Zoology Legends

BT302

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- Humans can make **10^7-10^8** different Ab molecules.
- Recombination involves rearrangement of DNA in somatic cells… **Somatic recombination.**
- Lymphoid linkage progenitor cells give rise to ------- B- lymphocytes, T- Lymphocytes, natural Killer, **All of the given**.
- Major class of antibody produced during primary antibody response is ------- **lgM**
- During complement fixation test, lysis of RBCs indicates a ----- Complement fixation test. **Negative**
- Which of the following comes under mechanical factors regarding anatomical barriers? Skin, Epithelium membrane, Desquamation, **All of the given**
- Lymph nodes, spleen and payer's patches are. **Secondary lymphoid organs**
- Substance that is non-immunogenic but can react with products of specific immune response called..... **Heptan**
- Humans can make **10^7 to 10^8** different Ab molecules
- T-cells maturation in… **Thymus**

- Ag & Ab reaction which can be detected on the basis of substrate utilization by enzyme …**ELISA**
- Nature of Ag & Ab reactions... **Non covalent bonding** Immunology is the study of ....both **immune system & immune response**
- Lag phase of secondary exposure is... **Shorter as compare to primary exposure**
- Peristalsis movement occurs in **digestive tract**
- **Valency** is the Number of antigenic determinants which can bind with **immunoglobulin.**
- Ag is presented to T-cells with..... **Class II MHC**
- Suppose 10,000 lymphocytes recirculate every hour. If 100 of these encounter an antigen in lymph node then what percentage it achieved... **1%.**
- Antigen selects those clones of cells that have the **appropriate receptor.**
- Suppose 10,000 lymphocytes recirculate every hour. If 100 of these encounter an antigen in the lymph node. What percentage is activated? **(1%)**

- Another term used for the physical barriers of innate immune system.....(**Anatomical Barriers**)
- Which of the following are primary lymphoid organ.... (**Bone Marrow, Thymus)**
- Which secondary lymphoid organ is responsible for the filtration of blood..... **(Spleen)**
- (**Phagocytosis**)....... The process of engulfing the invading or infectious agent by phagocytes.
- A substance that is non-immunogenic but can react with products of specific immune response......(**Hapten**)
- Which antibodies are complement fixing antibody......(**IgM and IgG)**
- IgG exist in the form of......(**Monomer**)
- Strength of binding of antigen with many antigenic determinant & multivalent antibody........(**Avidity**)
- Agglutinate is term used for visible clumps formation in.......(**Agglutination**)
- The process by which a B-Cell changes the class of Ab but not specificity..........(**Class Switching**)
- Antibody from a single antibody producing B-cell.....(**Monoclonal Ab**)

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- hybridoma cell can grow on **HAT medium**
- Snake venom pathway **Both pathways**
- TCR have **carbohydrates moiety**
- Immune response is carried out by **carrier immunogenic**
- **IgM** is the **third most common** serum Ig
- **IgA** is the **2nd most common** serum Ig
- **IgG** is the only class of Ig that crosses the **placenta**
- **Complement fixation** tests are most commonly used to assay for antibody in a test sample but they can be modified to measure antigen
- **Sandwich ELISAs** are the **most common** type of ELISA
- **Competitive ELISAs** are commonly used for **small molecules**
- **IgA deficiency:** This is the **commonest form** of immunoglobulin deficiency
- The CD3 stands for **Cluster of differentiation 3**
- **Age** is another biological factor which can also influence **immunogenicity**
- IgA is the major class of Ig in secretions **- tears, saliva, colostrum, mucus**
- **Diabetes mellitus** is non-infectious disease

- **Agglutination** Reactions: These are antigen and antibody reactions in which the particulate nature of antigen causes the reaction with its specific antibody to form visible clumps. Such visible clumps are called as **agglutinates**.
- **Antibodies** are produced by **lymphocytes**
- Natural killer (**NK**) cells (May develop from both **Myeloid and Lymphoid progenitor**).
- NK cells are produced from the **bone marrow** and are found in the bloodstream
- Which antigen in anaphylaxis...**IgE**
- The expanded clones of B cells differentiate into **plasma cells**
- **Skin and mucus** membrane are the examples of **anatomical barriers** that provides immunity
- Examples of infectious diseases include the **common cold, COVID-19, SARS and tuberculosis**
- Which of the following disease is transmitted between individuals is **tuberculosis**

- The prospective donor & recipient are tested for compatibility prior to **transplantation**. That's why MHC is also called as **Human leucocyte antigen (HLA)**
- Agglutination e.g Anti-nuclear antibodies (ANA) for **SLE & RA**
- The antibodies which render such kind of reactions are called as "**agglutinins**".
- **IgD** is primarily found on **B cell surfaces**
- Red blood cell surface antigens are **glycoproteins**
- These antigens are **protein** in nature **T-dependent antigens**
- Antigens are primarily composed of **proteins**
- penicillin are **haptens**
- **Chemical coupling** of a hapten to a large protein, called a **carrier**, yields an immunogenic hapten-carrier conjugate
- Antibodies are produced by **lymphocytes**, which are formed in lymph nodes
- **Naive (virgin) lymphocytes** enter the lymph nodes from the blood via **High Endothelial Venules (HEVs)**
- Tertiary lymphoid tissues, which normally contain fewer lymphoid cells than secondary lymphoid organs, can import lymphoid cells during an

inflammatory response. Most prominent of these are **cutaneous-associated lymphoid tissues**.

- Enzyme Linked Immunosorbent Assay (**ELISA**)
- T-independent antigens are more resistant to degradation by **phagocytic cells**.
- B-lymphocytes which differentiate into **plasma cells or antibody** forming cells (AFC).
- Ms.L, a 40 year old women , present with symptoms of joints pain , fatigue and skin rashes laboratory test reveals the presence of autoantibodies targeting her own body tissue ?**Autoimmune disease**
- Dendritic cell belongs to which cells lineage? **Myeloid lineage**
- For the alternative pathway of complement activation which of following is not needed? **Antibody**
- This pathway of complement activation is **antibody independent**
- How is the classical pathway for complement activation initiated? **By binding of C1q to antigen-antibody complexes(This pathway begins with C1 activation)**
- Which system features peristalsis movement as characteristics attributes? **Digestive system**

- Suppose, 10,000 lymphocytes encountered an antigen in the lymph node, what percentage is activated: **0.1%**
- The development of both humoral and cell-mediated immune responses requires interaction of **T cells** with antigen that has been processed and presented together with **MHC molecules.**
- The T and B lymphocytes (T and B Cells) are involved in the Adaptive immune response depends on the **B Cells** while cell immunity depends on the **T Cells.**
- These are antigen and antibody reactions in which the particulate nature of antigen causes the reaction with its specific antibody to form visible clumps. Such visible clumps are called: **Agglutination**
- defensive mechanisms which are related to various structures of body are the part of........**anatomical barriers**
- barriers in fact mediate that inflammatory process.....**Humoral**
- secretory molecules which are proteins in nature......**Interferons**
- Unlike PMNs they do not contain granules but they have numerous ------which have contents similar to the PNM granules....**Lysosomes**
- Bacteria with IgG antibody on their surface have the ----- region exposed......**Fc**

- which recognize broad molecular patterns called PAMPs......**Toll like receptors**
- fuse with the phagosome, myeloperoxidase is released into the phagolysosome..... **azurophilic granules**
- Complement proteins act as.......**opsonin**
- **IgG**.........is the major antibody of serum which is approximately 75% of total antibodies of the serum.
- **Avidity**..........is the strength of binding of antigen with many antigenic determinant & multivalent antibody.

Subjective

Difference between T dependent and independent Antigen

T-Dependent Antigen	T-independent Antigen
T-dependent antigens are those that do not directly stimulate the production of antibody without the help of T cells	T-independent antigens are antigens which can directly stimulate the B cells to produce antibody without the requirement for T cell help

Proteins are T-dependent antigens	Polysaccharides are T-independent antigens
Soluble proteins	Bacterial cell wall components Lipopolysaccharide (LPS), Capsular polysaccharide, flagella etc.
Antigen is processed and displayed on the surface of antigen presenting cells (B Cells) in association with MHC-II.	Antigen processing is not needed
Immunogenic over wide range of dose	Dose dependent immunogenicity
No polyclonal activation i.e. Activate B cells monoclonally	Polyclonal activation of B cells occur in high doses of Type-I TI Antigens
Immunologic memory present	No immunologic memory
Affinity maturation- Yes	Affinity maturation- No
Isotype switching occurs *(i.e. antibodies of all classes are produced)*	No isotype switching *(Antibody response is restricted to IgM and IgG3)*
Activate mature B cells only	Activate both mature and immature B cells

Three components of coagulation

Coagulation, also known as clotting, is the process by which blood changes from a liquid to a gel, forming a blood clot. It plays a crucial role in stopping bleeding after an injury.

Let's explore the three main components involved in coagulation:

1. **Platelets**:

These are cellular components of blood. When an injury occurs, platelets immediately form a plug at the site of injury, which is called primary hemostasis1. They play a key role in initiating clot formation.

2. **Coagulation Factors:**

These are proteinaceous components involved in the coagulation cascade. There are 13 traditional clotting factors, each assigned a Roman numeral (I to XIII). These factors respond in a cascade to form fibrin strands, which strengthen the platelet plug. The coagulation factors include fibrinogen (Factor I), prothrombin (Factor II), tissue factor (Factor III), calcium ions (Factor IV), and others1.

3. **Fibrin:**

Fibrin is a protein formed during the coagulation process. It plays a central role in clot formation. Once activated, fibrin forms threads that cross-link and stabilize the platelet plug, leading to the formation of a clot. This stage is known as secondary hemostasis

Humoral barriers

Humoral (Secretory) barriers after breaching the anatomical barriers, infectious agent penetrates the deeper tissue for inflammation which is the tissue response against infection. Humoral barriers in fact mediate that inflammatory process. These barriers consist of different molecules in the form of proteins, enzymes and cytokines which are present in the secretions of body particularly blood plasma including

A variety of soluble factors contribute to innate immunity, among them the soluble proteins

- Lysozyme
- Interferon
- Complement

What are the MHC? And Its Types I MHC & II MHC

or

Transplantation Antigens

The transplantation antigens which are also termed as Major Histocompatibility Complex (MHC) or Human Leucocytes Antigens (HLA). The MHC exist as a complex which is encoded by group of genes on a same chromosome called as haplotype. These genes are in fact responsible to influence allograft rejection

There are following two major types of MHC

1. Class I MHC

2. Class II MHC

Class I MHC

Location: Chromosome 6

Major Loci: A, B, C

Structure:

- α-chain: Contains antigenic determinants, highly polymorphic (many alleles).
- β2-microglobulin (β-chain): Encoded outside MHC I haplotype, essential for expression on cell surface.

Function:

- Necessary for cytotoxic T-lymphocytes (CTLs) to interact with target cells.
- Defects in the β2 chain prevent MHC I expression, leading to CTL deficiency.

Class II MHC

Location: Chromosome 6

Major Loci: DP, DQ, DR

Structure:

- Each locus codes for one α-chain and one β-chain.
- Both chains form the MHC II complex.
- Polymorphic (many alleles), especially DR locus with multiple β chain genes.

Expression: Found on B-lymphocytes and antigen-presenting cells (APCs).

Name the cells which are involved in immune system

Immune System Cells

Immune cells originate from hematopoietic stem cells in the bone marrow and differentiate into two main lineages:

1. Lymphoid Lineage

- **B Lymphocytes**: Differentiate into plasma cells (antibody-forming cells).
- **T Lymphocytes**:

- **Cytotoxic T cells**: Kill infected cells.
- **Helper T cells**: Activate other immune cells.

- **Natural Killer (NK) Cells**: Destroy virus-infected and tumor cells.

2. Myeloid Lineage

- **Monocytes**: Differentiate into macrophages (phagocytic cells).
- **Macrophages**: Engulf and digest pathogens.
- **Granulocytes**:
  - **Neutrophils**: First responders to infection.
  - **Basophils**: Involved in allergic responses.
  - **Mast Cells**: Release histamine during inflammatory and allergic reactions.
- **Megakaryocytes**: Source of platelets, involved in clotting and modulating immune responses.

Briefly describe the monoclonal antibodies usage

Monoclonal antibodies are important in medicine and research. They are used for:

1. **Disease Management**: Preventing, diagnosing, and treating diseases.
2. **Identifying Immune Cells**: Targeting cell surface markers like CD molecules to identify immune cells.
3. **Tumor Typing**: Classifying different types of tumors, such as leukemia.

4. **Tumor Analysis**: Studying solid tumors using immunohistochemistry.
5. **Cancer Treatment**: Targeting tumor markers, such as CD20 in B-cell lymphoma, for immunotherapy.
6. **Cell Sorting**: Separating cells using Fluorescence Activated Cell Sorting (FACS).

Basic Structure of Antibodies

Antibodies are proteins made up of four chains:

1. **Chains**:
    - **2 Light (L) Chains**: Smaller polypeptides (~25,000 molecular weight)
    - **2 Heavy (H) Chains**: Larger polypeptides (50,000 or more molecular weight)
2. **Structure**:
    - **Heterodimers**: Each light chain is bound to a heavy chain.
    - **Dimer of Dimers**: Two H-L pairs are linked together.
3. **Regions**:
    - **Variable Regions (V regions)**:
        - **VL** (light chains) and **VH** (heavy chains).
        - Determine antibody specificity and antigen binding.
        - Include **Complementarity-Determining Regions (CDRs)** where antigen binding occurs.

- **Constant Regions (C regions)**:
  - **CL** (light chains) and **CH** (heavy chains).
  - Consistent in sequence within the same antibody class.
  - Sites for carbohydrate attachment (glycoproteins).

4. **Hinge Region**:
   - Provides flexibility for the antibody to change shape upon binding to an antigen.
5. **Domains**:
   - **Heavy Chains**: Usually have four domains.
   - **Light Chains**: Have two domains.
   - Each domain has an intra-chain disulfide bond.
6. **Oligosaccharides**:
   - Carbohydrates attached to the CH2 domain in most immunoglobulins.

Describe the Two Forms of adjuvants

Adjuvants are substances that enhance the immune response to weak antigens. They come in two forms:

1. **Chemical Adjuvants**
   - **Aluminum Salts (Alum)**:
     - Commonly used in vaccines such as DTP (Diphtheria, Tetanus, and Pertussis).

- Functions by causing the slow release of the antigen, which increases interaction with Toll-like receptors (TLRs) and activates mononuclear phagocytes.
- This leads to increased cytokine secretion and a stronger immune response.

2. **Biological Adjuvants**
   - **Bacterial Products**:
     - Derived from various bacteria.
     - These biological substances act as adjuvants by stimulating the immune system through their bacterial components, enhancing the overall immune response to the vaccine antigen.

What is megakaryocytes and granulocytes with their functions?

Granulocytes

Granulocytes are a type of white blood cell characterized by the presence of granules in their cytoplasm. They play crucial roles in the immune response and can be categorized into three main types:

1. **Neutrophils**:
   - **Function**: First responders to infection.

- **Role**: Engulf and destroy bacteria and fungi, playing a key role in the innate immune response.

2. **Basophils**:
    - **Function**: Involved in allergic responses.
    - **Role**: Release histamine and other chemicals that contribute to inflammation and allergy symptoms.
3. **Mast Cells**:
    - **Function**: Release histamine during inflammatory and allergic reactions.
    - **Role**: Located in tissues, they are crucial for defense against pathogens and contribute to allergic responses by releasing histamine and other mediators.

Megakaryocytes

Megakaryocytes are large bone marrow cells responsible for the production of platelets.

- **Function**: Source of platelets.
- **Role**: Platelets, derived from megakaryocytes, are essential for blood clotting (hemostasis) and play a role in wound healing. They also help modulate immune responses by interacting with other immune cells.

TCR & BCR

B-Cell Receptors (BCR)

- **Recognition**: Recognizes soluble antigens such as proteins, nucleic acids, polysaccharides, lipids, and small chemicals.
- **Receptor Type**: Uses surface-bound immunoglobulin, which matches the antibody it produces.
- **Function**: Involved in directly recognizing antigens and initiating antibody production.
- **Antigen Recognition**: Directly binds to antigens in soluble form.
- **Antigen Specificity**: Reflects the specificity of the antibody it secretes post-activation.

T-Cell Receptors (TCR)

- **Recognition**: Primarily recognizes protein antigens presented by MHC molecules on nucleated cells.
- **Receptor Type**: Utilizes T-cell receptors.
- **Function**: T cells are categorized based on the MHC molecules they recognize: helper T cells bind to peptides presented by class II MHC molecules, while cytotoxic T cells bind to peptides presented by class I MHC molecules.

- **Antigen Recognition**: Requires presentation of antigens by MHC molecules.
- **Antigen Specificity**: Dependent on the class of MHC molecules presenting the peptide fragments.

Oxygen dependent & independent intracellular killing

There are two main ways in which immune cells kill bacteria inside the body:

1. **Oxygen Independent**
   - No need for oxygen.
   - Phagocytes release hydrolytic enzymes from their granules and vesicles.
   - These enzymes are bactericidal, meaning they kill bacteria.
   - Examples of hydrolytic proteins and their functions are listed in Table 1.
2. **Oxygen Dependent**
   - Requires oxygen, termed "Respiratory Burst."
   - Glucose and oxygen consumption increases after phagocytosis.
   - Results in the production of oxygen-containing bactericidal radicals.
   - Two types:
     - **Myeloperoxidase (MPO) Dependent**: MPO from phagocyte granules is involved.
     - **Halide Ion Formation**: Halide ions (OCl-) are formed, which are bactericidal.

Characteristics of antibodies

Characteristics of Immunoglobulins (Antibodies)

- **Antigen Binding Properties**:
  - Present on B-cell membranes and secreted by plasma cells.
  - Membrane-bound antibodies confer antigenic specificity on B cells, leading to antigen-specific B-cell proliferation.
- **Effectors of Humoral Immunity**:
  - Secreted antibodies circulate in the blood, neutralizing antigens or marking them for elimination.
  - Serve as effectors of humoral immunity by searching for and neutralizing antigens.
- **Structural Features and Effector Functions**:
  - All antibodies share structural features and bind to antigens.
  - Participate in a limited number of effector functions in the immune response.
- **Heterogeneity**:
  - Antibodies produced in response to a particular antigen are heterogeneous.

- Most antigens are complex, containing multiple antigenic determinants. The immune system produces antibodies to several epitopes on the antigen.

- **Monoclonal and Polyclonal Antibodies**:
  - Several clones of B cells are recruited, each producing monoclonal antibodies specific to a single antigenic determinant.
  - Together, these monoclonal antibodies make up the polyclonal and heterogeneous serum antibody response to an immunizing antigen.

- **Electrophoretic Migration**:
  - Immunoglobulins migrate with globular proteins when antibody-containing serum is placed in an electrical field, hence their name.

Antigen Processing and Presentation

Antigen processing and presentation are crucial steps in the immune response, where protein fragments are associated with major histocompatibility complex (MHC) molecules and presented on the cell surface for recognition by T cells.

1. **Process Overview**:
   - Proteins are fragmented (proteolysis) within cells.
   - Fragments associate with MHC molecules.

   - Peptide-MHC complexes are expressed on the cell surface of antigen-presenting cells (APCs) like macrophages.
2. **Class I MHC**:
   - Presents degradation products from intracellular (endogenous) proteins in the cytosol.
   - Recognized by cytotoxic T cells (CD8+), leading to cell killing.
3. **Class II MHC**:
   - Presents fragments from extracellular (exogenous) proteins located in intracellular compartments.
   - Recognized by helper T cells (CD4+), leading to immune activation and coordination.

These processes determine the function of T cells:

- **Cytotoxic T Cells** interact with MHC class I.
- **Helper T Cells** interact with MHC class II.

Differences Between Monoclonal & Polyclonal Antibodies

Monoclonal Antibodies:

- **Source**: Derived from a single antibody-producing B cell.
- **Antigen Specificity**: Bind to a single and unique antigen binding site (epitope).

- **Subtypes**: Typically consist of a single subtype of immunoglobulin G (IgG), such as IgG1, IgG2, or IgG3.

Polyclonal Antibodies:

- **Source**: Derived from multiple antibody-producing B lymphocytes.
- **Antigen Specificity**: Bind to multiple epitopes on the same antigen.
- **Composition**: Obtained from serum containing antibodies with varying affinities.
- **Class**: Mainly belong to the IgG class.

Brief note on Hybridoma

Hybridoma Formation:

- **Definition**: Fusion of a lymphoid tumor cell with a normal B-lymphocyte to create a hybrid cell line. This hybrid has two key properties:
  1. Immortality from the tumor cell.
  2. Antibody production with single specificity from the B-lymphocyte.

Steps Involved:

1. **Immunization**:
   - A mouse is injected with a specific antigen to stimulate an immune response.

2. **B-lymphocyte Isolation**:
   - B-lymphocytes are extracted from the spleen of the mouse.
3. **Cell Fusion**:
   - B-lymphocytes are fused with myeloma cells (immortal lymphocyte cells) to create hybridomas.
   - Myeloma cells provide immortality to the fused B-cells.
4. **Selection in HAT Medium**:
   - The fusion mixture is cultured in HAT medium (Hypoxanthine, Aminopterin, Thymidine).
   - HAT medium allows only hybridoma cells to grow, while unfused cells die.
5. **Hybridoma Harvesting**:
   - Selected hybridoma cells are grown and harvested to produce monoclonal antibodies.

Purpose:

- To produce large amounts of monoclonal antibodies, hybridoma cells are propagated.

Affinity maturation

The affinity of antibodies depend upon the dosage of antigen, the low dosage of antigen causes increase in the affinity of antibodies which is called as affinity maturation

Factors That Influence Immunogenicity

The Nature of the Immunogen Contributes to Immunogenicity. Immunogenicity is determined, by four properties of the immunogen:

- Foreignness
- Molecular Size
- Chemical Composition
- Complexity
- Ability to Be Processed and Presented with an MHC Molecule On the Surface of an Antigen-Presenting cell or altered self-cell.

How should be chemical nature of good immunogen?

A good immunogen should be complex and large, typically with a molecular weight greater than 10,000 daltons, to ensure it can be effectively recognized and processed by the immune system. It should be foreign to the host and chemically diverse, with multiple epitopes to elicit a strong immune response. Immunogens must also be stable enough to be recognized but degradable by antigen-presenting cells for presentation on MHC molecules.

Anatomical Barriers of immune system

Skin and Mucus Membranes:

- **Skin**:
  - Composed of an outer layer (epidermis) with dead cells filled with keratin, and an inner layer (dermis) with connective tissue, hair follicles, sebaceous glands, and sweat glands.
  - Acts as the first line of defense by blocking microorganisms, though it can be penetrated by injuries or insects.
- **Mucus Membranes**:
  - Found beneath the skin, lining body tracts, secreting mucus to trap microorganisms and prevent their entry.

Functions:

- **Mechanical Barrier**: Physically blocks microorganisms from entering the body.
- **Antimicrobial Mechanisms**: Contains substances like lysozyme, acidic pH, sebum, and high salt concentration in sweat that kill pathogens.

- **First Line of Defense**: The skin and mucus membranes are the initial barriers that encounter and stop microorganisms.

Secondary lymphoid organs

Secondary lymphoid organs, including lymph nodes, spleen, and mucosal-associated lymphoid tissues (MALT) such as gut-associated lymphoid tissue (GALT), trap antigens and provide sites for mature lymphocytes to interact with these antigens. Tertiary lymphoid tissues, like cutaneous-associated lymphoid tissues, can attract lymphoid cells during inflammation.

After maturing in primary lymphoid organs, lymphocytes circulate through the blood and lymphatic system, which collects and returns fluid to the bloodstream.

How the fragments of antibodies are obtained??

Antibodies, specifically immunoglobulin G (IgG), are around 150,000 molecular weight. When digested with enzymes, they produce specific fragments:

1. **Fab Fragments ("Fragment, Antigen Binding")**:
    - Created by digesting IgG with the enzyme papain.
    - Two identical fragments, each with a molecular weight (MW) of 45,000.
    - These fragments bind to antigens.
2. **Fc Fragment ("Fragment, Crystallizable")**:
    - Also produced by papain digestion.

- One fragment with a MW of 50,000.
- Does not bind antigens but crystallizes during cold storage.

3. **Pepsin Digestion**:
   - Digestion with pepsin separates antigen-binding properties from the rest of the antibody.

Write applications of ELISA. Describe direct and indirect ELISA

Applications of ELISA

- **Medical Diagnostics**: Detecting diseases such as HIV, hepatitis, and COVID-19.
- **Allergy Testing**: Identifying specific allergens in patient samples.
- **Hormone Levels**: Measuring hormone levels such as insulin and hCG.
- **Food Safety**: Detecting food allergens and contaminants.
- **Research**: Quantifying proteins, peptides, and antibodies in various samples.

Direct vs. Indirect ELISA

Feature	Direct ELISA	Indirect ELISA
Antigen Immobilization	Antigen is directly attached to the plate	Antigen is directly attached to the plate

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Feature	Direct ELISA	Indirect ELISA
Detection Antibody	Single, enzyme-conjugated antibody	Primary antibody (unconjugated) and secondary antibody (enzyme-conjugated)
Amplification	No amplification step	Includes an amplification step using a secondary antibody
Specificity	Less specific due to single antibody usage	More specific with additional amplification
When to Use	Assessing antibody affinity and specificity, blocking/inhibitory interactions	Measuring endogenous antibodies
Advantages	Fast, simple protocol	Amplification increases sensitivity
Disadvantages	Less specific, higher potential for background noise	Potential for cross-reactivity due to secondary antibody

If a person is grown and a new virus or bacteria harm it. Which type of immunity is used?

If a person is exposed to a new virus or bacteria, adaptive immunity responds. This type of immunity involves:

B cells: Produce antibodies to neutralize or mark the pathogen for destruction.

T cells: Destroy infected cells or help other immune cells respond.

Adaptive immunity provides a targeted response to new pathogens and remembers them for faster future responses.

Explain adjuvant role in immune system.

Adjuvants play a crucial role in boosting the effectiveness of vaccines by enhancing the immune response.

- Helping immune cells recognize vaccine antigens.
- Activating innate immune responses.
- Building long-lasting immune memory for future protection.

Role of pathology

Pathology plays a critical role in understanding diseases by:

1. Investigating the causes and mechanisms of diseases.
2. Diagnosing diseases through examination of tissues and cells.
3. Guiding treatment decisions by providing insights into disease progression and prognosis.
4. Conducting research to develop new therapies and preventive measures.
5. Contributing to public health efforts by identifying disease trends and risk factors.

Define antigen, immunogen, heptane

- **Antigen**: A substance that triggers an immune response in the body, typically by binding to specific antibodies or T cell receptors. Antigens can be proteins, polysaccharides, lipids, or other molecules.

- **Immunogen**: A substance capable of inducing an immune response in the body, leading to the production of antibodies or activation of T cells. Not all antigens are immunogens; immunogens are antigens that elicit an immune response.

- **Heptane**: Heptane is a hydrocarbon compound with the chemical formula C_7H_{16}. It is a colorless, flammable liquid that is commonly used as a solvent in laboratories and industrial processes.

Define phagocytosis and explain its process

Phagocytosis is the process by which certain cells, called phagocytes, engulf and digest foreign particles, such as bacteria and debris, to remove them from the body.

Process of Phagocytosis:

1. **Recognition**: Phagocytes detect foreign particles through receptors on their surface that bind to specific molecules on the particle's surface.

2. **Engulfment**: The phagocyte extends pseudopodia (cytoplasmic projections) around the particle, forming a phagosome, an internal vesicle containing the ingested material.
3. **Phagosome Formation**: The phagosome fuses with lysosomes, which contain enzymes that break down the engulfed material.
4. **Digestion**: Enzymes within the phagolysosome break down the foreign particle into smaller components.
5. **Excretion**: Digestion products are either utilized by the cell or expelled from the cell through exocytosis.
6. **Disposal**: Residual indigestible material is expelled from the cell.

Brief explain on subgroups of variable antibody

The variable region of antibodies contains hypervariable regions, also known as complementarity-determining regions (CDRs), and framework regions (FRs).

- **CDRs**: Short segments within the variable region that directly interact with antigens. They are highly diverse and include CDR1, CDR2, and CDR3.
- **FRs**: Regions between CDRs that provide structural support. They are less variable and help maintain the overall shape of the antibody.

Factors effect of immunity and antigen

Effector effects of immunity involve actions that immune cells and molecules perform to eliminate pathogens and protect the body. Two key effector functions are:

1. **Antibody-Mediated Effector Functions**: Antibodies neutralize pathogens, mark them for destruction by phagocytes, activate the complement system, and induce cell killing by cytotoxic cells.
2. **Cell-Mediated Effector Functions**: Cytotoxic T cells kill infected or abnormal cells, while helper T cells regulate immune responses by activating other immune cells.

Antigens are targets of the immune response, recognized as foreign molecules. They can be proteins, carbohydrates, lipids, or nucleic acids on the surface of pathogens. Immune effector functions aim to eliminate antigens from the body to prevent infections.

Define complement fixation test

Complement fixation test is a laboratory technique used to measure the presence of antigen-antibody complexes in a sample. It relies on the ability of these complexes to consume complement, a group of proteins involved in the immune response. In this test, the sample containing antigen and antibodies is mixed with complement proteins. If antigen-antibody complexes are present, they will fix complement, reducing its availability.

Then, red blood cells coated with anti-erythrocyte antibodies are added. The amount of red cell lysis, indicative of complement consumption, indirectly quantifies the presence of antigen-antibody complexes.

Roll of somatic hyper mutation in diversity of antibodies

Somatic hyper mutation plays a big role in creating diverse antibodies in our bodies. It helps generate a wide range of different antibody specificities, which are molecules that can recognize and fight off different types of germs.

After our bodies are exposed to various infections, the diversity of antibodies increases even more. This mutation process happens really quickly, about a million times faster than normal mutations.

Scientists are still figuring out exactly how this mutation occurs, but a key player in the process is a protein called activation-induced cytidine deaminase (AID), which helps change the DNA of the antibody genes without affecting other important parts.

Role of adjuvants in polyclonal antibodies production

Adjuvants are substances that boost the body's immune response to antigens, but they can have some side effects like toxicity. So, it's important to choose the right adjuvant to get the best immune stimulation without harmful effects. In making polyclonal antibodies, two common adjuvants are used:

1. Freund's Complete Adjuvants (FCA): These are mixtures of antigens and heat-killed Mycobacterium tuberculosis in an oil-water emulsion. They stimulate both the humoral (antibody-based) and cell-mediated immune responses.
2. Freund's Incomplete Adjuvants: These are similar to FCA but don't contain heat-killed Mycobacterium tuberculosis. They're used as booster doses for antigens.

Name the cells which are involved in immune system

Here are some key cells involved in the immune system:

1. **T Cells**: These cells are central to the adaptive immune system and play various roles, such as activating other immune cells and directly attacking infected or abnormal cells.
2. **B Cells**: They are responsible for producing antibodies, which are proteins that help identify and neutralize pathogens.

3. **Natural Killer (NK) Cells**: These cells are part of the innate immune system and specialize in detecting and destroying virus-infected cells and cancer cells.
4. **Macrophages**: They are phagocytes that engulf and digest pathogens and cellular debris. They also play a role in activating other immune cells.
5. **Dendritic Cells**: These cells are important for presenting antigens to T cells, initiating and shaping the adaptive immune response.
6. **Neutrophils**: They are the most abundant type of white blood cells and are essential for early defense against infections. They engulf and destroy pathogens.
7. **Eosinophils**: These cells are involved in combating multicellular parasites and are also implicated in allergic reactions and asthma.
8. **Basophils and Mast Cells**: They release chemicals such as histamine during allergic reactions and inflammation.

Chemical secretions of immunoglobulin/ Chemical nature of immunogens

Immunogens, which trigger immune responses, are mainly proteins or large polysaccharides. They can also be lipoproteins, lipopolysaccharides, or nucleoproteins. Proteins are potent antigens due to their complex structure and high molecular weight. Carbohydrates, while generally too small to provoke an immune response, can become antigenic when attached to larger molecules like glycoproteins.

Nucleic acids are usually non-immunogenic, except for single-stranded DNA. Polypeptides and hormones are weak antigens. Lipids are generally non-immunogenic, but they can act as antigens when combined with polysaccharides or proteins.

Enlist complement protein

- C1-C9: The components of the classical pathway, including C1q, C2, C3, C4, C5, C6, C7, C8, and C9.
- Factor B: Part of the alternative pathway.
- Factor D: Also part of the alternative pathway.
- Properdin: Stabilizes the alternative pathway C3 convertase.
- Factor H: Helps regulate the alternative pathway by promoting the decay of C3 convertase.
- Factor I: Cleaves and inactivates C3b and C4b.
- Mannose-binding lectin (MBL): Initiates the lectin pathway of complement activation.
- C3: Central component of all complement pathways, serving as a target for activation and a mediator of effector functions.

- Membrane attack complex (MAC) components: Including C5b, C6, C7, C8, and C9, involved in forming the MAC for cell lysis.

What is affinity maturation?

Affinity maturation is a process where B cells improve the strength of their binding to antigens over time. It happens in specialized areas called germinal centers within lymphoid organs. B cells undergo genetic mutations, resulting in changes to their antibody receptors.

B cells with better binding to the antigen are selected for survival and reproduction, leading to the production of antibodies with higher affinity for the antigen. This process enhances the effectiveness of the immune response.

What is immunoglobulin?

Immunoglobulins, also known as antibodies, are proteins produced by the immune system in response to the presence of foreign substances called antigens. They play a crucial role in defending the body against harmful pathogens such as bacteria, viruses, and toxins. Immunoglobulins recognize and bind to specific antigens, marking them for destruction or neutralization by other immune cells.

These proteins are diverse in structure and function, allowing the immune system to mount targeted responses against a wide range of pathogens.

Difference between exogenic Ag and endogenic Ag.

Exogenic antigens come from outside the body (like pathogens or environmental substances), while endogenic antigens originate within the body (like self-proteins or abnormal cells). The immune system reacts to exogenic antigens to defend against invaders, while it usually ignores endogenic antigens to avoid attacking healthy tissues.

How antibodies formed?

Antibodies are formed through a process called B cell activation and differentiation. When the immune system encounters an antigen, B cells specific to that antigen are activated. These B cells undergo clonal expansion and differentiation into plasma cells, which are specialized cells that produce antibodies. The antibodies then circulate in the body, binding to and neutralizing the antigen, thereby aiding in the immune response.

Characteristics of antibody response

The antibody response has some key characteristics:

1. Self/Non-self Discrimination: The immune system typically recognizes and reacts only to non-self substances, distinguishing them from the body's own cells.

2. Memory: The immune system remembers past encounters with antigens, responding more effectively upon secondary exposure to the same antigen.
3. Specificity: Immune responses are highly specific, targeting particular antigens or closely related ones with precision.

Step of phagocytosis

 Chemotaxis: Attracted by chemical signals, phagocytes move towards the site of infection or injury.

 Adherence: Phagocytes adhere to the surface of the pathogen or foreign particle.

 Ingestion: The phagocyte engulfs the pathogen, enclosing it within a membrane-bound vesicle called a phagosome.

 Fusion with lysosome: The phagosome fuses with a lysosome, forming a phagolysosome.

 Digestion: Enzymes within the phagolysosome digest the pathogen, breaking it down into smaller pieces.

 Exocytosis: Indigestible material is expelled from the cell through exocytosis, while digested components are released for further processing or elimination.

Primary and secondary anti body response

In the primary antibody response:

1. Antigen exposure: The immune system encounters a new antigen for the first time.
2. Activation of B cells: B cells specific to the antigen are activated and differentiate into plasma cells, which produce antibodies.
3. Antibody production: Plasma cells secrete antibodies specific to the antigen.

In the secondary antibody response:

1. Re-exposure to antigen: If the same antigen is encountered again, memory B cells from the primary response are quickly activated.
2. Rapid antibody production: Memory B cells differentiate into plasma cells more quickly and produce a larger quantity of antibodies compared to the primary response.
3. Enhanced immune response: The secondary response results in a faster and stronger immune response, providing more effective protection against the antigen.

Differentiate B cells receptor and T cell receptors?

B cell receptors (BCRs) and T cell receptors (TCRs) are both involved in the immune response, but they have distinct roles and structures:

1. **B cell receptors (BCRs):**
   - Located on the surface of B cells.
   - Recognize antigens in their native, intact form.
   - Comprised of immunoglobulin molecules (antibodies) that bind to antigens directly.
   - Responsible for the initiation of humoral immune responses, including antibody production by B cells.
2. **T cell receptors (TCRs):**
   - Found on the surface of T cells.
   - Recognize antigens in the form of short peptide fragments presented by major histocompatibility complex (MHC) molecules.
   - Consist of alpha and beta chains (or gamma and delta chains in some T cells).
   - Essential for cell-mediated immune responses, including activation of T cells and regulation of immune reactions.

Lymphocytes recirculation?

Lymphocyte recirculation is the process by which lymphocytes, including T cells and B cells, constantly migrate between the blood and lymphoid tissues. This movement facilitates immune surveillance and responses throughout the body. Lymphocytes exit the bloodstream into lymphoid organs like lymph nodes, spleen, and Peyer's patches via high endothelial venules.

Within these tissues, they encounter antigens, undergo activation, and differentiate into effector cells. After completing their immune functions, lymphocytes re-enter circulation through lymphatic vessels, allowing them to migrate to other sites to continue immune surveillance and responses.

If new born baby acquired infection which type of immune system help him to overcome the infection? Briefly explain

In newborns, the innate immune system plays a crucial role in combating infections. This system provides immediate, non-specific defense mechanisms against pathogens. Components such as skin barriers, mucous membranes, phagocytes, and natural killer cells act as the first line of defense, helping to prevent the entry and spread of pathogens.

Additionally, newborns may also receive passive immunity from maternal antibodies, providing temporary protection against specific infections until their own adaptive immune system develops.

Describe two types of Freund's adjuvants.

For producing polyclonal antibodies, adjuvants like Freund's Complete and Freund's Incomplete are commonly used.

- Freund's Complete Adjuvants (FCA) stimulate both humoral and cell-mediated immune responses. They contain antigens with heat-killed Mycobacterium tuberculosis.
- Freund's Incomplete Adjuvants lack Mycobacterium tuberculosis and are used as booster doses by mixing with antigens.

Structure of T-Cell

The T-cell receptor (TCR) is a surface receptor found on T-lymphocytes. It binds to antigens presented by major histocompatibility complex (MHC) molecules. Structurally, TCR resembles immunoglobulin and is part of the immunoglobulin superfamily. TCR is a heterodimer composed of one α and one β chain.

Both chains have constant and variable regions, with hypervariable regions determining antigen specificity. TCRs are anchored in the cell membrane and each T cell bears a TCR of only one specificity.

Activation of cytotoxic t cells

Cytotoxic T cells, or CD8+ T cells, become activated when their receptors recognize antigens on infected cells presented by MHC-I molecules. This recognition triggers a signaling cascade, leading to T cell activation, proliferation, and differentiation into killer cells. These activated cytotoxic T cells then target and eliminate infected or abnormal cells through various mechanisms, ultimately helping to control infections and prevent the spread of pathogens.

First type of immune system

The first type of immune system is the innate immune system. It provides immediate, nonspecific defense against pathogens. Key features include:

1. **Physical Barriers**: Skin and mucous membranes block pathogen entry.
2. **Cellular Defenses**: Phagocytes like macrophages and neutrophils ingest and destroy pathogens.
3. **Chemical Defenses**: Antimicrobial proteins and enzymes in bodily fluids kill or inhibit pathogens.

4. **Inflammatory Response**: Inflammation recruits immune cells to infection sites and helps contain and eliminate pathogens.
5. **Natural Killer Cells**: These cells target and destroy infected or abnormal cells.

On which basis the antibodies are divided into types? Explain the types and subtypes of the antibodies.

Antibodies, or immunoglobulins, are divided into types based on their heavy chain structure and function. There are five main types, each with specific roles in the immune response.

Types and Subtypes of Antibodies

1. **IgG (Immunoglobulin G)**
   - **Structure**: Monomer
   - **Function**: Provides long-term immunity and memory response. It can cross the placenta to protect the fetus.
   - **Subtypes**: IgG1, IgG2, IgG3, IgG4
2. **IgA (Immunoglobulin A)**
   - **Structure**: Usually a dimer

- **Function**: Protects mucosal surfaces like the gut, respiratory tract, and urogenital tract. Found in secretions such as saliva, tears, and breast milk.
- **Subtypes**: IgA1, IgA2

3. **IgM (Immunoglobulin M)**
   - **Structure**: Pentamer
   - **Function**: First antibody produced during an initial immune response. Effective in forming antigen-antibody complexes.
   - **Subtypes**: No subtypes
4. **IgE (Immunoglobulin E)**
   - **Structure**: Monomer
   - **Function**: Involved in allergic reactions and defense against parasitic infections. Binds to allergens and triggers histamine release from mast cells and basophils.
   - **Subtypes**: No subtypes
5. **IgD (Immunoglobulin D)**
   - **Structure**: Monomer
   - **Function**: Acts mainly as a receptor on B cells that have not been exposed to antigens. Plays a role in initiating B cell activation.
   - **Subtypes**: No subtypes

Secondary effector function of complement proteins

Complement proteins perform secondary functions that enhance various immune system processes:

1. **Opsonization**
   - Enhances phagocytosis by tagging microbes.
   - Proteins like C3b, iC3b, and C4b act as opsonins.
   - These proteins bind to microbes, forming complexes that are recognized by complement receptors on phagocytes, leading to phagocytosis.
2. **Chemotaxis**
   - Attracts phagocytic cells to infection sites.
   - Proteins like C5a serve as chemotactic factors, activating neutrophils, basophils, and macrophages.
   - Induces adhesion molecule expression on endothelial cells, facilitating phagocyte migration to the infection site.
3. **Anaphylaxis**
   - Triggers exaggerated immune responses against allergens.
   - Proteins like C4a, C3a, and C5a act as anaphylatoxins.
   - Cause degranulation of basophils and mast cells, releasing mediators that lead to smooth muscle contraction, vasodilation, and bronchoconstriction.

Factors that affect antibody and antigen test

Antibody affinity measures the binding strength between a single antigen-binding site on an antibody and a single epitope. High-affinity antibodies bind tightly and remain attached longer. Antibody avidity, on the other hand, incorporates the combined strength of multiple binding sites. It is a more accurate measure of an antibody's overall binding capacity, especially in biological systems, compensating for lower affinity by utilizing multiple interactions.

The ratio of antigen to antibody and the physical form of the antigen (particulate or soluble) also significantly influence the detection and size of antigen-antibody complexes.

Difference between exogenous and endogenous antigen processing

Feature	Exogenous Antigen Processing	Endogenous Antigen Processing
Source of Antigen	External pathogens (e.g., bacteria, viruses)	Internal pathogens or abnormal cell proteins
Antigen Presentation	Major Histocompatibility Complex class II (MHC-II)	Major Histocompatibility Complex class I (MHC-I)

Feature	Exogenous Antigen Processing	Endogenous Antigen Processing
Processing Location	Within endosomes or lysosomes	In the cytoplasm
Cell Types Involved	Antigen-presenting cells (e.g., dendritic cells, macrophages, B cells)	All nucleated cells
Targeted Immune Response	Activation of helper T cells (CD4+)	Activation of cytotoxic T cells (CD8+)

Domains

These are folded regions which contain an intra-chain disulfide bond. Usually, heavy chains contain four domains while light chains composed on two domains.

Cell of cellular barrier

Cells of the cellular barrier are crucial components of the immune system, acting as a first line of defense against pathogens. They include:

1. **Neutrophils**

- **Function:** Rapid response to infection, phagocytosis of bacteria, and release of antimicrobial substances.

2. **Macrophages**
   - **Function:** Phagocytosis of pathogens and debris, antigen presentation to T cells, and secretion of cytokines.
3. **Dendritic Cells**
   - **Function:** Capture antigens and present them to T cells, initiating the adaptive immune response.
4. **Natural Killer (NK) Cells**
   - **Function:** Destroy infected or cancerous cells by recognizing stress signals and inducing apoptosis.
5. **Eosinophils**
   - **Function:** Combat parasitic infections and participate in allergic reactions.

Neutralization against extracellular pathogens

Neutralization is a mechanism by which antibodies inhibit the infectivity of extracellular pathogens, such as bacteria and viruses. It involves:

1. **Binding to Pathogens:** Antibodies bind to surface antigens on pathogens.
2. **Blocking Interaction:** This prevents pathogens from attaching to and entering host cells.

3. **Inactivation:** The binding can neutralize toxins produced by the pathogens.
4. **Clearance:** Neutralized pathogens are then removed by phagocytes.

Cells produce by myeloid Lineage

Myeloid stem cells give rise to various types of blood cells, including:

1. **Erythrocytes (Red Blood Cells)**
   - **Function:** Transport oxygen and carbon dioxide.
2. **Megakaryocytes (Platelets)**
   - **Function:** Blood clotting and wound repair.
3. **Granulocytes:**
   - **Neutrophils:** Phagocytosis and killing of bacteria.
   - **Eosinophils:** Combat parasitic infections and participate in allergic reactions.
   - **Basophils:** Release histamine and other mediators of inflammation.
4. **Monocytes:**
   - **Function:** Differentiate into macrophages and dendritic cells, which are involved in phagocytosis and antigen presentation.

How v and j chains are rearranges in somatic re arrangement

V and J Chain Rearrangement

1. **Selection:** A V segment and a J segment are chosen from available gene segments.
2. **Cleavage:** Special proteins cut the DNA at the V and J segments' borders.
3. **Opening and Processing:** Enzymes open the DNA ends and add random nucleotides.
4. **Ligation:** The DNA ends are joined together to form a new gene segment.
5. **Expression:** The rearranged gene is used to make a light chain protein for the antibody.

Adjuvant and its effect on the immune system

Adjuvants(from Latin adjuvare,to help) are substances that, when mixed with an antigen and injected with it,enhance the immunogenicity of that antigen. Adjuvants are often used to boost the immune response when an antigen has low immunogenicity or when only small amounts of an antigen are available.

they appear to exert one or more of the following effects

• Antigen persistence is prolonged.

• Co-stimulatory signals are enhanced.

• Local inflammation is increased.

• The nonspecific proliferation of lymphocytes is stimulated.

Treatment of monoclonal antibodies

Monoclonal antibodies are used to treat cancer, autoimmune diseases, infections, and prevent organ rejection. They work by targeting specific proteins in cells or pathogens, helping the immune system fight diseases. Some mAbs also aid in diagnostic imaging. They offer precise treatment with fewer side effects.

Factors of physical barrier of pathogens

Physical barriers play a crucial role in preventing pathogens from entering the body. These barriers include:

1. Skin: The outermost layer of the body provides a protective barrier against pathogens. It acts as a physical barrier that prevents microorganisms from entering the body.
2. Mucous Membranes: Mucous membranes line various entry points to the body, such as the respiratory tract, gastrointestinal tract, and urogenital tract. They produce mucus, a sticky substance that traps pathogens and prevents them from entering the body.
3. Cilia: Cilia are hair-like structures found in the respiratory tract and other parts of the body. They help to sweep away mucus and trapped pathogens, preventing them from reaching deeper tissues.

4. Tears and Saliva: Tears and saliva contain enzymes and antibodies that can kill or neutralize pathogens, providing additional protection against infection.
5. Acidity: The acidic environment of the stomach and other parts of the body helps to kill pathogens that enter through the oral route, further enhancing the body's defense against infection.

How to determine nature of double bounded immunoglobulins?

Determining the nature of double-bonded immunoglobulins involves various laboratory techniques:

1. Electrophoresis: Immunoglobulins can be separated based on their charge and size using electrophoresis. Different immunoglobulin classes migrate at different rates, allowing their identification.
2. Immunodiffusion: This technique involves the diffusion of antigens and antibodies through a gel matrix. By observing the formation of precipitation lines, the presence and type of immunoglobulins can be determined.
3. Immunoelectrophoresis: This combines electrophoresis with immunodiffusion, allowing for the separation and identification of immunoglobulins based on their electrophoretic mobility and antigen-antibody interactions.

4. ELISA (Enzyme-Linked Immunosorbent Assay): ELISA tests can detect and quantify specific immunoglobulin classes or subclasses by utilizing antigen-antibody interactions and enzymatic reactions.
5. Western Blotting: This technique involves the transfer of proteins from a gel to a membrane, followed by the detection of specific immunoglobulins using labeled antibodies.

Role of complement system

The complement system plays several important roles in the immune response:

1. **Opsonization:** Complement proteins coat pathogens, marking them for phagocytosis by immune cells such as macrophages and neutrophils.
2. **Inflammation:** Complement activation leads to the release of inflammatory mediators, promoting vasodilation, increased vascular permeability, and recruitment of immune cells to the site of infection.
3. **Cell Lysis:** The membrane attack complex (MAC), formed by complement proteins, punches holes in the membranes of target cells, causing them to lyse and die.
4. **Clearance of Immune Complexes:** Complement helps remove immune complexes (antigen-antibody aggregates) from circulation, preventing tissue damage caused by their deposition.

5. **Enhancement of Adaptive Immune Responses:** Complement fragments (e.g., C3d) can enhance the activation of B cells and the production of antibodies.

CFT

CFT stands for Complement Fixation Test, a laboratory technique used to detect the presence of specific antibodies or antigens in a patient's blood serum. It measures the ability of antibodies to fix complement, which is a part of the immune system's response to pathogens.

Anatomical barriers are physical barriers present in the body that help protect against the entry of pathogens. Examples include the skin, mucous membranes, and the epithelial lining of the respiratory, gastrointestinal, and genitourinary tracts. These barriers provide the first line of defense against infection by preventing pathogens from entering the body.

What is feature of chemical nature of good immunogen?

A good immunogen typically exhibits certain features in its chemical nature that make it effective at inducing an immune response:

1. Complexity: Good immunogens are often large, complex molecules, such as proteins or polysaccharides, which provide multiple epitopes for recognition by the immune system.
2. Molecular size: They are typically of sufficient size to be recognized by the immune system as foreign and trigger an immune response. Small molecules may not be immunogenic unless they are conjugated to carrier proteins.
3. Foreignness: They possess molecular structures that are distinct from those found in the host organism, allowing the immune system to distinguish them as non-self.
4. Stability: Good immunogens are stable molecules that can withstand the conditions encountered in the body without being degraded too quickly.
5. Solubility: They are often soluble in body fluids, facilitating their interaction with immune cells and molecules.

Zoology Legends

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Remember me in you Precious Prayer

Jazak Allah