11.10B: Cytokines and Chemokines

Cytokines and chemokines are both small proteins secreted by cells of the immune system.

Learning Objectives

• Summarize the role of cytokines and chemokines

Key Points

• Cytokines and chemokines are important in the production and growth of lymphocytes, and in regulating responses to infection or injury, such as inflammation and wound healing.
• Cytokines are the general category of messenger molecules, while chemokines are a special type of cytokine that directs the migration of white blood cells to infected or damaged tissues.
• A cytokine and a chemokine both use chemical signals to induce changes in other cells, but the latter are specialized to cause cell movement.

Key Terms

• cytokine: Any of various small regulatory proteins that regulate the cells of the immune system.
• chemokine: Any of various cytokines, produced during inflammation, that organize the leukocytes.
• chemotaxis: The movement of a cell or an organism in response to a chemical stimulant.
CYTOKINES

These are small cell-signaling protein molecules that are secreted by numerous cells, and are a category of signaling molecules used extensively in intercellular communication.

Cytokines can be classified as proteins, peptides, or glycoproteins. The term “cytokine” encompasses a large and diverse family of regulators produced throughout the body by cells of diverse embryological origin. The term has also been used to refer to the immunomodulating agents, such as interleukins and interferons.

Biochemists disagree as to which molecules should be termed cytokines and which hormones. As we learn more about each, anatomic and structural distinctions between the two are fading. Classic protein hormones circulate in nanomolar ($10^{-9}$) concentrations that usually vary by less than one order of magnitude. In contrast, some cytokines (such as IL-6) circulate in picomolar ($10^{-12}$) concentrations that can increase up to 1,000-fold during trauma or infection.

The widespread distribution of cellular sources for cytokines may be a feature that differentiates them from hormones. Virtually all nucleated cells, but especially endo/epithelial cells and resident macrophages (many near the interface with the external environment), are potent producers of IL-1, IL-6, and TNF-alpha. In contrast, classic hormones, such as insulin, are secreted from discrete glands (e.g., the pancreas).

As of 2008, the current terminology refers to cytokines as immunomodulating agents.

CHEMOKINES

These are a family of small cytokines, or proteins secreted by cells. Their name is derived from their ability to induce directed chemotaxis in nearby responsive cells; they are chemotactic cytokines.

Proteins are classified as chemokines according to shared structural characteristics, such as small size (they are all approximately 8-10 kilodaltons in size), and the presence of four cysteine residues in conserved locations that are key to forming their 3-dimensional shape. However, these proteins have historically been known under several other names including the SIS family of cytokines, SIG family of cytokines, SCY family of cytokines, Platelet factor-4 superfamily or intercrines.

Some chemokines are considered pro-inflammatory and can be induced during an immune response to recruit cells of the immune system to a site of infection, while others are considered homeostatic and are involved in controlling the migration of cells during normal processes of tissue maintenance or development.
Chemokines are found in all vertebrates, some viruses and some bacteria, but none have been described for other invertebrates. These proteins exert their biological effects by interacting with G protein-linked transmembrane receptors called chemokine receptors, that are selectively found on the surfaces of their target cells.