SELF-GUIDED REVIEW OF KEY NORMAL ANATOMY

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Find the following structures on the annotated CT, checking the box next to each item as you find it.

You might find it helpful to review both the annotated and unannotated images and challenge yourself to find each structure without the annotations. Both can be found here in the same case.

Italicized teaching comments for expanding your knowledge are included under each section.

Solid organs:

- ❏ Liver
    - ❏ Left hepatic lobe
    - ❏ Right hepatic lobe
    - ❏ Caudate lobe
    - ❏ Hepatic veins
    - ❏ Portal veins
    - ❏ Gallbladder
    - ❏ Common hepatic and common bile ducts

Segmental liver anatomy is defined by Couinaud segments, which are determined by the hepatic and portal veins. This information is helpful to guide biopsy, surgical resection, thermal ablation, and follow-up. Getting comfortable with segmental anatomy is greatly beneficial and makes describing lesion location a breeze: "1 cm mass in the posterior/inferior aspect of the right hepatic lobe" versus "1 cm mass in hepatic segment 6". I highly recommend that all radiologists use segmental anatomy to describe lesions. Greater detail can be found here.

- ❏ Pancreas
    - ❏ Uncinate process
    - ❏ Head
    - ❏ Body
    - ❏ Tail
    - ❏ Duct

The normal pancreas duct measures 1-3.5 mm and can be difficult to see. It can get dilated in the setting of pancreatitis or mass.

- ❏ Spleen
    - ❏ Splenic artery
    - ❏ Splenic vein

Normal spleen size is usually less than 12 cm in it's longest dimension, but measuring a splenic index (which uses all three dimensions) is the most accurate way of determining the degree of enlargement.

- ❏ Adrenals

- ❏ Kidneys
    - ❏ Renal artery
    - ❏ Renal vein
    - ❏ Cortex
    - ❏ Pyramids
    - ❏ Calyces
    - ❏ Pelvis
    - ❏ Ureters

IV contrast is ultimately filtered by the kidneys and excreted into the urine. Thus, the kidneys can have variable appearance based on the delay after IV contrast. Around 3 minutes after injection the urine in the calyces will begin to opacify with contrast. CT urography is generally performed at a delay of 8 minutes to allow it to fill the ureters and begin to opacify the bladder.

- ❏ Urinary Bladder

Run the large bowel retrograde - *begin at the end!*

- ❏ Anal canal
- ❏ Rectum
- ❏ Sigmoid colon
- ❏ Descending colon
- ❏ Splenic flexure
- ❏ Transverse colon
- ❏ Hepatic flexure
- ❏ Ascending colon
- ❏ Ileocecal valve
- ❏ Appendix
- ❏ Terminal ileum

The large bowel can follow a redundant course and is often elongated as a patient ages. It is easiest to start at the anal canal and work your way retrograde through the large bowel until reaching the cecum, appendix, and terminal ileum. The ascending and descending colon are

retroperitoneal. It can be challenging to find the appendix (particularly in thin patients), and looking at the cecum in all three planes (axial, sagittal, and corona) is quite helpful. Please note that running the entire colon is very important for every case, even when large bowel pathology is not clinically suspected, as early cancers or important incidental findings can be detected.

Run the upper GI tract antegrade

- ❏ Distal esophagus
- ❏ GE junction
- ❏ Stomach
    - ❏ Fundus
    - ❏ Body
    - ❏ Antrum
    - ❏ Pylorus
- ❏ Duodenum
- ❏ Jejunum
- ❏ Ileum
- ❏ Terminal ileum

For the upper GI tract, it is easiest to start at the distal esophagus and work antegrade. Sequential anatomy can be followed through the proximal jejunum, which has a characteristic feathery fold pattern compared to the rather thin and featureless duodenum and ileum. After that, in the absence of an obstruction or mass, there is no reason to run the entire small bowel and instead I look at clusters of the small bowel in both axial and coronal planes, without trying to follow and lumen the whole way. Notice how much small bowel you can see in a single image on the coronal reformats - it covers a lot of anatomy!

Oral contrast is given for many studies and fills the small bowel with dense/bright material. This can help the radiologists differentiate structures when the patients is skinny (i.e. little abdominal fat surrounding organs, vessels, and bowel), provides functional information that helps in the assessment of small bowel obstruction (i.e. finding the transition point, high or low grade, follow-up radiograph to evaluate contrast transit), and helps to find the location of perforation.

Peritoneum

- ❏ Omentum
- ❏ Mesentery
- ❏ Retroperitoneum

Normally the omentum blends in with the intraperitoneal fat and is not distinguishable. In general, I think it is challenging to understand these compartments without reviewing pathologic cases involving them. Keep a look out for cases of peritoneal carcinomatosis, peritonitis, and perforations into the retroperitoneum which help to understand the CT appearance of these anatomic planes.

Vasculature

- ❏ Portal circulation
    - ❏ Portal vein
    - ❏ Portosplenic confluence
    - ❏ Splenic vein
    - ❏ Super mesenteric veins
- ❏ Systemic veins
    - ❏ IVC
    - ❏ Renal veins
    - ❏ Common iliac veins
    - ❏ External iliac veins
- ❏ Arteries
    - ❏ Abdominal aorta
    - ❏ Celiac artery
    - ❏ Splenic artery
    - ❏ Common hepatic artery
    - ❏ Renal arteries
    - ❏ Superior mesenteric artery
    - ❏ Inferior mesenteric artery
    - ❏ Common iliac arteries
    - ❏ External iliac arteries

Generally radiologists do NOT attempt to review arteries in detail unless a dedicated angiography is performed. CT-angiography is scanned 25-30 seconds after contrast administration, which means that the majority of the contrast is still in the arteries and they are quite bright and easy to see. Routine/general exams are performed in the portal venous phase (PVP) which is around 70-80 seconds, and allows the abdominal organs to be better evaluated. For PVP imaging you can evaluate the portal, splenic, superior mesenteric veins and usually the IVC for patency, but small and medium sized arteries have begun to washout are more challenging to evaluate beyond their origins.

Lymph nodes

- ❏ Lower thoracic/periesophageal
- ❏ Upper abdominal
    - ❏ Gastrohepatic ligament
    - ❏ Celiac axis
    - ❏ Portocaval/porta hepatis
- ❏ Retroperitoneal/periaortic
- ❏ Mesentery
- ❏ Pelvis
    - ❏ Iliac/pelvic sidewall
    - ❏ Presacral/mesorectal

- ❏ Inguinal

Similar to the peritoneum, it is hard to understand these spaces when there are only small, normal-appearing lymph nodes in them. Keep a look out for cases of metastatic disease and lymphoma which will help you to understand these nodal territories and what pathologic lymph nodes look like. A generally accepted measurement for abdominal lymph nodes is < 1 cm short axis (that is, the narrowest dimension), but there are greater nuances to many cases (i.e. growth of a small lymph node would still be considered suspicious in a cancer follow-up scan).

Reproductive organs

- ❏ Male
  - ❏ Prostate
  - ❏ Seminal Vesicles
  - ❏ Spermatic cord
  - ❏ Imaged penis, urethra, and scrotum
- ❏ Female
  - ❏ Uterus/endometrium
  - ❏ Cervix
  - ❏ Fallopian tubes
  - ❏ Ovaries
  - ❏ Vagina

CT is limited for reproductive organ evaluation. For male anatomy, CT can helpful for identifying prostatic enlargement or abscess, and spermatic cord masses. MRI is superior for detecting prostate cancer, and ultrasound is superior for scrotal/testicular evaluation. For female anatomy, CT can identify many important findings such as tubo-ovarian abscess, adnexal masses, fibroids, etc, but generally characterization with ultrasound or MRI is superior.

Musculoskeletal

- ❏ Lower ribs
- ❏ Vertebral bodies
- ❏ Spinal canal
- ❏ Pelvic bones
  - ❏ Sacrum
  - ❏ Iliac bones
  - ❏ Acetabula
  - ❏ Pelvic rings
- ❏ Hips and proximal femora
- ❏ Musculature
  - ❏ Abdominal wall (rectus abdominis, oblique/transverse abdominis)
  - ❏ Paraspinal
  - ❏ Pelvis (gluteal, obturator, proximal thigh)

- ❏ Subcutaneous fat

Musculoskeletal structures are often overlooked on CT. It is challenging to intuitively and accurately evaluate the spine on axial images, but much more straightforward on sagittal reformats which allows you to see the entire spinal column in a single image. Pelvic bones are well-evaluated on both axial and coronal reformats.

Evaluation of muscles is brief for routine images. For trauma or metastatic workup with higher likelihood of muscular involvement (such as melanoma, lymphoma, multiple myeloma), more careful evaluation is needed. Similar principles apply to evaluating the subcutaneous fat.