Antacid

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Introduction:

- Antacids are medications used to neutralize stomach acid, providing relief from symptoms like heartburn, indigestion, and gastroesophageal reflux disease (GERD).
- They work by increasing the pH of stomach contents, alleviating discomfort and promoting healing of the esophagus and stomach lining.

Mechanism of Action:

- Antacids neutralize excess hydrochloric acid (HCl) in the stomach.
- They contain alkaline ions that react with stomach acid to form water and neutral compounds, raising the pH and reducing acidity.

Types of Antacids:

1. **Systemic Antacids:**
   - Affect the body's acid-base balance beyond the stomach and can enter the bloodstream.
   - May cause metabolic alkalosis if used excessively.
   - Example: Sodium bicarbonate.
   - Not recommended for long-term use due to potential side effects.
2. **Non-Systemic Antacids:**
   - Act primarily within the gastrointestinal tract with minimal systemic absorption.
   - Less likely to cause metabolic alkalosis and are safer for long-term use.
   - Common Examples: Aluminum hydroxide, magnesium hydroxide, calcium carbonate.

Ideal Properties of Antacids:

1. **Rapid Onset:** Provide quick relief.
2. **Prolonged Duration:** Have long-lasting effects to minimize frequent dosing.
3. **Neutralizing Capacity:** Effectively neutralize stomach acid.
4. **Safety:** Have minimal side effects, suitable for long-term use if necessary.
5. **Palatability:** Acceptable taste for patient compliance.

Combinations of Antacids:

- Combination antacids contain more than one type of ingredient to balance benefits and minimize side effects.

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Examples of Combinations:

1. **Aluminum Hydroxide and Magnesium Hydroxide:**
   - Balance the constipating effect of aluminum with the laxative effect of magnesium.
   - Examples: Maalox, Mylanta.
2. **Calcium Carbonate and Magnesium Carbonate:**
   - Provide effective relief while minimizing the risk of constipation or diarrhea.
   - Example: Rennie.

- These combinations aim to provide effective symptom relief while reducing the risk of side effects like constipation or diarrhea.

Sodium Bicarbonate ($NaHCO_3$)

Properties:

- White crystalline powder
- Odorless
- Soluble in water
- Slightly alkaline taste
- Decomposes at high temperatures
- Chemical formula: $NaHCO_3$

Preparation (Solvay Process):

- Prepared industrially by passing carbon dioxide and ammonia through a concentrated sodium chloride (brine) solution.
- Chemical reaction:

$$NaCl + NH_3 + CO_2 + H_2O \longrightarrow NaHCO_3 + NH_4Cl$$

- Sodium bicarbonate precipitates out and is then filtered, washed, and dried.

Uses:

- As a systemic antacid to treat acid indigestion, heartburn, and upset stomach.
- As a leavening agent in baking.
- As an odor neutralizer and cleaning agent.
- In the management of metabolic acidosis and certain drug overdoses (under medical supervision).

Assay (Acid-Base Titration):

1. **Prepare a Standard Solution:**

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- Dissolve a known amount of a strong acid, such as hydrochloric acid (HCl), in water to create a solution with a known concentration.

2. **Sample Preparation:**
   - Weigh an accurate amount of $NaHCO_3$ and dissolve it in water.
3. **Add Indicator:**
   - Add a pH indicator, such as phenolphthalein, to the $NaHCO_3$ solution.
   - The indicator changes color at neutralization.
4. **Titrate:**
   - Slowly add the standard HCl solution to the $NaHCO_3$ solution while stirring.
   - $NaHCO_3$ reacts with HCl, forming water, carbon dioxide (CO_2), and sodium chloride (NaCl).
   - The endpoint is reached when the indicator changes color.
5. **Calculate Concentration:**
   - Measure the volume of HCl used in the titration to calculate the concentration or purity of $NaHCO_3$.

Aluminium Hydroxide Gel ($Al(OH)_3$)

Properties:

- White amorphous powder or gel
- Odorless and tasteless
- Insoluble in water
- Chemically stable and non-toxic
- Chemical formula: $Al(OH)_3$

Preparation:

- Produced by reacting aluminum sulfate with sodium hydroxide.
- Chemical Reaction:

$$Al_2(SO4)_3 + 6NaOH \longrightarrow 2Al(OH)_3 + 3Na_2SO_4$$

- Aluminum hydroxide precipitates out and is then filtered, washed, and dried.

Uses:

- As a non-systemic antacid to treat acid indigestion, heartburn, and upset stomach.
- As a phosphate binder in the treatment of hyperphosphatemia in patients with chronic kidney disease.

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Magnesium Hydroxide Mixture ($Mg(OH)_2$)

Properties:

- White, crystalline powder
- Odorless
- Slightly soluble in water
- Chemically stable
- Chemical formula: $Mg(OH)_2$

Preparation:

- Produced by reacting magnesium chloride with sodium hydroxide.
- Chemical Reaction:

$$MgCl_2 + 2NaOH \longrightarrow Mg(OH)_2 + 2NaCl$$

- Magnesium hydroxide precipitates out and is then filtered, washed, and dried.

Uses:

- As a non-systemic antacid to treat acid indigestion, heartburn, and upset stomach.
- As a laxative to relieve occasional constipation.
- As a component in antiperspirant products.

This structured format provides a clear overview of each compound, including their properties, preparation methods, and uses.

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