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Short Communication

Note on Hematopoiesis and Hematopoietic Growth Factors

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DESCRIPTION

The cellular components of blood can be divided into three major cell groups: RBCs (erythrocytes), megakaryocytes (which produce platelets), and WBCs (White Blood Cells). All of these cells originate from a common 'stem cell'. This common stem cell is called a pluripotent or totipotent stem cell because it can differentiate through many pathways that ultimately lead to mature blood cells. For many years, the mechanisms by which pluripotent stem cells engage in specific signalling pathways were unknown. Although our understanding of the exact mechanisms by which this differentiation occurs is by no means complete, the discovery of growth factors represents a major advance in this field. Hematopoietic growth factors are a family of regulatory molecules that play important roles in the proliferation, survival, and differentiation of blood progenitor cells and the functional activation of mature cells. Various transcription factors regulate the number and differentiation state of stem cells.

Several molecular switches have been identified that determine hematopoietic cell fate. In hematopoiesis process hematopoietic growth factors plays an important role that share structural homology and binds with type-1 transmembrane proteins belonging to the cytokine receptor family. Many of these proteins are physiological regulators of specific lineages of blood cells (eg: erythropoietin, granulocyte colony-stimulating factor, thrombopoietin) and others appear to represent hematopoietic growth-promoting activities of molecules that are essential for other biological functions (e.g: Interleukin-3 [IL-3], Interleukin-11 [IL-11], granule sphere-macrophage colony-stimulating factor) [1,2].

Thrombopoietin the primary regulator of platelet production is produced in the liver and by marrow stromal cells. Plasma levels of the hormone are normally inversely related to platelet mass and are regulated by the level of senescent platelet uptake, mediated by the hepatocyte Ashwell-Morrell receptor; inflammation, mediated by IL-6 and by transcriptional feedback inhibition of the thrombopoietin gene in marrow stromal cells by platelet granule proteins.

Erythropoietin is produced mainly by the kidney and to a lesser extent in the liver and acts on erythroid progenitor cells in the bone marrow to promote their survival, proliferation and differentiation. Erythropoietin levels are inversely related to blood hemoglobin concentration, which is reflected in renal oxygen tension [3]. In the presence of tissue (renal) hypoxia, the transcription factor hypoxia-Inducible Factor (HIF) 1α is stabilized against proteasome-mediated destruction and regulates erythropoietin transcription genes.

Granulocyte colony-stimulating factor stimulates the production of neutrophils from myeloid progenitor cells. Hormone levels are also inversely related to neutrophil numbers, but are primarily regulated by inflammatory stimuli such as Tumor Necrosis Factor-α (TNF-α) which acts on endothelial cells, fibroblasts, and macrophages. Similar to the effects of erythropoietin on erythroid progenitor cells, granulocyte colony-stimulating factor acts to promote survival, proliferation, and differentiation of neutrophil progenitor cells.

Haematopoiesis is the formation and development of functional, mature blood cells from immature progenitor cells residing in the bone marrow by hematopoietic growth factors produced by the body. T lymphocytes, monocytes/macrophages, fibroblasts, and endothelial cells are the major cellular sources of most hematopoietic growth factors. Erythropoietin is produced mainly in the adult kidney, and thrombopoietin is produced in the liver and kidney [4].

The recombinant Granulocyte macrophage colony-stimulating factor is locally active at the site of infection, localizing and activating neutrophils. Granulocyte macrophage colony-stimulating factor stimulates proliferation, differentiation, and activation of mature neutrophils and monocytes/macrophages, enhancing their function. Ancestim, is an non-glycosylated recombinant recombinant stem cell factor that stimulates proliferation of primitive and non-hematopoietic cells. It can also increase the activity of other hematopoietic growth factors such as granulocyte colony stimulating factor, Granulocyte macrophage-Colony Stimulating Factor (G-CSF). Recombinant erythroid progenitor factor increase red blood cells through

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proliferation of erythroid progenitor cells and differentiation into normoblasts, nucleated progenitor cells of the erythropoietic lineage. The recombinant G-CSF product maintains neutrophil production at steady state and increase neutrophil production during infection. It also reduces neutrophil maturation time and releases mature neutrophils from the bone marrow into the blood. They prolong the circulation half-life of neutrophils and enhance their function. Oprelvekin, a recombinant product, stimulates the production of megakaryocyte progenitor cells, megakaryocytes, and platelets. Oprelvekin is a recombinant human interleukin-11 which Stimulates megakaryocyte progenitor stem cells [5].

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