Physiology Team

LECTURE 1

Reticuloendothelial System (RES) & Spleen

HAEMATOLOGY BLOCK

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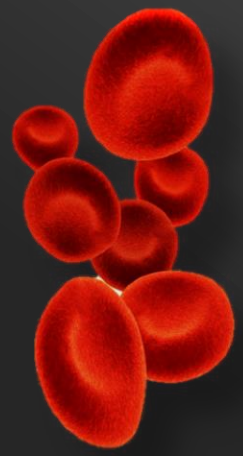

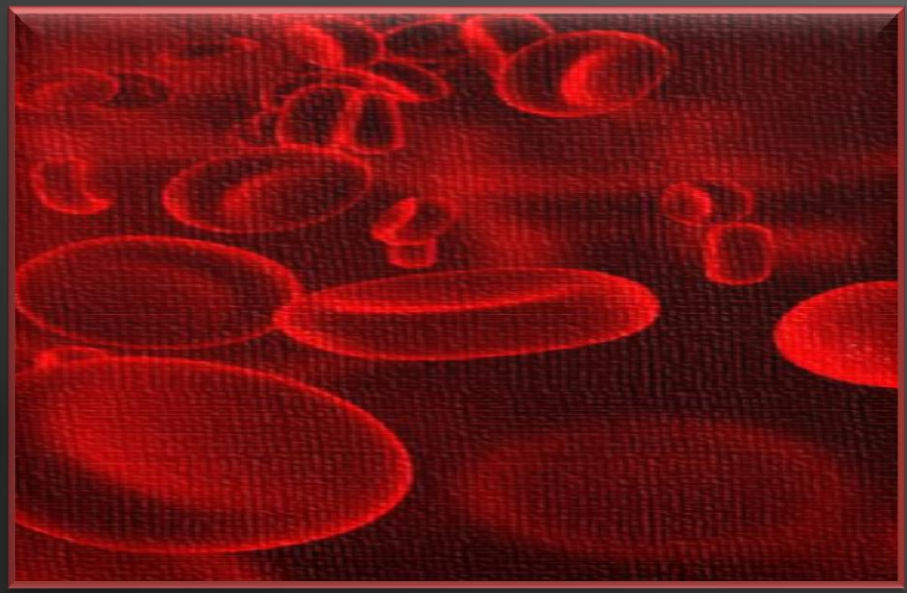

OBJECTIVES

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At the end of this lecture, student should be able to describe:

1. Define the term Reticuloendothelialsystem (RES).
2. Describe the cellular components of RES.
3. Describe the functions of the RES.
4. Define the structural function of the spleen.
5. Describe the functions of the spleen.
6. Understand the basic concept of the indication and risks of spleenectomy.

MIND MAP

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* RES

- **definition**
  - a network of connective tissue fibers inhabited by phagocytic cells
- **components**
  - Monocytes
    - "in Blood"
  - Macrophage
    - "in Tissues"
    - Types
    - Formation
  - Endothelial cells
- **Function**
  - Direct (**Phagocytosis**)
  - Indirect (**Immune function**)
  - **Breakdown of aging RBC**
  - **Storage and circulation of iron**

* Spleen

- **Structure**
  - White pulp
    - "immune function"
  - **Red pulp**
    - "Vascular part"
- **Function**
- **Spleenectomy**

■ Slides ■ Important ■ Females' Notes ■ Explanation ■ Males' Notes

Mononuclear phagocyte system :

- Reticuloendothelial system is an older term for the mononuclear phagocyte system.
- Most endothelial cells are not macrophages

The reticuloendothelial system (RES)

Definition

It is a network of connective tissue fibers inhabited "live" by phagocytic cells such as macrophages ready to attack and ingest microbes.

RES is an essential component of the **immune system.**

Components

1. **Monocytes.** " in the blood"
   - ↓ When it's enter the tissue it called " Macrophage"
2. **Macrophage** : located in all tissues such as skin (histiocytes), liver (kupffer), spleen, bone marrow, lymph nodes, lung.
   - * The name change with different sites
3. **Endothelial cells**: bone marrow, spleen, lymph node. * Not phagocytic

Macrophages

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Function :

Fixed

- Often remain fixed to their organs , **They filter and destroy objects which are foreign to the body, such as bacteria, viruses.**

Mobile

- Some macrophages are mobile, **and they can group together to become one big phagocytic cell in order to ingest larger foreign particles.**

Formation of Macrophages

Begin by Stem cell in Bone Marrow

↓

monoblast maturing to **promonocyte**

↓

mature monocytes released into blood.

↓

Stay for 10-20 hours in circulation.

↓

Then leave blood to tissues transforming into larger cells **macrophage**.

↓

Macrophage life span is longer up to few months in tissues.

Types

Macrophage differ depending on the organs in which they reside "live"

Kupffer cells	In the **liver**
Microglia	In the **brain**
Reticular	In the **lymph nodes** , **bone marrow**, **spleen** .
Tissue histiocytes	**"Fixed macrophages"** In **subcutaneous tissues** (Skin)
Alveolar	In the **lungs**

* Transformation of monocytes to macrophage :

* Characterized by an **increase in** " that's mean what change will happen to survive phagocytic function" :

1. **Cell size**
2. **Number and complexity of intracellular organelles Golgi, mitochondria, lysosomes.**
3. **Intracellular digestive enzymes.**

* General Functionsof RES:

1. **Phagocytosis** * — Bacterial, dead cells, foreign particles (direct).
2. **Immune function** — processing antigen and antibodies production (indirect).
3. **Breakdown aging RBCs**
4. **Storage and circulation of iron**

* Phagocytosis

- **Phagocytosis** is part of the natural or innate immune process.
- **Macrophages** are a powerful phagocytic cells:
  - ❖ Ingest up to 100 bacteria.
  - ❖ Ingest larger particles such as old RBC.
  - ❖ Get rid of waste products.

Illustrations

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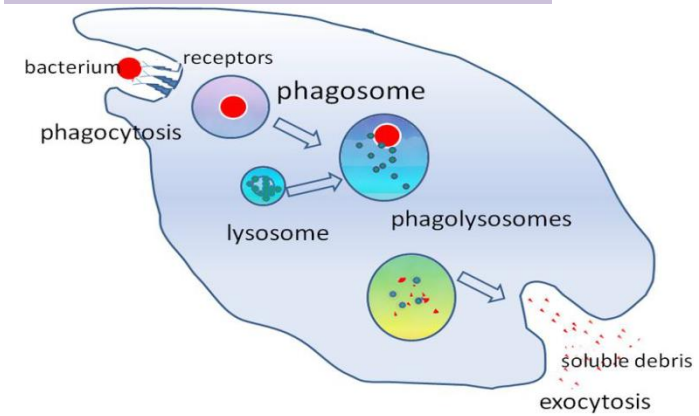
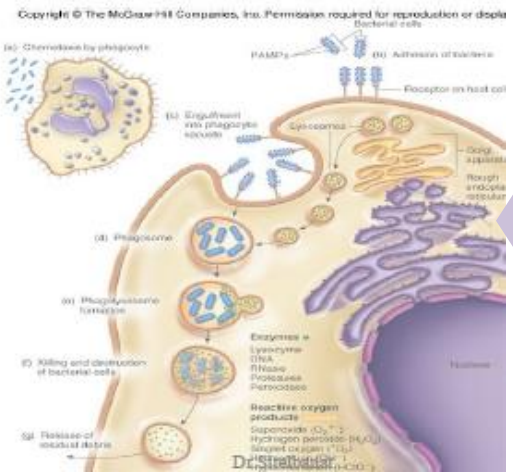
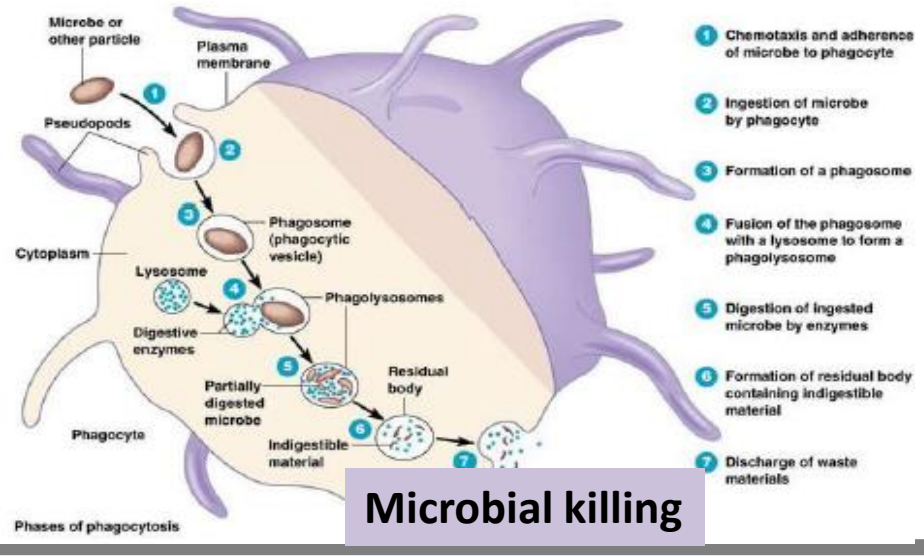
Direct anti-inflammatory



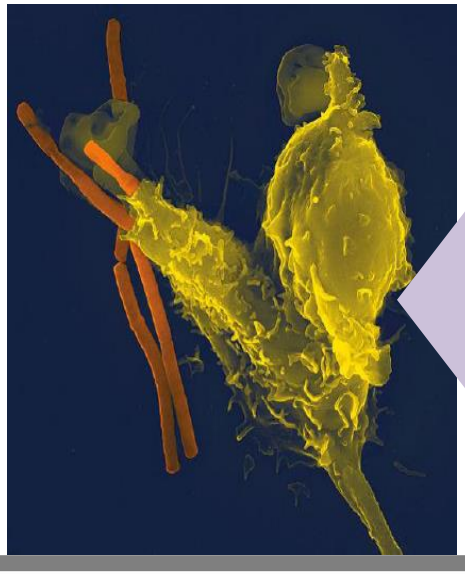


Indirect Immune function Of RES

- **Indirect immune function of RES:**
  - **–Ingest foreign body, process it and present it to lymphocytes.**



Microbial killing



A scanning electron microscopeimage of a single neutrophil (yellow), **engulfing** anthrax bacteria (orange).

■ Slides ■ Important ■ Females' Notes ■ Explanation ■ Males' Notes

* Lymphoid organs :

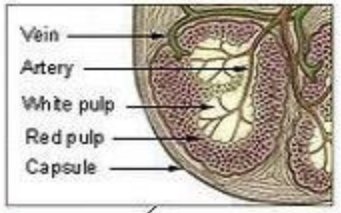
Thymus	Lymph nodes	Spleen
high rate of growth and activity until puberty, then begins to shrink; site of T-cell maturation.	small, encapsulated, bean-shaped organs stationed along lymphatic channels and large blood vessels of the thoracic and abdominal cavities.	structurally similar to lymph node, it filters circulating blood to remove worn out RBCs and pathogens.

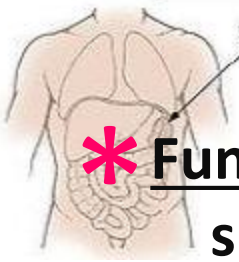
- Is soft purple gray in color located in the left upper quadrant of the abdomen.
- It is a highly vascular lymphoid organ. "in case of car accident the most important thing to worry about is spleen, because internal bleeding might happen which could lead to death "
- It plays an important roles in: red blood cells integrity and has immune function.
- It holds a reserve of blood in case of hemorrhagic shock. " the capsule has the ability to produce large number of RBCs and platelets , it will contract so RBCs and platelets will go out "
- It is one of the centers of activity of the RES and its absence leads to a predisposition toward certain infections.
  " that's why ppl with splenactomy should take vaccines cuz they prone to get infections "
- Despite its importance, there are no tests specific to splenic function.

Structural Function of Spleen :

- **WHITE PULP** — Thick sleeves of lymphoid tissue, that provides **the immune function** of the spleen.
- **RED PULP** — surrounds white pulp, composed of **Venous sinuses** filled with whole blood and Splenic cords of reticular connective tissue rich in **macrophages.**

Spleen





Functions of spleen :

1. **HAEMATOPOIESIS (HEMOPOIESIS):** fetal life.
   "synthesis of blood component as a whole "
2. Spleen is a main site for **DESTRUCTION OF RBCS** specially old and abnormal e.g. spherocytosis.
3. **BLOOD IS FILTERED** through the spleen.
4. **RESERVOIR OF THROMBOCYTES** and immature erythrocytes.
   "platelets originate in the bone marrow and then go to spleen to be reserved before get released into the blood circulation"
5. **RECYCLES OF IRON.** " storage of iron "

Spleen

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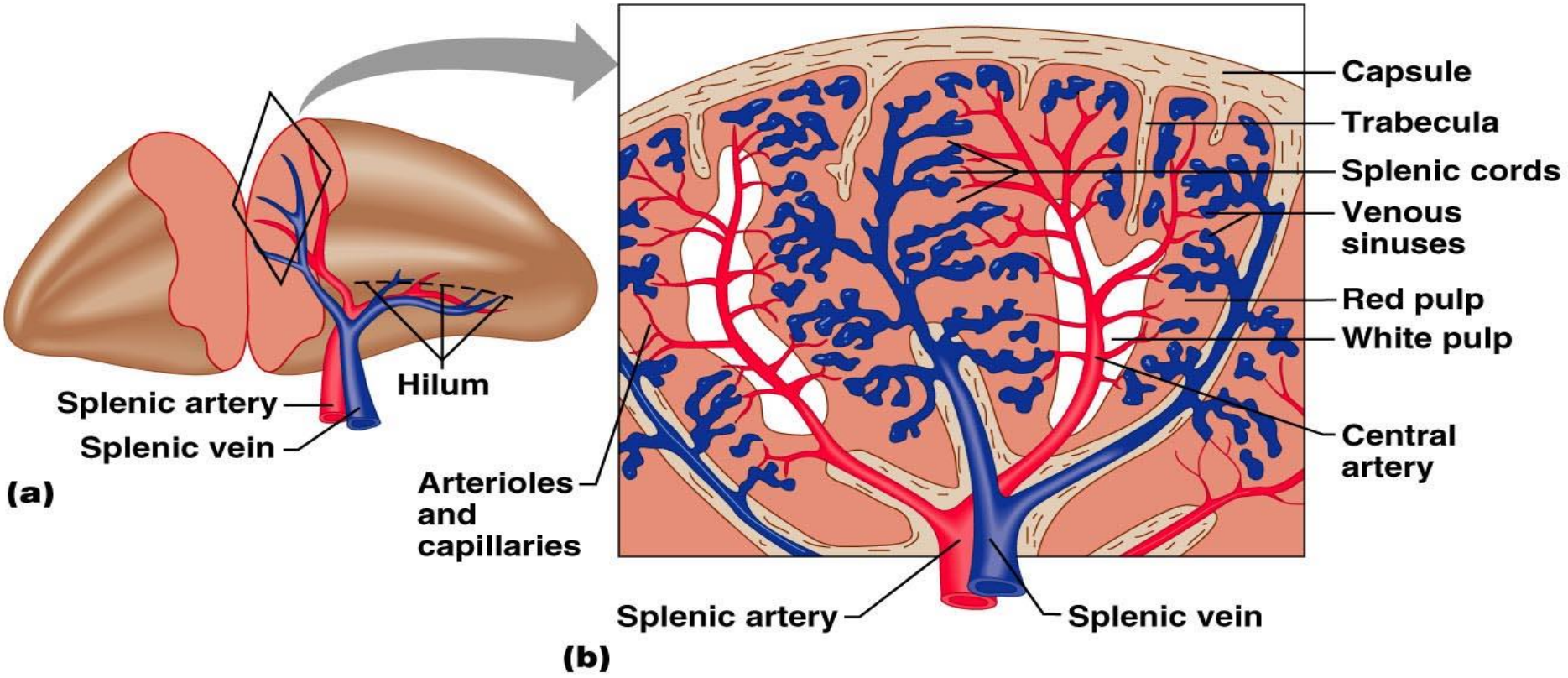

* IMMUNE FUNCTIONS OF SPLEEN :

1. Because the organ is directly connected to blood circulation, it responds faster than other lymph nodes to blood-borne antigens.
2. Destruction and processing of antigens.
3. Reservoir of lymphocytes in white pulp.
4. Site for Phagocytosis of bacteria and worn-out blood cells (Slow blood flow in the red pulp cords allows foreign particles to be phagocytosed)
5. Site of B cell maturation into plasma cells, which synthesize antibodies in its white pulp and initiates humoral response.
6. Removes antibody-coated bacteria along with antibody-coated blood cells.
7. It contains (in its blood reserve) half of the body monocytes within the red pulp, upon moving to injured tissue (such as the heart), turn into dendritic cells and macrophages that promoting tissue healing.

Splenectomy

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* Indications :

1. **Hypersplenism**
   - enlargement of the spleen (splenomegaly) with defects in the blood cells count.
2. **Primary spleen cancers.**
3. **Haemolytic anaemias**
   - Sickle cell anaemia, Thalassemia, hereditaryspherocytosis (HS) and elliptocytosis,
4. **Idiopathic thrombocytopenic purpura (ITP).**
5. **Trauma**
6. **Hodgkin's disease.**
7. **Autoimmune hemolytic disorders**

* Risks & complications :

- ❖ Overwhelming **bacterial infection** or post splenectomy **sepsis**.
- ❖ Patient prone to **malaria**.
- ❖ Inflammation of the **pancreas** and collapse of **the lungs**.
- ❖ Excessive post-operative **bleeding** (surgical) .
- ❖ Post-operative **thrombocytosis** and **thrombosis**. " after the platelets go out from bone marrow , they looking for a place to store in it , so in case of spleenectomy platelet count may rise to abnormally high levels (thrombocytosis), leading to an increased risk of potentially fatal clot formation "

* Click on the sign to show the meaning !

■ Slides ■ Important ■ Females' Notes ■ Explanation ■ Males' Notes

SUMMARY

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- **RES :** a network of connective tissue fibers inhabited by **phagocytic ,** its components are **Monocyte-Macrophages-Endothelial cells.**
- **Function of RES** : Phagocytosis"direct" – immune"indirect" – breakdown RBCs – storage iron
- **Macrophages:**
  - can be **Fixed** or **Mobile**
- **Types of macrophages:**

Very important

1. **Kupffer-Liver**
2. **Microglia-Brain**
3. **Reticular-LN,BM,S**
4. **Histiocytes"fixed"-Skin**
5. **Alveolar-Lungs**

- **Formation:**

✓ **Monoblast >> promonocyte >> monocyte >> Macrophage**

- **TransForm characterized by**

✓ increase cell size/ #of golgi – mitochondria-lysosomes / intracellular digestive enzymes .

Reticuloendothelial system is an older term for the mononuclear phagocyte System (MPS)

SUMMARY

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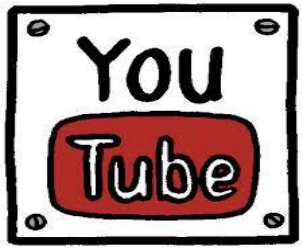
- **Macrophages** can be **Fixed or Mobile**
- **Lymphoid organs** : Thymus-Lymph n-spleen .

- **Spleen** : highly vascular **play an important role in** : RBCs integrity / Immune / reserve blood
  - **Structural Functio** : white pulp "immune" – Red pulp "vascular part" ..
  - **Function of spleen:**

Haematopoiesis /destruction of RBCs/filter blood/reservoir of thrombocytes/recycles iron .

  - **Immune Function of spleen:**

fast response to blood-borne antigens /destruction of Antigens-reservoir of lymphocytes"white pulp" / Phagocytosis/B cell maturation/ removes antibody/coated bacteria/contains monocytes "red pulp" turn into dendritic +macrophages "promoting tissue healing".



Splenectomy

Incase you 're interested !

- **Splenectomy**

Indications :Hypersplenism/PSC/Haemolytic Anemia/ ITP/ Trauma/ Hodgkin's disease/ AIHD .

Complications Bacterial infection /sepsis/malaria/ pancreatitis/ collapse of Lungs/ Bleeding / thrombocytosis and thrombosis.

QUESTIONS

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1.The spleen

A) has white pulp that is associated with the venous supply.
B) has red pulp that is associated with the arterial supply.
C) filters lymph and puts it back in the blood.
D) acts as a blood reservoir.
E) destroys worn-out lymphocytes.

2.The site of T-lymphocyte maturation

A) spleen
B) thymus
c) liver

3- what is the new term for RES ?

A)mononuclear phagocyte system
B) intrinsic phagocyte system
C) Mononucleur endothelial system

4- alveolar cells in :

A. CNS
B. lung
C. Skin
D. liver

D
B
A
B

THE END

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If there are any Problems or Suggestions,
Feel free to contact us:

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Actions Speak Louder Than Words