

Urinary System

Slide 151

This is a slide of the kidney of a small primate showing one lobe of the kidney. The medulla is at the center with the cortex surrounding it. There is a very small hilum just to left of the center. First, focus on the cortex and examine the medullary rays, which form the central axis of a renal lobule. This structure consists of relatively straight tubules in the medulla. In between the medullary rays are the regions of the cortical labyrinth. Examine a renal corpuscle, looking for some where the vascular pole is visible, with afferent and efferent arterioles. Observe the capillaries with podocytes and mesangial cells. Try to identify the macula dense of a distal tubule where the distal tubule abuts the arterioles at the vascular pole. Examine the very thin epithelium of Bowman's capsule and try to find a urinary pole where the uriniferous space empties into a proximal convoluted tubule. Try to identify some interlobular arteries in the mid-position between medullary rays. In the medulla, identify the collecting ducts as well as thin limbs of the loop of Henley and some peritubular capillaries. Also, observe the interstitial tissues. At the tip of the medullary pyramid, where the papilla projects into the calyx, notice the urothelium. The calyx has smooth muscle as well. Observe that the rest of the hilum is filled with blood vessels and fat.

Slide 152

This is a slide of a unilobar kidney. At low power you can see the zones, including the cortex, outer medulla (with outer and inner stripes), inner medulla, papilla, calyx and some of the ureter. Again examine the features of the renal corpuscles in the cortical labyrinth. Observe the proximal and distal convoluted tubules. The proximal tubules have somewhat larger cells with redder cytoplasm. The medullary rays are quite prominent, as are interlobular arteries and veins. In the outer medulla, identify the thin limbs of Henley and the capillaries, which often contain some red blood cells. The collecting ducts have very uniform cells with fairly clear borders between cells due to their interdigitating membranes. These are easiest to see down towards the papilla. Gradually these collecting tubules become larger near the papilla where they drain into the calyx. Notice that the calyx is lined by urothelium, which is relatively well preserved in the specimen. Also, examine the ureter at the left of the slide.

Slide 26

This slide of the kidney, stained with PAS, shows the tubules very nicely. Since PAS stains basement membrane, the tubules are very nicely outlined. Also, the glomerular capillaries are very well seen with their basement membranes between them and the podocytes. Examine the glomerulus, visualize proximal

and distal convoluted tubules and try to identify a macula densa. Follow a medullary ray (which is a cortical structure) into the medulla and observe the structure of the collecting ducts and the very thin walled structures that comprise the afferent and efferent arterioles and thin limbs of Henle. These thin limbs and capillaries are most visible towards the apex of the specimen.

Slide 154

Examine the layers of the ureter. The epithelium is very well preserved. Notice that this is supported by a lamina propria and then extensive smooth muscle that consists of bundles and does not have a very uniform organization.

Slide 42

This slide contains two specimens that are not very well preserved. The lower side of each of these specimens shows urothelium. Notice how thin it is in the distended bladder at the top while there are many more layers in the bottom section, where it almost appears like a stratified squamous epithelium. Notice that the bladder has an adventitia with a muscularis layer that is somewhat irregular but is usually described as consisting of 3 layers. There is a lamina propria between the muscularis and the epithelium.

Slide 31

This slide shows the urothelium quite nicely as well as the lamina propria. Observe the several layers in the muscularis.

Lymphoid

Slide 117

This slide is of human infant thymus (one of the primary lymphoid organs. is a typical H&E stained section. Define **cortex** and **medulla** and observe that the thymus is partially divided into lobules by connective tissue septa derived from the gland capsule. N.B. these are NOT lymphoid follicles. Next, study the cortex. Note that most of the cells (**thymocytes**) look like small T-lymphocytes and are packed rather tightly together with a few interspersed large cells having large pale staining nuclei. The latter are the **epithelial (reticular) cells (or epithelioreticular cells)** of the thymus. Examine the medulla. Note that overall there are fewer cells in this zone compared to cortex. The lymphocytes here are mostly immunocompetent but naive (virgin) **T cells** that have passed the selection process. How will they leave the thymus? The medulla is more heterogeneous in appearance, containing in addition to lymphocytes many macrophages, “epithelioreticular cells”, abundant blood vessels and usually some

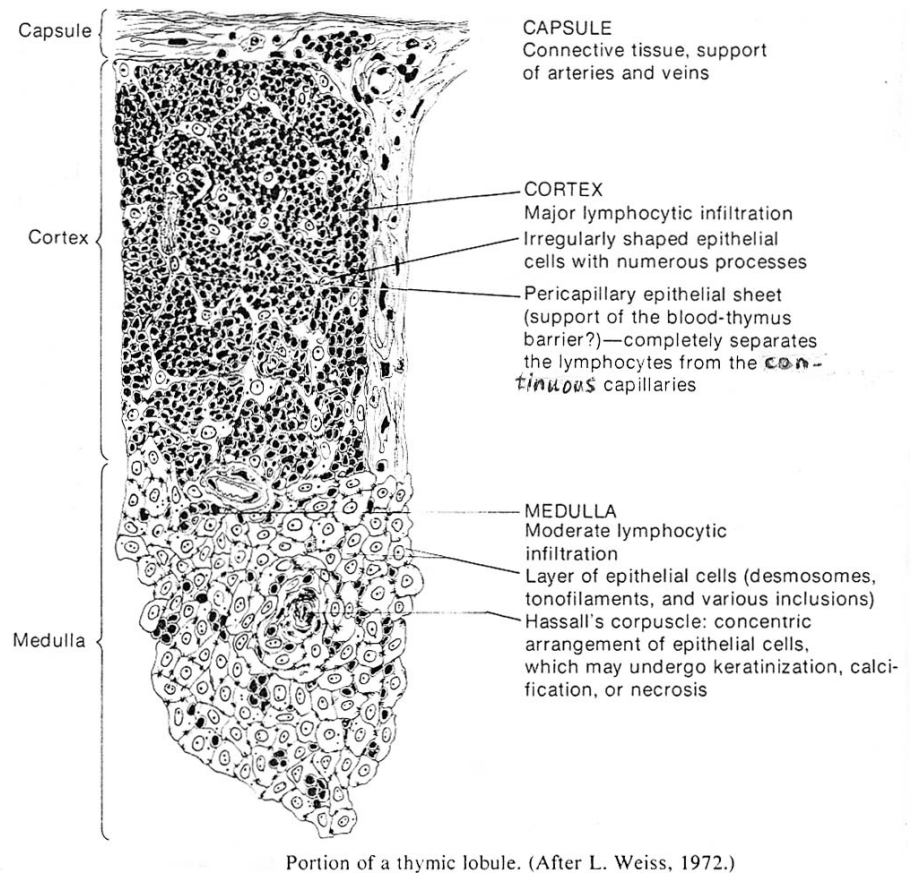
thymic (Hassall's) corpuscles. The latter are balls of squamoid epithelial cells that are usually keratinized and often contain keratohyaline granules. They probably are formed from defunct epithelioreticular cells, but their function is still unknown.

Slide 118

This is a 1.5 μm thin section of thymus stained by a technique similar to H&E. It is from a more mature animal, so the cortex is diminished and thymic corpuscles are more abundant in the medulla. Otherwise, look for the same features as described above. Because this is a thinner section and tissue is better preserved, more cellular detail is visible. Look for the peculiar capillaries in the cortex contributing to the **blood-thymic barrier**.

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This is a section of an involuted adult human thymus. Note that the lymphoid tissue is substantially less abundant and is typically replaced by fibroadipose tissue (note the fat and connective tissue). Most important for histological identification is the fact that **Hassall's corpuscles** persist.



Slide 120

A **lymph node** ("gland") is an encapsulated lymphoid organ. This slide has longitudinal sections of one or more nodes and is good for general histological features. Identify **afferent and efferent lymph vessels** (some with valves), **capsule**, **subcapsular sinus** (and the abundant macrophages therein), **cortex** with **lymphoid nodules** and **medulla** with **medullary cords and sinuses**.

You can see the region of the hilum of two of these three lymph nodes.

Note that the cortex is divided into a superficial (containing nodules; "**B cell-dependent**") and a deep portion (**paracortex**; "**T cell-dependent**"). Note that lymph nodes are well supplied with both blood and lymph vessels. Look in the paracortex for **high endothelial venules** (HEV), the site where most circulating lymphocytes enter the node. If a small group of cells breaks off from a malignant tumor and enters a lymphatic vessel it will be filtered out by a lymph node, usually lodging in the subcapsular sinus.

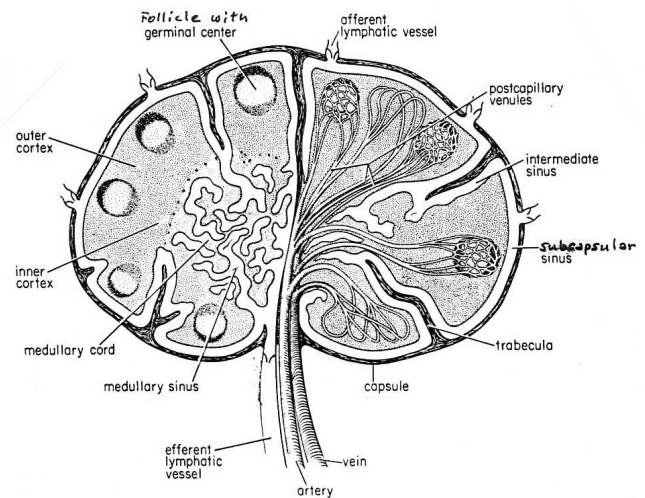


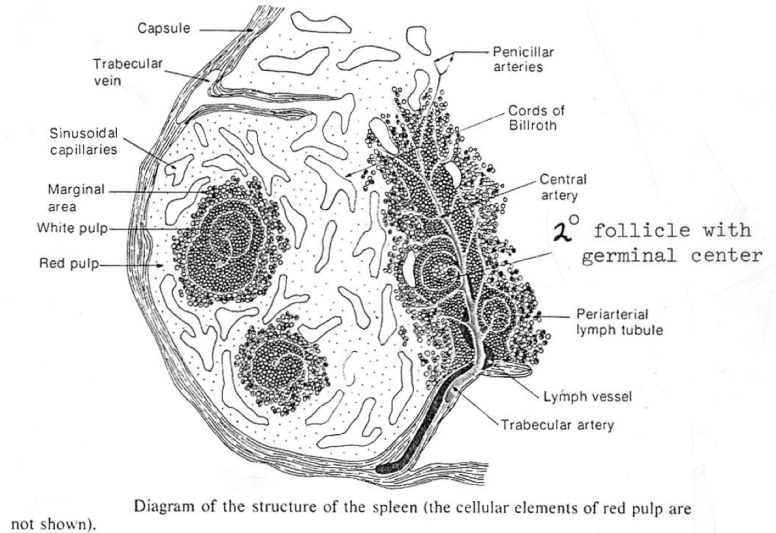
Diagram of the organization of a lymph node, with the parenchyma depicted on the left, and the blood supply on the right.

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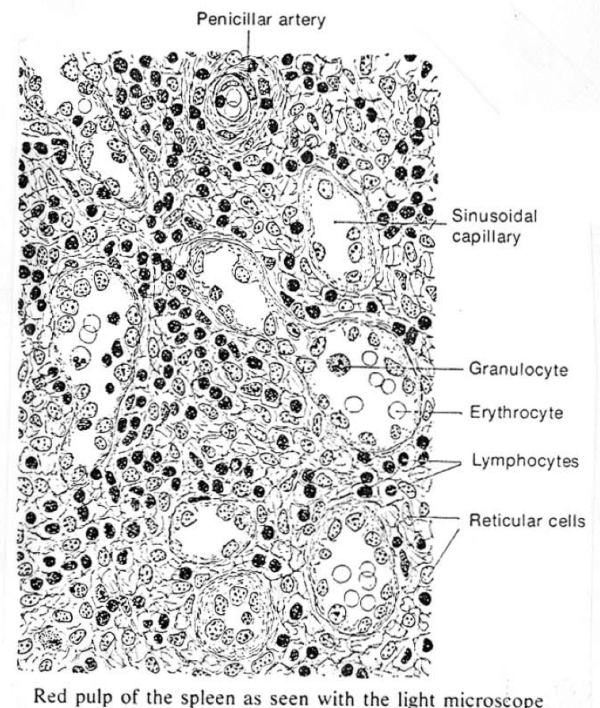
This section of plastic-embedded lymph node is much thinner than the previous one and is well suited for study of cellular detail. Look at the **germinal centers** of the **secondary follicles** in the cortex. The largest nuclei are those of the macrophages and **follicular dendritic cells**; in the cytoplasm of some of these cells there are often small particles of foreign material ("tingible bodies"). Other large nuclei (often with prominent nucleoli) are those of large activated lymphocytes on their way to becoming plasma cells or B memory cells. Nuclei of reticular cells are less obvious. See any mitotic figures? Examine the medulla. Here you can find lymph-filled sinusoids (the lymph is eosinophilic [pink] and homogeneous) that contain variable numbers of lymphocytes, some polymorphonuclear leukocytes, and occasional plasma cells. Macrophages, lymphocytes and some plasma cells can be found in the medullary cords that separate the sinusoids. Many of the macrophages have finely vacuolated cytoplasm. Finally, look for blood vessels and identify arteries, veins, and venules in the node. Other vessels, along with nerves, fat and fibrous connective tissue is seen adjacent to the node.

Slide 122

This is a relatively thick section of human spleen, but shows the general features well. First, identify the **capsule** and **trabeculae**. Note that the largest trabeculae contain both arteries and veins whereas those of intermediate size contain only veins. Scattered smooth muscle cells may be seen within the substance of the trabeculae. A reticular cell stroma provides support for the central regions of the spleen. Next, identify the areas of **red** and **white pulp**. Note that the white pulp is arranged so as to surround small (central) arteries thus forming a **periarterial lymphatic sheath (PALS)**. The PALS is mainly populated by **T cells**. In places **lymphoid nodules** with **germinal centers** may develop next to the PALS, in which case the **central artery** appears eccentrically-located. As in lymph nodes, these nodules are the focus of **B cells**. In the intervening red pulp you will see cellular strands, the **splenic cords** (of Billroth) separating large, thin-walled **sinusoids**. You should be able to trace the flow of blood through the spleen from trabecular arteries to trabecular veins. What is the significance of the “closed” vs. “open” circulation discussion?

Slide 123

This is a thin section of monkey spleen and shows cellular detail reasonably well. Define the **red** and **white pulp**, **PALS**, and **germinal centers**. The cellular components of the latter are similar to those in lymph nodes. Examine closely the red pulp **sinusoids**. In those that are relatively free of blood you may be able to identify, at higher power, the characteristic elongated endothelial cells (“**stave cells**”). You may also see red blood cells and white blood cells squeezing through the spaces between these cells.



Red pulp of the spleen as seen with the light microscope

Slide 125

The **tonsils** (palatine, pharyngeal, and lingual) are incompletely encapsulated aggregates of lymphoid nodules that surround the entrance to the oral pharynx (tonsillar ring of Waldeyer). They are interposed in the path of both airborne and ingested pathogens. Not infrequently in young people they are “reactive” (enlarged) due to lymphocyte response to antigenic challenge. What types of epithelium characteristically covers the free surfaces of the pharyngeal tonsils? Note the well-developed “**crypts**” of the palatine tonsils. Observe the extensive diffuse and condensed aggregates of lymphoid tissue beneath the surface epithelium. Look for lymphoid nodules. The nodules are **B** cell domains, the internodular zones are **T** cell dominated. Tonsils typically have efferent but no afferent lymphatic vessels.

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Try to find some respiratory epithelium covering this pharyngeal tonsil. These are referred to as “adenoids” when abnormally enlarged, and can block the nasopharynx and auditory tube. Again, observe the aggregates of lymphoid tissue beneath the surface epithelium.

Slide 137

This slide of the appendix is stained with H&E and has both transverse and longitudinal sections. It serves as a good demonstration of the unencapsulated but aggregated nodular lymphatic tissue found in the lining mucosa of the digestive tract. Another example would be the **Peyer’s patches** located within the antimesenteric mucosa of the ileum [see **Slide 134**]. Other parts of the **gut-associated lymphatic tissue (GALT)** are more diffuse and may or may not develop nodules (e.g., **Slide 131 [Duodenum]**).