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Commentary

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Role of macrophages in adaptive immunity

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DESCRIPTION

Macrophages are versatile cells that play many roles. As scavengers, they remove worn-out cells and other debris from the body. Together with dendritic cells, they are among the cells that present antigens and play an important role in eliciting an immune response. As secretory cells, monocytes and macrophages are important in the regulation of immune response and the development of inflammation. They produce a wide range of potent chemicals (monokines), including enzymes, complement proteins, and regulators such as interleukin-1. At the same time, they have receptors for lymphokines and can "activate" them to deliberately track microorganisms and tumor cells. After digesting the pathogen, macrophages present the pathogen's antigen (a molecule, a protein normally found on the surface of the pathogen and used by the immune system) to the appropriate helper T cells. The presentation is generated by incorporating into the cell membrane and binding to MHC class II molecules (MHCII). This indicates to other white blood cells that macrophages have antigens on their surface but are not pathogens.

Ultimately, antigen presentation leads to the production of antibodies that attach to pathogen antigens, allowing macrophages to attach more easily to their cell membranes and phagocytosis. In some cases, the pathogen is highly resistant to macrophage attachment. Antigen presentation on the surface of infected macrophages (related to MHC class II) in the lymph nodes stimulates and proliferates TH1 (type 1 helper T cells) mainly due to IL12 secretion from macrophages. When B cells in the lymph nodes recognize the same untreated surface antigen of the bacterium with its surface-binding antibody, the antigen is endocytosed and processed. The processed antigen is then presented to MHCII on the surface of B cells. T cells that express T cell receptors that recognize the antigen-MHCII complex (including co-stimulators CD40 and CD40L) trigger B cells to produce antibodies that aid in the opsonin action of the antigen and are phagocytic and promote the elimination of bacteria.

Macrophages provide another line of defense against fungal or parasite-infected tumor and somatic cells. When a T cell recognizes its particular antigen on the surface of the deviated cell, it becomes an activated effector cell, producing a chemical mediator known as lymphokine that stimulates macrophages in a more aggressive manner. Macrophages have several activated forms. There are many ways to activate macrophages, but there are two major groups called M1 and M2. M1 "killer" macrophages are activated by LPS and IFN gamma and secrete high levels of IL12 and low levels of IL10. M1 macrophages have pro-inflammatory, bactericidal, and phagocytic functions. In contrast, the M2 term "repair" (also called alternative activated macrophages) refers to macrophages involved in constructive processes such as wound healing and tissue remodeling, and the detrimental activity of the immune system through anti-inflammatory effects. Broadly refers to macrophages that turn off the formation-inflammatory methods produce cytokines such as IL10.

M2 is a phenotype of resident tissue macrophages and may be further increased by IL4. M2 macrophages produce high levels of IL10, TGF beta, and low levels of IL12. Tumor-related macrophages are primarily M2 phenotypes and appear to actively promote tumor growth. Macrophages exist in a variety of phenotypes that are determined by their role in wound maturation. M1 macrophages are the major phenotypes observed in the early stages of inflammation and are activated by four major mediators: interferon gamma (IFNγ), Tumor Necrosis Factor (TNF), and Damage-Associated Molecular Pattern (DAMP). These mediator molecules generate pro-inflammatory responses, which in turn produce

pro-inflammatory cytokines such as interleukin 6 and TNF. In contrast to M1 macrophages, M2 macrophages secrete an anti-inflammatory response through the addition of interleukin 4 or interleukin 13. They also play a role in wound healing and are required for revascularization and re-epithelialization. M2 macrophages are classified into four major types, M2a, M2b, M2c, and M2d, based on their role. How the M2 phenotype is determined is still controversial, but studies have shown that their environment can adapt to the most suitable phenotype for efficient increase of wound healing.