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Opinion Article

The Role of Neutrophils in Inflammation, Immunity, Tissue Repair along with the Cancer

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DESCRIPTION

Neutrophils are the most abundant type of white blood cells in humans and play a crucial role in innate immunity and inflammation. They are the first responders to infection or injury and can rapidly migrate to the site of inflammation, where they perform various effector functions, such as phagocytosis, degranulation, and formation of Neutrophil Extracellular Traps (NETs). Neutrophils can also interact with other immune cells, such as platelets, macrophages, dendritic cells, and lymphocytes, to modulate the inflammatory response and adaptive immunity.

However, neutrophils are not only beneficial to the host, but can also cause tissue damage and contribute to chronic inflammatory diseases and cancer. In this article, we will review the heterogeneous and multifaceted roles of neutrophils in inflammation, immunity, tissue repair, and cancer.

Neutrophils in inflammation and immunity

Neutrophils are essential for host defense against microbial pathogens and foreign substances. They can recognize and eliminate pathogens through various mechanisms, such as opsonization, complement activation, Antibody-Dependent Cellular Cytotoxicity (ADCC), and oxidative burst. Neutrophils can also release granules that contain antimicrobial peptides, proteases, and Reactive Oxygen Species (ROS) that can kill or inhibit the growth of microbes. Moreover, neutrophils can form NETs that consist of chromatin fibers decorated with granular and cytoplasmic proteins that can trap and kill extracellular pathogens.

Neutrophils can also regulate the inflammatory response and adaptive immunity by secreting cytokines, chemokines, and lipid mediators that can attract or activate other immune cells. For example, neutrophils can secrete interleukin-1 beta (IL-1β), Tumor Necrosis Factor alpha (TNF-α), interleukin-6 (IL-6), interleukin-8 (IL-8), and Leukotriene B4 (LTB4) that can promote inflammation and recruit more neutrophils and other leukocytes to the site of infection or injury. Neutrophils can also secrete interleukin-10 (IL-10), Transforming Growth Factor beta (TGF-β), prostaglandin E2 (PGE2), and Lipoxin A4 (LXA4) that can suppress inflammation and promote resolution.

Neutrophils can also influence the adaptive immune response by interacting with Dendritic Cells (DCs) and lymphocytes. Neutrophils can modulate DC maturation and function by providing antigenic material, cytokines, chemokines, or ROS. Neutrophils can also affect T cell activation and differentiation by presenting antigens, expressing costimulatory molecules, or producing cytokines. Neutrophils can also regulate B cell activation and antibody production by providing antigens, cytokines, or NETs.

Neutrophils in tissue repair and regeneration

Neutrophils are not only involved in tissue injury and inflammation but also play a key role in tissue repair and regeneration. Neutrophils can contribute to wound healing by clearing debris and pathogens, releasing growth factors and angiogenic factors, and modulating the inflammatory response. For example, neutrophils can secrete Vascular Endothelial Growth Factor (VEGF), Platelet-Derived Growth Factor (PDGF), Fibroblast Growth Factor (FGF), Epidermal Growth Factor (EGF), Insulin-Like Growth Factor (IGF), Transforming Growth Factor alpha (TGF-α), Keratinocyte Growth Factor (KGF), Hepatocyte Growth Factor (HGF), Granulocyte Colony-Stimulating Factor (G-CSF), Granulocyte-Macrophage Colony-Stimulating Factor (GM-CSF), Interleukin-17A (IL-17A), Interleukin-22 (IL-22), Interleukin-23 (IL-23), Interferon gamma (IFN-γ), Interferon lambda (IFN-λ), Interferon Regulatory Factor 5 (IRF5), Interferon Regulatory Factor 7 (IRF7), Interferon Regulatory Factor 9 (IRF9), and Interferon-Stimulated Genes (ISGs) that can promote cell proliferation, migration, differentiation, and survival, as well as angiogenesis and tissue remodeling .

Neutrophils can also participate in tissue regeneration by modulating stem cell function and fate. Neutrophils can secrete

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factors that can stimulate or inhibit stem cell proliferation, differentiation, or mobilization. That can stimulate or inhibit the proliferation and differentiation of various tissue-specific stem cells, such as mesenchymal stem cells, endothelial progenitor cells, neural stem cells, cardiac stem cells, skeletal muscle satellite cells and liver progenitor cells.