

بسم الله الرحمن الرحيم

→ Physiology of Gastrointestinal Tract:

* Lecture 2: Salivary Secretion & Deglutition...

Mastication "Chewing" المضغ

↳ Muscles of Mastication Are supplied By Mandibular Division of Trigeminal Nerve.

↳ Two Types of Teeth:

① Incisors: Exerts Pressure Equals 25Kg.

② Molars: Exerts Pressure Equals 90Kg.

↳ Mastication Is Partially Voluntary & Partially Involuntary.

* Bolus In Mouth → Reflex Inhibition of Muscles of Lower Jaw → Dropping of Lower Jaw → Stretch In Ms. of Mastication → Rebound Contraction → Closure of Teeth " & So On "

N.B. Mastication Isn't Essential For Digestion...

لأنه يمكن تناول كل ما يتضغ الأكل لفترة طويلة

Stimulate Taste & Olfactory Receptors → Salivation

With Little Amount of Food مع كميات قليلة

Appetite Centers لا Inhibition لا يعمل

Salivary Secretions

There Are Two Types of Salivary Secretory Cells:

① Serous Cells: Secrete Serous "Watery" Secretion Which Contains α -Amylase (Ptylin) Which Digest Starch. (Can Be Done with Pancreatic Amylase)

(2) Mucous Cells: Secrete Mucous "Viscous" Secretion Which Contains Mucous/Mucin.

* Pairs of Salivary Glands:

- Parotid Gland: الغدة النكافية
 - ↳ Secretes 25% of Saliva "Mostly Serous"
- Sublingual Glands: تحت اللسان
 - ↳ Secrete 5% of Saliva "Mostly Mucous"
- Submandibular Glands
 - ↳ Secretes 70% of Saliva "Mixed Serous & Mucous"

N.B. Removal of These Pairs Will Not Result In Absence of Saliva; Due To The Presence of Scattered Buccal Glands "Mucous Secretion"

Composition of Saliva: 1500ml/Day

- pH: → Neutral (7) During Rest
 - ↳ Alkaline (8) During Active Secretion

الـ Ca^{++} يذوب في الورط الحامضي، وأثره ناتجاً عن زيادة Ca^{++} في الدم. لو كان الـ pH في الـ Saliva حامضي، لحدثت زيادة في Ca^{++} خلال 24 ساعة.

- Contents of Saliva: Mucin, Ptyalin
 - Saliva is Hypotonic To Plasma: Due To
 - ↳ Less NaCl = 15 mEq/L ($\frac{1}{10}$ NaCl of Plasma)
 - ↳ More K^+ & HCO_3^-
- له بباله الـ NaCl قليل والـ K^+ كثير. هادامعناه في أنسجة الـ Aldosterone في الدور. بيحب Na^+ 3 وبيحب K^+ 2.

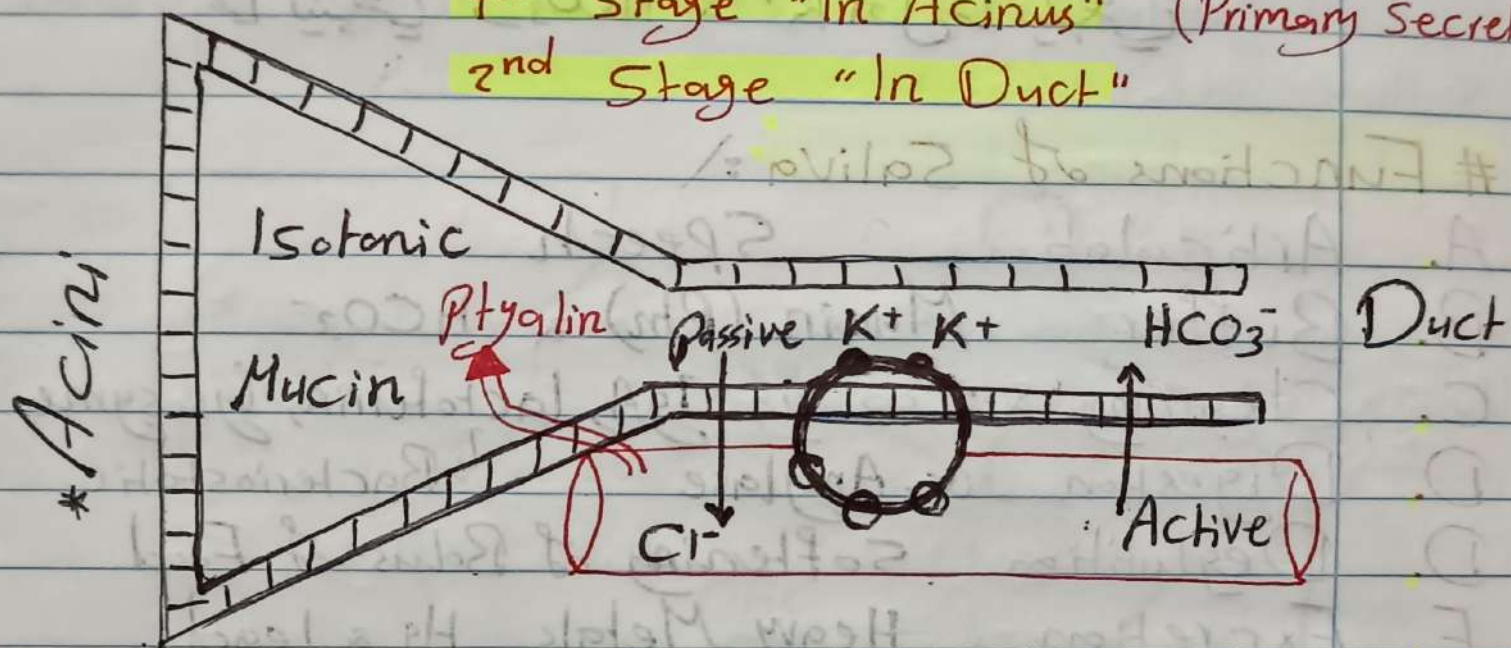
Secretion of Saliva:

- ↳ Any Secretion Is Coupled With Vasodilation.
- ↳ It's An Active Process (The Composition of Secretion Differs From Composition of Plasma)

• Salivary Secretion Occurs In Two Stages:

1st Stage "In Acinus" (Primary Secretion)

2nd Stage "In Duct"



* في الدم Filtration من الدم Blood يعني يتطوع

كل ال Ions ال Same Ionic Composition of Plasma

Primary Secretion Is **Isotonic** To Plasma.

و نوع الخلية فيها بطة (Ptyalin OR Mucin)

* في ال Duct يتم تعديل هادا ال (Secretions) بواطة

ال (Aldosterone) ... بيحب 3Na^+ و يحب عوضاً

عن 2K^+ يعني أخذ أكثر مالت Na^+ ال تالت مالت

ال Saliva **Hypotonic** ...

* ورا ال Na^+ بيحب Cl^- Passively و بيحل

↳ Active Secretion of Bicarbonate (HCO_3^-)

ال Aldosterone جعل ال Saliva أغنى بال K^+

وال HCO_3^- ، أفقر بال (NaCl)

*Parasympathetic Stimulation Can Alters
The Amount & Composition of Saliva.
يُخفّي الـ Saliva رطوبت أكبر وأسهل، بالتالي
يسهل وقت Exchange بين الـ K^+ والـ Na^+ ...
وهذا يخلي الـ Saliva تحتوي على $NaCl$ أكثر
ما ينبغي و HCO_3^- & K^+ أقل مما ينبغي.

Functions of Saliva:

- A. Articulation Speech
- B. Buffer Mucin (Ptn) & HCO_3^-
- C. Cleaning & Cooling IgA, lactoferrin, lysozyme
- D. Digestion α -Amylase $\rightarrow$ Bacteriostatic
- D. Deglutition Softening of Bolus of Food
- E. Excretion Heavy Metals Hg & Lead
- F. Facilitate Stimulation of Taste Buds.
- G. Growth Hormone
- H. H_2O Regulation Thirst
- H. Heat Regulation يسهل سرعة التبريد

في وقت ثانية لهاي الوظائف:

1 Protection of Oral Mucosa.

Cooling / Buffering / IgA / lysozyme / washing

2 Protection of Teeth:

Buffers / Proline-Rich Ptn / Fluorides

$\rightarrow$ Enamel of Teeth نمو

3 Lubrication & Wetting

Articulation / Deglutition / Taste

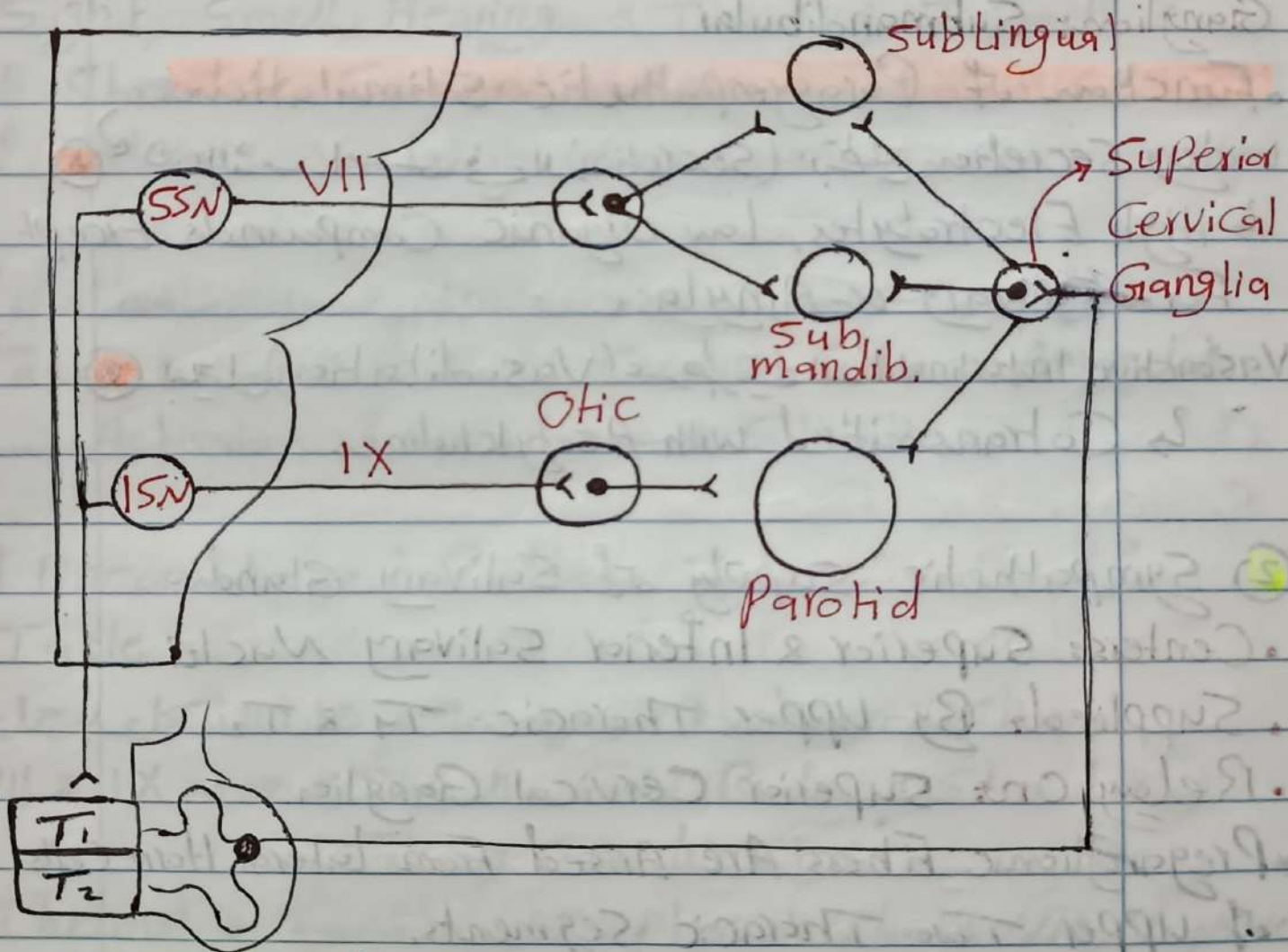
4 Digestion Salivary α Amylase

Control of Salivary Secretion...

↳ All GIT Secretions Is Regulated First By Rapid Nervous Regulation Then Slow Hormonal Regulation

Except Salivary Secretion "Only Nervous"

الـ Bolus of Food يتقعد فترة قصيرة جداً في الفم، والفم فرضا
الـ (Saliva) تطلع بسرعة بواقي (Nervous Regulation)



• Innervation of Salivary Glands:

① Parasympathetic

الـ Vagus به ~ فخل كل الجهاز الهضمي ما عدا النهاية
النهاية الرئوية هي العند اللعابية لا VII & IX Cranial N.
والنهاية الرئوية هي العند اللعابية لا Distal 1/2 of Large Int. & Rectum
عند عنها الر (Pelvic Nerve).

Parasympathetic Supply of Salivary Glands Are
VII Cranial Nerve "Facial" & XI "Glossopharyngeal"

Chorda tympani عَصَبُ قَرِيْب

(Sublingual) بِيْعِيْنِ الْوَا

(Submandibular) الْوَا

Nucleus: Superior

Salivary Nucleus (SSN)

Parotid G. بِيْعِيْنِ الْوَا

Nucleus: Inferior

Salivary Nucleus (INS)

Ganglion: Otic Ganglion

Ganglion: Submandibular

Function of Parasympathetic Stimulation:

Watery Secretion بَيَضَ (Secretion) الْوَا فِي الْوَا ①

↳ High Electrolytes, Low Organic Compounds Except For Salivary α -Amylase.

Vasodilatory Intestinal P. عَصَبُ قَرِيْب (Vasodilation) الْوَا ②

↳ Co-transmitted with Acetylcholine.

② Sympathetic Supply of Salivary Glands:

• Centers: Superior & Inferior Salivary Nuclei.

• Supplied By Upper Thoracic T₁ & T₂

• Relay On: Superior Cervical Ganglion.

* Preganglionic Fibers Are Arised From Lateral Horn Cells of Upper Two Thoracic Segments.

Function of Sympathetic Stimulation:

① Viscid Secretion "Small Amount, Rich In Organic Compounds "Mucin".

② Vasoconstricting بَا لِيُو كِيَا بِيْعِيْنِ الْوَا عَصَبُ قَرِيْب

③ Contraction of Myoepithelial Cells.

There Are Two Types of Reflexes:

[1] Conditioned Reflex "Acquired"

• Ivan Pavlov's Experiment "Classical Conditioning"

في الوضع الطبيعي، لو جينا أكل للكلب بي عمل (Salivation)
لو صرنا نضرب الجرس كل ما نجيب أكل هادا الدريسي
حيرط. عنده الجرس بالأكل لغاية ما يصير صوت الجرس
حالة بي سبب (Salivation) عند الكلب...

* Sight, Smell, Hearing, & Thinking of Food

All Stimulate Cerebral Cortex → Activation
of Salivary Nuclei → Salivation...

• Hypothalamus - Appetat (منظم الشهية)

Taste & Smell Areas in Cerebral Cortex & Amygdala
→ Activation of Appetat → Salivation.

[2] Unconditioned Reflex "Inborn"

• Taste Receptors via VII & IX Nerves

لو جينا كلب و حطينا أكله فيه فم، هادا الأكل بي عمل
Stimulation لل Taste Buds الرقيقة VII & IX Nerves
بالتالي بي خلوا ال (Salivary Glands).

• Thermal & Tactile Receptors in Mouth via V nerve

منظمه وظائف ال (Saliva) زئنا تعمل (Cooling) مثله
كده بيصير (Salivation) لما تاكل دشي حار...

وانت عند طبيب الأسنان لو قلت قنوا أداة في الفم
فتأثر دشي زئنا وجود الأدوات في الفم هادا بي عمل

Stimulation لل Touch Receptors → Salivation

- Irritation of Lower Part of Esophagus, Stomach, & Small Intestine Via X Nerve, "Vagus"

لو أكلت شيء (Spicy) مجادل تخلص منها وتبلعها
 بتعمل Irritation لنهاي الذجرا من ال (Gut) س طب انت
 لو أكلت شيء حار بتروع تشرب مية ... فالج ...
 فقه بيطلع مية على شكل (Saliva).

* Differences Between Conditioned & Unconditioned

- ① Conditioned Reflex is An Acquired Reflex Requires Training & Cerebral Cortex, while Unconditioned Reflex is An Inborn Reflex And Doesn't Require Training Nor Cerebral Cortex.
- ② Receptors of Conditioned Reflexes Found Outside The Gut, while Receptors of Unconditioned Reflexes Are Found In The Gut.

Swallowing "Deglutition" (3 Stages)

↳ Consists of Three Stages

- ① Buccal Stage "Voluntary"
- ② Pharyngeal Stage "Involuntary"
- ③ Esophageal Stage "Involuntary"

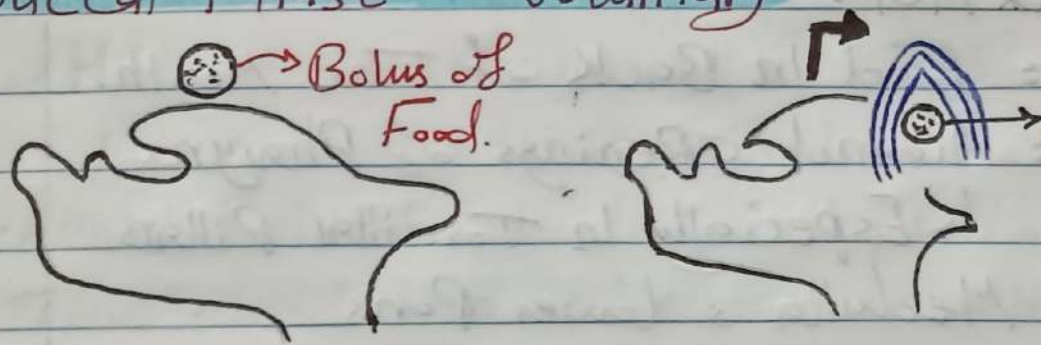
له انت بتتحكم بالأكل طول ما هو في ال (Mouth) و بكسر

بجهد وانت ببلع الأكل بغير كلى (Involuntary) على

طول ال (Gut) لغاية ما يوصل (External Anal Sphincter)

- Center of Swallowing Found In Medulla & Lower Pons.

1) Buccal Phase "Voluntary"



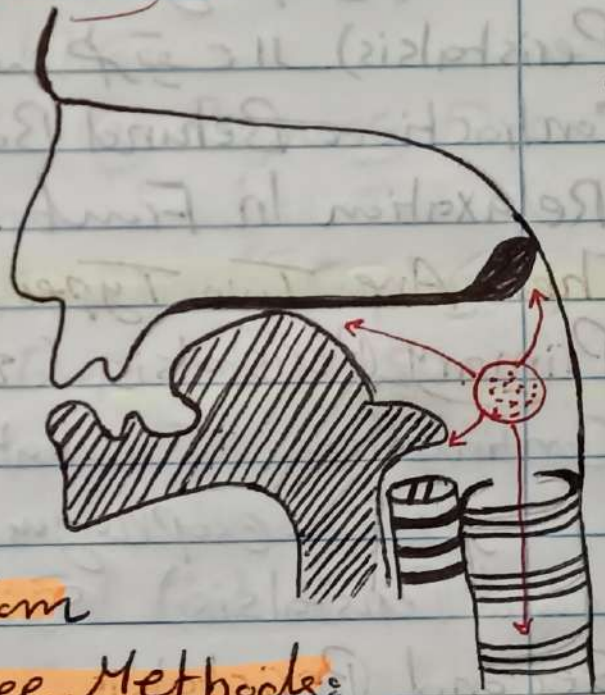
* Bolus of Food يندفع
 Upwards & Backwards Against Palate.

* Myelohyoid Muscle Contraction مضغ
 ↳ Squeezing of Bolus Posteriorly in Pharynx.

2) Pharyngeal Phase "Involuntary"

• Bolus of Food Has One out of Four ways:

- ① Nose → Elevation of Soft Palate
- ② Mouth → Elevation of Tongue
- ③ Larynx → Elevation of larynx
- ④ Pharynx ✓ هادى العج



• The Food Is Prevented From Entering Into larynx By Three Methods:

- ① Elevation of larynx To Be Covered By Epiglottis
- ② Closure of Glottis (الأنفاس الصوتية يتقرب من بعضها)
- ③ Apnea أثناء البلع، يتوقف التنفس

* The Pharynx Has Three Constrictions: → Successive Contractions of Pharyngeal sphincters

↳ + Relaxation of Pharyngo-esophageal Junction

* A Reflex Act:

- Stimulus: Food In Back of The Mouth.
- Receptors: Around openings of Pharynx
↳ Especially In Tonsillar Pillars.
- Center: Medulla & lower Pons.

[3] Esophageal Phase "Involuntary"

من غير ما تاكل، ال Esophagus عبارة عن
أنبوبية مقفولة من فوق بواسطة ال UES
عشان تمنع مرور الهواء، ومقفولة من تحت
بواسطة ال LES عشان تمنع ارتجاع
محتويات المعدة للـ (Esophagus).

الكل يتبعه طريق ال (Peristalsis)
↳ Contraction Behind Bolus of Food
& Relaxation In Front.

• There Are Two Types of Peristalsis:

[1] Primary Peristalsis (8-10 seconds)

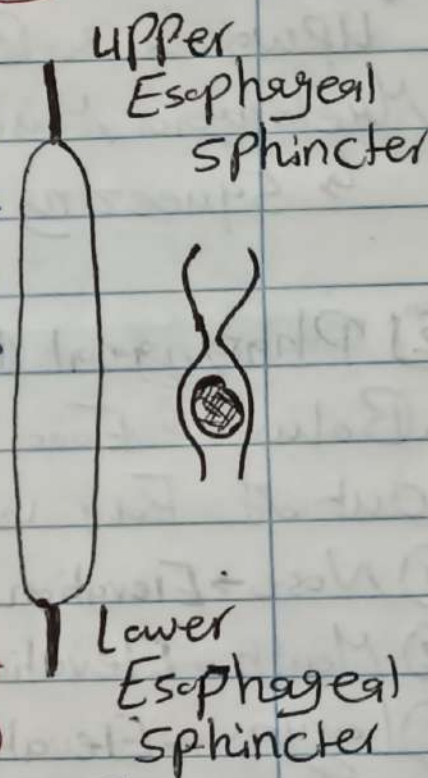
↳ Continuation To what Happened In Pharynx.
غالباً يتبعه تشنج ال Esophagus عالى قوة.

(Second Peristalsis) تشنج عاشر مرة ثانية.

[2] Second Peristalsis.

- ↳ Via Esophageal Distention By Remnants of Food
- ↳ It's Initiated → Partly By Enteric Nervous System
↳ Partly By Vago-Vagal Reflex

• Peristalsis In Upper $\frac{1}{3}$ of Esophagus Is Rapid,
while It's Slow In lower End of Esophagus.



↗ = Lower Esophageal Sphincter, (LES)

Functions of Gastro-esophageal Sphincter:

له عادة يكون مكرعاً يمنع ارتجاع الـ HCl من المعدة
بواسطة Relaxation مع عملية البلع من أجل الدخول
ويعود يقفل ثانية بواسطة Receptive Relaxation

* The Tone of LES Is Under Neural Control:

① Acetylcholine From The Vagus Nerve Causes of Lower Esophageal Sphincter.

② Nitric Oxide & VIP From Interneurons which Are Innervated By Vagus Causes Relaxation of LES.

↳ Between Meals, Normal Tonic Activity of LES Prevents Reflux of Stomach Content Into Esophagus.

* Abnormalities of Tone of LES:

① Decreased Tone of LES During Pregnancy Due To High Levels of Progesterone Leading To Gastroesophageal Reflux → Heartburn, Esophagitis, Ulceration, & Stricture of Esophagus By Scarring.

② Achalasia: Incomplete Relaxation of LES Due To Failure To Release of NO & VIP which leads To Accumulation of Food In Esophagus → Massive Dilatation of Esophagus. Rat Tail Appearance

ttt: Dilatation of sphincter, Esophageal ms. Incision or Injection of Botulinum Toxin In LES To Inhibit Acetylcholine Release.

فحسب الله ...

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