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DEPARTMENT OF BIOTECHNOLOGY
FACULTY OFENGINEERING & TECHNOLOGY

LT.1: IMMUNITY & ITS TYPES

Content Outline

1. What is immunity?
2. Innate immunity & Passive immunity
3. Adaptive/Acquired immunity
4. Cells of adaptive immunity
5. Characteristic of innate and adaptive immunity
6. Immunity at glance
7. References & Further reading

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What is immunity?

•The Latin term ***immunis***, meaning “exempt,” is the source of the English word immunity, meaning the state of protectionf rom infectious disease.

•**Immunity** is the capability of multi-cellular organisms to resist harmful microorganisms from entering their cells.

•**Immunity** involves both specific and nonspecific components.

•The nonspecific components act as barriers or eliminators of a wide range of pathogens irrespective of their antigenic make-up.

Types of immunity

•Innate immunity

•Adaptive Immunity (Acquired Immunity)

Acquired immunity is further divided into two category

•Naturally acquired immunity (Active & passive)

•Artificially acquired immunity (Active & Passive)

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Innate immunity

•Innate Immunity: **Innate immunity** refers to nonspecific defense mechanisms that come into play immediately or within hours of an antigen's appearance in the body. These mechanisms include physical barriers such as skin, chemicals in the blood, and **immune** system cells that attack foreign cells in the body.

•Most components of innate immunity are present before the onset of infection and constitute a set of disease-resistance mechanisms that are not specific to a particular pathogen but that include cellular and molecular components that recognize classes of molecules peculiar to frequently encountered pathogens.

➢Innate immunity can be seen to comprise four types of defensive barriers: anatomic, physiologic, phagocytic, and inflammatory

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Type	Mechanism
Anatomic barriers	
Skin	Mechanical barrier retards entry of microbes. Acidic environment (pH 3–5) retards growth of microbes.
Mucous membranes	Normal flora compete with microbes for attachment sites and nutrients. Mucus entraps foreign microorganisms. Cilia propel microorganisms out of body.
Physiologic barriers	
Temperature	Normal body temperature inhibits growth of some pathogens. Fever response inhibits growth of some pathogens.
Low pH	Acidity of stomach contents kills most ingested microorganisms.
Chemical mediators	Lysozyme cleaves bacterial cell wall. Interferon induces antiviral state in uninfected cells. Complement lyses microorganisms or facilitates phagocytosis. Toll-like receptors recognize microbial molecules, signal cell to secrete immunostimulatory cytokines. Collectins disrupt cell wall of pathogen.
Phagocytic/endocytic barriers	Various cells internalize (endocytose) and break down foreign macromolecules. Specialized cells (blood monocytes, neutrophils, tissue macrophages) internalize (phagocytose), kill, and digest whole microorganisms.
Inflammatory barriers	Tissue damage and infection induce leakage of vascular fluid, containing serum proteins with antibacterial activity, and influx of phagocytic cells into the affected area.

Summary of non specific host response

Adaptive/ Acquired immunity

•**Adaptive immunity** is an **immunity** that occurs after exposure to an antigen either from a pathogen or a vaccination. This part of the **immune** system is activated when the innate **immune** response is insufficient to control an infection.

•Adaptive immunity is defined by the presence of lymphocytes, either T or B cells, and includes both CD8+ cytotoxic T cells that are the effector cells that directly destroy tumor cells, CD4+ helper T cells that regulate CD8+ T-cell and B-cell function, and B cells that present antigen and produce antibodies.

•The hallmark of the adaptive immune system is clonal expansion of lymphocytes. Clonal expansion is the rapid increase of T and B lymphocytes from one or a few cells to millions. Each clone that originates from the original T or B lymphocyte has the same antigen receptor as the original and fights the same pathogen.

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Active immunity refers to the process of exposing the body to an antigen to generate an adaptive **immune** response: the response takes days/weeks to develop but may be long lasting—even lifelong.

•Active immunity is created by our own immune system when we are exposed to a potential disease-causing agent (i.e., pathogen)

•In addition to "fighting off" these pathogens, active immunity is important because it lasts a long time in the form of immunologic memory. Immunologic memory consists of B and T cells that can recognize a particular pathogen

Active immunity is usually classified as natural or acquired.

Passive immunity

•Passive immunity occurs when we are protected from a pathogen by immunity gained from someone else.

•passive immunity is short-lived because the antibodies are not continually replenished as they would be in an individual whose immune system is responding directly.

Passive immunity can occur in a couple of ways:

1.Maternal antibodies

•Unborn and newly born babies are protected by antibodies from the maternal immune system. These antibodies are shared in two ways: across the placenta and in breast milk.

•Only IgG can cross placenta, providing immunity to developing foetus before child birth

•Breast milk — Babies also get antibodies from breast milk, particularly from a protein-rich version of breast milk supplied in the first few days after birth known as colostrum. Colostrum, which is produced in the first three to five days after birth, contains higher levels of antibodies that protect the intestinal surface (immunoglobulin A or IgA) and lower levels of nutritional ingredients than milk produced in the weeks following birth.

2.Immunoglobulin treatments

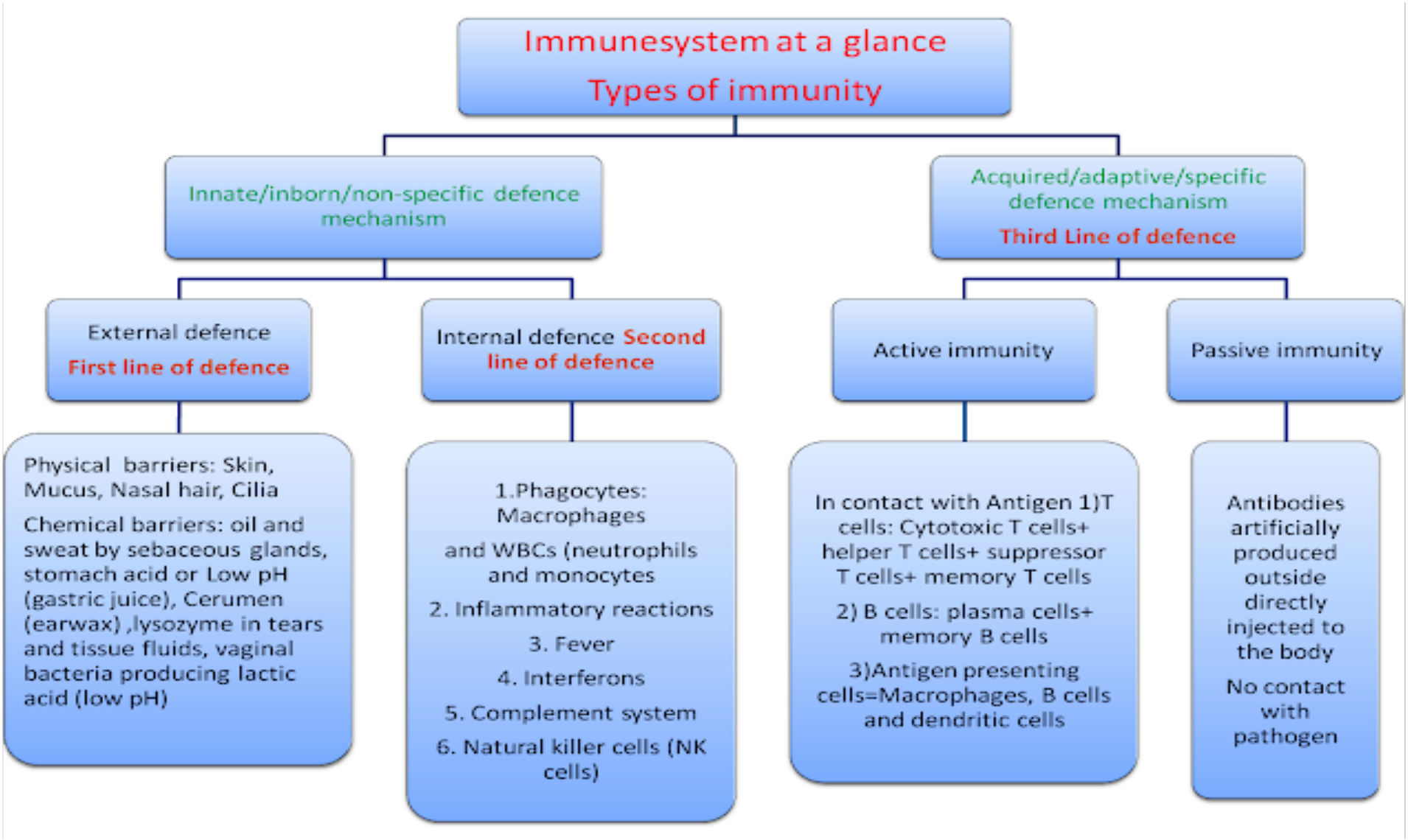
In certain situations, antibodies obtained from animals, from other people, or synthesized in a laboratory can be used to treat individuals at risk of infections. For example, infants born to women infected with hepatitis B are treated with antibody preparations in addition to being vaccinated in an effort to protect them from also becoming infected with hepatitis B. In another example, people bitten by some poisonous snakes may be treated with antivenom, a mixture of antibodies against the type of snake venom to which the person was exposed.

Cells of adaptive immune system

	B cells	T cells
Origin	Bone marrow	Bone marrow
Site of maturation	Bone marrow	Thymus
Antigen receptor	B cell receptor (BCR)	T cell receptor (TCR)
Target of binding	Soluble antigens	Biomolecular complex displayed at the surface of APC
Branch of immune response	Antibody-mediated immune response	Cell-mediated and antibody-mediated immune response
MHC and antigen presentation	Class II MHC molecules	Class I MHC molecules ($CD8^+$ T cells) and class II MHC molecules ($CD4^+$ T cells)

Characteristic of Innate & Adaptive immunity

	Innate immunity	Adaptive immunity
Components	Physical barriers (skin, gut villi, lung cilia, etc.); protein and non-protein secretions; phagocytes, NK cells, eosinophils, K cells	Immunoglobulins (antibodies), T cells, B cells
Antigen dependent	No: system in place prior to exposure to antigen	Yes: induced by antigens
Antigen specific	No: lacks discrimination among antigens	Yes: shows fine discrimination
Time lag	No: immediate response	Yes: delayed (3–5 days) response
Immunologic memory	No	Yes
Pathogen	Essentially polysaccharides and polynucleotides	Most derived from polypeptides (proteins)
Pathogen recognition	Pathogen recognized by receptors encoded in the germline	Pathogens recognized by receptors generated randomly
Receptor specificity	Broad specificity, i.e. recognize many related molecular structures called pathogen-associated molecular patterns	Very narrow specificity, i.e. recognize a particular epitope
Receptors	Pattern recognition receptors	B cell receptors and T cell receptors
Enhancement	Can be enhanced after exposure to antigen through effects of cytokines	Enhanced by antigens
Existence	Occurs in all metazoans	Occurs in vertebrates only


Immunesystem at a glance
Types of immunity
Innate/inborn/non-specific defence mechanism
Acquired/adaptive/specific defence mechanism
Third Line of defence
External defence
First line of defence
Internal defence Second line of defence
Active immunity
Passive immunity
Physical barriers: Skin, Mucus, Nasal hair, Cilia
Chemical barriers: oil and sweat by sebaceous glands, stomach acid or Low pH (gastric juice), Cerumen (earwax) ,lysozyme in tears and tissue fluids, vaginal bacteria producing lactic acid (low pH)
1.Phagocytes: Macrophages
and WBCs (neutrophils and monocytes
2. Inflammatory reactions
3. Fever
4. Interferons
5. Complement system
6. Natural killer cells (NK cells)
In contact with Antigen 1)T cells: Cytotoxic T cells+ helper T cells+ suppressor T cells+ memory T cells
2) B cells: plasma cells+ memory B cells
3)Antigen presenting cells=Macrophages, B cells and dendritic cells
Antibodies artificially produced outside directly injected to the body
No contact with pathogen

Test your understanding

The ____ immune system uses ____ as well as molecules (e.g. complement components). The ____ immune system uses ____ as well as antigen recognition molecules.

a. Adaptive; Phagocytes; Innate; Lymphocytes
b. Adaptive; Lymphocytes; Innate; Phagocytes
   Innate; Phagocytes; Adaptive; Lymphocytes
c. Innate; Lymphocytes; Adaptive; Phagocytes

Adaptive immune system response typically takes how long

a. Microseconds
b. Seconds
c. Minutes
d. days

Which of the following is NOT true when comparing innate to adaptive immunity

a. Innate responds quickly and adaptive responds slowly
b. Innate has few pathogen (non-self) recognition mechanisms and adaptive has many
c. Innate has immunologic memory and adaptive does not
d. Innate does not show response improvements over time and adaptive does

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References & Further reading

References

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Further reading

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