



## Anatomy

● Sheet

○ Slide

number

3

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In this sheet we will talk about the abdomen and the digestive system in the abdominal cavity.

- We have anterior abdominal wall and posterior abdominal wall.

### ❖ **The boundaries (borders) of the abdomen:**

#### ➤ **Above- Diaphragm:**

- Separate the abdominal cavity and the thoracic cavity.
- There are only three major orifices and minor orifices , that allow some structures to pass through the diaphragm to the abdomen:
  - ✓ **Aortic orifice** (THAT PASS THROUGH IT THE ABDOMINAL AORTA) .
  - ✓ **Inferior vena cava orifice** (THAT PASS THROUGH IT THE INFERIOR VENA CAVA FROM THE ABDOMEN UPWARDS TO THE RIGHT ATRIUM).
  - ✓ **Esophageal orifice** (THAT PASS THROUGH IT THE ESOPHAGUS AND ALSO THE ANTERIR VAGUS AND THE POSTERIOR VAGUS) .

#### ➤ **Below- inlet of the pelvis:**

- The difference between thoracic cavity and the pelvic cavity is that the pelvic cavity is opened with abdominal cavity (no separation).

#### ➤ **Superiorly-(in the anterior border):**

- Xiphoid process (the end of the sternum)
- Lower five Costal cartilages (7-12)

#### ➤ **Inferiorly- (anterior border)**

- Pubic bone (symphysis pubis) ANTERIORLY
- iliac crest at the level of L4 ( ON THE LATERAL SIDE )

#### ➤ **POSTERIORLY - the lumbar vertebrae L4 + L5**

#### ➤ **Umbilicus - at the level of IV disc (L3-L4)**

The digestive system is found in the abdomen , and the doctor can examine its organs by hand , so in order to locate each organ correctly ; the abdominal area is divided into **four quadrants** :

- **Upper left**
- **Upper right**
- **Lower left**
- **Lower right**

For example when a patient tells the doctor that he/she has a pain in the lower right quadrant, the doctor knows that there is a problem in the cecum and appendix – which are located in that quadrant – for example , the pain could be due to appendicitis. But the four quadrants method is an old way that the doctors used to use previously, so there is a new method for dividing the abdominal area, which is the “ **the nine areas**”.

### ❖ **What are the 9 areas/regions?**

They are made **by**:

#### ➤ **Two Vertical Planes: (Midclavicular planes)**

They extend from the middle of clavicle , to the midpoint between pubic symphysis and anterior superior iliac spine (midpoint of the inguinal ligament): **left and right lateral planes.**

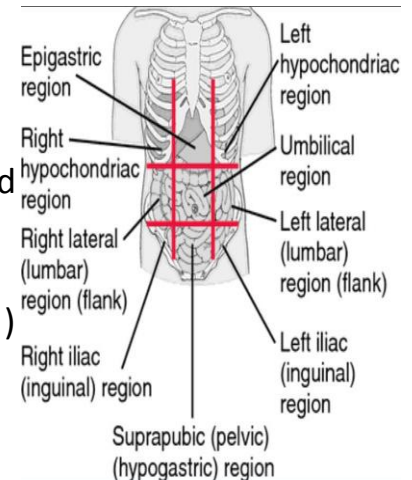
#### ➤ **Two Horizontal Planes:**

- **Upper Subcostal plane:** at the level of L3 vertebra.  
Subcostal means: under the costal cartilage, and to be more accurate the costal cartilage number **9** .
- **Lower Intertubercular plane:** At the level of L5 vertebra, pass between the tubercles of iliac crests of the hip bone.

## The names of the regions:

### ➤ First row:

- **Right hypochondriac region** (below the costal cartilage) , you find there the right lobe of the liver and the gall bladder. Eg : cholecystitis (gall bladder inflammation).
- **Left hypochondriac region** (below the costal cartilage) , you find the spleen.
  - If a car accident or any other reason caused fracture of left ribs, the first thing that should come to your mind is a ruptured spleen (the spleen is a reservoir of blood so any trauma can cause bleeding, so it needs a fast diagnosis and fast treatment).
- **Epigastric region** (above the stomach), you find the stomach and the left lobe of the liver .



### ➤ Second row:

- **Umbilical region** (in the middle, around the umbilicus), the small intestines are deep to it, eg: intestinal colic مغص معوي
- **Right lateral lumbar** (ascending colon).
- **Left lateral lumbar** (descending colon).  
(The kidneys lie in the posterior part of the right and left lateral lumbers),  
eg : renal colic مغص كلوي

### ➤ Third row:

- **Right iliac (inguinal) region** ( where you find the cecum and the appendix , eg : appendicitis).
  - *The appendicitis` pain first starts around the umbilicus , because there is a dermatome around it , then the pain moves to the lower right of the abdomen .*
- **Left iliac (inguinal) region**
  - The word inguinal , is in relation to the inguinal canal( which pass through it :the spermatic canal , and also where hernia happens .)
  - Also the ovaries are found in these regions , so pain in this region in women , could be due to the menstrual cycle. So you have to differentiate between appendicitis and menstrual pain.

- **The suprapubic ( pelvic ) or the hypogastric region (below the stomach) :** and the most important thing in it is the urinary bladder.

As we said before , we have anterior abdominal wall and posterior abdominal wall, which has in the middle , the lumbar vertebrae ( 5 vertebrae ) , and the floating ribs ( 11+12) at the upper part of the posterior abdominal wall , and the rest of it is muscles ( muscles of the abdomen that originate from the back ).

## ❖ **Anterior abdominal wall**

It is important for surgeons to know the layers in order to know how to open the abdomen .

### **What are the Layers of Anterior Abdominal Wall?**

#### **1. Skin**

#### **2. Superficial Fascia :**

- Above the umbilicus one layer (fatty layer).
- Below the umbilicus **two layers** (fatty and membranous layers) :
  - ✓ **Camper's fascia** - fatty superficial layer. In the scrotum it is called **dartos** muscle under the skin ( in males ).
    - Which means that the abdominal wall descends to the perineum .
    - In females , it goes to the labia majora .
  - ✓ **Scarp's fascia** - deep membranous layer: attaches to the fascia lata below the inguinal ligament . Also , it is attached to the pubic arch from the sides , and posteriorly to the perineal body.
    - **The membranous layer in the scrotum , is called COLLE`S FASCIA ( around the scrotum and the penis ).**

#### **• What is the perineal body ?**

→ It is a fibrous structure between the anal orifice and the urethral orifice anteriorly.

#### **• Clinical application on the scarp`s fascia ( very important ):**

They found out that scarp`s fascia and its attachments is continuous around the penis and scrotum, so when we have a rupture in the penile urethra, this leads to extravasations of urine into(scrotum, perineum, penis, lower abdomen ( below the umbilicus ) and 2 fingers below the inguinal ligament in the fascia lata , since it is attached to it).

**Regarding to the Deep fascia:** there is NO deep fascia, or a very thin layer of connective tissue covering the muscle, so it is absent especially in women. But why?!

→ To allow the protrusion of the uterus in pregnant women forward and upward.

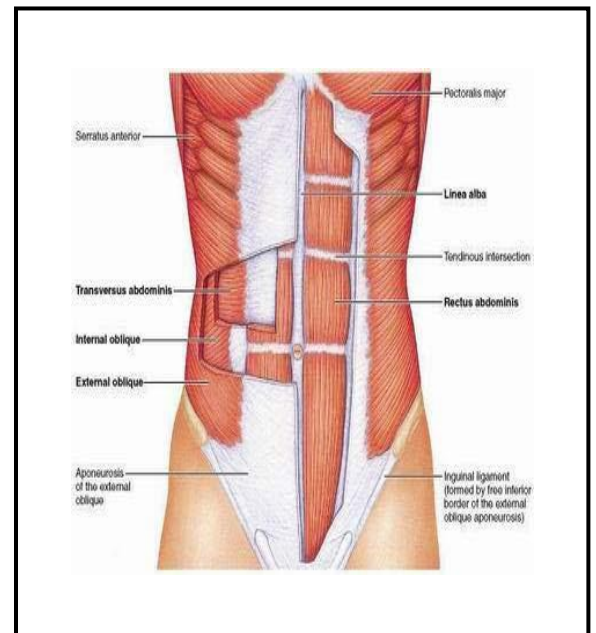
### 3. Muscular layer: four muscles .

**All the abdominal muscles insert themselves in the linea alba** ( which is a fibrous tissue , that extends from the xiphoid process to symphysis pubis).

**Advantages of linea alba :** doesn't bleed much, because it is fibrous .

**Disadvantages of linea alba :** slow healing rate , that takes long time .

- In case of tumors in the abdomen for example, or any other purpose that requires opening of the abdomen, **a midline incision in the linea alba,** provides a wide space for the surgeon , which you can consider as an advantage.



#### a) ***External oblique muscle*** (external abdominis muscle)

- external -> outer muscle
- Comes from the back and extends in an oblique fashion -> the fibers are oblique (Downward forward and medially).
- **Origin:** outer surface of lower 8 ribs.
- **And the origin is fleshy , while the insertion is a fibrous tissue ( apponeurosis ).**
- **Insertion:**
  - ✓ Xiphoid process
  - ✓ Linea alba (fibrous line with little supply of blood starts from xiphoid process to symphysis pubis, used in midline incisions during surgeries because of small amount of bleeding, but longer time in healing).
  - ✓ Pubic crest Pubic tubercle Iliac crest
- **Nerve Supply:**
  - ✓ Lower 6 thoracic/intercostal nerves ( that pass between the internal oblique and the transverses abdominus , till the midline) .

- ✓ L1( iliohypogastric n., ilioinguinal n).
- Motor and sensory

## Aponeurosis of external oblique muscle

External oblique is converted to aponeurosis before reaching linea Alba, so what is aponeurosis?

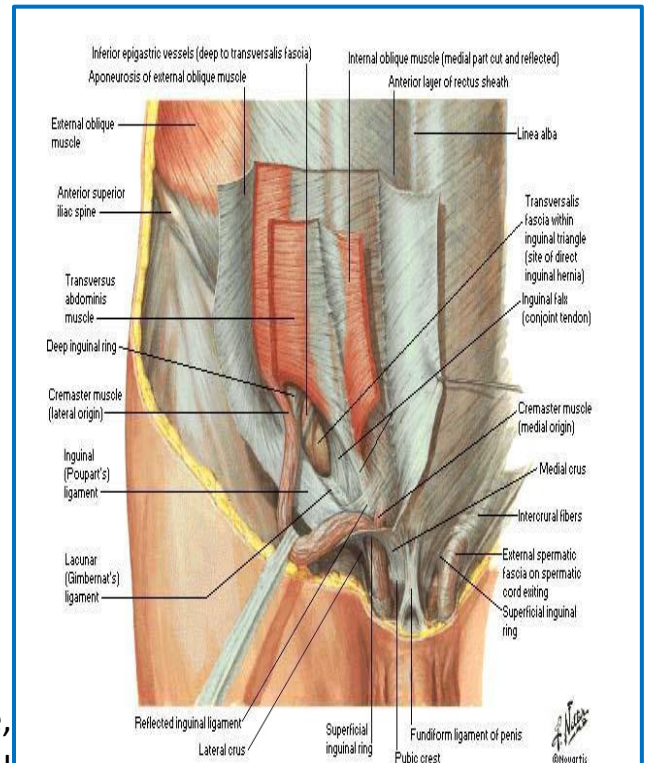
It is non-fleshy fibers which make :

- 1) **Inguinal ligament:** folding of the aponeurosis of the lower fibers of external oblique upon itself, attaches between anterior superior iliac spine and pubic tubercle.

*\*so now , you know that the inguinal ligament is from the external oblique aponeurosis .*

- 2) **Lacunar ligament:** crecentric in shape, extension of aponeurosis of external oblique muscle attached to the pubic tubercle and the pectineal line of pubis forming the medial boundary to the femoral ring.
- 3) **Pectineal ligament:** extension of aponeurosis attached to the pectineal line, and embedded with periosteum of ramus of pubis.
- 4) **Superficial inguinal ring:** **triangular** shape, it is a defect in external oblique aponeurosis for the passage of the spermatic cord (males) or ligament of uterus (females).

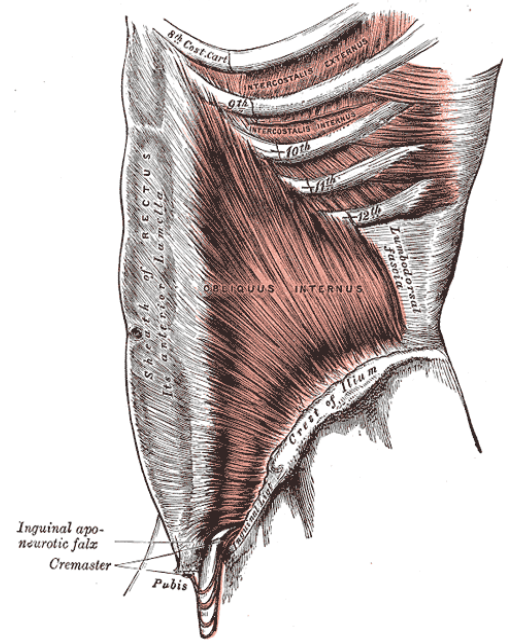
\* **Inguinal canal** lies between superficial and deep inguinal rings .





**b) Internal oblique muscle (deep to external oblique muscle and opposite to it, but in different direction)**

- the direction of this muscle is **(upward forward and medially)**.
- **Origin**
  - ✓ Lumbar Fascia
  - ✓ Anterior 2/3 of iliac crest
  - ✓ lateral two thirds of inguinal ligament.
- **Insertion**
  - ✓ Lower three ribs and costal cartilage
  - ✓ Xiphoid process
  - ✓ Linea alba
  - ✓ Symphysis pubis.
- **Nerve Supply**
  - ✓ Lower 6 thoracic nerves
  - ✓ iliohypogastric nerve & ilioinguinal nerve (L1).

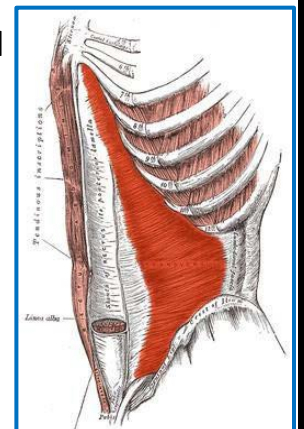


**The internal oblique muscle makes a Conjoint tendon:**

- Fusion of the fibers of internal oblique and transversus abdominis.
- The conjoint tendon is attached to the pubic bone ( ramus of pubis ).
- Attached medially to linea alba supporting the inguinal canal
- Has lateral free border
- **It is important to take stitches in herniorrhaphy ( in inguinal hernia فتق ) because it is very strong tendon , that supports the inguinal canal , where the inguinal hernia happens.**

**The internal oblique muscle gives the Cremastic muscle and fascia:**

Follows internal oblique and starts from inguinal canal and descend until the scrotm ( around/covering the wall of the spermatic cord ).



**c) Transverses abdominis muscle**

- “transverse “ means that the fibers extend horizontally.
- **Origin:**
  - ✓ lumbar fascia
  - ✓ lower 6 costal cartilage
  - ✓ anterior 2 thirds of the iliac crest
  - ✓ the lateral third of the inguinal ligament.



- **Insertion:**  
in the **linea alba** only from the xiphoid process to symphysis pubis.
- ***Its lower fibers fuse with the internal oblique fibers forming conjoint tendon.***
- **Nerve supply :**
  - ✓ Lower 6 thoracic nerves
  - ✓ L1 (iliohypogastric and ilioinguinal nerves)
- It also contributes to form the **rectus sheath**.
- Its fibers run in transverse manner.

The collection of the abdominal muscle fibers (downward, upward, transverse) make a very strong network, thus the abdominal muscles are very strong muscles. **(That's for the protection of the abdominal viscera).**

#### **d) Rectus abdominis muscle**

- The abs (عضلات المعدة), obvious in body builder, because of **the tendentious intersection** between the muscle parts.
- In the embryo it comes from the myotome, continue as a separated myotome because of the tendons.
- This muscle is found in a sheath between the linea alba and the semilunaris .
- **Origin: symphysis pubis (downwards )**
- **Insertion:** upwards in the 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup> costal cartilage and the xiphoid process.
- Nerve supply: lower 6 thoracic nerves. **(NOT L1)**
- Its lateral edge is called **semilunaris**.  
It has tendinous intersections attached to the anterior wall (not the posterior, it is separated from the wall posteriorly).



- **Pyramidalis muscle:**

- May be absent
- Within the rectus sheath in the lower part ( if present).

- **Origin:** from the anterior surface of the pubis.
- **Insertion:** linea alba .
- **Action:** pulls linea alba.
- **Nerve supply:** 12th subcostal nerve ( the last intercostal N.)

**4. Transversalis fascia:** fibrous connective tissue covering the muscles from inside (deep to the muscle)

- If you remember , we talked about this fascia in the femoral sheath ( in the MSS System ).

**5. Extraperitoneal fascia or fat.**

**6. Parietal Peritoneum :** a thin layer lining the abdominal cavity.

\* **Peritoneum:** is a membrane, the same as a balloon, it contains a cavity which is the abdomen, the wall is parietal peritoneum .

\* **Question : what is the difference between the visceral peritoneum and the parietal peritoneum ?**

→ the parietal peritoneum : covering the abdominal cavity.

→ the visceral peritoneum : adherent to the viscera ( the organs) , for example : a membrane covering the small intestines , a membrane covering the stomach ... and so on.

→ and that means , when a doctor wants to make a surgery in the stomach , the layers that he/she should go through are : skin , superficial fascia , deep fascia , the muscles through the midline incision of the linea alba ( **separation**) , transversalis fascia , extraperitoneal , parietal peritoneum , then the visceral peritoneum.

\* **Question : If I want to make a surgery in the kidneys , do you have to open the abdomen ?**

→ no , you make the surgery outside the abdominal cavity through what is called the “ Morrison incision” , you make it over the kidney on the flank. ( keep in mind that the kidney is out of the abdominal cavity ).

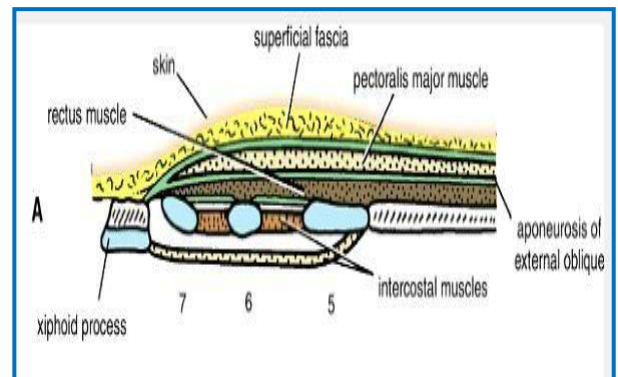
## ❖ Rectus sheath:

- It has anterior and posterior wall and content.
- Starts from **linea semilunaris** and **fuses (ends)** in the **linea alba**.
- The linea semilunaris is the beginning of the rectus sheath, till the linea alba.
- We said before that the incision in the linea alba gives the doctor a wide space in the abdomen, incision may be at the level of the xiphoid process, one at the level of the umbilicus, or between the umbilicus and the anterior superior iliac spine.
- Formed by the aponeurosis of the abdominal muscles (external and internal oblique muscles and transversus abdominis muscle).
- **Contents:**
  - **Two muscles:** rectus abdominis and pyramidalis.
  - Pyramidalis muscle is sometimes absent, if present it helps in the function of the abdominal muscle, used in surgery as reconstructive muscle.
  - **two arteries:** **inferior epigastric** (from external iliac) and **superior epigastric** (from internal thoracic artery which is branch from a subclavian artery which is a branch from the brachiocephalic artery).
  - ➔ **the anterior wall of the rectus sheath is adherent to the muscle which is the rectus abdominis, while the posterior wall is separated by these two blood vessels (which are present between the posterior abdominal wall and the rectus abdominis muscle).**
  - Anterior primary rami of the lower six intercostal/thoracic nerves), **so L1 is not included.**
  - Lymphatic vessels.

It has different relations at different levels but, *The same content always :*

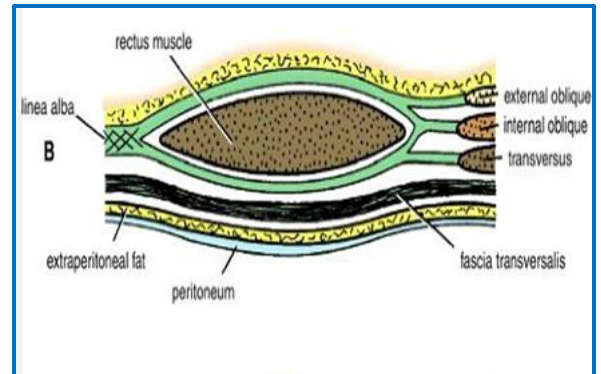
**a) Above costal margin( 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup>) and xiphoid process: (look at figure A)**

- **The anterior wall:** only aponeurosis of external oblique muscle. (for sure, there are skin, superficial fascia, pectoralis major, then the aponeurosis mentioned above).
- **Posterior Wall :** costal cartilage number 5, 6 and 7,
- then intercostal muscle, and xiphoid process in the front
- **Content:** rectus abdominis muscle.



**b) Mid way between umbilicus and xiphoid and Mid way between umbilicus and symphysis pubis:( between the costal margin and ant. Superior iliac spine): (look at figure B) ( the doctor said it is important)**

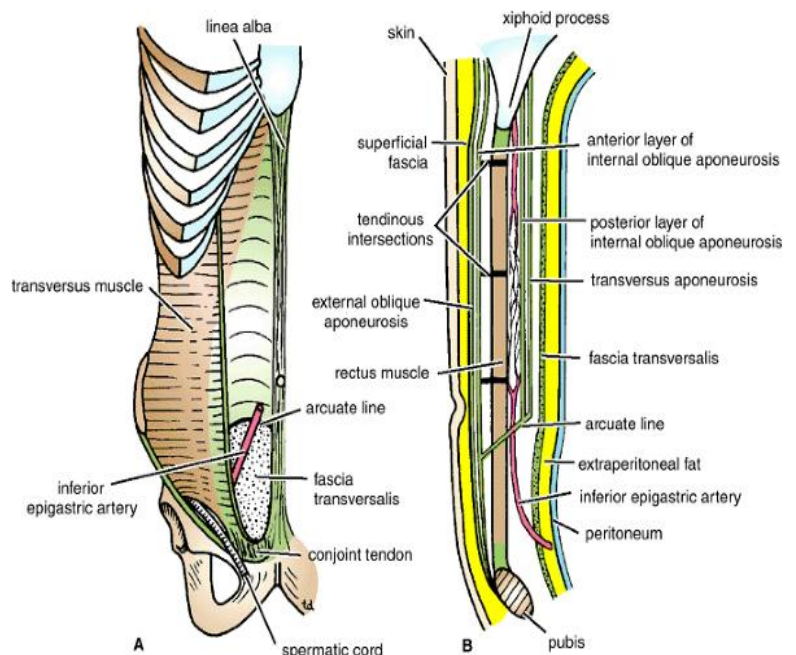
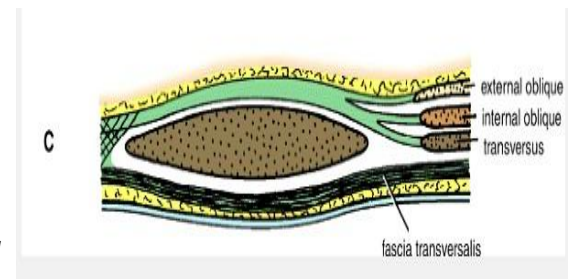
- **Anterior Wall:** the aponeurosis of external oblique and **one layer** of internal oblique.  
*\*\* The internal oblique muscle splits into two layers , one goes anteriorly , while the other goes posteriorly.*
- **Posterior Wall:** one layer of internal oblique aponeurosis and transversus abdominis aponeurosis.
- **Contents:** rectus abdominis muscle (notice that it is enclosed by the 2 layers of internal oblique).



**c) Below ant. Sup. Iliac spine (below Mid way between umbilicus and symphysis pubis): (look at figure c)**

*The inferior epigastric artery enters the rectus sheath below the arcuate line , and the arcuate line is a very important mark , because the rectus sheath below this level , all the muscles are at the anterior wall , and the posterior wall is only formed from fascia transversalis , so :*

- **Ant. Wall:** only the aponeurosis of all muscles ( external,internal and transversus).
- **Post. Wall:** transversalis fascia only , and lies below it extra peritoneum fat and peritoneum.
- **Content:** rectus abdominis muscle.



**\*Arcuate line ( linea semicircularis):** The end of the muscles in the posterior wall where they attach to the anterior superior iliac spine, under it is the transversalis fascia.

## ❖ Other fascia in the anterior Abdominal wall:

### ➤ Transversalis fascia:

- Deep to the muscles.
- Starts below the diaphragm.
- Continue downwards to the femoral triangle and participates in the formation of the femoral sheath.
- Found in the posterior wall of the rectus sheath, below the anterior superior iliac spine.

### ➤ Extrapertoneal fascia:

- Usually it is in the form of adipose tissue(fat).
- Located above the parietal peritoneum, and below the transversalis fascia.

### ➤ Parietal peritoneum:

- The membrane which covers the abdominal viscera
- While the visceral peritoneum is adherent to the viscera.
- So we can't reach any organ in the abdomen without opening the parietal peritoneum.
- Inferior epigastric artery is branch from the external iliac artery and it is an important landmark
- Medial to inferior epigastric artery is inguinal triangle ( where direct inguinal hernia occurs) and lateral to it is the inguinal canal ( where the indirect inguinal hernia occurs).

Important note : the inferior epigastric artery anastomoses with the superior epigastric artery, and they separate the rectus abdominis muscle from the posterior layer .

Note: The lumbar triangle is not required.

## ❖ The action of the anterior abdominal muscles:

The abdominal muscles are one of the strongest muscles in the body as a group, due to the arrangement of fibers, making a very strong network.

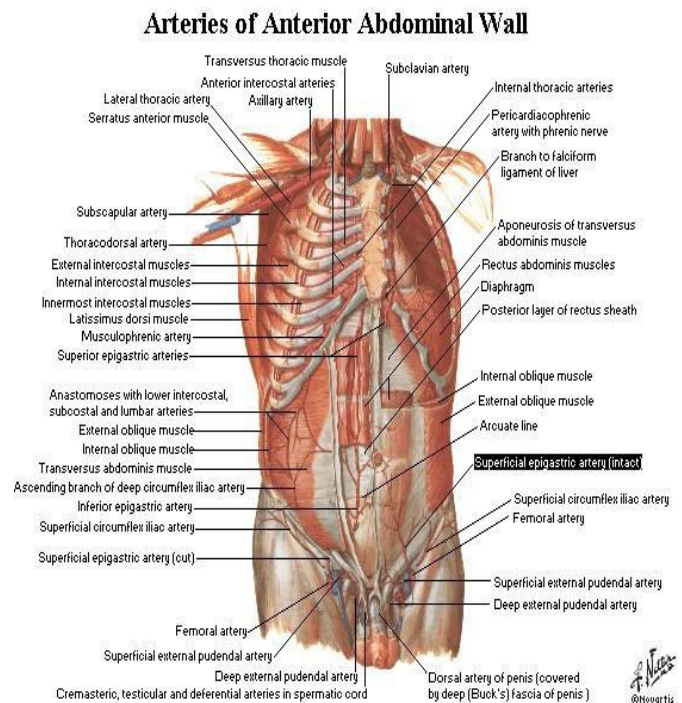
- Increase the ***intra-abdominal pressure*** where is needed in the following

processes: Vomiting, Coughing, Defecation, Labour, Micturition and Bending of the trunk anteriorly or laterally.

- Protect the viscera when **contracted** (when you are playing boxing, you have to protect your visceral organs from the boxes you take, so the muscles of the abdomen take the role of the protection **when contracted**. If contraction didn't take place the viscera will be affected and bleeding may occur)
- Keep the viscera in position
- They help in raising heavy objects (people who lift heavy objects tie a strap on the abdomen to help the muscles doing their action, to avoid hernia).

### ❖ Blood supply of the abdominal muscles:

- Superior and inferior epigastric arteries supply the abdomen (remember they are from the rectus sheath contents).
- Intercostal arteries (lower 6) which arise from the descending thoracic aorta.
- Lumbar arteries and they are 4 in number. They arise from the abdominal aorta.
- Deep circumflex iliac artery (arises from the external iliac artery and heads towards superior iliac spine)



### ❖ The corresponding veins and they drain into:

- Lateral thoracic vein which drains into the axillary vein (in the upper limb) >>>>> **above the umbilicus**
- Inf. Epigastric draining into the femoral vein
- >>>>> **below the umbilicus**
- Paraumbilical veins in the ant. Abdominal
- Wall around the umbilicus and then pass through **ligamentum teres** of the liver to drain into the portal vein (Porto- systemic anastomosis). And if there is portal-hypertension, these veins will be affected and form something called **caput medusae** (like a scar around the umbilicus).



## ❖ Nerve supply of the ant. Abdominal wall:

- Lower 6 subcostal nerves and L1.

**Note:** L1 nerve passes above inguinal ligament and divides into 2 branches: ilio-hypogastric and ilio-inguinal.

## ❖ Dermatomes:

- Skin around or below the xiphoid process>>> lateral cutaneous terminal branches of **T7**.
- Skin around the umbilicus>>> from **T10**.
- Skin below the umbilicus (above symphysis pubis)>>> from **L1** (ilio-hypogastric and ilio-inguinal).

## ❖ Lymphatic drainage of the ant. Abdominal wall:

- Above the umbilicus>>> Ant. Axillary L.N.
- Below the umbilicus>>> superficial Inguinal L.N.
- Posteriorly,
  - ✓ Above iliac crest >>> post. axillary L.N.
  - ✓ Below the iliac crest >>> superficial Inguinal L.N.

## ❖ Clinical notes:

We should be able to know the layers, muscles, organs and structures affected by a stab wound by knowing the region only.

### ➤ Gun shot

### ➤ Abdominal stab wound:

### ➤ Surgical incision:

- Doctors seek to make the incision in an area where healing is fast (and without leaving a scar) and bleeding is minimal.
- And the surgical incision should be parallel to skin cleavage so that it won't leave a scar. doctors should also be aware of the pathway of the nerves. So they pull rectus sheath laterally to protect the nerves which pass from medial to lateral. And the direction of the muscle fibers is also important ( **paramedian incision** ).
- If there is a large tumor on the abdomen for example so we need to make a large incision, **we open the linea alba**.
- To remove the gallbladder when inflamed (on the right side) we make a **subcostal incision** ( also called **kocher** incision).
- To reach the **kidney** we make an incision on the back called **Morrison incision**.
- To remove the **appendix**>>> the incision is called **McBurney's incision** ( **parallel to the inguinal ligament** ). This incision is not used nowadays , doctors use the laparoscope instead .

*The End*

*Sorry for any mistakes*