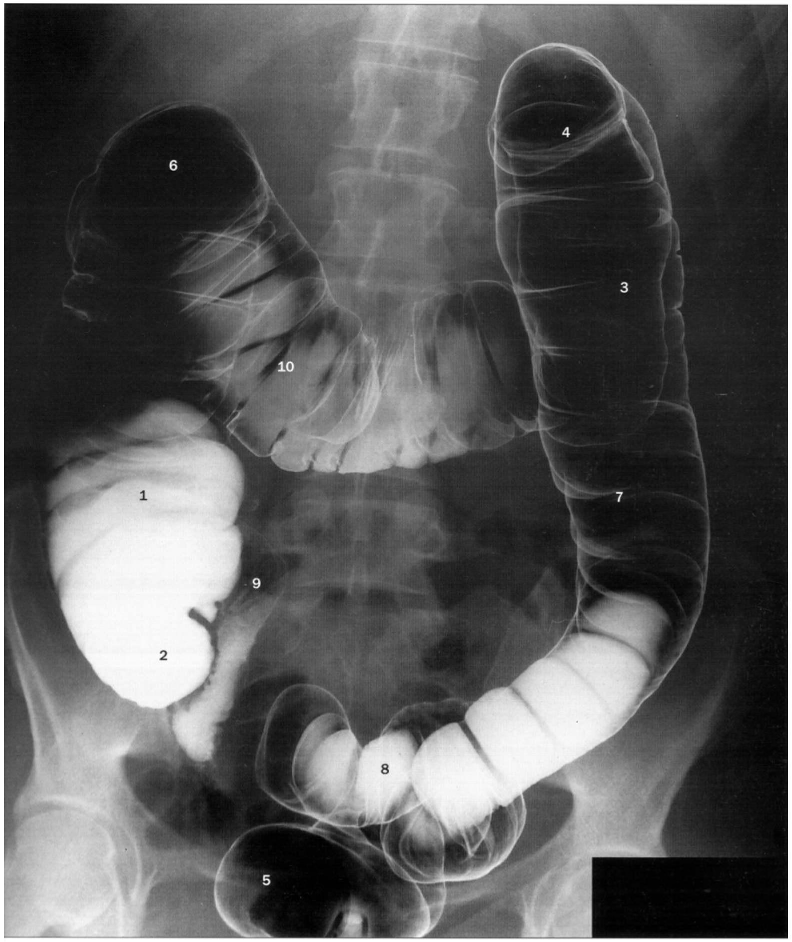




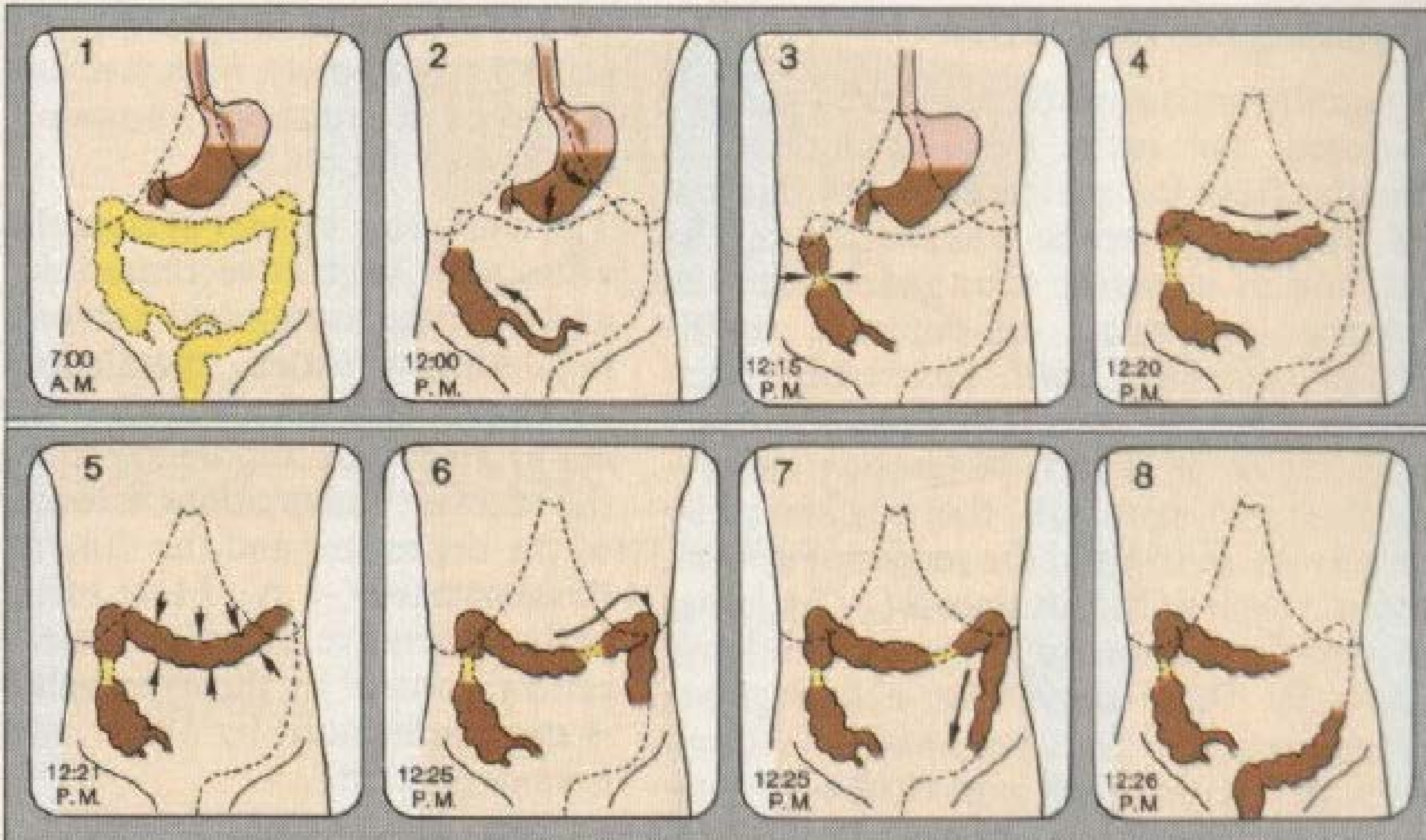
MOTILIDADE DO INTESTINO GROSSO



⇔ Movimento de mistura- haustrações



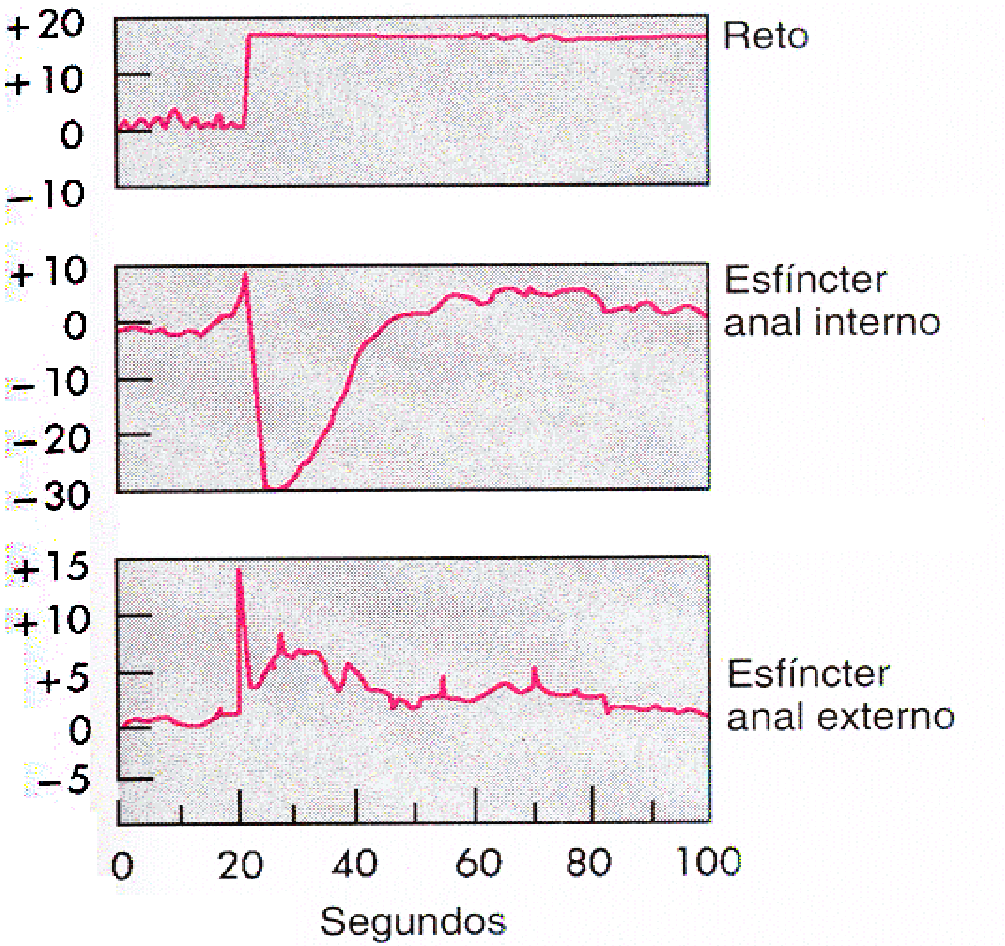
Movimentos de Massa



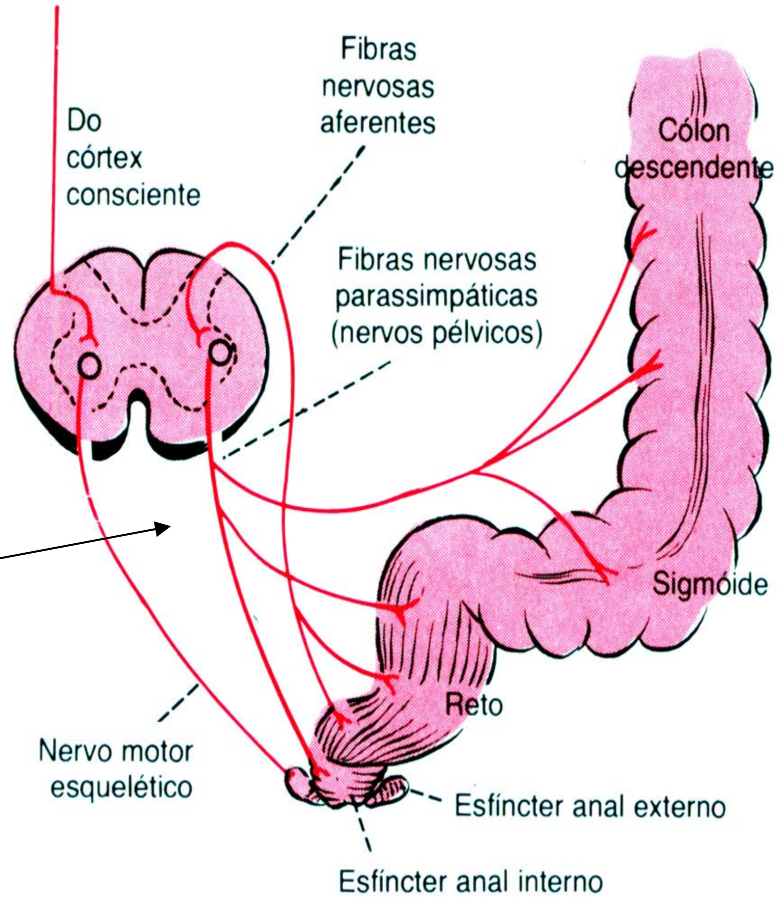
A. Motility of large intestine

(after Hertz and Newton)

REFLEXO DA DEFECAÇÃO



REFLEXO DA DEFECAÇÃO



INTRÍNSECO

REFLEXO
PARASSIMPÁTICO


LE BAROM