

Immunity and Immune system

*** What is immune system??

→ It's the study of our body's defence mechanisms against infection and disease. The immune system is a complex network of cells, organs and molecules that work together to detect and eliminate harmful infection and disease and protecting our body's own cells.

The immune system keeps record of every antigens it has ever defeated so it can ^{fast} detect and destroy the antigen ~~at~~ if it enters the body again.

*** components of immune system??

The main part of immune system that work together against infection are

- | | | | |
|---------------|---------------------|------------|-----------|
| * Thymus | * Antibodies | * Adenoids | * Tonsils |
| * Spleen | * Complement system | | |
| * Lymph nodes | * Lymphatic system | | |
| * Bone marrow | * White blood cells | | |

Mechanisms of immune system

1. Innate (non-specific) immune system.

→ The innate immune system is the first line of defense against pathogens and providing a rapid response to infection.

It is the immunity that is present at birth and lasts a person's entire life. It gives a quick and general response against any germ and it doesn't have learn/remember the germ.

main part of innate immune system.

- * Present from birth not learned
- * Fast, same response every time.
- * No memory of past record
- * Uses barriers - skin, mucosa
- * Microphages and macrophages.
- * Protein like CRP

* Natural killers
e. neutrophil, mast cell.

*** 2. Adaptive (specific) immune system. ***

→ Adaptive immunity is the type of immunity that develops after a person is exposed to a foreign substance like infection or vaccination. It involves B cells and T cells and produce antibodies to fight specific invaders. This system can remember those invaders and attack more fast if they return. It's not coming with born, this system develops over time and ^{can} provide protection for lifetime.

*** Main feature of adaptive immune system.

- * adaptability, developed after infection or vaccination
- * It's not inherited and specific response for each germ.
- * Involves B cells and T cells and produce antibodies.
- * remember any germ who attack before and memories it for future.

** Bone marrow

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It is the soft tissue that is found in the center of ~~our~~ bones.

It is red and blue types.

Red bone marrow → ^{yellow} It contains blood stem cells that

can be red/white blood cells.

Yellow bone marrow → mostly made by fat and contains stem

cells that can become fat/bone cells.

Function

* Red blood cells carry oxygen

* White blood cells fight against infection

* Platelets blood clot

* Produce and release blood cells when needed.

T-cell have CD8 and present T-lymphocyte cells.

white blood cells find bacteria, viruses and cancer

Immune cells

What is blood cells and white blood cells?

From bone marrow, blood cells produce and it's a very important part of our body. main types of blood cells are:

1. Red blood cells → carry oxygen
2. platelets → help to blood clot.

3. white blood cells → Also known as leukocytes

that include Lymphocyte like B-cells, T-cells, natural killer cell. T helper cells have CD4 and cytotoxic.

T-cell have CD8 and present T regulatory cells.

white blood cells find bacteria, viruses and launch immune attack.

*** Mechanism of CD8 T cells in killing? ***

1. Recognition: by using T-cells receptors, CD8 T cells identify infected cell when they release antigen.

2. Activation: CD8s become activated and release cytotoxic granules to kill infected cells.

3. Target cell killing: * Perforin - makes tiny holes in the target cell's membrane.

* Granzymes - enter through the holes and induce apoptosis (cell's self destruction).

* Fas-FasL pathway - CTLs use FasL to bind with Fas receptors and tell the cell to kill itself (apoptosis).

*** Role of CD8 T cells in CD4 T cell activation

→ through cytokine production, APC change, enhanced antigen presentation and cellular interactions.

*** Mechanism of Natural Killer (NK) cells.

It's attack on infected cells immediately. Mechanism

* Detect abnormal signal: NK cells attack cancer or virus cells when they send chemical signals.

* Kill the target cells by release perforin and ~~granzymes~~ ^{lysozymes}, which create holes and enzymes enter through

* through the whole and kills the abnormal cells.

* Activated NK cells release cytokines like

TNF- α which boosts the action of other immune cells like macrophages.

*** How B cells produce Antibodies by Antigenic stimulation? ^{on how B cells produce memory cells}

→ B cells develop from stem cells in the bone marrow. They produce antibodies to bind with antigen. ~~step~~ steps of Antibodies production

1. Antigen Recognition → B cells can detect a antigen.
2. Activation → Helper T cells release signal to active B cell.
3. Clonal Expansion → The activated B cells divide into so many identical cells.
4. Some B cells become plasma cells and produce antibodies and antibodies bind with antigen and neutralize it.
5. Others B cells become memory cells that remember the antigen so that our immune system kill them quickly in future.

Antibodies

*** What is antibodies? characteristics and types?

→ Antibodies are protein that made by B cells to fight against invaders like bacteria, virus and toxins. They bind with antigens and neutralize it.

Characteristics of Antibodies

- * Each antibody binds to a specific antigen.
- * They have 2 arms that attach to antigen called antigen bind sites.
- * After binding with antigens, they neutralize and destroy pathogens and help our immune system.
- * Block and destroy toxins/viruses from infecting cells.

Types of an

*** Types of antibodies

by production

- * monoclonal antibody → produced in the laboratory that made from single B cell clone.
- * polyclonal antibody → Produced by many different B cell clones that preparation from immunized animals.

*** 5 type of antibodies

1. IgG → most common, 70-75% of total human antibodies, gives long term immunity
2. IgA → protect mucosal area.
3. IgM → first antibody made during infection
4. IgE → involve in allergic reactions
5. IgD → Helps in B cell activation.

~~***~~ Antigens ~~**~~

What is antigens? type of antigens and Epitope?
→ Antigens are usually proteins/large polysaccharides from foreign organism that trigger our immune response.

Epitope

- * a small part of antigen that bind with antibody
- * an antigen can have many epitope
- * each epitope recognized by different antibody.

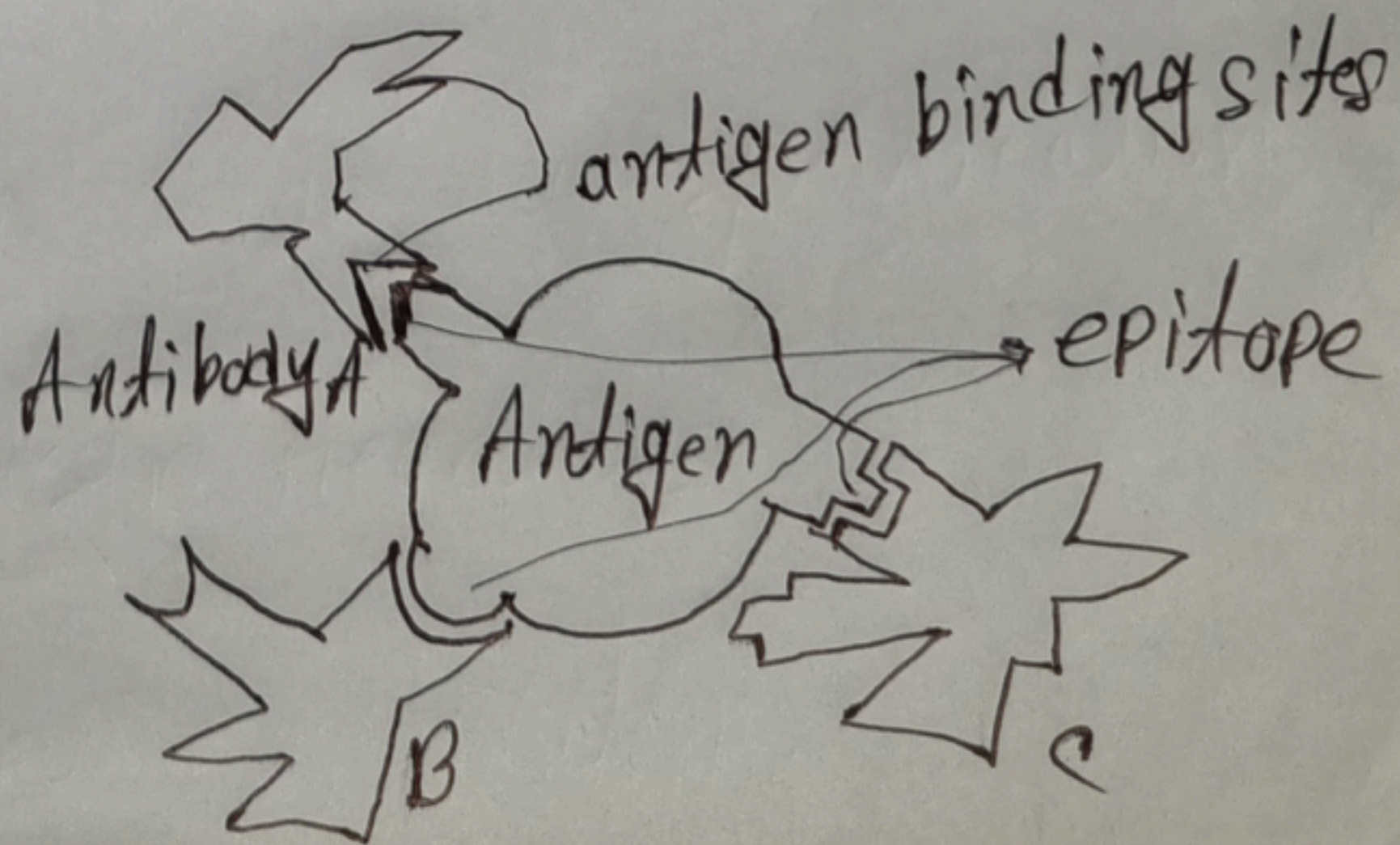
Different type of antigens

1. Cancer antigens → mutated protein that made by cancer cells

2. Microbs → found in bacteria or virus.

3. Non-microbial antigens

- A. Tumor Antigens
- B. Pathogens Antigens
- C. Bacterial Antigens



What happens if our immune system is
Hyper/over active/overly sensitive??

→ If our immune system over active then
it can be killed harmless or own cells. Then some
diseases happens:

1. Allergic diseases: allergies to food, medicine, Asthma,
etc
2. Autoimmune diseases: When immune system attack
non normal part of our body.
then problems like thyroid,
types 1 diabetes, Lupus happens.

Microscopes → found in bacteria or virus.

Non-microscopic →

*** What happens when our immune system under active/immuno deficiency?

→ When immune system weak and can't fight against infection properly.

Causes

some people

* Inherited: born with weak immune system

* Medical treatment: due to certain drug like ^{chemotherapy}

* Diseases like HIV/AIDS

* due to organ transplanted

*** How do vaccine work ***

- * Vaccine contain a weakened, inactive part of antigen.
- * Vaccine train immune system to recognize and fight against viruses/bacteria without illness.
- * After training, the immune cells detect antigen and produce B cell.
- * Now B cell produce antibody to destroy antigen and kill bacteria/viruses.
- * Some vaccine help to create memory cells to remember the antigen for future so it can quickly destroy it.
- * Some vaccine need multiple doses to build strong for ~~so long~~ long-lasting protection to prevent illness.

~~***~~ How to design a vaccine?

1. Identify the pathogen (virus/bacteria).

2. Find Antigen of the pathogen

3. Choose the vaccine type

- mRNA/DNA (genetic instruction)
- Inactive (killed virus)
- Subunit of protein

4. Test in the lab and make component of the vaccine

5. Trials on ^{first} animals to check safety

5. ~~App~~ get approval

6. Now production more and more for use.