OBJECTIVES:

At the end of the lecture, the participant should be able to:

1. Define the terms: acidosis, alkalosis, acidemia, and alkalemia
2. Distinguish metabolic from respiratory acid-base disorders
3. Describe and quantitate the compensatory response to each acid-base disorder
4. Review the differential diagnosis (clinical causes) of acid-base disorders
5. Understand treatment considerations for the acid-base disorders
Comments on Acid-Base Terminology

The terms acidosis and alkalosis do not mean an abnormal blood pH. Instead, acidosis indicates a physiologic process or disease state which, if unopposed by treatment or disease would lead to acidemia, i.e., an increase in hydrogen ion concentration and a fall in arterial pH. An example would be abnormal retention of acid because of renal failure. Alkalosis indicates a primary process (for example, vomiting) which, if not counterbalanced, would lead to alkalemia, i.e., a fall in hydrogen ion concentration in blood and a rise in arterial pH. Respiratory disturbances are caused by abnormal excretion of CO₂ from the lungs and therefore either a deficit or excess of carbonic acid in body fluids. Metabolic disturbances begin with a primary changes in plasma bicarbonate concentration, due to excessive intake, production, or loss of bicarbonate or acids other than carbonic acid.

Primary changes in the metabolic component (HCO₃⁻) stimulate secondary or compensatory changes in ventilation and therefore pCO₂ which tends to bring pH back toward normal. Similarly, a primary change in pCO₂ (respiratory disturbances) leads to compensatory changes in HCO₃⁻ concentration through buffering mechanisms and changes in the renal secretion of hydrogen ion. These secondary changes in pCO₂ and HCO₃⁻ are not referred to as “acidosis” or "alkalosis.” Instead, they are referred to as compensatory hyperventilation in metabolic acidosis, compensatory hypoventilation in metabolic alkalosis, secondary fall in HCO₃⁻ in respiratory alkalosis, and secondary rise in HCO₃⁻ in respiratory acidosis.

A simple acid-base disturbance is the initial process producing the primary change in HCO₃⁻ or pCO₂ and all compensatory mechanisms secondarily affecting pCO₂ or HCO₃⁻. Since compensatory mechanisms for metabolic disturbances are rapid, there are only two metabolic disturbances, acidosis and alkalosis. Since renal compensation for respiratory disturbances is not so rapid, respiratory disturbances are further subdivided into acute and chronic. The acid-base nomogram which follows gives the predictable range of these six primary disturbances in clinical medicine.

A mixed acid-base disturbance is the resultant acid-base picture when two or more primary disturbances develop simultaneously in one patient. They are often clinically serious since the presence of a respiratory disturbance will affect respiratory compensation for a metabolic disturbance and vice versa. Mixed disturbances may be additive in their effects on pH or they may tend to cancel one another out and be quite difficult to diagnose. The acid-base map is extremely helpful in such situations. Accurate diagnosis, however, depends on a rational interpretation of the laboratory data in the context of the clinical picture.