Chapter 4: Abdomen
Vasculature of Abdomen

I. Vasculature of Abdomen
   A. Overview
      • The vasculature of the abdomen is focused around the paired and unpaired branching vessels off of the descending aorta
      • The aorta is located retroperitoneal, left of the midline vertebral bodies and provides blood to all abdominal and pelvic structures
      • The venous system is unique in that it drains blood directly to the liver for detoxification and nutrient processing rather than to the IVC/heart

II. Aorta
   A. Overview
      • The aorta is the largest blood vessel in the human body that provides freshly oxygenated blood to the body. The aorta has four sections: 1) ascending, 2) arch, 3) descending and 4) abdominal aorta.
      – For the purposes of the abdomen, the fourth section is most relevant
      • It enters the abdominal cavity through the diaphragm at the T12 vertebra and terminates at L4 as the common iliac arteries
      • There are five paired branches and four unpaired branches. The branches from superior to inferior consist of:
         – Inferior phrenic arteries
         – Celiac trunk
         – Superior Mesenteric Artery (SMA)
         – Middle suprarenal arteries
         – Renal arteries
         – Gonadal arteries
         – Inferior Mesenteric Artery (IMA)
         – Median sacral artery
         – Lumbar arteries

Figure 4.1: Anterior View of the Abdominal Aorta

III. Branched Arteries
   A. Inferior Phrenic Arteries
      • Provide blood to the inferior diaphragm
   B. Middle Suprarenal Arteries
      • Provide blood to the adrenal glands
   C. Renal Arteries
      • Provide blood to the kidneys
D. Gonadal Arteries  
   • Provide blood to the testes and ovaries

E. Lumbar Arteries  
   • Four paired arteries that branch bilaterally to provide blood to the abdominal wall and spinal cord  
     (Great Radicular Artery of Adamkiewicz)

IV. Unpaired Arteries
A. Celiac Trunk  
   • Large branched vessel that provides dominant blood supply to the liver, spleen, stomach, duodenum, pancreas and lower esophagus

B. Superior Mesenteric Artery (SMA)  
   • Large branched vessel that provides blood to the lower duodenum, pancreas, jejunum, ileum, appendix, cecum, ascending colon and proximal transverse colon

C. Inferior Mesenteric Artery (IMA)  
   • Large branched vessel that provides blood to the distal transverse colon, descending colon, sigmoid colon and upper rectum

D. Median Sacral Artery  
   • Small branched vessel that arises posteriorly off of the aorta to provide blood to the lumbar, sacral and coccygeal vertebrae

V. Celiac Trunk
A. Overview  
   • Second branch and first unpaired vessel off of the aorta at the level of T12. The celiac trunk is crucial for the support of all upper abdominal organs and foregut.  
   • Splits immediately into three branches:  
     – Left gastric artery  
     – Splenic artery  
     – Common hepatic artery

B. Branches  
   • Left Gastric Artery  
     – Provides blood to the lower esophagus, then continues to provide blood to the lesser curvature of the stomach  
     – Forms an anastomosis with the right gastric artery  
   • Splenic Artery  
     – Tortuous blood vessel that runs posterior to the stomach and provides blood to the spleen  
     – Numerous branches including left gastroepiploic, short gastric and pancreatic arteries  
   • Common Hepatic Artery  
     – Dominant arterial blood supply to the liver
Abdomen

VI. Superior Mesenteric Artery (SMA)

A. Overview
- Second unpaired artery off of the aorta at the level of L1
- Provides blood to the midgut, the inferior portion of the pancreas, distal duodenum, small bowels, ascending colon and hepatic flexure of transverse colon territory
- The stomach, splenic vein and neck of pancreas run anterior to the SMA while the left renal vein, inferior duodenum and uncinate process of the pancreas run posteriorly

B. Branches
- Inferior Pancreaticoduodenal Artery
  - Branches into anterior and posterior segments that anastomose with the superior pancreaticoduodenal artery
- Middle Colic Artery
  - Supplies the transverse colon and forms an anastomosis with the IMA via the artery of Drummond
- Right Colic Artery
  - Supplies the ascending colon
- Ileoceleic Artery
  - Last branch of the SMA and provides blood to the ascending colon, cecum and appendix
- Appendicular Artery
  - Branch of ileocecal artery and provides blood to the appendix
- Jejunal and Ileal Arteries
  - Multiple branches that form proximal arcades, then vasa recta before entering the organs
  - The arcades and vasa recta are confined within the mesentery, are not easily dissected, but their architecture helps distinguish the jejunum from ileum
  - Jejunal arteries = fewer arcades, longer vasa recta
  - Ileal arteries = more arcades, shorter vasa recta
VII. Inferior Mesenteric Artery (IMA)

A. Overview
- Third unpaired artery off of the aorta at the level of L3
- Provides blood to the hindgut, the splenic flexure of the transverse colon, descending colon, sigmoid and upper rectum

B. Branches
- Left Colic Artery
  - Branches into the ascending and descending divisions
  - Provides blood to the distal \( \frac{2}{3} \) of the transverse colon and descending colon
  - Ascending branch forms an anastomosis with the marginal artery of Drummond, and the descending branch forms an anastomosis with the sigmoid artery
- Sigmoid Artery
  - Provides blood to the descending colon, sigmoid colon and runs anterior to the psoas major, left internal spermatic vessels and ureter
- Superior Rectal Artery
  - Descending branch of the IMA that provides blood to the upper rectum
  - Combines with the middle and inferior rectal arteries off of the internal iliac artery to complete blood supply to the rectum

VIII. Portal Venous System

A. Overview
- The IVC is present in the retroperitoneal space, but does not directly drain the abdominal viscera
- The IVC bifurcates at L5 and drains the common iliac veins
- The portal venous system of venous drainage directs blood from the abdominal organs to the liver
- The body uses this system to help detoxify material that the intestines absorb as well as help the liver process nutrients and fat
- Receives GI blood from the stomach to the anal canal, spleen, pancreas and gallbladder
- Connects back with the systemic system via the hepatic veins in the distal IVC before it enters the right atrium

B. Portocaval Connections
- Vascular connections in which the blood from the portal system communicates with the blood from the systemic system
  - During periods of portal congestion/hypertension, blood can be rerouted and flow retrogradely through these connections
C. Gonadal Vein Drainage
   - Neither gonadal vessels arterial nor venous supply communicates with the portal venous system
     - Left gonadal vein connects to the renal vein (at a 90° angle)
     - Right gonadal vein connects directly to the IVC

IX. Clinical Pearls
A. Celiac Compression Syndrome
   - The median arcuate ligament of the diaphragm may have a variant origination that occludes the celiac trunk
   - Presentation: asymptomatic, nausea, vomiting, diffuse abdominal pain or postprandial abdominal pain from decreased intestinal perfusion

B. SMA Compression Syndrome
   - SMA is anterior to the inferior portion of the duodenum
     - In normal patients, there is a fat pad that keeps these structures separate
     - In elderly, emaciated or anorexic/bulimic patients when the fat is decreased or in acutely branching SMAs, compression of the duodenum occurs
     - Presentation: postprandial pain, nausea and abdominal discomfort

C. Portal Venous Congestion/Portal Hypertension
   - Portal venous congestion can result from hepatic or venous pathology that compromises blood flow from the portal system to the caval system
     - Dilation of portocaval connections cause varices
       - Esophageal varices
       - Caput Medusae (paraumbilical veins)
       - Internal Hemorrhoids
   - Most commonly from cirrhosis and other hepatic dysfunction including malignancies, hepatitis, autoimmune disorders (e.g. SLE), Budd-Chiari Syndrome (thrombosis of hepatic veins) and vascular hypercoagulable states (e.g. Factor V Leiden)
   - Aside from aforementioned varices, other clinical presentations associated with portal venous congestion and hepatic dysfunction include: coagulopathy, jaundice, testicular atrophy, gynecomastia, ascites, asterixis and encephalopathy

D. Nutcracker Syndrome
   - Occurs when the left renal vein is compressed between the overlying SMA and the underlying abdominal aorta
   - Presentation is variable but can cause hematuria, engorgement of the left gonadal vein/varicocele, nausea and vomiting