Exercise 7
Lymphatic (Immune) System

Objectives:

After completing this exercise, you should be able to:

- Identify – different lymphatic organs in microscopic sections
- Identify – the different gut associated lymphatic tissues (GALT) in microscopic sections

Introduction:

The lymphatic system includes all cells, tissues and organs that contain lymphocytes. The lymphocytes are distributed throughout the body either as isolated aggregates of cells, as distinct non-encapsulated lymphatic nodules in the loose connective tissue, or as encapsulated individual lymphoid organs.

In this laboratory exercise we will examine the spleen, lymph nodes, tonsils, the aggregated lymphatic nodules of the digestive tract (commonly called Peyer’s patches), and their avian equivalent; the bursa of Fabricius.

Spleen:

The spleen is enclosed by a dense connective tissue capsule from which connective tissue (trabeculae) extend deep into the spleen. Located in the trabeculae are the trabecular arteries and trabecular veins. Trabeculae that are cut in transverse sections appear round. Look for them in your sections.

On microscopic examination (low power) the spleen appears to consist of discrete nodules, the white pulp, embedded in a matrix called the red pulp. The white pulp consists of lymphoid aggregations and the red pulp, making up the bulk of the organ, is a highly vascular tissue rich in venous sinuses.

The white pulp nodules exhibit a peripheral zone, densely packed with small lymphocytes, in a germinial center, which may not always be present, and an eccentric arteriole. The red pulp, its major constituent being the parenchyma, is permeated by broad interconnected venous sinuses.

Accounts of the histology of the spleen vary according to the animals models used, all being somewhat different from the human spleen. There is also considerable variation between individuals and in the same individual under different physiological and immunological circumstances.

List of slides – Spleen

L-25 Primate
L-26 Mammal
L-27 Cat
L-28 Human
L-29 Monkey, t. s.
L-30 Human, t. s.
L-31 Frog
L-32 Perch
L-33 Amphibian
L-34 Amphibian, t. s.
L-36 Reticular tissue

REVIEW BOX SLIDE 93
Thymus Gland:

The thymus gland is a lobulated lymphoid organ. It is enclosed by a connective tissue capsule from which arise numerous trabeculae. The trabeculae extend into, and subdivide the thymus gland into incomplete lobules. Each lobule consists of a dark staining outer cortex and a light staining inner medulla. Because the lobules are incomplete, the medulla exhibits continuity between neighboring lobules. The cell types in the cortex and medulla are the same, but their distribution is not uniform. The cortex of each lobule contains numerous densely packed lymphocytes without forming lymphatic nodules. In contrast, the medulla contains fewer lymphocytes but more epithelial reticular cells. The medulla also contains numerous thymic (Hassall’s) corpuscles, resulting from the degeneration of epithelio-reticular cells. These degenerating cells organize themselves into concentric eosinophilic whorls of material that seem to be nothing more than debris.

The histology of the thymus varies with the age of the individual. The gland attains its greatest development shortly after birth but by puberty it begins to involute. Lymphocyte production declines, Hassall’s corpuscles become larger and the parenchyma of the gland is gradually replaced by loose connective and adipose tissue.

List of slides – Thymus

L-19 Mammal
L-20 Mammal
L-21 Infant
L-22 Aging
L-23 Monkey, t. s.
L-24 Human, t. s.

REVIEW BOX SLIDE 97

Lymph Nodes:

The lymph node is the most organized of the lymphatic organs. Grossly, they are shaped somewhat like beans, with a depression on one side: the hilus. Blood vessels enter and leave the lymph node at the hilus, but lymphatic vessels enter at the periphery.

Lymph nodes have a discrete CT capsule which sends trabeculae deep into the volume of the organ. The capsule acts as an overall envelope for the node, and also as a route of entry for lymphatic vessels. It is composed of dense irregular collagen with a few elastic fibers as well.

A delicate CT stroma arises off the trabeculae to support the very cellular parenchyma, consisting almost wholly of lymphocytes. The fibers of the stroma arise from, and are anchored to the trabeculae and to the inner surface of the capsule. The stroma consists of reticular fibers and the cells which make them, the reticulocytes, which are a form of fibroblast. The fibers and their covering reticulocytes form a complex web work that crisscrosses the greatest part of the volume of the node, especially the cortical region. These fibers also traverse the sub capsular space and the sinus.

The parenchyma of the lymph node is packed with lymphocytes. It is divided into a cortex and a medullary region, with the boundary between them rather indistinct. Lymphocytes fill the bulk of its volume. They are supported by the complex 3-D latticework of the stroma. Macrophages are scattered throughout the parenchyma.

The cortex is densely packed with cells, and usually shows nodular lymphoid tissue, discrete locations where lymphocyte proliferation is taking place in germinal centers. In the medulla the parenchyma takes on the structure of anastomosing cords of cells, separated by lymph sinuses.
Other Lymphatic Organs:

A few of what might be called “miscellaneous lymph organs” are scattered in various places in the body. While unorganized masses of diffuse lymphatic tissue can be found in almost any CT or any epithelial organ, in these “miscellaneous organs” it has a regular organization into nodular lymphoid tissue, often showing a germinal center.

**Tonsils**

Tonsils are found in association with the oral cavity, and can be easily identified by their surface covering of stratified squamous epithelium. The gross structure of a tonsil is what you might get if you pushed your extended fingers into modeling clay, deep crypts, with lymphoid tissue filling the spaces between them. The cells types are the same as those seen in other lymphoid organs, including lymphocytes, macrophages and plasma cells. Germinal centers are common.

**Lymphatic Nodules of the Ileum**

In the sub mucosal parts of the ileum (the CT layer separating the lining epithelium from the outer muscular coats) there are aggregates of lymphoid tissue, classically called Peyer’s patches (after Johann K. Peyer, Swiss anatomist). These structures are large enough to be visible with the naked eye as whitish areas on that side of the intestine, opposite to its mesenteric attachment.
**Avian Bursa**

The bursa of Fabricius (Giralamo Fabrizi, Italian anatomist) is an organ peculiar to birds. This is a blind, sac-like structure on the caudo-dorsal side of the cloaca. Like the tonsil, it is a number of blind, crypt-like invaginations. Its appearance is at first glance similar to the thymus and in some way it performs a thymus-like function. It is involved in conferring immuno-competence on the avian – equivalent of B-cells in birds. The aggregated lymphatic nodules of the ileum are mammalian equivalent of this organ.

The free surface of the avian bursa is covered with stratified columnar epithelium, not stratified, and squamous, which makes it easy to distinguish the bursa from the tonsils or the thymus. Most of the cells in it are lymphocytes.

**List of slides – Bursa**

L-37  Bursa of Fabricius, bird

**Diffuse lymphatic tissue**

There are lymphatic tissue aggregates in the gastrointestinal tract and respiratory system. Together with tonsils and Peyer’s patches, this diffuse tissue is known as gut associated lymphatic tissue (GALT). See if you can identify this tissue in the following:

BOX SLIDES 39, 41, 42, 43, 50