

## Episode 24 - Abdominal & Pelvic Anatomy

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# Primary Cast

### 1. Medical Imaging of the abdomen

#### Identify structures on the axial slice of an abdo CT

*Tip: Its likely that it will be at the level of the transpyloric plane. Make sure you have the orientation right before you start naming organs. When you get stressed it is easy to point to the wrong things.*

Must be able to identify:

- Liver
- Intestines
- Pancreas
- Spleen
- Kidneys
- Descending aorta
- Vertebral body
- Rectus muscle
- Diaphragm
- Inferior vena cava

#### Which structures are retroperitoneal?

Pancreas, kidneys, aorta, IVC

#### Where is the transpyloric plane?

Passes through the lower border of L1

#### What structures lie in the transpyloric plane?

- Pylorus – free on mesentery
- Pancreas- head, neck and body
- Fundus of the gallbladder
- Conus medulla of the spinal cord
- SMA as it leaves the aorta
- Hila of both kidneys
- 9<sup>th</sup> costal cartilages
- Liver, spleen

### 2. The Aorta

#### Outline the course of the abdominal aorta

- Enters the abdomen through the aortic hiatus at the level of T12
- Left of the midline
- Bifurcation at L4 just below the umbilicus

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### Describe the branches of the abdominal aorta

#### Unpaired

- Coeliac
- Superior mesenteric
- Inferior mesenteric

#### Paired

- Suprarenal
- Renal
- Gonadal
- Subcostal
- Inferior Phrenic
- Lumbar
- Common iliacs

### What is the relationship of the IVC to the aorta?

- IVC lies posterolateral to the right of the aorta
- It leaves the abdomen through the caval opening of the diaphragm at T8 after draining from the lower limbs and other non-portal blood tributaries.
- These tributaries correspond to the paired vessels of the aorta.

### Name the branches of the coeliac trunk and what they supply

- Arises at T12
- Branches are left gastric, common hepatic and splenic
- Supplies the liver, stomach, spleen, oesophagus and superior part of the duodenum and pancreas

### Describe the arterial blood supply of the small and large intestine

- Small intestine is supplied by the branches which arise from the superior mesenteric artery
- The large intestine is supplied by both the superior mesenteric and the inferior mesenteric artery
- SMA supplies the supplies the ascending and the proximal 2/3 of the transverse colon
- IMA supplies the descending colon and the sigmoid & rectum

### Describe the course of the iliac arteries

- Common iliacs originate from the aorta at L3
- Follow the medial border of the psoas to the pelvic brim
- Divide at the level of L5/S1 into the internal and external iliacs
- Internal iliac artery enters the pelvis
- External iliac artery follows the iliopsoas and ends at the inguinal ligament, where it becomes the femoral artery at the mid inguinal point

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### 3. Porto systemic anastomosis

#### **Describe the portosystemic anastomoses**

Portosystemic anastomosis is the collateral communication between the portal and the systemic venous system. There are 4 main sites.

- Oesophageal - oesophageal veins drain into the azygous (systemic) or left gastric (portal) veins.
- Rectal - inferior and middle rectal veins go into the IVC (systemic) and the superficial rectal vein goes to the inferior mesenteric vein (portal)
- Umbilical - paraumbilical veins (portal) and epigastric veins on the anterior abdominal wall (systemic)
- Retroperitoneal - visceral (portal) veins on the bare areas of organs and the systemic veins on the posterior abdominal wall

#### **When do these become clinically significant?**

- When there is obstruction to portal flow from something i.e. liver disease that leads to portal hypertension
- Blood is redirected to the low pressure venous system via shunting
- Porto-systemic shunting occurs because there are no valves in the portal system
- Over time, veins can become dilated and can cause major haemorrhage via rupture - typically in ED this is seen in oesophageal variceal bleeding.

### 4. The Liver

#### **Anatomy of the Liver**

**Note: Need to be able to identify parts of the liver. There is a particular image in the anatomy book that has been used in past exams. Photo of the liver from underneath and is confusing if you've never seen it before.**

Name the lobes (left and right, caudate, quadrate)

- Vascular stuff – IVC, hepatic artery, portal vein
- Biliary – common hepatic duct, gallbladder
- Ligaments – ligamentum teres, diaphragm

#### **What are the anatomical relations of the liver?**

- Located in the right upper portion of the abdominal cavity
- Lies adjacent to the chest wall and ribs - makes it vulnerable during rib fractures and one of the possible complications associated with low placement of a chest tube
- Superiorly it abuts the right hemidiaphragm
- Inferiorly it contacts the right kidney, right adrenal gland, right colic flexure, transverse colon, the first part of the duodenum and the stomach

#### **Describe the anatomy of the biliary tree**

- (You can draw it out if that's easier)
- Left and right hepatic ducts run into common hepatic duct

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- Joined by cystic duct from the gallbladder to become the common bile duct which joins with the pancreatic duct and both empty into the duodenum

### What is the blood supply of the liver?

- Hepatic artery
- Portal vein
- 3 hepatic veins

## 5. The Pancreas

### What are the anatomical relationships of the pancreas?

- Posteriorly – portal vein, right renal artery and vein, bile duct, superior mesenteric vessels, aorta, L2 vertebrae, L kidney, L adrenal
- Medial – duodenum makes a C shape around the head
- Laterally the hilum of the spleen at the tail of the pancreas
- Anterior – stomach, peritoneum, lesser omentum, bowel

## 6. Duodenum (no viva questions, but comes up a lot in the MCQ)

### What are the parts of the duodenum?

- 1st part ("superior") - runs to the right, superiorly and posteriorly from the pylorus, anterior to L1 vertebra
- 2nd part ("descending") - covered by the peritoneum in front and crossed by the transverse mesocolon, crosses downward and over the hilum of the right kidney
- 3rd part ("horizontal") - curves forwards over the right psoas and over the IVC and aorta to reach the left psoas
- 4th part ("ascending") - ascends to the left of the aorta to lie on the left psoas and sympathetic trunk. Reaches back up to the lower border of the pancreas

### What is the blood supply of the duodenum?

- 1st 2cm of the first part, blood from everywhere
- Hepatic artery, the gastroduodenal artery (usually the one that ulcerates and bleeds) supraduodenal artery, right gastric and right gastroepiploic arteries
- The most of the rest is supplied via the coeliac trunk via the gastroduodenal artery and SMA via the inferior pancreatic/duodenal arteries

## 7. SPLEEN

### Describe the anatomical relationships of the spleen

- Lies deep to and along the plane of the 9/10/11<sup>th</sup> ribs in the left upper quadrant of the abdomen
- Inferiorly there is the left kidney and the splenic flexure of the colon
- Superiorly and laterally is the diaphragm
- Medially is the stomach and pancreas
- Deep is the splenic artery and veins

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### 8. The Renal Tract

#### **Describe the relations of the right kidney**

- Surrounded by perinephric fat
- Superior – right adrenal + liver + portal vein
- Superolaterally – right lobe of liver
- Medially – psoas and vertebrae
- Posteriorly – 12<sup>th</sup> rib + abdo muscles, deep back muscles
- Anteriorly – gallbladder + duodenum + ascending colon
- Anteromedially – right renal vein, IVC, pancreas

#### **Please outline the course of the ureters**

- Originate at the renal hilum – approx. L1- L2
- Run inferiorly over the psoas
- Just medial to the tips of transverse process of lumbar vertebrae
- Cross the pelvic brim over the SI joint
- Travel anterior to the bifurcation of common iliac arteries
- Lie on the lateral wall of the pelvis
- Travel medially to the bladder at the ischial spines
- Short intramural path at VUJ

#### **What are the three narrowest points of the ureters?**

- PUJ
- VUJ
- Pelvic brim

#### **What is the arterial blood supply of the ureter?**

- Renal arteries supply the upper portion
- Gonadal vessels can supply some of the upper part
- Mid portion comes from branches of the abdominal aorta
- Inferiorly by branches of common iliacs
- Venous drainage is via the renal and gonadal vessels

### 9. BLADDER

#### **Please describe the motor innervation of the bladder**

#### **Innervation is via both autonomic and somatic arms of the nervous system**

- Sympathetic fibres travel via the hypogastric nerve plexus to excite the internal urethral sphincter and cause relaxation of the detrusor muscle. This promotes urinary retention
- Parasympathetic fibres travel via the pelvic nerve and are the motor supply to the detrusor. They also provide inhibitory signals to the internal urethral sphincter. This promotes micturition.

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- Somatic innervation is via the pudendal nerve. It innervates the external urethral sphincter providing voluntary control over micturition

### **Please describe the stretch reflex of the bladder**

- Is a primitive spinal reflex arc
- Bladder fills with urine, and the bladder wall is stretched. Sensory nerves detect the stretch and transmit the information to the spinal cord
- Interneurons within the spinal cord relay the signal to the parasympathetic efferent fibres (the pelvic nerve)
- Pelvic nerve acts to contract the detrusor muscle to stimulate micturition
- This reflex arc is overridden during the process of toilet training of children but can be important to consider in spinal injuries (where descending inhibition cannot reach the bladder) and in neurodegenerative diseases where the brain is unable to generate inhibition

## 10. Genital system- Female

**Note: need to be able to label anatomy on the midline sagittal section of the male and female pelvis**

### **What is the blood supply to the uterus?**

- Uterine artery from the anterior division of the internal iliac artery
- Crosses above the ureter on its course to the uterus (bridge over water)
- Commonly anastomoses with the vaginal and ovarian arteries

### **What are the potential spaces within the female pelvis where free fluid may accumulate?**

- Rectouterine pouch
- Vesicouterine pouch

### **What are the boundaries, relations and the significance of the recto-uterine pouch?**

- Inferior most extension of the peritoneal cavity
- Important because it is a potential space for fluid collection
- Between the anterior rectum and the posterior uterus
- Close to the cervix and the posterior fornix of the vagina
- Open superiorly to the peritoneum

## 11. Genital system - MALE

**Using the model, identify the components that make up the male urogenital system**

Bladder, ureter, prostate gland, seminal gland, spermatic cord, testis, epididymis, penis

### **What are the contents of the spermatic cord?**

- Ductus deferens

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- Artery of the ductus deferens
- Testicular artery
- Testicular vein and pampiniform plexus
- Lymphatics
- Autonomic nerves (both sympathetic and parasympathetic)

### What are the components of the male urethra?

- Intramural component – in the base of the bladder wall
- Prostatic component in the prostate
- Membranous component (short, narrow section surrounded by the external sphincter)
- Spongy component (length of the corpus spongiosum)

### What is the innervation of the urethra in a male?

- Prostatic nerve plexus arising from the inferior hypogastric plexus to the first three parts
- Then the dorsal nerve of the penis to the spongy part

### What is the lymphatic drainage of the male genitalia?

- Testicles – lymph drains back along the path of the testicular artery to para-aortic nodes
- Skin from the scrotum and penis drains to inguinal nodes

## 12. Inguinal Canal

### What is the difference between a direct and indirect hernia?

Direct hernia is acquired - goes “directly” through the muscle

- Secondary to weakness in the anterior wall
- Traverses the medial third of the inguinal canal
- Exits superficial ring lateral to the cord
- Rarely enters the scrotum

Indirect hernia is a congenital condition

- Occurs due to a patent processus vaginalis (allows communication between the peritoneum and the scrotum)
- Traverses the entire canal - from internal to external ring
- Travels inside the cord and into either the scrotum in males or the external labia in females