CT ANATOMY OF ABDOMEN AND OARs CONTOURING

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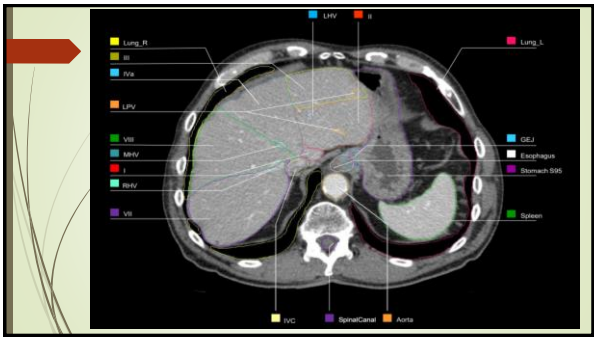
IMPORTANT STRUCTURES:

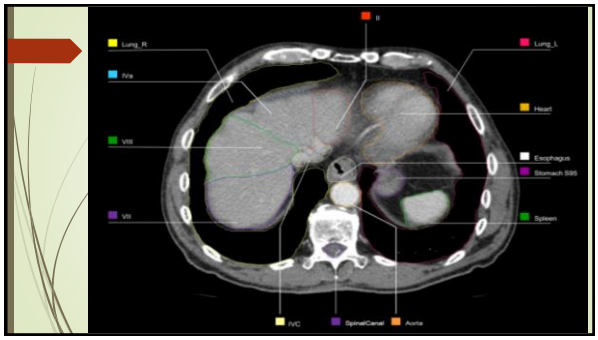
- GE-JUNCTION
- STOMACH
- DUODENUM
- LIVER
- PANCREAS
- ADRENALS
- KIDNEYS
- JEJUNUM AND ILEUM (SMALL BOWEL) AND COLON
- MAJOR VESSELS

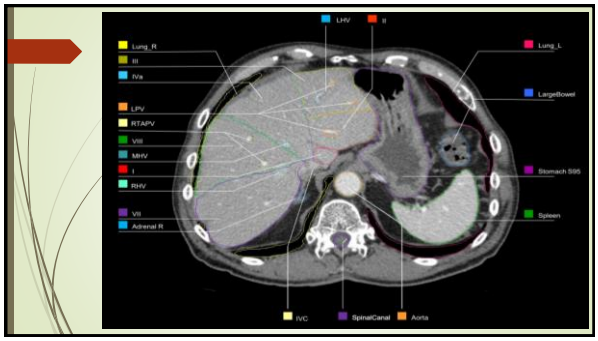
UPPER ABDOMINAL NORMAL ORGAN CONTOURING GUIDELINES

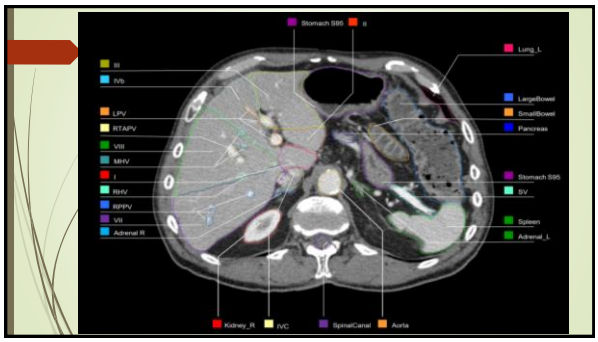
- **GASTRO-ESOPHAGEAL JUNCTION:**
- The GEJ, marked on the mucosal surface between the squamous esophageal mucosa and the gastric columnar mucosa at the "Z line".
- On axial imaging, the GEJ may appear thickened, at the level of the lower esophageal sphincter.
- The wedge-shaped GEJ contour should include (and overlap with) the most distal esophagus and the cardia of the stomach.
- Although GEJ contouring is not routine practice, better understanding of the precise location of the GEJ may be important for dose escalation or combined modality studies.

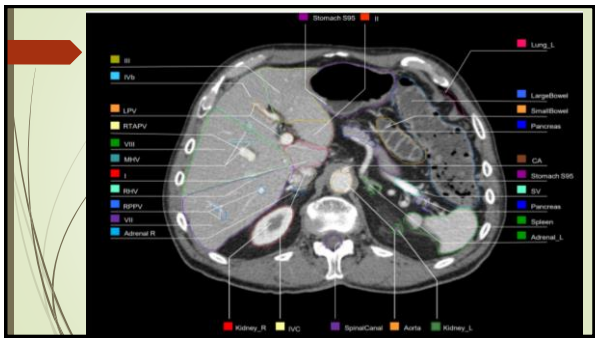


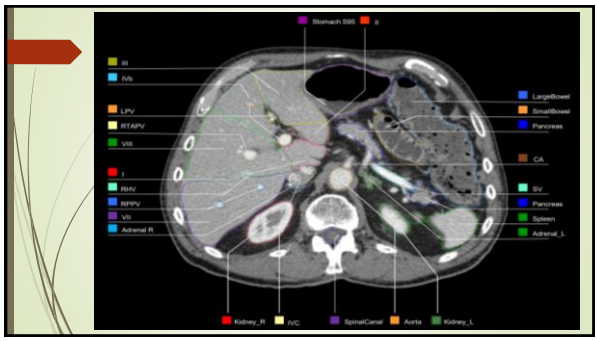
- **STOMACH :**
- Oral contrast is recommended during imaging for optimal delineation of the gastric walls.
- The stomach, separated into **cardia** (near the heart), **fundus**, **body**, and **antrum and pylorus**, should be contoured as 1 organ.
- The cardia begins caudal to the GEJ. The lesser and greater curvatures of the stomach intersect here.
- The gastric fundus, the most cephalad portion of the stomach, abuts the left hemidiaphragm, and is to the left and superior to the cardia.
- The body is the central, largest portion of the stomach and the antrum is the gateway into the pylorus, the sphincter opening into the duodenum.

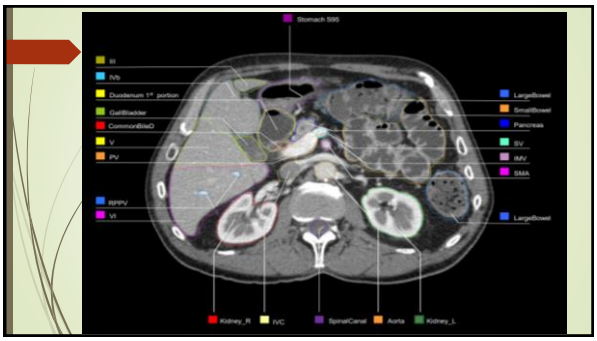


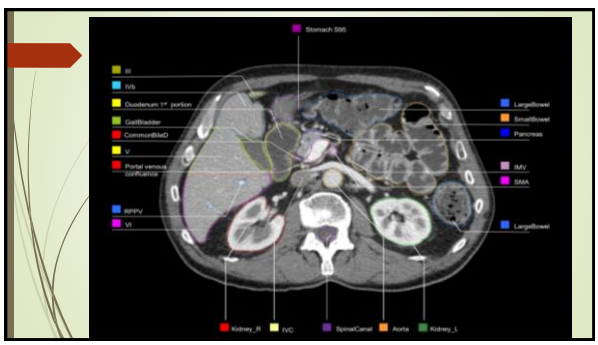




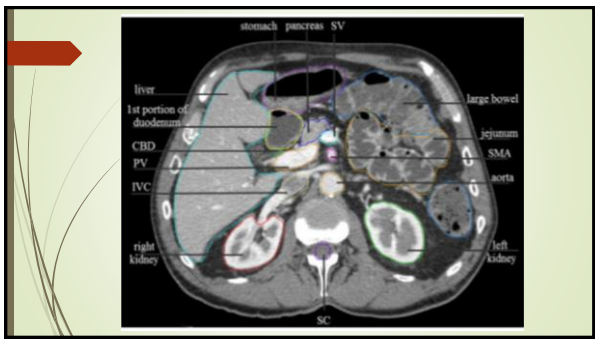


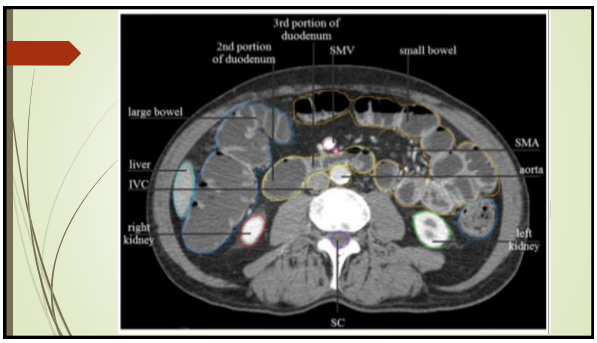


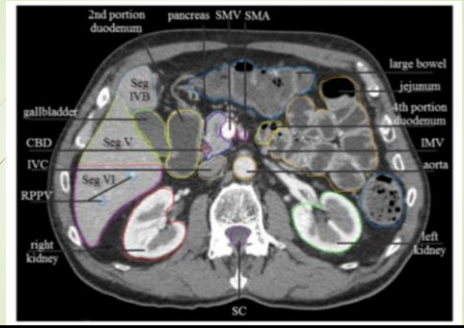




- **DUODENUM:**
- The duodenum begins caudal to the pylorus and is retroperitoneal except for the first portion of the duodenum, which spans approximately 5 cm and is suspended by the hepatoduodenal ligament. The CBD, PV, and IVC are posterior to the first portion of the duodenum.
- The second (descending) part of the duodenum is attached to the head of the pancreas, where the pancreatobiliary papilla enters medially through the ampulla of Vater.
- The second portion is located to the right of the L1 to L3 vertebral bodies, parallel to and right (lateral) of the IVC ,turning medially at L3, where it becomes the third (transverse) portion of the duodenum, crossing to the left, anterior to the aorta and IVC and posterior to the SMA and SMV, marking the end of the C-loop of the duodenum.
- The fourth (ascending) duodenum travels superiorly, left of L3, to the inferior pancreatic body. The ligament of Treitz suspends the duodenojejunal junction, marking the end of the duodenum and the start of the jejunum.
- Coronal views can aid in accurate contouring, specifically the third portion that may be under-distended. An anatomic landmark that can help identify the transition from the duodenum to the jejunum is the IMV.



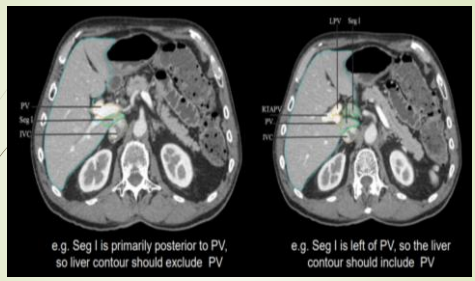




- **LIVER:**
- The porta hepatis is the site of entry of the PV, CHA, hepatic ducts, the hepatic nerve plexus, and lymphatic vessels.
- The liver has a dual afferent blood supply consisting of the PV, the major tributary to the liver supplying 70%-80% of the liver's blood supply, and the hepatic artery, which contributes to the balance.
- There are usually 3 hepatic veins (right, middle, left), which collect blood from the liver and return it to the IVC at the confluence of the hepatic veins.
- There are 8 hepatic segments (often referred to as **'sectors'** or **'sections**,' labeled with Arabic or Roman numerals),beginning with the caudate lobe known as segment I, part of the left lobe, and moving clockwise on a coronal view.
- The left lobe of the liver consists of segment II (lateral superior), segment III (lateral inferior), segment IVA (medial superior), and segment IVB (medial inferior).
- The right lobe includes segment V (anterior inferior), segment VI (posterior inferior), segment VII (posterior superior), and segment VIII (anterior superior).

- The right and left lobe are separated by a plane extending vertically through the gallbladder fossa and middle hepatic vein.
- The right anterior and posterior segments are divided by a vertical plane through the right hepatic vein (V and VIII anteriorly from VI and VII posteriorly).
- The left hepatic vein and falciform ligament separate the left lateral and medial segments (II and III from IV).
- A plane of the main right and left PV demarcates superior from inferior segments (VII and VIII from V and VI).
- Radiation oncologists should become familiar with this nomenclature because it will aid in descriptions of multiple tumors and in communication with other specialists.
- For liver contouring the gallbladder should be excluded. The IVC should be excluded from the liver contour when it is discrete and separate from the liver.

- On the right side of the liver, the caudate has a small process ("tail"), which separates the portal vein from the IVC and forms a bridge between the caudate lobe and right lobe.
- For "simple" contouring of the liver, rather than excluding all vessels from the liver contour, the consensus recommendation is that the PV should be excluded from the liver contour only when segment I is present posterior to the PV. The PV can be included in the liver contour when segment I is left of the PV. Branches of the PV and other vessels should be included within the liver contour.



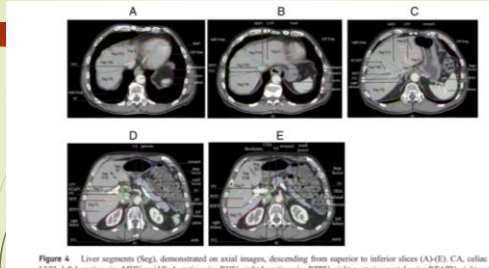
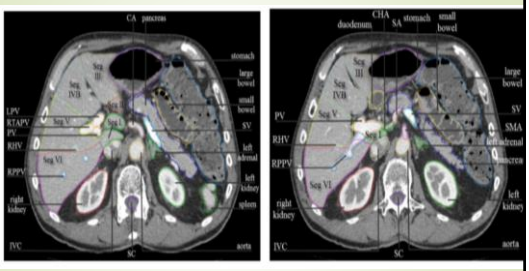


Figure 4 Liver segments (Seg), demonstrated on axial images, descending from superior to inferior slices (A)-(E). CA, celiac axis; LVH, left hepatic vein; MHV, middle hepatic vein; RHV, right hepatic vein; RPPV, right posterior portal vein; RTAPV, right anterior portal vein; LPV, left portal vein; SA, splenic artery; IVC, inferior vena cava; CHA, common hepatic artery; SV, splenic vein; SC, spinal canal.

- **PANCREAS:**
- The pancreas sits at the level of L1-L3.
- The pancreatic head is located to the right of the SMA.
- The uncinate process, an extension of the pancreatic head, is posterior to the SMV, which abuts the aorta posteriorly.
- The pancreatic body is between the celiac trunk and SMA, where it lies anterior to the aorta.
- The pancreatic tail is to the left of the SMA and SMV.



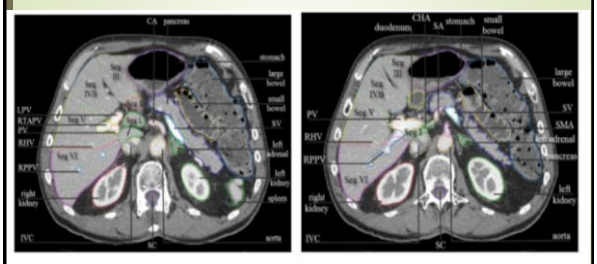
- **ADRENALS:**
- Each adrenal gland sits superior and medial to the kidneys, appearing as inverted Ys or Vs on axial images.
- The right adrenal gland is nestled among the liver to the right, the crus to its left, and the IVC anteriorly.
- The left adrenal gland is bordered by the crus to the left, the pancreas anteriorly, and the kidney medially

- **KIDNEYS:**
- The renal pelvis is generally included in kidney contours for upper abdominal malignancy radiation therapy

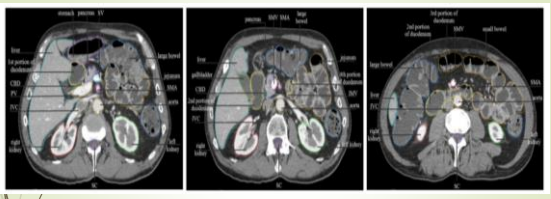
- **JEJUNUM AND ILEUM (SMALL BOWEL) AND COLON:**
- The simplest path to achieving the correct small bowel and colon contours is to track the bowel slice by slice without the intertwining mesentery from proximal to distal bowel (or vice versa).
- Another option is to contour the "bowel bag," which incorporates all portions of the peritoneal cavity aside from non-bowel structures.
- The bowel bag technique may be useful in instances during which no small bowel oral contrast was used, there is a small proportion of large bowel in the upper abdomen, or to avoid hotspots during IMRT planning.
- The panel's consensus is the bowel bag technique is not routinely recommended in place of small and large bowel contouring for upper abdomen treatment planning, as the maximal doses to the large and small bowel are clinically important.

MAJOR VESSELS:

- **PORTAL VEIN:**
- The PV is formed behind the pancreatic neck by the intersection of the SMV and SV.
- The PV is located posterior to the CBD and hepatic artery.
- The PV bifurcates into the right posterior portal vein, right anterior PV, and left PV.
- The PV divides the liver anatomy into superior and inferior segments. The bifurcation may be extrahepatic (26%), at the liver capsule (26%), or intrahepatic (48%).



- **Superior mesenteric vein:**
- The SMV lies to right of and slightly anterior to the SMA, unites with SV at the confluence of SV and SMV to form the PV behind the pancreatic neck.
- SMV and SMA are located behind the pancreatic neck and anterior to the third part of the duodenum.
- **Celiac artery :**
- The CA has 3 branches consisting of the left gastric, splenic, and CHA. The CHA gives rise to the gastroduodenal and proper hepatic arteries.
- **Superior mesenteric Artery:**
- The SMA lies 1 cm caudal to the celiac artery, posterior to the body of the pancreas and the splenic vein. The SMA usually arises at the level of the lower portion of L1.



- **Common hepatic artery :**
- The CHA arises from the CA, which branches into the proper hepatic artery followed by the right and left hepatic arteries, which supply the corresponding lobes of the liver.
- **Hepatic vein :**
- Hepatic veins, formed by the union of the central veins, drain blood from the liver into the IVC just below the diaphragm.
- Superior and inferior hepatic veins drain blood from the left and right lobes of the liver, respectively.
- The caudate lobe is usually supplied by the MHV. The IVC bifurcates into the RHV, MHV, and LHV.

DOSE CONSTRAINTS

CRITICAL STRUCTURE	VOLUME	DOSE/ VOLUME	TOXICITY RATE	TOXICITY ENDPOINT
Liver	Mean	<30-32Gy	<5%	RILD(in normal liver function
Kidney, bilateral	Mean	<15-18Gy	<5%	Clinical Dysfunction
Kidney, bilateral	Mean	<28Gy	<50%	Clinical Dysfunction
Kidney, bilateral	V12	<55%	<5%	Clinical Dysfunction
Kidney, bilateral	V20	<32%	<5%	Clinical Dysfunction
Kidney, bilateral	V23	<30%	<5%	Clinical Dysfunction
Kidney, bilateral	V28	<20%	<5%	Clinical Dysfunction

CRITICAL STRUCTURE	VOLUME	DOSE/ VOLUME	TOXICITY RATE	TOXICITY ENDPOINT
Stomach	D100	<45Gy	<7%	Ulceration
Small Bowel (peritoneal cavity)	V45	<195cc	<10%	Grade 3+ toxicity

THANK YOU