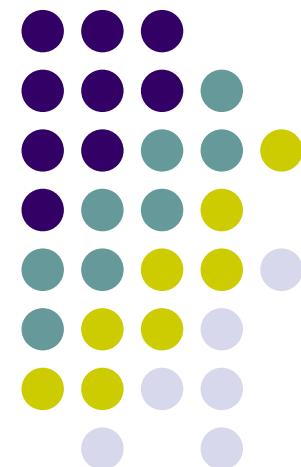


Anatomy of the Abdomen, Pelvis & Retroperitoneal Structures



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Outline

- Abdomen
 - Layers, muscles and organs
- Innervation of abdominal organs
- Retroperitoneum
 - Structures and innervation
- Pelvic Organs and innervation



Abdomen

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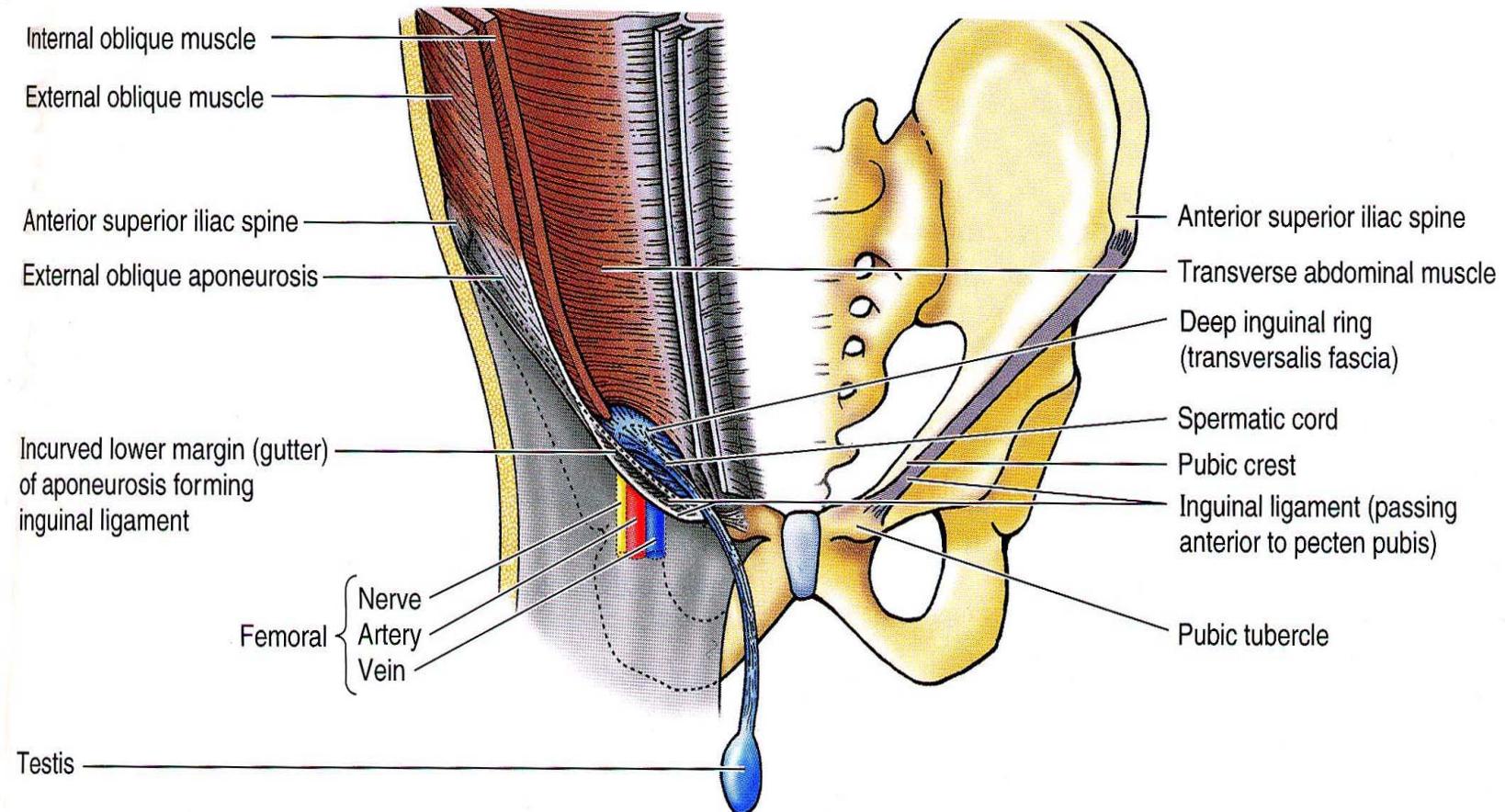


Surface Anatomy of Abdomen

- Umbilicus
- Linea alba = white line
 - Xiphoid process to pubic symphysis
 - Tendinous line
- Inferior Boundaries
 - Iliac crest
 - Ant. Sup. Iliac spine
 - Inguinal ligament
 - Pubic crest
- Superior Boundary
 - Diaphragm



Abdominal wall





Layers of abdominal wall

- Fatty superficial layer - Camper's fascia
- Membranous deep layer - Scarpa's fascia
- Deep Fascial
 - External oblique muscle
 - Internal oblique muscle
 - Transverse abdominal muscle
- Transversalis fascia
- Parietal Peritoneum



Muscles of Anterior Abdominal Wall

- **External Obliques**

- O: lower 8 ribs I: aponeurosis to linea alba
- Function: Flex trunk, compress abd. wall (together)
Rotate trunk (separate sides)

- **Internal Obliques**

- O: Lumbar fascia, iliac crest, inguinal ligament
- I: Linea alba, pubic crest, last 3-4 ribs, costal margin
- Function: Same as External obliques

- **Transversus Abdominis**

- O:same as Internals, plus last 6 ribs
- I: Xiphoid process, costal cart. 5-7
- Function: Compress abdomen

- **Rectus Abdominis**

- O: Pubic crest, pubic symphysis I: Xiphoid, cost cart 5-7
- Function: Flex, rotate trunk, compress abdomen, fix ribs



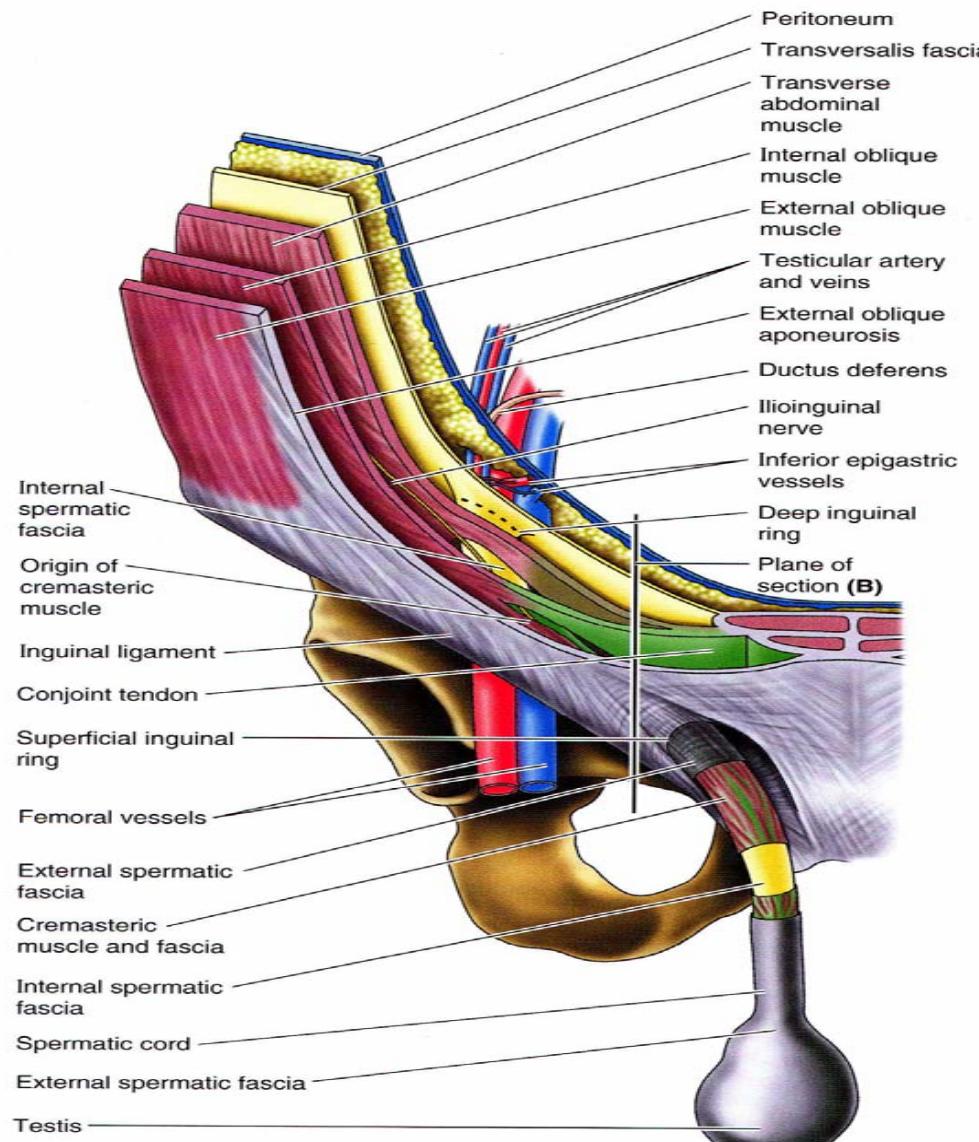
Peritoneum

- Extension of serous membrane in the abdomino-pelvic cavity
- Mesentery: Double layer of peritoneum
 - Hold organs in place
 - Store fat
 - Route for vessels + nerves
- Retroperitoneal: some organs behind peritoneum (eg) distal esophagus, duodenum, ascending + descending colon, rectum, pancreas
- Peritoneal: remain surrounded by peritoneal cavity (eg) liver, stomach, ileum + jejunum, +

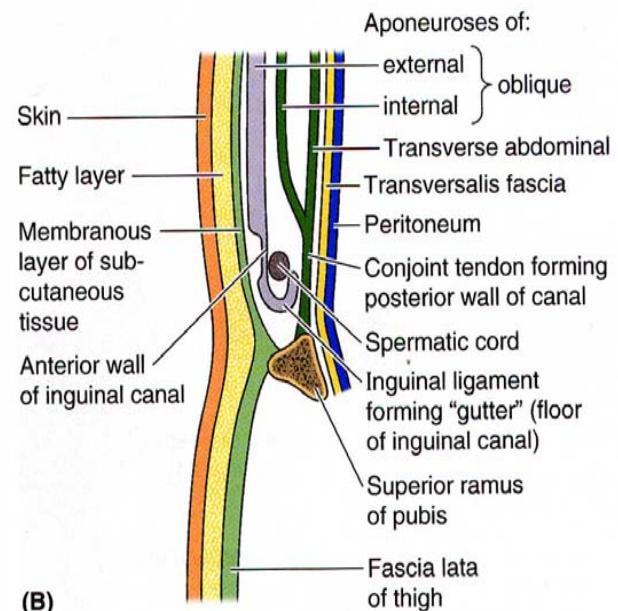


Diaphragm

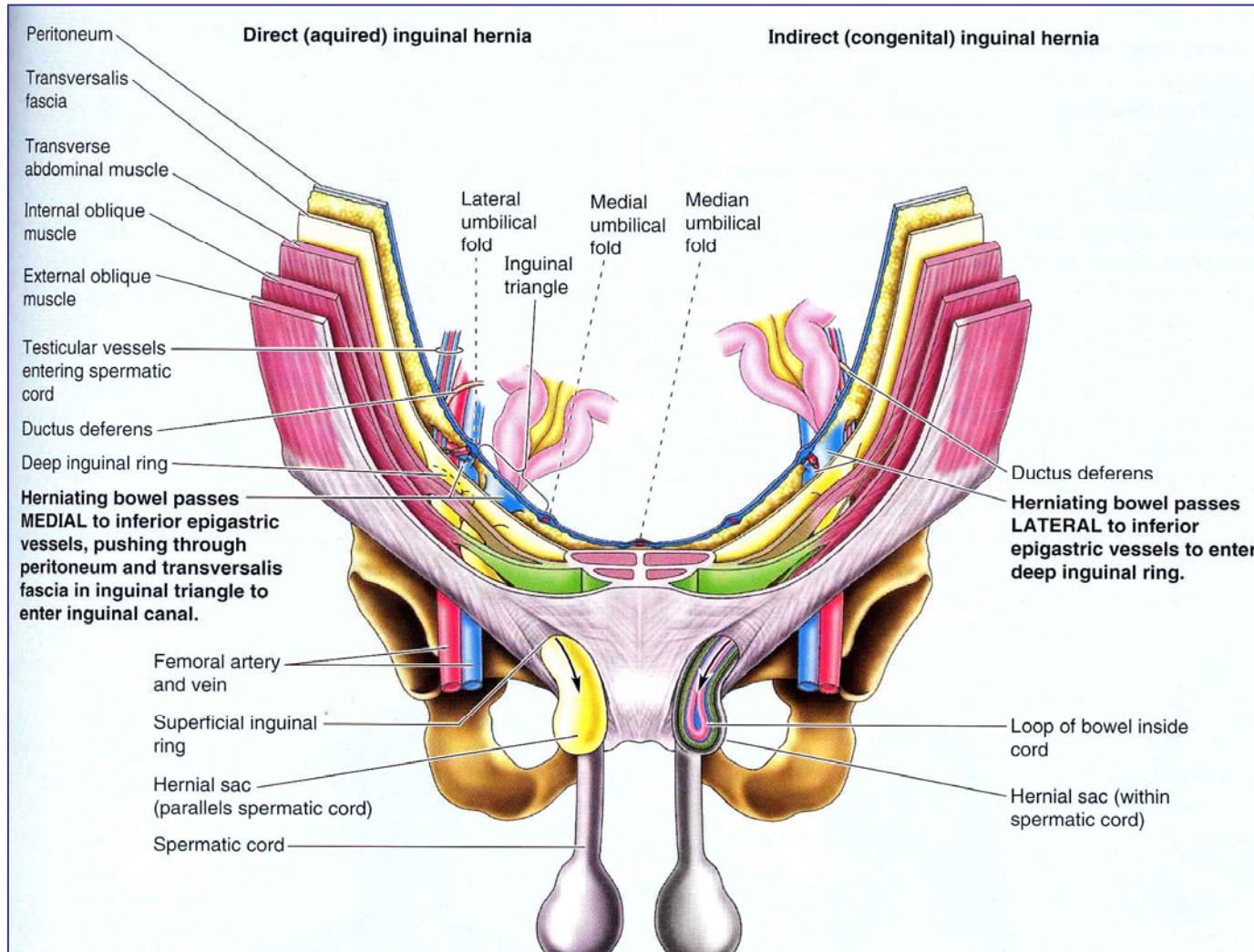
- Trefoil central tendon
- 5 openings
 - Caval
 - Esophageal
 - Aortic
 - Gaps for psoas m
- Crus arise from lumar vertebrae
- Innervation
 - Phrenic nerve unilaterally plus associated pleura and peritoneum
 - Peripheral - lower intercostal nerves



Inguinal Canal



Inguinal Hernias





Innervation of Abdominal Organs

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Overview of Nerves of Abdomen

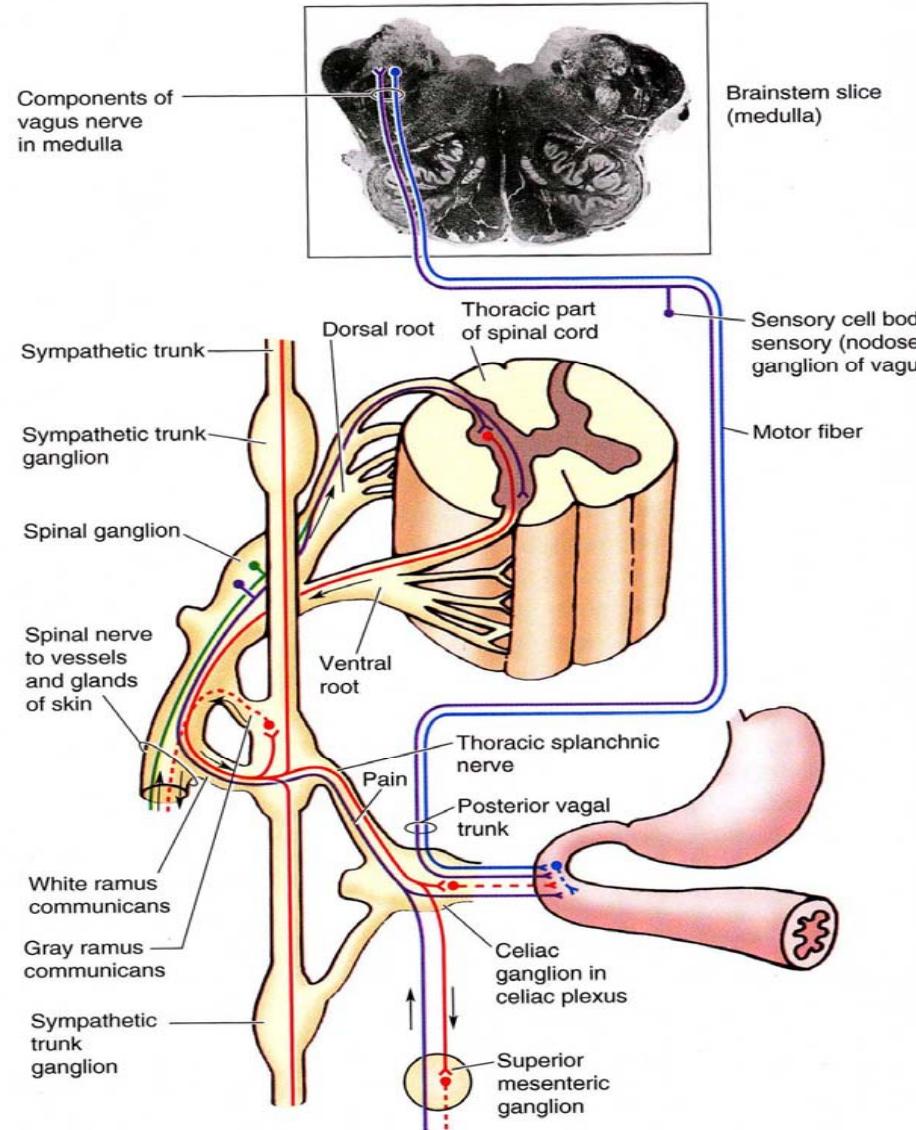
- Diaphragm
 - Parietal peritoneum of under surface of diaphragm supplied by phrenic nerve centrally and intercostal nerves peripherally
 - Stimulation centrally refers to neck and shoulder (C3 - C5)
 - Peripheral irritation refers to lower chest wall
- Parietal Peritoneum
 - Somatic nerves from spinal nerves
- Visceral Peritoneum
 - Nerves from autonomies; sensitively similar to viscera



Innervation of Viscera

- Viscera normally not sensitive to painful stimuli applied to skin
 - Mid-esophagus to anal verge
 - Burn and crush not painful
 - Stretch, over distension, traction are normally painful
 - Spasm, isometric conditions, ischemia and inflammation painful

Visceral Afferents and Efferents





Vagus Nerves

- Parasympathetic preganglionic fibers and sensory fibers to viscera of abdomen
- Except left half of transverse colon and descending colon
- Sacral parasympathetics
- Cell bodies
 - Motor: dorsal motor nucleus of medulla
 - Sensory: inferior nodose ganglion



Abdominal Splanchnics

- Lower thoracic splanchnics main source of presynaptic sympathetics to abdominal viscera
 - Greater: T5-T9
 - Lesser: T10-T11
 - Least: T12
- Pierce crus of diaphragm to reach prevertebral ganglia



Abdominal Prevertebral Ganglia

- Celiac Plexus
 - Largest prevertebral plexus
 - Composed of celiac ganglia and fibers
 - Anterior to crura of diaphragm and L1
 - Anterior to abdominal aorta at level of celiac artery and root of superior mesenteric artery
 - Posterior to stomach, omental bursa, pancreas, portal vein and inferior vena cava
- Organs innervated by fibers passing thru celiac plexus
 - Stomach, duodenum, jejunum, ileum, spleen, appendix, gallbladder and liver, kidneys, ureters, adrenals, ascending and transverse colon



Secondary Ganglia andPlexuses from Celiac Plexus

Subsidiary prevertebral ganglia

- Celiac ganglia
- Superior mesenteric ganglia
- Inferior mesenteric ganglia
- Aortorenal ganglia
- Secondary plexuses
 - Phrenic, gastric, hepatic, splenic, renal, superior mesenteric, intermesenteric, aortic, etc
 - Inferior mesenteric plexus chiefly from aortic but also from lumbar sympathetics



Table of Splanchnic Nerves

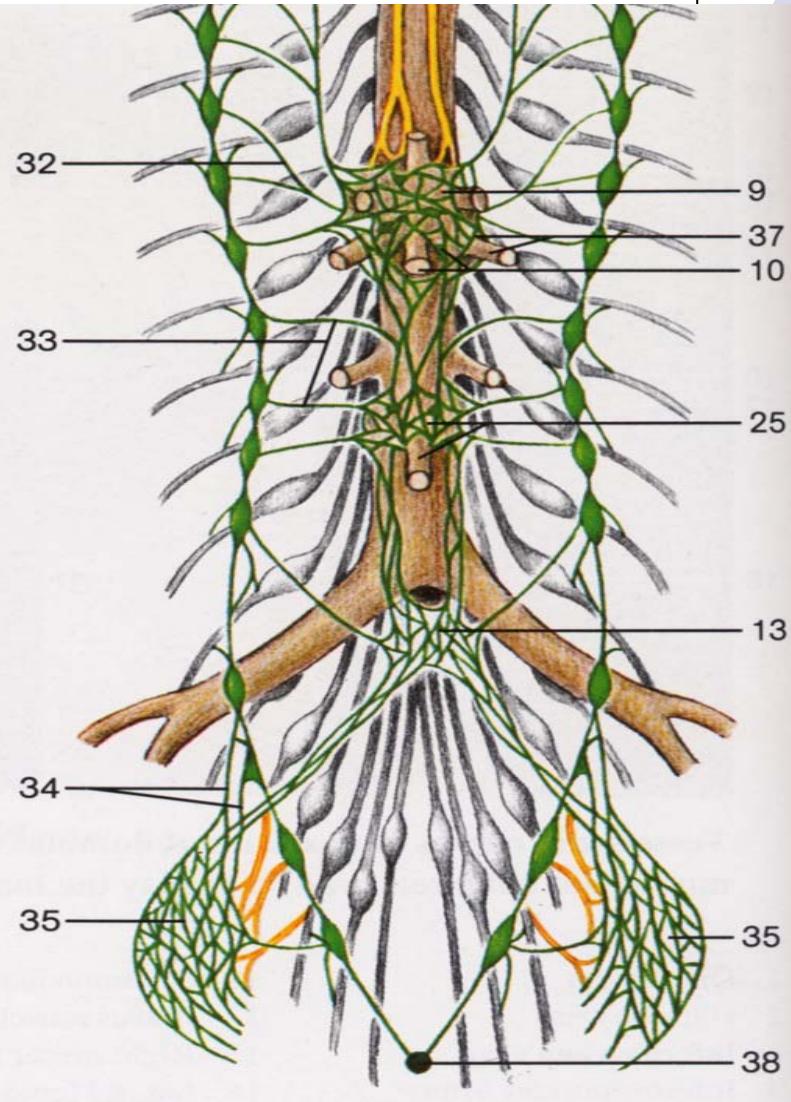
Splanchnic Nerves	Autonomic Fiber Type ^a	System	Origin	Destination
A. Cardiopulmonary	Postsynaptic	Sympathetic	Cervical and upper thoracic sympathetic trunk	Thoracic cavity (viscera above level of diaphragm)
B. Abdominopelvic			Lower thoracic and abdominal sympathetic trunk	Abdominopelvic cavity (prevertebral ganglia serving viscera below level of diaphragm)
1. Lower thoracic: a. Greater b. Lesser c. Least	Presynaptic	Sympathetic	Thoracic sympathetic trunk: a. T5–T9 or T10 level b. T10–T11 level c. T12 level	Prevertebral ganglia: a. Celiac ganglia b. Superior mesenteric ganglia c. Aorticorenal ganglia
2. Lumbar			Abdominal sympathetic trunk	Inferior mesenteric ganglia and ganglia of intermesenteric and hypogastric plexuses
C. Pelvic	Presynaptic	Parasympathetic	Ventral rami of S2–S4 spinal nerves	Intrinsic ganglia of descending and sigmoid colon, rectum, and pelvic



Autonomic Fibers and Ganglia

Key

- 9. Celiac trunk and ganglion
- 10. Superior mesenteric artery and ganglion
- 13. Superior hypogastric plexus and ganglion
- 32. Lesser splanchnic nerve
- 33. Lumbar splanchnic nerves
- 34. Sacral splanchnic nerves
- 35. Inferior hypogastric ganglion and plexus
- 37. Aorticorenal plexus and renal artery
- 38. Ganglion impar





Abdominal Organs

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Esophagus, Stomach and Bowel

- Distal esophagus (retroperitoneal)
 - Nociception via greater and lesser splanchnics (T5-9) and vagus
- Stomach and duodenum
 - Nociception via greater splanchnic nerves (T_{5-9}) for stomach and T_{8-11} splanchnics for distal duodenum
- Jejunum and ileum
 - Nociception via sympathetic afferents in splanchnic nerves to superior mesenteric plexus
 T_{8-12}

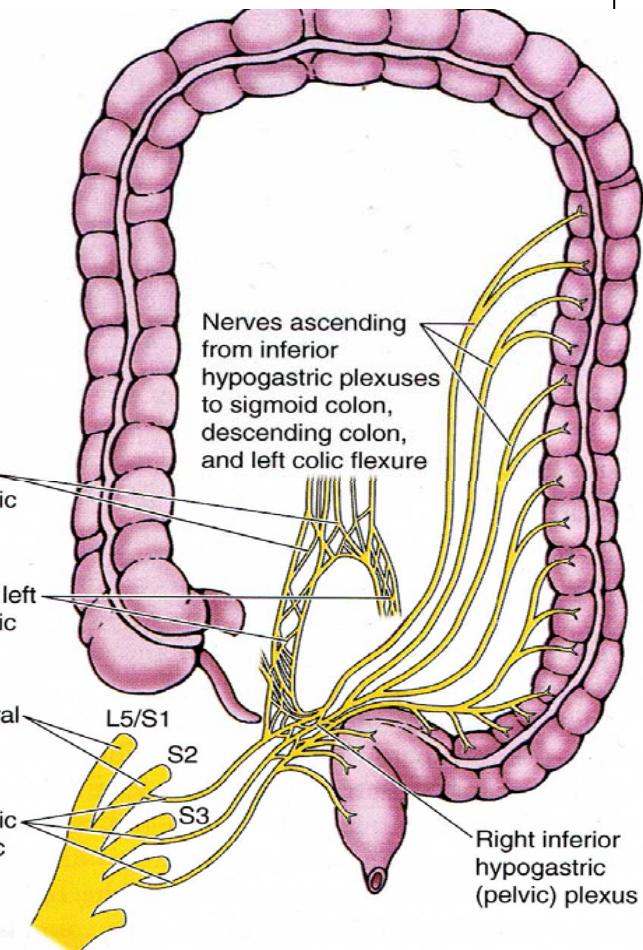
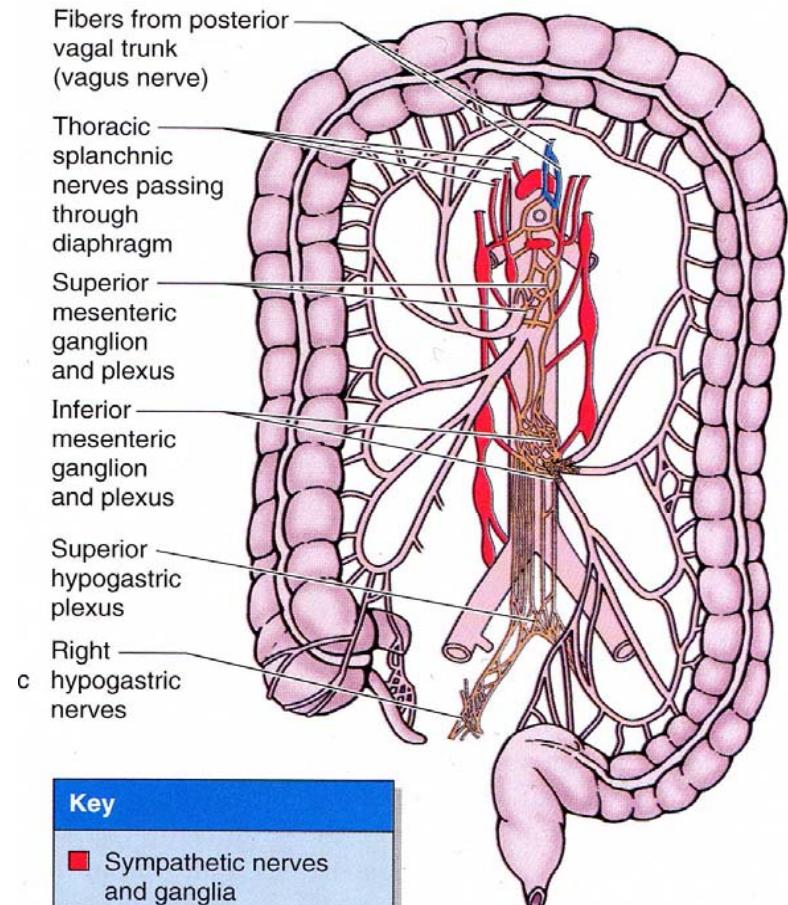


Large intestine

- Nociception to transverse colon via sympathetic afferents from T_{8-12} splanchnics to superior and inferior *mesenteric plexuses*
- Descending and sigmoid colon via superior hypogastric plexus and parasympathetic afferents to the pelvic plexus at S_2-S_4
- Rectum
 - Superior hypogastric plexus
- Note that there are some nociceptive afferents with the vagus



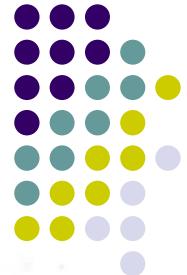
Diagrams of Innervation of Colon





Liver and Biliary Tree

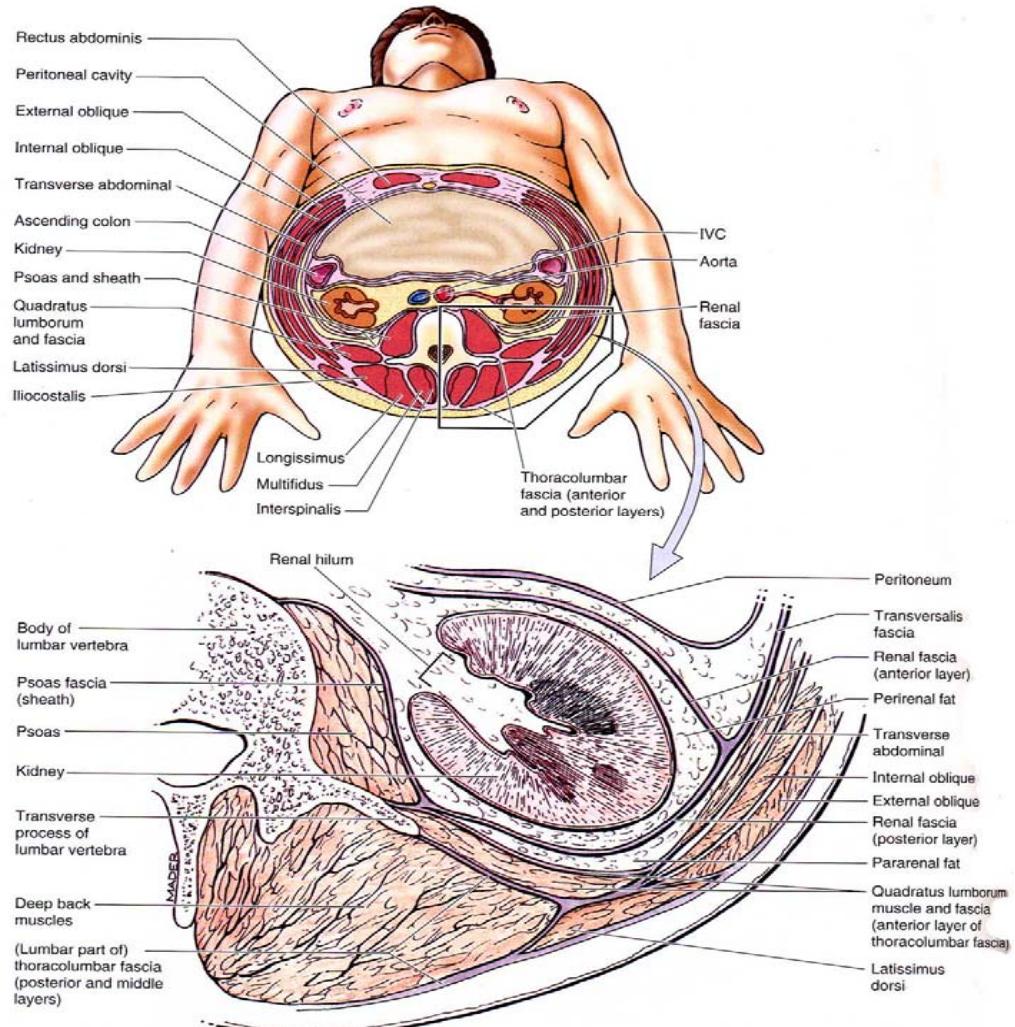
- Liver
 - Hepatic Plexus - largest derivative of celiac plexus
- Biliary Ducts
 - Nociception via sympathetic fibers and right splanchnic nerves from T₆₋₁₀
 - Vagus nerve plays no role in pain transmission
 - Inflammatory biliary disease stimulates afferent fibers of the parietal peritoneum causing somatic pain in the T₆₋₉ distribution (RUQ)



Retroperitoneum

Retroperitoneal organs

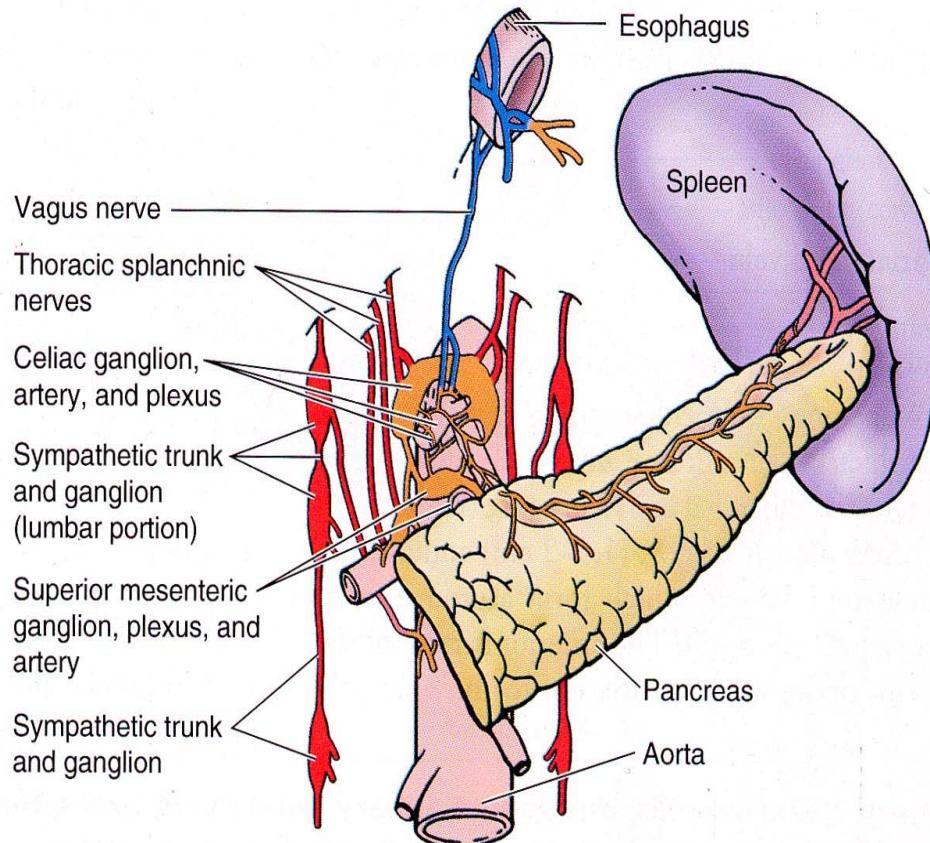
- Duodenum and pancreas
- Ascending and descending colon
- Kidneys and ureters
- Bladder and uterus
- Great vessels
- Rectum





Pancreas

- Nociception via splanchnic nerves T_{5-9} through celiac plexus
- Vagal afferents do not mediate pancreatic pain





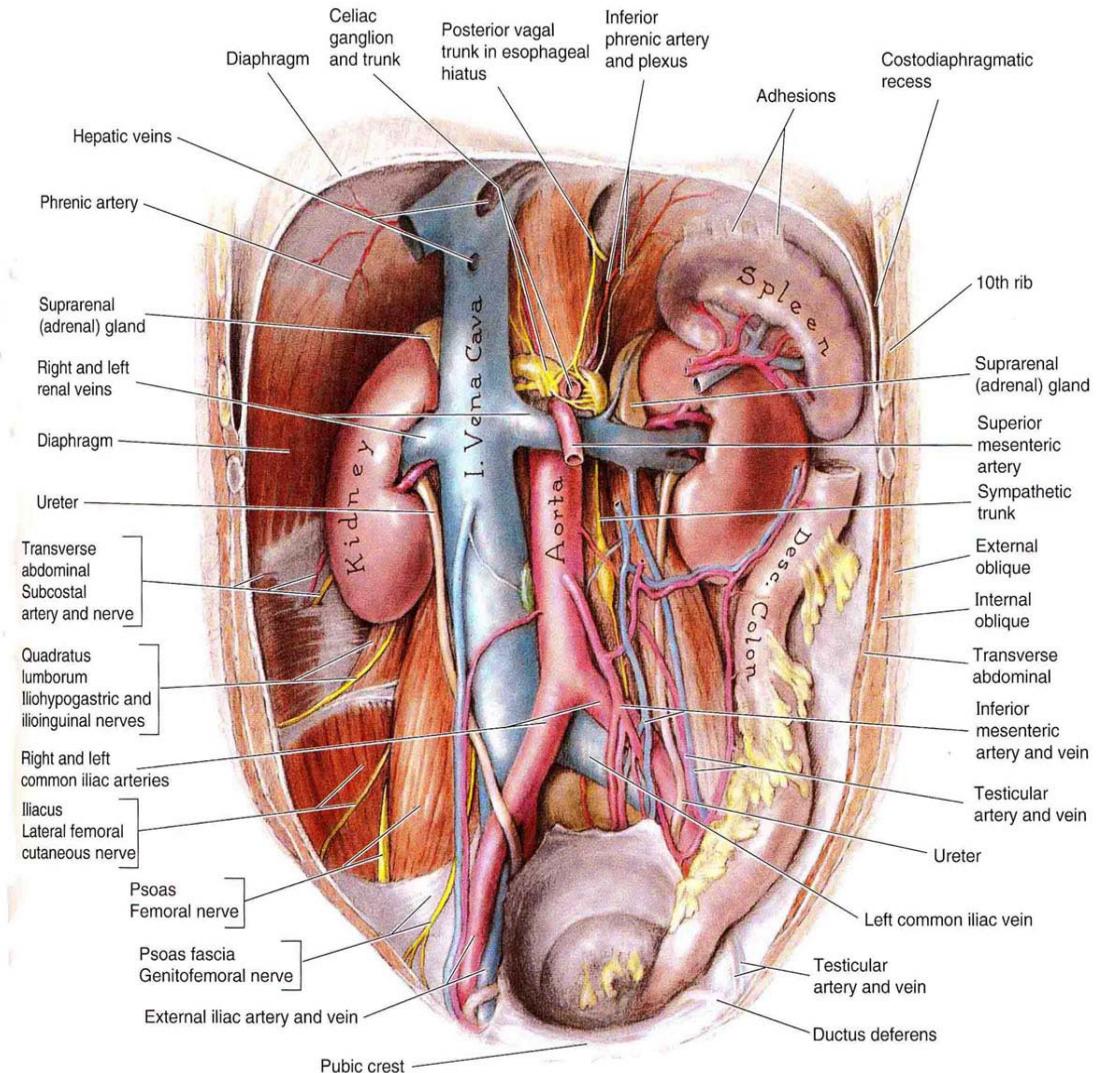
Kidneys and Ureters

- Kidneys
 - Lesser and least splanchnic nerves
 - Celiac plexus
 - Aorticorenal plexus
- Adrenals
 - Greater, lesser and least slanchnics
 - Celiac plexus
- Ureters
 - Nociceptive fibers with sympathetics in renal, aortic and superior and inferior hypogastric plexuses



Posterior Abdomen

- Fascia removed
- Ureter crosses common iliac
- Vas deferens and inguinal canal
- Lateral femoral cutaneous, ilioinguinal and genitofemoral n.
- Celiac and mesenteric arteries



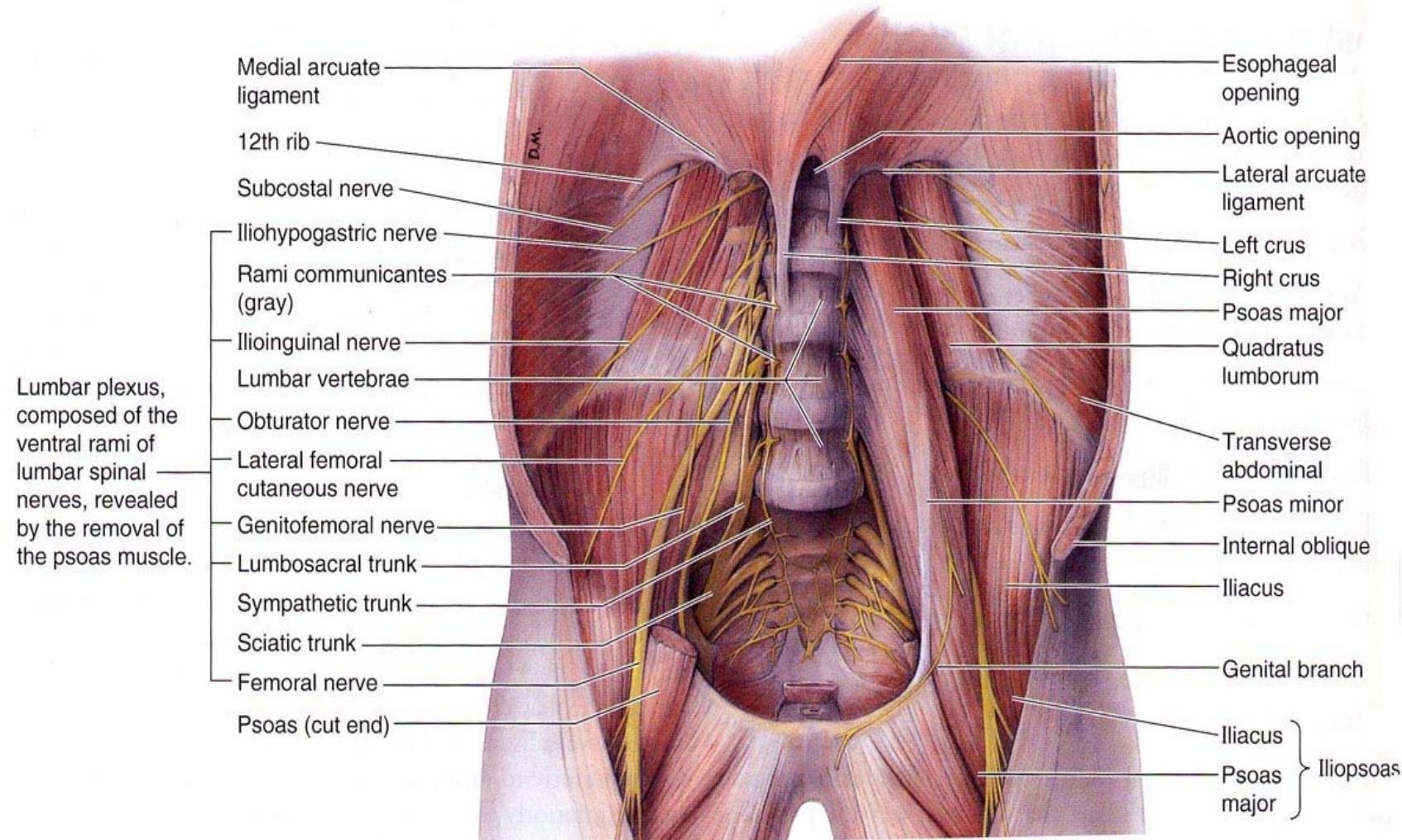


Muscles of the Posterior Abdominal Wall

- Psoas major
 - O: Lumbar vertebrae + T₁₂
 - I: Lesser trochanter of femur via iliopsoas tendon
 - Function: Thigh flexion, trunk flexion, lateral flexion
- Quadratus lumborum
 - O: iliac crest, lumbar fascia
 - I: trans. proc of upper lumbar vertebrae
 - Function: Flex vertebral column



Posterior Abdominal Wall





Somatic Nerves of Posterior Abdominal Wall

- Obturator (L2 - L4)
 - Medial border psoas
- Femoral (L2- L4)
 - Lateral border psoas
- Lumbosacral trunk
 - L4, L5 over sacral ala
 - S1-S4 sacrum
- Nerves
 - Ilioinguinal (L1)
 - Iliohypogastric (L1)
 - Genitofemoral (L1, L2)
 - Lateral femoral cutaneous (L2, L3)



Pelvic Organs and Innervation

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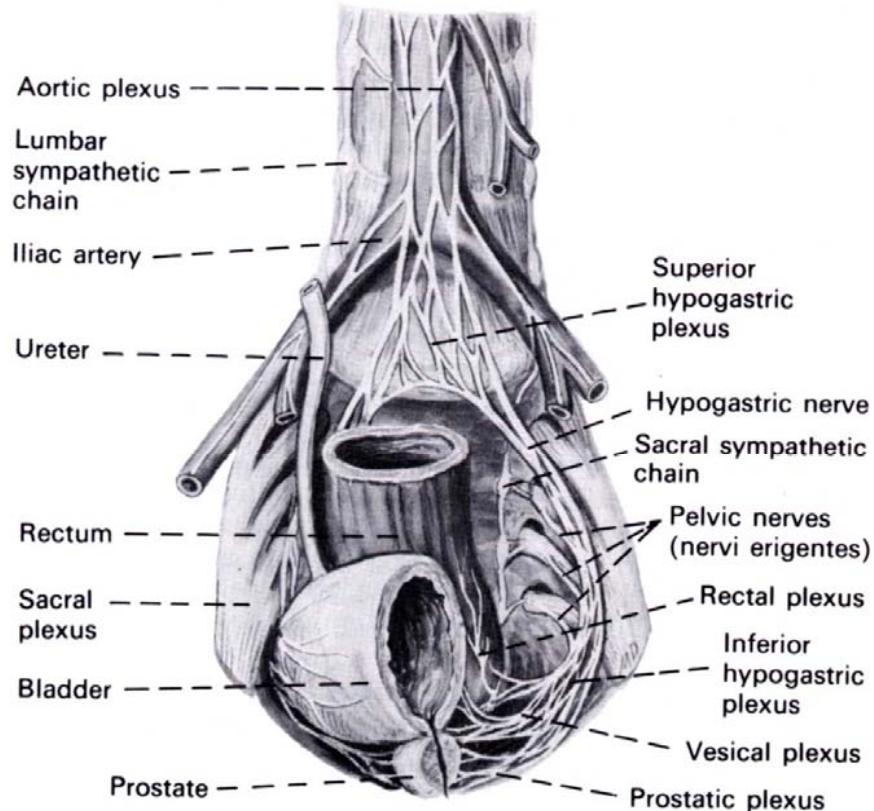
Pelvic Autonomics

- Superior hypogastric plexus (presacral nerve)
 - Contains no parasympathetics
- Hypogastric nerve
- Inferior hypogastric plexus
 - Contains parasympathetic fibers from the pelvic splanchnics
- Ganglion impar



Pelvic Innervation

- Hypogastric Plexuses
- Pelvic Splanchnics not sympathetic
- Derive from ventral rami of spinal nerves (S2-S4)
- Convey presynaptic parasympathetic fibers to inferior hypogastric (pelvic) plexus

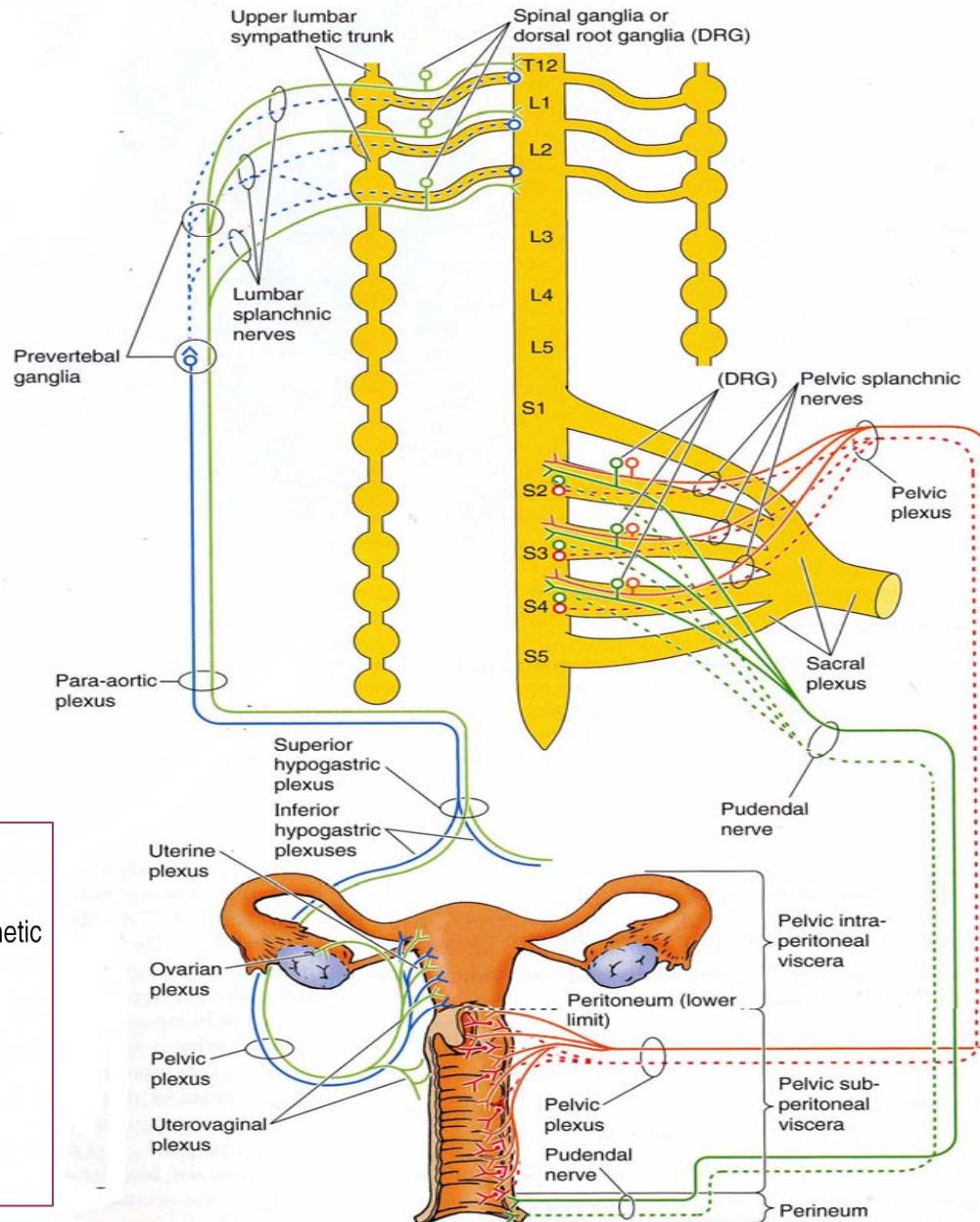


Anatomy of the superior and inferior hypogastric plexuses and subsidiary plexuses.

Pelvic Autonomics



- Visceral afferents running with parasympathetic fibers
- - - Presynaptic } Parasympathetic
- Postsynaptic }
- - - Presynaptic } Sympathetic
- Postsynaptic }
- Visceral afferents running with sympathetic fibers
- - - Somatic motor
- Somatic afferent





Innervation of the Bladder

- Sympathetics
 - T12, L1, L2
- Parasympathetics
 - Pelvic splanchnic nerves
 - Nervi erigentes
 - S 2, 3, 4
- Nociceptive afferents
 - Sacral roots (S 2, 3, 4)
 - Not sympathetics



Innervation of Uterus, Cervix and Ovaries

- Uterovaginal plexus from superior and inferior hypogastric plexuses
 - Sympathetic, parasympathetic and somatic afferent
 - Fundus and body (intraperitoneal) - Inferior and superior hypogastric plexuses
 - Cervix (subperitoneal)
 - Inferior hypogastric plexus to pelvic (splanchnic) nerves (S2-S4) (most texts)
 - Bonica: LUS and CX same as fundus
- Ovaries - afferents with hypogastric plexuses (T10-11)



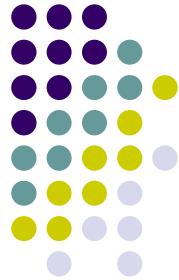
Innervation of the Vagina

- Superior 3/4ths
 - Uterovaginal plexus
 - Pelvic plexus (sacral fibers)
- Lower 1/4th
 - Pudendal nerve via sacral fibers
- Perineum
 - Pudendal nerve



Innervation of Prostate, Testes and Scrotum

- Prostate
 - Prostatic plexus
 - Inferior hypogastric plexus
- Testicle (T10)
- Vas deferens (T10-L1)
- Epididymis (T11-12)
- Prostate (Prostatic plexus; similar to bladder)
- Scrotum
 - Ilioinguinal and genitofemoral
 - Perineal nerve (branch of pudendal)



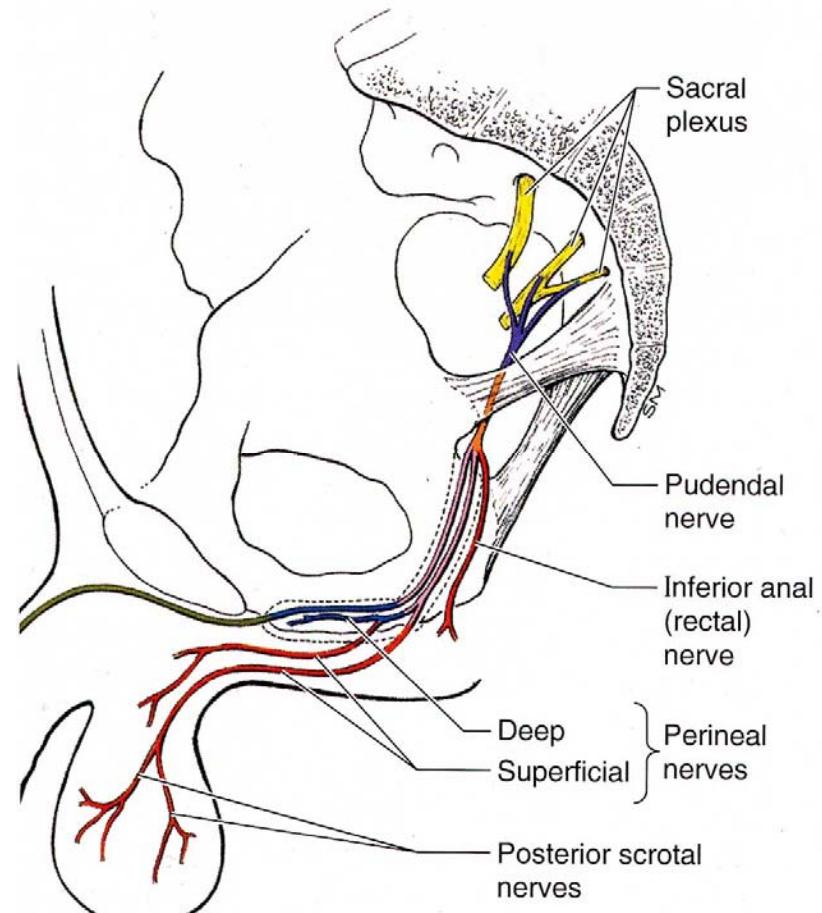
Rectum, Anus and Perineum

- Sympathetics
 - Superior and inferior hypogastric plexuses
- Parasympathetics
 - Pelvic splanchnic nerves
- Nociceptive afferents
 - Pudendal nerve (somatic)
 - Also with pelvic splanchnic nerves
- Anus
 - Inferior rectal nerve via pudendal
- Perineum by pudendal and branches



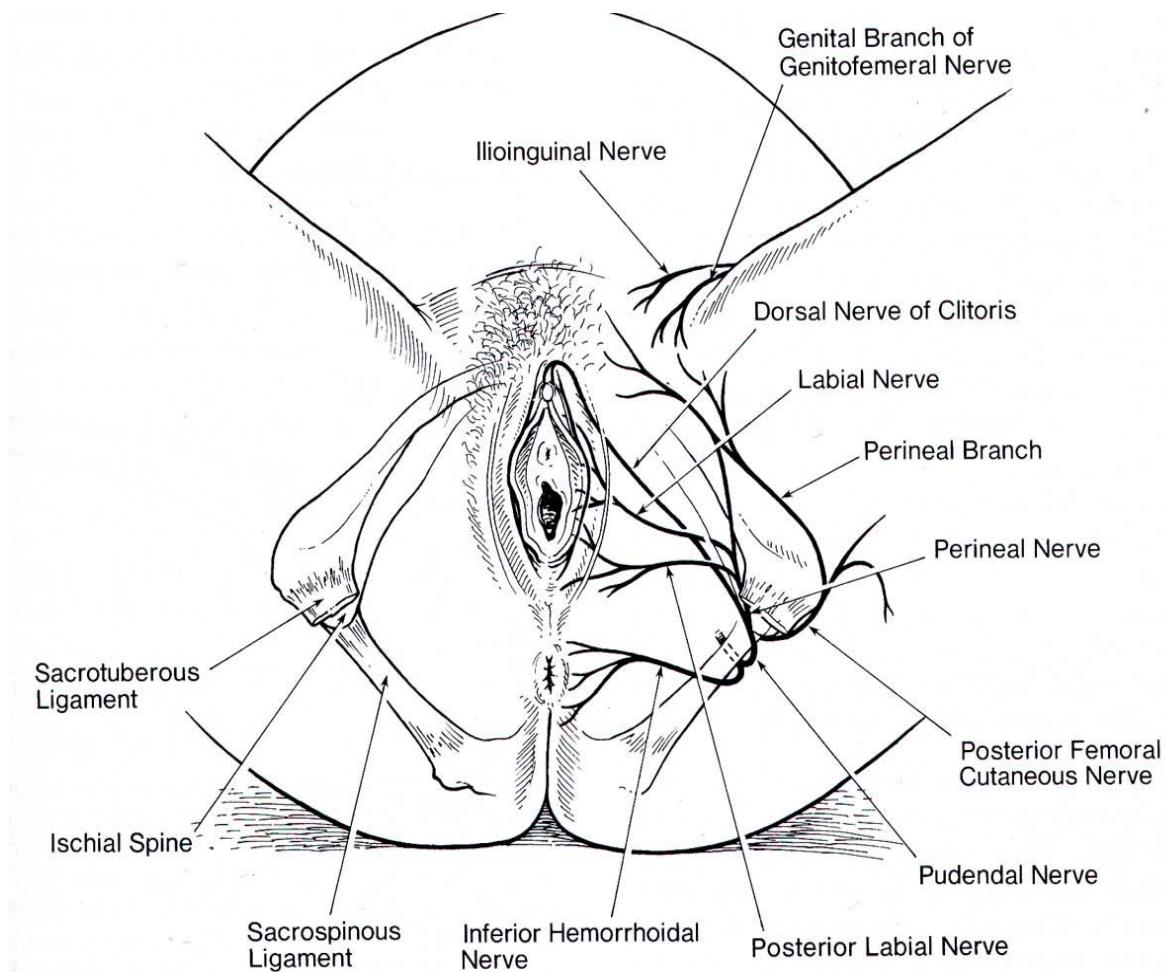
Pudendal Nerve

- Supplies skin, organs and muscles of perineum
- Distribution similar in males and females
- Pudendal nerve blockade
 - Medial to ishial tuberosity at sacrospinous ligament
 - Transvaginal
- Functions
 - Micturition
 - Defecation
 - Erection
 - Ejaculation
 - Parturition



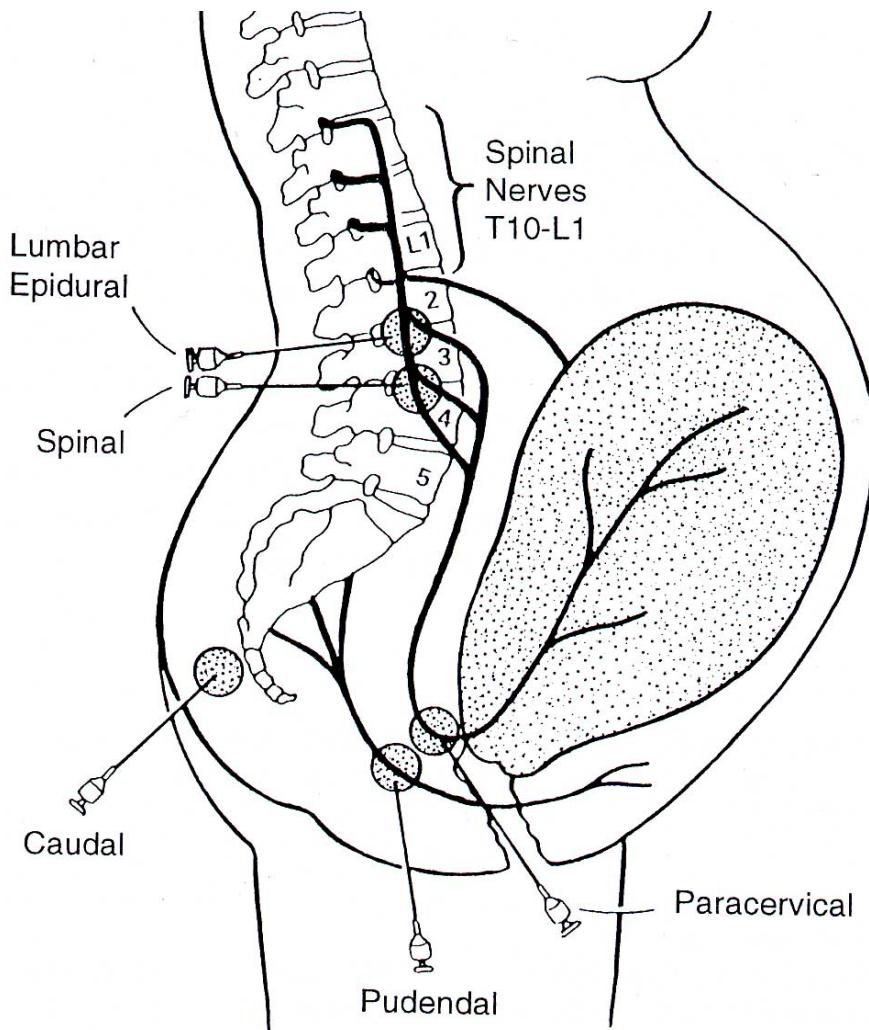


Neural Blockade of Perineum





Neural Blockade for Childbirth





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