Exploring Mechanisms that Control Immune Memory Using the Basic Immune Simulator

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The Basic Immune Simulator (BIS) is an agent-based model of the immune system created using RepastJ for the purpose of studying the complexity of immune system behavior in health and disease. It is a model with agents representing the cells of the immune system interacting in three zones including a generic tissue, the lymphoid organs and the blood. Together these represent the body of an organism. Although it was created with a high level of abstraction from an immunologist's viewpoint, it demonstrated both normal and abnormal behavior that emulated such behavior in living systems (1). The BIS is now being updated to include the lymphocyte cell types T-$_{17}$ (2-4) and T-reg (5) that were not yet well described at its inception, and it is also undergoing a conversion to study specific idiopathic disease processes, one of the major goals for the BIS. The intermediate version will be presented.

Part of what makes the immune system complicated as well as complex is the multitude of components that must remain in balance while perturbation of the system is taking place. The balance between inflammatory versus regulatory and regenerative processes, and between proliferation versus programmed death of immune cell populations is what makes the difference between surviving and succumbing to a wide variety of diseases. This is because excessive inflammation causes damage or shock, excessive regeneration causes scar tissue formation, excessive proliferation of immune cells (or their failure to die quietly when the pathologic stimulus is overcome) causes chronic inflammation, and insufficient immunity allows an infection or cancer to kill an organism. All of these components are necessary for fighting disease and developing adaptive memory. The candidate explanations or rules for agent behavior that maintain a proper balance (or not) in the development of adaptive immune memory are explored and described.

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