TABLE 42–1 **Hematopoietic and Immune Cytokines (*continued*)**

Type/Name	Main Source	Main Functions
IL-13	Activated lymphocytes Helper T cells	Similar to IL-4 Promotes proliferation of B lymphocytes Helps to regulate inflammatory process by inhibiting activation and release of inflammatory cytokines from macrophages
IL-14	T cells and malignant B cells	Promotes proliferation of B cells Inhibits B-cell production of immunoglobulins May stimulate growth of non-Hodgkin's lymphoma
IL-15	T lymphocytes	Stimulates growth of T cells, NK cells, and activated B cells
IL-16	T lymphocytes (mainly cytotoxic) and eosinophils	Acts on helper T cells to induce chemotaxis, synthesis of cytokines, and other functions
IL-17	T lymphocytes	Promotes T cell chemotaxis and function Acts on macrophages to initiate and maintain inflammation Stimulates bone marrow stem cells to differentiate into neutrophils
IL-18	Activated macrophages	Acts on T cells to stimulate production of gamma interferon and on NK cells to enhance cytotoxicity
Tumor Necrosis Factors (TNFs)		
TNF-alpha	T lymphocytes, macrophages, mast cells	Cytotoxic effects on tumor cells Enhances inflammatory and immune responses (eg, stimulates production of cytokines)
TNF-beta	T lymphocytes	Cytotoxic and other effects on tumor cells, similar to TNF-alpha Enhances phagocytic activity of macrophages and neutrophils

however, cytokines rarely, if ever, act alone. Instead, a target cell is exposed to an environment containing a mixture of cytokines, which may have synergistic or antagonistic effects on each other. Third, cytokines often induce the synthesis of other cytokines. The resulting actions and interactions among cytokines may profoundly alter physiologic responses. Fourth, proteins that act as cytokine antagonists are found in the bloodstream and other extracellular fluids. These proteins may bind directly to a cytokine and inhibit its activity or bind to a cytokine receptor but fail to activate the cell.

The main groups of cytokines (also called biologic response modifiers) are categorized as colony-stimulating factors (CSFs), interferons, and interleukins.

Colony-Stimulating Factors

As their name indicates, CSFs stimulate the production of red blood cells (erythropoietin), platelets (thrombopoietin), granulocytes (G-CSF), granulocyte–macrophages (GM-CSF), and monocyte–macrophages (M-CSF). In addition to granulocytes (neutrophils, basophils, and eosinophils), G-CSF also affects other blood cells (eg, erythrocytes, platelet precursors, and macrophages). Interleukin-3 (IL-3) is sometimes called multi-CSF because it stimulates the production of all types of blood cells.

Interferons

Interferons "interfere" with the ability of viruses in infected cells to replicate and spread to uninfected cells. They also inhibit reproduction and growth of other cells, including tumor cells, and activate natural killer cells. These antiproliferative and immunomodulatory activities play important roles in normal host defense mechanisms.

Interleukins

Interleukins (ILs) were initially named because they were thought to be produced by and to act only on leukocytes and lymphocytes. However, they can be produced by body cells other than leukocytes and they can act on nonhematopoietic cells. Interleukins 1 through 18 have been identified. Especially important ILs include IL-3 (stimulates growth of stem cell precursors of all blood cells), IL-2 (stimulates T and B lymphocytes), IL-12 (stimulates hematopoietic cells and lymphocytes), and IL-11 (stimulates platelets and other cells). Interleukin action may occur only when combined with another factor, may be suppressive rather than stimulatory (eg, IL-10), or may involve a specific function (eg, IL-8 mainly promotes movement of leukocytes into injured tissues as part of the inflammatory response).

OVERVIEW OF BODY DEFENSE MECHANISMS

The immune system is one of several mechanisms that protects the body from potentially harmful substances, including pathogenic microorganisms. The body's primary external defense mechanism is intact skin, which prevents entry of foreign substances and produces secretions that inhibit microbial growth. The mucous membranes lining the gastrointestinal (GI) and respiratory tracts are internal defense mechanisms that act as