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MULTI-COMPONENT ANTACID SYSTEM

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ABSTRACT

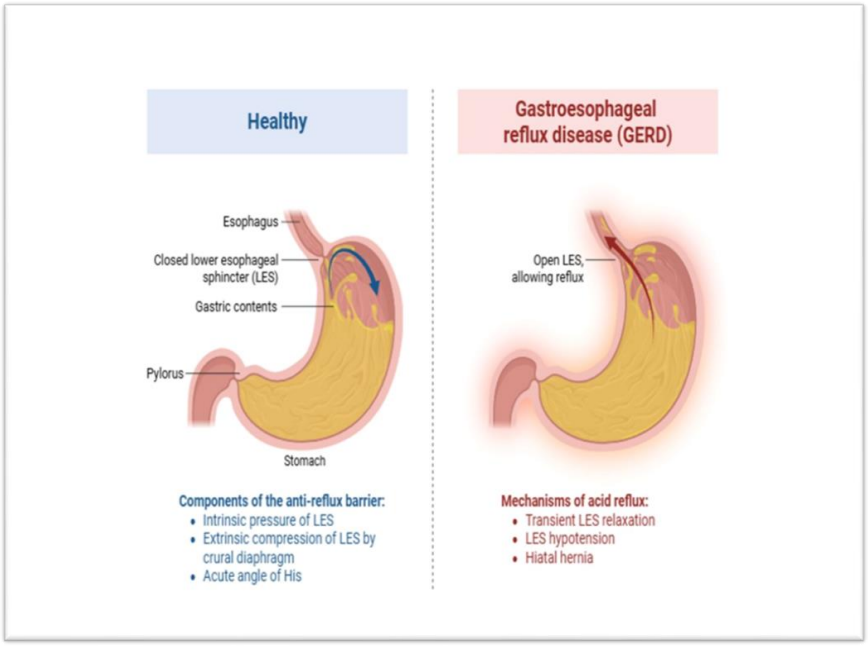
Gastroesophageal reflux disease (GERD), hyperacidity, and related acid-peptic disorders are commonly treated with antacids, though conventional formulations often provide limited and short-lasting relief. This study focuses on developing a semi-solid gel-based combination antacid containing sodium alginate, sodium bicarbonate, and calcium carbonate to enhance acid neutralization and patient compliance. The gel system offers faster drug release, better mucosal adhesion, and prolonged gastric retention. The formulation was evaluated for physicochemical properties, acid-neutralizing capacity (ANC), release profile, and stability, and compared with a marketed product. The findings aim to establish a more effective, patient-friendly, and cost-efficient antacid gel for improved management of acid-peptic disorders.

KEYWORDS: Antacids, Calcium Carbonate, Sodium Alginate, Sodium Bicarbonate.

Highlights

- Provide rapid relief from hyperacidity, heartburn, GERD, and peptic ulcer disease.
- Neutralize gastric hydrochloric acid and raise stomach pH.
- Useful for short-term and intermittent symptoms

Graphical Abstract



1. INTRODUCTION

For more than a century, antacids have been a useful drug. As a result of what is now regarded as a misinterpretation of scientific facts in the late 1950s and early 1970s, the unjustified assumption that antacids should only be taken when necessary was born. According to twelve recent endoscopic controlled studies, antacids can effectively treat duodenal ulcers, with healing rates of about 75% in just four weeks. Antacids and H2-receptor antagonists are controversial when it comes to treating stomach ulcers; this is probably because the illness has even greater genetic variation. Because they likely work by neutralizing postprandial acid formation, Antacids should be taken an hour after meals and at least four times daily.[1] For many years, there has been a class of drugs called antacids. Although they were initially the first line of treatment for peptic ulcer disease, the discovery of proton pump inhibitors significantly changed the way the condition is managed. These days, heartburn and moderate intermittent GERD are the only conditions for which antacids are advised. This activity covers important information that members of an interprofessional team managing the care of individuals with mild GERD and heartburn need to know. This information includes the indications, contraindications, pharmacological action, adverse events, and other important aspects of antacid therapy in the clinical setting.[2] Antacids are substances that decrease stomach acidity by raising the pH of the duodenum and stomach. Gastric acidity is caused by the stomach secreting too much HCl for a variety of reasons. Low pH is caused by endogenous HCl, which is present continuously under physiological settings. The following are possible outcomes of hyperacidity: after the stomach is empty, its pH is 1.5–2.5; after food is taken, it rises to 5–6.1) Peptic or oesophageal ulcers (lower end of oesophagus) 2) Gastritis (general inflammation of the stomach mucosa) 3) Stomach ulcer (gastric) 4) Ulcers in the duodenum.[3]

As with hiatal hernias, a faulty oesophageal Sphinter is the cause of peptic ulcers. When gastric ulcers first appear, they are in their most basic form and are caused by less curvature. Antacids are mostly alkaline drugs that are used to combat stomach acid. Reduction of stomach acidity is one method of treating symptoms that might be brought on by reflux into the oesophagus, excessive stomach acid production, or a decrease in the stomach lining's resistance.[5] The medication known as an antacid reduces stomach acid, which helps with indigestion and heartburn. By preventing

pepsin, an enzyme that produces acid to break down food for digestion, from working, antacids balance the acidity of your stomach. Antacids are not prescription drugs and can be purchased over-the-counter. Due to their weak base nature, antacids can lessen the acidity of stomach contents and alleviate associated discomfort. 7. The primary medicinal advantage of antacids is their rapid beginning of action, which enables them to alleviate gastrointestinal distress within a few minutes. Using data from the literature and expert judgment, this review examines the pharmacological properties of antacids and their therapeutic efficacy—their quick, long-lasting action with little chance of side effects.[6]

2. Importance Of Antacids:[7]

Aspect	Details
Purpose	By neutralizing stomach acid, you can lessen symptoms like indigestion, heartburn, and acid reflux.
Mechanism of Action	In the stomach, antacids react with hydrochloric acid to produce water and other neutral substances, which lessens acidity.
Types of Antacids	- Sodium bicarbonate (alka-seltzer, for example) -Tums, or calcium carbonate -Magnesium Hydroxide, such as Magnesia Milk
Common Uses	-GERD treatment, -stomach ulcer prevention, -Indigestion, and -Heartburn treatment
Benefits	- Fast relief from acid-related discomfort - Non-prescription availability - Can be used for short-term relief
Side Effects	- Constipation (with calcium or aluminum-based antacids) - Diarrhea (with magnesium-based antacids) - Risk of kidney stones
Precautions	- Not suitable for long-term use without medical supervision - Should be taken with caution if you have kidney disease
Overuse Risks	- Can cause altered mineral balance (e.g., calcium, magnesium) - Can affect the absorption of other medications
Alternatives	Proton pump inhibitors (like omeprazole) and H2 blockers (like ranitidine) for the long-term treatment of acid-related disorders

Stage I of GERD is characterized by three episodes per week, whereas Stage II is characterized by more than three episodes per week. This division is based on the frequency of symptoms. Heartburn is an excruciating burning sensation that can occasionally travel from the chest, behind the breastbone, or upper belly to the neck. Just one It specifically has a connection to the common GERD symptom of stomach acid reflux via the lower esophageal sphincter. Some GERD patients may also experience atypical symptoms (epigastria fullness, pressure, or pain, dyspepsia, nausea, bloating, or belching), stage III (daily symptoms) and extra-esophageal symptoms (such a chronic cough, bronchospasm, wheezing, hoarseness, sore throat, asthma, laryngitis, or teeth erosions). The sensations increase in recumbent positions and are more frequently seen after meals.[5]

3. Purpose of Combining Antacids:[8]

Purpose	Explanation	Example
Balancing Side Effects	Combines antacids to counteract side effects like diarrhea and constipation.	Magnesium hydroxide + Aluminum hydroxide (e.g., Maalox, Mylanta)
Enhancing Effectiveness	Combines antacids with different neutralizing capacities for broader pH coverage and quicker relief.	Aluminum hydroxide + Calcium carbonate
Achieving Balanced	Combines antacids with additional agents (e.g.,	Antacid + Simethicone (e.g., Maalox

Therapeutic Profile	antifoaming agents) for more comprehensive symptom relief.	Plus)
Improving Duration of Action	Combines fast-acting and slow-acting antacids for both immediate and long-lasting relief.	Calcium carbonate (fast-acting) + Aluminum hydroxide (slow-acting)
Reducing Frequency of Dosing	By using combination antacids, a single dose can provide longer-lasting relief, reducing the need for frequent use.	Calcium carbonate + Magnesium hydroxide
Addressing Multiple Symptoms	Combines agents to treat multiple gastrointestinal symptoms simultaneously (e.g., acid reflux, bloating, indigestion).	Antacid + H2-blocker (e.g., Pepcid Complete)

4. Classifications of Antacids

Antacids are classified as either systemic or non-systemic, depending on whether they are absorbed into the body. Systemic absorbs them or not, antacids.[9]

Class of Antacid	Active Ingredient(s)	Mechanism of Action	Examples
Aluminum-based	Aluminum hydroxide	Neutralizes stomach acid and forms aluminum salts	Asphodel, Alternagel
Magnesium-based	Magnesium hydroxide	Neutralizes stomach acid and promotes laxative effect	Milk of Magnesia, Phillips' Milk of Magnesia
Calcium-based	Calcium carbonate	Neutralizes stomach acid, increases gastric pH	Tums, Rolaids, Caltrate
Sodium-based	Sodium bicarbonate	Rapid neutralization of stomach acid, may cause bloating	Alka-Seltzer, Baking soda
Combination Antacids	Aluminum hydroxide + Magnesium hydroxide	Balanced neutralization, minimizes side effects (e.g., constipation or diarrhea)	Maalox, Mylanta
Histamine H2-receptor antagonists (H2 blockers)	Ranitidine, Famotidine, Cimetidine	Decrease acid production by blocking histamine action on H2 receptors	Zantac, Pepcid, Tagamet
Proton Pump Inhibitors (PPIs)	Omeprazole, Lansoprazole, Esomeprazole	Inhibit proton pumps in parietal cells, reducing acid production	Nexium, Prilosec, Prevacid

5. Indications[10]

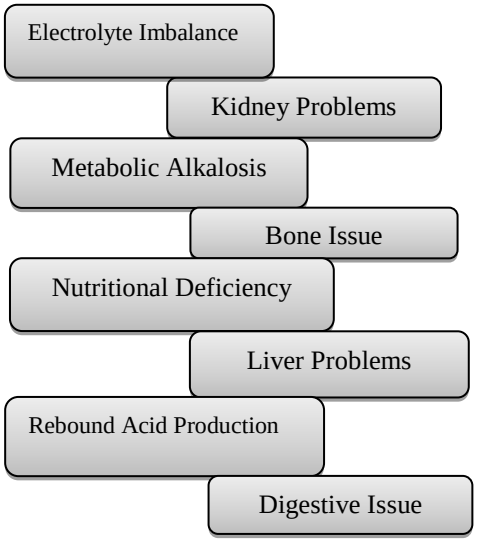
1) Heartburn symptoms in GERD: Chest burning, which typically occurs after eating and can worsen at night or while you're sleeping. When a bitter or sour acid backs up into the mouth or throat, it's called regurgitation. Often misdiagnosed as heart pain, chest pain is actually the result of acid reflux. Swallowing difficulties, or dysphagia, are caused by esophageal irritation or constriction. Feeling as though your throat hurts, especially after eating. Voice cord and throat acid damage might result in laryngitis, a persistent cough, or a sore throat. Increasing asthma symptoms, especially at night.[11]
2) Duodenal and gastric ulcers: The inside lining of the stomach and the upper portion of the small intestine are the sites of open sores called gastric ulcers and duodenal ulcers, respectively. Both types of ulcers are commonly referred to as Peptic Ulcer Disease (PUD). Antacids frequently alleviate the symptoms of duodenal and stomach ulcers. They neutralize stomach acid, reduce ulcerated mucosal irritation, and provide rapid and temporary pain relief.[12]
3) Stress Gastritis: The stomach lining becomes inflamed when physiological stress, such as severe sickness, trauma, or surgery, occurs, leading to stress gastritis. Patients in critical condition are usually affected, particularly those in intensive care units (ICUs). In contrast to chronic gastritis brought on by Helicobacter pylori or NSAIDs, stress gastritis manifests abruptly.[13]

4) Insufficiency Pancreatic: A disorder known as pancreatic insufficiency occurs when the pancreas is unable to produce enough digestive enzymes and/or bicarbonate, which results in malabsorption of nutrients, particularly proteins, lipids, and fat-soluble vitamins (A, D, E, and K). It most frequently relates to exocrine pancreatic insufficiency (EPI), though it can also be endocrine.[14]
5) Diarrhoea caused by bile-acid: Bile acid diarrhea, also known as bile acid malabsorption (BAM), is the result of too much bile acids getting into the colon and producing watery diarrhea. It occurs when the terminal ileum's bile acid reabsorption is inadequate or its production is deregulated.[15]
6) Constipation: The symptoms of constipation, a common gastrointestinal disorder, include: Infrequent bowel movements (often fewer than three per week). Stool that is hard, dry or lumpy. Passing stool with difficulty or strain. A feeling that one has not completely evacuated.[7]

6. Contraindications[16]

1) Renal failure: Renal failure, or kidney failure, is the term used to describe the situation where the kidneys are unable to effectively filter waste products from the blood.[17]
2) Heart failure: Antacids are frequently used to treat indigestion and heartburn, but they can have serious side effects for heart failure patients. These side effects are brought on by substances in some antacids that pose serious health risks and exacerbate the symptoms of heart failure.[18]
3) Edema: The medical term for swelling brought on by an excess of fluid that becomes trapped in your body's tissues is edema. The hands, arms, lungs (pulmonary edema), abdomen (ascites), and even the face might be affected, but the most common places are the legs, ankles, and feet.[19]
4) Cirrhosis: Many liver diseases, such as chronic alcohol consumption and hepatitis, can cause cirrhosis, a late stage of liver fibrosis. Every time the liver is damaged, whether by disease, excessive alcohol consumption, or another cause, it tries to repair itself. This leads to the development of scar tissue. As the cirrhosis worsens, more and more scar tissue forms, making it harder for the liver to function.[20]
5) Hyperparathyroidism: When the parathyroid glands overproduce parathyroid hormone (PTH), blood calcium levels rise, resulting in hyperparathyroidism. This imbalance can lead to a number of health issues, such as kidney stones, bone loss, fatigue, and depression.[21]

7. Side Effects



8. Examples of antacids

1) aluminium hydroxide
2) magnesium carbonate
3) magnesium trisilicate
4) magnesium hydroxide
5) calcium carbonate
6) sodium bicarbonate
7) magnesium oxide
8) aluminium phosphate[22]

9. Combination of Antacids[23]

- Aluminium Hydroxide + Magnesium Hydroxide
- Calcium Carbonate + Magnesium Hydroxide
- Aluminium Hydroxide + Magnesium Carbonate
- Aluminium Hydroxide + Magnesium Trisillicate
- Aluminium Hydroxide + Calcium Carbonate
- Combinations containing Alginic Acid
- Product containing Simethicone

1) Aluminium Hydroxide Gel + Magnesium Hydroxide

One of the components of the several aluminum salts is aluminum hydroxide, an inorganic salt. In most antacid formulations, it is mixed with calcium or magnesium salts and is rarely used alone. The gastrointestinal system absorbs just a small amount of aluminum hydroxide and about 17–30% of the aluminum chloride generated (Drug Bank Online). Al3+ and OH- are the products of the breaking of aluminum hydroxide in the stomach. Water and insoluble aluminum compounds, primarily Al(C l)3, are produced when the free hydroxide group in the stomach attaches itself to the free proton. This proton binding lowers indigestion by raising the stomach's total pH and making it less acidic. Feces are the resultant aluminum salt's excretion.[6] Milk of magnesia is another name for magnesium hydroxide. The dosage will vary depending on the condition being treated, however it can be used as a laxative and an antacid. In order to temporarily alleviate heartburn, sour stomach, upset stomach, or acid reflux, it is used as an antacid. Gastric acid is neutralized by magnesium hydroxide instead. In general, the combination of the two antacids eliminates the laxative and constipating effects of each one alone. Each component is used in suspension in amounts ranging from two to four per cent.[6]

Mechanism of Action: Magnesium hydroxide and aluminum hydroxide gel are frequently used as antacids to neutralize stomach acid and alleviate indigestion, heartburn, and acid reflux symptoms. Here's how each part functions:

The mechanism of action of aluminum hydroxide gel ($Al(OH)_3$): In the stomach, hydrochloric acid (HCl) and aluminum hydroxide, a weak basic, react. Aluminum chloride and water are produced when excess stomach acid (HCl) is neutralized. This lessens the stomach's acidity, which helps people with acid reflux and heartburn.

The following is the response:

(OH) 3 + 3 $H\ C\ l \rightarrow A\ l\ C\ l$ 3 + 3 H 2 O Al(OH) 3 + 3HCl→AlCl 3 + 3H 2 O

Side Effects: Excessive usage of aluminum-based antacids might decrease intestinal motility, which can result in constipation.[24]

The mechanism of action of magnesium hydroxide ($Mg(OH)_2$): Another base that works similarly to neutralize gastric acid is magnesium hydroxide. In the stomach, it combines with hydrochloric acid to produce water and magnesium chloride. This lessens stomach acidity as well.

The following is the response

$Mg\ (OH)$ 2 + 2 $HCl \rightarrow M\ gCl$ 2 + 2 HO

Mg(OH) 2 + 2HCl → MgCl 2 + 2H 2 O

Adverse Reactions: When eaten in excess, magnesium hydroxide may cause diarrhea due to its laxative properties. The effect of aluminum hydroxide on the bowel is the opposite of this.[25]

Combined Mechanism

Aluminum and magnesium hydroxides combine to neutralize gastric acid. Constipation may occur from aluminum hydroxide slowing down stomach motility, whereas diarrhea may result from magnesium hydroxide increasing it.[26] The theory is that their conflicting impacts on bowel movements balance each other out, reducing adverse consequences like diarrhea or constipation.[27]

1. Overall Effects: This mixture aids in reducing the discomfort brought on by heartburn, peptic ulcers, and acid reflux by neutralizing the excess acid in the stomach. By increasing the stomach's pH, it creates a more neutral environment.[28]
2. Dose: Suspension: Usual Dose: 15ml four to six times a day .Usual Dose Range: 5 to 120ml daily.
   Tablets: Usual Dose: 1 or 2 tablets four to six times a day. Usual Dose Range: 1 to 4 tablets up to twelve times daily.

Marketed Formulation: Mylanta, Mygel, kudrox, Maalox HRF, Maalox TC, Magagel, Magnalox, Digene, Gaviscon, Almagel, Rennie Duo, Gelusil, Aludrox, winGel, Creamalin.

2) Calcium Carbonate + Magnesium Hydroxide

The naturally occurring minerals calcium and magnesium are necessary for many body functions. Calcium is necessary for bone growth and preservation. Heartburn, upset stomach, and indigestion are treated with an antacid consisting of calcium carbonate and magnesium hydroxide. This medication guide does not cover all of the uses for calcium carbonate and magnesium hydroxide.[29] The naturally occurring minerals calcium and magnesium are necessary for many body functions. Calcium is necessary for bone growth and preservation. To treat indigestion, upset stomach, and heartburn, an antacid consisting of calcium carbonate and magnesium hydroxide is utilized. This medication guide does not cover all of the uses for calcium carbonate and magnesium hydroxide.[30]

Mechanism of Action:

In over-the-counter antacid preparations, calcium carbonate (CaCO3) and magnesium hydroxide (Mg $(OH)_2$) are frequently combined. They work by neutralizing stomach acid, also known as hydrochloric acid, or HCl, which lessens the symptoms of GERD, such as heartburn and indigestion.

Below is an explanation of how each part functions:[31]

Neutralization of Acid: In the stomach, calcium carbonate (CaCO3) combines with hydrochloric acid (HCl) to generate calcium chloride ($CaCl_2$), carbon dioxide (CO_2), and water (H_2O). The response is:

$CaCO$ 3 + 2 $HCl \rightarrow CaCl$ 2 + CO 2 + H 2 $O \rightarrow$ Ca Cl 2 + CO 2 + H 2 O = Ca CO 3 + 2HCl

This reduces the discomfort brought on by indigestion or acid reflux by neutralizing stomach acid, increasing pH, and decreasing acidity.

Effect on pH: The stomach contents become less acidic as a result of the neutralization process, which elevates their pH.[32]

Magnesium Hydroxide ($Mg(OH)_2$): Acid Neutralization: Magnesium hydroxide neutralizes hydrochloric acid in the stomach in a similar way as calcium carbonate, although it tends to produce less carbon dioxide.

$Mg\ (OH)$ 2 + 2 $HCl \rightarrow M\ gCl$ 2 + 2 H 2 O

Mg(OH) 2 + 2HCl → MgCl 2 + 2H 2 O

Impact on pH: Similar to calcium carbonate, magnesium hydroxide lowers stomach acidity by raising the pH of the contents.

Laxative Effect: Because magnesium hydroxide draws water into the intestines, it has a slight laxative effect that might help ease constipation, a typical side effect of various antacids. This counteracts the potential constipating effects of calcium carbonate.[33]

Combined Mechanism: Magnesium hydroxide and calcium carbonate work well together to produce a balanced result. While magnesium hydroxide aids in regulating acidity and preventing excessive acid rebound—a condition in which the stomach overproduces acid after an antacid neutralizes it—calcium carbonate provides efficient acid neutralization and prompt relief. Magnesium hydroxide also helps avoid constipation, which is a common side effect of calcium-based antacids.[34]

- **Key Benefits of Combination**

1. Efficient Acid Neutralization: Both components effectively reduce stomach acid, albeit in slightly different ways.
2. Balanced Effects on Digestion: The laxative action of magnesium hydroxide counteracts the constipating action of calcium carbonate.
3. Quick Acting: Magnesium hydroxide has a longer-lasting effect than calcium carbonate, which brings relief more quickly.

When combined, these substances offer a more comprehensive strategy for treating problems associated with stomach acid.[35]

Dose: Oral tablet, chewable (80 mg-14.2 mg)

Marketed Formulation: Rolaids, Mylanta supreme, CallExa-Plus

3) Aluminium Hydroxide + Magnesium Carbonate

Occasionally, heartburn, indigestion, upset stomach, and other problems brought on by too much stomach acid are treated with magnesium carbonate and aluminum hydroxide (a LOO minumhye DROX ide; mag NEE zee um KAR bon ate). It functions by lowering the stomach's acid production. It is a member of the antacid drug class of pharmaceuticals.[36] Aluminum is one mineral that occurs naturally. An antacid is aluminum hydroxide. Acid reflux, sour stomach, upset stomach, and heartburn can all be treated with aluminum hydroxide. In patients with specific kidney disorders, aluminum hydroxide can also be utilized to reduce phosphate levels. Not all of the uses for aluminum hydroxide are covered in this medicine guide.[37] The acidity of stomach acid can be reduced with antacids such as magnesium carbonate and aluminum hydroxide. An aluminum hydroxide and magnesium carbonate combination medication is used to treat heartburn, acid reflux, sour stomach, and upset stomach. The uses of aluminum hydroxide and magnesium carbonate are not all included in this medicine guide.[38]

Mechanism of Action: An antacid made of magnesium carbonate and aluminum hydroxide is frequently used to treat acid reflux, heartburn, and indigestion. These two elements cooperate as follows:[39]

Mechanism of Aluminum Hydroxide ($Al(OH)_3$): By reacting with excess stomach acid (hydrochloric acid, HCl) to produce aluminum chloride ($AlCl_3$), water (H_2O), and carbon dioxide (CO_2), aluminum hydroxide neutralizes the acid. By increasing the stomach's pH, this neutralization lessens the symptoms of heartburn and acid reflux.

The response is:

Al(OH) 3 + 3 H 2 O → AlCl 3 + 3 HCl

Al(OH) 3 + 3HCl → AlCl 3 + 3H 2 O

Additional Effect: Magnesium carbonate's effects may be counterbalanced by aluminum hydroxide's mild constipating properties.[40]

Magnesium Carbonate ($MgCO_3$): Mechanism: By reacting with hydrochloric acid to form magnesium chloride ($MgCl_2$), carbon dioxide (CO_2), and water (H_2O), magnesium carbonate also neutralizes stomach acid and raises the pH of the stomach, relieving acidity. The reaction is as follows:

MgCO 3 + 2 HCl→ MgCl 2 + CO 2 + H 2 O

MgCO 3 + 2HCl−MgCl 2 + CO 2 + H 2 O

Magnesium carbonate has a laxative effect that helps counteract the constipating effects of aluminum hydroxide.[41]

Combined Combination: Aluminum hydroxide and magnesium carbonate combine to effectively neutralize stomach acid. The aluminum hydroxide component lowers acid and relieves symptoms, while magnesium carbonate counteracts the laxative effects of aluminum hydroxide, making the treatment of indigestion more comprehensive and effective. Therefore, the combination helps avoid common side effects like diarrhea or constipation that could occur from using either drug alone and improves acid-induced stomach discomfort.[42]

Dose: Aluminum Hydroxide/Magnesium Carbonate

Tablet, chewable: 160mg/105mg

Suspension, oral : (31.7mg/119.3mg)/5mL, (84.6mg/79.1mg)/5mL, (254mg/237mg)/5mL[43]

Marketed Formulation: Gelusil, Mylanta, Gaviscon, Digene, Mucaine Gel

4) Aluminium Hydroxide + Magnesium Trisilicate

Antacids do not instantly relieve symptoms because their effects are slow. However, the action goes on for a while. It also functions effectively as an adsorbent in the digestive system. When magnesium trisilicate combines with stomach contents, gelatinous silicon dioxide is created, which is said to protect and aid in the healing of ulcerated mucosal surfaces. Aluminum hydroxide is another acid that is insoluble. Food in the stomach prolongs the aluminum hydroxide reaction by delaying gastric emptying. By balancing their laxative and constipating qualities, magnesium trisilicate and aluminum hydroxide work together to reduce adverse effects on the gastrointestinal system.[44] Supplemental Magnesium Trisilicate Tablets The name of the medication you are taking is BP. Its active components are magnesium trisilicate and aluminum hydroxide. Antacids include substances like magnesium trisilicate and aluminum hydroxide. They attach to too much acid, changing the stomach's acidity.This drug is used to treat unsettled stomachs, which are typified by nausea, excessive gas (dyspepsia), and stomach burning and discomfort.[45]

Mechanism of Action: In antacid formulations, magnesium trisilicate and aluminum hydroxide are frequently combined to neutralize stomach acid and cure ailments like acid reflux, heartburn, and indigestion. A summary of their modes of action is provided below:[46]

Aluminium Hydroxide ($Al(OH)_3$): Neutralisation of Gastric Acid: This substance neutralises stomach acid. In the stomach, it combines with hydrochloric acid (HCl) to neutralize excess stomach acid and produce water (H2O) and aluminum chloride ($AlCl_3$).

$Al\ (OH)\ 3 + 3\ HCl \rightarrow AlC\ l\ 3 + 3\ H$

$2\ O$ Al(OH) 3 +3HCl→AlCl 3 +3H 2 O

Protective Effect: By coating the stomach lining with a gel-like substance, aluminum hydroxide can also have a minor protective effect on the gastric mucosa, shielding it from irritation brought on by stomach acid.

Possible Side Effects: Because aluminum hydroxide affects gastrointestinal motility, it may cause constipation as a side effect.[47]

Neutralization of Gastric Acid: Magnesium trisilicate ($Mg_3Si_4O_{10}\cdot 8H_2O$) also neutralizes excess stomach acid. In the stomach, it combines with hydrochloric acid to produce silica (SiO_2), water, and magnesium chloride ($MgCl_2$).

$Mg\ 3\ Si\ 4\ O\ 10 \cdot 8\ H\ 2\ O + 8\ HCl \rightarrow 3\ Mg\ Cl\ 2 + 4\ Si\ 2 + 8\ H\ 2\ O$

Mg 3 Si 4 O 10 ·8H 2 O+8HCl→3MgCl 2 +4SiO 2 +8H 2 O

Laxative Effect: Because magnesium ions pull water into the intestines to aid with bowel movements, magnesium compounds, such as magnesium trisilicate, can have a slight laxative effect. This negates aluminum hydroxide's constipating effects.[42]

Combination of Both: The effects of magnesium trisilicate and aluminum hydroxide are counterbalanced by their combination. Magnesium trisilicate works similarly to aluminum hydroxide in neutralizing stomach acid, but it also has the added advantage of preventing constipation.

Balanced Effect: Because aluminum hydroxide tends to encourage bowel motions and magnesium trisilicate helps relieve them, the two chemicals work together to alleviate constipation. Together, they successfully lessen the symptoms of acid reflux, heartburn, and indigestion while also lowering side effects including constipation.[48]

Dose: Tablet, Chewable**:** 80mg/14.2mg
Heartburn and Gastric Hyperacidity
Ordinary Strength Tablets: As needed, chew two to four pills orally every six hours, but don't take more than sixteen tablets in a day.

In pediatric patients, safety and effectiveness have not been shown[49]
Marketed Formulation: Gaviscon regular Strength tablet, Fiflux, Filux Forte, Acigon, Gelusil, Triosgel, Tricreamalate

5) Aluminium Hydroxide + Calcium Carbonate

In this study, the effects of aluminum hydroxide and calcium carbonate antacids on the bioavailability of ciprofloxacin (Cipro) were investigated. Twelve healthy participants received oral Cipro (750 mg) using a three-way randomized crossover design. Four 850 mg calcium carbonate tablets were administered five minutes prior to Cipro, three 600 mg aluminum hydroxide tablets were administered five minutes prior to Cipro, and Cipro was the only treatment.[50] An open-label, randomized, crossover, 32-subject trial examined the effects of 5-ml and 15-ml doses of calcium carbonate (CC) and magnesium-aluminum hydroxide (MAH) antacids, respectively, on the bioavailability of ofloxacin following single oral 400-mg doses of the antibiotic. Ofloxacin or an antacid were administered four times (n=16 for each antacid) to individuals twenty-four hours prior to, two hours prior to, or two hours following the ofloxacin dose. Whether the antacid was taken at any time, CC administration had no discernible effect on the pace or degree of ofloxacin absorption.[48]

Mechanism of Action: In antacid formulations, calcium carbonate (CaCO3) and aluminum hydroxide ($Al(OH)_3$) are frequently combined to alleviate ailments like heartburn, acid reflux, and indigestion. Although the two substances neutralize stomach acid in separate ways, their combined actions contribute to immediate and sustained relief.[12]
$Al(OH)_3$, or aluminum hydroxide:

Hydrochloric acid (HCl) in the stomach is neutralized by aluminum hydroxide, which functions as a base. Acidity is decreased by the chemical reaction of $Al(OH)_3$ with HCl, which produces water (H_2O) and aluminum chloride ($AlCl_3$).

Al(OH) 3 + 3 H 2 O → AlCl 3 + 3 HCl
Al(OH) 3 + 3HCl → AlCl 3 + 3H 2 O

Impact on gastric pH: By increasing the stomach's pH, aluminum hydroxide helps to lessen the burning feeling brought on by acid reflux.

Possible adverse impact: Aluminum compounds have the potential to induce constipation, which is why they are frequently mixed with other substances, such as calcium carbonate or magnesium compounds, to counteract this effect.[40]

Carbonate of calcium (CaCO3): Potential negative effect: Although constipation is typically less severe than with aluminum compounds, it is a potential side effect of excessive calcium carbonate use. Hypercalcemia, or high blood calcium levels, can also occur from prolonged overuse. Neutralization of stomach acid: However, calcium carbonate also neutralizes stomach acid, but in a different way. It produces calcium chloride ($CaCl_2$), carbon dioxide (CO_2), and water when it combines with hydrochloric acid.

HCl + CaCO 3 → CaCl 2 + CO 2 + H 2 O
CaCO 3 + 2HCl → CaCl 2 + CO 2 + H 2 O

Generation of carbon dioxide: Belching or a bloating sensation may result from the gas released by the CO_2. This is usually a brief step in the acid neutralization process.

Impact on stomach pH: Calcium carbonate supports a swift pH rise, providing immediate alleviation of acid reflux.[40]
Combined Mechanism of Both: Synergistic Action: These two substances work together to neutralize stomach acid quickly and continuously. Aluminum hydroxide gives longer-lasting relief, while calcium carbonate provides acute relief by quickly neutralizing acid.

Managing Adverse Effects: Sometimes bloating and the production of carbon dioxide, which can lead to belching, are the drawbacks of calcium carbonate. Constipation may result from aluminum hydroxide's slower rate of action. Combining these two substances balances these side effects. Calcium carbonate helps reduce the discomfort that acid produces immediately, while aluminum hydroxide works gradually and helps prevent the acid from returning without causing obvious bloating or burp. In conclusion, the combination provides effective and long-lasting relief from stomach acidity while reducing the typical side effects connected to each individual antacid.[51]

Dose: OTC Antacid Dosage for Adults:
320–600 mg of aluminum hydroxide per dosage
500–1000 mg of calcium carbonate per dosage
Frequency: taken at bedtime and in between meals up to four times per day

The maximum daily intake of elemental calcium (from all sources) is between 2500 and 3000 mg of calcium carbonate.[52]
Marketed Formulation: Tums, Alka-Seltzer, Gelusil MPS,

6) Combinations containing Alginic Acid

Aluminum hydroxide gel, sodium bicarbonate, magnesium trisilicate, and the hydrophilic colloids alginic acids have all been sold together. ALGH is a naturally occurring biocompatible and biodegradable polymer that finds extensive use in a variety of biological applications. It is possible to produce natural alginates at low cost using brown sea algae. ALGH appears physiologically as ALGNa, a sodium salt that is extremely soluble. In polysaccharide ALGH, Mannuronate and guluronate monomers are present. In solutions, ALGH exhibits anionic properties due to the COO^- groups of the different monomers. At low pH values, ALGH gel precipitation is observed. The gel-forming properties of ALGH

provide an adaptable foundation for the development of innovative drug delivery systems. ALGH can be cross linked with metal ions or organic molecules to produce gels with improved mechanical properties, chemical stability, cell compatibility, surface wettability, and the necessary form.[53] The naturally occurring anionic carbohydrate alginic acid is also known as algin or alginates. Alginate actually functions as a linear polymer. Marine brown algae and some microorganisms are its sources. The qualities that make alginate a perfect biomaterial for a variety of uses in the culinary, chemical, medical, and agricultural sectors are its low toxicity, relative affordability, ease of gelation, and biocompatibility. For instance, the structural resemblance of alginic acid to the extracellular matrix of living tissues allows for several uses in tissue engineering, cell transplantation, wound healing, and medication delivery.[53] Due to its unique method of action, alginic acid—which is not an antacid is added to some antacid medications to increase their effectiveness in treating and reducing GERD symptoms. In the presence of saliva, sodium bicarbonate and alginic acid mix to form sodium alginate. When there is stomach acid present, this alginate precipitates, forming a thick, frothy gel that floats on the stomach contents' surface. As a result, GERD drugs work better and a somewhat pH-neutral barrier is formed during acid reflux episodes. It is not advised to use products containing alginic acid to treat PUD.[54]

Mechanism of Action: The naturally occurring polysaccharide alginic acid is found in the cell walls of brown algae. To treat conditions including heartburn, acid reflux, and indigestion, alginic acid is commonly mixed with other ingredients in pharmaceutical formulations. Often, these mixes contain antacids or other drugs used to relieve stomach discomfort. Here's how combinations including alginic acid work:

When stomach acid (hydrochloric acid, or HCl) and alginic acid combine, a gel-like substance is created. Alginic acid creates a foam barrier by combining with saliva and stomach acids to create a viscous gel that rises to the top of the stomach contents.

This foam barrier relieves heartburn and acid reflux symptoms by acting as a mechanical barrier that stops acid from refluxing into the esophagus.

1. Acid Reflux Reduction

By physically preventing acid from ascending into the esophagus, this foam barrier remains in the stomach and lowers the risk of symptoms associated with gastroesophageal reflux disease (GERD). It's especially helpful for relieving acid reflux-related inflammation and shielding the esophagus from the damaging effects of stomach acid.

2. In conjunction with other agents or antacids

Antacids (such as calcium carbonate or sodium bicarbonate) that neutralize stomach acid are frequently used with alginic acid. Alginic acid produces the foam barrier in these mixtures, whereas antacids aid in lowering overall acidity. This two-pronged strategy offers both physical protection against acid reflux and acid neutralization

3. Alkalinization

Other alkaline agents, such as sodium bicarbonate, may also be used into some formulations. By neutralizing excess stomach acid, these can help lessen the symptoms of gastritis and acid reflux.

4. Indigestion Relief

By creating this protective layer, alginic acid can occasionally help relieve indigestion and gastrointestinal pain by halting further gastric juice-induced irritation of the esophagus and stomach lining.

Dose: For Liquid Form Oral Suspension in Adults and Children Over 12.
Usually, 10–20 milliliters of the beverage are consumed before bed and after meals.
Generally, up to four times a day is advised, though this can be changed depending on the severity of the symptoms. Youngsters (6–12 years): Usually 5–10 mL up to 4 times a day, after meals and before bed. Youngsters under six: Because dosages in this age group are frequently limited, it is imperative to heed a pediatrician's advice. Children younger than two years old may not benefit from certain formulations.

For Adults and Children Over 12 Who Take Chewable Tablets or Lozenges: Two to four chewable tablets are usually taken at bedtime and after meals. Up to four dosages per day may be advised by certain goods. Youngsters (6–12 years): Typically, one or two chewable tablets up to four times a day, after meals and before bed. Youngsters under six: As with liquid versions, a healthcare professional should decide on the dosage for kids in this age range.

For Adults and Children Over 12 Who Take Regular or Extended Release Tablets: One or two tablets taken before bedtime and after meals, up to three or four times a day, is the usual dosage.[55]
Marketed Formulation: Gaviscon, Foamtab

7) Product Containing Simethicone

One drug used to manage and treat flatulence is called simethicone. The indications, mode of action, and contraindications of simethicone—a useful drug in the management of excess gas production—are covered in this activity.[56] The adverse event profile, dosage, and medication interactions that are relevant to the interprofessional healthcare team members in the treatment of patients with flatulence and associated disorders will also be highlighted in this exercise.[57] The stable, non-ionic surfactant simethicone can cause air bubbles to rupture throughout the digestive tract by reducing their surface tension and preventing the development of mucus-surrounded gas pockets throughout the colon.[58]

Key Points

Typical Items That Include Simethicone:
Gas-X among the most recognizable brands. Comes in soft gels, chewable pills, and varieties with added strength. Typical dosages are 125 mg and 80 mg.

The Phazyme: Another well-known brand that is frequently promoted as maximum strength. A dosage of 180 mg or more is possible.
Mylicon: frequently applied to babies and kids. You can mix drops with meals or formula.
Gas in Mylanta: Some formulations combine simethicone with antacids.

Equivalent Gas Relief: A store-brand substitute (from Walmart, for example). 1. Similar to Gas-X in terms of dosage and chemicals.

Alka-Seltzer Gas Preventive: contains simethicone; however, the formulation may also contain additional substances.[59]

Mechanism of Action: A typical treatment for bloating, pain, and excess gas in the digestive tract is simethicone, a gastric anti-foaming agent. It reduces the symptoms of gas buildup by a physical mechanism rather than a chemical one. This is how it operates:

Gas bubbles in the intestines and stomach: Small bubbles of gas frequently occur in the stomach and intestines. Bloating, pain, and a fullness sensation can all be brought on by these gas bubbles.

Simethicone's Action: A silicone-based substance with surface-active qualities (it functions similarly to a surfactant) is called simethicone. Simethicone lowers the surface tension of gas bubbles when consumed. The gas bubbles can merge into bigger ones as a result of this activity.

Impact of Bigger Bubbles in Gas: Larger bubbles are easier to discharge from the body or move through the digestive tract once the smaller ones have joined together. This lessens the discomfort and bloating brought on by trapped gas.[40]

Key Points: Simethicone does not absorb gas or prevent the formation of gas bubbles; instead, it alters the physical properties of gas bubbles to make their removal easier.... It is commonly found in over-the-counter drugs, such as antacids and fluids and pills for gas relief, and is typically used to treat the symptoms of excess gas, like flatulence and bloating. In summary, simethicone reduces the discomfort associated with gas by dissolving gas bubbles in the digestive tract so they can pass more easily.[60]

Dose: For signs of excessive gas:
Regarding oral dose forms (tablets or capsules):
The standard dosage for adults and teenagers is 60–125 mg four times a day, after meals, and before bed. No more than 500 mg should be taken in a 24-hour period.
Children: The doctor must decide the dosage.

For chewable pills, an oral dose form: For adults and teenagers, the usual dosage is 40–125 mg four times a day, right before bed, or 150 mg three times a day, right after meals. No more than 500 mg should be taken in a 24-hour period. Children: The doctor must decide the dosage.

For adults and adolescents: The standard dosage for the oral dosage form (suspension) is 40–95 mg four times a day, after meals, and before bed. No more than 500 mg should be taken in a 24-hour period. Children: The doctor must decide the dosage.[61]

Marketed Formulation: Mylicon, Phazyme, Gas-X, Mylanta Gas, Ovol

10. SUMMARY

In conclusion, antacids remain a relevant and effective option for the rapid relief of acid-related gastrointestinal symptoms. Their ability to neutralize stomach acid, inhibit pepsin activity, and provide symptom relief through carefully balanced formulations makes them especially useful for managing mild, intermittent, or acute episodes of gastric discomfort. While not suitable for all patients, particularly those with certain health conditions, antacids continue to hold an important place in gastrointestinal therapy alongside more advanced treatments. In conclusion, understanding the interactions between antacids and fluoroquinolone antibiotics is essential to ensure optimal

therapeutic outcomes, as certain antacids—particularly those containing aluminum—can significantly reduce antibiotic absorption. Meanwhile, agents like alginic acid and simethicone offer effective, well-tolerated relief for gastrointestinal discomfort without systemic absorption or significant drug interactions. Together, these insights highlight the importance of careful medication timing and selection in managing both gastrointestinal and infectious conditions safely and effectively.

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