Contribution to the study of a mathematical model of Erythropoisis (Red Blood cell production)

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Abstract:

Production and regulation of erythrocytes (red blood cells) is performed through complex processes. Cells are produced in the bone marrow (and the spleen, in mice), where hematopoietic stem cells, that have abilities of self-renewal and differentiation in all blood cell types, allow the appearance of erythroid cells. Throughout successive diviffsions, erythroid progenitors (immature red cells) acquire maturity (via cell markers) to ultimately become mature red blood cells (erythrocytes) that enter the bloodstream in order to carry oxygen to organs and tissues.

This continuous production of erythroid cells is permanently controlled in order to adapt very quickly to changes in or needs of the organism. One of the main feedback controls, discovered in the early 1990's by Koury and Bondurant [3] deals with cell death. Erythroid progenitors die by apoptosis, a programmed cell death (contrary to necrosis). Koury and Bondurant showed that, during an anemia (lack of red blood cells), a growth factor named erythropoietin (Epo) was released by the kidneys and inhibited progenitor apoptosis, allowing a fast production of numerous erythrocytes to get a correct level of red blood cells in blood.

Others controls occur at early stages of erythropoiesis, for instance differentiation of hematopoietic stem cells in cells committed to the red blood cell lineage is partly controlled by Epo. In the presence of Epo, hematopoietic stem cells will preferentially differentiate in red blood cells rather than in white blood cells or platelets.

References:

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