

Immunity of Infection

Immunity To Bacterial Infections

Immunity To Viral Infections

Immunity To Parasitic Infections

Immunity To Bacterial Infections

- General structure of bacteria
 - Cell wall
 - Cytoplasm
 - Flagella
 - Pilli
 - DNA and RNA
 - Capsule

Antigenic structure of Bacteria

- Somatic antigens (O). Include all the cell wall structures, proteins and lipopolysaccharides.
- Capsular antigens (K): mostly polysaccharides with great affinity to react with proteins. Such antigens are hydrophilic, so resist phagocytosis.
- Exotoxins: Produced by some gram positive bacteria.
- H antigens: structural proteins of flagella and Pili

Factors Affecting Pathogenicity of Bacteria

- Host's resistance
- Damaged tissues
- Site of colonization
- Virulence

Resistance to Bacteria

- Non-specific defense mechanisms: Include all the innate defense mechanisms that mentioned before.
- Specific Immunity: Includes
 - 1-Neutralization of toxins and enzymes by antibodies.
 - 2-Killing of bacteria by complement antibodies and CMI, like Tc cells, killer cells.
 - 3-Opsonization associated with active macrophages and phagocytosis.

Factors Affecting Body Resistance To Bacteria

1-Genetic Factors:

Some causative agents infect some animal species but cannot infect some others. Brucella infects sheep and goats but not poultry.

2-Age

Mostly related to the level of hormones:

High levels of steroids inhibit immune response while low levels induce such responses.

3-Stress Factors:

Increase steroids and inhibit immune responses.

4-Nutrition

This is affecting the development of immune system.

Resistance of Bacteria to Immune System

- Presence of capsule
- Multiplication of bacteria inside the macrophages, like salmonella, Brucella, Listeria, and Mycoplasma.
- Changing of surface antigens: some bacteria like *Campylobacter fetus*.
- Suppression of T lymphocytes: some bacteria have the ability to inhibit T cells, like *Mycoplasma mycoides*
- Production of aflatoxins: This toxin inhibits immune responses.
- Release of cAMP (cyclic adenine monophosphate): This prevents fusion of lysosomes with phagosomes.

Immunity To Viral Infections

- General Structure of Viruses
 - Capside (Protein)
 - DNA or RNA
 - Envelope
 - Spikes
 - **Viruses** are intracellular parasites that live only in living cells. They cause many changes in infected cells.

Viruses that Infect Lymphocytes and Lymphatic Tissues

1-Viruses that destroy lymphatic tissues.

- Canine Distemper Virus
- Infectious Bursal Disease Virus
- New Castle Disease Virus
- Bovine Viral Diarrhea

2-Viruses that abnormally induced lymphatic tissues.

- Visna virus
- Yutan disease virus

3-Viruses that cause lymphoma.

- Marek's disease virus
- Feline leukemia virus.

Resistance To Viruses

A- Non-specific Resistance

B-Specific Resistance:

1-Cell mediated immunity: associated with modification of plasma membrane of infected cell.

2-Humoral Immunity.

SUDIES SHOWED THAT CMI IS MORE EFFECTIVE IN VIRAL INFECTIONS THAN HUMORAL IMMUNITY

How Viruses Escape Immune Responses?

- Changing of viral surface antigens: like influenza viruses.
- Changing of cellular surface antigens: like measles viruses.
- Integration of viral N.A. with cellular N.A.: like HIV virus in AIDS.
- Immuno-suppression due to lymphatic tissue infection.
- Stress factors and Steroids.

Immunity To Parasitic Infections

I- Immunity To Protozoa

A-Non-specific resistance against amoeba, toxoplasma, trypanosome, coccidia, babesia and others.

Resistance to protozoa affected by two factors:-

1-Animal species: some protozoa infect certain animal species but do not infect others, for example *Trypanosome Lewis* infects rats only and *Trypanosome vivax* infects mouse only.

2-The strain of animal species: The strain N-Dama of African cows resists Trypanosome when compared to others.

B-Specific defense mechanism

1-humoral Immune response:

Antibodies against protozoa can help in:-

a-Phagocytosis of protozoa by opsonization.

b-Agglutination of protozoa that can help Tc cells and complement to destroy the parasite.

c-Neutralize the enzyme of protozoa to prevent their multiplication and growth. These antibodies are known as **ablastin antibodies**

IgE antibodies induce allergy that causes vasodilation and help IgG antibodies to reach the site of parasite and help in its neutralization.

B-Specific Def. Mech.-----

2-Cell mediated immunity: CMI can also play a role in immunity to protozoa by producing Tc and macrophages and opsonization.

Evasion of Immune Response by Protozoa

- Immunosuppression: like *Babesia bovis* to cattle accordingly its host vector the tick *Boophilus microplus* is better able to survive on infected animal. *T.gondii* can avoid neutrophil attachment and phagocytosis.
- Development of the ability to alter surface antigens rapidly and repeatedly: for example *Trypanosome theileri* in cattle and *Trypanosome Lewis* in rats.
- Some parasites become non-antigenic like *Toxoplasma gondii* in the cyst stage.

II-Immunity To Helminthes

- A-Non-specific defense mechanisms

There are many factors affecting such mechanism:

1-Factors related to parasites.

a-The presence of adult worms in the intestine may delay the further development of larval stages of the same species within tissues. For example, calves infected with *Cysticercus bovis* show increased resistance to further infestation by this parasite.

b-Interspecies competition between helminthes for mutual habitats and nutrients in the intestinal tract will determine the numbers and location of parasites.

Helminthes -----

2-Factors related to the host:

a-Age and gender

In animals whose sexual cycle is seasonal, parasites tend to synchronize their reproductive cycle with that of their hosts. Example: ewes show a spring rise in fecal *nematode ova*.

b-Genetics

An example of genetically mediated resistance to helminthes is seen in the superior resistance of sheep with hemoglobin A to infestation with *Hamonchus contortus* and *Ostertagia circumcicta*, as compared to sheep with hemoglobin B.

Helminthes -----

B- Specific defense mechanisms (Immunity).

1-Humoral Immunity:

The production of antibodies like IgG, IgM and IgA. The most important antibodies are those of class IgE. For example: in sheep infected with Haemonchus contortus, the presence of IgE and antigens will trigger mast cells to release their vasoactive molecules and proteases. These molecules stimulate smooth muscle contraction and increase vascular permeability. Accumulation of fluids in the intestine with muscle contraction can remove many parasites.

Antibodies also help in:

A-Fixation of many migrated larvae.

B-Neutralize many enzymes that used by larvae.

C-Immunological complexes close some orifices of larvae.

D-Inhibit larval development and growth.

E-Interfere with parasitic egg production.

Helminthes -----

B- Cell mediated immunity

1-CMI induces delayed type hypersensitivity that leads to accumulation of neutrophil and phagocytes.

2-Tc cells of CMI destroy larvae.

Evasion of Immune Responses

- 1-The possibility that helminthes may synthesize and express host antigens on their surface, for example *Haemonchus contortus* in sheep.
- 2-Tissue helminthes may also reduce their antigenicity by adsorbing host antigens on their surface and so masking parasite antigens. Example: *Taenia solium* infestation.
- 3-Sequential antigenic variation. Example: *T. spiralis* larvae are extensively altered following each molt.
- 4-Production of immunosuppressive materials.
Examples:
 - H. contortus*
 - Fasciola hepatica*
 - Trichostrongylus axei*
- 5-Tolerance: mostly occurs in young animals infested with large parasitic doses.