

Spleen Anatomy and Physiology

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Spleen Overview

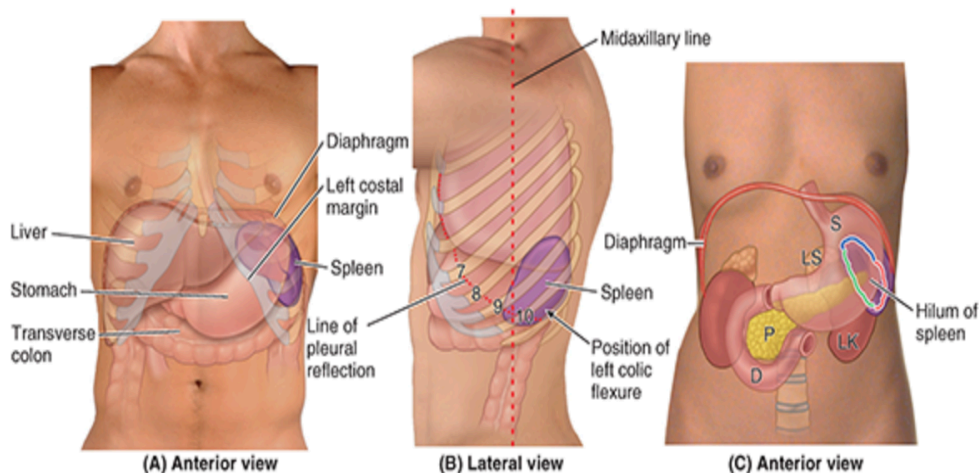
- The spleen is an ovoid, usually purplish, pulpy mass about the size and shape of one's fist.
- It is relatively delicate and considered the most vulnerable abdominal organ.
- Located in LUQ, or L Hypochondrium of the abdomen
- Protection of the inferior thoracic cage

Spleen Palpation

- Normally, the spleen does not extend inferior to the left costal margin.
- It is seldom palpable through the anterolateral abdominal wall unless it is enlarged.
- When it is hardened and enlarged to approximately three times its normal size, it moves inferior to the left costal margin.

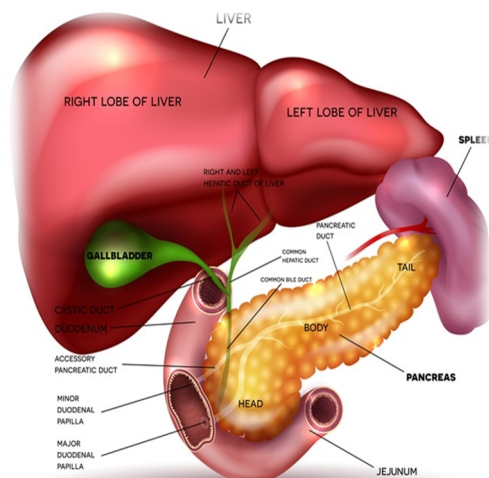
Spleen Relationship to Other Organs

- The spleen is a mobile organ, although it normally does not descend inferior to the costal (rib) region
- It rests on the left colic flexure which is also called the splenic flexure
- It is associated posteriorly with the left 9th–11th ribs (its long axis is roughly parallel to the 10th rib)
- The relations of the spleen are as follows:
 - Anteriorly, the stomach
 - Posteriorly, the left part of the diaphragm, which separates it from the pleura, lung, and ribs 9–11
 - Inferiorly, the left colic flexure
 - Medially, the left kidney



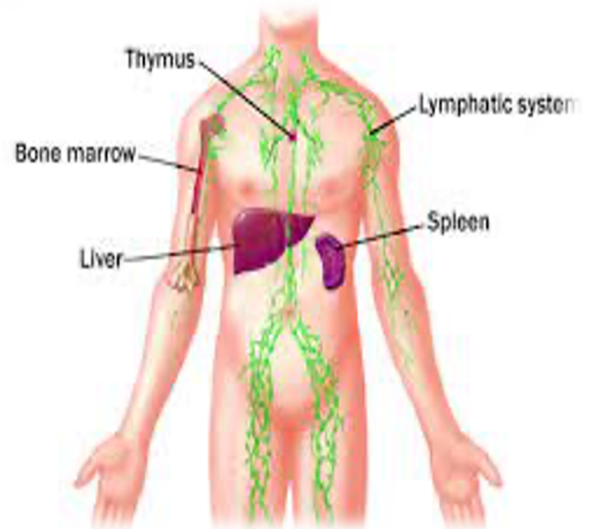
Spleen Size

- The spleen varies considerably in size, weight, and shape; however, it is usually approximately 5 inches long and 3 inches wide.
- A nonmetric memory device exploits odd numbers: The spleen is 1 inch thick, 3 inches wide, and 5 inches long and weighs 7 ounces.
- The diaphragmatic surface of the spleen is convexly curved to fit the concavity of the diaphragm and curved bodies of the adjacent ribs.
- The close relationship of the spleen to the ribs that normally protect it can be a detrimental one in the presence of rib fractures.



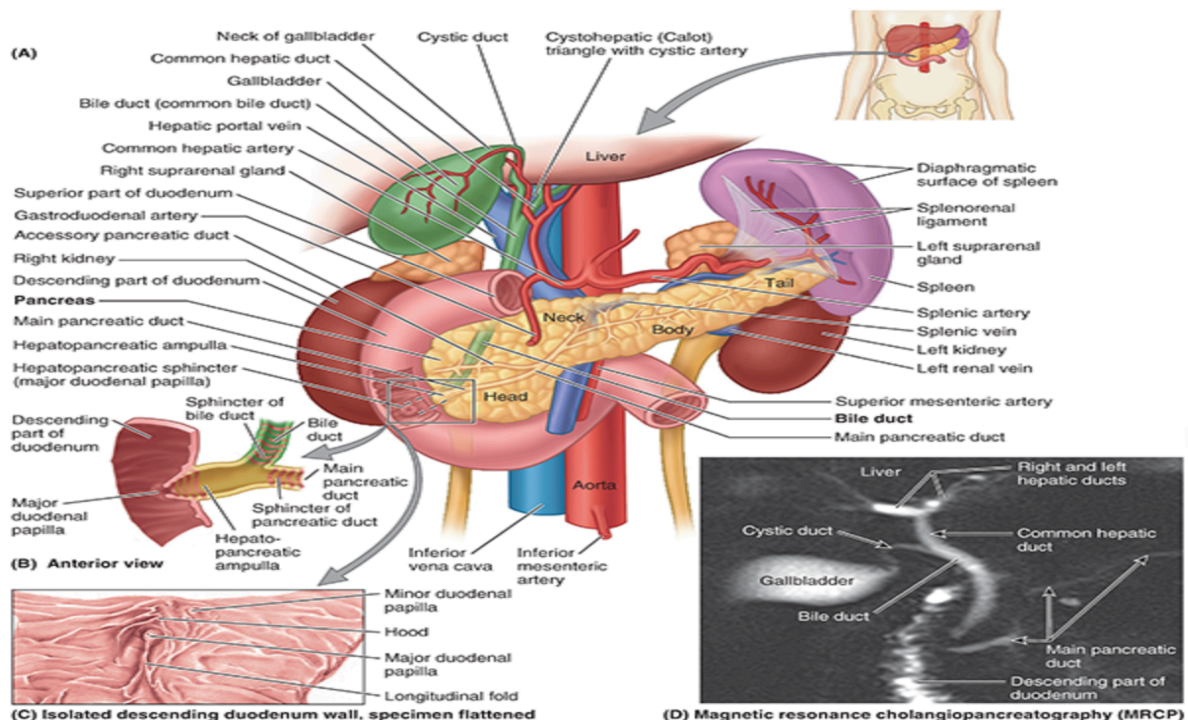
Lymphatic Organ

- As the largest of the lymphatic organs, it participates in the body's defense system as a site of lymphocyte (white blood cell) proliferation and of immune surveillance and response.



Spleen Vascularity

- Prenatally, the spleen is a hematopoietic (blood-forming) organ.
- After birth, it is involved primarily in identifying, removing, and destroying expended red blood cells (RBCs) and broken-down platelets and in recycling iron and globin.
- The spleen serves as a blood reservoir, storing RBCs and platelets.
- To a limited degree, can provide a sort of "self-transfusion" as a response to the stress imposed by hemorrhage.
- In spite of its size and the many useful and important functions it provides, it is not a vital organ (not necessary to sustain life). This has been a classical teaching for decades, but is now changing the treatment approach.
- The spleen is a soft, vascular (sinusoidal) mass with a relatively delicate fibroelastic capsule.
- The thin capsule is covered with a layer of visceral peritoneum that entirely surrounds the spleen except at the splenic hilum, where the splenic branches of the splenic artery and vein enter and leave.

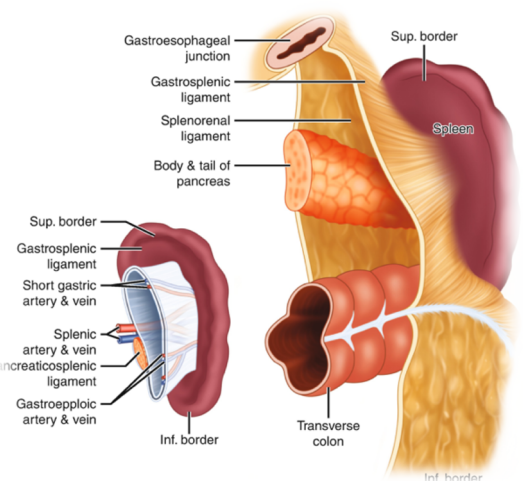


Spleen ligament attachment

- The spleen contacts the posterior wall of the stomach and is connected to its greater curvature by the gastrosplenic ligament and to the left kidney by the splenorenal ligament.

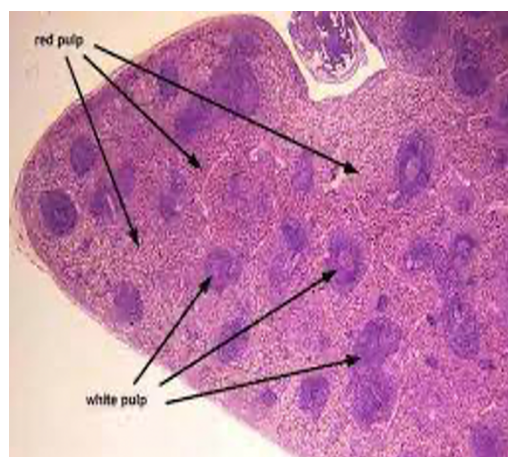
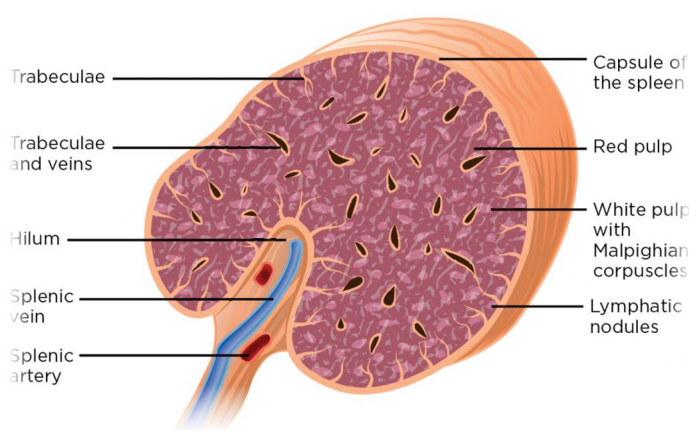
Spleen Internal Blood Supply

- The spleen normally contains a large quantity of blood (1 cup) that is expelled periodically into the circulation by the action of the smooth muscle in its capsule and trabeculae.
- The large size of the splenic artery (or vein) indicates the volume of blood that passes through the spleen's capillaries and sinuses.



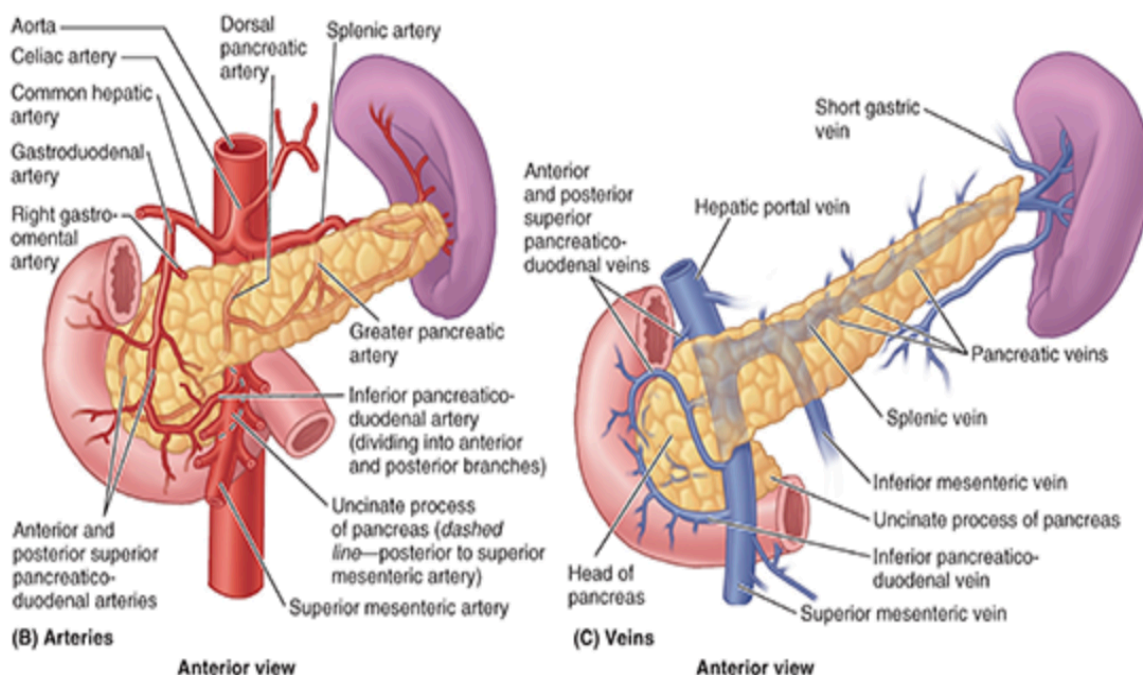
Spleen Internal Blood Supply

- The thin fibrous capsule of the spleen is composed of dense, irregular, fibroelastic connective tissue that is thickened at the splenic hilum.
- Internally, the trabeculae (small fibrous bands), arising from the deep aspect of the capsule, carry blood vessels to and from the parenchyma or splenic pulp, the substance of the spleen.
- The spleen contains two main types of tissue - white pulp and red pulp.
- White pulp is material which is part of the immune system (lymphatic tissue) mainly made up of white blood cells.
- Red pulp is made up of blood-filled cavities (venous sinuses) and splenic cords.



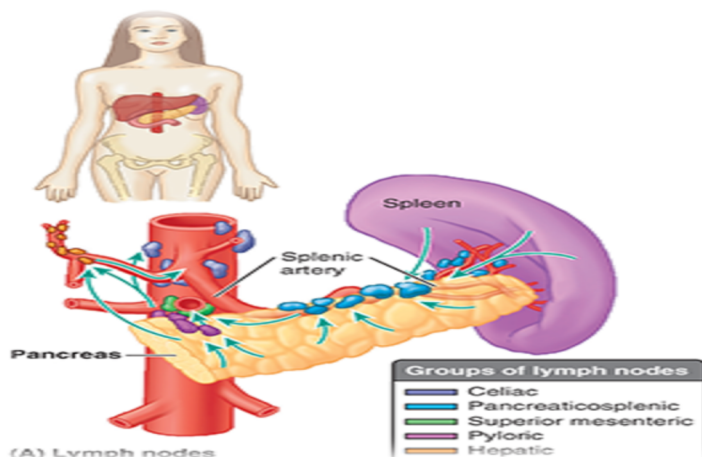
Spleen Arterial Supply

- The arterial supply of the spleen is from the splenic artery, the largest branch of the celiac trunk.
- Venous drainage from the spleen flows via the splenic vein, formed by several tributaries that emerge from the hilum.



Spleen Lymphatics

- The splenic lymphatic vessels leave the lymph nodes in the splenic hilum and pass along the splenic vessels to the pancreaticosplenic lymph nodes en route to the celiac nodes.



Spleen Nerve Supply

- The nerves of the spleen, derived from the celiac plexus, are distributed mainly along branches of the splenic artery.

Functions of Spleen

- The spleen was previously thought to be dispensable, increasing knowledge of its function has led to a conservative approach in the management of conditions involving the spleen.
- It is now recognized that an incidental splenectomy during the course of another operative procedure increases the risk of complication and death.
- The surgeon should therefore normally endeavor to preserve the spleen to maintain the following functions:
 - Immune Function
 - Filter Function
 - Reservoir Function
 - Cytopoiesis

Immune Function

- The spleen processes foreign antigens and is the major site of specific immunoglobulin M (IgM) production.
- The non-specific opsonins, properdin and tuftsin, are synthesized.
- These antibodies are of B and T cell origin and bind to the specific receptors on the surface of macrophages and leukocytes, stimulating their phagocytic, bactericidal and tumoricidal activity.

Filter Function

- Macrophages in the reticulum capture cellular and noncellular material from the blood and plasma.
- This will include the removal of platelets and outdated red blood cells.
- This process takes place in the sinuses and the splenic cords by the action of the endothelial macrophages.
- Iron is removed from the degraded hemoglobin during red cell breakdown and is returned to the plasma.
- Removed non-cellular material may include bacteria and, in particular, pneumococci.

Reservoir Function

- This function in humans is less marked than in other species, but the spleen does contain approximately 8 per cent of the red cell mass.
- An enlarged spleen may contain a much larger proportion of the blood volume.

Cytopoiesis

- From the fourth month of intrauterine life, some degree of hemopoiesis occurs in the fetal spleen.
- Stimulation of the white pulp may occur following antigenic challenge, resulting in the proliferation of T and B cells and macrophages.
- This may also occur in myeloproliferative disorders, thalassaemias and chronic hemolytic anemias.

Splenic Trauma

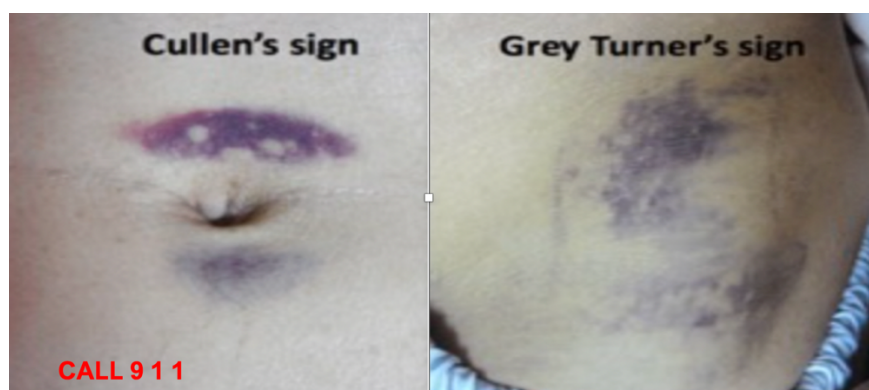
- Spleen is the most common organ to be injured in abdominal trauma.
- Etiology of trauma
 - Closed trauma - Direct, Indirect, & Spontaneous
 - Open trauma - Gun-shots, Puncture, & Iatrogenic (e.g. Gastrectomy)

Classic Presentation of Rupture Spleen

- Initial shock \longrightarrow Lucid interval \longrightarrow Internal hemorrhage
- Stage of Shock General
 - Tachycardia
 - Hypotension
 - Hypothermia
 - Decreased urine output

Findings in Spleen Rupture

- Local Findings in Spleen Rupture
 - Inspection - Ecchymosis, Bruises, Fracture of ribs, Abdominal distention
 - Palpation - Rigidity, Tenderness, Rebound tenderness
 - Percussion - Shifting dullness
 - Auscultation - Diminished intestinal sounds
- Special Signs in Spleen Rupture
 - Referred pain in Lt shoulder
 - Hyperesthesia form diaphragmatic irritation
 - Balance sign
 - Shifting dullness on Right side (free blood) + Fixed Dullness on Left side (clots, hematoma)
 - Cullen's sign: (late) Bluish discoloration around the umbilicus
- Bruising in this area can also be an alert to the following:
 - Aortic or carotid artery injuries
 - Rib, sternum, or collar bone fractures
 - Injury to the heart, lungs, or esophagus
 - Injury to any organ/muscle in the abdomen including but not limited to diaphragm; liver; pancreas; spleen; female organs, bowel; and pelvic bone.



Diagnosis of Spleen Rupture

- U/S & CT
 - Shows hematoma, free peritoneal bleeding
- Arteriography (diagnostic)
- Plain x-ray
 - Elevated left diaphragm
 - Indentation of fundic air bubble
 - Obliteration of Lt. psoas shadow
- Laboratory
 - CBC, Kidney Function Tests, Fasting Blood Sugar, Electrolytes

Delayed Type Spleen Rupture

- Initial shock → Long lucid interval up to 15 days → Internal hemorrhage
- This delay is due to sub-capsular hematoma that may rupture later
- The omentum seals the tear then retracts later
- Blood clot seals the vessel then dislodges when BP rises

Fatal Type Spleen Rupture

- Dies within short period
- Severely Shocked
- Associated with other visceral injury

Splenomegaly

- Splenomegaly is a common feature of many disease processes
- It should be borne in mind, however, that many conditions affecting the spleen, such as idiopathic thrombocytopenic purpura, may be associated with enlargement, but the gland is seldom palpable.
- Few conditions that cause splenomegaly will require splenectomy as part of treatment.

Splenomegaly Causes

- Infective
 - Bacterial - Typhoid, TB, Pyogenic, Abscess
 - Viral – Mono
 - Parasites – Malaria
- Blood Diseases
 - Leukemia
 - Anemia
 - Polycythemia
 - Hemolytic anemia
- Neoplastic
 - Lymphoma - most common
 - Hemangioma
 - Fibrosarcoma
- Congestive
 - Portal Hypertension
- Metabolic
 - Gaucher's - genetic fatty accumulation in organs
 - Amyloidosis
 - Rickets
 - Cystic Fibrosis
- Collagen Buildup
 - Felty's disease - complication of RA
 - Still's disease
- Huge Splenomegaly - enlargement of spleen crossing umbilicus
 - Myeloid Leukemia
 - Chronic Leukemia
 - Amyloidosis
 - Thalesemia

Hypersplenism

- It is a clinical syndrome that is characterized by
 - Splenic enlargement, and
 - Any combination of:
 - Anemias, leukopenia or thrombocytopenia
 - Compensatory bone marrow hyperplasia
- Improvement after splenectomy.
- Careful clinical judgement is required to balance the long and short-term risks of splenectomy against continued conservative management.

Primary Hypersplenism

- Etiology - Idiopathic
- Clinical Picture
 - Low WBC - fever, frequent infections, oral ulcers
 - Low RBC - pallor
 - Low platelets - petechiae & ecchymosis
- Blood work
 - Pancytopenia
 - Increased reticulocytes (indicating left shift)
- Treatment - Splenectomy

Secondary Hypersplenism

- Etiology - portal hypertension
- Treatment - splenectomy and vasoligation