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April 2006 *"Peptic Ulcer Disease"* 707-000-06-004-H01

THIS MONTH
"Peptic Ulcer Disease"

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HAVE YOU RECENTLY MOVED? PLEASE NOTIFY US.

There are so many medications that are being used for treating peptic ulcer disease that this seems to be an appropriate time to review this topic. Our overall goal is to discuss therapeutic options. This lesson provides 1.25 hours (0.125 CEUs) of credit, and is intended for pharmacists in all practice settings.

The program ID # for this lesson is 707-000-06-004-H01.
Pharmacists completing this lesson by April 30, 2009 may receive full credit.

To obtain continuing education credit for this lesson, you must answer the questions on the quiz (70% correct required), and return the quiz. Should you score less than 70%, you will be asked to repeat the quiz. Computerized records are maintained for each participant.

If you have any comments, suggestions or questions, contact us at the above address, or call toll free 1-800-323-4305. (In Alaska and Hawaii phone 1-847-945-8050). **Please write your ID Number (the number that is on the top of the mailing label) in the indicated space on the quiz page** (for continuous participants only).

The objectives of this lesson are such that upon completion the participant will be able to:

1. List & describe the types of peptic ulcers.
2. Describe the anatomy & physiology of the stomach.
3. State the causative, as well as the contributing factors, that result in peptic ulcers.
4. List the symptoms associated with peptic ulcers.
5. Identify the methods used to diagnose these disorders.
6. Discuss the drugs used to treat peptic ulcers.

OVERVIEW

The term "peptic" is derived from the word pepsin, an enzyme found in the gastric fluid. A peptic ulcer is acute, subacute, or chronic erosion in the lining of the esophagus, stomach, or duodenum. The names and types of peptic ulcers are based on their anatomical location:

1. Esophageal ulcers are located in the lower portion of the esophagus.
2. Gastric ulcers usually develop in the lesser curvature of the stomach.
3. Duodenal ulcers occur in the first part of the small intestine (duodenum).

A peptic ulcer is an erosion or lesion in the lining of the mucosa. Acute peptic ulcers are often multiple, and range in size from a few millimeters to 3 cm in diameter. The lesions are shallow, extend through the mucosa, and have well-defined margins. Sub acute peptic ulcers consist of lesions that are in transition from acute to chronic. These are deeper than the acute ones, and are capable of penetrating through the mucosa, sub mucosa, and occasionally the muscular layer. Sub acute ulcers may be multiple or single and are usually larger than acute ulcers, but smaller than the chronic ones. Chronic ulcers are almost always single, although they may be surrounded by scars of previously healed acute or sub acute ulcers. The lesion is round with a sharp margin, and has a depth that ranges from 10 to 15 millimeters. The floor of the ulcer is usually clear and covered with fibrous tissue. Peptic ulcers heal from the floor upward. In superficial ulcers, healing is complete, and gastric glands may regenerate. In chronic ulcers, healing is slow and the mucosa is replaced by smooth scared tissue that is devoid of glands. Duodenal ulcers are chronic in nature and recur if treated improperly. The lesions are usually deep and sharp at the edges. They are capable of penetrating through the mucosa, sub mucosa, and into the muscularis. The lesion is usually clear, but at times it may contain blood or exudates along with inflammatory cells. In over 95% of patients with DU, the ulceration occurs in the first portion of the duodenum, and the vast majority of the cases appear within 3 cm of the junction of the pyloric and duodenum mucosa. The lesion is about 1 cm in diameter. In the late 1970's, the prevalence of DU in the industrialized nations ranged from 6% to 15% of the population. Peak incidence of GU is usually in the age range of 55 to 65 years. Like DU, it occurs almost equally in both males and females. GU are usually deep, and the lesion is surrounded by inflammation. They usually occur in the fundus of the stomach and are accompanied by antral gastritis due to the colonization by *Helicobacter pylori*. GU appears as a single lesion within 6 cm of the pyloric sphincter. It is not uncommon for patients to develop both DU and GU simultaneously.

ANATOMY AND PHYSIOLOGY

The upper gastrointestinal tract is normally in contact with acid and pepsin. In healthy individuals, the gastric tissue is not affected by the gastric fluid. However, damage to the tissue may occur if an imbalance develops between the stomach contents and the factors that provide protection to the gastric mucosa. The wall of the stomach consists of mucosa, sub mucosa, and serous layers. Anatomically, the stomach is divided into cardia, which connects the esophagus with the stomach and contains mucus secretory cells; the fundus, which is situated at the upper end of the stomach; the body; and the antrum. Both the body and the fundus comprise about 80 to 90% of the stomach and contain parietal cells that secrete hydrochloric acid. The antrum contains G cells that secrete gastrin. The pyloric mucosa secretes viscid, alkaline mucus whose function is to protect and lubricate the gastric mucosa. The proteolytic enzyme pepsin is formed as a result of a reaction between hydrochloric acid and pepsinogen. Pepsin is active only in a highly acidic environment. The parietal cells possess receptors for histamine, acetylcholine, and gastrin. H_2 receptors are capable of triggering the production of gastric secretions. The interaction between these chemicals and their receptors results in an increase in the level of the intracellular calcium, cyclic adenosine and

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cyclic adenosine monophosphate (C-AMP), which in turn activates a proton pump located in the parietal cells. Activation of the proton pump leads to the secretion of hydrogen ion in the stomach, in exchange for potassium. The main factors that induce proton pump stimulation and the resultant increase in acid formation are calcium, C-AMP, histamine, acetylcholine and the hormone gastrin. The parasympathetic fibers of the vagus nerve control gastric secretion. Vagal stimulation results in the release of hydrochloric acid, gastrin, and pepsinogen. Additionally, food present in the stomach causes the release of the gastrin from the antral portion of the gastric mucosa. The mechanism for the release of gastrin is not fully known. However, once released, gastrin is absorbed into circulation and is carried to the gastric glands where it stimulates the parietal cells to secrete acid, and the chief cells of the body and fundus to produce pepsinogen. Although digestion occurs in the stomach, the gastric tissue itself is not affected by the gastric fluid. The gastric mucosal barrier is responsible for protecting the gastric tissue. The mucus as well as the bicarbonate secreted by the gastric epithelial cells serves as a barrier that prevents penetration of hydrogen ion across the gastric mucosa. Additionally, gastric mucosal blood flow tends to remove the hydrogen ions that penetrate the gastric mucosa. Interference with blood flow can reduce its protective function and increases the risk of gastric mucosal damage. Prostaglandins that are synthesized by the gastric mucosa also help in the protection of the gastric mucosa by: 1) inhibiting acid secretion from the parietal cells; 2) increasing the secretion of mucus and bicarbonate from the epithelial cells; and, 3) maintaining proper blood flow in the mucosa. Disruption of the protective mucosal defense mechanism results in an increase in the level of acid and pepsin which in turn causes mucosal damage and ulceration.

DIAGNOSIS

Symptoms as well as the presence of occult blood in the stool (melena) are suggestive of peptic ulcer disease. Confirmation of ulcers may be achieved by one or a combination of the following tests: **X-ray** of the esophagus, stomach and duodenum with barium, gastric analysis and upper endoscopy. **Gastric analysis** is intended to measure the acidity of the gastric fluid and the amount of acid produced in the area. In this procedure a wire is inserted into the lower part of the esophagus that assists in giving pH readings. **Upper endoscopy** is a procedure allowing the clinician to visually examine the linings of the esophagus, stomach and duodenum. A small flexible tube with a tiny camera, called an endoscope, is inserted into the throat of the sedated patient and down into the stomach and duodenum. The endoscope blows air into the stomach to expand the folds of the lining. Tests for the presence of *H. pylori* are essential in successful treatment of gastric and duodenal ulcers and in avoiding other GI disorders. **Urea Breath Test** for *H. Pylori* involves exhaling into a balloon-like bag. The patient will be given a small glass of a solution that contains radioactive carbon as part of the urea that will be broken down by *H. pylori*. After 15 to 30 minutes the patient is asked to exhale in another bag. The second breath sample is then tested for any increase in the level of carbon dioxide. Four weeks prior to the breath test, the patient should refrain from taking antibiotics or Pepto-Bismol. Likewise, two weeks prior to the test, the patient should not take any anti-peptic ulcer medications. **Antibody or Antigen Test** also may be conducted for the detection of infection. Diagnosis may also be achieved through histological examination.

ETIOLOGY

Peptic ulcers develop when an imbalance exists between aggressive factors (i.e., drugs, excessive gastric acid, pepsin, bile and *H. pylori)* and reduced protective factors (i.e., amount of gastric mucus, bicarbonate, mucosal blood flow and presence of prostaglandins). A few generations ago, peptic ulcers resulted in morbidity and mortality. However, over the past 30 years remarkable advances in the pathogenesis of peptic ulcers and their treatment have been realized. At the present time, there are effective therapies that not only heal ulcers, but also result in curing a relatively high percentage of patients. GU and DU may develop when physiological factors that protect the mucosa of the stomach and duodenum are weakened as a result of *H. pylori* invasion, or due to a drug. Unprotected mucous membranes will allow the acidic gastric fluid to penetrate through the lining beneath and form erosion and subsequent ulcers. The bacterium *H. pylori* usually establishes itself during childhood, most likely through consuming contaminated water, food, or close contact (i.e., kissing) with an infected person. Symptoms of the infection appear during adulthood and often the person may be asymptomatic throughout life. Even though presence of *H. pylori* during childhood may not cause immediate health problems, inflammation and erosion of the gastric mucous membrane as well as peptic ulcer disease may emerge as the person becomes older.

Helicobacter Pylori

This is a major etiological factor of peptic ulcer disease. In 1984, it was reported that a link exists between this corkscrew-shaped bacterium and the formation of peptic ulcers. Currently, it is known that many cases of the disease are a result of infection by the bacteria. It has been shown that the one year relapse rate of DU occurs in less than 15% of patients who were treated for *H. pylori,* compared to 70 to 80% relapse following treatment with H_2 receptor antagonists. It is estimated that about 95 to 100% of patients suffering from DU and 75 to 85% of patients with GU harbor *H. pylori*. In the US, 20% of individuals 40 years of age and younger, and 50% of persons 60 years of age and older harbor *H. pylori* in their stomachs. This microorganism is an acid resistant, gram-negative bacilli that is microaerophilic and ranges between 0.2 to 0.5 micrometer in length. Even though its presence may not result in ulceration, sometimes it disrupts the mucosa and causes inflammation and erosion. The damage caused to the gastric mucosa occurs as a result of proteins produced by the bacterium. One of these proteins is urease, an enzyme that catalyzes the hydrolysis of urea to ammonia and carbon dioxide. In addition, urease plays an important role in protecting the microorganism from the damaging effects of gastric acid and in allowing colonization within the mucous layer of the stomach. The equilibration of water and ammonia forms hydroxide ions that cause damage to the gastric mucosa. In addition to urease, *H. pylori* produces proinflammatory factors as well as proteases and phospholipase that cause a breakdown in the glycoprotein-lipid complex of the mucus gel layer. One aspect of these microorganisms is that they are capable of producing an adhesion that allows them to attach themselves to the gastric epithelial cells. It should be kept in mind that not everyone with *H. pylori* infection develops peptic ulcerations. This indicates that other factors play a role.

Medications are one of these. The NSAIDs are the most widely used analgesic and anti-inflammatory group. They can irritate or inflame the lining of the stomach and small intestine, thereby increasing the vulnerability of the gastric mucosa for the formation of peptic erosion. These drugs include: aspirin, ibuprofen, naproxen, and ketoprofen. The frequency of injuries caused to the stomach is more common than those in the duodenum. The NSAIDs block the synthesis of cyclooxygenase, which causes biosynthesis of endogenous prostaglandins. Prostaglandin is a hormone-like substance that protects the stomach lining from chemical injury. In the absence of prostaglandin, NSAID use results in erosion and inflammation of the lining. Furthermore, NSAIDs interfere with cell replication at the ulcer margin, thereby retarding the healing and repair processes. The intake of aspirin and weakly acidic NSAIDs can cause local injury. In the acidic environment of the stomach, weak acids are present in the unionized form and can freely penetrate the gastric barrier, especially in the absence of protective factors.

Hypersecretion of acid-pepsin fluid may be another factor that plays an important role in the development of peptic ulcers. Peptic ulcers occur in areas of the digestive system exposed to acid-pepsin secretions, and only in persons whose stomach secretes hydrochloric acid. Peptic ulcer disease is not encountered in patients who suffer from achlorhydria (absence of acid in the gastric fluid).

Emotional stress is another contributing factor that may aggravate symptoms of peptic ulcers and delay healing. It may cause an increase in the tonus of the vagus nerves that ultimately lead to stimulation of the gastric glands. Other than NSAIDs and aspirin, many drugs such as corticosteroids, caffeine and aminophylline are capable of stimulating the gastric glands to secrete more acid.

Cigarette smoking may enhance the development of DUs. Smoking has been shown to increase acid secretion due to nicotine content in tobacco. Nicotine may inhibit pancreatic bicarbonate secretion, and may increase the gastric emptying rate into the duodenum.

Excessive intake of **alcohol** can also lead to irritation of the gastric lining. Furthermore, alcohol could lead to further erosion of the mucus membrane due to its gastric stimulation.

SYMPTOMS

Symptoms of peptic ulcers vary depending on the severity and location of the ulcer. Some patients may experience minimal symptoms, as in elderly patients, while others may have moderate to severe complaints. Burning pain is often located in the epigastric region located in an area 3 to 4 centimeters between the xiphoid process and the umbilicus. This is caused by the ulcer, and is exacerbated by the acidic gastric fluid while in contact with the inflamed lesion. The pain may be accompanied by a cramp-like sensation, distention, nausea, and vomiting. The pain is steady, mild or moderately severe and may radiate to the back. It may last from a few minutes to several hours, and worsens when the stomach is empty. Pain may flare at night, usually within a few hours after retiring. In DU, the pain is usually absent upon awakening in the morning, but develops in mid-morning, temporarily relieved by

food that buffer's stomach acid, but reappears within one to two hours. The pattern of GU ulcer symptoms differs somewhat from those of DU. For example, food may cause, rather than relieve, pain. Less often, symptoms such as vomiting of blood, dark stool, iron-deficiency anemia, weight loss, or anorexia may occur.

COMPLICATIONS OF PEPTIC ULCERS

Perforation and internal hemorrhage may lead to peritonitis (inflammation of the abdominal cavity), a life-threatening condition. Perforation is the most serious complication, and occurs as an acute abdominal emergency. It is more common among males. It is characterized by a sudden onset of intense epigastric pain that may spread to the chest and shoulders. The patient becomes pale, and tends to be motionless in an attempt to reduce the abdominal pain. Breathing is shallow as a reaction to the pain caused by the normal movement of the diaphragm. In the early stages, the pulse is normal, but if the condition is not treated promptly, symptoms of peritonitis, including body temperature elevation, tachycardia, reduced blood pressure, nausea and vomiting, may appear within several hours. Surgery to close the perforation must be performed without delay. The earlier the surgery, the better the prognosis.

Hemorrhage is a common complication that occurs as a result of erosion into the veins, arteries or capillaries of the gastric tissue. The vast majority of patients, especially those who ignore treatment, experience bleeding as a result of seepage of blood from the lesion. Occult blood is often present in the stool. In cases of moderate to severe bleeding, the patient becomes nauseous and may vomit fresh blood. Weakness, pallor, thirst and sweating usually accompany bleeding ulcers.

TREATMENT

Self-care is important in avoiding complications. Therapy compliance; eating a restricted diet; reduction in amount of stress; limiting or avoiding the intake of alcohol, NSAIDs and smoking may reduce the risk of perforation and hemorrhage and may enhance healing. Prior to the discovery of the H_2 receptor antagonists and the realization of the role of *H. pylori* infection in the development of peptic ulcers, the disease was common. Over three generations ago, peptic ulcer therapy consisted of the intake of antacids, anticholinergics and bland diet. The introduction of antisecretory drugs, H_2 receptor antagonists and proton pump inhibitors, along with the utilization of upper gastrointestinal gastroscopy and the development of antibiotic combination therapies for eradication of *H. pylori* have revolutionized peptic ulcer therapy. Such therapies resulted not only in healing ulcers, but in curing many cases.

The **main therapeutic goals of drug therapy** are to alleviate the symptoms, enhance healing, and prevent complications. These can be achieved by eradicating *H. pylori*, lowering acid production, and neutralizing and protecting the eroded or ulcerated area to allow healing. Patients should refrain from smoking and eliminate alcohol consumption. Duration of therapy for GU ranges from 8 to 12 weeks, and for DU from 4 to 6 weeks. Healing is usually achieved within these time frames. Recurrences may arise within 12 months. However, these happen when *H. pylori* eradication is much lower. To prevent the risk of relapse, maintenance therapy should be instituted.

Antiulcer drugs may be divided into the following: 1) **antisecretory drugs**; 2**) mucosal protectants**; 3) **antisecretory agents that stimulate mucosal defenses**; 4) **antacids**; and 5) **antibiotics**.

Antisecretory Agents

Histamine H_2 Receptor Antagonists

These medications enhance healing by suppressing secretion of gastric acid. Histamine acts on two classes of receptors. Stimulation of H_2 receptors leads to symptoms of allergy, whereas stimulation of H_2 receptors that are present on parietal cells of gastric mucosa results in increased gastric secretion. The histamine H_2 receptor antagonists cause a reduction in the amount of gastric secretion as well as its hydrogen ion concentration through blockade of the H_2 receptors. In addition, these agents reduce the gastric stimulating effects of gastrin and acetylcholine. The H_2 receptor antagonists are **cimetidine**, **famotidine**, **nizatidine**, and **ranitidine**.

Cimetidine may be administered orally, intramuscularly or intravenously. The blood levels obtained via these routes are relatively similar. Its oral availability is 60 to 70%. The drug is well-absorbed following oral administration. However, foods delay its absorption, but do not affect the extent of absorption. The concurrent intake of antacids may diminish absorption of cimetidine. The drug is eliminated in the urine. When the blood concentration of cimetidine reaches 0.5 ìg/ml, the basal gastric acid secretion is reduced by approximately 80%, while meal simulated acid secretion is diminished by about 50%. Ulcers usually heal two weeks after initiation of

therapy. However, the average duration of therapy to achieve healing is about 4 weeks. Following acute healing or discontinuation of therapy, it is not uncommon for the ulcer to recur. The usual adult oral dose is 800 mg daily at bedtime. Reduction of nocturnal gastric acid secretion plays an important role to induce healing of peptic ulcers. The recommended maintenance dose is 400 mg daily at bedtime.

Famotidine has action similar to that of cimetidine, i.e., reduces gastric secretions during daytime and at night and when such secretion is stimulated by food. Because famotidine is slowly dissociated from H_2 receptors, the activity of the drug may be reversible. On a molar basis, famotidine is considered more potent than either cimetidine or ranitidine, but for the short-term treatment of peptic ulcer, it has similar effect. The drug is completely absorbed from the GI tract. The presence of food in the stomach may enhance bioavailability of famotidine, while antacids may slightly decrease availability. However, concomitant administration of antacid may be attempted. Its oral availability is about 45%. It is excreted mainly in the urine. The administration of the usual adult dose of 40 mg at bedtime appears to have the same effect as the intake of 20 mg twice daily.

Nizatidine is well absorbed after oral administration. The time to peak plasma level is 0.5 - 3 hours after oral dose. It is metabolized in the liver and eliminated in the urine. The oral availability is 90%. The usual adult dosage for peptic ulcer is 300 mg daily at bedtime or 150 mg twice daily. Preventative or maintenance dose is 150 mg at bedtime.

Ranitidine has similar properties of the H_2 receptor antagonists. It is more potent than cimetidine and causes fewer side effects. It may be administered orally, intramuscularly or intravenously. The oral availability is approximately 50%. Unlike cimetidine, it is absorbed at the same rate on a full or empty stomach. It is metabolized in the liver and excreted in the kidneys. The usual adult dose is 300 mg daily at bedtime or 150 mg twice daily. The recommended maintenance dose is 150 mg daily.

Proton Pump Inhibitors

Proton pump inhibitors act as gastric antisecretory agents by binding to hydrogen/potassium adenosine triphosphatase located in the parietal cells. Inhibition of this enzyme system, which is known as the proton pump, can block the final step in the secretory pathway of hydrochloric acid. Proton pump inhibitors usually accumulate in the parietal cell secretory canaliculi where the drug is converted to its active sulfonamide metabolite and ultimately binds with the sulfhydryl groups of H^+/K^+ exchange ATPase, thereby inactivating the proton pump and inhibiting the transport of H^+ to the gastric lumen. The duration of action of the proton pump inhibitors usually is prolonged due to the fact that they will require more time for additional enzymes to be synthesized. **Omeprazole** and **lansoprazole** are two examples of this group.

Omeprazole is a gastric acid pump inhibitor that is effective within one hour following administration, and its activity peaks within 2 hours. A single oral dose of 30 mg can reduce 97% of acid secretion within 2 hours, and its duration of activity lasts for about 72 hours. It is more potent than the H_2 receptor antagonists. The gastric antisecretory effect intensifies until it reaches a plateau that usually occurs within four days after initiation of therapy. Omeprazole is capable of suppressing *H. Pylori* infection in patients with duodenal ulcer. However, its administration along with antiinfective agents such as clarithromycin and amoxicillin can effectively eliminate the infection. Omeprazole is indicated for short-term periods for treating peptic ulcers. The drug is unstable in acid medium, and, consequently, it is dispensed in capsules that contain enteric-coated granules that dissolve when reaching the alkaline medium of the duodenum. Approximately 50% of the dose reaches circulation. The drug is metabolized in the liver and excreted in the urine. Its plasma half-life is short (approximately one hour.) However, due to its irreversible enzyme inhibition, its activity remains longer after its presence in the blood has disappeared. Omeprazole is used orally. The recommended adult dose for peptic ulcers is 20 mg once daily. To enhance healing, the drug must be taken for 2 - 4 weeks. Higher doses may be used if the patient fails to respond positively to therapy. The adverse effects include headache, diarrhea, nausea, and vomiting. The incidence of these effects occurs in less than 1% of patients.

Lansoprazole is a proton pump inhibitor having a mechanism similar to omeprazole. It can suppress *H. Pylori* infection of the gastric or duodenal mucosa when given with one or more appropriate antibiotics. The recommended adult dose is 15 mg once daily. It has been reported that higher doses of up to 60 mg daily were no more effective than the 15 mg regimen. The maintenance dosage after healing is 15 mg daily.

Mucosal Protectants

Sucralfate is a complex that consists of an anionic sulfated disaccharide and aluminum hydroxide. It is used as an antiulcer due to the protection it provides against acid and pepsin. In the acidic medium of the stomach, sucralfate undergoes polymerization and cross-linking reactions, resulting in a viscid and adhesive gel that adheres and forms a complex with the fibrinogen in the ulcer lesion. This action results in the establishment of a barrier to pepsin and bile. The formed complex at the ulcer lesion may last for up to 6 hours. Sucralfate is administered orally. Only 3 to 5% of the dose is systemically absorbed, and 90% is excreted in the feces. It has a healing rate similar to that of cimetidine. Because it is minimally absorbed into the system, sucralfate has no known serious adverse effects. The most common side effect is constipation, diarrhea, nausea, indigestion, dry mouth and rash. The recommended adult dose for treating duodenal ulcer is 1 gram, four times daily, on an empty stomach and at least one hour before meals and at bedtime. For prophylactic purposes, the dose is 1 gram, twice daily.

Antiulcer Drugs that Promote Mucosal Defenses

Misoprostol is an analogue of prostaglandin E, and it is utilized for the prevention of gastric ulcers triggered by the long-term use of NSAIDs. It is classified as a gastric protectant that enhances the mucosal defenses. Misoprostol achieves this action by: 1) suppression of secretion of basal and nocturnal gastric acid from the parietal cells, 2) increasing gastric mucus and mucosal secretion of bicarbonate, and 3) maintains adequate blood flow in the submucosa. Aspirin, as well as NSAIDs, promote the formation of gastric ulcers in part by inhibiting prostaglandin synthesis. Misoprostol is well absorbed following oral administration, reaching a peak serum level within 15 minutes. It is metabolized in the liver and excreted in the urine. The most common adverse effects are diarrhea, and abdominal discomfort, which are dose related, constipation, gas, headache and nausea. In some women, dysmenorrhea and spotting may be experienced. The drug is contraindicated during pregnancy. The usual dose is 200 ì g four times daily taken with meals and at bedtime.

Antacids

Antacids are alkaline compounds that are commonly used in the treatment of peptic ulcers. Their main function is to lower the acidity of the gastric fluid and by doing so, they tend to deactivate pepsin. Consequently, healing is promoted and pain is relieved. Antacids have no inhibiting effect on gastric secretion. With the exception of sodium bicarbonate, antacids are poorly absorbed and, therefore, they have no effect on systemic pH. The most widely used antacids are aluminum hydroxide, calcium carbonate, magnesium salts, and bismuth compounds. Aluminum hydroxide is insoluble and has a long duration of activity when compared to other antacids. The main side effect of this antacid is constipation and fecal impaction, especially in the elderly and in patients with impaired bowel motility. Constipation may be relieved if aluminum hydroxide is given concurrently with magnesium hydroxide. Calcium carbonate provides a rapid, prolonged and potent neutralizing effect. About 10% of the dose may be absorbed in the stomach. When taken regularly and in large doses, it may cause hypercalcemia, leading to calculi and electrolyte imbalance. Magnesium oxide, hydroxide, trisilicate, and carbonate are the magnesium salts that are utilized as antacids. When given in larger doses, magnesium hydroxide is used as a laxative. Bismuth salts can promote healing by providing a protective coating to the ulcer crater. In addition, they stimulate secretion of bicarbonate and prostaglandins, as well as suppressing the multiplication of *H. pylori*. Bismuth salts, in particular, bismuth subsalicylate, are well tolerated and have no harmful side effects when given for a period of 8 weeks or less, otherwise, they may result in neurological disorders. Bismuth salts may cause stool discoloration.

Antibiotics

Several antibiotics may be used to combat *H. pylori* infection. Quadruple therapy consists of a combination of bismuth compounds, antisecretory agents such as proton pump inhibitors or H_2 receptor antagonists and two antibiotics composed of tetracycline and metronidazole. Such therapy should be employed for 14 days. A triple therapy utilizes a combination of proton pump inhibitors or H_2 - receptor antagonists, clarithromycin, and amoxicillin administered for 14 days. Both therapies have resulted in eradication of *H. pylori*.

SUMMARY

Peptic ulcers are common. The discovery of H_2 receptor antagonists, proton pump inhibitors and others, as well as the realization that *H. Pylori* plays an important role in causing peptic ulcers has drastically improved the prognosis of these disorders. Cure of peptic ulcers is achievable. Change in life style is essential.

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LESSON EVALUATION

Please fill-out this section as a means of evaluating this lesson. The information will aid us in improving future efforts. Either circle the appropriate evaluation answer, or rate the item from 1 to 7 (1 is the lowest rating; 7 is the highest).

1. Does the program meet the learning objectives?

List & describe types of peptic ulcers	Yes	No
Describe anatomy & physiology of stomach	Yes	No
State causes of peptic ulcers	Yes	No
List symptoms of peptic ulcers	Yes	No
Identify diagnostic techniques used for peptic ulcers	Yes	No
List & describe therapeutic drug options for peptic ulcers	Yes	No

2. Was the program independent & non-commercial? Yes No

	Poor			Average			Excellent
3. Relevance of topic to your practice	1	2	3	4	5	6	7

4. What did you like most about this lesson?_____

5. What did you like least about this lesson?_____

(WATCH OUR WEBSITE FOR RESULTS OF PARTICIPANT EVALUATIONS)

Quiz—Please Select the Most Correct Answer

1. Gastric ulcer usually appears in:
   A. Lesser curvature of the stomach
   B. Upper portion of the stomach
   C. Longer curvature of the stomach
   D. Junction between the stomach & small intestine
2. Which of these is not an etiological or contributing factor of peptic ulcers?
   A. Excessive alcohol consumption
   B. Gender
   C. Stress
   D. NSAIDs
3. Hydrochloric acid is secreted:
   A. Only in the duodenum
   B. By G cells
   C. By parietal cells
   D. By the submucosa
4. Which of these is not a diagnostic method for ulcers?
   A. Upper endoscopy
   B. X-ray
   C. Colonoscopy
   D. Gastric analysis
5. *Helicobacter pylori*:
   A. Is a gram-positive microorganism
   B. Usually resides in folds of the stomach
   C. Is acquired only via blood transfusion
   D. Is harbored by only 10% of persons 60 years of age & older
6. Chronic ulcers;
   A. Are multiple
   B. Are larger than subacute ulcers
   C. Are never surrounded by scars
   D. Are almost always single
7. Which statement is INCORRECT?
   A. A therapeutic goal of treating peptic ulcer is to eradicate *H. pylori*
   B. Lowering gastric acid production helps to treat peptic ulcers
   C. Ulcer patients should not smoke
   D. To achieve good therapeutic results peptic ulcer patients are sedated
8. Which of these acts as a gastric mucosal protectant?
   A. Sucralfate
   B. Ranitidine
   C. Famotidine
   D. Omeprazole
9. Cimetidine acts:
   A. As a H_2 receptor antagonist
   B. As a long acting antacid
   C. Inhibits adenosine triphosphatase
   D. As an anticholinergic
10. A side effect of sucralfate is:
    A. CNS stimulation
    B. Constipation
    C. Tachycardia
    D. Drowsiness

Contributing Author
Farid Sadik, Dean
University of South Carolina
College of Pharmacy
Columbia, SC

Executive Editor
William J. Feinberg,
BS Pharm, MBA

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