



# Inflammation and Repair

## CHAPTER CONTENTS

### Overview of Inflammation: Definitions and General Features 69

Historical Highlights 71

Causes of Inflammation 71

Recognition of Microbes and Damaged Cells 72

### Acute Inflammation 73

Reactions of Blood Vessels in Acute Inflammation 73

*Changes in Vascular Flow and Caliber 73*

*Increased Vascular Permeability (Vascular Leakage) 74*

*Responses of Lymphatic Vessels and Lymph Nodes 74*

Leukocyte Recruitment to Sites of Inflammation 75

*Leukocyte Adhesion to Endothelium 75*

*Leukocyte Migration Through Endothelium 76*

*Chemotaxis of Leukocytes 77*

Phagocytosis and Clearance of the Offending Agent 78

*Phagocytosis 78*

*Intracellular Destruction of Microbes and Debris 79*

*Neutrophil Extracellular Traps 81*

*Leukocyte-Mediated Tissue Injury 81*

*Other Functional Responses of Activated Leukocytes 82*

Termination of the Acute Inflammatory Response 82

Mediators of Inflammation 82

*Vasoactive Amines: Histamine and Serotonin 83*

*Arachidonic Acid Metabolites 83*

*Cytokines and Chemokines 86*

*Complement System 88*

*Other Mediators of Inflammation 89*

Morphologic Patterns of Acute Inflammation 90

*Serous Inflammation 90*

*Fibrinous Inflammation 90*

*Purulent (Suppurative) Inflammation, Abscess 91*

*Ulcers 91*

Outcomes of Acute Inflammation 92

Summary of Acute Inflammation 93

### Chronic Inflammation 93

Causes of Chronic Inflammation 93

Morphologic Features 93

Cells and Mediators of Chronic Inflammation 94

*Role of Macrophages 94*

*Role of Lymphocytes 96*

*Other Cells in Chronic Inflammation 96*

Granulomatous Inflammation 97

### Systemic Effects of Inflammation 99

### Tissue Repair 100

Overview of Tissue Repair 100

Cell and Tissue Regeneration 101

*Cell Proliferation: Signals and Control Mechanisms 101*

*Mechanisms of Tissue Regeneration 101*

Repair by Connective Tissue Deposition 102

*Steps in Scar Formation 103*

*Angiogenesis 104*

*Deposition of Connective Tissue 105*

*Remodeling of Connective Tissue 105*

Factors That Influence Tissue Repair 105

Selected Clinical Examples of Tissue Repair and Fibrosis 106

*Healing of Skin Wounds 106*

*Fibrosis in Parenchymal Organs 109*

Abnormalities in Tissue Repair 109

## Overview of Inflammation: Definitions and General Features

**Inflammation is a response of vascularized tissues to infections and damaged tissues that brings cells and molecules of host defense from the circulation to the sites where they are needed, in order to eliminate the offending agents.** Although in common medical and lay parlance, inflammation suggests a harmful reaction, it is actually a protective response that is essential for survival. It serves to rid the host of both the initial cause of cell injury (e.g., microbes, toxins) and the consequences of such injury

(e.g., necrotic cells and tissues). The mediators of defense include phagocytic leukocytes, antibodies, and complement proteins. Most of these normally circulate in the blood, from which they can be rapidly recruited to any site in the body; some of the cells also reside in tissues. The process of inflammation delivers these cells and proteins to damaged or necrotic tissues and foreign invaders, such as microbes, and activates the recruited cells and molecules, which then function to get rid of the harmful or unwanted substances. Without inflammation, infections would go unchecked, wounds would never heal, and injured tissues might remain permanent festering sores. In addition to inflammatory cells, components of innate