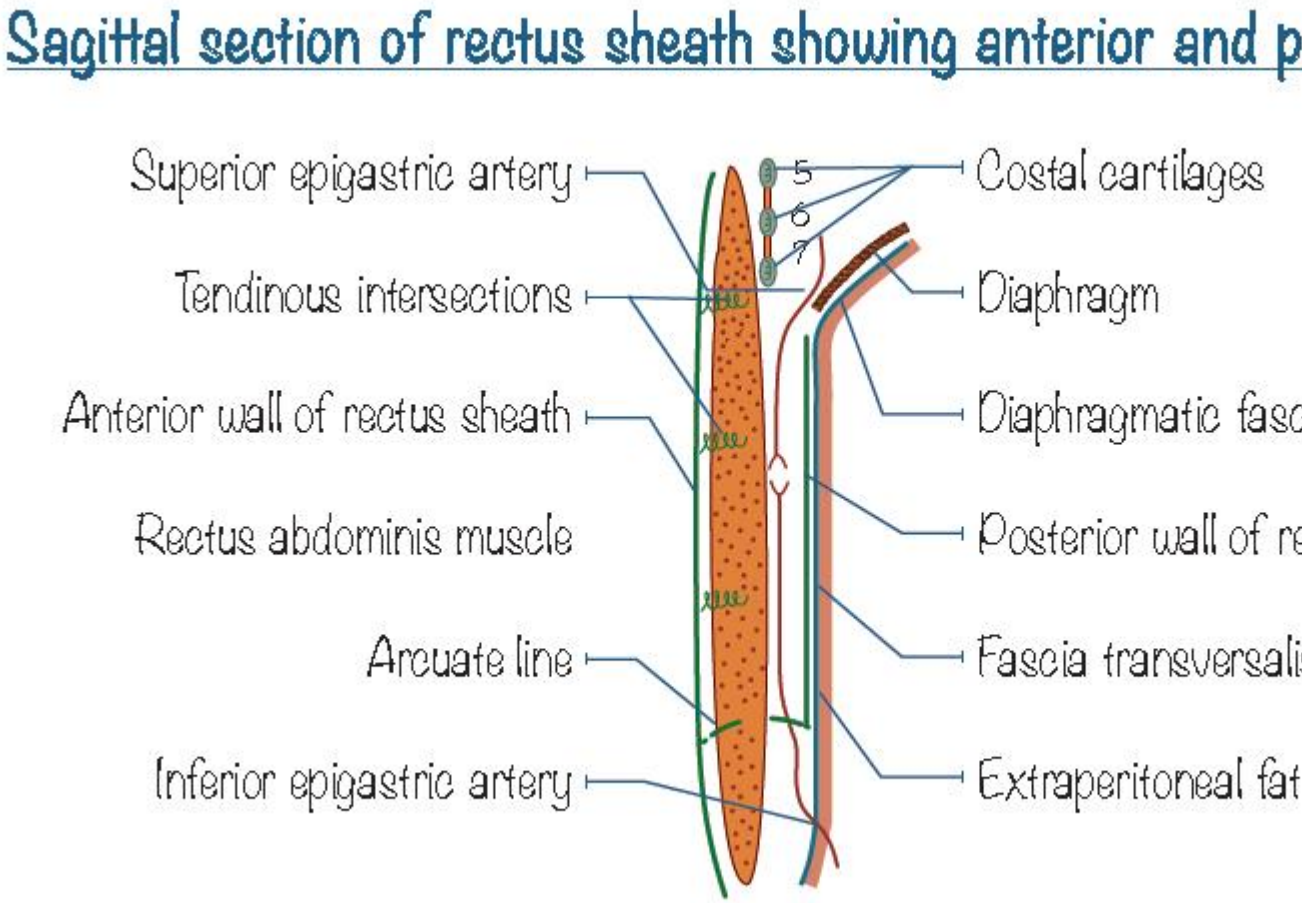
Abdominal Wall

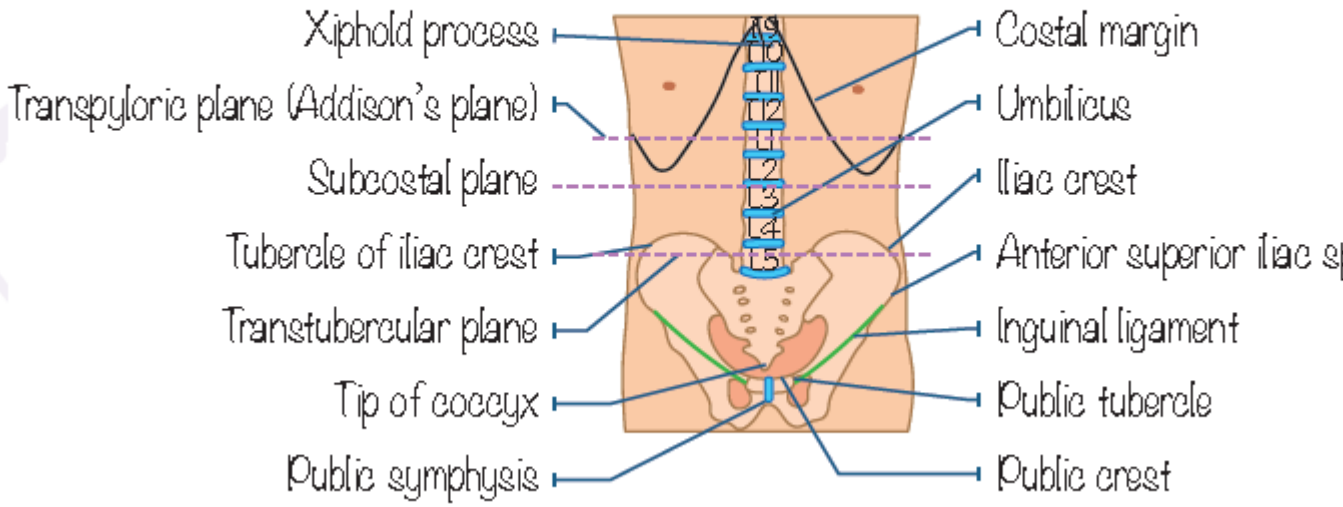
Extends
From xiphoid process (T9) to pubic symphysis (coccyx)



Abdominal Regions

1. 9 regions by 2 horizontal planes
2. 2 vertical planes pass through mid-inguinal points

Bony landmarks and planes of the abdomen

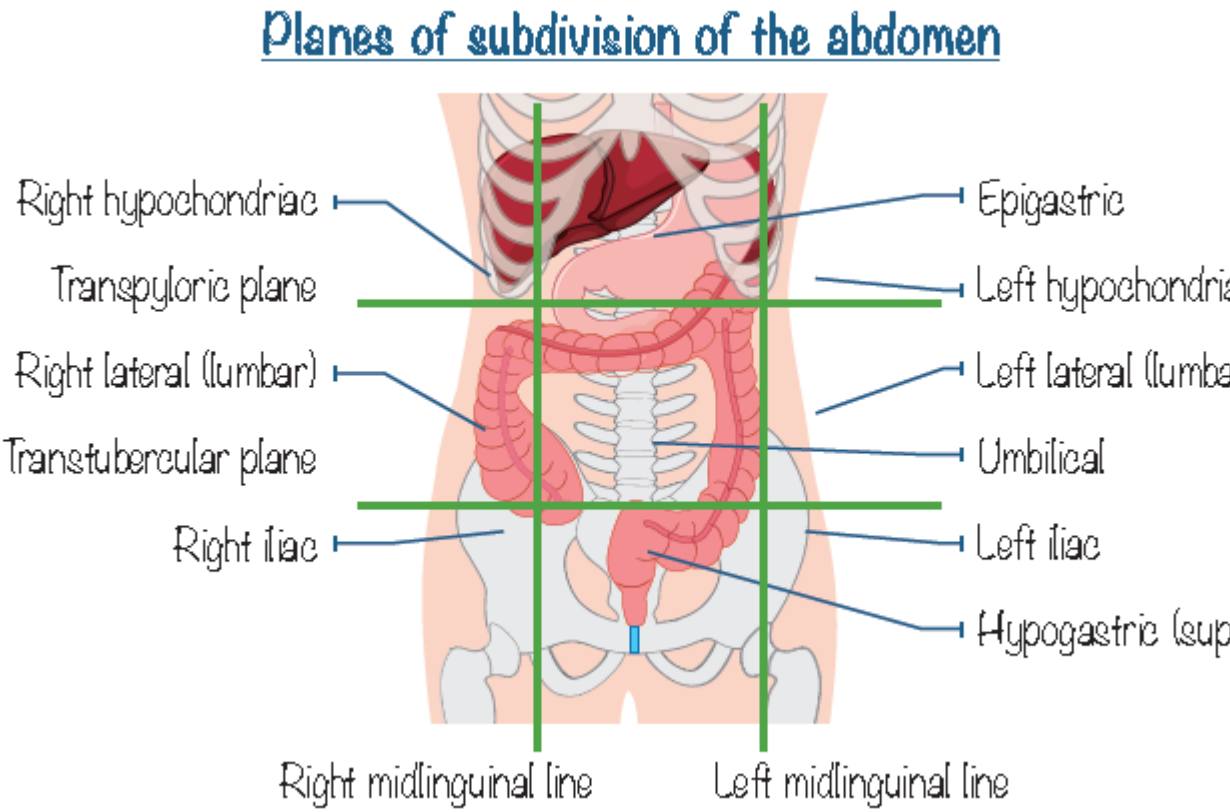


Transpyloric Plane
• Lower border of L1 • Horizontal • Midway between the jugular notch of the sternum and the pubic symphysis. • Midway between the xiphisternal joint and the umbilicus • Intersects 9th costal cartilage anteriorly Structures within transpyloric plane: - Superior mesenteric artery origin - Origin of the portal vein - Hilum of the left kidney - Origin of the renal arteries - Duodenojejunal flexure - Termination of adult spinal cord - Pylorus

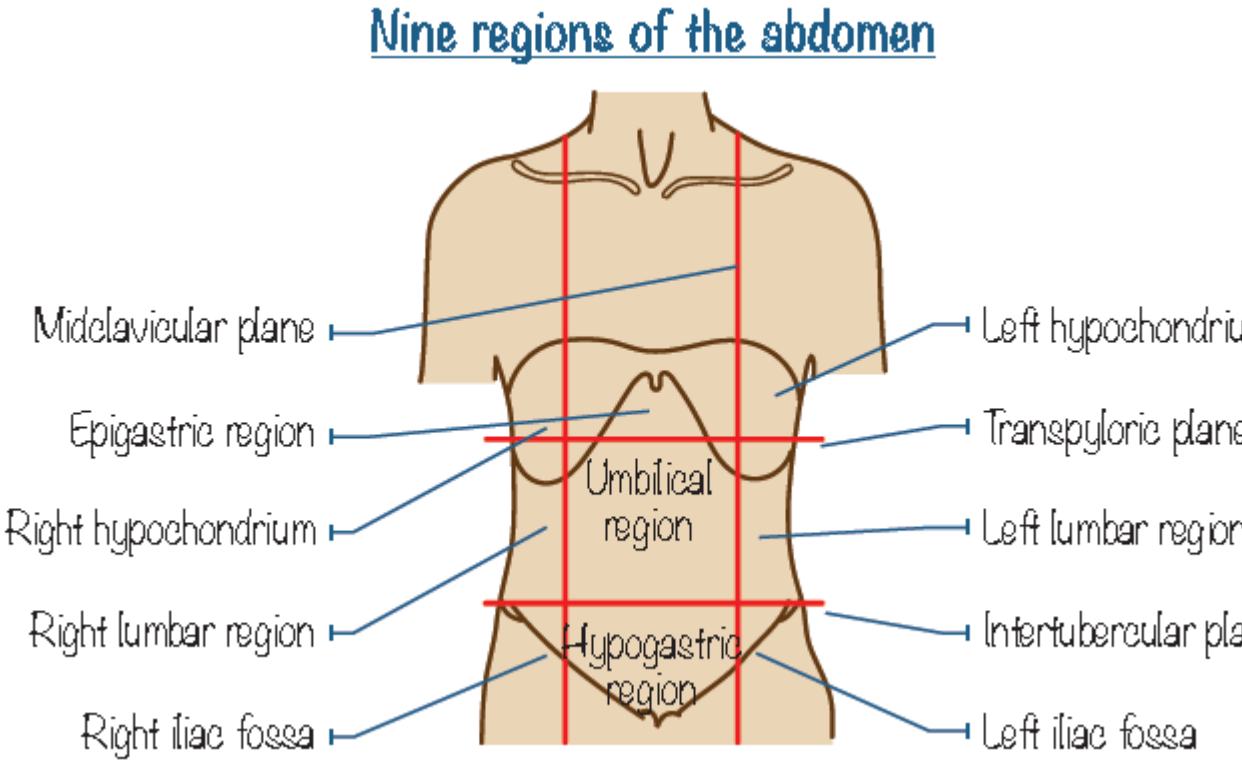
Mid Inguinal Point
Midpoint of a line between the pubic symphysis and the anterior superior iliac spine

Deep Inguinal Ring
Opening in transversalis fascia, midway between ASIS and the pubic symphysis 1 cm above the inguinal ligament.

Transtubercular Plane
• Horizontal • Through tubercles of the iliac crests at the level of L5.



Abdominal Regions And Content		
Right Hypochondrium	Epigastric Region	Left Hypochondrium
• Liver • Gall bladder	• Stomach • Pancreas •Duodenum	• Spleen • Left colic flexure
Right Lumbar Region	Umbilical Region	Left Lumbar Region
• Right kidney • Right ureter • Ascending colon	• Small intestine loops • Aorta • Inferior vena cava	• Left kidney • Left ureter • Descending colon
Right Iliac Fossa	Hypogastric Region	Left Iliac Fossa
• Caecum • Appendix	• Small intestine coils • Distended bladder • Enlarged uterus	• Sigmoid colon



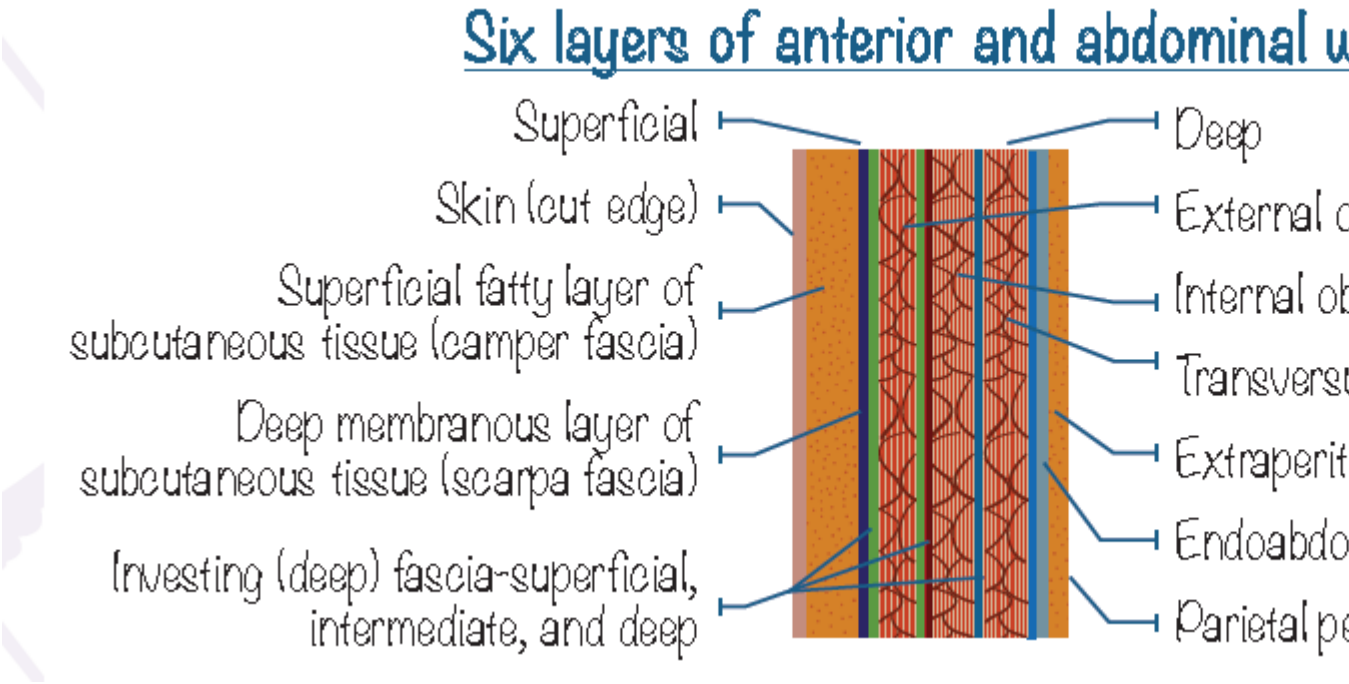
Subcostal Plane	Trans Umbilical	Interspinous
Upper border of L3	Intervertebral disc between L3 – 4 vertebrae	Body of S1

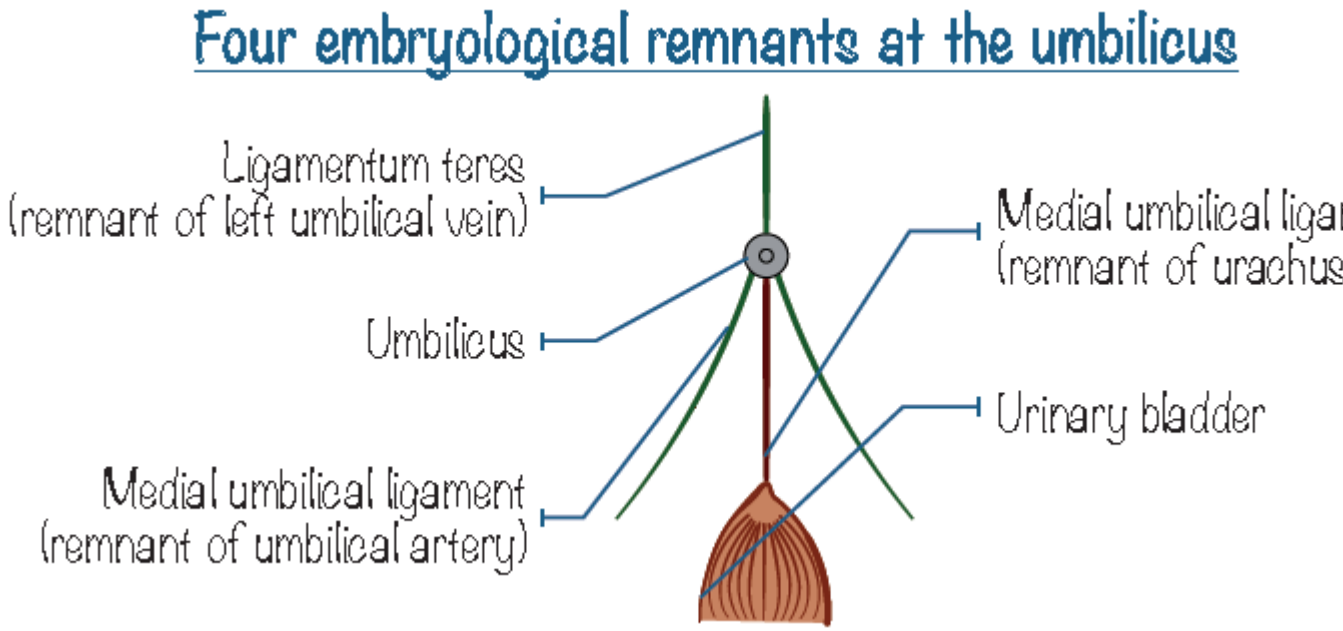
Surface Landmarks Of Abdominal Viscera	
Organ	Landmark
Diaphragm	• Right dome: 5th intercostal space • Left dome: 6th rib
Liver	• 1st point: Right 5th rib/intercostal space mid clavicular line • 2nd point: Left 5th intercostal space/6th rib mid clavicular line • 3rd point: Right 10th costal cartilage mid axillary line
Gastrooesophagealjunction	Posterior to left 7th
Spleen	• Deep to 10-12 • Long axis aligned with 11th rib
Kidneys	• Anterior to 12th rib on right • Anterior to 11th and 12th rib on left

Layers of Abdominal Wall

Superficial → Deep

1. Skin
2. Superficial fascia
3. External oblique muscle
4. Internal oblique muscle
5. Transversus abdominis muscle
6. Fascia transversalis
7. Extra peritoneal tissue
8. Parietal layer of peritoneum





Superficial Fascia

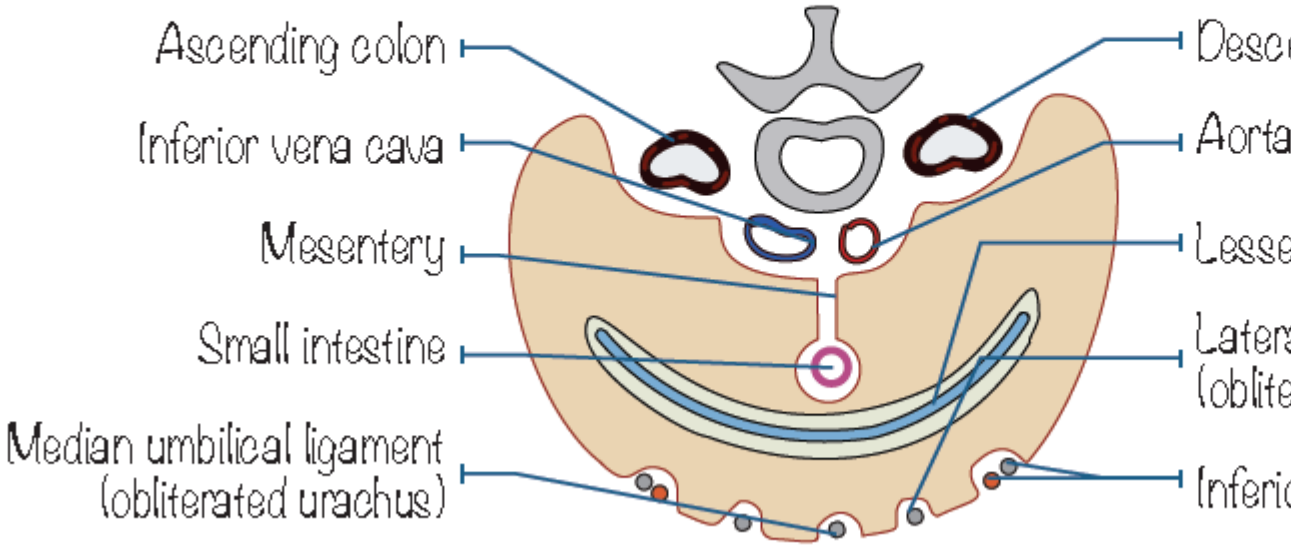
1. Superficial fatty and deep membranous layers

2. Fibrous septa connects dermis with membranous layer

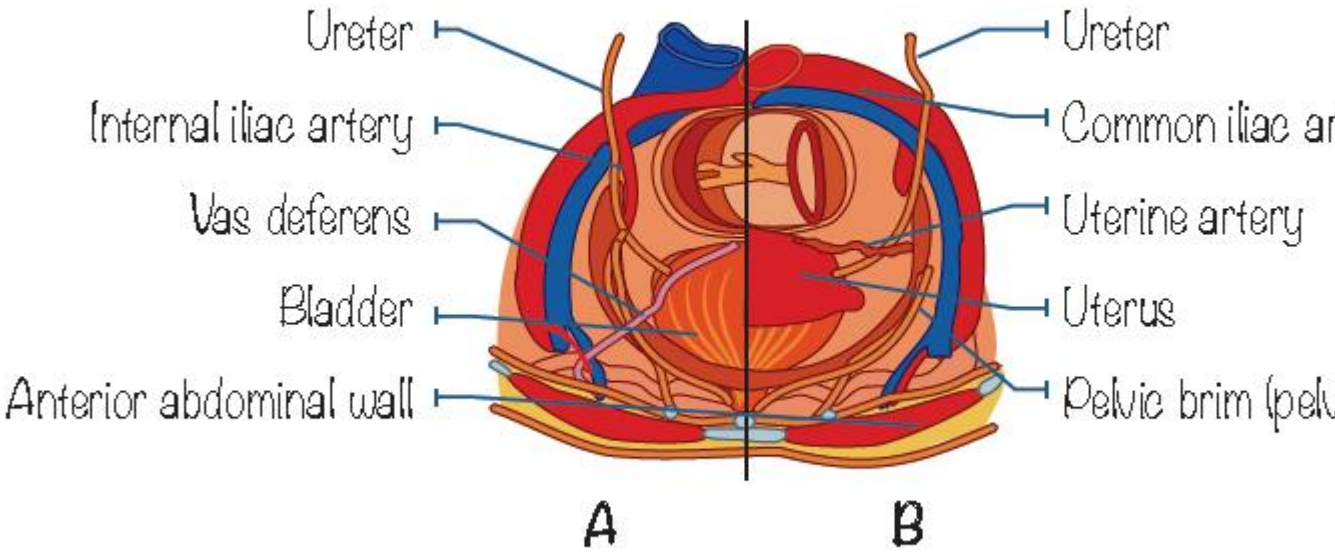
Camper's Fascia
• Contains blood vessels, lymphatics, nerves • Superficial inguinal lymph nodes • Continuous over linea alba • Continuous over male external genitalia, becomes thin and pale red • Continuous over pubis and perineum

Membranous Layer (Scarpa's Fascia)
• Represents elastic suspensory ligament of quadrupeds • Thickness varies • Separated from external oblique by loose areolar layer • Inferiorly, fuses with deep fascia of thigh (fascia lata), medial inguinal ligament, pubic tubercle, iliac crest • Attachment to fascia lata (just below the inguinal ligament) • Adherent to linea alba and pubic symphysis • Extends to dorsum of penis forming superficial ligament of the penis • Continuous with Colle's fascia (perineum) • Continuous with labia majora and perineal fascia • Superficial inguinal pouch - b/w membranous layer over inguinal canal and external oblique aponeurosis

Horizontal section through infracolic compartment o
showing horizontal disposition of peritone



Relations of the lower ureter, seen from above



(A) The male pelvis. (B) The female pelvis

Deep Areolar Layer

1. Variable thickness
2. Thick in morbid obesity

Linea Alba

1. Tendinous median raphe between the two rectus abdominis muscles
2. Three aponeuroses pass towards median plane, fuses with opposite side in the median linea alba.
3. From xiphoid process to pubic symphysis
4. Narrow and indistinct below umbilicus
5. Pigmented in pregnancy- Linea nigra

Linea Semilunaris:

Along lateral border of the rectus abdominis

Arcuate Line of Douglas

1. Linea semicircularis
2. Crescent shaped
3. Lower free margin of the posterior layer of the rectus sheath
4. Below the level of the iliac crest

External Oblique Muscle:

Fan shaped

Origin

1. External surfaces of the lower 8 ribs (5–12)
2. Radiates downwards and forwards

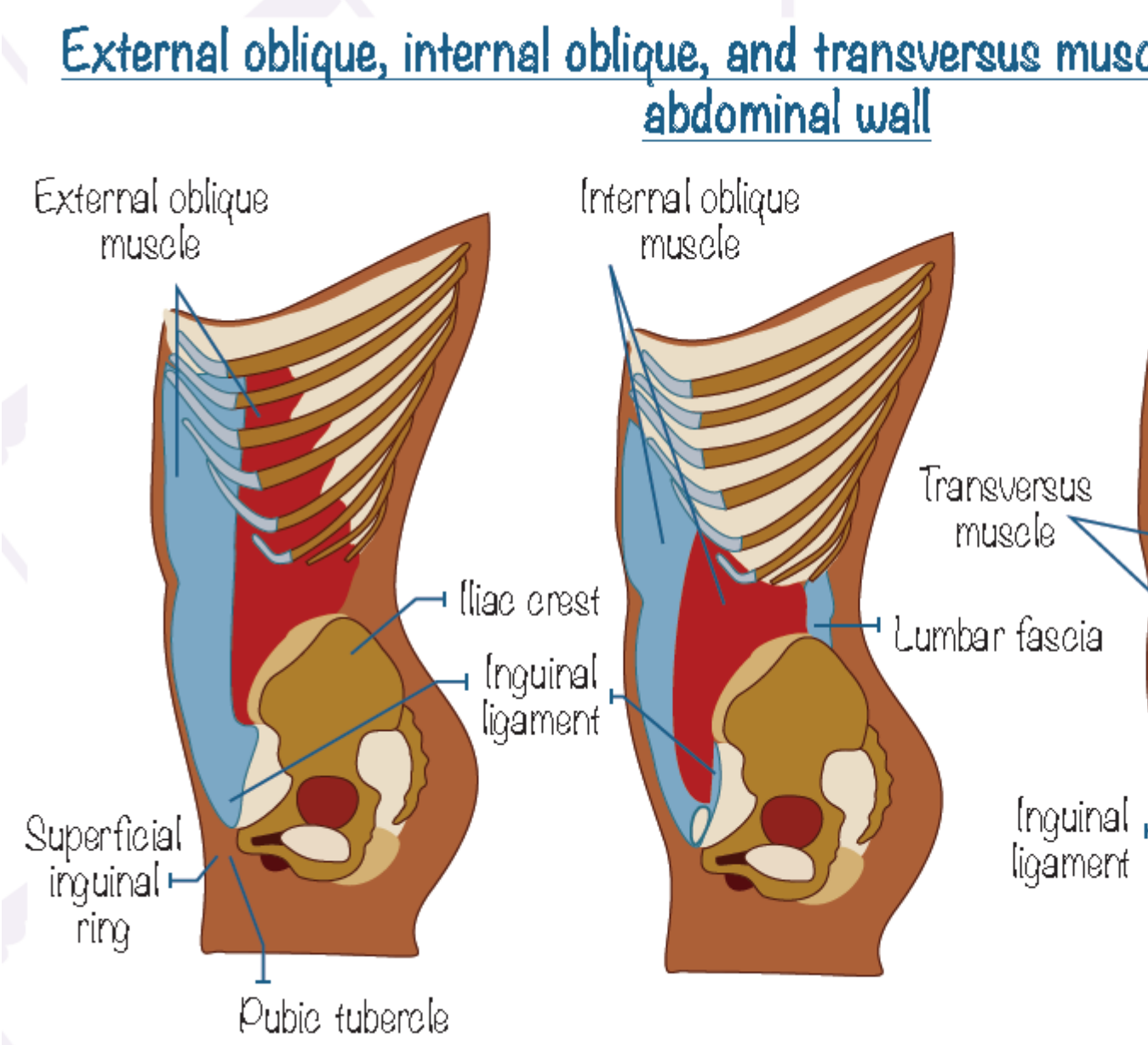
Insertion

1. Posterior fibres to the anterior half of iliac crest
2. Anterior fibres to linea alba and pubic tubercle

Muscle is replaced by aponeurosis below a line joining ASIS to umbilicus

Innervation:

T7–T11 spinal nerves (thoracoabdominal nerves), T12 subcostal nerve



Internal Oblique Muscle

Origin

1. From lumbar fascia, the iliac crest (anterior 2/3rd), lateral two thirds of the inguinal ligament.
2. Radiates upwards and forwards

Insertion

1. Inferior borders of 10th-12th ribs
2. Linea alba
3. Pectin pubis via conjoint tendon

Innervation:

T6-T12 spinal nerves, L1

Action of EO and IO

1. Flexion and rotation of trunk

2. Supports abdominal viscera

Transversus Abdominis

Origin:

Runs from internal surfaces of 7th-12th costal cartilages, the lumbar fascia, the iliac crest, the lateral third of the inguinal ligament

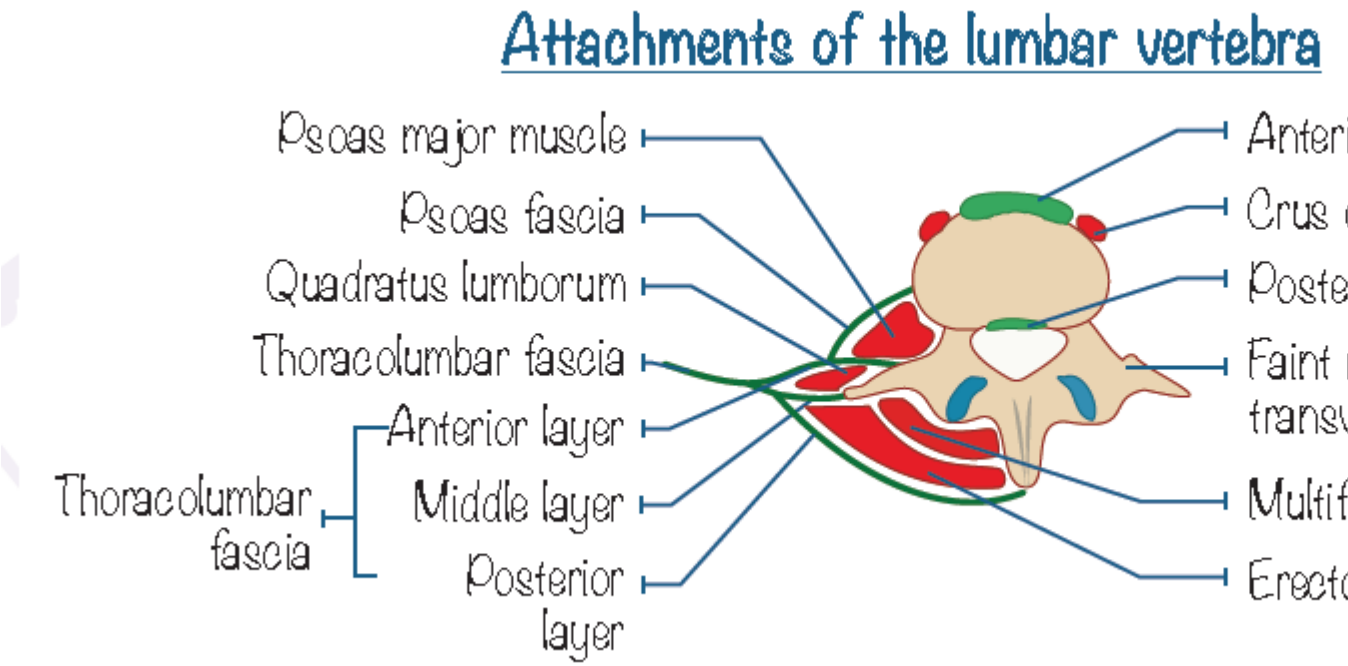
Insertion

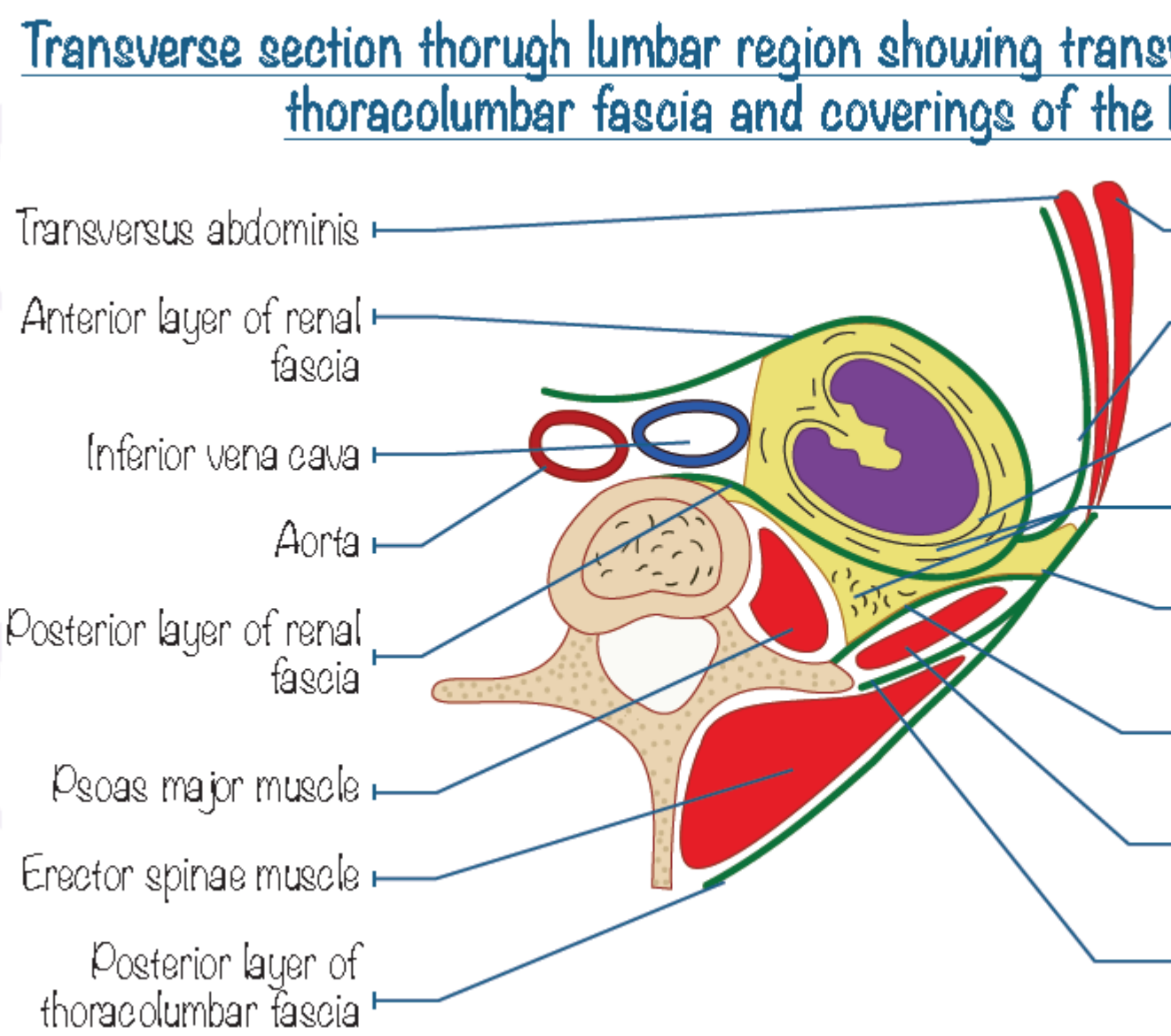
1. Linea alba
2. Fuses with aponeurosis of IO to form conjoint tendon to attach to the pubic crest and the pectin pubis.

Action:

Compresses and supports viscera

Rectus Abdominis





Origin

1. Pubic crest (lateral head)
2. Anterior pubic ligament (pubic symphysis)

Insertion

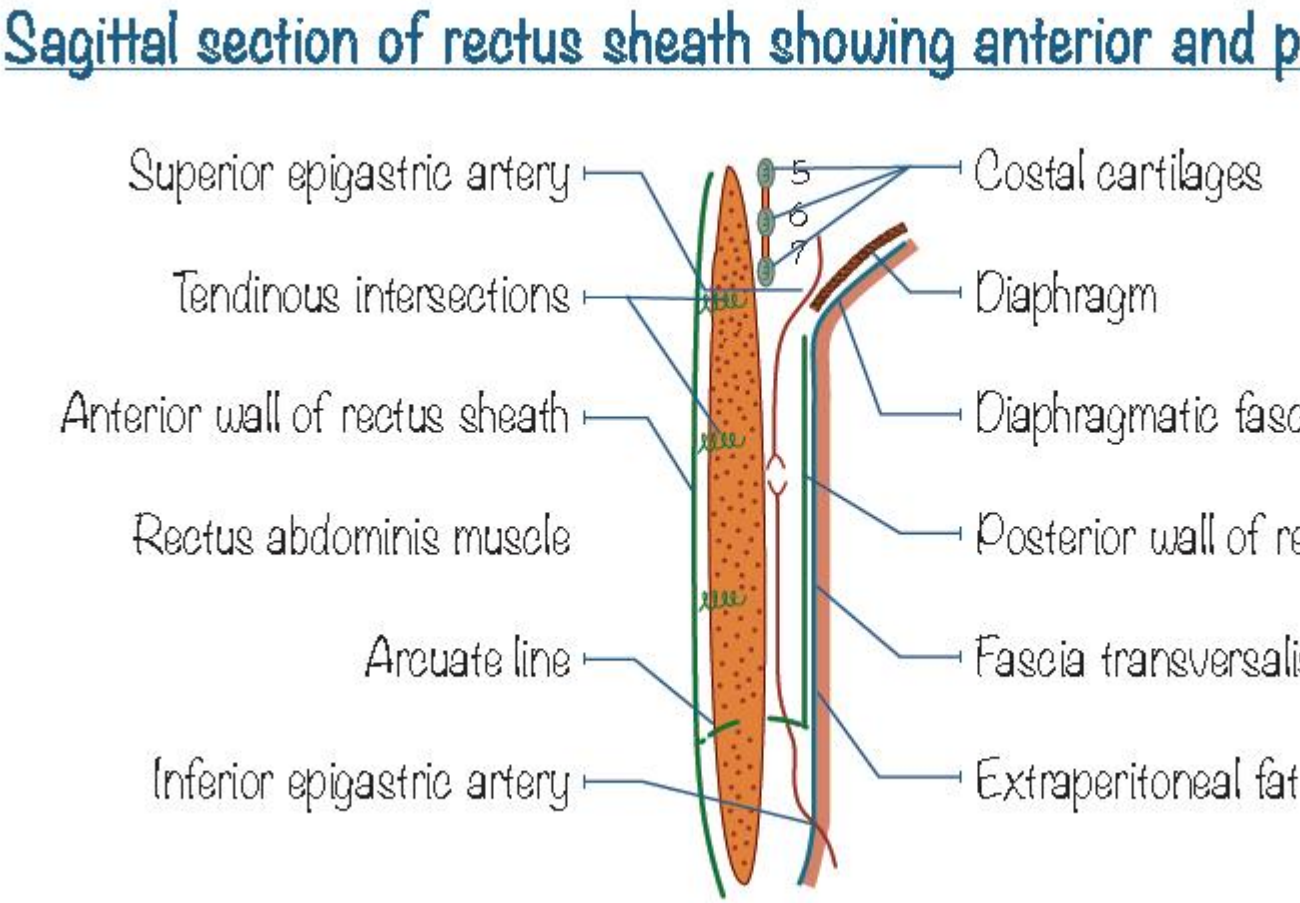
1. Anterior surfaces of 5th, 6th, 7th costal cartilages
2. Below arcuate line, lies over fascia transversalis
3. Above arcuate line, IO aponeurosis splits to enclose the rectus
4. Superficial transverse tendinous insertion adhere to rectus sheath
5. At xiphisternum
6. At umbilicus
7. One between these two

Rectus Sheath

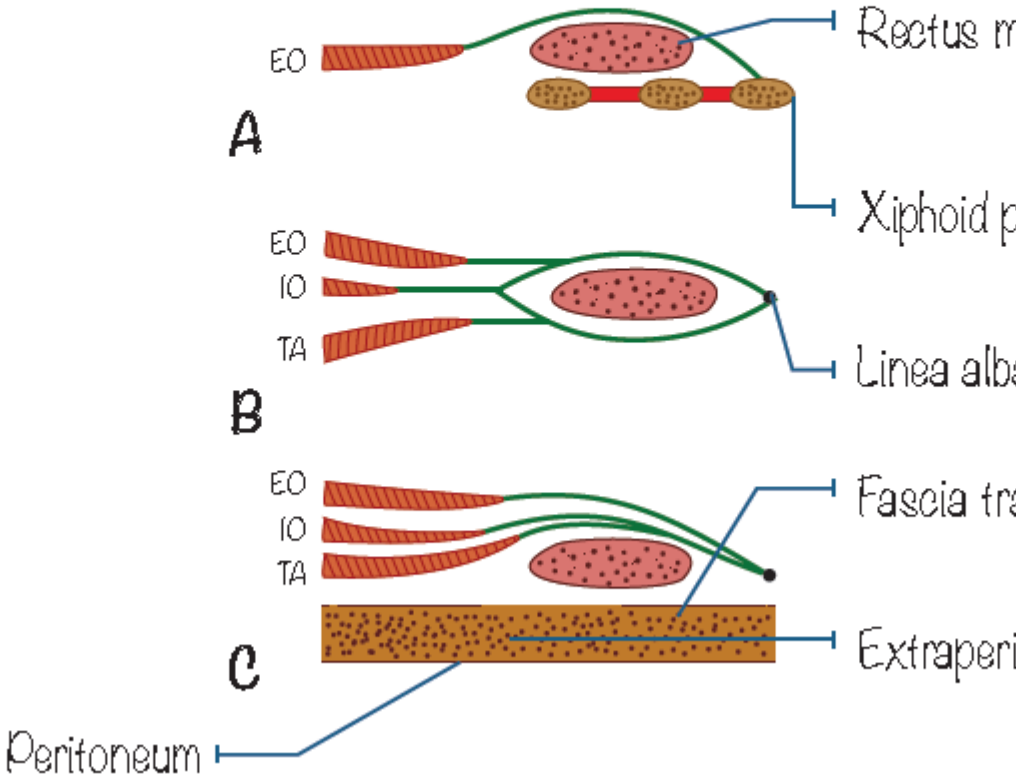
1. Fusion of the aponeurosis of the external oblique, internal oblique and transverse muscles of the abdomen.

2. Contains rectus abdominis, pyramidal muscle
3. Contains superior and inferior epigastric vessels and the ventral rami of T7–T12
4. Superior epigastric artery (branch of internal thoracic artery)
5. Inferior epigastric artery (branch of external iliac artery)
6. Bilaminar aponeurosis (6 laminar in all)
7. Oblique upward fibres of anterior, oblique downward fibres of posterior
8. Closely approximated at midline

	Anterior Layer Of The Rectus Sheath	Posterior Layer Of The Rectus Sheath
Above the level of costal margin	Aponeurosis of external oblique	• Deficient • Lies directly on the 5th, 6th, 7th costal cartilages
Between costal margin and above the arcuate line	Aponeuroses of the external and internal oblique muscles	Aponeuroses of the internal oblique and transverse muscles
Below the arcuate line	Aponeuroses of the external oblique, internal oblique and transverse muscles	• Deficient • Muscle in contact with fascia transversalis



Formation of rectus sheath as seen in transverse sections abdominis and seen in transverse sections through rect and its sheaths at three different levels



A. above the costal margin; B. between costal margin and arcuate line; C. below the arcuate line (EO= External oblique, IO= internal oblique, TA= transversus abdominis

Fascia Transversalis

1. Thin layer
2. Between transverse abdominis and extraperitoneal fat

Anteriorly	Posteriorly	Superiorly	Inferiorly
Continuous sheet	Fuses with thoracolumbar fascia	Blends with fascia covering inferior surface of the diaphragm	Continuous with iliac and pelvic parietal fascia

1. Forms the anterior part of femoral sheath
2. Attached to the iliac crest between transverse abdominis and iliacus
3. Forms internal spermatic fascia through deep inguinal ring

Iliopubic Tract

1. Inferior thickening parallel to inguinal ligament

2. Fan towards anterior superior iliac spine, blends with iliopsoas fascia
3. Medially behind conjoint tendon to the pubic bon

Extraperitoneal Connective Tissue

Between the peritoneum and the fascia lining the abdominal and pelvic cavities

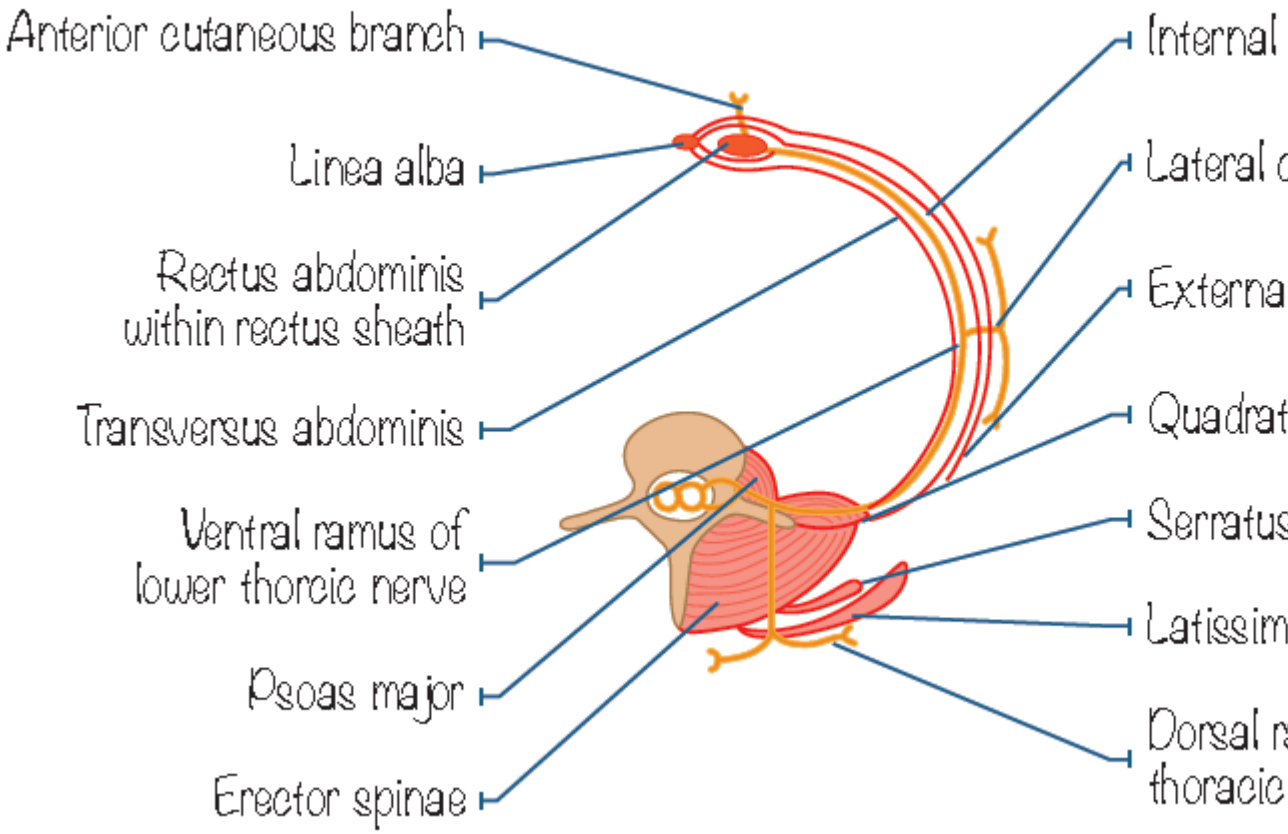
Neurovasculature of Anterior Abdominal Wall

Nerves

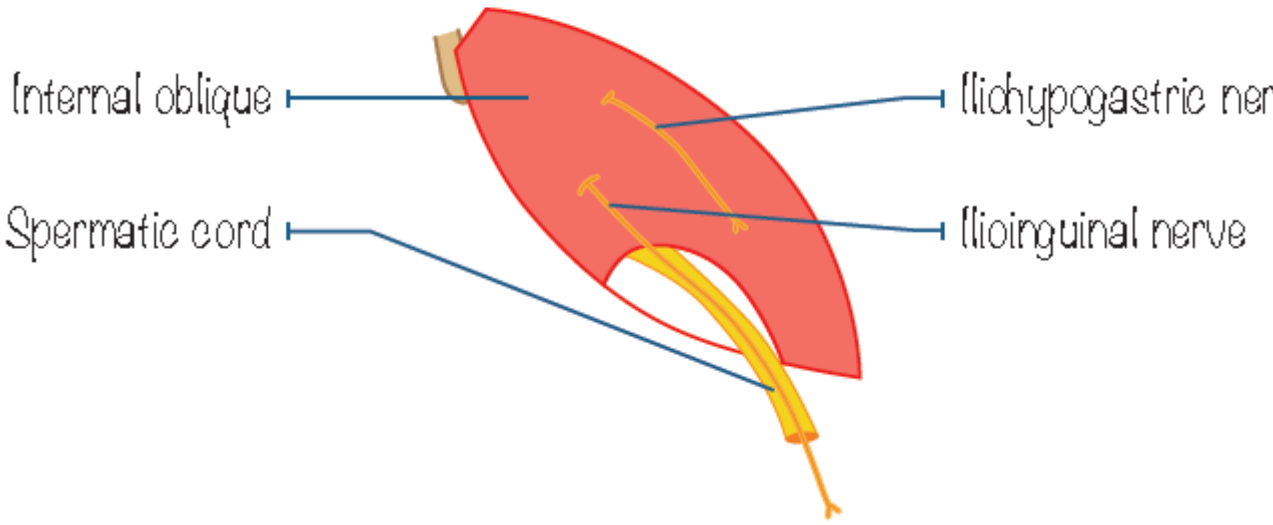
1. Ventral rami of lower six thoracic nerves
2. First lumbar nerve- Iliohypogastric and ilioinguinal nerve
3. T7-T12 continue anteriorly between slips of transversus and internal oblique
4. Supply and pierces rectus
5. T7-T10 curve medially between the digitations of diaphragm and transversus abdominis
6. All segmental nerves enclosed in a fascia run between transversus abdominis and internal oblique.
7. Cutaneous supply to anterolateral wall
8. Pierces rectus from posterior aspect to supply muscle

9th intercostal nerve	10th intercostal nerve	11th intercostal nerve	Subcostal nerve
Supplies skin above umbilicus	Includes umbilicus	Below umbilicus	Anterior gluteal skin below iliac crest + lower abdomen

Muscles and nerves in abdominal walls



Iliohypogastric and ilioinguinal nerves



Course of Nerves

Nerve - Subcostal Nerve (Anterior Rami Of T12)	Nerve - T7-T9 Lateral Cutaneous Branches	Nerve - Thoracoabdominal Nerve (T7-T11)
Course	Course	Course
• From T12 • Run along inferior border of 12th rib • Supplies subumbilical wall between abdominal muscle layers	• Continuation of T7-T9 intercostal nerves • Continue across costal margin insubcutaneous tissue	• Continuation of intercostal nerves • Enter subcutaneous tissue as lateral cutaneous branch (T10-T11) in anterior axillary line. • Anterior cutaneous branches in parasternal line (T7-T11).

Iliohypogastric Nerve

1. From anterior rami of L1 spinal nerve (Superior terminal branch)
2. Runs in the NV plane (between internal oblique and transversus abdominis)
3. Pierces internal oblique, 2.5 cm in front of the anterior superior iliac spine
4. Pierce external oblique aponeurosis 2.5 cm above the superficial inguinal ring
5. Areas supplied: Skin over iliac crest, upper inguinal and hypogastric regions, internal oblique and transversus abdominis muscle.

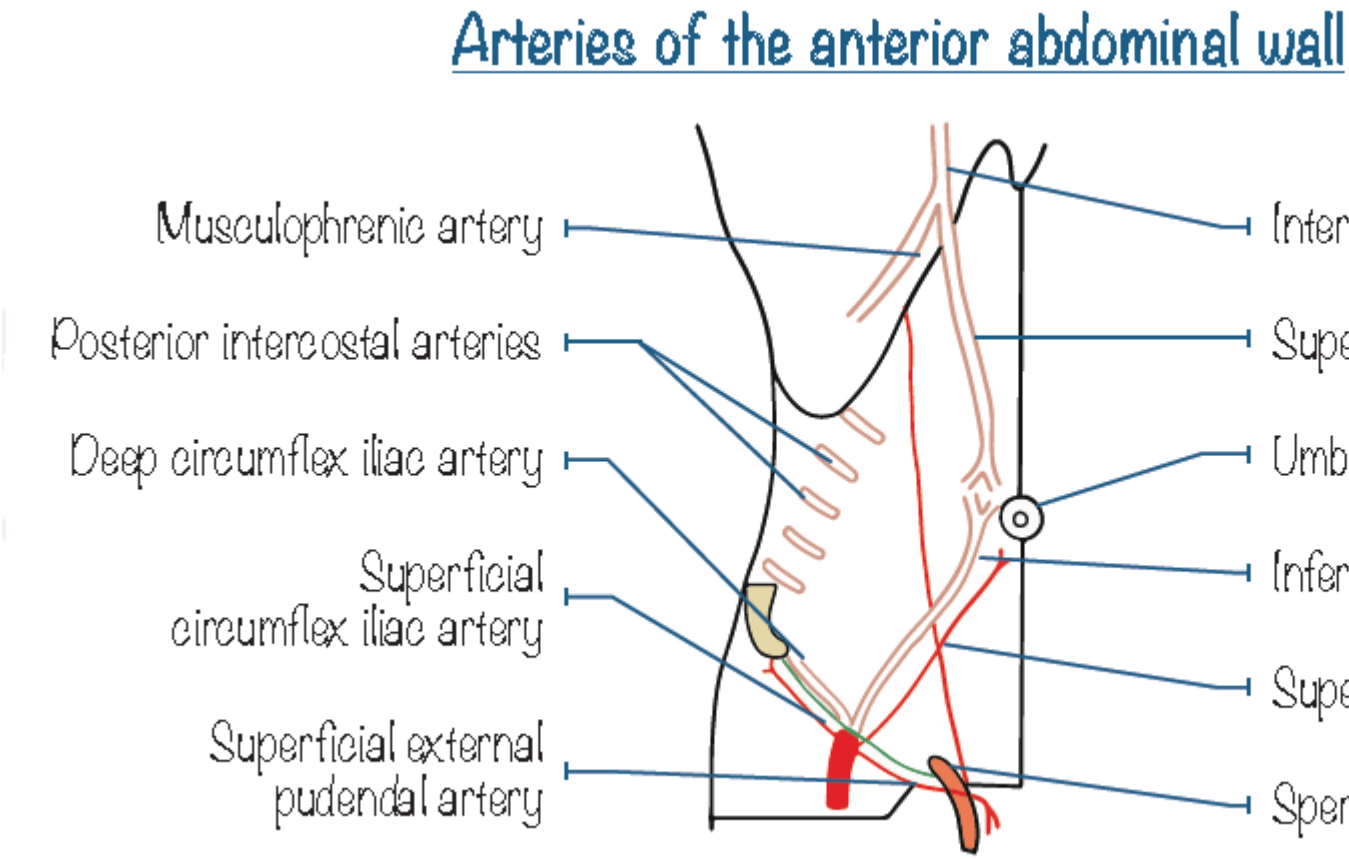
Ilioinguinal Nerve

1. From anterior rami of L1 spinal nerve (inferior terminal branch)
2. Enters inguinal canal by piercing internal oblique muscle
3. Runs along inferolateral side of the spermatic cord
4. Comes out through superficial inguinal ring
5. Areas supplied: Skin of lower inguinal region, mons pubis, anterior scrotum/labium majus, adjacent medial thigh, internal oblique and transversus abdominis

Arteries

Superior Epigastric Artery

1. One of the terminal branches of Internal thoracic artery
2. Enters rectus sheath between sternal origin and origin from 7th costal cartilage of diaphragm
3. Anastomoses with inferior epigastric artery within the rectus muscle



1. A branch passes anterior to xiphoid (may bleed during surgical incisions)
2. Small branches reach falciform ligament which anastomose with those of hepatic artery

Inferior Epigastric Artery

1. "Deep inferior epigastric artery"
2. Branch of external iliac artery, just above inguinal ligament
3. Dominant supply to rectus
1. Course
1. First passes upwards and medially in the extra peritoneal tissue behind the fascia transversalis
2. Along the medial margin of the deep inguinal ring
3. Hooked by vas deferens/uterine round ligament laterally (vessel is lateral)
4. Pierces fascia transversalis at the lateral border of rectus abdominis, anterior to arcuate line.
5. Anastomoses at the level of umbilicus
6. Surgical incisions at the site of piercing fascia leads to haematoma
1. Variations
1. Anastomose with superior epigastric artery without branching- 30%
2. Branching into two vessels- 60%
3. Trifurcation- 10%
4. Occasionally arise from femoral artery

Applied Anatomy

1. It is preliminary ligated when preparing myocutaneous flap using rectus
2. Forms the lateral border of Hesselbach's inguinal triangle
1. Lies close to medial border of femoral ring (high chance of damage)
1. Neck of hernia sac is lateral to artery in oblique hernia, medial to artery in direct hernia
2. Pubic branch enlarges in absence of obturator artery- Abnormal obturator artery
1. Branches
1. Cremastric artery (accompanies spermatic cord/round ligament)
2. Pubic, muscular and cutaneous branches

Subcostal Artery

1. Pierce posterior aponeurosis to enter the neurovascular plane
2. Gives off muscular branches

Musculophrenic Artery

1. Branch of internal thoracic artery
2. Descends along costal margin
3. Supplies abdominal wall of hypochondrial areas, anterolateral diaphragm

Posterior Intercostal Arteries

1. 10th and 11th
2. Branch of Aorta
3. Supplies abdominal wall of lumbar region

Deep Circumflex Iliac Artery

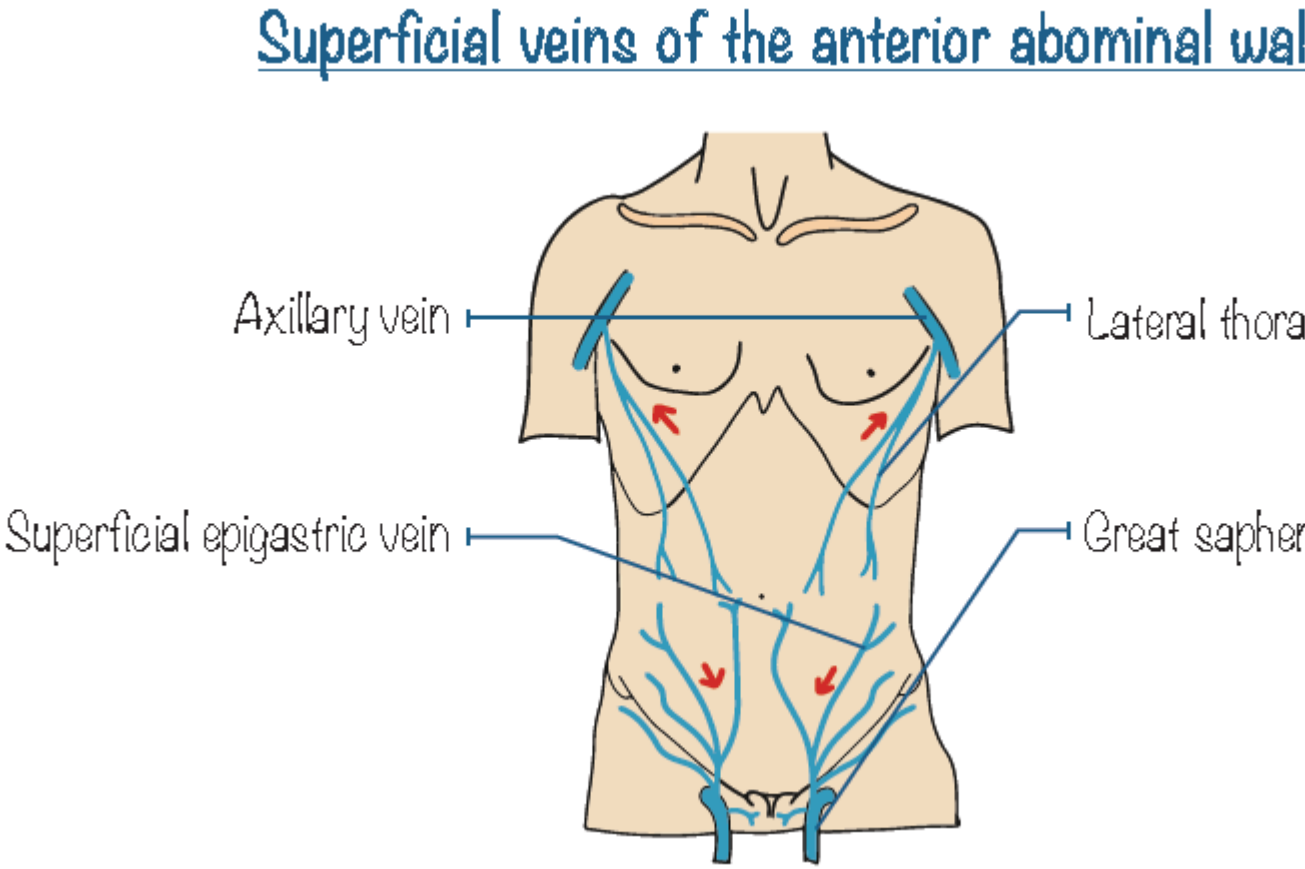
1. From external iliac artery
2. Runs deep on anterior abdominal wall parallel to inguinal ligament
3. Supplies Iliacus muscle, Iliac fossa, deep abdominal wall of inguinal region

Superficial Circumflex Iliac Artery

1. Branch of femoral artery
2. Subcutaneous along inguinal ligament
3. Supplies superficial abdominal wall of inguinal region, anterior thigh

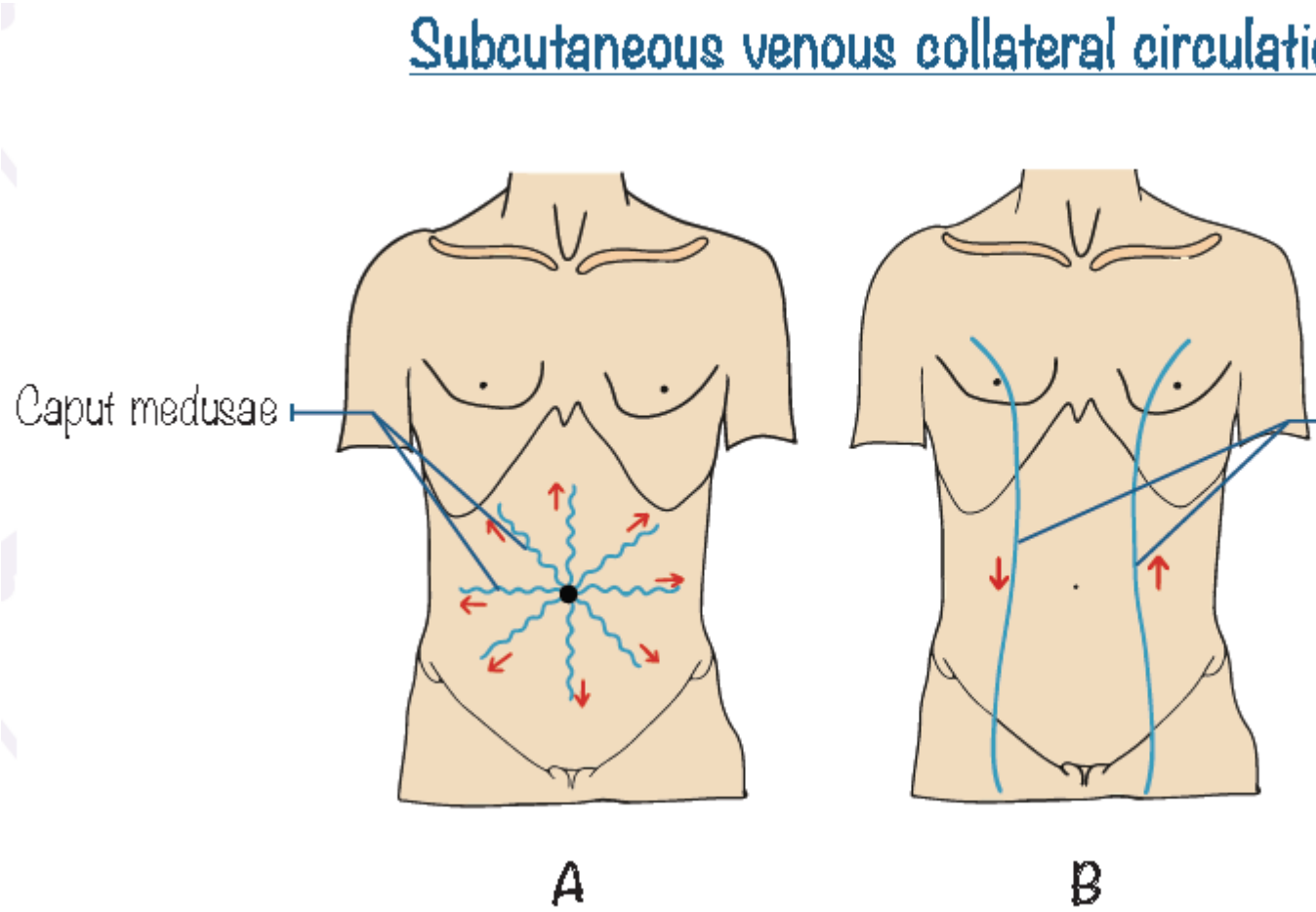
Superficial Epigastric Artery

1. Branch of femoral artery
2. Supplies superficial wall of pubic and inferior umbilical regions

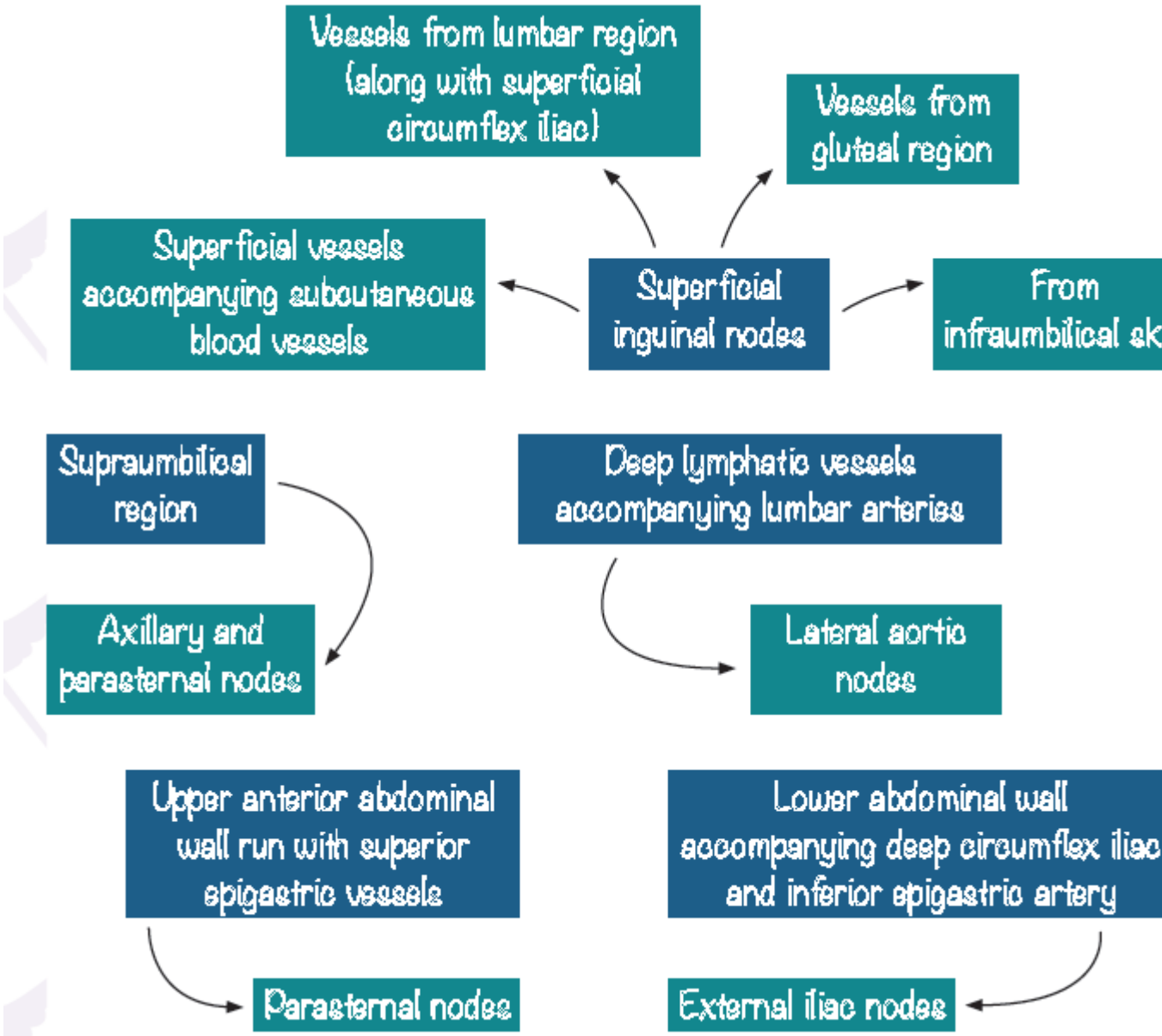


Venous Drainage

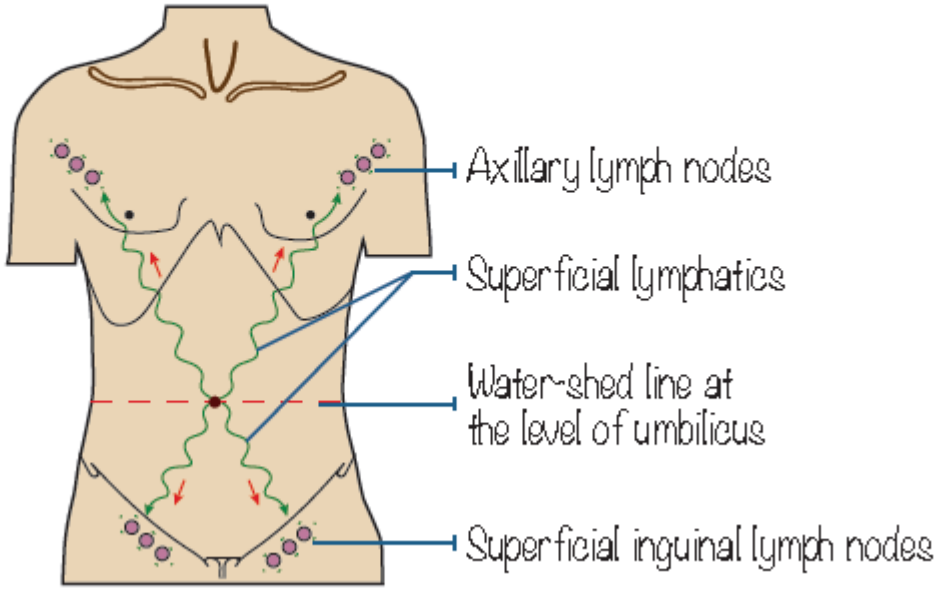
1. Small tributaries of the inferior epigastric vein draining skin around umbilicus anastomose with terminal branches of umbilical vein.
2. 2 veins accompany inferior epigastric artery, unite to a single vein and drain to external iliac vein
3. Superior epigastric artery accompanied by 2 or more veins, that drain to internal thoracic vein.



Lymphatic Drainage of Anterior Abdominal Wall


Vessels from lumbar region (along with superficial circumflex iliac)
Vessels from gluteal region
Superficial vessels accompanying subcutaneous blood vessels
Superficial inguinal nodes
From infraumbilical sk
Supraumbilical region
Axillary and parasternal nodes
Deep lymphatic vessels accompanying lumbar arteries
Lateral aortic nodes
Upper anterior abdominal wall run with superior epigastric vessels
Parasternal nodes
Lower abdominal wall accompanying deep circumflex iliac and inferior epigastric artery
External iliac nodes

Lymphatic drainage of anterior abdominal wall



Posterior Abdominal Wall

Paravertebral Gutter
• Above Iliac crest (medial to lateral) • Psoas major; minor, quadratus lumborum, aponeurotic origin of transversus abdominis

1. Below Iliac crest
1. Medial – Psoas major, Lateral – Iliacus muscle

Muscles Of Posterior Abdominal Wall			
Origin	Insertion	Nerve Supply	Action
Muscle – Psoas Major			
• Anterior surfaces and lower borders of transverse processes of all lumbar vertebrae. • Five fleshy slips from bodies and disc of lumbar vertebrae. • Four tendinous arches across the bodies of the lumbar vertebrae.	• Anterior surface of the tip of the lesser trochanter of femur	• Ventral rami of L2, L3	• Chief flexor of the hip joint (with iliacus) • Flexes the trunk • Foot on ground- Medial rotator of the hip joint
Muscle – Iliacus			

• Superior 2/3rd of iliac fossa • Ala of sacrum • Anterior sacro iliac ligaments	Lesser trochanter of femur, inferior to psoas major	Femoral nerve L2, L3, L4	Flexion of thigh Stabilize hip joint
Muscle - Quadratus Lumborum			
Posterior 1/3rd of the inner lip of the ventral segment of the iliac crest Iliolumbar ligament	Fleshy fibres → to the lower border and anterior surface of the medial part of 12th rib Tendinous fibres → anterior surface of transverse process of upper four lumbar vertebrae	Ventral branches of T12, L1-L4	Lateral flexor of trunk Extension of the vertebral column Fixes 12th rib during inspiration

Lumbo-Sacral Triangle of Marcille:

On either of body of L5 vertebrae

Boundaries				
Medially	Laterally	Apex	Base	Floor Or Posterior Wall
Body of L5	Medial border of the psoas major	Junction of psoas major ad L5 body	Upper surface of the lateral mass or ala of sacrum	By the transverse process of fifth lumbar vertebrae and ilio lumbar ligament

Contents

1. Deep- Ganglionated sympathetic trunk, lumbo sacral trunk, ilio lumbar artery, obturator nerve
2. Intermediate- Common iliac artery dividing into external and internal iliac arteries, common iliac vein (union of external and internal iliac veins)
3. Superficial- Ureter crosses common iliac vessels at the lateral angle of the triangle, ovarian vessels cross the common iliac vessels lateral to the ureter, inferior mesenteric vessels traverse the pelvic inlet in front of common iliac vessels, nerve fibres from the hypogastric plexus ascend in front of the common iliac vessels.

Fascia Iliaca

1. Covers the iliacus and psoas major
2. Iliac part- Covers iliacus + psoas major, below the iliac crest
3. Psoas part- Covers only psoas major above iliac crest

Structures Piercing

1. Genitofemoral nerve
2. Iliohypogastric, ilio inguinal nerves and fourth lumbar artery
3. Lumbo sacral trunk, ilio lumbar artery and obturator nerve

Nerves

Ilio Hypogastric Nerve:

Larger branch of L1

Emerges beneath the lateral border of thepsoas major
Passes in front of quadratus lumborum
Lies between subcostal vessels and nerve above and ilioinguinal nerve below
Nerve pierces aponeurosis of transverse abdominis at border of quadratus lumborum
Runs between transversus and internal oblique
Divides to lateral and anterior cutaneous branches close to iliac crest

Notes

Liposuction aims to remove deep areolar layer beneath membranous layer of superficial fascia(to avoid skin dimpling).

In rectus sheath-superior epigastric artery anastomose with inferior epigastric artery.

Colle's fascia prevents urine extravasation to ischiorectal fossa during urethral injury.

Pyramidalis is supplied by subcostal nerve.

Rectus abdominis is not attached to the linea alba.

Local anaesthetic is injected into the NV plane between internal oblique and transversus
abdominis (anaesthetize anterolateral wall).

Nerve supply to skin around umbilicus: T10 ventral ramus.