

8.1: Introduction to Basic Physiology

Introduction to Basic Physiology

In order to understand how toxic substances cause harmful changes in organs, tissues, or cells, knowledge of normal physiology and anatomy is needed. This section is an overview of normal physiology, especially as related to the normal body components and how they function. While we show how some xenobiotics can damage the different body components, detailed examples of toxic cellular and biochemical reactions will be covered in later sections.

Complexity of the Body

The body is immensely complex with numerous components, all of which perform precise functions necessary for the body to maintain health and well-being. Malfunction of any component can result in disease or a breakdown of a portion of the body. Toxic substances can damage an organ or organ system so that it cannot function properly, leading to death or sickness of the organism (for example, liver or kidney failure). However, in nearly all cases, the toxic substance actually exerts its harmful effect directly on specific cells or biochemicals within the affected organ. These cell and chemical changes in turn cause the tissue or organ to malfunction.

Specific Toxic Effects

Most toxic substances are usually specific in their toxic damage to particular tissues or organs, referred to as the "target tissues" or "target organs." Toxic effects may affect only a specific type of cell or biochemical reaction. For example:

- The toxic effect of carbon monoxide is due to its binding to a specific molecule (hemoglobin) of a specific cell (red blood cell).
- Organophosphate toxic substances, which inhibit an enzyme (acetylcholinesterase) responsible for modulating neurotransmission at nerve endings.

Systemic Toxic Effects

On the other hand, the effect of some toxic substances may be generalized and potentially damage all cells and thus all tissues and all organs.

- An example is the production of free radicals by whole body radiation. Radiation interacts with cellular water to produce highly reactive free radicals that can damage cellular components. The result can be a range of effects from the death of the cell, to cell malfunction, and to the failure of normal cell division (for example, cancer).
- An example of a multi-organ chemical toxic substance is lead, which damages several types of cells, including kidney cells, nerve cells, and red blood cells.

The body is a remarkable complex living "machine" consisting of trillions of cells and multitudes of biochemical reactions. Each cell has a specific function and cells work together to promote the health and vitality of the organism. The number and types of toxic reactions are likewise very large. While this tutorial cannot possibly present all these types of cellular and biochemical toxic reactions, it is our goal to provide an overview of the primary toxic mechanisms with a few examples that illustrate these mechanisms. It is important to understand that changes at one level in the body can affect homeostasis at several other levels.

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