Innate and Adaptive Immunity

Innate immunity (also called natural or native immunity) provides the early line of defense against microbes. It consists of cellular and biochemical defense mechanisms that are in place even before infection and are poised to respond rapidly to infections. The mechanisms of innate immunity are specific for structures that are common to groups of related microbes and may not distinguish fine differences between microbes.

The principal components of innate immunity are:
(1) Physical and chemical barriers, such as epithelia and antimicrobial chemicals produced at epithelial surfaces;
(2) Phagocytic cells (neutrophils, macrophages), dendritic cells, and natural killer (NK) cells and other innate lymphoid cells;
(3) Blood proteins, including members of the complement system and other mediators of inflammation.

Adaptive immunity (also called specific or acquired immunity) system recognizes and reacts to a large number of microbial and nonmicrobial substances. The defining characteristics of adaptive immunity are the ability to distinguish different substances, called specificity, and the ability to respond more vigorously to repeated exposures to the same microbe, known as memory. The unique components of adaptive immunity are cells called lymphocytes and their secreted products, such as antibodies. Foreign substances that induce specific immune responses or are recognized by lymphocytes or antibodies are called antigens.

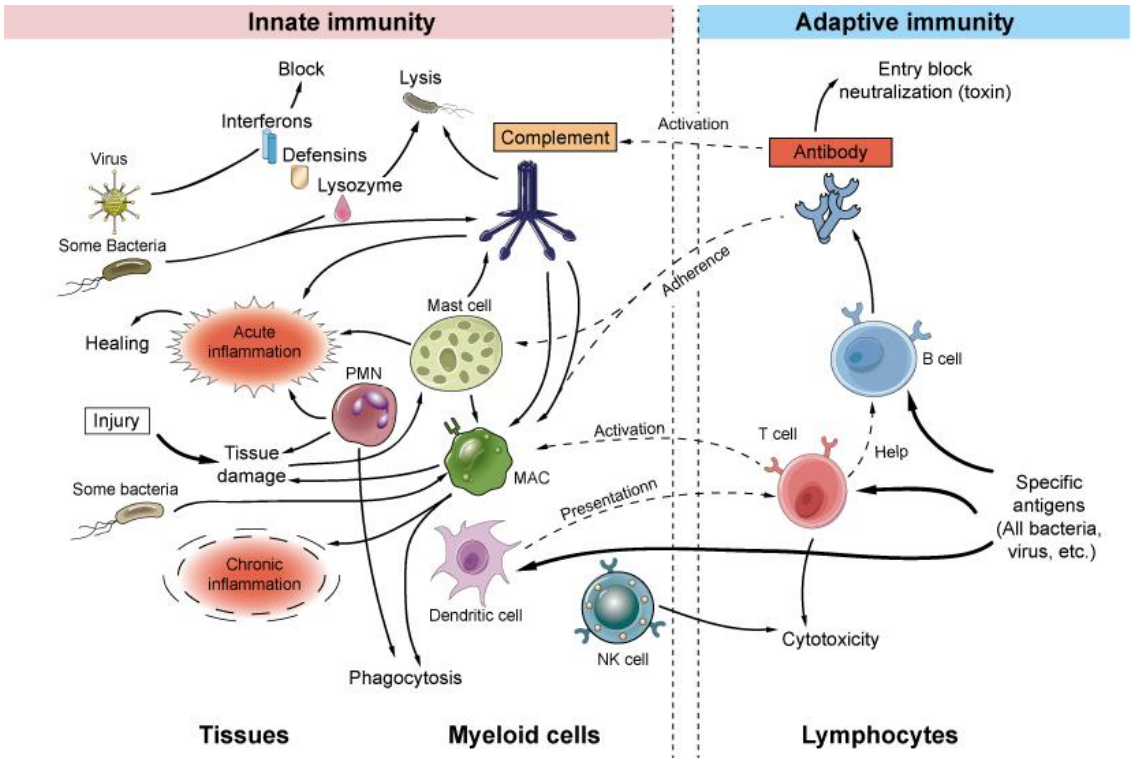

Figure 1. Just as resistance to disease can be innate (inborn) or acquired, the mechanisms mediating it can be correspondingly divided into innate (left) and adaptive (right), each composed of both cellular (lower half) and humoral elements (i.e. free in serum or body fluids; upper half). Adaptive mechanisms, more recently evolved, perform many of their functions by interacting with the older innate ones.

Innate immunity is activated when cells use specialized sets of receptors (Pattern recognition receptor, PRR) to recognize different types of microorganisms (bacteria, viruses, etc.) that have managed to penetrate the host. Binding to these receptors activates a limited number of basic microbial disposal mechanisms, such as phagocytosis of bacteria by macrophages and neutrophils, or the release of antiviral interferons. Many of the mechanisms involved in innate immunity are largely the same as those responsible for non-specifically reacting to tissue damage, with the production of inflammation (cover up the right-hand part of Figure 1 to appreciate this). However, as the nature of the innate immune response depends on the type of infection, the term 'nonspecific', although often used as a synonym for 'innate', is not completely accurate. Adaptive immunity is based on the special properties of lymphocytes (T and B, lower right), which can respond selectively to thousands of different non-self-materials, or 'antigens', leading to specific memory and a permanently altered pattern of response - an adaptation to the animal's own surroundings. Adaptive mechanisms can function on their own against certain antigens (cover up the left-hand part of Figure 1), but the majority of their effects are exerted by means of the interaction of antibody with complement and the phagocytic cells of innate immunity, and of T cells with macrophages (broken lines).

Through their activation of these innate mechanisms, adaptive responses frequently provoke inflammation, either acute or chronic; when it becomes a nuisance this is called hypersensitivity.

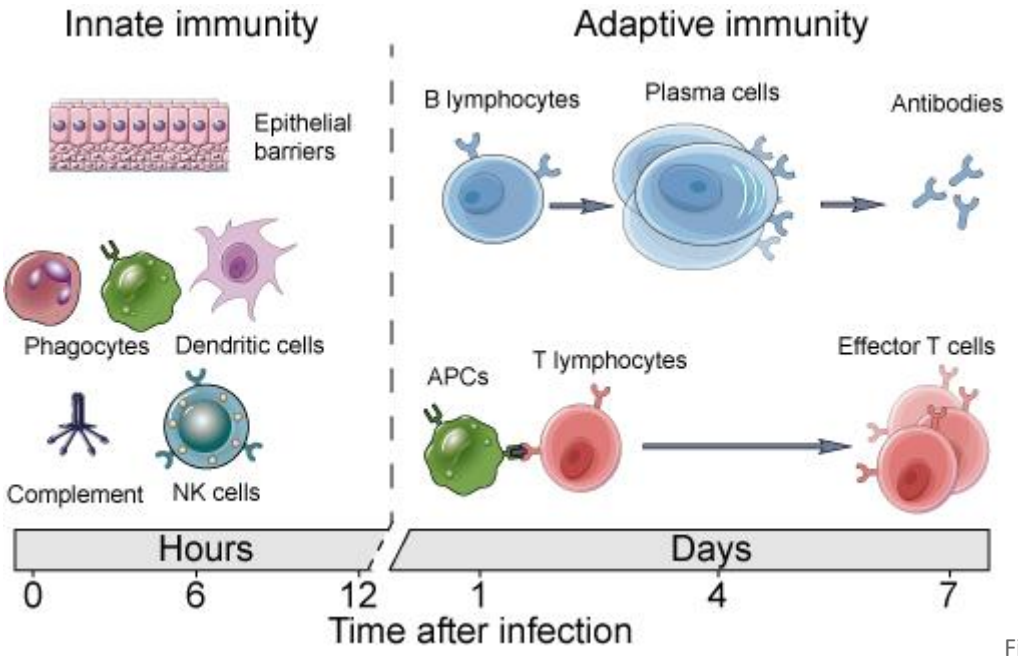

Figure 2.

Innate and adaptive immunity time line. The mechanisms of innate immunity provide the initial defense against infections. Adaptive immune responses develop later and require the activation of lymphocytes. The kinetics of the innate and adaptive immune responses are approximations and may vary in different infections.