MEDICAL EDUCATION RESOURCE

Spleen, Pancreas and Liver

? Spleen, Pancreas, and Liver – Spleen

Introduction

- The spleen is the **largest lymphoid organ** in the body.
- It acts as both a **blood filter** and a **reservoir**.
- Situated in the **left hypochondrium**, between the **fundus of the stomach** and the **diaphragm**.
- Lies along the **axis of the 10th rib**; long axis corresponds to the 10th rib.

External Features

- **Shape:** Ovoid, wedge-shaped.
- **Surfaces:**
  - **Diaphragmatic surface** — smooth, convex.
  - **Visceral surface** — concave; shows gastric, renal, colic, and pancreatic impressions.
- **Borders:**
  - **Superior border** — notched (diagnostically important).

    - **Inferior border** — rounded.

- **Poles:**
    - **Anterior pole** — broad, directed forward.
    - **Posterior pole** — pointed, directed backward.
- **Hilum:** Located on visceral surface; transmits **splenic artery, vein, and lymphatics**.

Relations

- **Anteriorly:** Stomach (fundus).
- **Posteriorly:** Diaphragm, left pleura, 9th–11th ribs.
- **Inferiorly:** Left colic flexure and phrenicocolic ligament.
- **Medially:** Left kidney and tail of pancreas (in lienorenal ligament).

Arterial Supply

- **Splenic artery**, the **largest branch of the celiac trunk**, tortuous course along superior border of pancreas.
- Divides into **5–6 segmental branches** before entering hilum.
- Each branch supplies a distinct splenic segment (no anastomosis ? *segmental resection possible*).

Venous Drainage

- **Splenic vein** arises from hilum ? runs behind pancreas ? joins **superior mesenteric vein** to form **portal vein**.

Lymphatic Drainage

- Drains into **pancreaticosplenic lymph nodes**, then into **celiac lymph nodes**.

Clinical Anatomy

- **Rupture of spleen:** Common in trauma; profuse internal bleeding ? splenectomy may be required.
- **Splenomegaly:** Enlargement in malaria, kala-azar, leukemia, and portal hypertension.
- **Accessory spleen:** Seen in ~10% of individuals; usually near hilum or tail of pancreas.
- **Splenic enlargement direction:** Downward and obliquely toward the right iliac fossa (limited by phrenicocolic ligament).
- **Splenic puncture site:** 9th or 10th left intercostal space in midaxillary line (to avoid lung injury).

Histology

- **Capsule:** Fibroelastic with smooth muscle fibers.
- **Trabeculae:** Extend inward carrying blood vessels.
- **Splenic pulp:**
    - **White pulp:** Lymphatic tissue (Malpighian corpuscles).

    - **Red pulp:** Sinusoids filled with RBCs; macrophages filter aged RBCs.

- **Reticular cells** and macrophages form splenic cords.

Mnemonic for Dimensions

1 × 3 × 5 × 7 × 9 × 11 rule:

- 1 inch thick
- 3 inches wide
- 5 inches long
- Weight 7 ounces
- Lies between 9th and 11th ribs

Summary Points

- Intraperitoneal organ.
- Develops from **dorsal mesogastrium (mesodermal origin)**.
- Moves with respiration.
- Splenic artery and vein + tail of pancreas lie in **lienorenal ligament**.
- Short gastric and left gastroepiploic vessels lie in **gastrosplenic ligament**.

? Pancreas

General Introduction

- A soft, lobulated **retroperitoneal gland** located transversely across the posterior abdominal wall.
- It is both **exocrine (digestive enzymes)** and **endocrine (hormones like insulin and glucagon)** in function.
- Extends from the **duodenal C-loop** (right) to the **spleen** (left).

Head of the Pancreas

- Lies within the **C-shaped curve of the duodenum**.
- **Uncinate process:** Small projection from the lower part of the head that hooks behind the **superior mesenteric vessels**.
- **Relations:**
  - **Anterior:** Transverse colon and jejunum.
  - **Posterior:** Inferior vena cava, right renal vessels, bile duct.
- The **bile duct** passes through the posterior surface of the head before opening into the **second part of the duodenum**.

Body of the Pancreas

- Triangular in cross-section.

- Lies **obliquely across** the midline at the level of **L1 vertebra**.
- **Anterior surface:** Related to stomach (via lesser sac).
- **Posterior surface:** Related to aorta, left kidney, renal vessels, and splenic vein.
- **Inferior surface:** Related to duodenojejunal flexure and coils of jejunum.
- **Superior border:** Lodges the **splenic artery** (tortuous).

Tail of the Pancreas

- Narrow, tapering left end.
- Lies in the **splenorenal ligament**, close to **hilum of spleen** and **left kidney**.
- The only **intraperitoneal** part of the pancreas.
- Contains many **islets of Langerhans** (endocrine-rich zone).

Ducts of the Pancreas

- **Main pancreatic duct (Duct of Wirsung):**
  - Runs from tail ? head.
  - Joins **common bile duct** to form **hepatopancreatic ampulla (of Vater)**.
  - Opens at **major duodenal papilla** in the second part of duodenum.
- **Accessory pancreatic duct (Duct of Santorini):**

- Opens separately into duodenum at the **minor duodenal papilla** (above the major).
- Drains upper part of head and uncinate process.

Arterial Supply

- **Head:** Superior and inferior pancreaticoduodenal arteries (from gastroduodenal and superior mesenteric arteries).
- **Body and Tail:** Branches from **splenic artery** (pancreatic, great pancreatic, and caudal pancreatic arteries).

Venous Drainage

- Corresponds to the arteries.
- Veins drain into the **splenic vein**, **superior mesenteric vein**, and then into the **portal vein**.

Lymphatic Drainage

- Into **pancreaticosplenic**, **pyloric**, and **superior mesenteric lymph nodes**, then to **celiac nodes**.

Nerve Supply

- **Sympathetic:** From celiac and superior mesenteric plexuses (vasomotor, inhibitory to secretion).

- **Parasympathetic:** From vagus (stimulates secretion).
- **Pain fibers:** Follow sympathetic nerves to **T6–T10** segments.

Functions

- **Exocrine part:**
  - Secretes digestive enzymes—amylase, lipase, trypsinogen—into the duodenum.
  - Bicarbonate secretion neutralizes gastric acid.
- **Endocrine part (Islets of Langerhans):**
  - **?-cells:** Glucagon
  - **?-cells:** Insulin
  - **?-cells:** Somatostatin
  - **PP-cells:** Pancreatic polypeptide

Clinical Anatomy

- **Carcinoma of head of pancreas:**
  - Compresses the **bile duct ? painless jaundice**, clay-colored stools, Courvoisier's sign.
- **Pancreatitis:**
  - Inflammation from duct obstruction (gallstones, alcohol).

- Severe epigastric pain radiating to the back.

- **Pancreatic cysts and pseudocysts:**
  - May compress stomach or duodenum.
- **Accessory duct obstruction:**
  - Leads to pain and minor pancreatic inflammation.
- **Referred pain:**
  - To back and left shoulder due to retroperitoneal position (T6–T10 dermatomes).

Histology

- **Exocrine part:**
  - Compound tubuloalveolar gland; **serous acini** lined by pyramidal cells with zymogen granules.
  - **Centroacinar cells** mark the start of intercalated ducts.
- **Endocrine part:**
  - Scattered **islets of Langerhans** (1–2% of mass).
  - Rich capillary network for hormone secretion into blood.

Development

- Develops from **two endodermal buds** of the foregut:

- **Dorsal pancreatic bud** ? body, tail, and most of head.
- **Ventral pancreatic bud** ? uncinate process and part of head.

- Fusion occurs during rotation of duodenum; ducts unite to form **main pancreatic duct**.

Molecular Regulation of Development of Pancreas

- **Transcription factors:**
  - **PDX1 (pancreatic and duodenal homeobox gene):** Essential for pancreatic bud formation.
  - **PTF1A:** Promotes exocrine differentiation.
  - **NGN3:** Stimulates endocrine islet cell differentiation.
- **Sonic hedgehog (SHH)** is inhibited in foregut endoderm to allow pancreatic bud formation.

Summary Points

- Retroperitoneal organ except tail.
- Supplied by celiac and superior mesenteric branches.
- Dual function gland: exocrine + endocrine.
- Clinical significance in **pancreatic carcinoma, pancreatitis, and cysts**.

? Liver

Introduction

- The **largest gland** in the body (weighs about 1.5 kg).
- Lies mainly in the **right hypochondrium**, extending partly into the **epigastrium** and **left hypochondrium**.
- Performs vital **metabolic, secretory, and detoxification** functions.
- Secretes **bile**—an exocrine secretion essential for fat digestion.

External Features

- **Shape:** Wedge-shaped, soft, reddish-brown organ.
- **Surfaces:**
    1. **Diaphragmatic surface** — smooth and convex, facing upward.
    2. **Visceral surface** — irregular, facing downward and backward.
- **Lobes:** Right and left lobes divided by **falciform ligament** on anterior surface and **ligamentum teres** on inferior surface.
- **Weight:** ~1.5 kg (adult male), ~1.3 kg (female).

Five Surfaces

1. **Superior surface** – Fits under the diaphragm.
2. **Anterior surface** – Related to diaphragm and anterior abdominal wall.
3. **Posterior surface** – Related to inferior vena cava and vertebral column.
4. **Inferior (visceral) surface** – Shows impressions of stomach, duodenum, right kidney, and colon.
5. **Right surface** – Related to right dome of diaphragm and ribs 7–11.

One Prominent Border

- **Inferior border** separates diaphragmatic and visceral surfaces.
- It is **sharp anteriorly** and **notched** by:
    - **Falciform ligament**
    - **Gallbladder fossa**
    - **Ligamentum teres**

Visceral Relations

- **Right lobe:**
    - Impressions: Gallbladder, right kidney, hepatic flexure of colon, duodenum.
- **Left lobe:**
    - Impressions: Stomach, oesophagus, lesser omentum.

- **Caudate lobe:** Lies between inferior vena cava and ligamentum venosum.
- **Quadrate lobe:** Lies between gallbladder fossa and ligamentum teres.

Arterial Supply

- **Dual supply:**
  - **Hepatic artery (30%)** – oxygenated blood from celiac trunk via common hepatic artery.
  - **Portal vein (70%)** – nutrient-rich blood from intestines, pancreas, and spleen.
- Both vessels enter liver at **porta hepatis**.

Venous Drainage

- Blood from liver drains via **hepatic veins (right, middle, left)** ? directly into **inferior vena cava**.
- No valves are present in hepatic veins or portal vein.

Lymphatic Drainage

- **Superficial lymphatics:** From capsule ? phrenic and hepatic nodes.
- **Deep lymphatics:** Along portal triads ? hepatic ? celiac lymph nodes.
- Portal hypertension ? retrograde lymph flow ? ascites.

Nerve Supply

- **Sympathetic:** From celiac plexus (vasomotor).
- **Parasympathetic:** From anterior and posterior vagal trunks.
- **Sensory fibers:** Travel with right phrenic nerve (referred pain to right shoulder).

Hepatic Segments

- Liver divided into **eight functional segments (Couinaud's classification)** based on **branching of hepatic artery, portal vein, and bile ducts**.
- **Right functional lobe:** Segments V–VIII
- **Left functional lobe:** Segments II–IV
- **Segment I:** Caudate lobe (independent drainage).
- Each segment has its own **vascular inflow, outflow, and biliary drainage** ? allows **segmental resection**.

Dissection Notes

- Identify **porta hepatis**: transverse fissure on inferior surface transmitting portal triad—
    - **Hepatic artery (left)**
    - **Portal vein (behind)**
    - **Bile duct (right)**
- Posterior to porta: **caudate lobe** and **inferior vena cava**.

- Ligaments: Falciform, coronary, triangular (right and left), and lesser omentum.

Clinical Anatomy

- **Cirrhosis:** Fibrosis and nodular regeneration ? portal hypertension, ascites, varices.
- **Hepatomegaly:** Infections (malaria, hepatitis), congestion, or malignancy.
- **Portal hypertension:** Causes esophageal, umbilical, and rectal varices.
- **Jaundice:** Accumulation of bilirubin due to liver, bile duct, or hemolytic pathology.
- **Liver biopsy:** Needle inserted in right 8th or 9th intercostal space in midaxillary line.
- **Referred pain:** Right shoulder (via phrenic nerve).
- **Trauma:** Can cause dangerous intra-abdominal bleeding due to high vascularity.

Histology

- **Capsule:** Thin connective tissue (Glisson’s capsule) covering liver surface.
- **Lobule:** Hexagonal structural unit with:
    - **Central vein** in center.
    - **Portal triads** (branch of portal vein, hepatic artery, and bile duct) at each corner.
- **Hepatocytes:** Radiating plates of polygonal cells forming sinusoids.
- **Kupffer cells:** Phagocytic macrophages lining sinusoids.

- **Bile canaliculi:** Between hepatocytes, draining bile into ductules ? hepatic ducts.
- **Blood flow:** Periphery ? center; **Bile flow:** Center ? periphery.

Development

- Derived from **hepatic diverticulum** of foregut endoderm.
    - **Cranial part:** Forms liver and intrahepatic bile ducts.
    - **Caudal part:** Forms gallbladder and cystic duct.
- **Mesoderm** of septum transversum contributes **hematopoietic cells, Kupffer cells, and connective tissue**.

Molecular Regulation of Liver Formation

- **FGF (Fibroblast Growth Factor)** from cardiac mesoderm induces hepatic bud formation.
- **BMP (Bone Morphogenetic Protein)** from septum transversum enhances hepatic specification.
- **HNF (Hepatocyte Nuclear Factors)** regulate differentiation of hepatocytes.
- **Proliferation and growth:** Controlled by VEGF, HGF (hepatocyte growth factor), and EGF.
- **Vascular invasion** of hepatic sinusoids occurs early under VEGF influence.

Summary Points

- Largest gland; intraperitoneal except bare area.
- Dual blood supply: portal vein and hepatic artery.
- Functional lobes defined by vascular segmentation.
- Develops from foregut endoderm and septum transversum mesoderm.
- Clinically vital in portal hypertension, cirrhosis, jaundice, and trauma.

? Mnemonics

1. Spleen – Dimensions, Weight, and Surface Anatomy

“1 × 3 × 5 × 7 × 9 × 11 rule”

- **1 inch** thick
- **3 inches** wide
- **5 inches** long
- **Weight:** 7 ounces
- **Lies between:** 9th and 11th ribs

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2. Structures at Porta Hepatis (Anterior to Posterior)

Mnemonic: “DAV”

- **D** ? Hepatic **Ducts**

- **A** ? Hepatic **Artery**
- **V** ? **Portal Vein**

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3. Hepatic Segments

- **Left lobe:** Segments II, III, IV
- **Right lobe:** Segments V, VI, VII, VIII
- **Caudate lobe:** Segment I (independent venous drainage)

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4. Pancreatic Ducts

- **Main duct:** *Wirsung* (W ? Wide/main)
- **Accessory duct:** *Santorini* (S ? Secondary/Small)

> **? Facts to Remember**

- **Spleen**
  - A collection of **lymphoid tissue** with rich vascular supply.
  - Moves **up and down with respiration**.
  - **Mesodermal in origin.**
  - In splenectomy, before cutting the **lienorenal ligament**, the **tail of pancreas** and **splenic vessels** must be identified and preserved.

- Enlarged spleen moves **downward and obliquely toward right iliac fossa**; descent limited by **phrenicocolic ligament**.

- **Pancreas**
  - Mainly develops from **dorsal pancreatic bud**; the **ventral bud** forms **uncinate process and part of head**.
  - **Islets of Langerhans** are maximum in the **tail** of the pancreas.
  - **Portal vein** is formed by union of **splenic and superior mesenteric veins** behind the **neck** of the pancreas.

- **Liver**
  - **Largest gland** of the body.
  - Kept in position by hepatic veins (upper group) draining into **inferior vena cava**.
  - Has **eight functional segments** (Couinaud classification).
  - **Bare area** is one of the sites of **portosystemic anastomoses**.
  - Enlarges **downward into right iliac fossa** during hepatomegaly.

Bonus Clinical Mnemonics

- **Gallstones risk factors:**
  "**Four F's** – Female, Forty, Fertile, Fat.

- **Portal triad contents (in hepatoduodenal ligament):**
  "**DAVE**" – **Duct**, **Artery**, **Vein**, **Epiploic foramen (behind)**.

?? Clinicoanatomical Problem

Case:
A young boy is kicked by his classmate in the **left upper abdomen**. Shortly afterward, he faints due to **internal bleeding**.

Questions:

1. What organ is likely to be ruptured?
2. What precaution is necessary during its removal?

Answer:

- The organ most likely ruptured is the **spleen**, leading to **massive internal hemorrhage** because of its high vascularity.
- The treatment is **splenectomy** (removal of the spleen).

Surgical Precautions during Splenectomy:

- The spleen must be carefully freed from its peritoneal attachments:
  - **Gastrosplenic ligament** — contains **short gastric vessels** (must be ligated before division).

    - **Lienorenal ligament** — contains **splenic artery, splenic vein, and tail of pancreas**.

- These structures should be **identified and preserved** before cutting the ligaments.
- Careless incision can injure the **tail of the pancreas**, leading to **pancreatic leakage or fistula formation**.

Clinical Insight:

- Ruptured spleen commonly follows **blunt trauma** to the left hypochondrium.
- The condition presents with **hypotension, tachycardia, and Kehr's sign** (left shoulder pain due to diaphragmatic irritation).
- Early diagnosis and prompt management are life-saving.

?? Clinicoanatomical Problems – Spleen, Pancreas, and Liver

Spleen

1. Traumatic Splenic Rupture
A child falls on his left side and suddenly becomes pale with hypotension.
? *Explanation:* The spleen is highly vascular; rupture causes massive intraperitoneal hemorrhage.
? *Sign:* Kehr's sign – referred pain to left shoulder via phrenic nerve (C3–C5).
? *Treatment:* Splenectomy after securing short gastric and splenic vessels.

2. Accessory Spleen
During splenectomy, a second small splenic tissue is found near the tail of pancreas.
? *Explanation:* Accessory spleen (10–15% cases) arises from lobulated embryonic spleen; may hypertrophy after splenectomy.

3. Splenomegaly in Malaria

A patient with chronic malaria shows palpable spleen reaching the right iliac fossa.

? *Reason:* Congestive enlargement due to repeated parasitic invasion.

? *Direction of enlargement:* Downward and medially, limited by phrenicocolic ligament.

4. Hypersplenism

A patient with portal hypertension shows anemia and leucopenia.

? *Mechanism:* Overactive spleen destroys blood cells due to chronic congestion.

5. Wandering Spleen

A woman presents with an abdominal mass shifting on posture change.

? *Cause:* Lax or absent splenic ligaments; torsion may cause infarction.

Pancreas

6. Acute Pancreatitis

A middle-aged man with gallstones develops severe epigastric pain radiating to the back.

? *Cause:* Blockage of pancreatic duct; activation of enzymes leads to autodigestion.

? *Referred pain:* To the back and left shoulder (retroperitoneal organ, T6–T10).

7. Carcinoma of Head of Pancreas

An elderly male has painless jaundice, clay-colored stool, and palpable gallbladder.

? *Mechanism:* Tumor compresses bile duct ? obstructive jaundice (Courvoisier's sign).

8. Pancreatic Pseudocyst

A patient recovering from pancreatitis presents with an epigastric swelling.

? *Reason:* Leakage of pancreatic juice forming fibrous-walled pseudocyst behind stomach.

9. Annular Pancreas

A newborn shows bilious vomiting.

? *Cause:* Ventral pancreatic bud encircles duodenum ? constriction ? duodenal obstruction.

10. Pancreatic Pain Referred to Back

Due to pancreas lying retroperitoneally over T12–L1 vertebrae, pain radiates to back and left shoulder.

Liver

11. Cirrhosis of Liver

A chronic alcoholic presents with ascites and spider angiomas.

? *Explanation:* Fibrosis leads to portal hypertension, collateral formation, and venous congestion.

12. Portal Hypertension

Patient shows distended abdominal veins radiating from the umbilicus (“Caput medusae”).

? *Cause:* Blockage of portal venous flow due to cirrhosis.

? *Sites of portosystemic anastomoses:* Lower esophagus, umbilicus, rectum, retroperitoneum.

13. Liver Trauma

A road accident victim with right hypochondrial injury shows internal bleeding.

? *Cause:* Laceration of liver parenchyma ? profuse hemorrhage due to dual blood supply.

14. Hepatomegaly in Congestive Cardiac Failure

? *Mechanism:* Venous backflow causes congestion ? tender, enlarged liver (“nutmeg liver”).

15. Liver Abscess

A patient with high fever and right upper quadrant tenderness.

? *Cause:* Amoebic infection through portal vein; abscess in right lobe.

? *Referred pain:* Right shoulder via phrenic nerve.

16. Gallstones and Jaundice

? *Pathway:* Stone in cystic duct ? obstructed bile flow ? jaundice, pale stools, dark urine.

? *Pain location:* Right hypochondrium, radiating to right shoulder.

17. Referred Pain to Right Shoulder

? *Reason:* Liver, gallbladder, and diaphragm share sensory fibers of the right phrenic nerve (C3–C5).

18. Hepatic Carcinoma

A cirrhotic patient develops a firm nodular mass in right hypochondrium.

? *Spread:* Commonly metastasizes via hepatic veins to lungs.

19. Portal Vein Thrombosis

Patient presents with splenomegaly and ascites but normal hepatic function tests.

? *Mechanism:* Thrombosis before liver blocks portal inflow ? prehepatic portal hypertension.

20. Neonatal Jaundice (Physiologic and Pathologic)

? *Cause:* Immature hepatocytes fail to conjugate bilirubin efficiently.

? *Pathologic type:* Hemolytic disease, biliary atresia, or intrahepatic infection.

Summary

These twenty scenarios together cover:

- **Spleen:** trauma, ligaments, enlargement, accessory spleen.
- **Pancreas:** inflammation, cancer, development, ductal anatomy.
- **Liver:** portal hypertension, cirrhosis, referred pain, trauma, and jaundice.

? Frequently Asked Questions

1. Describe the spleen under the following headings:

a. Situation

b. Gross anatomy

c. Relations and functions

d. Clinical anatomy

2. Describe the pancreas under the following headings:

a. Parts

b. Ducts

c. Blood supply

d. Development

e. Clinical anatomy

3. Write short notes on:

a. Hilum of spleen and its contents

b. Head of pancreas

c. Bare area of liver

d. Relations of the inferior surface of liver
e. Porta hepatis

These questions test core structural and functional anatomy while integrating important clinical points such as:

- **Hilum of spleen** and its vascular content (splenic artery and vein).
- **Head of pancreas** (relations to duodenum and bile duct).
- **Bare area of liver** (its surgical and clinical significance in infection spread).
- **Porta hepatis** (arrangement of ducts, arteries, and veins — DAV mnemonic).

? Multiple Choice Questions

1. Blood supply of the liver is:
a. 80% arterial, 20% venous
b. 70% arterial, 30% venous
? **c. 80% venous, 20% arterial**
d. 60% arterial, 40% venous

Explanation:
About 80% of hepatic blood flow comes from the *portal vein* (venous) and 20% from the *hepatic artery* (arterial).

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2. Accessory pancreatic duct is also called:
a. Wirsung duct
? **b. Santorini duct**
c. Henson’s duct
d. Hoffmann’s duct

Explanation:

The *accessory pancreatic duct* (duct of Santorini) drains into the *minor duodenal papilla*, while the *main duct (Wirsung)* opens into the *major duodenal papilla*.

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3. The bare area of liver is:

a. Covered by visceral peritoneum

? **b. A non-peritoneal area in contact with diaphragm**

c. Occupied by falciform ligament

d. Found on inferior surface

Explanation:

The *bare area* lies on the posterior surface of the liver, devoid of peritoneum, and directly contacts the diaphragm.

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4. The portal vein is formed by the union of:

a. Superior and inferior mesenteric veins

? **b. Superior mesenteric vein and splenic vein**

c. Splenic and left gastric veins

d. Inferior mesenteric and left gastric veins

Explanation:

The *portal vein* forms behind the *neck of pancreas* by the union of *splenic vein* and *superior mesenteric vein*.

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5. The spleen is related posteriorly to which ribs?

a. 6th to 8th

b. 7th to 9th

? **c. 9th to 11th**

d. 10th to 12th

Explanation:

The spleen lies under cover of the 9th–11th ribs in the left hypochondrium.

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6. Islets of Langerhans are maximum in:

a. Head of pancreas

b. Body of pancreas

? **c. Tail of pancreas**

d. Neck of pancreas

Explanation:

Endocrine tissue (Islets of Langerhans) is densest in the *tail region* of the pancreas.

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7. Which structure passes through porta hepatis?

a. Hepatic veins

? **b. Hepatic artery, portal vein, and bile ducts**

c. Cystic duct only

d. Hepatic lymph nodes

Explanation:

The porta hepatis transmits:

- Hepatic ducts (anterior),
- Hepatic artery (middle),
- Portal vein (posterior).
  Mnemonic: **DAV — Duct, Artery, Vein**.

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8. Which ligament prevents the spleen from descending downward?

a. Gastrosplenic

? **b. Phrenicocolic ligament**

c. Lienorenal ligament

d. Splenocolic ligament

Explanation:

The *phrenicocolic ligament* acts as a shelf supporting the spleen inferiorly.

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9. The hepatic veins drain directly into:

? **a. Inferior vena cava**

b. Portal vein

c. Hepatic sinusoids

d. Hepatic artery

Explanation:

Three hepatic veins (right, middle, left) open directly into the *inferior vena cava* near the diaphragm.

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10. The head of pancreas is related to which part of duodenum?

a. First part

b. Third part

? **c. Second part**

d. Fourth part

Explanation:

The head of pancreas lies in the *C-shaped curve* of the *second part of duodenum*.

? Additional MCQs – Spleen, Pancreas, and Liver

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1. Which of the following ligaments contains the tail of the pancreas?

a. Gastrosplenic ligament

? **b. Lienorenal (splenorenal) ligament**

c. Hepatoduodenal ligament

d. Phrenicocolic ligament

Explanation:

The *tail of pancreas* lies in the *lienorenal ligament* along with *splenic vessels*.

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2. The spleen is derived from which embryonic layer?

a. Endoderm

b. Neural crest

? **c. Mesoderm**

d. Ectoderm

Explanation:

Unlike other abdominal viscera (endodermal origin), the spleen develops from *mesenchymal condensation* in the *dorsal mesogastrium*.

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3. The hepatic segments are based on the branching pattern of:

a. Hepatic veins

b. Inferior vena cava

? **c. Portal vein, hepatic artery, and bile ducts**

d. Lymphatic drainage

Explanation:

Liver segmentation follows the distribution of the *portal triad* structures, not venous drainage alone.

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4. The pancreatic duct opens with the bile duct into the duodenum at:

a. Minor duodenal papilla

? **b. Major duodenal papilla**

c. Ampulla of Vater only

d. Foramen of Winslow

Explanation:

The *main pancreatic duct (Wirsung)* and *bile duct* unite to form the *hepatopancreatic ampulla (of Vater)*, which opens at the *major duodenal papilla*.

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5. Which of the following is NOT a peritoneal ligament of the liver?

a. Falciform ligament

b. Coronary ligament

? **c. Lienorenal ligament**

d. Right triangular ligament

Explanation:

The *lienorenal ligament* belongs to the spleen, not the liver.

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6. The chief cell type in pancreatic islets responsible for insulin secretion is:

a. Alpha cell

? **b. Beta cell**

c. Delta cell

d. PP cell

Explanation:

Beta cells (70% of islet cells) secrete *insulin*, which lowers blood glucose levels.

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7. The bile duct passes through which surface of the head of pancreas?

a. Anterior

? **b. Posterior**

c. Superior

d. Inferior

Explanation:

The *bile duct* runs in a groove or canal on the *posterior surface of the head of pancreas*.

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8. A stab wound in the 9th intercostal space in midaxillary line on left side is likely to injure:

? **a. Spleen**

b. Kidney

c. Pancreas

d. Stomach

Explanation:

The *spleen* lies between the 9th and 11th ribs along the 10th rib axis.

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9. The ligamentum teres hepatis is a remnant of:

a. Umbilical vein

? **b. Left umbilical vein**

c. Ductus venosus

d. Umbilical artery

Explanation:

The *ligamentum teres* is the fibrosed remnant of the *left umbilical vein* carrying oxygenated blood from placenta to fetus.

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10. The ligamentum venosum represents:

? **a. Ductus venosus of the fetus**

b. Umbilical vein

c. Right hepatic vein

d. Umbilical artery

Explanation:

The *ductus venosus* shunted blood from umbilical vein to inferior vena cava in the fetus; postnatally it becomes the *ligamentum venosum*.

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11. Which lobe of the liver lies between inferior vena cava and ligamentum venosum?

a. Quadrate lobe

? **b. Caudate lobe**

c. Right lobe

d. Left lobe

Explanation:

The *caudate lobe* occupies this area on the posterior surface.

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12. Which of the following veins drain directly into the inferior vena cava?

a. Splenic veins

? **b. Hepatic veins**

c. Portal veins

d. Superior mesenteric vein

Explanation:

The *hepatic veins* open directly into the *inferior vena cava* at the posterior surface of the liver.

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13. Which is the most common site of referred pain in gallbladder disease?

? **a. Right shoulder and tip of scapula**

b. Left shoulder

c. Umbilicus

d. Suprapubic region

Explanation:

Gallbladder pain is referred via *phrenic nerve (C3–C5)* to the *right shoulder tip*.

14. The spleen enlarges in the following direction:

? **a. Downward, forward, and medially**

b. Upward and outward

c. Downward and backward

d. Horizontally

Explanation:

Due to its oblique orientation along the 10th rib, enlargement occurs *downward and medially* toward the umbilicus.

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15. The hepatic veins lack:

a. Valves

b. Smooth muscle

? **c. Both a and b**

d. Endothelium

Explanation:

Hepatic veins are thin-walled and *valveless*, allowing free communication with the inferior vena cava.

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16. The ligament connecting liver to anterior abdominal wall is:

? **a. Falciform ligament**

b. Coronary ligament

c. Lesser omentum

d. Hepatorenal ligament

---

17. The pancreatic head is supplied mainly by branches of:

? **a. Gastroduodenal and superior mesenteric arteries**

b. Splenic and inferior mesenteric arteries

c. Left gastric and celiac trunk

d. Right gastric and renal arteries

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18. Which part of pancreas lies intraperitoneally?

a. Head

b. Body

? **c. Tail**

d. Uncinate process

---

19. Which peritoneal fold transmits the portal triad?

? **a. Hepatoduodenal ligament**

b. Gastrosplenic ligament

c. Lienorenal ligament

d. Falciform ligament

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20. The chief function of bile is:

? **a. Emulsification of fats**

b. Protein digestion

c. Enzyme activation

d. Vitamin synthesis

? Summary

These MCQs cover:

- Structural anatomy (lobes, ligaments, ducts)
- Embryological derivatives
- Relations and applied anatomy
- Blood and lymphatic supply
- Common pathologies and referred pain

> **? Viva Voce – Spleen, Pancreas, and Liver**

Spleen

Q1. Where is the spleen situated?
In the **left hypochondrium**, along the axis of the **10th rib**, between the **fundus of stomach** and **diaphragm**.

Q2. What is the peritoneal covering of spleen?
It is completely covered by **peritoneum**, except at the **hilum**.

Q3. What is the rule of 1×3×5×7×9×11?
The spleen measures **1 inch thick, 3 inches wide, 5 inches long**, weighs **7 ounces**, and lies between the **9th and 11th ribs**.

Q4. What ligaments attach the spleen?

- **Gastrosplenic ligament** – connects spleen to stomach.
- **Lienorenal ligament** – connects spleen to left kidney.
- **Phrenicocolic ligament** – supports spleen inferiorly.

Q5. Why does splenomegaly move obliquely downward?
Because the spleen lies obliquely along the **10th rib** and its descent is limited by the **phrenicocolic ligament**.

Q6. What is an accessory spleen?
Small additional splenic nodules near the **hilum** or **tail of pancreas**, occurring in about **10% of individuals**.

Q7. What is the most common cause of splenic rupture?
Blunt trauma to left upper abdomen or lower ribs causing subcapsular hematoma and rupture.

Q8. What is Kehr's sign?
Pain referred to left shoulder due to diaphragmatic irritation from splenic rupture (phrenic nerve involvement).

Pancreas

Q9. What type of gland is the pancreas?
It is a **mixed gland** — *exocrine* (digestive enzymes) and *endocrine* (hormones like insulin).

Q10. Which part of pancreas is intraperitoneal?
Only the **tail** of pancreas; the rest is **retroperitoneal**.

Q11. Where does the main pancreatic duct open?
Into the **major duodenal papilla** with the bile duct via the **ampulla of Vater**.

Q12. What is the accessory pancreatic duct?
It is the **duct of Santorini**, which opens at the **minor duodenal papilla**.

Q13. What is the blood supply of pancreas?

- **Head:** Superior and inferior pancreaticoduodenal arteries.
- **Body and tail:** Branches from **splenic artery**.

Q14. Which part of pancreas contains maximum islets of Langerhans?
The **tail** of the pancreas.

Q15. What is the relation of bile duct to the head of pancreas?
It runs **behind the head** of pancreas.

Q16. What are the endocrine secretions of pancreas?

- **Insulin** (?-cells)
- **Glucagon** (?-cells)
- **Somatostatin** (?-cells)
- **Pancreatic polypeptide** (PP cells)

Liver

Q17. What is the weight of the liver?
Approximately **1.5 kg in males** and **1.3 kg in females**.

Q18. What is the largest lobe of liver?
The **right lobe**.

Q19. What divides the anatomical lobes of liver?
The **falciform ligament** on anterior surface and **ligamentum teres** on inferior surface.

Q20. What divides the functional lobes of liver?
The **plane of the gallbladder fossa and inferior vena cava** (Cantlie's line).

Q21. What is the bare area of liver?
A **non-peritoneal area** on the posterior surface, directly contacting the diaphragm.

Q22. What passes through porta hepatis?

- **Hepatic ducts** (anterior)
- **Hepatic artery** (middle)
- **Portal vein** (posterior)
  Mnemonic: **DAV**.

Q23. What forms the portal vein?
Union of **splenic vein** and **superior mesenteric vein** behind **neck of pancreas**.

Q24. Into which vessel do the hepatic veins drain?
Directly into the **inferior vena cava**.

Q25. What is ligamentum teres hepatis derived from?
From the **left umbilical vein** of the fetus.

Q26. What is ligamentum venosum derived from?
From the **ductus venosus** of the fetus.

Q27. Name the functional segments of liver.
Eight **Couinaud segments**, each with independent vascular inflow and biliary drainage.

Q28. What is the main function of bile?
Emulsification of fats to aid digestion and absorption.

Q29. Why is right shoulder pain seen in liver disease?
Due to **phrenic nerve irritation** (C3–C5) from diaphragmatic inflammation.

Q30. What are common causes of hepatomegaly?
Cirrhosis, congestive heart failure, infection (malaria, hepatitis), and malignancy.

Histology & Development

Q31. What is Glisson's capsule?
The **fibroelastic capsule** of the liver that sends septa between lobules.

Q32. What is the classic liver lobule?
A **hexagonal structure** with a central vein and six portal triads at its corners.

Q33. What are Kupffer cells?
Specialized **phagocytic macrophages** lining hepatic sinusoids.

Q34. What are the two pancreatic buds and what do they form?

- **Dorsal bud:** Body, tail, and upper head.
- **Ventral bud:** Uncinate process and lower head.

Q35. From which part of the foregut does the liver develop?
From the **hepatic diverticulum** of **foregut endoderm**.

Clinical Viva Highlights

Q36. What is Courvoisier's law?
In *obstructive jaundice* due to **carcinoma of head of pancreas**, gallbladder is **palpable**; but not in *stone obstruction* due to fibrosis.

Q37. What is the difference between physiological and pathological jaundice?
Physiological – transient in newborns;
Pathological – due to bile duct obstruction, liver disease, or hemolysis.

Q38. What are portosystemic anastomoses?
Venous communications between **portal** and **systemic** veins at:

- Lower esophagus
- Umbilicus
- Anal canal
- Retroperitoneal areas

Q39. What is the surgical importance of the caudate lobe?
It drains directly into the **inferior vena cava** and functions independently from right and left lobes.

Q40. What is the surface marking for the lower border of the liver?
From the **right 5th rib in midaxillary line** to the **left 5th intercostal space near the midclavicular line**.