DC-1, Semester-1
Paper: History and Scope of Microbiology
Chapter: An introduction to Immunology
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Lesson: An Introduction to Immunology

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Immunity

The natural capability of the body to fight infections by pathogenic microorganisms or foreign substances, cancer and other disorders on its own is termed 'immunity'. Our immune system is composed of a number of components. Some people are more 'immune' than others. The mechanisms of immunity include both genetic factors as well as proper healthcare measures. Dysfunction of immunity may result in immunodeficiency (inadequate immunity), hypersensitivity like allergies and asthma (overreaction of the immune system to the invading antigens) and autoimmunity (immune response wrongly mounted to the 'self' antigens).

Immunity may be obtained by two ways: Active and Passive**.**

Active Immunity

The term is used when the components of our immune system are triggered and start working against the antigen in order to overcome it and acquire immunity against the same. For example, as a response to suffering from an infectious disease, certain 'memory cells' and their products are prepared and stored in the living body of the host. When the same infection is subsequently encountered, these memory cells and their products recognize the antigen and clear it quickly, resulting in immunity. This kind of immunity is termed as Natural Active Immunity.

Likewise, when an individual is given a vaccination that contains either an attenuated microorganism, or any of its surface component(s) / DNA, it triggers an immune response without causing illness to the person. Also it generates memory cells which impart lifelong protection to the person from this pathogen. Whenever this individual contracts the live antigen or pathogen, the memory cells and their products already present capture the incoming antigen, thereby imparting immunity to the individual, *i.e.*, even if one gets that infection, one doesn't suffer from this particular disease. Such type of immunity is referred to as Artificial Active Immunity.

Passive Immunity

When the body receives the immune components in a readymade state from outside or other sources, *e.g.*, mothers' antibodies reach the foetus/infant's body via the placenta or breast milk, it is called passive immunity. Since the immune system of a foetus is not fully developed, the antibodies prepared by the mother's body (for her own use) reach the foetus. It happens because the cells of the placenta are permeable to the same. As the mother's circulating blood nourishes the child, her antibodies provide passive immunity to the fetus, enabling the subsequently born infant to fight these pathogens, effectively. This is an example of Natural Passive Immunity.

Similarly, an example of Artificial Passive Immunity includes the treatment of a patient by transfusion of readymade immune cells and antibodies from another source in a hospital.

Immunology

It refers to the science of immunity and the components of immune system of the body that deal with foreign invaders. Applied and therapeutic immunology includes the understanding of immune disorders and immunotherapy, *i.e.*, to be able to treat these diseases.

Some Interesting Facts of Immune System

Fact 1: Our body is exposed to millions of germs every day, but the immune system kills them so they don't get us sick.

Fact 2: When we get older, our body is more immune to germs.

Fact 3:The immune system can remember how to fight off a germ in case it ever comes back again.

Fact 4: When our immune system reacts to a certain allergen that should be ignored it is called allergies.

Fact 5: The immune system is not the cause of the common cold.

Source: https://sites.google.com/site/immunesystem305/interesting-facts

Immune Response

The body's defense system protects it from pathogenic microorganisms as well as from cancer and aging. Its components recognize foreign substances that do not belong to own body, and subsequently clear them. The microbes are recognized by virtue of their cell surface molecular patterns and are efficiently cleared by our immune system. Our immune system is a single integrated system composed of two defense mechanisms: serum antibodies that constitute part of humoral immunity and sensitized cells called T lymphocytes that constitute cellular immunity. Together, they are branches of the Adaptive Immune Response.

Innate Immunity

It is natural and non-specific immunity present from the birth. It can't differentiate between different pathogens and mounts same response against all pathogens. It doesn't display memory and is antibody independent. It forms the first line of defense against pathogenic microbes, which includes the natural physical, chemical and physiological barriers, as well as phagocytic cells and certain molecules that recognize specific categories of pathogens. Anatomical and physiological barriers such as skin,

body hair, mucus linings located at all body openings, presence of eyelids and eyelashes, occurrence of lysozyme in tears, as well as fine cilia in the respiratory tract are some of the most common examples of inherent or innate components of immunity. Low pH in the stomach due to presence of hydrochloric acid effectively kills the pathogens ingested along with our food. All of these features are present in the body prior to the microbial infection, and that is why innate immunity doesn't require any preparation time to start operating when the infection occurs, unlike adaptive immunity.
All human beings possess these physical, chemical, physiological and inflammatory barriers, which play general and non-specific, yet powerful and significant roles in saving us from a whole lot of microbial pathogens, hence enabling us to enjoy a healthy life.

Moreover, phagocytic barriers are present in our bodies that include certain specialized immune cells present in our tissues and blood, termed macrophages and phagocytes. These are endowed with the capability of recognizing the invading pathogens and foreign material, followed by 'eating' them up, thus protecting us from infectious diseases. These phagocytes use a number of strategies to kill the pathogens, such as antimicrobial peptides, reactive oxygen & nitrogen species, and cytolytic proteins. They internalize the invading pathogens and digest them in order to disintegrate and destroy the same and protect the individual from their ill effects (Fig. 1).

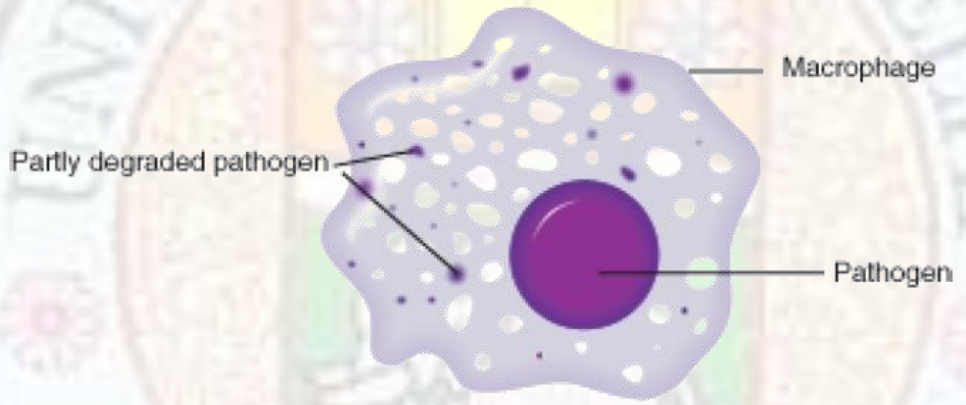

Figure 1: Phagocytosis of pathogens by macrophages.

Source: **http://www.theopencurriculum.org/articles/science/?q=immune-system-nonspecific-defenses (cc)**

The innate immune system utilizes certain common receptors present on specialized immune cells for detecting infectious agents that invade the human body by recognizing the generally found molecular patterns on infectious microbes(pathogen associated molecular patterns or PAMPs). Various toll- like receptors (TLRs) are the most common receptors which detect a large number of specific pathogenic categories very accurately, and in the process, manage to handle a vast number of pathogens remarkably efficiently and successfully.

When pathogens invade the skin and mucous membranes, the tissue infection or injury triggers a complex cascade of events known as inflammatory response. Inflammation may be classified as acute or chronic, *i.e.*, very intense and long lasting, respectively. Romans were the first ones to identify the features of inflammation 2000 years back. They outlined the signs of inflammation to be swelling, redness, heat and pain. To these, Galon in 2nd century added a function called "function laesa" meaning that the inflamed organ or area is rendered incapable of performing its natural functions well. With a goal of healing this disorder, the diameter and permeability of blood vessels in the nearby

area increases, causing a lot more influx of blood into that area, resulting in lots of types of leukocytes and other immune cells collecting there. Phagocytes and antiviral cells migrate to the site of inflammation by chemotaxis, which contribute a great deal in fighting the invaded pathogens. This gradually overcomes all the signs of inflammation, eventually enabling the person to return to his/her original healthy state.

Features and components of innate immunity appeared early in evolution of multicellular organisms. Not only all animals, but also a vast variety of plants exhibits a variety of features of innate immunity, in contrast to those of adaptive immunity which is displayed only by vertebrates.

Adaptive Immunity

Though it is certainly the second line of defense, it works very specifically and precisely to clear the particular invading antigen. When a foreign invader gets access to the interior of the body, it triggers certain specific cells of our immune system to awaken and take action to clear the same. The immune system of a healthy human possesses an army of B & T lymphocytes with such amazing diversity, that it is capable of clearing just any antigen on earth.
Adaptive immunity is characterized by four features:

- Specificity
- Recognition of self from non-self
- Diversity
- Memory

The ADAPTIVE immune response to foreign invaders IS HIGHLY SPECIFIC, and works via two distinct mechanisms & components: HUMORAL (mediated by antibodies, that are produced by specific B lymphocytes of the body after the system is exposed to a particular antigen) and CELLULAR (Cell-mediated, by T lymphocytes).

Antigen

Antigen (Ag) is a substance, that usually does not belong to the body, which the immune system recognizes as foreign or non-self. Subsequently, the system produces a specific antibody that reacts with it and clears it. A single antibody can't bind to the entire antigen as most of the antigens are large complex molecules. It binds to only a small region of the antigen which is made of just 9-13 amino acids and is called epitope or an antigenic determinant. Each antigen is made up of several such epitopes requiring a number of antibody molecules to clear it. Each antibody has two antigen binding sites (ABS) which bind only to compatible epitopes.

Hapten

It refers to the smallest form of the antigen, which is capable of binding to the antibody (displays antigenicity) but cannot generate immune response on its own. It can become antigenic after bonding to a large carrier molecule.

Adjuvant

It is a formulation that stabilizes the antigen inside the host body, and serves to prolong as well as enhance its presentation for generation of better immune response. Alum is the simplest adjuvant. Adjuvants are usually incorporated while formulating a good vaccine as it enhances its effectiveness a great deal.

Antibody

Antibodies are also termed 'Immunoglobulins' since they are glycoproteins with immune function. These are synthesized by plasma cells (produced from mature B lymphocytes) of the body when a foreign antigen invades it. It binds the antigen with high specificity & affinity. Plasma cells can produce various antibodies in response to infection or immunization, which in turn bind to & neutralize pathogens or prepare them for uptake & destruction by phagocytes.

Antibody structure

Antibodies have a basic unit of 4 polypeptide chains: Two mutually identical light (L) chains and 2 identical heavy (H) chains – bound together by covalent disulfide bridges as well as by noncovalent interactions. These molecules can be proteolytically cleaved to yield 2 F_{ab} fragments (the Ag binding part of the molecules) and the F_c fragment (the part of the molecule responsible for the effector functions, *e.g.*, complement activation). Both H- &L-chains are divided into V & C regions. V (variable) regions exhibit variation in their structure and contain the Ag-binding site (ABS) that physically binds to the epitope of the antigen. On the other hand, C (constant) regions determine the fate of the bound antigen since it is through the constant region that the antibody binds to certain specialized immune cells which helps the antigen-antibody complex to be effectively cleared (Fig. 2 and 3).

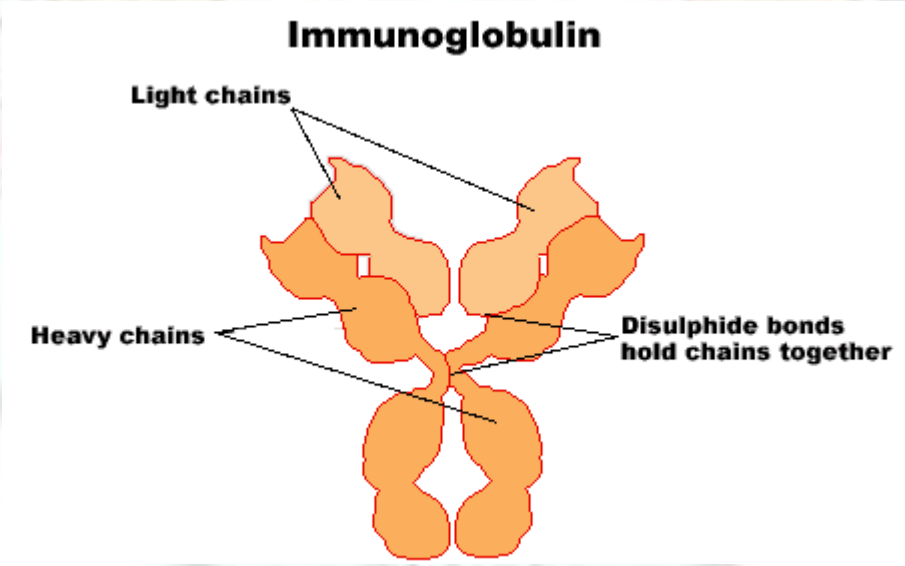

Figure 2: Immunoglobulin structure.
http://www.mcld.co.uk/hiv/?q=immunoglobulins (cc)

V region: It stands for variable region, located at the amino terminal of the antibody. It is named so since its amino acid composition varies from antibody to antibody. It is also termed the F_{ab} (Fragment antigen binding) region. ABS or antigen binding site of the antibody lies in the V region only.
C region: It refers to the constant region, located at the carboxy terminal of the antibody. It is also called the F_c (Fragment crystallizable) region**.**

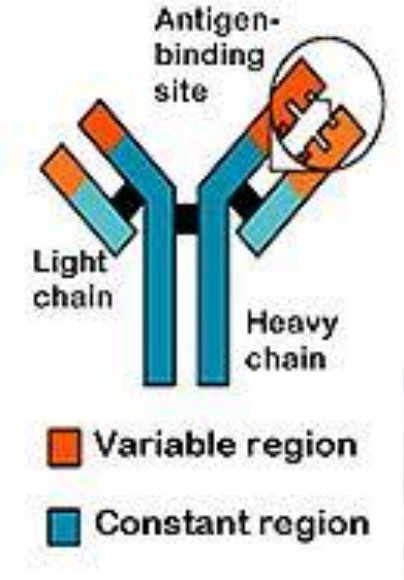

Figure 3: Antibody showing the antigen binding site (ABS) in its variable region.

Source :http://en.wikipedia.org/wiki/Adaptive_immune_system (cc)

Types or Classes of Antibody

In humans, there are 5 distinct antibody classes (Fig. 4) with different biological activities which have evolved to deal with antigens (*e.g.*, microbes) exhibiting varied properties and entering the human body through different routes, *viz.* skin, gastrointestinal & genitourinary tracts.

IgG: It occurs in highest concentration in serum, and hence provides maximum immunity towards most blood borne infectious agents, and is the only antibody class to cross the placenta to provide passive immunity to the infant. There are 4 subclasses of IgG: IgG1, IgG2, IgG3 & IgG4.

IgA: Among all antibodies, it is present in the mucous or other secretions produced by the body openings. Hence, among antibodies, it is the first line of defense against microbes entering through mucosal surfaces (the respiratory, gastrointestinal and genitourinary tracts). Secretory form of IgA is dimeric with 4 ABS; it is synthesized locally by plasma cells; binds to the poly-Ig receptor on epithelial cells and is transported through these cells to the luminal surface where it is released with a portion of the poly-Ig receptor (called secretory component, SC). This antibody prevents colonization of mucosal surfaces by pathogens and mediates their phagocytosis.

IgM: It is the Ag receptor on B cells and the first antibody produced in an immune response. In circulation, IgM is composed of 5 four-chain units with 10 ABS. It, thus, has extremely high avidity for antigens and is very efficient in dealing with pathogens, especially early in the immune response before sufficient quantities of IgG have been produced.

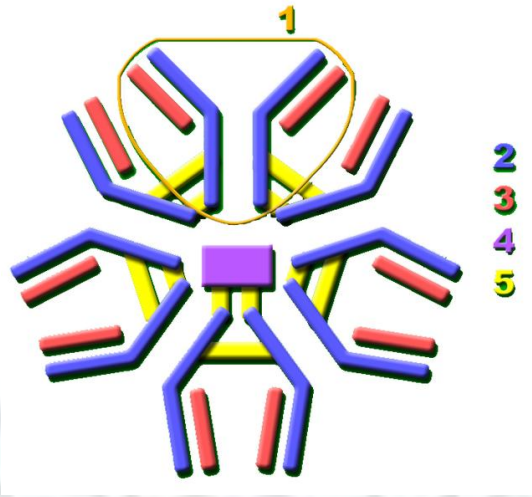

Figure 4: IgM, the pentameric antibody. (1) The Ig Monomer; (2) The Heavy Chain; (3) The Light Chain; (4) The Secretory Component; (5) The J {joining} Chain.
Source **:https://en.m.wikipedia.org/wiki/File:IgM_white_background.png (cc)**

IgD: It functions primarily as an antigen receptor on B cells.

IgE: This form of antibody is produced in high amounts in cases of allergic reactions and helminthic infestations. Antigen reintroduced into a previously sensitized individual binds to Ag-specific IgE on 'armed' mast cells (IgE gets attached to the receptors present on mast cells) and triggers release of the pharmacologically active agents (*e.g.*, histamine) from these cells. These agents then cause immediate hypersensitivity syndromes such as hay fever, asthma *etc.*

Specific Features Of Antibodies

Valence

The number of epitopes on any antigen(s) to which antibody can bind is termed its valence. It is also defined as the number of antigen binding sites (ABS) antibodies possess**.**

Affinity

It is defined as the tightness of binding of an ABS of the antibody to the antigenic determinant (epitope) of the Ag. The tighter the binding, the less likely the antibody is to dissociate from Ag. Different antibodies to a single epitope of an antigen vary considerably in their affinity for that epitope. Clearly, the affinity of an antibody population is critical when the Ag is a toxin or virus, and must be neutralized by rapid and firm binding with the antibody. Antibodies produced by a memory response have higher affinity (about 1000 times higher) than those in a primary response (soon after the first exposure to the Ag).

Antibody Valence & Avidity

The valence of an antibody is the maximum number of antigenic determinants with which it can react. For example, IgG contains 2 F_{ab} regions and can bind 2 molecules of antigens or 2 epitopes of the same antigenic particle, and thus is said to have a valence

of 2. Having multiple binding sites for an antigen dramatically increases its binding to antigens on particles such as bacteria or virus. This synergistic and strengthened binding effect is termed avidity, which provides firmness of association between a multi-determinant antigen and the antibodies produced against it. In other words, avidity is the sum total of the strength of binding of these 2 molecules to each other at multiple sites (It is distinct from affinity, which is the strength of binding of at a single site). Determining the avidity of an antibody population is very difficult since it involves evaluating some function of the group interactions of a large number of different antibodies, with a large number of different antigenic determinants. But the importance of avidity is immense. For instance, 2 binding sites on IgG are 10-100 times more effective at neutralizing a virus than 2 unlinked binding sites. In case of IgM, whose valence may be up to 10, the avidity shoots up to a million times. This can be explained as follows.
Antibody with a single binding site to the antigen can bind it, but may also dissociate later. This results in the parting of the antibody from the antigen. However, if the valence is more than 1 for epitopes, even if dissociation occurs at one site, the association at other site(s) remains, and helps the reassociation at the first site. Hence, larger is the number of the bonds formed between the antigen and antibody, it is less likely that they will dissociate from each other.

Importance of Avidity: Despite relatively poor intrinsic affinity for an antigenic determinant but a high valence value, antibodies are able to clear their specific antigens (virus etc.) with great efficiency due to a derived high avidity feature.

Additional information

Now a days customized antibodies can be produced in laboratories. They are called monoclonal antibodies as they are produced by a single clone of B-cells and are against a single epitope of the antigen. They are widely used in the form of drugs, enzymes, therapeutics, detectors of diseases, *etc*.

Primary & Secondary Immune Response

The immune response that takes place in response to the very first encounter to the antigen is termed the PRIMARY IMMUNE RESPONSE. It is rather weak, and takes a longer duration to develop. Also, the predominant type of antibody produced here is IgM, and its general affinity towards the antigen is rather low. The valence of IgM (10) makes up for this weak affinity.

SECONDARY IMMUNE RESPONSE is the response given to the same antigen by the body upon the subsequent (second or later) exposures. It happens relatively quickly, and is much more intense than the primary one. The memory cells from the primary response contribute toward the strength and rapidity of secondary immune response. The bulk of antibodies produced in secondary immune response are of IgG type. The affinity of the antibodies produced to combat the incoming antigen (pathogen) may also increase by this time due to changes in the DNA in the variable region of the antibody so as to 'adapt' to the antigen better (termed 'Affinity Maturation'). The differences between these two responses are listed in Table 1.

Table 1: Differences between a primary and a secondary immune response.
Source: Author

	PRIMARY IMMUNE RESPONSE	**SECONDARY IMMUNE RESPONSE**
1.	When an antigen is encountered for the first time, it generates primary immune response.	Subsequent or second exposure to the same antigen creates secondary immune response.
2.	It is a weak response.	It is more intense and strong.
3.	It is slow and takes time to develop.	It is quick and develops fast.
4.	IgM is the predominant antibody here.	IgG is its predominant antibody.
5.	The antibody produced here has low affinity towards antigen.	The affinity of the antibody produced towards the antigen increases in secondary immune response.
6.	No memory is present before the primary immune response.	Secondary immune response is the result of memory of primary immune response, and also leaves its memory for future immune responses.

Human Infectious Diseases and Their Causative Agents

Our body is inhabited by many microorganisms like viruses, bacteria, fungi *etc*. They are normally harmless, but under certain conditions may cause a disease. Some of these diseases are infectious or communicable or transmissible. They can spread through direct contact from person to person, animal to person and mother to unborn child. The disease also can be passed by indirect contact *e.g.* touching a knob of the door, also touched by an infected person. Similarly, insect bites, food contaminations *etc* can also cause infectious diseases. Some of these diseases along with their causative agents are mentioned in Table 2.

Table 2: A list of some important human infectious diseases along with their causative agents.
Source: Author

	HUMAN DISEASES	**CAUSATIVE AGENT**
I	**BACTERIAL**	
*	Tuberculosis	*Mycobacterium tuberculosis*
*	Anthrax	*Bacillus anthracis*
*	Cholera	*Vibrio cholera*
*	Typhoid	*Salmonella typhi*
*	Diphtheria	*Cornybacterium diphtheriae*
*	Plague	*Yersinia pestis*

*	Syphilis	*Treponema palladium*
*	Tetanus	*Clostridium tetani*
II	**PROTOZOAL**	
*	Amoebic dysentery	*Entamoeba histolytica*
*	Giardiasis	*Giardia intestinalis*
III	**VIRAL**	
*	AIDS	Human ImmunoDeficiency Virus
*	Polio	Polio virus
*	Measles	Paramyxovirus
*	Mumps	Mumps virus
IV	**FUNGAL**	
*	Ringworm	*Trichoderma trichophytan*

SUMMARY

1. Immunity refers to our body's capability to fight the invasion of pathogens, occurrence of cancer and presence of ageing cells.

2. Immunity is termed Active immunity when the immune components of our body are synthesized by our own body. Body uses its immune system to prepare its own immunity imparting components, such as after suffering from an infectious disease, or getting a vaccination, the person becomes 'immune' to it, *i.e.*, even if gets infection, doesn't suffer from this particular disease.

3. Passive immunity is when the body receives the immune components in a readymade state from outside or other sources, *e.g.*, mothers' antibodies reach the foetus / infant's body via the placenta or breast milk. Transfusion of readymade blood cells and antibodies to the patient is another example of passive immunity.

4. Immunology refers to the study of immunity and the immune system, immune disorders and immunotherapy.

5. Our immune response is our body's defense system that fights microbial infections, cancer and aging. The two arms of immunity are 'Humoral immunity' contributed by the soluble immunoglobulins (produced by B lymphocytes) and 'Cellular immunity' by T lymphocytes.

6. Innate Immunity is the natural and non-specific immunity present from birth and is antibody independent. It forms the first line of defense for our body, and

includes skin, body hair, mucous linings located at all body openings, presence of acid in stomach, lysozyme in tears, fine cilia in the respiratory tract. General inflammation and phagocytosis are also part of innate immunity.

7. Adaptive Immunity is specific and antibody dependent. It is characterized by four immunologic attributes: specificity, diversity, memory and recognition of self from non-self. Despite taking some time to develop and being the second line of defense, it clears the invaded antigens very specifically and efficiently.

8. The adaptive immune response to foreign invaders is executed via two mechanisms: Humoral (antibody-mediated, which are produced by specific B lymphocytes after the system is exposed to a particular antigen) and Cellular (Cell mediated, by T lymphocytes).

9. Antigen is a substance, non-self to the body, which is capable of triggering the body to produce antibodies which in turn can clear the antigen from the system. An epitope is the antigenic determinant of the antigen that binds to the ABS of the variable region of the antibody. A hapten is the smallest possible form of the antigen, which is capable of antigenicity (binding to the antibody).

10. An Adjuvant is formulation which, when incorporated into vaccines, stabilizes the antigen inside the host body, and enhances the presentation of the antigen there. Alum is the simplest adjuvant.

11. Antibodies, also termed Immunoglobulins, are synthesized by mature B lymphocytes (plasma cells) of the body when a foreign antigen invades it. It binds the antigen with high specificity and affinity. Plasma cells can produce various antibodies in response to infection or immunization, which in turn bind to and neutralize pathogens or prepare them for uptake and destruction by phagocytes.

12. The Antibody typically contains 4 polypeptide chains, of which 2 are heavy and other 2 are light chains, all of which are bound together by disulfide bridges. The amino terminal of all the four chains is termed variable regions. Likewise, the carboxy terminal is called constant region, as its amino acid remains relatively constant in all antibodies. The five distinct antibody classes observed in human beings include IgG, IgA, IgM, IgD and IgE, which carry out distinct biological activities. IgGis highest in concentration, and is the only one that can cross the placenta and reach the fetus from the mother. IgA is found in all body secretions, such as mucus, milk etc. Hence, it can encounter the pathogens through mucosal surfaces even before they can enter the body. IgM is the pentameric immunoglobulin, that is the first type of antibody produced in an immune response. IgD is produced in traces, and functions primarily as an antigen receptor on the producer B cell itself. Last but not the least, IgE is produced in high amounts during allergic reactions, such as hay fever & asthma, and plays a role in controlling the same.

13. Valence of any antibody refers to the number of antigen binding sites (ABS) it contains. Affinity of any antibody is defined as the tightness of binding of a single ABS of the antibody to the antigenic determinant (epitope) of the Ag. On the other hand, avidity of an antibody refers to the sum total of the strength of binding of these 2 molecules to each other at multiple sites. In the earliest appearing antibody such as IgM, even if its affinity to the antigen is poor, the avidity value attained becomes very high due to five times higher valence value.

14. Primary Immune Response is the immune response of the body that takes place upon the very first exposure to the antigen. It is less intense, slower and comprises mainly IgM whose general affinity towards the antigen is rather low.

15. Secondary Immune Response is the term given to the body's immune response to the same antigen following the subsequent (second or later) exposure. It is relatively quicker, more intense response than the primary one, and comprises primarily of IgG. The antibodies produced by this time usually exhibit better affinity towards the same antigen.

Exercises

Short Answer Questions

1. Define active and passive immunity.
2. What are an epitope and a hapten?
3. Differentiate antigenicity from immunogenicity.
4. Define humoral immunity.
5. What is meant by Fab and Fc portions of an antibody?
6. What do you understand by the V and C portions of an immunoglobulin?
7. Define valence of an antibody. What does it signify?
8. Specify the valence value of IgG, IgM and IgA.
9. Differentiate affinity from avidity.
10. Define an infectious disease giving suitable example.

Long Answer Questions

1. How is the secondary immune response distinct from the primary immune response? Compare both of them in detail.
2. Discuss the features of innate immunity.
3. Explain the four features of adaptive immune response.
4. What is an adjuvant? Give examples. What is it used for?
5. Why are antibodies also termed immunoglobulins?
6. How many types of antibodies are there? Compare them and specify their functions.
7. Compare the affinity and avidity of IgG and IgM.

Glossary

Passive Immunity: Immunity of the body when it receives the immune components in a readymade state from an outside source.

Active Immunity: The form of immunity acquired when the components of our immune system are triggered to produce antibodies by themselves against the antigen in order to clear the same.

Innate Immunity: The natural, inherent and nonspecific immunity of the body towards infectious agents.

Adaptive Immunity: The specific and developed immunity of a living being that is directed towards a specific antigen. Specific B and T cell clones are selected and multiplied to impart adaptive immunity in response to the antigen entry in the system.

Phagocytosis: The capability of macrophages to "eat up" and clear any foreign invaders.

Inflammation: The reddening, heating up, pain and swelling of the local area at the site of infection/injury in an effort by the body to clear the invader and heal that area. It is a part of innate immunity.

Antigen: Any foreign substance, which when enters the body, triggers an immune response towards itself.

Epitope: This refers to the portion of antigen that physically and specifically binds to the antigen binding site (ABS) of the antibody.

Hapten: The smallest form of the antigen which is antigenic but not immunogenic.

Antigenicity: The property of an antigen of being able to bind to the immunoglobulin.

Immunogenicity: The property of an antigen to trigger the production of antibody in the body in which it gains entry. This antibody has the capability of clearing the antigen.

Adjuvant: A formulation that is added to the antigen to enhance its persistence and presentation inside the body, so that an effective immune response may be mounted.

Antibody (immunoglobulin): One of the main players of adaptive immunity, it is a glycoprotein, produced by B lymphocytes. It contains two each of light and heavy chains, 2ABS (variable regions) and a constant region.

Light Chain: Two in number in all antibodies, these contain a single variable domain and a single constant domain.

Heavy Chain: Two in number in all antibodies, these are composed of a single variable domain and 3-4 constant domains.

Variable Region: The amino terminals of both light and heavy chains of the antibody, which keep varying in sequence due to DNA rearrangements.

Constant Region: The carboxy terminals of both light and heavy chains of the antibody, which remain conserved in all antibodies.

Antigen binding site (ABS): The amino terminal of the antibody, comprising of the V regions of a light and heavy chain each, that physically binds to the epitope of the antigen specifically in order to clear it.

Isotypes: The distinct classes or varieties of the antibodies are termed asisotypes.

Valence: The total numbers of antigen binding sites (ABS) present in the antibody.

Affinity: The force with which a single ABS of an antibody is attracted to the epitope of the corresponding antigen.

Avidity: Sum total of affinity values of all the ABS-epitope pairs of any immunoglobulin.

Primary Immune Response: The immune response after the first exposure to the antigen.

Secondary Immune Response: The immune response after the second and subsequent exposures to the antigen.

Infectious Diseases: Diseases caused by certain pathogenic bacteria, viruses, protozoans and fungi that may be transmitted from the environment to the individual. Also these are communicable, i.e., may spread within a population. A person's robust immune system helps to prevent/overcome these diseases.

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