

ACID-BASE BALANCE

7.35 to 7.45

This balance is maintained through mechanisms that:

- generate, buffer, and
- eliminate acids and bases.

Acid-Base Chemistry

- An acid is a molecule that can release a hydrogen ion (H^+),
- A base is a molecule that can accept or combine with an H^+ ion

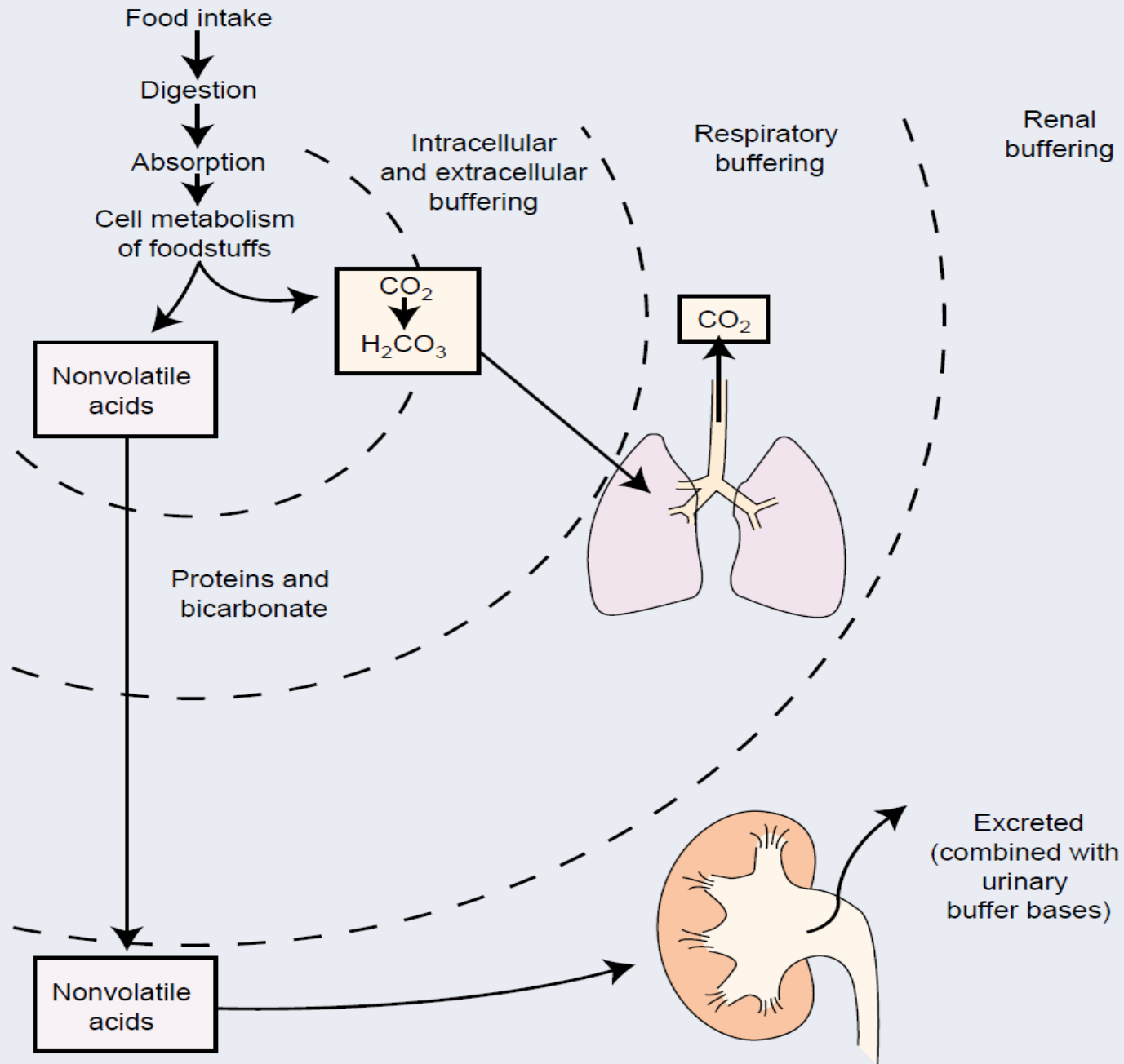
Most of the body's acids and bases are weak acids and bases

Carbonic acid (H_2CO_3), which is a weak acid derived from carbon dioxide (CO_2), and bicarbonate (HCO_3^-), which is a weak base.

H conc. And ph

Volatile and nonvolatile acids

- H_2CO_3 is in equilibrium with the volatile CO_2
- Sulfuric, hydrochloric, phosphoric



Carbon Dioxide and Bicarbonate Production

- 15,000 mmol of CO₂ each day
- (1) attached to hemoglobin,
- (2) dissolved CO₂ (i.e., PCO₂), and as
- (3) HCO₃⁻

Pco₂ and H₂CO₃ CONC.

Production of Metabolic Acids

- Oxidation of the sulfur-containing amino acids
- Oxidation of arginine and lysine : HCL
- Oxidation of phosphorus-containing nucleic acids : phosphoric acid H_2PO_4
- Incomplete oxidation of glucose : lactic acid
- incomplete oxidation of fats : ketoacids

The major source of base is:

- Metabolism of amino acids such as aspartate and glutamate
- Metabolism of certain organic anions (e.g., citrate, lactate, acetate)

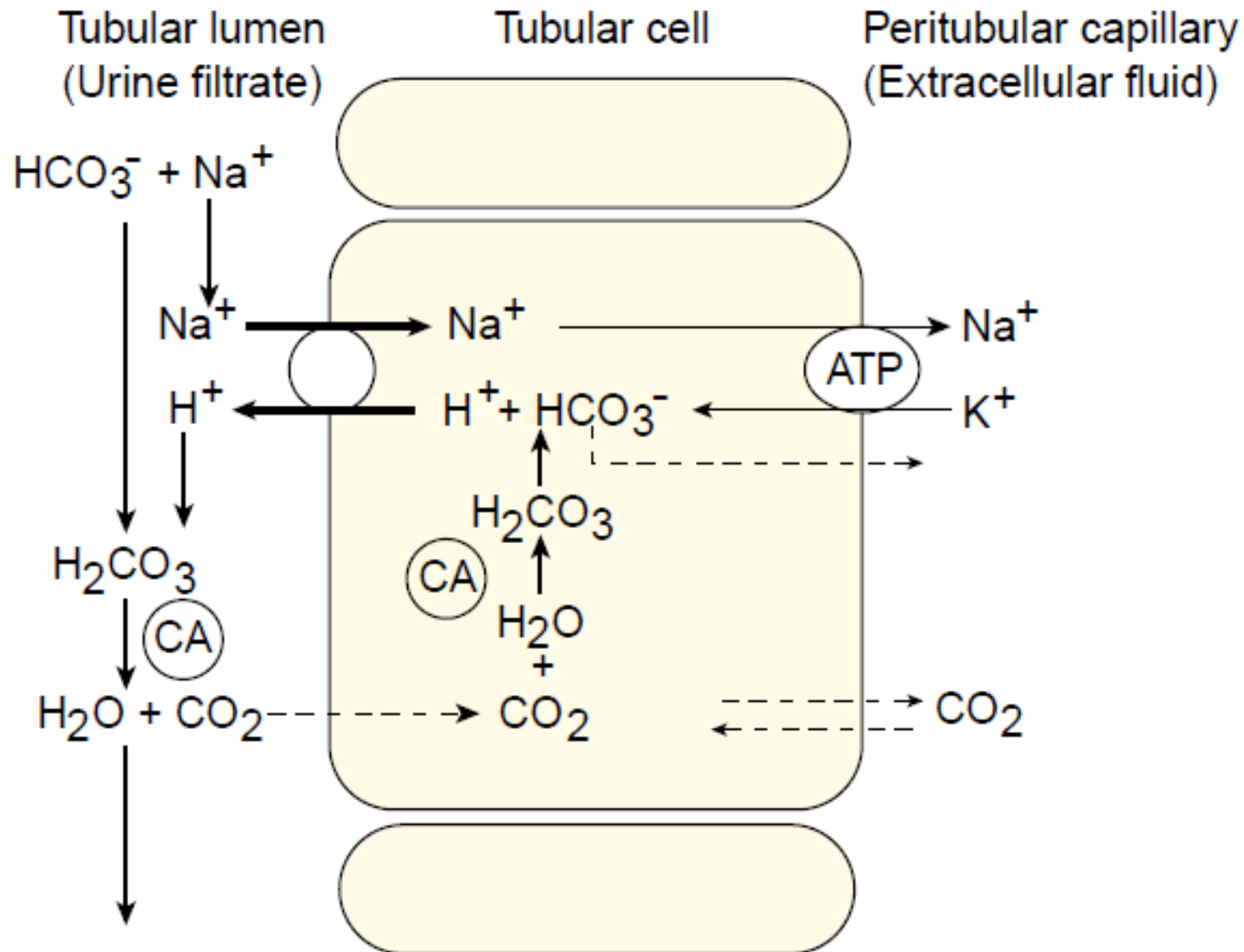
Acid production normally exceeds base production, with approximately 1 mmol/kg/day
Except for vegi.

Regulation of pH

- (1) ICF and ECF buffering systems,
- (2) the lungs, which control the elimination of CO₂, and
- (3) the kidneys

Intracellular and Extracellular Buffer Systems

- (1) Proteins,
- (2) $\text{HCO}_3^-/\text{H}_2\text{CO}_3$ buffer, and
- (3) Trans cellular H^+/K^+ exchange system
- (4) Bone?



Arterial blood gases

Normal arterial PCO₂ is 38 to 42 mm Hg

*0.03

The anion gap

Normally, the anion gap ranges between 8 and 12 mEq/L

(a value of 16 mEq is normal if Na^+ and K^+ concentrations are used in the calculation)

Metabolic Versus Respiratory Acid-Base Disorders

Primary Versus Compensatory Mechanisms

a person may have a primary metabolic acidosis as a result of overproduction of ketoacids and respiratory alkalosis because of a compensatory increase in ventilation

Metabolic Acidosis

- (1) Increased production of nonvolatile metabolic acids,
- (2) Decreased acid secretion by the kidney,
- (3) Excessive loss of bicarbonate, or
- (4) An increase in chloride

Acute lactic acidosis

- Shock or cardiac arrest
- Vigorous exercise or grand mal seizures
- leukemia, lymphomas, or other cancers
- Patients with severe liver failure

ketoacidosis

DKA

Kidney failure is the most common cause of chronic metabolic acidosis

Hyperchloremic acidosis

The anion gap is within the normal range, but the chloride levels are increased and bicarbonate levels are decreased.

Signs and symptoms

- Weakness, fatigue, general malaise, and a dull headache.
- Anorexia, nausea, vomiting, and abdominal pain also may be reported.
- The skin is warm and flushed
- More free calcium is available to decrease neural activity.
- As acidosis progresses: The level of consciousness declines, and stupor and coma develop.

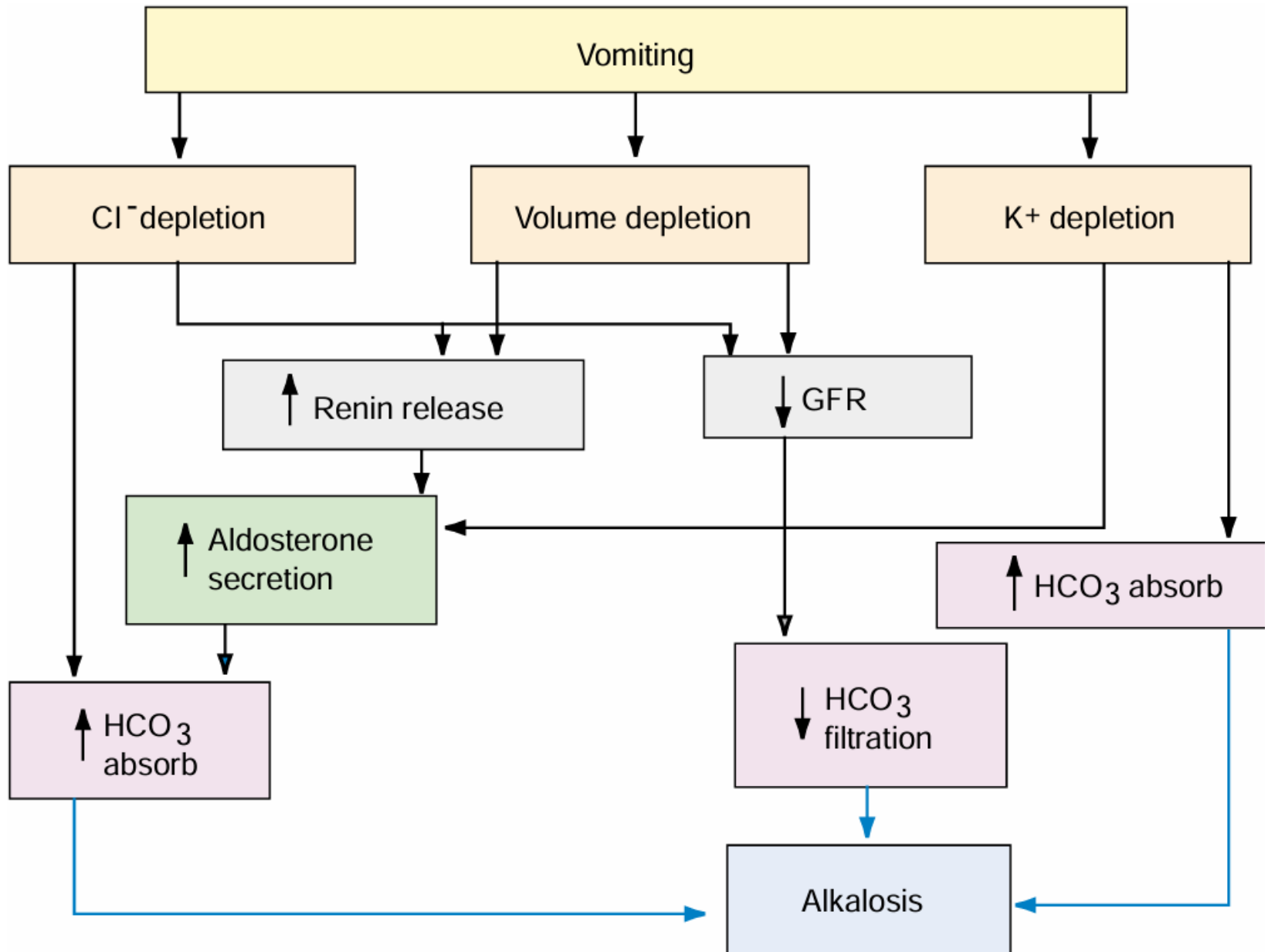
When the pH falls to 7.0, cardiac contractility and cardiac output decrease, the heart becomes less responsive to catecholamines (i.e., epinephrine and norepinephrine), and dysrhythmias, including fatal ventricular dysrhythmias, can develop.

Treatment

Focus on the cause

Metabolic Alkalosis

- (1) Ingestion or administration of excess NaHCO_3 or other alkali,
- (2) Excess H^+ , Cl^- , and K^+ loss, or
- (3) ECF volume contraction.



Symptoms

- Mental confusion, hyperactive reflexes, tetany, and carpopedal spasm
- Compensatory hypoventilation

Treatment

Focus on the cause

Thank you