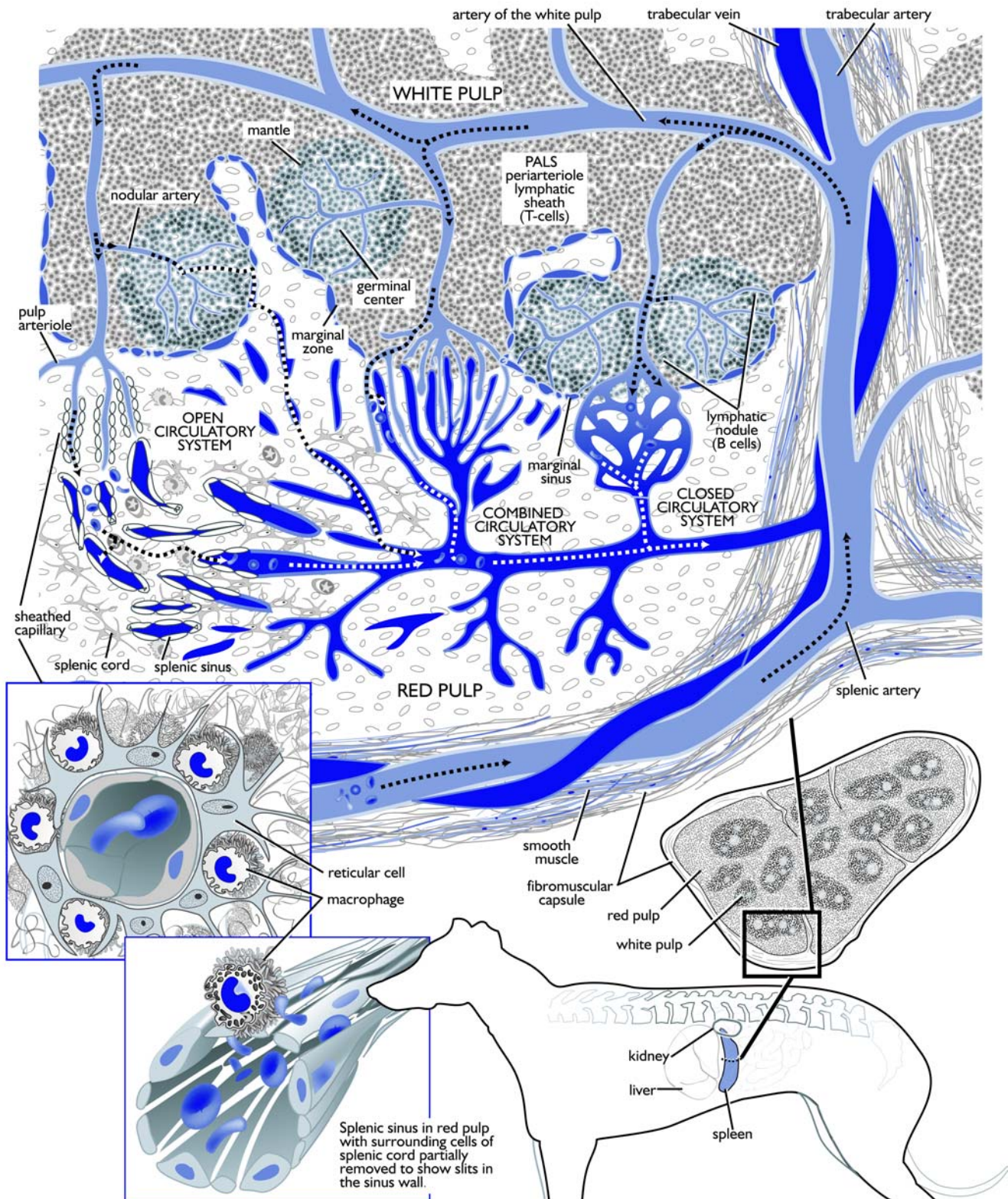


# Ch21

## Spleen



## Overview

- The spleen has both red pulp consisting of splenic cords and blood-filled sinuses and white pulp containing large numbers of lymphocytes.
- The white pulp forms periarteriolar lymphatic sheaths and lymphatic nodules around blood vessels entering the spleen.
- T lymphocytes predominate in the PALS while B lymphocytes predominate in nodules.
- In closed circulation through the spleen, blood empties from the vessels of the white pulp into sheathed capillaries of the red pulp and then directly into the sinuses.
- In open circulation, blood empties from the sheathed capillaries into the splenic cords and then enters the sinuses through slits in the wall.

The spleen filters and stores blood, participates in blood cell formation in the fetus, and removes spent erythrocytes. An immune response against blood-borne antigens is also mounted by the spleen.

Lymphatic nodules are scattered throughout the parenchyma of the spleen. A defined cortex and medulla found in other organs of the immune system is not present. Instead, the spleen is organized as **red pulp**, consisting of blood-filled sinuses and cords of splenic cells, or **white pulp**, containing large numbers of lymphocytes. White pulp is abundant in a so-called defensive spleen while red pulp predominates in a storage spleen.

## Capsule of the Spleen

The spleen is surrounded by a connective tissue capsule with variable amounts of smooth muscle, depending on the species. Smooth muscle may relax when barbiturate anesthesia is administered, causing the capsule to expand and allowing the spleen to engorge with blood. The capsule can also contract, forcing stored blood into peripheral circulation. Connective tissue trabeculae extend from the capsule into the parenchyma.

## White Pulp of the Spleen

The white pulp is comprised of **periarteriolar lymphatic sheaths** (PALS) and **lymphatic nodules** with associated efferent lymphatics. Large numbers of lymphocytes account for the basophilic staining. Reticular cells and reticular fibers form the supporting network for the white pulp.

PALS are sheaths of cells which surround arteries passing into the parenchyma from the connective tissue trabeculae. Adjacent to the tunica media of the vessel, T lymphocytes predominate. In the periphery of the sheath, both T and B lymphocytes, macrophages and dendritic cells are present.

Lymphatic nodules of the spleen are scattered along the blood vessels within the white pulp and may or may not have active germinal centers. B lymphocytes predominate in the nodules.

## Red Pulp of the Spleen

Splenic sinuses and cellular splenic cords form the red pulp. The sinuses are lined by longitudinal endothelial cells which can contract and allow gaps to form between the cells. Reticular fibers surround the fenestrated basement membrane of the endothelium and create supporting structure for the sinus wall.

Splenic cords form a network around the outside of the

sinuses. The cords contain erythrocytes, macrophages, plasma cells and lymphocytes within a framework of reticular cells and fibers.

## Marginal Zone of the Spleen

The marginal zone is located between the red and white pulp. Reticular cells surround the periphery of the white pulp and extend into the red pulp. Capillaries from the white pulp drain into venous sinuses of the red pulp at the marginal zone. Slow-flowing blood in the sinuses can then contact local macrophages and lymphocytes, and initiate an immune response.

## Blood Supply to the Spleen

Blood flows into the spleen via the splenic artery which then branches into trabecular arteries. As an individual **trabecular artery** emerges from the connective tissue, it is then known as the **artery of the white pulp** (central artery) which is surrounded by the PALS. The blood vessel continues into a lymphatic nodule as the **nodular artery**. The nodular artery becomes smaller and terminates in the marginal zone or forms a vascular tuft (penicillus) in the red pulp.

Blood vessels from the white pulp, known as **pulp arterioles**, continue in the red pulp as **sheathed capillaries**. The sheathed capillaries are surrounded by macrophages and a network of reticular cells and fibers.

Two theories predominate relative to the connection between the sheathed capillaries and the venous circulation. The **closed circulation theory** proposes that blood empties from the capillary directly into the splenic sinus. In the **open circulation theory**, blood empties into spaces between the reticular cells of the red pulp outside the sinus and then enters circulation through slits in the sinus wall. Another theory says that the methods of circulation alternate between closed and open based on physiologic need.

Blood then continues through the terminal sinuses or venule to exit the spleen through the trabecular vein.

## Blood Filtration Mechanisms in the Spleen

As blood passes through splenic sinuses, the endothelium of the sinuses traps defective erythrocytes and prevents their reentry into the blood. This process is termed **mechanical filtration**.

**Biological filtration** occurs as macrophages recognize non-functional blood cells and remove them from the splenic circulation.