SPLEEN

The spleen is an ingeniously designed filter for the blood and a site of immune responses to blood-borne antigens. Normally in the adult it weighs about 150 gm and is enclosed within a thin, glistening, slate-gray connective tissue capsule. Its cut surface reveals extensive red pulp dotted with gray specks, which are the white pulp follicles. These consist of an artery with an eccentric collar of T lymphocytes, the so-called periarteriolar lymphatic sheath. At intervals this sheath expands to form lymphoid nodules composed mainly of B lymphocytes, which are capable of developing into germinal centers identical to those seen in lymph nodes in response to antigenic stimulation (Fig. 13-39).

The red pulp of the spleen is traversed by numerous thin-walled vascular sinusoids, separated by the splenic cords or "cords of Billroth." The endothelial lining of the sinusoid is discontinuous, providing a passage for blood cells between the sinusoids and cords. The cords contain a labyrinth of macrophages loosely connected through long dendritic processes to create both a physical and a functional filter. As it traverses the red pulp, the blood takes two routes to reach the splenic veins. Some flows through capillaries into the cords, from which blood cells squeeze through gaps in the discontinuous basement of the endothelial lining to reach the sinusoids; this is the so-called open circulation or slow compartment. In the other "closed circuit," blood passes rapidly and directly from the capillaries to the splenic veins. Although only a small fraction of the blood pursues the "open" route, during the course of a day the entire blood volume passes through the cords, where it is closely examined by macrophages.

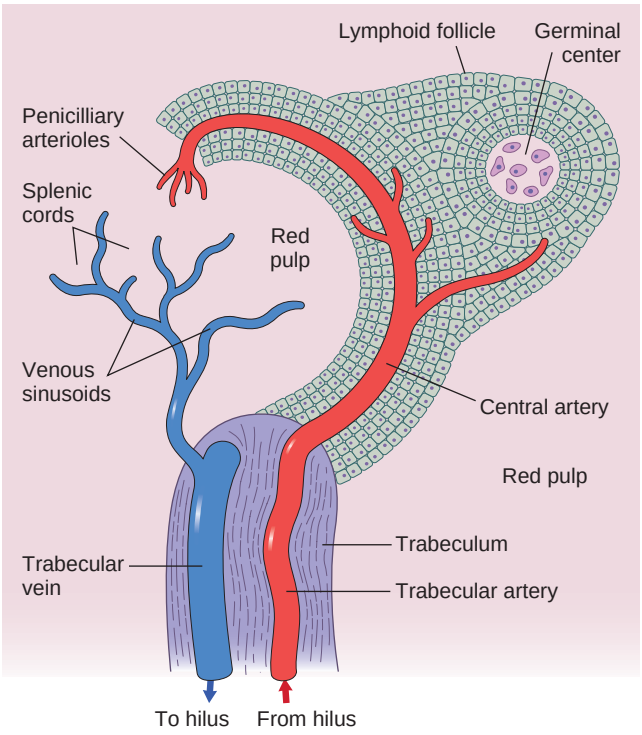

Figure 13-39 Normal splenic architecture. (Modified from Faller DV: Diseases of the spleen. In Wyngaarden JB, Smith LH (eds): *Cecil Textbook of Medicine*, 18th ed. Philadelphia, WB Saunders, 1988, p 1036.)

The spleen has four functions that impact disease states:

1. *Phagocytosis of blood cells and particulate matter.* As is discussed under the hemolytic anemias (Chapter 14), red cells undergo extreme deformation during passage from the cords into the sinusoids. In conditions in which red cell deformability is decreased, red cells become trapped in the cords and are more readily phagocytosed by macrophages. Splenic macrophages are also responsible for "pitting" of red cells, the process by which inclusions such as *Heinz bodies* and *Howell-Jolly bodies* are excised, and for the removal of particles, such as bacteria, from the blood.
2. *Antibody production.* Dendritic cells in the periarterial lymphatic sheath trap antigens and present them to T lymphocytes. T- and B-cell interaction at the edges of white pulp follicles leads to the generation of antibody-secreting plasma cells, which are found mainly within the sinuses of the red pulp. The spleen seems to be an important site of production of antibodies against microbial polysaccharides, as well as autoantibodies against a variety of self antigens.
3. *Hematopoiesis.* During fetal development, the spleen may be a minor site of hematopoiesis, but this normally disappears by birth. However, the spleen can become a major site of compensatory extramedullary hematopoiesis in the setting of severe chronic anemia (e.g., in patients with thalassemia, described in Chapter 14) and in patients with myeloproliferative disorders, such as chronic myelogenous leukemia and primary myelofibrosis.
4. *Sequestration of formed blood elements.* The normal spleen contains only about 30 to 40 mL of red cells, but this volume increases greatly with splenomegaly. The normal spleen also harbors approximately 30% to 40% of the total platelet mass in the body. With splenomegaly up to 80% to 90% of the total platelet mass can be sequestered in the interstices of the red pulp, producing thrombocytopenia. Similarly, the enlarged spleen can trap white cells and thereby induce leukopenia.

As the largest unit of the mononuclear phagocyte system, the spleen is involved in all systemic inflammations, generalized hematopoietic disorders, and many metabolic disturbances. In each, the spleen undergoes enlargement *(splenomegaly)*, which is the major manifestation of disorders of this organ. It is rarely the primary site of disease. Splenic insufficiency due to splenectomy or autoinfarction (as in sickle-cell disease) has one major clinical manifestation, an increased susceptibility to sepsis cause by encapsulated bacteria such as pneumococci, meningococci, and *Haemophilus influenzae*. The decrease in phagocytic capacity and antibody production that result from asplenia both contribute to the increased risk of sepsis, which may be fatal. All asplenic individuals should be vaccinated against these agents to reduce the risk of this tragic complication.