** Click on the arrow at the bottom right to move forward **

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Sequence of learning tutorial, Click on one of the shapes for shortcut.

- BASIC ANATOMY
- WHAT GERD IS
- GENETICS
- INFLAMMATION
- STRESS RESPONSE
- PHARMOCOGENOMICS
- CELL GROWTH AND DEATH
- ACKNOWLEDGEMENTS
- SUMMARY
“Population based survey revealed that 44 % of the population reported monthly heartburn and 19.8 % suffered from heartburn or acid regurgitation at least once a week”.

(Zuckschwerdt, W. 2001)
“GERD is more common in whites compared with other ethnic groups. However, the prevalence is increasing in Asians.” (Fennerty, 2003)

It is also more common in women, however men & people over the age of 60 develop more complications.

(Fennerty, 2003)
BASIC ANATOMY

“The upper GI or gastro-intestinal tract consists of the:
Mouth
Pharynx
Esophagus
Stomach
The small & large intestines form the lower GI tract”.

(Porth, 1998)
The upper GI Tract is sometimes referred to as the Alimentary canal.

(wikipedia)
Once any food enters the mouth, it moves into the pharynx, which is the back of the throat.

(Porth, 1998)
Food is passed from the pharynx into the esophagus by a mechanism called peristalsis. This propelling motion is carried out by the muscles and the central nervous system. (Porth, 1998)
Peristalsis continues in the esophagus.

The food is carried from the esophagus to the stomach where acid production is formed.

(Porth, 1998)
“The esophagus is very muscular and collapses when empty. It is 10 inches or 25cm in length”

(Porth, 1998)
The esophagus is sometimes referred to as the “food tube” or the gullet. It extends from the pharynx, which is the back of the throat and goes through the diaphragm to the stomach.
The esophagus is posterior to (behind) the trachea

Image made available by a generous grant from Bristol-Myers Squibb

Image with permission from Bristol-Meyers Squibb
“The esophagus produces bicarbonate and mucus”. (Kahrilas, 2003)

“The bicarbonate buffers the acid and mucus forming a protective barrier”. (Kahrilas, 2003)
This creates an environment in the esophagus of a higher pH than that of the stomach. The pH in the esophagus is normally about 7-8, whereas the pH in the stomach is generally 2-4. (Kahrilas, 2003)
pH stands for potential of hydrogen.

Hydrogen is what causes materials to become acidic. 7 is considered neutral; anything under 7 is considered acidic. (Porth, 1998)
There are specialized cells deep in the stomach lining that affect the rate of acid production. The primary cells which contribute to acid production are known as parietal cells. (Kahrilas, 2003)
The binding of these 3 receptors in the parietal cells initiates the process of acid production. (Kahrilas, 2003)
Each gastric parietal cell contains about 1 million acid pumps.

“The primary function of the activated pumps are to:

Exchange hydrogen ions from the parietal cells to potassium using energy derived from splitting ATP.”

(Kahrilas, 2003)
Ions exchange at different rates based on the permeability of the parietal cells. The rate influences the intracellular pH, resulting in an environment of acidity or alkalinity of the cells of the stomach. (Kahrilas, 2003)
“The stomach produces an average of 2 liters of HCL a day, which in combination with the protein-splitting enzyme pepsin, breaks down chemicals in food”. (Kahrilas 2003)
There is a rare disorder, called Zollinger-Ellison syndrome: With this, the body produces an excessive amount of acid, this can increase the risk of GERD. (CNN.com)
The esophagus is divided into:

**Upper**
It has a sphincter to prevent air from entering the esophagus during respirations. The sphincter generally only opens for food to pass.

**Lower**
It has a sphincter that opens while food is being passed into the stomach. It is known as the LES, lower esophageal sphincter.

(Porth, 1998)
What GERD is

It is quite a complex process, my goal is to simplify it for you. First, let’s break it down to the words it is made up of: gastro = stomach
esophageal = food tube
reflux = back flow
disease = abnormal condition of physiologic functioning.
The Lower Esophageal Sphincter is the primary focus relating to GERD.
If the Lower Esophageal Sphincter (LES) is not working properly creating a dysfunction – the acid from the stomach can backflow into the esophagus. (Porth, 1998)
In addition to a dysfunction of the lower esophageal sphincter (LES), another factor is:

Percentage of time the esophagus is exposed to a low pH. Clearance of the acid depends on peristalsis & exposure to the saliva. (Porth, 1998)
People with this dysfunction, often experience an uncomfortable feeling in the chest, neck, and throat area due to acid exposure.

This uncomfortable feeling can sometimes be confused with other conditions, even a heart attack.

Image with permission from Healthy Living
Sometimes, just drinking water may help relieve the symptoms, by washing the irritating acids back into the stomach. (Porth, 1998)
This discomfort can be precipitated by lifestyle, diet, and even certain medications.

(Kaynard, Flora, 2001)
Lifestyle

“Smoking – Inhibits saliva, may also increase acid production & weaken the LES”.

Certain exercising & bending – that may increase the abdominal pressure.

“Wearing of tight clothing – increases the abdominal pressure”.

Lying flat after a meal – relaxes the muscles making susceptibility for reflux.

(Kaynard, A., Flora, A., 2001)
“Fatty, greasy foods - take longer to digest keeping food in the stomach longer”.
“Peppermint, spearmint, and chocolate weaken the LES”.
“Carbonated and alcoholic beverages increase the acidity in the stomach”.
Large meal portions – produce large acid levels.
Citrus, onions, and acid from tomatoes can be irritating to the esophagus. (Howard, B., 2004)
“Medications that relax the LES”

- Benzodiazepines
- Theophylline
- Narcotics containing codeine.
- Calcium channel Blockers
- Nitroglycerine

- Anticholinergics
- Potassium supplements
- Iron supplements
- NSAIDS
- Fosamax
- Erythromycin

(CNN)

Clip Art derived from Microsoft Office
The 3 mechanisms during swallowing that keep acid out of the esophagus include:

- "Swallowed saliva which helps neutralize stomach acid".
- "Sweeping muscles contractions that act to cleanse the lower esophagus of stomach acid".
- Protective contracture of the LES

(Jackson Gastroenterology - 2005)
The 3 mechanisms of the lower esophageal sphincter (LES) which prevent backflow are:

- Pressure in the LES is greater than that of the stomach.
- High levels of Acetylcholine, a neurotransmitter increases constriction of the LES.
- Gastrin, a hormone also increases constriction of the LES. (Porth 1998)
Some conditions that can interfere with the 3 mechanisms of the Lower Esophageal Sphincter (LES):

- **OBESITY** - “excess weight puts extra pressure on the stomach & diaphragm”. (CNN.com)
- Pregnancy – “results in greater pressure on the stomach & also has a higher level of progesterone. This hormone relaxes many muscles, including the LES”. (CNN.com)
- **ASTHMA** – it is unsure why, but, is believed that the coughing leads to pressure changes on the diaphragm. (CNN.com)
- **HIATAL HERNIA** – which is the following topic.
In addition to the 3 swallowing mechanisms & the 3 mechanisms of the LES – anatomical structures certainly play a role in the development of GERD.
A hiatal hernia is an anatomical abnormality

“In individuals with hiatal hernia, the opening of the esophageal hiatus is larger than normal, and a portion of the upper stomach slips up or passes (herniates) through the hiatus and into the chest.”  (Kahrilas, 2003)
“The diaphragm supports and puts pressure on the sphincter to keep it closed when you’re swallowing”.

“But a hiatal hernia raises the sphincter above the diaphragm, reducing pressure on the valve. This causes the sphincter muscle to open at the wrong time”. (MayoClinic.com)
Do you think Genetics is a factor?

There is evidence that genetics is a factor in pediatric patients. This is reported in the Journal of the American Medical Association from the July issue in 2000. (Spice, B., 2000)
Inflammation and its impact

Often the suffix of “itis” leads the reader to know there is inflammation. Therefore, inflammation caused by GERD is called, “esophagitis”.

Clip Art derived from Microsoft Office
Inflammation is the body’s response, as a protective measure against infection and injury. Repeated exposure to acid in the esophagus will cause inflammation and injury to the mucosa.
“Inflammation as a result of GERD can cause epithelial changes, marked by polymorphonuclear or mixed polymorphonuclear and round cell infiltration”. (Fennerty, 2003)
There are 3 inflammatory processes that can occur with esophagitis:

- Erosive Esophagitis
- Esophageal Strictures
- Barrett’s Esophagus — (Fennerty, 2003)
"Erosions appear in esophageal mucosa as eroded endothelium".
(Fennerty, 2003)
Contributing factors of Erosive Esophagitis:

- Hiatal Hernia
- Decreased pressure in the lower esophageal sphincter (LES)
- Impaired ability of the tissue to resist injury
- Impaired esophageal clearance
- Increased volume of acid

(Fennerty, 2003)
People with erosive esophagitis may have mild to severe symptoms of pain. (Fennerty, 2003)
A stricture is a narrowing. If esophagitis is left untreated, scarring can occur resulting in a stricture that is irreversible. (Fennerty, 2003)
Contributing Factors of Esophageal Strictures

- Decreased pressure in the lower esophageal sphincter (LES)
- Hiatal Hernia
- Ineffective peristalsis

(Fennerty, 2003)
People with strictures often feel like there is something stuck in their throat. Severe strictures result in difficulty swallowing (dysphagia).

(Fennerty, 2003)
Those with severe strictures usually have less symptoms of heartburn, acid is not able to reflux due to the narrowing of the esophagus. (Fennerty, 2003)
Those with strictures may also have weight loss, due to a change in their diet to accommodate the strictures.

(Fennerty, 2003)
Stress Response

Stress is a complex physiological response to changes in the environment.
Prolonged stress has the ability to decrease the immune system, making the body susceptible to inflammation and infection. (Porth, 1998)
In an effort to cope with the disruption in routine, caused by stress, unhealthy lifestyles become evident.
Pharmacogenomics

There are 3 categories of medications that can help alleviate or prevent symptoms from occurring.

(Kaynard, Flora, 2001)

- Antacids
- H-2 receptor blockers
- Proton pump inhibitors

Clip Art derived from Microsoft Office
Antacids

- Maalox
- Mylanta
- Tums
- Rolaids

These medications help to neutralize stomach acid. They usually provide quick relief, however, will not heal any inflammation.

(CNN.Com)
H-2 Receptor Blockers

- Tagamet
- Zantac
- Pepcid AC

“These medications reduce the acid production. They do not act as quickly as antacids, but provide longer relief”. (CNN.Com)

They start working in about 30 minutes.
Proton Pump Inhibitors

- Prevacid
- Prilosec
- Aciphex
- Protonix
- Nexium

These medications are long acting and block acid production. “Because of this, they have the ability to allow time for damaged tissue to heal from inflammation”.

(CNN.Com)
Cell Growth and Death

As mentioned earlier, as a result of inflammation:
cellular changes can occur.
These cellular changes can be a precursor to cancer. (Fennerty, 2003)
Some articles may refer to these changes as “metaplasia”. This is the actual transformation of cells or tissue from normal to abnormal; whereas, “dysplasia” is the growth of abnormal cells or tissue. (Porth, 1998)
Barrett’s Esophagus is the outcome of these cellular changes.

Cells in the lining of the esophagus are actually replaced with abnormal cells similar to those in the stomach.

(Fennerty, 2003)
This would be, “metaplasia”. As the cells replicate to multiply, dysplasia is occurring. (Porth, 1998)
The exact mechanism is not known. However, these cellular changes are believed to be a protective response to adapt to the repeated inflammation of exposure to stomach acid. (MedicineNet.com)
Ulcers, although not a common symptom, can be found with Barrett’s Esophagus. The ulcers can lead to Gastrointestinal bleeding. (Fennerty, 2003)