Reticuloendothelial System & Spleen
Physiology Team 430
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Reticuloendothelial system (RES) Mononuclear phagocyte system: -

Reticuloendothelial system is an older term for the mononuclear phagocyte system, but it is used less commonly now, as it is understood that most endothelial cells are not macrophages.

Definition: It is a network of connective tissue fibers inhabited by phagocytic cells such as macrophages ready to attack and ingest microbes that passed the first line of defense.

RES is an essential component of the immune system.

Cellular components of RES: -

1- **Monocytes** (in the blood, when they reach the tissues they turn into and will be called Macrophages).
2- **Macrophages** Located in all tissues such as skin (**histocytes**), liver (**kupffer cells**), spleen, bone marrow, lymph nodes, lungs.
3- **Endothelial cells** some of endothelial can present antigen (bone marrow, spleen, lymph node)

Macrophages: -

- Often remain fixed to their organs.
- They filter and destroy objects that are foreign to the body, such as bacteria, viruses.
- Some macrophages are mobile, and they can group together to become one big phagocytic cell in order to ingest larger foreign particles.

Types of Macrophages: -

Macrophages differ depending on the organs in which they reside.

Organ	Macrophages
Liver	**Kupffer** cells
Brain	**Microglia**
Lymph nodes, Bone marrow, Spleen	**Reticular** cells
Subcutaneous tissues	**Tissue histocytes** (fixed macrophages)
Lungs	**Alveolar** cells

Formation of Macrophages: -

1. Begin by Stem cell in Bone Marrow→ proliferate to monoblast→ maturing to promonocyte and mature monocytes released into blood
2. Stay for 10-20 hours in circulation
3. Then leave blood to tissues transforming into larger cells (macrophages).
4. Macrophage life span is longer up to few months in tissues unless destroyed while performing phagocytic functions.

Transformation of monocytes to macrophage : -

Is characterized by an increase in:

1- Cell size

2- Number and complexity of intracellular organelles Golgi apparatus, mitochondria, lysosomes. (it has a lot of these organelles to help its function, for ex: phagocytosis)

3- Intracellular digestive enzymes.

General Functions of RES : -

1- Phagocytosis: Bacterial, dead cells, foreign particles. (Direct)
2- Immune function: processing antigen and antibodies production (indirect).
3- Breakdown of aging RBC.
4- Storage and circulation of iron. (This is important to prevent iron loss from the body).

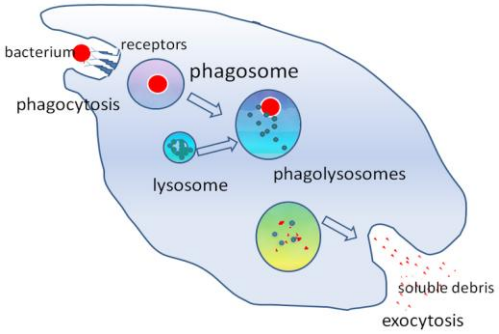
Phagocytosis: -

- Phagocytosis is part of the natural, or innate immune process.

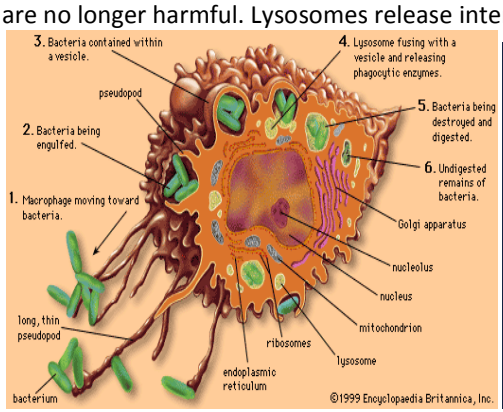
- Macrophages are a powerful phagocytic cells:

  - Ingest up to 100 bacteria,
  - Ingest larger particles as old RBC
  - Get rid of waste and survive

Direct anti inflammatory: (picture)



- Nb: when the bacterium (big molecule) is turned into small soluble debris (small particles) these small particles are no longer harmful. Lysosomes release intercellular digestive enzymes to break down the bacterium.



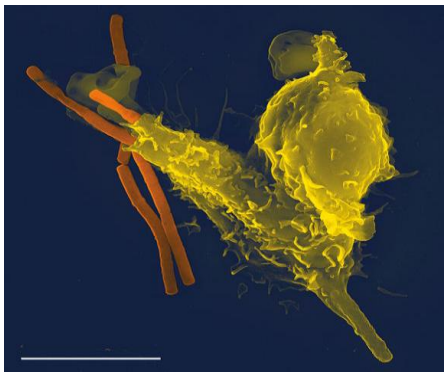


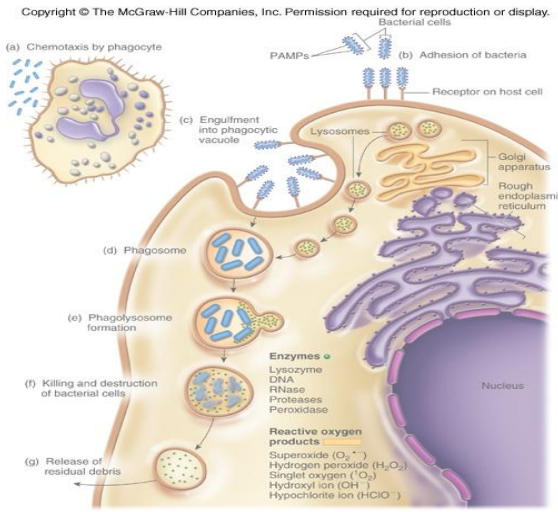
Figure 1-A scanning electron microscope image of a single neutrophil (yellow), engulfing anthrax bacteria.

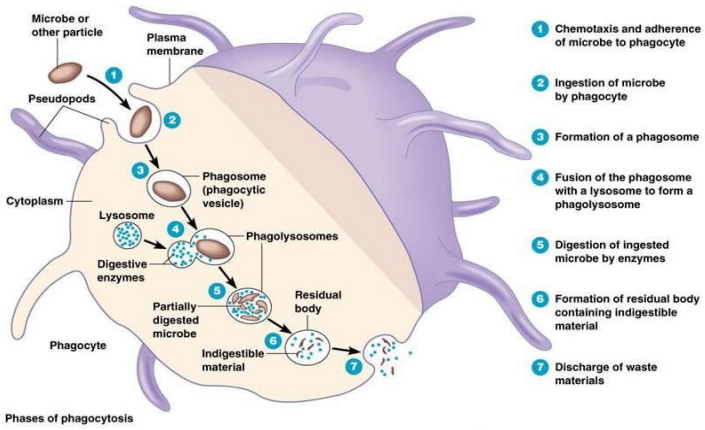
Microbial Killing:

Indirect Immune function Of RES: -

- Indirectly immunity

- Ingest foreign body→ process it→ and present it to lymphocytes.





Lymphoid Organs

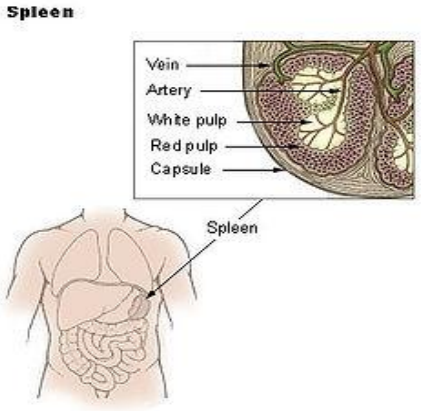
Thymus	Lymph nodes	Spleen
- High rate of growth and activity until puberty - Then begins to shrink - Site of T-cell maturation	- Small - Encapsulated - Bean-shaped organs stationed along lymphatic channels and large blood vessels of the thoracic and abdominal cavities	- Structurally similar to lymph node it filters circulating blood to remove worn out RBCs and pathogens

Spleen

- ⊡ It is soft purple gray in color located in the left upper quadrant of the abdomen.
- ⊡ It is a highly vascular lymphoid organ
- ⊡ It plays important roles in: red blood cells integrity and an immune system.
- ⊡ It holds a reserve of blood in case of hemorrhagic shock.
- ⊡ It is one of the centers of activity of the RES and its absence leads to a predisposition toward certain infections
- ⊡ Despite its importance, there are no tests specific to splenic function

Structural Function of Spleen

- **White pulp: Thick sleeves of lymphoid tissue, 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**



Functions of Spleen

1. **Haematopoiesis (Hemopoiesis) → (fetal life)**
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**
5. **Recycle of iron**

Immune Functions of Spleen

Because the organ is directly connected to blood circulation, it responds faster than other lymph nodes to blood-borne antigens

1. **Reservoir of lymphocytes in white pulp**
2. **Destruction and processing of antigens**
3. **Site for Phagocytosis of bacteria and worn-out blood cells (Slow blood flow in the red pulp cords allows foreign particles to be phagocytosed)**
4. **Site of B cell maturation into plasma cells, which synthesizes antibodies in its white pulp and initiation of humoral response**
5. **Removes antibody-coated bacteria along with antibody-coated blood cells.**
6. **It contains in its blood reserve half of the body's monocytes within the red pulp, upon moving to injured tissue (such as the heart), turn into dendritic cells and macrophages while promoting tissue healing.**

Splenectomy

What are the indications of Splenectomy?

1. **Hypersplenism: enlargement of the spleen (splenomegaly) with defects in the blood cells count.**
2. **primary spleen cancers**
3. **hereditary spherocytosis (HS) and elliptocytosis**
4. **Idiopathic thrombocytopenic purpura (ITP).**
5. **Trauma.**
6. **Hodgkin's disease.**
7. **Autoimmune hemolytic disorders.**
8. **Thalassemia**

And what are the risks?

- ⊡ **Overwhelming bacterial infection or post splenectomy sepsis.**
- ⊡ **Patient prone to malaria**
- ⊡ **Inflammation of the pancreas and collapse of the lungs.**
- ⊡ **Excessive bleeding after the operation**
- ⊡ **Post operative thrombosis**