2010

Introduction to Dendritic Cells

Steinman Laboratory

Ralph Steinman: Introduction to Dendritic Cells

Research following the discovery of dendritic cells thirty five years ago is profoundly changing the science of immunology and its many interfaces with medicine. These previously unknown cells are now recognized as controllers that both create and curtail immunity.

Dendritic cells are stellate or tree-like cells (Greek, *dendron*, tree) that are found in lymphoid or immune organs, and at the interfaces between our bodies and the environment. The epidermal layer of the skin has a rich network of dendritic cells, which were first described in 1868 by a medical student in Germany, Paul Langerhans, who thought they were part of the nervous system. In addition, dendritic cells line the surfaces of the airway and intestine, where they function as sentinels that sample proteins and particulates from the environment. It took until 1973 for Ralph Steinman and Zanvil Cohn to begin the modern era of dendritic cell science by showing that dendritic cells are a new class of white blood cells with a number of distinctive features and functions.

In the steady state, and when the body is challenged by injury and infection, dendritic cells travel from body surfaces to immune or lymphoid tissues, where they home to regions rich in T cells. There, dendritic cells deliver two types of information: they display antigens, the substances that are recognized by T cells, and they alert these lymphocytes to the presence of injury or infection. This directs the T cells to make an immune response that is matched to the challenge at hand.

Dendritic cells are a critical, and previously missing, link in the immune system. As sentinels, dendritic cells patrol the body seeking out foreign invaders, whether these are bacteria, viruses, or dangerous toxins. After capturing the invaders, often termed antigens, dendritic cells convert them

into smaller pieces and display the antigenic fragments on their cell surfaces. The dendritic cells then travel to lymph nodes or the spleen where they stimulate other cells of the immune system to make vigorous responses, in particular, the B cells that make antibodies to neutralize the invaders and killer T cells that launch specific attacks to destroy them.

New research is showing that dendritic cells are equally responsible for a seemingly opposite role in health called immune tolerance, which silences dangerous immune cells and prevents them from attacking innocuous materials in the body or the body's own tissues.

Given these functions of dendritic cells, it is not surprising that they are the subject of much research in medicine. During infection and cancer, microbes and tumors exploit dendritic cells to evade immunity, but dendritic cells also can capture infection- and tumor-derived protein and lipid antigens and generate resistance, including new strategies for vaccines. During allergy, autoimmunity an transplantation, dendritic cells instigate unwanted innate and adaptive responses that cause disease, but dendritic cells also can suppress these conditions. In other words, dendritic cells because they orchestrate innate and adaptive immune responses, are an unavoidable target in studying disease and in designing treatments.

In sum, studies of immunology and disease have long focused on antigens and lymphocytes (B cells, T cells, NK cells) as the mediators of immune responses. However, accumulating evidence shows that dendritic cells provide vital links between antigens and all types of lymphocytes.