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Kidney and Retroperitoneum

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2:44 PM

Learning Module: Autnomics of the Abdomen

Sympathetic supply (vasoconstriction and inhibition of peristalsis):

- greater thoracic splanchnic n. (T5-9) - synapses in celiac and superior mesenteric ganglia, some presynaptic fibers reach suprarenal medulla; postsynaptic fibers supply caudal foregut and midgut
- lesser thoracic splanchnic n. (T10-11) - synapses in aorticorenal ganglion; postsynaptic fibers pass primarily into renal plexus
- least thoracic splanchnic n. (T12) - passes into renal plexus
- lumbar splanchnic nn. - L1-2 pass into intermesenteric plexus primarily, synapsing in inferior mesenteric ganglion and supplying hindgut; L3-4 pass into superior hypogastric plexus and into pelvis
- gray rami communicantes - L1-5 pass into lumbar ventral primary rami to innervate vascular smooth muscle, arrector pili muscles, and sweat glands in portions of the body wall and lower limb supplied by L1-5

Parasympathetic supply (stimulates peristalsis and secretomotor to glands):

- anterior vagal trunk - gastric and hepatic branches; supplies stomach and liver/gall bladder
- posterior vagal trunk - gastric and celiac branches; supplies stomach and remainder of caudal foregut and midgut (distribution of superior mesenteric a.)
- pelvic splanchnic nn. - send branches through fusion fascia to reach hindgut (from distal one-third of transverse colon to anal canal)

Review Items

[Kidney:](#) (N [334,342](#))

Paravertebral gutters (N [263,342,329](#)) - space between psoas major and quadratus lumborum where kidneys lie

Pararenal fat - fat outside renal fascia

Renal fascia - layer of membrane between two layers of fat, perirenal and pararenal

Perirenal fat (adipose capsule) - fat deep to the fascia covering the kidneys and suprarenal gland

Renal (fibrous) capsule: directly surrounding kidney; no fat deep to it (visceral fascia)

Hilum: opening on medial margin of kidney where vessels and ureter leave/enter kidney

Sinus: hollowed out area in medial margin; contains renal vessels, calyces, pelvis and perirenal fat

Cortex: outer layer of kidney; contains majority of glomeruli

Renal columns: cortical tissue in medulla btwn pyramids

Medulla: inner layer of kidney; contains tubules

Renal pyramids: cone of tubules in medulla

Renal papillae: tip of pyramid projecting into minor calyx

Minor calyx: drains one renal papilla

Major calyx: unification of several minor calyces

Renal pelvis: major calyces come together and form large collecting duct; dilated origin of ureter

Ureter: muscular tube that carries urine to bladder; passes over pelvic brim medial to testicular/ovarian vessels; passes obliquely through posterior wall of bladder and drains into posterolateral angle of the vesical trigone

[Suprarenal gland:](#) (N [347](#)): endocrine gland located superomedial to the kidney; right

suprarenal gland is somewhat triangular in shape, left suprarenal gland is semilunar in shape

Cortex: manufactures corticosteroids

Medulla: manufactures EPI/NE

Branch of greater thoracic splanchnic n. (N [318,346](#)): sympathetic innervation of medulla

Diaphragm: (N [185,263](#))

Lateral arcuate lig: thickening of quadratus lumborum fascia; fibers originating here along w/ fibers from medial arcuate lig fill in the gap between the crura and costal part of the diaphragm

Medial arcuate lig: thickening of psoas major fascia

Median arcuate lig: formed by right and left crus of diaphragm anterior to aortic hiatus

Central tendon: where everything attaches and aorta passes through

Right and left crura: right originates at L1-L3; left at L1-L2; fibers from right and left crus intermingle to form aortic hiatus; right splits to enclose esophagus

Aortic hiatus: formed by intermingling of right and left crus fibers; T12; transmits descending aorta, thoracic duct and azygos vein (sometimes)

Esophageal hiatus: formed by splitting of right crus; T10; transmits esophagus, ant/post vagal trunks, branches of left gastric vessels, and small lymphatic vessels

Caval foramen (hiatus): T8; transmits IVC, right phrenic nerve branches, small lymphatics

Vertebrocostal trigone: area of diaphragm superior to lateral arcuate ligament; muscle is deficient and primarily enclosed by fascia; herniation

Muscles (N [263](#))

Psoas major & minor: originates at bodies and transverse processes of lumbar vertebrae; inserts at lesser trochanter of femur w/ iliopsoas tendon; flexes thigh, lateral bends of lumbar; VPR L2-4; subcostal and lumbar aa.; minor only in 60% of individuals

Quadratus lumborum: originates on posterior part of iliac crest and the iliolumbar ligament; inserts on transverse processes of lumbar vertebrae 1-4 and 12th rib; laterally bends the trunk, flexes 12th rib; subcostal n. and VPR L1-4; subcostal and lumbar aa.; lateral arcuate ligament crosses anterior surface

Iliacus m.: origin at iliac fossa and crest, ala of sacrum; inserts on lesser trochanter of femur; flexes thigh and pelvis on thigh; femoral n.; iliolumbar a; combines w/ psoas

Abdominal aorta: (N [264](#))

Inferior phrenic a.: supplies diaphragm and suprarenal gland (via superior suprarenal aa.); first abdominal branch of aorta, may come off celiac trunk

Celiac trunk (N [300,301,302](#)): refer to Dudodenum lab, comes off at L1

Superior mesenteric a. (N [306](#)): comes off at L2

Renal aa. (N [332,335](#)): comes off at L2 caudal to SMA; supplies kidney, upper ureter, suprarenal gland; right longer than left, right passes posterior to IVC

Interlobar aa.: branches of renal aa. supplying lobes of kidney

Supernumerary renal aa. (N [333](#)): often there are multiple renal arteries coming directly off the abdominal aorta

Gonadal aa. (N [332,400,401](#)): come off abdominal aorta at L3

Suprarenal aa. (N [332](#)): supply suprarenal gland

Superior: multiple branches of inferior phrenic

Middle: directly off ab aorta

Inferior: off renal artery

Inferior mesenteric a. (N [307](#)): comes off at L3

Lumbar segmental aa.: comes off at bottom margin of its respective level; course posterior to psoas major m

Median sacral a.: continuation of abdominal aorta in median plane

Common iliac aa.: comes off at L4; supplies pelvis and lower limb; aorta bifurcates at L4

to form common iliac aa.; common iliac bifurcates anterior to sacroiliac articulation into external and internal branches

Inferior vena cava: (N [265](#))

Common iliac vv.: paired w/ artery; joins IVC at L5

Lumbar segmental vv. (N [332](#)): paired w/ artery

Right gonadal v. (N [332,400,401](#)): joins IVC at L2; paired w/ artery; left drains into left renal

Right renal v. (N [332,341](#)): paired w/ artery; shorter than left

Right suprarenal v. (N [332](#)): drains into IVC at L1

Right inferior phrenic v.: paired w/ artery; drains directly into IVC

Left renal v. (N [332,328](#)): drains into IVC at L1

Left gonadal v. (N [332,400,401](#)): drains in left renal

Left suprarenal v. (N [332](#)): drains into left renal

Left inferior phrenic v. (N [332](#)): drains into left renal

Nerves:

Celiac branches of posterior vagal trunk (N [318,319](#)): fibers from posterior vagal trunk that innervate the organs supplied by SMA and celiac trunk

Celiac ganglia and plexus (N [318,319,320](#)): preganglionic sympathetics arrive via greater thoracic splanchnic; postganglionic fibers distribute via plexus around celiac trunk; supplies vascular smooth muscle of branches of celiac trunk, sensory from stomach, liver, biliary system, spleen, upper half of duodenum and pancreas; usually 2 ganglia, branches of vagus pass through w/o synapsing

Aorticorenal ganglion (N [318](#)): preganglionic sympathetic via lesser thoracic splanchnic; branches to renal plexus; vascular smooth muscle of renal aa.; pain from kidney, suprarenal gland and upper ureter; ganglion is located above or near origin of renal a.

Superior mesenteric ganglion & plexus (N [318,322](#)): preganglionics from celiac plexus; VSM of branches of SMA; pain from lower half of pancreas and duodenum, jejunum, ileum, cecum, appendix, ascending colon and transverse colon; at origin of SMA

Greater thoracic splanchnic n.: T5-T9; senses pain from abdominal viscera, causes release of EPI/NE from adrenal gland; passes through crus of respiratory diaphragm

Lesser thoracic splanchnic n.: T10-11; goes to aorticorenal ganglion, senses pain from kidney and suprarenal gland; passes through crus of diaphragm

Least thoracic splanchnic n.: T12; renal plexus; pain from kidney/suprarenal gland; synapses in minute ganglia of renal plexus

Lumbar ganglia (N [318](#)):

Lumbar splanchnic nn. (N [318](#)): lumbar sympathetic ganglia L1-4; VSM of abdominal and pelvic viscera; pain; contribute to preaortic abdominal plexuses

Intermesenteric plexus (N [318](#)): lumbar splanchnic 1-2; renal, testicular/ovarian, ureteric brs; sympathetic to smooth muscle of vessels distal to splenic flexure; pain from descending, sigmoid colon and rectum; continuous w/ superior mesenteric plexus and inferior mesenteric plexus; doesn't carry vagal fibers; anterior to aorta

Superior hypogastric plexus (N [318](#)): fibers from intermesenteric and lumbar splanchnic nn.; gives off hypogastric nn.; VSM of pelvic viscera; pain; crosses pelvic brim

Lumbar segmental nn. (N [267,496,497](#)): form lumbar plexus; same as spinal nerves?

Lumbar sympathetic trunk (N [267,318](#)):

Gray rami communicantes: carries postganglionic sympathetic axons to the spinal nerve; spinal nerve carries those peripherally to body; connect to spinal nerve at all levels

White rami communicantes: T1-L2; axons synapse on postganglionic cell bodies to innervate body; carries pain signals; connect w/ sympathetic chain on level T1-L2; preganglionic sympathetic axons

Subcostal n. (N [267,496](#)): VPR of T12; has lateral/anterior cutaneous brs; innervates muscles of ab wall; skin of anterolateral ab wall

Lumbar plexus (N [267,497,498](#)): VPR L1-4; see below for branches

Iliohypogastric n.: VPR L1; muscles of lower ab wall; skin of lower ab wall, upper hip and thigh; contribution from T12 in 50% of cases

Ilioinguinal n.: VPR L1; gives off anterior scrotal br.; muscles of lower ab wall; skin of lower ab wall and scrotum/labia; courses through inguinal canal and superficial inguinal ring

Genitofemoral n.: VPR L1-2; genital and femoral brs; cremaster m.; skin of anterior scrotum and labia major and upper medial thigh; lies on anterior surface of psoas major in abdomen

Lateral femoral cutaneous n.: VPR L2-3; sympathetic motor innervation to skin of lateral thigh; carries postganglionic sympathetic fibers to skin

Femoral n.: VPR L2-4; muscles of anterior thigh; skin of anterior thigh; passes under inguinal ligament lateral to femoral a.

Obturator n.: VPR L2-4; muscles of medial thigh; skin of lower medial thigh; passes through obturator canal

Lymphatics: (N [266,546](#))

Lumbar (lateral aortic) nodes: along IVC and aorta from aortic bifurcation to aortic hiatus; empty into lumbar trunk; drains lower limb, pelvic organs, perineum, anterior and posterior ab wall, kidney, adrenal gland, diaphragm

Lumbar lymph trunks: btwn lumbar vertebral bodies and IVC/aorta at upper end of lumbar chain of nodes; empties into thoracic duct/cisterna chyli; drains body below diaphragm

Intestinal trunk: located on left side of aorta or btwn aorta and IVC near SMA; union of vessels from celiac and SM nodes; empties into left lumbar trunk (70%) or directly into cisterna chyli/thoracic duct (25%) (5% into right lumbar trunk); drains intestines; rich in fat lymph

Cisterna chyli: union of left and right lumbar trunks; enlargement of thoracic duct present in 25% of people; btwn aorta and IVC around L1 or L2

Femoral ring & deep inguinal lymph nodes:

Clinical Terms:

Femoral nerve iatrogenic injury: during open abdominal surgeries, retractor blades rest on femoral nerve crushing it as it is in groove btwn iliacus and psoas major

Renal calculus (kidney stone)

Cystic kidney: growth of fluid filled cysts in kidney replacing functional tissue; can cause complications elsewhere distinguishing it from harmless cysts that come w/ age

Horseshoe/pelvic kidney: kidneys united at inferior poles and migrate until stopped by IMA

Hiatal hernia: portion of stomach protrudes through diaphragm; obesity and smoking risk factors; associated w/ reflux esophagitis (heartburn, difficulty swallowing, chest pain and belching); tx w/ H2 antagonists, proton pump inhibitors and antacids

Congenital diaphragmatic hernia: congenital abnormal protrusion of ab contents upward through defect in diaphragm; treated surgically b/c it can interfere w/ breathing; common occurs on left

Abdominal aortic aneurysm (AAA): distended and weakened area of aortic wall; usually below renal arteries and above bifurcation; sudden, sever ab pain w/ radiation to back

Intravenous pyelogram (IVP): diagnostic test that follows time course of excretion of radiopaque contrast due through kidneys, ureters and bladder after injection into a cutaneous vein

The obturator nerve lies along the medial border of the psoas major muscle. The femoral nerve lies along the lateral border of the psoas major muscle, between psoas major and iliacus. The genitofemoral nerve pierces psoas major then lies on top of that muscle. The ilioinguinal nerve emerges at the lateral border of psoas major, then travels laterally.