Post-Transplantation Dynamics of the Immune Response to Chronic Myelogenous Leukemia

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Abstract:
We model the immune dynamics between T cells and cancer cells in leukemia patients after bone marrow transplants. We use a system of six delay differential equations to track the various cell-populations. Our approach incorporates time delays and accounts for the progression of cells through different modes of behavior. We explore possible mechanisms behind a successful cure, whether mediated by a blood-restricted immune response or a cancer-specific graft-versus-leukemia effect. Characteristic features of this model include sustained proliferation of T cells after initial stimulation, saturated T cell proliferation rate, and the possible elimination of cancer cells, independent of fixed-point stability. In addition, we use numerical simulations to examine the effects of varying initial cell concentrations on the likelihood of a successful transplant. Among the observed trends, we note that higher initial concentrations of donor-derived, anti-host T cells slightly favor the chance of success, while higher initial concentrations of general host blood cells more significantly favor the chance of success. These observations lead to the hypothesis that anti-host T cells benefit from stimulation by general host blood cells, which induce them to proliferate to sufficient levels to eliminate cancer. This is a joint work with R. DeConde, P. Kim, and P. Lee.