P. G. Sem III CC-10 : Vertebrate Immunology

Unit-1 : Innate and Acquired Immunology

Submit : 1.3 & 1.4 (Part-I) (Humoral & Cell-mediated Immunity)

By
Immunology (Part I)
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Innate & Acquired Immunology : Humoral & cell. m. Immunity

Immunology is basically a the study of Immune Syetem and grew out of the comman experience that people who recover from certain infections become there-after "Immune" to the disease again. Immunity is highly specific : an individual who recovers from a perticular disease like pox is protected against that virus. In Normal conditions also, many of the repones of the Immune Syetem initiate the destruction and elimination of invading organisms and any toxic molecules produced by them. This ability to distinguish foreign moleculs from self-molecules is another fundamental feature of the Immune Syetem. Almost any macromolecule (i.e. protein, polysaccheride or nucleic acid) as long as it is foreign to the recepient, can instruce an immune reepones. Any substance capable of eliciting an immune reepones is

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called an antigen. There are two broad classes of Immune responses.—

A Humoral Immunity or Antibody Response
B Cell-mediated Immune Response or Immunity

A **Humoral Immunity** : Humoral Immunity or Antibody mediated Immunity involves the production of antibodies which are proteins, called Immunoglobulins or Ig. The antibodies circulate in the blood stream and permeate the other body fluids, where they bind specifically to the foreign antigen that have induced them. Genetically, the antibodies either adhere to the surface of the microorganisms, making them clump together (agglutination) or they may cause them to disintegrate or lyse. Binding with antibody inactivates viruses and bacterial toxins by blocking their ability to bind to receptors on the target cells.

Antibody binding also marks or tags invading microorganisms for destruction, either by making it easier for a phagocytic cell to ingest them (such antibodies are called 'opsonins') or by activating a system of blood proteins collectively called Complement that kills the invaders. Precipitin type antibodies cause aggregation of antigen molecules leading to the formation of a precipitate.

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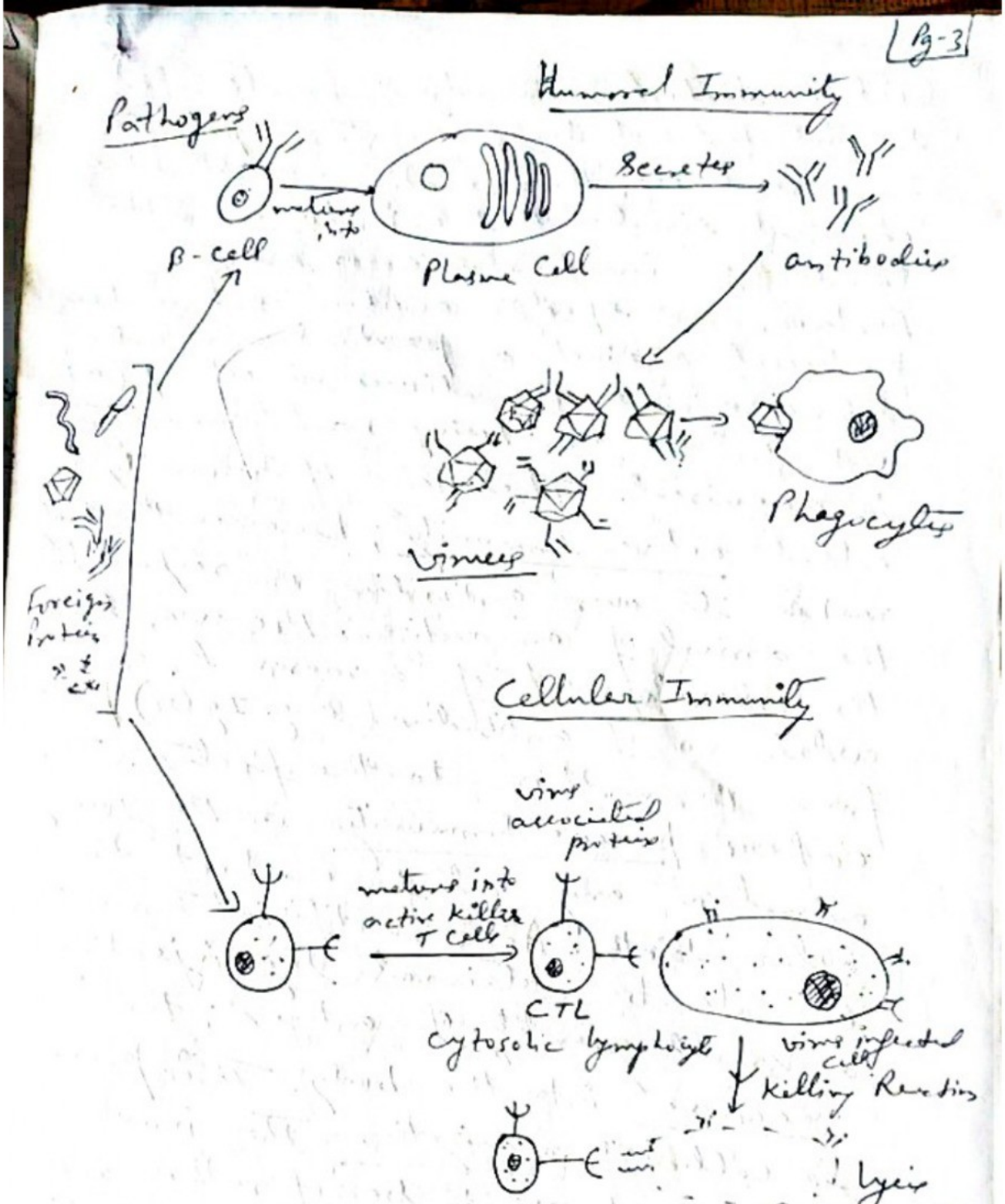

Humoral Immunity and Cellular Immunity (After Dunnell & et.al 1986)

Cell-mediated Immune Responses involve the production of specialized cells that react with foreign antigens on the surface of other host cells. The reacting cell can kill a virus-infected host cell that contains viral proteins on its surface.

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Cell mediated Immunity thus eliminates the infected cell before the virus replicates. In other cases, the reacting cell secretes chemical signals that activate macrophages to destroy invading micro-organisms.
Further, once specific antibodies have been produced against a particular microbe, defence against the disease is set up (at least for the time being) and immunity is acquired. This kind of Immunity is called active Immunity; because the body makes its own antibodies in response to the arrival of an antigen. However, during the development of a mammal, a certain no. of antibodies (e.g. IgG) pass from the mother to the foetus. This confers passive Immunity on the young animal at any rate for a short time after birth. Active artificial Immunity can also be obtained by injecting a small quantity of antigen; the vaccine into the body. This process is called Immunization. The immune response appears to be of rather recent evolutionary origin, because antibodies production is the characteristic only of vertebrates.

Cellular Basis of Humoral Immunity:-

Immunoglobulins or antibodies are the basis of Humoral Immunity. The human body is capable of synthesizing more than a million different kinds of Igs.

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Each of these Immunoglobulins is capable of reacting with a different antigen, but all of them appear to share the same fundamental quarternary (globular) structure. Typically, an Immunoglobulin molecule is a Y-shaped heteromer and composed of two identical heavy (H) polypeptide chains and two smaller identical light (L) chains. Each arm of the Y contains a complete L chain and a part of an H chain and the leg of the Y contains the remaining part of the H chain. Near its C-terminus, each L chain is linked to H chain by disulphide bridge and two additional disulphide bridges link the H-chains together. The H chains possesses antigenic determinants in the 'tail' segment by which they can be classified as Ig G, Ig M, Ig A, Ig D or Ig E. Ig G is characterised by γ (gamma) type of H chain, while Ig M with μ (mu) type of H chain, Ig A with α (alpha), δ (delta) type of H chains are present in Ig D and ε (Epsilon) type of H chain is characteristic of Ig E. Light chains can likewise be typed as Kappa (κ) or Lambda (λ). Within a H chain or L chain, C-terminal segments exhibit very little variation in primary structure from one individual to another and are called Constant regions (C). The amino ends or N-terminal of both heavy and light chains, however, are extremely diverse in primary structure that a million type

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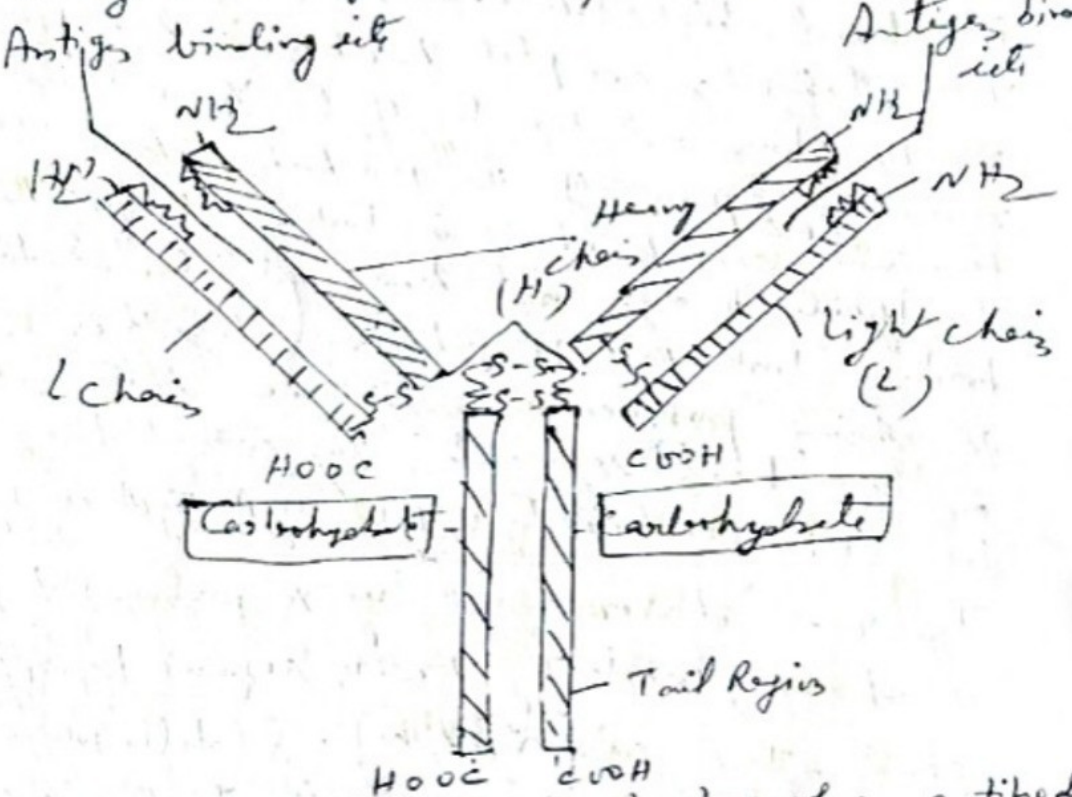
even within a clone and are called Variable (V) regions. The V_L and V_H regions together form antibody combining site for specific interaction with a homologous antigen molecule. Thus each Y-shaped antibody has two identical antigen binding sites, one at the tip of each arm of Y. Because of their two antigen binding sites, antibodies are said



Generalised chemical structure of an antibody molecule

to be bivalent. The efficiency of antigen binding and cross linking of antibodies is greatly increased by the flexible hinge regions in antibody molecules, which allow the distance between the two antigen binding sites to vary. Recently, it has been found that antigen binding site of antibodies is formed by only about 20 to 30 of amino acid residues in the variable region of L & H chains.

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