

Co and Benjamin
Laboratory Manual in Animal Histology
2nd Ed

Laboratory Manual in Animal Histology (Biology 134)



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EXERCISE 8: THE IMMUNE SYSTEM

Introduction

The immune system is composed of lymphocytes that may be diffused in other organs or aggregated to form lymphoid organs. The former infiltrate the lamina propria of the mucosal epithelium of the respiratory and digestive organs. The latter consist of organs that are strategically located in our body so as to trap antigens and remove them.

I. The Histology of the Immune System

A. Lymph nodes – non-encapsulated ovoid bodies found in the axilla, groins, thorax, and mesenteries. Using LPO, note that it is enveloped by a capsule and is divided into an outer cortex and an inner medulla.

1. Capsule – a thick covering of fibrous connective tissue and a few smooth muscles. This extends halfway into the organ as the trabeculae seen as thick bands that partly divide the organ into several compartments.

- ❖ **Subcapsular Sinus** - a large cavity between the capsule and the cortex containing reticular cells, reticular fibers and macrophages.
- ❖ **Reticular cells** - can be distinguished from the macrophages by their small size and thin cytoplasmic processes.
- ❖ **Macrophages** – large and lightly-stained cells associated with the reticular cells.
- ❖ **Reticular fibers** – fine, thread-like structures not visible with H and E but stained black with silver impregnation.

2. Cortex - peripheral region which appears as light areas containing round bodies.

- ❖ **Cortical nodules** – round bodies composed of aggregated lymphocytes found in the outer cortex. Note that it has a basophilic region and a central light region. The former is composed of tightly packed B lymphocytes but only their darkly-stained nuclei can be discerned. **What kind of cells can you find in the germinal center?**

- ❖ **Inner Cortex** – light region between the medulla and the outer cortex. It is composed of T-lymphocytes and a few lymph nodules.

3. Medulla – light central portion of the lymph node containing B-lymphocytes and irregular sinuses.

- ❖ **Medullary Cords** – highly basophilic rod-like structures that give off short branches. These are aggregated B-lymphocytes and plasma cells.
- ❖ **Medullary Sinuses** – narrow and highly irregular spaces lined by reticular cells and macrophages. These minute channels are interrupted by large medullary cords.

4. Hilum – indented region on the medial region of the lymph node. This is characterized by the presence of nerves, blood vessels and efferent lymphatic vessel.

A. Spleen-ovoid body which is the largest of the lymphoid organs. Using a scanner, an overview of this organ would show it to be almost identical in appearance with the lymph node.

1. Capsule – has fibroelastic components and smooth muscles. It also extends into the organ as trabecula.

2. White Pulp – refers to the white spots or gray nodules visible on the cut surface of the fresh spleen. Under the microscope, they appear as small or large rounded bodies similar to lymph nodules. The outer peripheral region is also basophilic due to high concentration of small lymphocytes. The central region appears light having few and scattered macrophages and B-lymphocytes.

- ❖ **Central Arteries** – small branches of arteries which are located in the white pulp. Usually, there is a single central artery per nodule but two or three central arteries may be observed in white pulps near the trabeculae.
- ❖ **Periarterial Lymphatic Sheath (PALS)** – a thin layer of T-lymphocytes immediately surrounding the central artery.

3. Red Pulp – region outside the white pulps and trabeculae. This appears as deep red when the organ is cut on the surface owing to the presence of circulating blood. In this region are two components:

- ❖ **Bilroth's Cords** – dark bands composed of a meshwork of reticular cells and reticular fibers associated with a variety of cells: T and B-lymphocytes, macrophages, plasma cells and other types of blood cells.
- ❖ **Venous Sinuses** – minute channels seen as elongated cavities lined with reticular cells. They occupy the spaces between the white pulp and the cells of the red pulp. They are best seen when using HPO. Focus on one area of the red pulp near the Bilroth's cord and examine the cells in it. Look for the macrophages and notice their close interaction with the RBC. **What does it signify?**

C. Thymus-large bilobed organ located in the mediastinum. This is unique among other lymphoid organs in having lobules but no lymph nodules and sinuses. Under LPO, observe the organization of the thymus into two main parts. Identify the following:

1. Capsule – fibrous connective tissue that enveloped the entire organ. It extends deeply into the parenchyma as the trabeculae, thus separating the lobules from each other.

2. Lobules – polyhedral structures of varied sizes filling the organ. Focus on one lobule under HPO and examine its components.

- ❖ **Cortex** – peripheral zone that is basophilic composed of dense population of T-lymphocytes and a few reticular cells and macrophages. Active cell proliferation occurs in this region. Adipose tissues are also found in this region which increases in number with advancing age. Other cells such as monocytes and eosinophils may be observed in this region.

- ❖ **Medulla** – pale-staining region owing to the predominance of large epithelial reticular cells. Note that in some lobules, there is continuity of medulla with adjacent lobules.

3. Epithelio-Reticular Cells (ERC) – large pale staining cells with prominent nucleoli. They are quite few in the cortex. Thin sections of these cells reveal that they possess several, long cytoplasmic processes that about one another. However, they are not associated with reticular fibers as in the other lymphoid organs.

4. T-lymphocytes – have prominent, dark nuclei and an indistinct thin cytoplasm. Mostly, small lymphocytes are found and a few medium and large lymphocytes.

5. Hassal's Corpuscles – round acidophilic structures composed of concentrically arranged flattened epithelio-reticular cells. These cells appear heterogenous as they undergo various stages of degeneration and hyalinization forming keratinized and calcified cells. These bodies are characteristic features of the medulla of thymus. Their size and number increase in adults.

D. Tonsils- a ring of lympho-epithelial tissues at the entrance to the pharynx. There are three kinds of tonsils.

1. **Palatine Tonsil** – paired clusters of lymphoid tissues on the lateral walls of the pharynx.

- ❖ **Capsule** – dense connective tissue which surround the lymphoid tissue. Stratified squamous epithelium – located inner to the capsule and surrounding the parenchyma of the tonsil.

- ❖ **Crypts** – invagination of the epithelium which serve as septa subdividing it into incomplete compartments.

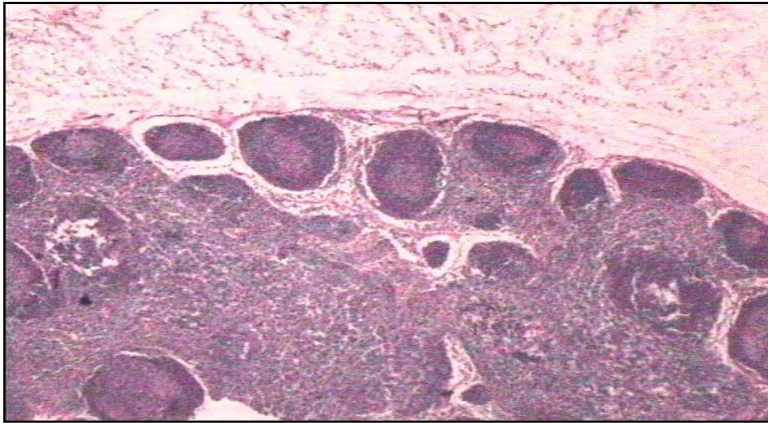
- ❖ **Lymphoid Nodules** – round bodies with dark peripheral region and light central region. There numerous lymphoid nodules which almost fill the organ.

2. Pharyngeal Tonsil – differs from the palatine tonsil in having pseudostratified columnar epithelium that form deep folds rather than crypts.

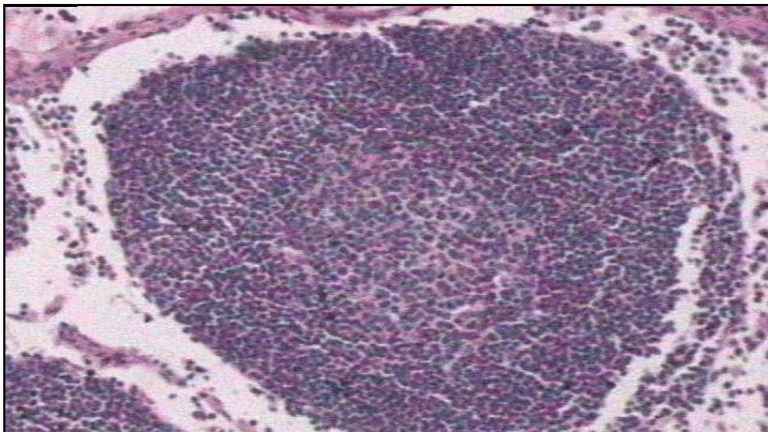
3. Lymphoid nodules - larger and fewer than those in palatine tonsil and are confined to the peripheral region.

4. Lingual Tonsil – dense aggregation of small round bodies at the base of the tongue. These are lined by stratified squamous epithelium with only one crypt.

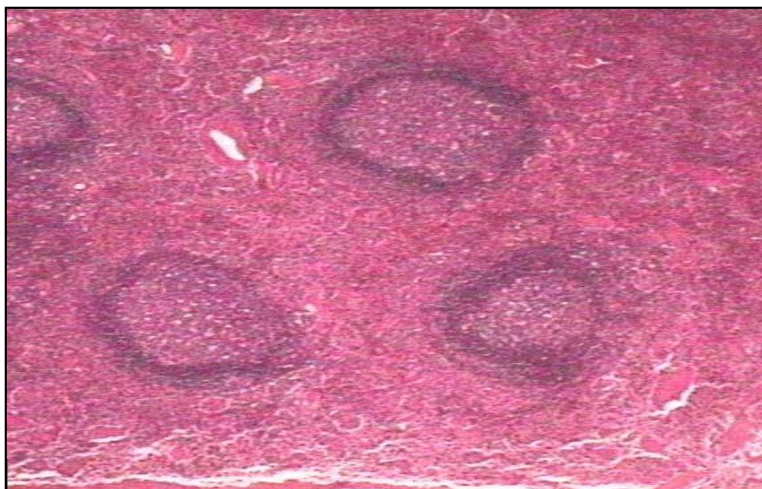
Illustrations



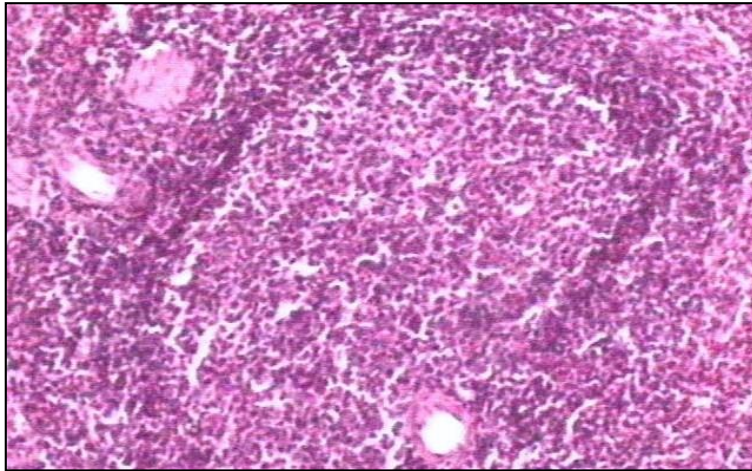
Lymph node (LPO)



Lymph nodule (HPO)



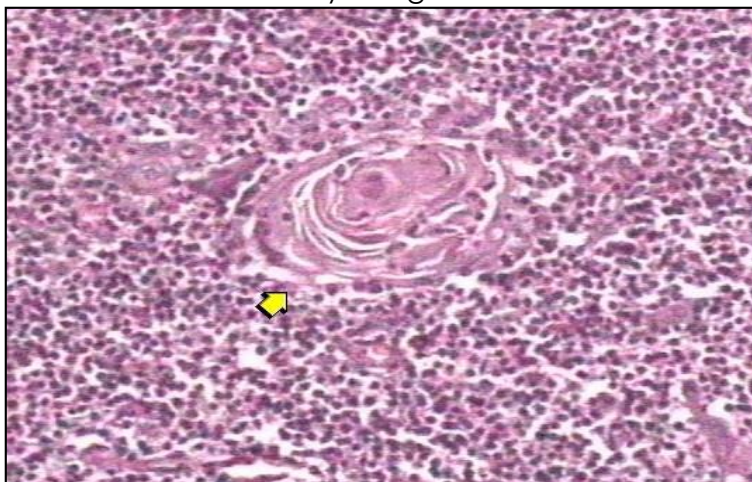
Spleen



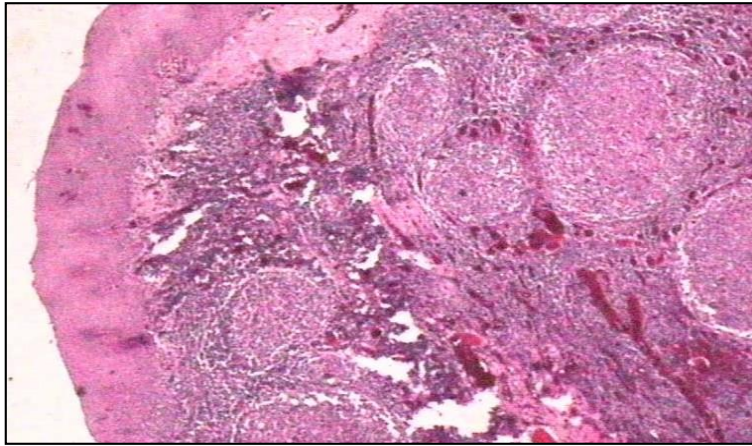
Central Artery (400x)



Thymus gland



Hassal's corpuscle



Tonsil

Guide Questions:

1. What structures are unique to the organs of the immune system?

2. What is the significance of reticular tissue and macrophages in the immune system?

3. What is the blood-thymus barrier? Why is this vital to the organism?
