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STRUCTURE OF ANTIBODIES AND HUMORAL IMMUNITY

Sobirjonova Shaxzodaxon G‘offorjon qizi
Assistant of the Department of “Dermatovenerology and Allergology”,
Ferghana Medical Institute of Public Health

Baxtiyorova Afruzabonu Baxodir qizi
Student of Ferghana Medical Institute of Public Health

Annotation

The terms antibody and immunoglobulin (Ig) are frequently used interchangeably. However, the term antibody is used more frequently in health care settings. When a B cell matures in response to antigen exposure, it becomes a plasma cell capable of producing antibodies.

There are five classes of antibodies (IgG, IgA, IgM, IgE, and IgD) which are characterized by differences in structure and function. Both IgG and IgA have subclasses.

IgG is the most abundant class of antibody, constituting 80% to 85% of the antibodies in the blood and accounting for most of the protective activity against infections. During pregnancy maternal IgG is transported across the placenta and protects the newborn child during the first 6 months of life.

IgM is the largest antibody and usually exists as a pentamer (a molecule consisting of five identical smaller molecules) that is stabilized by a J chain. It is the first antibody produced during the initial, or primary, response to antigens. IgM is usually synthesized early in neonatal life but may be increased as a response to infection in utero.

IgA is found in blood and in bodily secretions as secretory IgA (subclass IgA2). Secretory IgA is a dimer consisting of two IgA2 molecules held together through a J chain and secretory piece. The secretory piece is attached to dimeric IgA during transportation through mucosal epithelial cells to protect against degradation by enzymes also found in secretions.

IgD functions as a part of the BCR antigen receptor on the surface of early B cells.

IgE is normally at low concentrations in the circulation. It has very specialized functions as a mediator of many common allergic responses and as a defense against parasitic infections.

A major component of B-cell maturation is class switch, the process that results in the change in antibody production from one class to another (e.g., IgM to IgG). Antibody diversification is essential for the immune system to produce protective humoral responses. Before exposure to antigens and Th2 cells, the B cell produces IgM and IgD, which are used as cell membrane receptors. During the clonal selection process, a B cell proliferates and develops into antibody-secreting plasma cells, and each B cell has the option of becoming a secretor of IgM or changing the class of antibody to a secreted form of IgG, IgA, or IgE. The antigenic specificity of the antibody remains unchanged. Thus during clonal selection, a B cell may produce a population of plasma cells that are capable of producing many different classes of antibodies against the same antigen. The type of antibody produced is under the control of Th cytokines. For instance, the Th2 cytokines IL-4 and IL-13 appear to preferentially stimulate switch to IgE secretion.

All in all, Antibodies contribute to immunity in three main ways. To enter cells, viruses and intracellular bacteria bind to specific molecules on the target cell surface. Antibodies that bind to the pathogen can prevent this and are said to neutralize the pathogen. Neutralization by antibodies is also important in preventing bacterial toxins from entering cells. Antibodies protect against bacteria that multiply outside cells mainly by facilitating uptake of the pathogen by phagocytic cells that are specialized to destroy ingested bacteria.

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