

Lymphatic System

Is Lymphatic system is composed of:

Lymphocytes make up:

The major lymphoid tissues outside the circulating blood are:

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Lymphoid tissue is also widely dispersed throughout

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Lymph Vessels:

Lymph Fluid:

Lymph fluid is formed by

Lymph Fluid is returned:

Lymphatic System

Is Lymphatic system is composed of: body tissues that contain large numbers of WBCs called lymphocytes.

Lymphocytes make up: make up 30% of the circulating WBC.

The major lymphoid tissues outside the circulating blood are:

- Lymph nodes
- Spleen
- Thymus gland

Lymphoid tissue is also widely dispersed throughout

- the mucous membranes,
- the GI tract, and
- respiration tract.

Lymph Vessels: connect all of these tissues and contain lymph fluid.

Lymph Fluid: Lymph fluid is blood plasma minus much of the circulating proteins.

Lymph fluid is formed by The excess fluid that's left in the interstitial spaces that did not get back into the capillaries.

Lymph Fluid is returned: Left subclavian – the lower body and left side of the upper body, head, upper extremity. Right side of head, neck, shoulder and right extremity into the right subclavian.

Lymphatic System (Cont)

Three major functions of of the lymphatic system

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Lymphocyte is

Other WBC's

- Granulocytes:
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- Agranulocytes
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Lymphatic System (Cont)

Three major functions of of the lymphatic system

- Collects excess fluid from the tissue spaces and returns it to the heart. (If this isn't working you get edema)
- Absorbs large fat molecules from the GI tract and transports them to the heart. (by way of subclavian veins) (Fat molecules are too big to get into the hepatic portal circulation system the way it should.)
- Forms the corner stone of the immune system.

Lymphocyte is the cell of specific immunity.

Other WBC's

- Granulocytes:
 - Neutrophil – 60% of circulating white blood cells (phagocytes)
 - Basophils and eosinophils in the single digits.
- Agranulocytes
 - Monocyte – biggest of the WBC. It does macrophage.
 - Lymphocyte – 30% of the circulating WBC

B and T Cells

Lymphocytes are “born”:

Some of the lymphocytes migrate to the thymus gland

The lymphs that mature in the “bone marrow”

Of the B and T cells are circulating in the blood and lymph systems: 7

There is also a small number of lymphocytes:

B and T Cells

Lymphocytes are “born”: in red bone marrow as are all blood cells. While they are born in the bones, they mature in at least two different locations.

Some of the lymphocytes migrate to the thymus gland and are called T-lymphocytes. Or more correctly – Thymus dependent lymphocytes.

The lymphs that mature in the “bone marrow” are called B-lymphocytes or bone marrow dependent lymphocytes.

Of the B and T cells are circulating in the blood and lymph systems: 70% are T-cells, 30% are B-cells.

There is also a small number of lymphocytes: are called null cells. Their function is to destroy tumor cells.

Lymph Nodes

Location:

Function:

Reticular connective tissue

Lymph node contains:

- **Superficial portion of the cortex**
- **Deeper portion of the cortex**
- **The inner medulla contains mostly**

Afferent lymphatic vessels:

Hilus & Efferent Vessels:

Lymph Nodes

Location: Small bean shaped structure located along the lymph channels.

Function: They act as filters to detect and destroy foreign material.

Reticular connective tissue – It is loose and net like and keeps the organ together.

Lymph node contains an outer cortex and inner medulla

- **Superficial portion of the cortex** – mostly B-cells
- **Deeper portion of the cortex** – Mostly T-cells
- **The inner medulla contains mostly** mononuclear phagocytes (monocytes). These phagocytes are big cells who's job is to scavage and eat anything it comes into contact with it.

Afferent lymphatic vessels – bring lymph fluid to the lymph node where they pierce the capsule.

Hilus & Efferent Vessels: The fluid is filtered thru the gland and then enters the efferent vessels at the hilus – They carry the fluid out of the node at the concave side of the hilus. (Only the stuff leaving uses the hilus, it enters everywhere.)

Spleen & Thymus

White Pulp –

Red Pulp –

The spleen performs:

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Antigen-

Antibody –

Injury or disease that requires the removal of the spleen

Thymus Location:

Thymus Function:

Spleen & Thymus

White Pulp – masses of lymphocytes that surround the splenic artery.

Red Pulp – Fluid filled sinuses formed by reticular connective tissue. (filters the blood, the white blood cells will get rid of the old or bad red blood cells.) There are WBC's found here. (The spleen is where most of the red blood cells are removed as well as a major site for the lymphatic system. You can live without it.)

The spleen performs:

- Phagocytes breakdown and destroy worn out red blood cells.
 - 120 days is the average life of a RBC.
- Phagocytes also destroy RBC's that are abnormal or carry abnormal hemoglobin.
- It filters out bacteria and other foreign substances and phagocytes will promptly remove the foreign material.
- The phagocytes will also interact with lymphocytes to initiate an antigen-antibody response.

Antigen-any foreign substance in the body that the body doesn't recognize as self.

Antibody – something the body produces to destroy the antigen. (incomplete, will do more later)

Injury or disease that requires the removal of the spleen is not life threatening.

Thymus: Located over the base of the heart and behind the sternum. According to western, it has no function after a few months after birth. The thymus is very large in the infant but shrinks and turns into a remnant of connective tissue by adulthood. Discussion: It never really degenerates totally.

Non-specific Immunity

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Non-specific Immunity

- Intact skin (it's a barrier) PH Changes (slightly acidic), Skin destruction (it sloughs off)
- Mucous – it is found in the respiratory passages. A thick and sticky substance that will latch on to and hold foreign substances. We can cough it up and spit it out. There's also mucous in the GI tract.
- Gastric Acid – in the stomach, you have an extraordinarily low pH (under 1). (Carnivores is even lower than ours).
- Chemical compounds produced by the body.
 - Enzyme – lysozymes – tears, saliva, respiratory, etc... and other fluids
 - Polypeptides that seem to inactivate some Gram-negative bacteria. (blue colored – tend to be more problematic for the human body.)
 - Serum protein called properdin that destroys – Gram positive bacteria.
- The inflammatory response – nonspecific but complex response to any foreign substance.

Specific Immunity

Specific or acquired immunity consists of two mechanisms

Antigen –

Antibody –

Antibody response:

-
-

Cell mediated immunity

- Carried out by _____ & Macrophages present digested antigen _____
- The T-cells now:

Humoral immunity

- carried out by _____ & macrophages present digested antigen _____
- The b cells now

Specific Immunity

Specific or acquired immunity consists of two mechanisms called cell mediated immunity and humoral immunity. Both mechanisms work together by targeting a specific invading agent including viruses, bacteria, toxins, and other foreign substances.

Antigen – a substance foreign to the body that causes a reaction by the body to that one specific antigen.

Antibody – a substance produced by the body (specifically by a B lymphocyte) that will attack and destroy that one particular antigen, but no other antigen.

Antibody response:

- B- cells make antibodies.
- T-cells go out and fight directly

Cell mediated immunity

- Carried out by – t cells & Macrophages present digested antigen – to the t cell
- The T-cells now recognize the material as an antigen and – and take the fight directly to the antigen

Humoral immunity

- carried out by – b-cells & macrophages present digested antigen – to the b-cell
- The b cells now recognize the material as an antigen and – turn into plasma cells and produces antibodies to combat the antigen.

Specific Immunity (Cont)

First time an antigen meets a T or B cell: the first time a b or t cells meets an antigen, there's not that many of them. So not much happens. So, they are taken care of by the macrophages or neutrophils. The next time it comes around is when the T or B cells are ready to fight with the antibody response. It's only limited the first time.

Memory cells are T or B cells that have been sensitized to the antigen and have the capability of rapid proliferation of either T cells or production of antibodies.

Quick review of specific immunity:

- 1.
- 2.
3.
 - a.
 - b.
- 4.

Specific Immunity (Cont)

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Quick review of specific immunity:

1. Invasion – a foreign material enters he body and the body recognizes it as an antigen.
2. That specific antigen is an antigen because of some unique chemical formation that's large enough to be recognized by the lymph cells.
3. Macrophages ingest the foreign material and then
 - a. Digest it.
 - b. separate the specific antigenic material that's going to be present to the lymphocytes.
4. the lymphocytes then reacts to the antigen and does it's specific thing.

Cell Mediated Immunity

Cell mediated immunity goes with

Cell mediated immunity defends against

Cell mediated immunity is the cause of

The cell mediated immunity is often related to

There are three types of sensitized t-lymphocytes -

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Cell Mediated Immunity

Cell mediated immunity goes with T-cells.

Cell mediated immunity defends against viruses, fungus, parasites, abnormal cells in the body, some bacteria

Cell mediated immunity is the cause of transplant rejection.

The cell mediated immunity is often related to hyper sensitivity reactions.

There are three types of sensitized t-lymphocytes . We mean a few T-lymphocytes are exposed to an antigen and have now multiplied. And are now prepared to react vigorously against this antigen in a subsequent exposure.

- Cytotoxic T Cells (AKAK Killer cells) act by – directly killing a foreign organism.. They bind very tightly to the foreign cell and release toxic chemical into the foreign cell.
- Helper T-Cells interact with other T and B cells to enhance the immune reaction.
 - Lymphokines/substances released by the helper T's which increase the activity of other lymphocytes and attract macrophages needed to activate the lymph cells.
- Suppressor t cells inhibit the immune response by decreasing the effectiveness of Helper T-cells and toxic substances.

T Lymphocytes

T lymphocytes are classified into two major groups

CD4 cells –

CD8 cells –

A lack of CD4

A lack of CD8

T Lymphocytes

T lymphocytes are classified into two major groups based on specific antigens found on their surfaces. They are called CD4 and CD8 cells.

CD4 cells – these are the t-helper cells and make up 70% of the T-cells.

CD8 cells – these are the suppressor and toxic t cells and make up 30% of the t-cells.

A lack of **CD4** cells leads to (as in AIDS) diminished immune response. (AIDS – the HIV virus attacks primarily the CD4 cells)

A lack of **CD8** cells leads to things like autoimmune disease because the immune system is out of control.

Humoral Immunity

Major Component of defense against:

B-Cells release:

Immunoglobulins –

Immunoglobulins attack antigens in one of four ways:

- 1.
- 2.
- 3.
- 4.

Humoral Immunity

Major Component of defense against: bacteria and bacterial toxins.

B-Cells release: immunoglobulins

Immunoglobulins – antibodies.

Immunoglobulins attack antigens in one of four ways:

1. Agglutination – makes things stick together. It makes antigens clump together.
2. Neutralization – refers to the neutralizing the activity of the antigen.
3. Precipitation – The antibody causes the antigens to drop out of circulation. (They fall out and land somewhere and stay there...)
4. Lysis – It breaks it up.

Compliment System

Compliment system

The compliment system is a group

Complement may do to assist in the immune reaction (it works with B-cells)

- 1.
- 2.
- 3.
- 4.

Compliment System

Compliment system – nonspecific defense (but very advanced) In mammals it assists in specific immunity. In addition to the four attack modes we just mentioned, humoral immunity may also call the complement system into action to aid in humoral immunity.

The compliment system is a group of proteins found in both blood and tissue fluids. When activated it proceeds thru a series of steps just like the clotting mechanism, for blood. In the complement cascade, however, various things can happen along the way.

Complement may do to assist in the immune reaction (it works with B-cells)

1. Opsonization - It makes the antigen more tasty to the macrophages. It increases the rate of ingestion of foreign material.
2. Lysis – destroys it.
3. Agglutination – makes it clump together. (this is non specific)
4. Chemotaxis – chemical movement – produces chemical that attract white cells to the area of invasion.

Immunoglobulins

Five types:

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-
-

The basic structure is

- Inner tines
- Handles
- Outer Tines

They are held together

Function of the tines –

Functions of the handle –

Immunoglobulins

Five types:

- IgG – most numerous
- IgA – in fluids (tears, snot, urine, mucous in our butts, etc)
 - IgM – biggest
 - IgE – seems to be related to allergies
 - IgD – don't truly understand this.

The basic structure is a fork with four tines. And two handles.

Inner tines – heavy chains

Handles – also described as heavy chains.

Outer Tines – light chains

They are held together by sulfide bonds

Function of the tines – Are specific to the antigens.. This is where you have the reaction between the antibodies and antigens.

Functions of the handle – Let other things happen (stimulating compliment cascade, etc...)

Immunoglobulin Functions

IgM -

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

IgG

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

IgA

- 1.
- 2.
- 3.
- 4.

IgE

- 1.
- 2.

IgD

- 1.
- 2.

Immunoglobulin Functions

IgM -

1. the **largest**
2. pentamers – there are five units
3. **first** antibody to be secreted by a plasma cells after an initial exposure to an antigen.
4. Agglutinate and lysis of bacteria. Significance – between viruses and bacteria. Bacteria are most likely to reproduce quickly.
5. Makes up about **10%** of the immunoglobulins.
6. This is traveling in blood and lymph fluid.

IgG

1. **most abundant 75%**
2. **found in blood and lymph.**
3. monomere, one unit,
4. **major antibody produces on the second exposure to the antibody.**
5. Only antibody to pass through the **placenta**. (this is a function of the **handles**)
6. Triggers the **compliment** system – function of the **handle**.

IgA

1. dimer – two units
2. makes up about **15%** of the antibodies
3. **found in body fluids (tears, urine, snot, mucous) – provides localized protective resistance on areas of mucous membrane.** (Reduced in times of stress. (you also dry up when you sleep... this is much like Wei Qi!)) (It's on the surface...)
4. Present in **mothers milk** – second form of passive immunity given to the infant.

IgE

1. less than 0.1% of immunoglobulins
2. found on the surfaces of mast cells and basophiles and involved with **allergic reactions.**

IgD

1. makes up less than 1%
2. **least understood of the immunoglobulins.** Believed to be involved with the activation of B lymphocytes.