

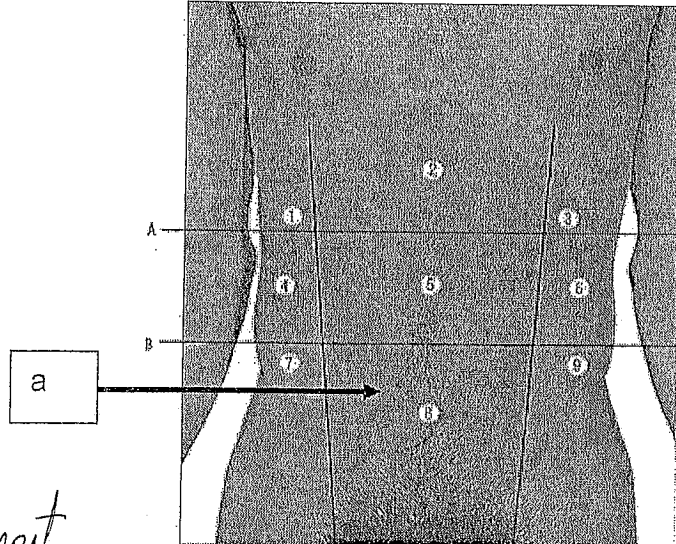
STRUCTURAL BASIS OF MEDICAL PRACTICE  
EXAMINATION 3

September 16, 2010

PART I. Answer in the space provided. (7 pts)

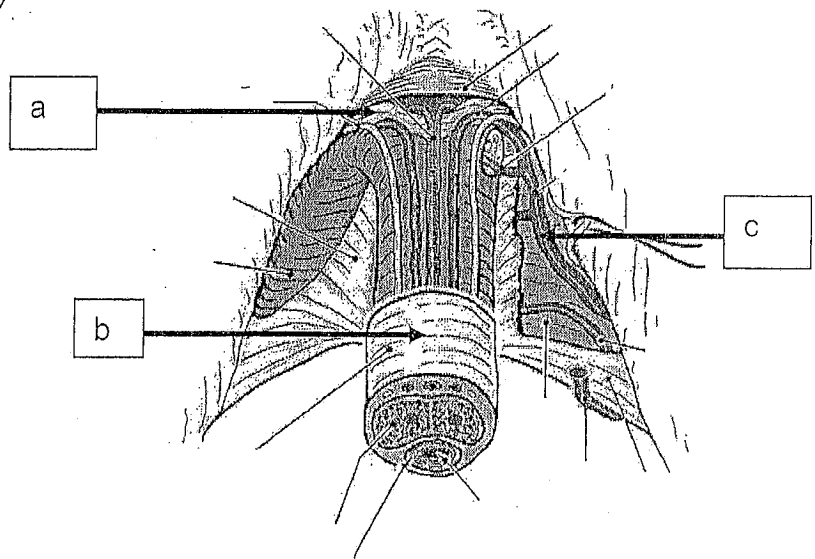
1. Identify the region. (0.5 pt)

a. Hypogastric



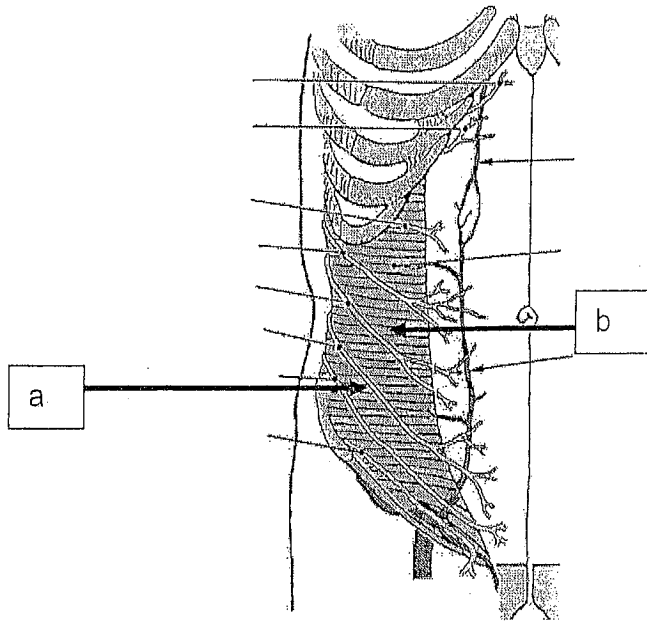
2. Identify the structure. (1.5 pts)

- a. Transverse Perineal Ligament
- b. Buck's Fascia
- c. Lateral Pudendal Artery



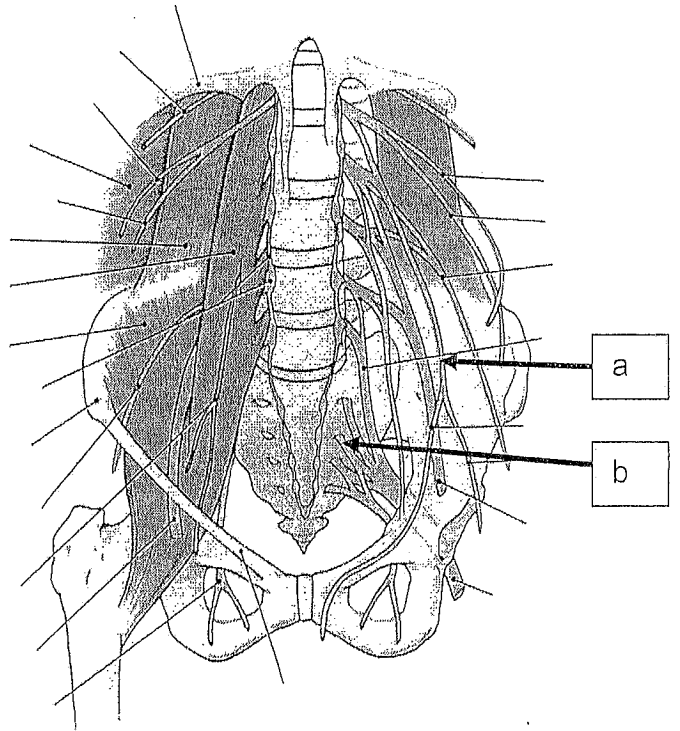
3. Identify the structures. (1 pt)

- a. Subcostal Nerve
- b. Transversus Abdominis



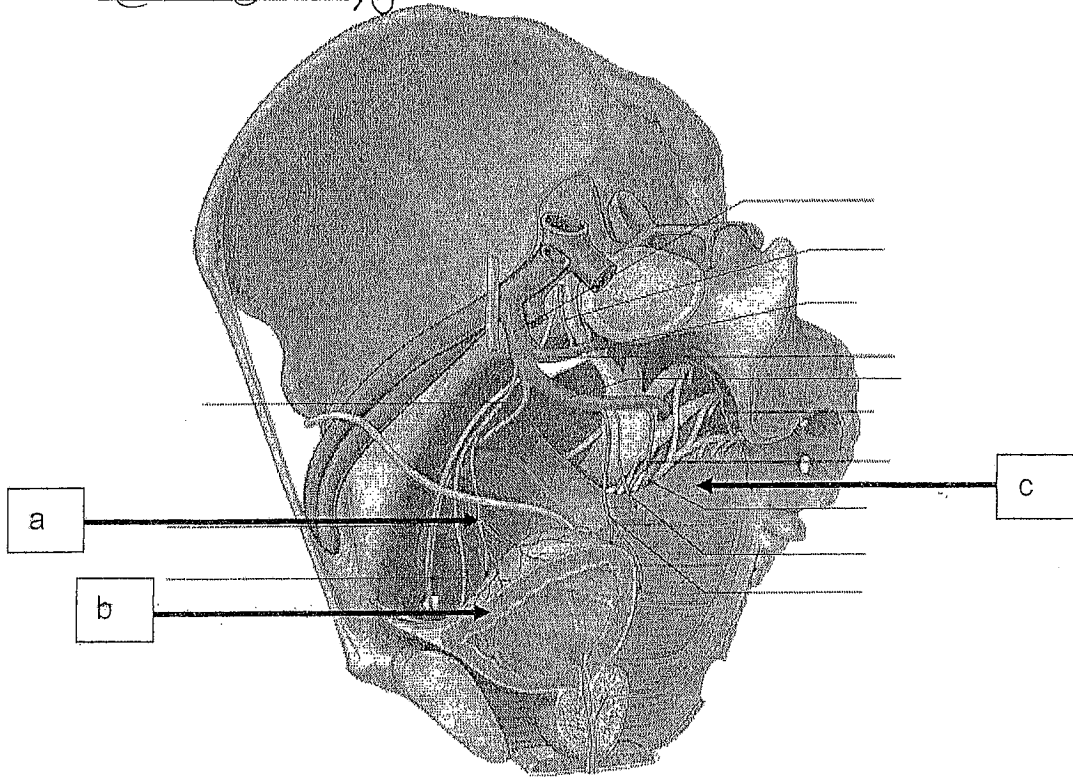
4. Identify the structures. (1 pt)

- a. Genitofemoral
- b. S2



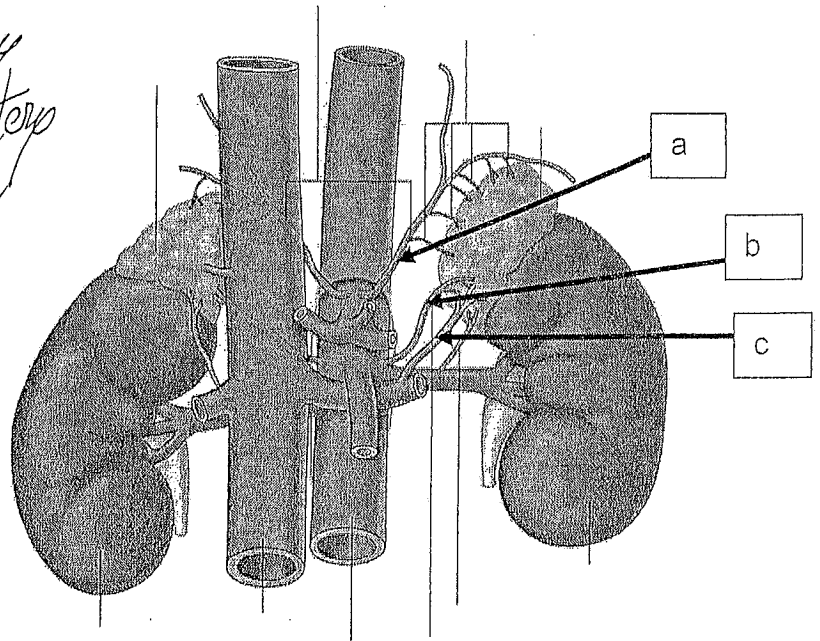
5. Identify the structures. (1.5 pts)

- a. Superior Vessel
- b. Defusor
- c. (Ischio) Coccygeus



6. Identify the structure. (1.5 pts)

- a. Inferior Phrenic Artery
- b. Middle Suprarenal Artery
- c. Central (Suprarenal) Vein



**Part II. Circle the correct answer. All, none, or some may apply. (33 pts)**

1. In regard to the abdominal vasculature, organs, and nerves:

a. The right gastric artery courses through both the hepatoduodenal and the hepatogastric ligaments.

b. The esophagus enters the abdomen at the level of T10.

c. The first part of the duodenum lies anterior to the portal vein, gastroduodenal artery, and the common bile duct.

d. The suspensory ligament (Ligament of Trietz) stabilizes the duodenojejunal flexure.

e. The gastroduodenal artery lies deep to the transversalis fascia.

f. The left and right gastroepiploic veins drain into the splenic vein.

g. Lymph in the lesser curvature of the stomach drains, in part, into the left gastric nodes.

h. The portal vein courses through the greater omentum.

i. The hepatic veins are entirely intrahepatic and drain into the portal vein.

j. According to internal morphology, the quadrate lobe and part of the caudate lobe belong to the left lobe of the liver.

k. The coronary ligaments of the liver are derived from the ventral mesentery.

l or i. The ligamentum venosum represents the obliterated umbilical vein that carried blood to the fetus.

m. The superior mesenteric artery arises from the aorta at the level of L1 just posterior to the neck of the pancreas.

n. The arcades in the ileum are "simple" compared to those in the jejunum.

o. The supraduodenal artery is embedded in extraperitoneal connective tissue.

p. The testicular (or ovarian) arteries arise inferior to the superior mesenteric artery.

q. Derivatives of the midgut include the jejunum, ileum, and the pancreas.

2. With respect to the nervous system:

a. The sympathetic trunk extends from the cervical region to the coccyx.

- b. Pelvic splanchnic nerves synapse in the inferior hypogastric plexus.
  - c. Lumbar splanchnic nerves are preganglionic sympathetic fibers.
  - d. Pelvic splanchnic nerves follow the inferior mesenteric artery to innervate the descending colon.
  - e. The appendix has parasympathetic innervation from the vagus nerve.
  - f. The testis receives parasympathetic innervation from the vagus nerve.
  - g. The lumbosacral trunk lies lateral to the femoral nerve in the pelvic cavity.
  - h. The anterior labial nerves are derived from the pudendal nerve.
  - i. Transection of the spinal cord above the sacral segments maintains reflex arcs and is termed an automatic "cord" bladder.
  - j. Defecation involves peristaltic contractions stimulated by the nervi erigentes.
  - k. Erections of the clitoris include engorgement of blood in the helicine veins.
  - l. The sympathetic trunks join and form the ganglion impar in front and anterior to the coccyx bone.
  - m. The hypogastric nerves course lateral to the rectum and join in the inferior hypogastric plexus.
  - n. Sharp pain in the lower right quadrant of the abdomen from an inflamed appendix is an example of referred pain.
  - o. The celiac ganglion serves for the synapses of pre-ganglionic fibers of the greater splanchnic nerve onto post-ganglionic cell bodies.
  - p. The superficial transverse perineal muscle is innervated by sympathetic nerves from the lumbar splanchnics and parasympathetics derived from S2-4.
  - q. The 2nd part of the duodenum is innervated, in part, by the vagus nerve.
3. With regard to the thoracic diaphragm and posterior abdominal wall:
- a. The right crus of the diaphragm forms the esophageal hiatus.
  - b. The hiatus for the aorta is made of fibers from both the right and left crura.
  - c. The lateral lumbocostal arch (arcuate ligament) is a thickening of the fascia of the quadratus lumborum.

- d. The lumbocostal trigone is a weakness in the structure of the diaphragm related to the lateral lumbocostal arch (lateral arcuate ligament).
- e. The thoracic duct passes from through the diaphragm into the abdominal cavity with the esophagus at level T10.
- f. The sympathetic trunks pass posterior to the diaphragm through the venal caval foramen at the level of T8.
- g. The left testicular vein drains into the left renal vein.
- h. The peripheral portion of the diaphragm has motor innervation from intercostal nerves 9, 10, and 11.

4.3. With respect to the abdominal wall and inguinal canal:

- a. The suspensory ligament of the penis is derived from the tela subcutanea.
- b. The external oblique muscle arises from the lower 8 ribs, thoracolumbar fascia, and the lateral two-thirds of the inguinal ligament.
- c. d. c. Nerves and vasculature of the anterior abdominal wall travel in the neurovascular plane, located between the external oblique and transversus abdominis muscles.
- d. The lacunar ligament is derived from fibers of the inguinal ligament that attach to the pecten pubis.
- e. Tendinous intersections of the rectus abdominis muscle are adherent to the anterior layer of the rectus sheath.
- f. The conjoint tendon (falx inguinalis) is formed by fibers of the internal oblique and transversus abdominis muscles.
- g. The cremaster muscle is innervated by the genital branch of the ilioinguinal nerve.
- h. The scrotal ligament, round ligament (ligamentum teres), and Cardinal ligament are derivatives of the gubernaculum.
- i. Direct inguinal hernias occur medial to the median umbilical ligament.

5.4. In regard to the kidneys and pelvis:

- a. The renal fascia is a derivative of the extraperitoneal connective tissue.
- b. The transversalis fascia in the ischiorectal fossa is termed parietal pelvic fascia.

- c. The uterosacral ligaments in the female are derived as condensation of the visceral pelvic fascia.
- d. The iliococcygeus is a skeletal muscle.
- e. The inferior fascia of the pelvic diaphragm is a condensation of the visceral pelvic fascia.
- h. The inferior gluteal artery courses superior to the upper border of the coccygeus muscle.
- i. The deep dorsal vein of the penis lies deep to Buck's fascia on the dorsal surface of the corpora cavernosa penis.

65. "This and that":

- a. The suspensory ligament of the ovary contains the ovarian artery.
- b. The greater vestibular glands in the female reside in the superficial pouch/space.
- c. The cisterna chyli is located at the level of the second lumbar vertebrae.
- d. The parietal layer of the tunica vaginalis is a continuation of the transversalis fascia into the scrotum.
- g. The appendix contains 3 distinct taenia coli.
- h. Meckel's diverticulum is an occasional feature of the ileum.
- i. The obliterated umbilical veins in the adult are termed medial umbilical ligaments.
- j. The reflected inguinal ligament is derived from the internal oblique muscle.

4. Define the "puborectal sling." (muscle(s), innervations, vascularization, function). (4 pts)

**Muscles-**

Puborectalis muscles from each side form the puborectal sling

Proximal attachment- body of the pubis

Distal attachment- puborectalis of the opposite side

Wraps around anorectal junction

Some fibers blend with the external anal sphincter

Deep to anal coccygeal raphe

Lateral boundary of the urogenital hiatus

**Innervation-**

S4- Nerve to Levator ani

Inferior rectal branches from pudendal nerve (S2, 3, 4)

**Vascularization-**

Arterial supply from internal iliac specifically inferior gluteal, middle rectal, inferior rectal, and internal pudendal arteries

Venous drainage is similar to arterial supply

**Function-**

Puborectalis is tonically contracted to constrict the rectum- inhibiting defecation

Forms the anorectal flexure at the ampulla of the rectum when contracted

Puborectalis relaxes and the anorectal flexure straightens to facilitate defecation



3. A 59 yr-old male presents to your clinic with an indirect inguinal hernia that descends into the scrotum. As a 1<sup>st</sup> year resident in surgery you are asked to: **Discuss where the herniated mass will be located and what will its relationship be to the testis, and the spermatic cord.** (4 pts)

- Arising lateral to the inferior epigastric vessels
- Congenital defect: patent vaginal process (or persistent weakening of lateral and posterior walls of canal)
- Passes through the **deep inguinal ring**
  - Transversalis fascia
- Continues through **inguinal canal**
  - Anterior- External oblique aponeurosis
  - Anterior/Lateral- Internal oblique aponeurosis
  - Posterior- Inguinal ligament, conjoint tendon, transversalis fascia
  - Superiorly-internal oblique and transverses abdominis
  - Medial- lacunar ligament
- Lies inferior and lateral to the conjoint tendon
  - Formed by transversus abdominis and internal oblique aponeurosis
  - Attached to the pubic crest and pectineal line
  - Strengthens medial portion of the posterior wall of the inguinal canal
- Passes through the **superficial inguinal ring**
  - Aponeurosis of external oblique
- Deep to superficial, surrounded by internal spermatic fascia (transversalis fascia), cremasteric muscle/fascia (internal oblique aponeurosis), and external spermatic fascia (external oblique aponeurosis)
- Descends into the scrotum anterior to the testis between the parietal and visceral layers of **tunica vaginalis**

Part III

Question 1.

Anatomy of varicosities radiating from the umbilicus

Cause:

**Caput Madusae** (increase in size of **paraumbilical veins**) due to abnormal increased load. The portal hypertension (increased pressure in the portal vein) is due to **obstruction within the liver**. The **increase in pressure in the portal vein causes blood to flow in the opposite direction** (retrograde) and is only possible due to the **lack of valves** in the venous system associated with the posterior body wall.

Anatomy:

While blood flow normally goes from the portal vein → hepatic veins → IVC, liver obstruction associated with alcohol abuse reverses this flow in the following manner (either superiorly or inferiorly):

Superior Drainage Pathway:

Portal vein → paraumbilical v (**portal circulation**) → superficial epigastric v and/or superficial circumflex iliac (**systemic /caval circulation**) → lateral thoracic v → THORACOEPIGASTRIC vein → Axillary v → subclavian v → brachiocephalic v → SVC → Right Atria

Or

Inferior Drainage Pathway:

Portal Vein → paraumbilical v → superficial epigastric vein → great saphenous vein → Femoral v → external iliac v → common iliac v → IVC → Right Atria

Question 2:

Boundaries of the epiploic foramen

Significance: Communication between the lesser and greater sacs

Anterior: hepatoduodenal ligament (lesser sac and encases hepatic artery, portal vein, and bile duct)

Posterior: IVC

Superior: Caudate lobe of liver

Inferior: Duodenum (superior portion)

Right: opening into hepatorenal recess and right paracolic gutter

Left: lower recess of lesser sac

### **Arcus tendineus**

- Specialization of obturator internus fascia
- On medial side of obturator internus muscle
- Posterior relationship to ischial spine
- Anterior relationship to posterior side of body of pubis
- Relationships to levator ani:
  - Pubococcygeus- anterior attachment
  - Ischiococcygeus- posterior attachment
- Part of the superior boundary of the ischioanal fossa posterior recess- limits extravasation of urine, spread of infection.
- Indirect support of pelvic viscera via pelvic diaphragm

### **Lienorenal ligament:**

- Location: Double layer of peritoneum between spleen and left kidney (posterior abdominal wall)
- Contents: tail of the pancreas, splenic a/v, autonomic
- Significance: boundary of splenic recess (lesser sac), suspends spleen in peritoneal cavity
- Embryologic derivation: derived from dorsal mesentery

## Prostate - September 16, 2010

Review the anatomy of the prostate. Include structure, supports, relationships, vascularization, innervation, and lymphatic drainage. (12 pts)

### Structure of the prostate

- The prostate, a walnut sized structure located superior to the pelvic floor and inferior to the neck of the bladder, is uniquely in the male. The glandular structure is encapsulated in a shiny capsule that is, in turn, surrounded by a thickened periprostatic fascia derived from pelvic visceral fascia. The posterior aspect of this fascia is especially thickened and is named the fascia of Denonvillier. A considerable amount of smooth muscle within the stroma adds firmness to the gland. Glandular follicles drain by way of 15 - 20 prostatic ducts into the prostatic sinuses of the prostatic urethra.
- The median lobe of the prostate is posterior to the prostatic urethra. This lobe includes the ejaculatory ducts, seminal colliculus, urethral crest, and most distal aspect of the uvula. Benign prostatic hypertrophy commonly affects the median lobe. In addition to the median lobe, there designated two lateral lobes and an anterior lobe. There are no anatomical landmarks delineating the lobes.
- The prostatic urethra occupies about 2.5 cm of the central prostate. The superior posterior wall receives a projection of the uvula that becomes the urethral crest within the prostatic urethra. Approximately one-third of the way into the prostatic urethra the urethral crest widens for 2-4 mm to form the seminal colliculus. The ejaculatory ducts empty into the prostatic urethra on either side of the seminal colliculus. Lateral to the seminal colliculus the posterior wall deepens posteriorly to form the prostatic sinuses receiving the prostatic ducts. The utricle, thought to be a vestigial uterus in the male, might be visible on the anterior surface of the seminal colliculus.

### Support of the prostate

- Puboprostatic ligament - Condensation of pelvic visceral fascia secures prostate to anterior pelvic wall
- Lateral ligaments - Condensation of pelvic visceral fascia secures prostate to lateral pelvic wall
- Median umbilical ligament - obliterated urachus secures bladder, and thus prostate, to anterior abdominal wall
- Levator prostatae muscle - fibers of pubococcygeus insert into the prostatic fascia and capsule

### Relations of the prostate

- Inferior - superior fascia of the pelvic diaphragm located at the urogenital hiatus of the urogenital diaphragm
- Superior - neck of the bladder and the uvula
- Anterior - inferior aspect of the pubic symphysis
- Posterior - rectum, rectovesical space
- Posterior/superior - ampulla of ductus deferens, ureter, seminal vesical
- Lateral - pelvic diaphragm, superior aspect of conjoint rami, pelvic wall

### **Vasculature of prostate**

- The arterial supply to the prostate is derived from the inferior vesical, middle rectal, and inferior rectal (internal pudendal) arteries. Each of these arteries is a branch of the internal iliac artery
- The prostatic venous plexus is superficial to the capsule and deep to prostatic fascia. It receives the deep dorsal vein of the penis and the vesical venous plexus. Venous drainage to internal iliac veins follow the aforementioned arterial pathways. There is free drainage by the lateral sacral veins into the internal vertebral venous plexus. This drainage is thought to account for the propensity of prostatic cancers to metastasize to the vertebral column.

### **Innervation of prostate**

- The prostatic autonomic plexus is derived from the inferior hypogastric plexus. Preganglionic sympathetic cell bodies are located in the IMLCC of L1-2. Preganglionic fiber pathways involve the superior hypogastric plexus and the right and left hypogastric nerves. Further, preganglionic fibers can follow the common iliac plexus to the internal iliac plexus and arrive at the prostatic plexus by way of the arterial supply. Postganglionic sympathetic cell bodies are thought to be located in unnamed ganglia distributed throughout the inferior hypogastric plexus. Additionally, preganglionic fibers within the sacral sympathetic trunk contribute sacral splanchnics to the inferior hypogastric plexus.
- Parasympathetic preganglionic cell bodies are located in the IMLCC of S2-4. Pelvic splanchnic nerves convey preganglionic fibers to the inferior hypogastric plexus. Postganglionic cell bodies are located in enteric ganglia at the target location.
- The inferior hypogastric plexus forms extensions that spread out over the pelvic organs. The prostatic autonomic plexus forms a collection of nerves that run along the lateral aspect of the prostate and onto the membranous urethra to enter the cavernous tissue of the perineum. The cavernous nerves provide the parasympathetic innervation to the helicine arteries. To avoid impotency, it is essential that the cavernous nerves are preserved during prostatic surgery.

### **Lymphatic drainage of prostate**

- The internal tissues of the prostate have relatively little lymphatic drainage. For this reason, it is thought that metastatic disease reaches the vertebral column through venous channels (see above).
- The prostatic capsule and fascia drain into internal iliac nodes to common iliac, to lumbar, to cisterna chyli.

## Scarpa's Fascia - September 16, 2010

Discuss the boundaries of Scarpa's fascia and its derivatives with respect to the containment of urine in the male. Specify the fascial layers associated with the accumulation of urine. Discuss whether urine will be found in the ischioanal fossa. (12 pts)

### General comments

- Scarpa's fascia is membranous tela subcutanea. This fascia is capable of holding sutures and defines a potential space between it and deep fascia. This space can be invaded by infection or the extravasation of urine. The tear in the inferior fascia of the urogenital diaphragm transmits urine from the deep pouch to the superficial perineal pouch. The intact superior fascia of the urogenital diaphragm together with the intact superficial perineal fascia will prevent urine from entering the ischioanal fossa. The accumulation of urine is restricted by the boundaries of Scarpa's (membranous) fascia.

### Anterior abdominal wall - between Scarpa's fascia and deep fascia of external oblique

- Superior: Scarpa's fascia attaches to deep fascia in finger like projections at level of umbilicus
- Inferior medial: open passage to scrotum
- Inferior lateral: passage to thigh
- Lateral: near mid-axillary line at the thoracolumbar fascia
- Medial: along the linea alba, fundiform ligament
- Anterior: Scarpa's fascia
- Posterior: deep fascia of external oblique

### Thigh - between Scarpa's fascia and fascia lata

- Inferior: 2 cm below inguinal ligament
- Superior: open
- Lateral: iliotibial tract
- Medial: pubic ramus
- Anterior: Scarpa's fascia
- Posterior: fascia lata

### Scrotum - between Dartos's tunic (Scarpa's derivative) and external spermatic fascia (deep fascia)

- Superficial: Dartos's tunic
- Deep: external spermatic fascia

### Penis - between Colle's fascia (Scarpa's derivative) and Buck's fascia (deep fascia)

- Extends distally toward base of, but not including, the glans
- Superficial: Colle's fascia
- Deep: Buck's fascia

**Urogenital triangle - within superficial pouch between superficial perineal fascia (derivative of Scarpa's fascia) and perineal membrane (deep fascia)**

- Superior: perineal membrane (inferior fascia of the urogenital diaphragm)
- Inferior: superficial perineal fascia
- Anterior: open into scrotum
- Posterior: posterior free edge of urogenital diaphragm, superficial perineal fascia
- Lateral: conjoint rami
- Medial: not restricted

**Extravasation into the ischiorectal fossa? - NO**

- Limited by superior fascia of UG diaphragm
- Limited by superficial perineal fascia (attached to posterior free edge of UG diaphragm and conjoint rami)

## Transverse Colon - September 16, 2010

Discuss the anatomy of the transverse colon. Include structure, support, relationships, innervation, vasculature, and lymphatics. (12 pts)

### General comments

- The transverse colon is an intraperitoneal segment of the large bowel. It spans from the right colic flexure to the left colic flexure. Surgical access to the lesser sac is provided by the gastrocolic ligament. The transverse colon divides the greater sac into supracolic and infracolic compartments.

### Structure

- Layers - from inner to outer
  - mucosa (columnar epithelium) - no villi in large intestine
  - submucosa (vascular and submucosal nerve plexuses) - padding between mucosa and muscular layer
  - tunica muscularis - inner circular and outer longitudinal smooth muscle, myenteric plexus, peristalsis
  - mesothelium and connective tissue
  - serosa - visceral peritoneum covers the transverse colon except at the attachment of transverse mesocolon
- Teniae coli - 3 longitudinal bands of smooth muscle
- Haustra coli - sacculations caused by the teniae coli being shorter than the gut tube
- Appendices epiploicae - fat appendages hanging from the teniae
- Caliber is generally larger than the small intestine

### Support

- Right
  - superior aspect of retroperitoneal ascending colon, cradled by right lobe of liver
  - right hepatocolic ligament
- Middle
  - transverse mesocolon attaches to posterior abdominal wall crossing right kidney, duodenum, IVC, aorta, pancreas, left kidney
  - gastrocolic ligament provides anchoring to the stomach
- Left
  - phrenicocolic ligament

### Relationships

- Right - level of L2
  - Superior - liver, gallbladder, descending duodenum
  - Inferior - coils of jejunum and ileum
  - Anterior - costal margin, diaphragm, liver
  - Posterior - diaphragm, right kidney, inferior vena cava, pancreas, quadratus lumborum
  - Medial - itself
  - Lateral - liver, right paracolic gutter, hepatorenal recess



- Middle - level of L1-2
  - Superior - stomach, gastrocolic ligament, liver, lesser sac
  - Inferior - coils of jejunum and ileum
  - Anterior - greater omentum, costal margin, diaphragm, falciform ligament
  - Posterior - pancreas (head, body, and tail), horizontal duodenum, aorta, superior mesenteric artery, intestinal mesentery
  - Lateral left - left colic flexure (see below)
  - Lateral right - right colic flexure (see above)
- Left - level of T12-L1
  - Superior - spleen, diaphragm
  - Inferior - jejunum, descending colon, left paracolic gutter
  - Anterior - diaphragm
  - Posterior - diaphragm, left kidney, quadratus lumborum
  - Lateral - phrenicocolic ligament, superior aspect of left paracolic gutter
  - Medial - itself

## Innervation

- Right Side
  - Parasympathetic
    - Preganglionic
      - vagus nerves \* preganglionic pathway - vagus nerves, superior mesenteric ganglion (no synapse), superior mesenteric plexus, right and middle colic arteries
    - Postganglionic
      - enteric ganglia at the target
      - cell bodies in submucosal layer - postganglionic fibers contribute to submucous plexus, enteric plexus
  - Sympathetic
    - Preganglionic
      - cell bodies within intermediolateral cell column (IMLCC) of T10-11
      - preganglion fiber path - ventral root to spinal nerve, to ventral ramus, white ramus communicans, thoracic sympathetic trunk, thoracic splanchnic nerves, lesser splanchnic nerve
    - Postganglionic
      - cell bodies in the superior mesenteric ganglion
      - postganglionic fiber pathway - superior mesenteric plexus, right colic artery, middle colic artery, enteric plexus
  - Visceral Afferent
    - High threshold (pain)
      - follow sympathetic preganglionic and sympathetic postganglionic pathways
    - Low threshold (homeostatic)
      - follow the vagus nerves

- Left Side
  - Parasympathetic
    - Preganglionic
      - pelvic splanchnics
      - preganglionic pathway - IMLCC S2-4, pelvic splanchnics, inferior hypogastric plexus, left hypogastric nerve, sigmoid mesocolon, retroperitoneal along medial margin of descending colon, left transverse mesocolon
    - Postganglionic
      - enteric ganglia at the target
      - cell bodies in submucosal layer - postganglionic fibers contribute to submucous plexus, enteric plexus
  - Sympathetic
    - Preganglionic
      - cell bodies within intermediolateral cell column (IMLCC) of L1-3
      - preganglion fiber path - ventral root to spinal nerve, to ventral ramus, white ramus communican, lumbar sympathetic trunk, lumbar splanchnic nerves, aortic plexus, inferior mesenteric ganglia (synapse here)
    - Postganglionic
      - cell bodies in the inferior mesenteric ganglia
      - postganglionic fiber pathway - inferior mesenteric plexus, left colic artery, enteric plexus
  - Visceral Afferent
    - High threshold (pain)
      - follow sympathetic preganglionic and sympathetic postganglionic pathways
    - Low threshold (homeostatic)
      - follow parasympathetic preganglionic pathway (see parasympathetic preganglionic pathway)

**Vasculature - provided by the arteriovenous supply of midgut and hindgut, venous drainage is into portal system**

- Right
  - Right colic artery/vein from superior mesenteric artery/vein
    - retroperitoneal up to right colic flexure
    - contributes to marginal artery/vein
- Middle
  - Middle colic artery/vein from superior mesenteric artery/vein
    - travels through to transverse mesocolon
    - contributes to marginal artery/vein
- Left
  - Left colic artery/vein from inferior mesenteric artery/vein
    - retroperitoneal up to left colic flexure
    - contributes to marginal artery/vein

## Lymphatic drainage

- General
  - intestinal nodes to central nodes (superior and inferior mesenteric nodes) to intestinal lymph trunks to cisterna chyli
- Right
  - paracolic nodes to superior mesenteric nodes
- Middle
  - paracolic nodes to superior mesenteric nodes
- Left
  - paracolic nodes to inferior mesenteric nodes