

HISTOLOGY SHEET

Doctor 2021 -mercy- | medicine | MU

DONE BY:

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Corrected by:

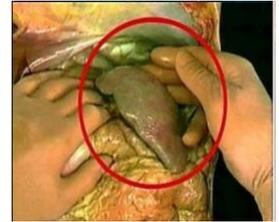
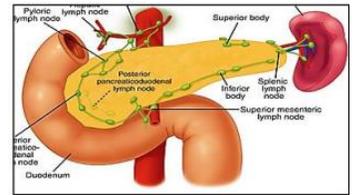
Emran Younis

DOCTOR

Dr. Hala El mazar

1.Spleen

- Largest single hemo-lymphatic organ
- Important blood filter. Site of destruction of aged RBCs & recycling of iron
- Immunological function through B & T cells (humoral & cell mediate immunity)
- A site of hematopoiesis in the fetus, and stores RBCs & platelets (blood reservoir in animals).



• Spleen characteristics:

1. Fist in size
2. Intra-peritoneal organ
3. Intra-abdominal organ
4. Located at upper left quadrant

• increasing in size of spleen known as splenomegaly

• We can't feel with spleen except with splenomegaly.

• Spleen function:

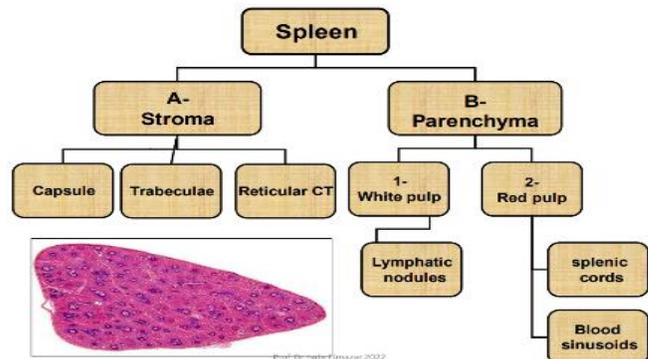
1. Blood formation in the fetus, and blood destruction in the adult.
2. Spleen destruct RBCs into iron & globin together make hemoglobin.

• Splenomegaly: Splenomegaly occurs when the human have liver problem and liver failure as a result of blood that return back and swell (fill) the spleen

• Elastic fibers function appears when the splenomegaly occurs, because it keeps the elasticity of spleen.

• Smooth muscle fibers in spleen are required for contraction

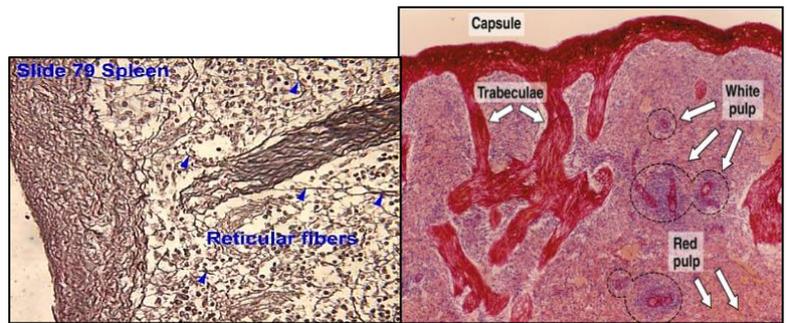
• Periarteriolar lymphoid tissue is the T cells site of spleen.



Structure of spleen

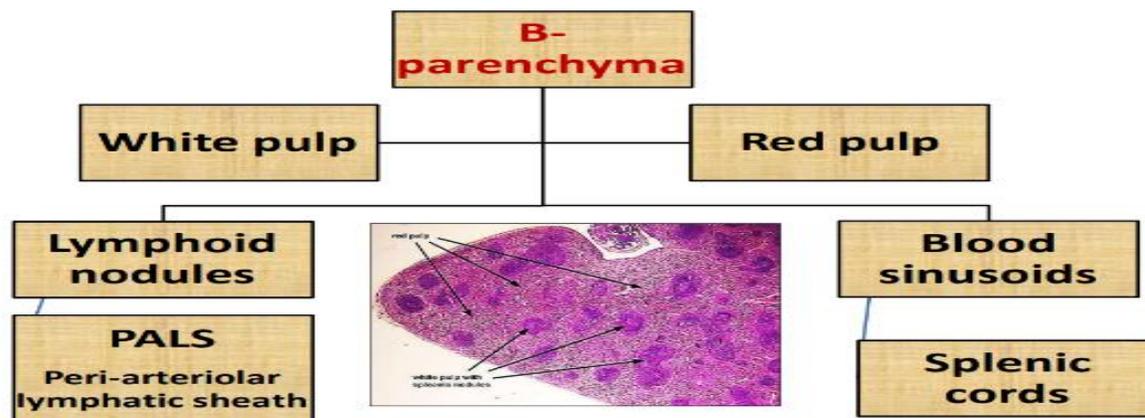
A-Stroma

1-Capsule: thick, rich in collagenous, elastic fibers & smooth ms cells.



2-Trabecula: are short ones, extend from capsule. divide the spleen into incomplete compartment, rich in elastic fibers & smooth ms. Cells

3-Reticular CT: reticular cells and fibers, form background



I- white pulp

1- lymphatic nodules (splenic Malpighian corpuscles):

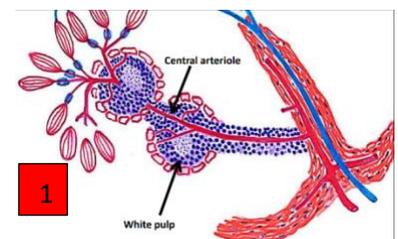
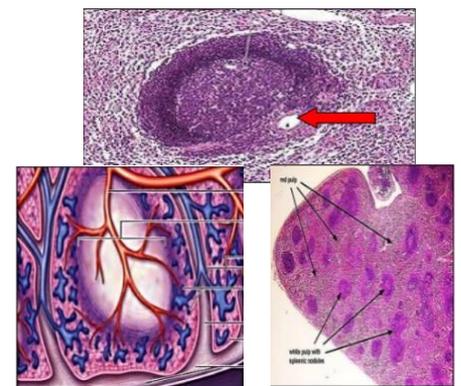
aggregations of lymphocytes forming 1ry or 2ry nodules distributed throughout the parenchyma of the spleen

2- Central arterioles (follicular arterioles):

- Run at the periphery of the nodules (eccentric). They are branches of splenic artery
- which give numerous branches before leaving the white pulp to enter the red pulp.

Central artery is actually eccentric, yet it is called “central” as it was located centrally during early fetal life.

The sketch¹ shows the lay out of the blood supply of the spleen.



Splenic artery → trabecular arteries → central arterioles → penicillinar arterioles enter the red pulp and they terminate as: ➤ Closed circulation when terminate directly into splenic sinusoids ➤ Open circulation when terminate in splenic cords

Penicillar²: from pencil , its pain as a pencil

Organization of Cells in white pulp of spleen:

- **Periarteriolar lymphoid sheaths (PALS):** mainly T lymphocytes encircle the central arteriole and called (**Thymus dependent zone of spleen**)
- **Germinal center:** lightly stained, contain activated B cells, plasma cells & macrophages (located between PALS and marginal zone)
- **Marginal zone** at the periphery of W. pulp close to red pulp has APCs & macrophages.

Filtration starts from marginal zone

The space between marginal zone and germinal center contains small B cells

Organization of Cells in white pulp of spleen³

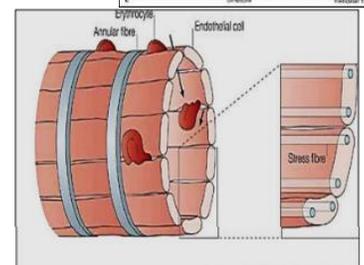
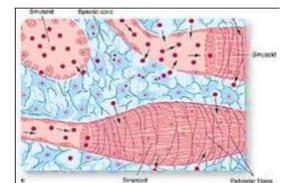
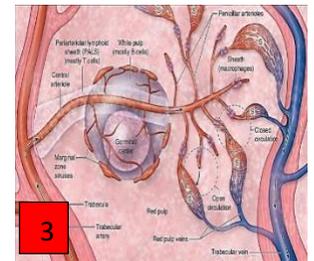
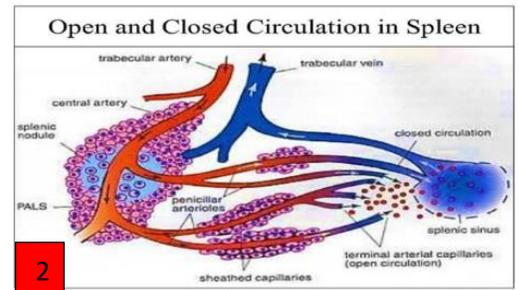
II- Red pulp (79%)

1-Splenic cords (Billroth cords):

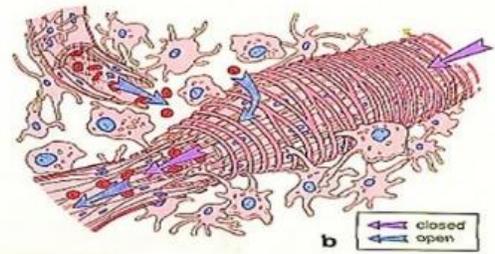
- Network of reticular fibers between blood sinusoids to support the free cells found e.g. blood cells, T & B lymphocytes, plasma cells, macrophages

2-Blood sinusoids (venous sinuses): • wide spaces lined e fenestrated endothelium called **stave cells** which filter the blood & surrounded e Macrophages called **Littoral cells**

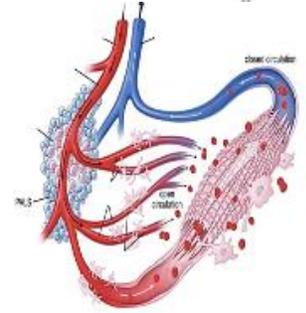
- **Stave cells** , unusual elongated endothelial cells(rod-like) oriented parallel to the sinusoidal blood flow
- These cells have discontinues basement membrane which wrap the cells cross wise



- The gaps between the endothelial cells mechanically filter the blood cells.. Old or abnormal RBCs attempting to squeeze through the endothelial gaps become badly damaged and subsequently removed by macrophages.

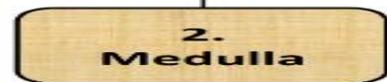
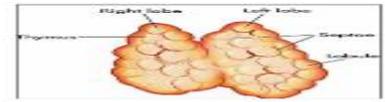
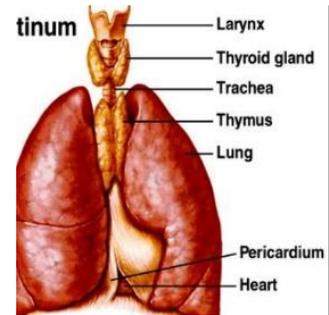


After about 120 days the erythrocytes undergo membrane changes & swell , signals for their engulfment by macrophages in the cords of the reticular between the venous sinuses. The lining of splenic sinusoids and the EM of Stave cells



Thymus

- is a 1ry lymphatic organ e an endocrine function
- Location: behind the sternum in the mediastinum (End at the 4th rib)
- Single bi-lobed structure, highly lobulated organ
- Development: ➤ Infant – ↑ in size ➤ Puberty – maximum size ➤ Adult – ↓ in size
- Function Differentiation and maturation of T cells

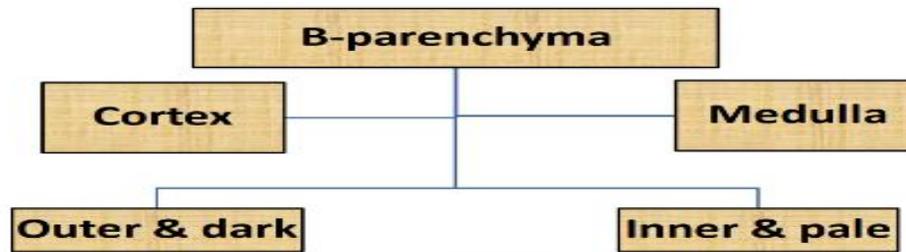
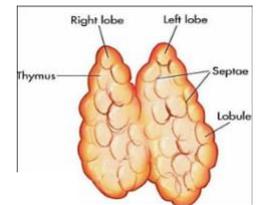


A- Stroma:

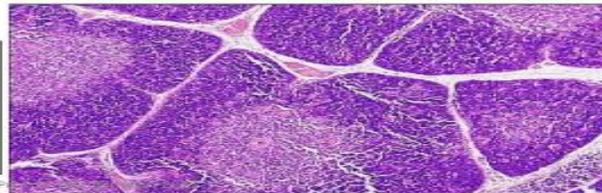
1- Capsule: loose CT

2- Trabeculae (septa): Arise from capsule, penetrate its substance forming lobes, carry blood vessels. Each lobe is divided into incomplete lobules (Blood vessels contain mother cells that enter the thymus)

3- Thymus has no reticular fibers. Reticulum is formed by the processes of epithelial reticular cells



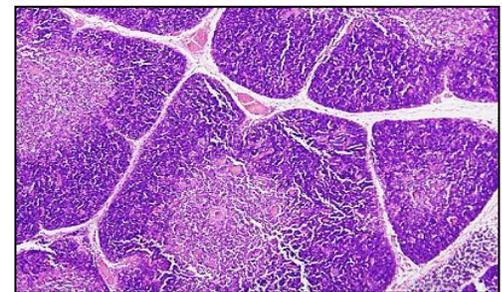
Both contain:
 1- T. Lymphocytes.
 2- Epithelial reticular cells.
 3- Few macrophages.
 4- Blood capillaries



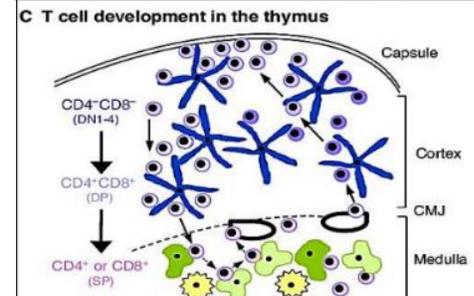
1- Cortex:

- Peripheral dark-stained zone, where T cell maturation occur
- Cortex contains thymocytes.

The hematopoietic precursors which migrated from bone marrow → thymus. Thymocytes supported by a network of finely branched epithelial reticular cells



- Thymocytes are completely surrounded epithelial reticular cells
- The cortex is the site of earliest events in thymocyte development, where T cell receptor mature & positive selection take place



- Mature T lymphocytes leave the cortex → the medulla.

T- lymphocytes:

- Responsible for cell mediated immunity & also assist B lymphocytes in initiating the humoral response (T- helper)
- T- cells are several subtypes:

➤ **Naïve**

➤ **Memory**

➤ **Effector** (T- helper, T- cytotoxic , T- suppressor (T reg cells) & T- killer cells)

The progression of T- cell development:

- The Stem cells from bone marrow travel to the thymus to reside in the **outer part of cortex**, once there they are called **thymocytes**
- These thymocytes have neither CD4 nor CD8 surface markers (double –ve T cells)

Naïve T cells characteristics

1. Mature

2. Competent

3. Fresh

4. Transport to 2ry lymphoid organ

5. Didn't differentiate and don't have specific function.

- Within outer cortex the thymocytes will proliferate & undergo genetic arrangement & express 2 cell markers:

✓ **TCR (T cell receptor)**

✓ **Cluster differentiation: CD4⁺ & CD8⁺ (double positive T cells)**

- Double positive T cells that don't recognize **self –MHC epitope** offered to them by cortical ER cells are forced into apoptosis

• (MHC: is a large section on vertebrates DNA contains all genes that code for cell surface proteins)

- Still in cortex: double +ve cells that in **contact** e ER cells that carry **MHC I** **will** stop expressing CD4⁺ marker & become single +ve T cells that express **only CD8⁺ maker**

- Double +ve T cells contact ER cells carry **MHC-II** stop expressing CD8⁺ marker & become single +ve T cells that express **only CD4⁺ marker**

- By doing that the T cells acquired the **Thymic education** which was done under the influence of hormones secreted by epithelia R cells

- Only **1- 3%** of **Double +ve T cells** will survive the **selection process** and will allow to enter the medulla

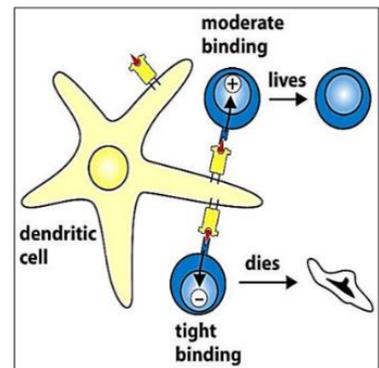
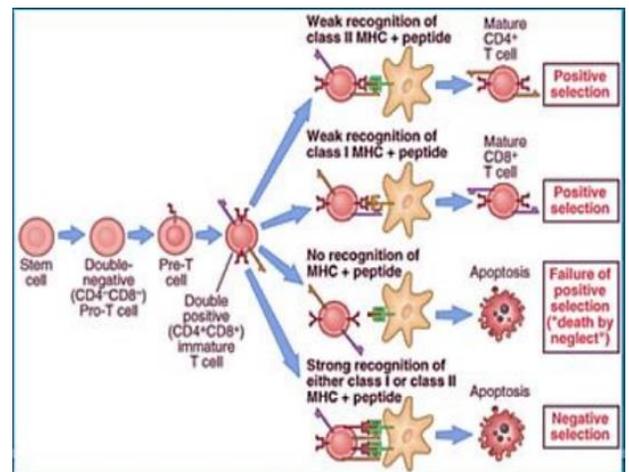
- **The previous process is called positive selection and take place in the thymus cortex**

- The final step in maturation of T cells occurs in the medulla

- The **medullary ER** cells will do another test & present **self-epitopes of MHC-I & MHC-II** to the **single +ve T cells** & those who bind **strongly are forced to apoptosis**

- **It has to be weak reaction** to the MHC - epitopes complex to prevent autoimmune response. This called **negative selection** and takes place in the **Thymic medulla**

- T cells re-enter blood stream & travel to 2ry lymphatic organs (LN & spleen) where they settle in **thymus dependent zones**



- Epithelial Reticular cells secrete **thymic hormones** that stimulate:

- T cell differentiation ➤ Expression of surface markers

- CD4⁺ cells called **helper T cells:** indirectly can kill cells indicated as foreign.

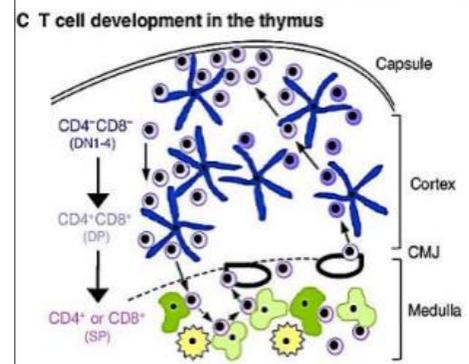
- CD8⁺ cells called **cytotoxic T cells** are able directly to kill virus infected & tumor cells

- **MHC I** molecule is expressed on all nucleated cells Except RBCs

- **MHC II** molecule is expressed on antigen presenting cells: macrophages , dendritic cells

Epithelial reticular cells (ERCs) :

- Branched, acidophilic cells e oval nuclei, their long processes contain tonofilaments
- Also called thymic nurse cells
- They are connected together by desmosomes
- Do not produce reticular fibers.
- Found in both cortex & medulla (Cortical ERCs & medullary ERCs)
- Contain secretory granules which contain the thymic hormones]



Functions of ERCs:

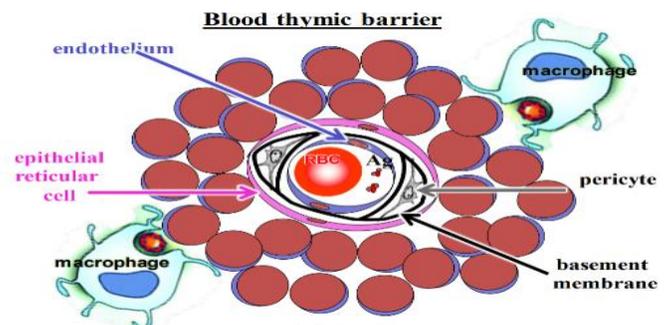
- 1- nursing cells for T cells during their differentiation
- 2- Secrete the thymic hormones
 - Thymulin • Thymopoietin • Thymosins • Thymic humoral factor
- 3- Share in the blood-thymus barrier
- 4- Antigen presenting cells for developing T lymphocytes
- 5- in medulla form Hassall's corpuscles

Blood-thymus barrier

Barrier exists in the cortex only to separate the developing T-lymphocytes from antigens in blood

The barrier is formed by:

- 1-continuous capillary endothelium
- 2- pericytes
- 3-thick, continuous basal lamina around endothelium
- 4- perivascular space contains macrophages to deal e any antigen escape
- 5- complete layer of epithelial reticular cells around capillaries



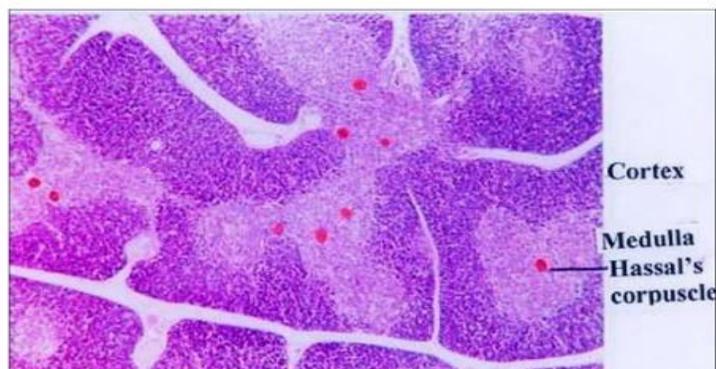
The barrier allow immature T lymphocytes to multiply & differentiate free from foreign Ags before they migrate to medulla & leave thymus to blood

2-Medulla:

Contains fully differentiated T lymphocytes, which leave medulla through venules.

T cells travel to 2ry lymphatic organs (LN & spleen) where they settle in thymus dependent zones

Contains Hassall's corpuscles (diagnostic feature), which vary in size from 25 to 200 μm in diameter & are acidophilic in reaction.



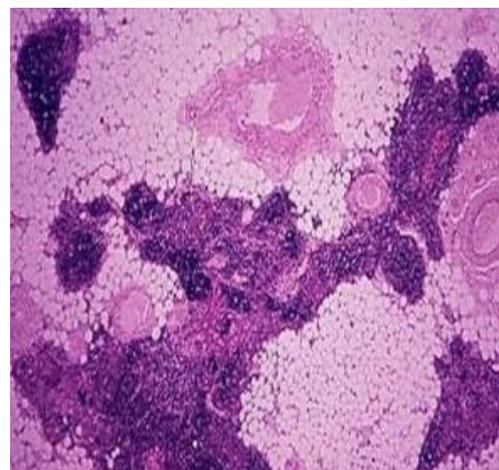
Thymus gland showing Hassall's corpuscles in medulla

Hassall's corpuscle⁴

Hassall's corpuscle consist mass of degenerated reticular cells surrounded e concentric layers of epithelial reticular cells

Thymus gland of adult Formed by:

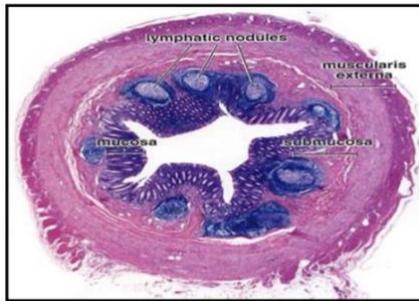
- * Fibrous & adipose tissue.
- * Few lymphocytes, \downarrow ER cells.
- * \uparrow Hassall's corpuscles



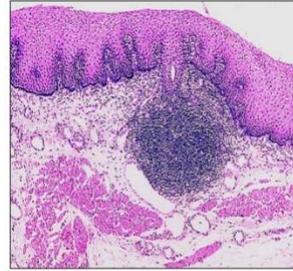
MALT- mucosa associated lymphoid tissue

- Collective name for the cells of the immune system in the mucosa of respiratory , alimentary , urogenital tracts
- Function : is to augment the mechanical & chemical barriers of surface mucosal epithelium
- Distribution : ✓ Tonsil ✓ Bronchus : BALT ✓ Gut: GALT

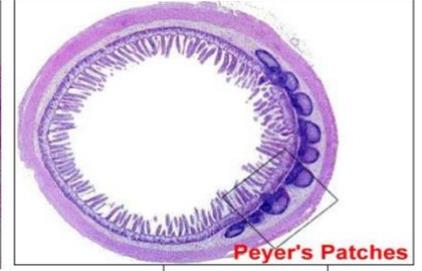
MALT Examples are: 1 .Payer's patches of ileum . 2. MALT of appendix.



MALT in appendix



MALT in wall of esophagus



MALT in ileum

ألا تضيع مُحاولاتنا عبثًا، أن يُبارك الله في الوقت والجهد القليل، أن
نصلَ لنهاية النفقِ دون حزنٍ آخر، نجد الطمأنينة قبل النور..

يا رب