Traveling waves in a coupled reaction-diffusion and difference model of hematopoiesis

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Résumé

The formation and development of blood cells (red blood cells, white cells and platelets) is a very complex process, called hematopoiesis. This process involves a small population of cells called hematopoietic stem cells (HSCs). We propose a mathematical model describing the dynamics of HSC population, taking into account their spatial distribution and diffusion. The resulting model is an age-structured reaction-diffusion system. The method of characteristics can be used to reduce this model to an unstructured time-delayed reaction-diffusion equation coupled with a difference equation. We investigated mathematical studies of the model and showed the existence of travelling wave front solutions connecting the zero steady state with the unique positive uniform one. We used the classical monotone iteration technique coupled with the upper- and lower-solutions method. A numerical simulations carried out to show the propagation of the solution in a travelling wave front.

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