



ANATOMY

Sheet

Slide

Handout

Number

4

Subject

General Anatomy of

UGS

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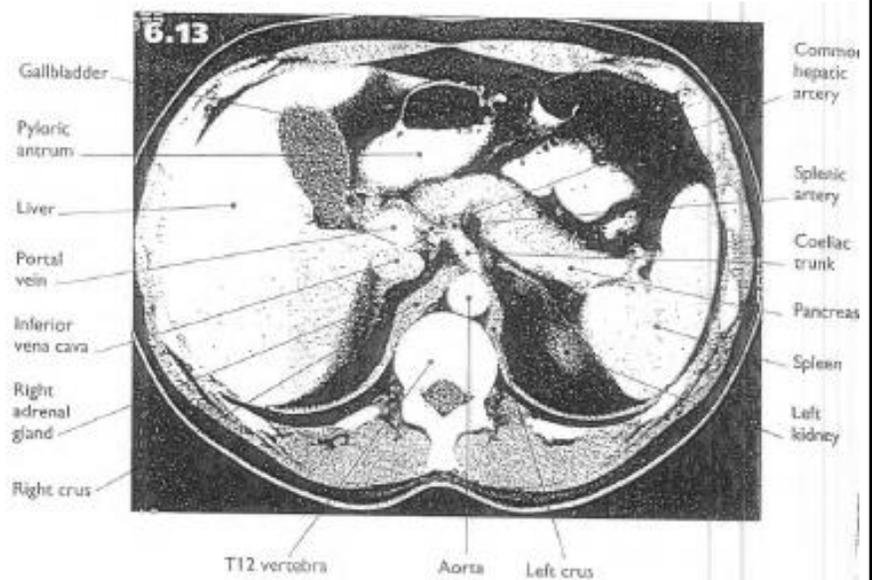
- This sheet was written according to section 1 recording.



CT SCANS OF THE KIDNEYS:

□ Image at level T12:

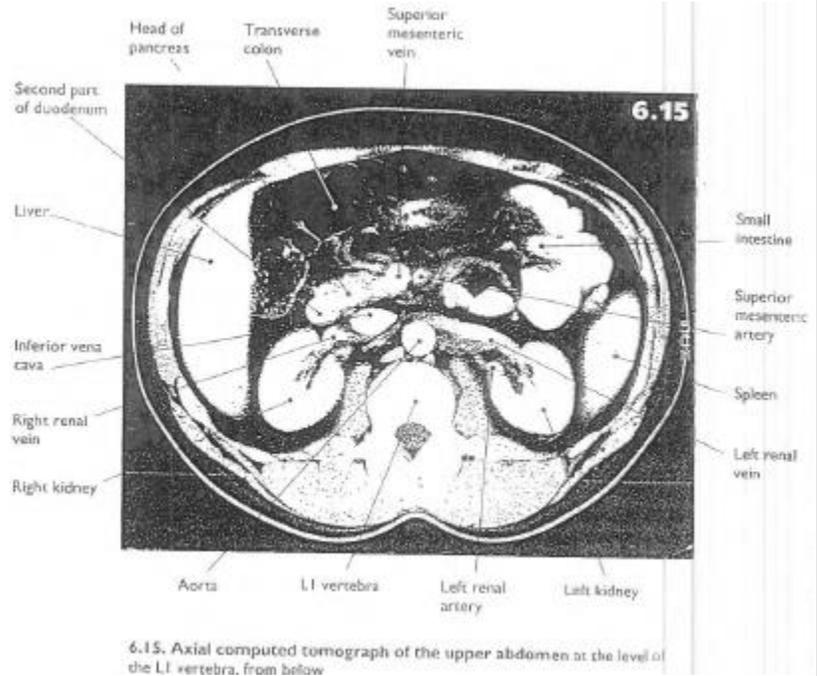
- We will see the liver as a big structure on the right, spleen on the left, pancreas in the middle.
- We barely see the upper pole of the left kidney
- we can see the gallbladder
- any black color means gas which is found in the colon and fundus of the stomach
- abdominal aorta right to it IVC, the portal vein is close to IVC.
- in case of liver cirrhosis, the portal vein is connected to the IVC to lower the portal pressure
- the cruses of diaphragm are seen around the aorta (left crus & right crus)
- behind the pancreas there's the celiac trunk, which is the biggest branch of the abdominal aorta, and the splenic artery is the biggest branch of the celiac trunk.
- the right kidney is lower so we can only see the pole of the left kidney at the level of **T12**



6.13. Axial computed tomograph of the upper abdomen at the level of the T12 vertebra, from below

□ Image at level L1:

- the **kidneys** are clear
- the **liver** becomes smaller and also the **spleen**
- we can also see the abdominal aorta and the IVC
- part of the pancreas and the duodenum
- in the left kidney, from anterior to posterior we have renal vein then artery then ureter
- so the left renal vein in order for it to reach the IVC it will pass in front of 3 structures (anteriorly), the left renal artery & the abdominal aorta & the beginning of the right renal artery
- we will also talk about the left renal vein when we will talk about the gonads, veins coming from testes and veins from the supra renal gland will open in it
- between the spleen and the kidney is the greater sac!, so a splenectomy is done through the greater sac only, there's no need to enter lesser sac



+ ANATOMY OF THE URETERS

- ❖ The Ureters like the kidney are retro-peritoneal, yet not all of it are covered with the peritoneum, certain vessels lie between them at some points
- ❖ The Ureter starts at the pelvis of ureter, and the pelvis of the ureter is formed of the union of **2-3 major calyces** → each calyx is formed by the union of variable number of **minor calyces** → **renal papilla** opens in the minor calyx → and the renal papilla is the apex of the renal pyramid → and the apex of the pyramid contains many **collecting tubules**

- ❖ the ureter is about 10 inches long (25 cm), the upper half is within the abdomen, and the lower half is in the pelvis.
 - ❖ The ureter descends along the posterior abdominal wall to the pelvis
 - ❖ in the abdomen the **psaos major** muscle lies behind it and separates it from the lumbar transverse process
 - ❖ the ureters enter pelvis by crossing the termination of the common iliac artery or the beginning of external iliac artery
 - ❖ in the pelvis they run along the anterior margin of the greater sciatic notch
 - ❖ when it reaches the **ischial spine** it will change its direction and goes **medially** to the bladder and opens at the posteriosuperior angle of the bladder
- *this is the course of the ureter in the abdomen and the pelvis

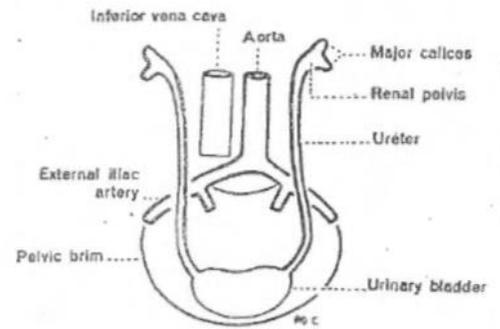
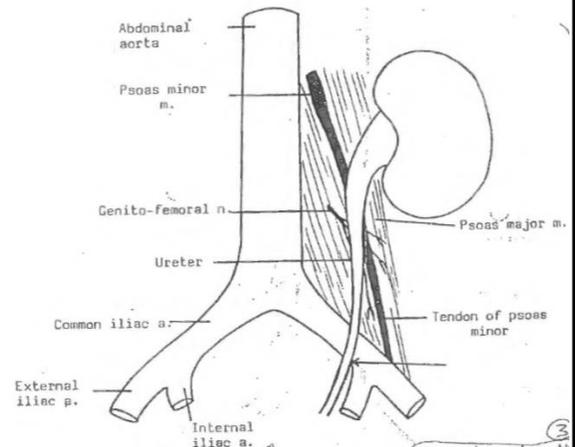


Fig. 279 The location of ureters on the posterior abdominal and lateral pelvic walls.



- ❖ posterior to the ureter in the abdomen is the psaos major as we said and psaos minor if found,
- ❖ between the ureter and the psoas major there's the genitofemoral nerve (from L2)
- ❖ how the ureter enters the pelvis?
 - by crossing the termination of common iliac or the beginning of external iliac

- The ureters have three major constrictions that occurs at the:

- 1) Renal pelvis: At the junction of the ureters and renal pelvis.
- 2) Pelvic brim: this is when the ureters pass the brim of the pelvic inlet at the bifurcation of the common iliac artery or the beginning of the external iliac artery.
- 3) Ureterovesticular junction: this is during the course of the ureter through the urinary bladder.

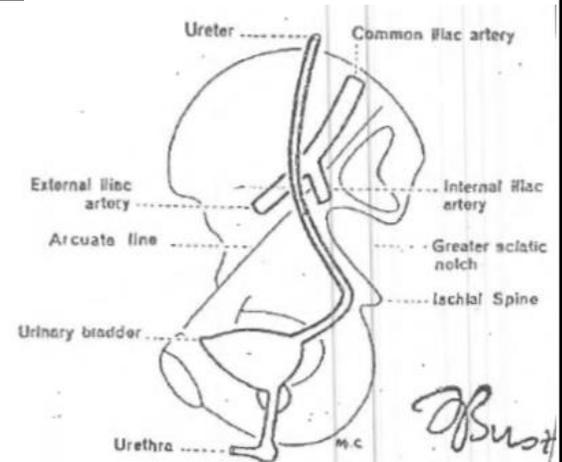
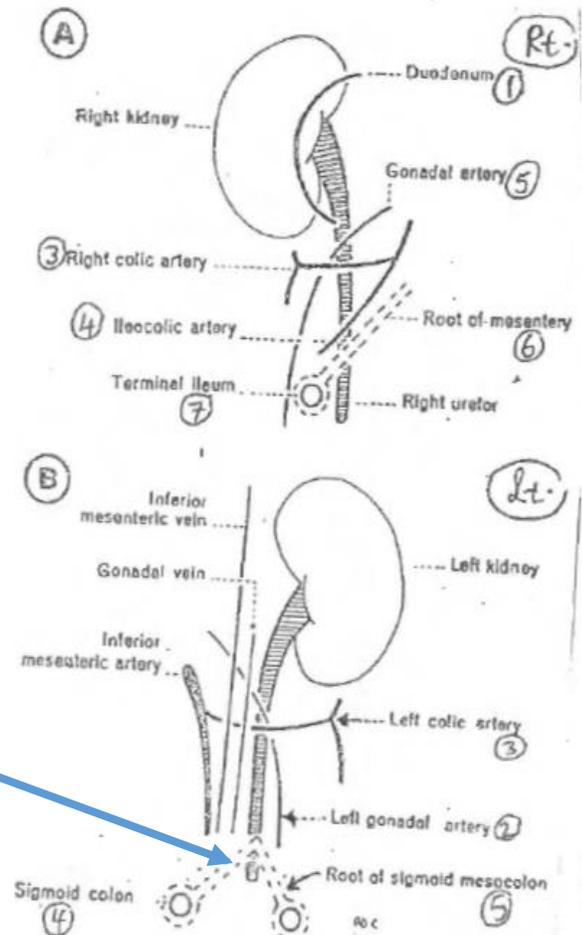


Fig. 280 General course of ureter in the pelvis.

& anterior relation to ureter:

- ❖ The Ureter is adherent to the parietal peritoneum, but there are some blood vessels **between** them,
- ❖ now, anterior to the **right** ureter is the duodenum (2nd part) and at the end of the ureter there's the terminal **ileum**, between them (the duodenum and the ileum) lies the blood vessels,
- ❖ relation of the **left** ureter are the pelvic colon "sigmoid colon" and its mesocolon "mesentery of the sigmoid" (very important relation),
- ❖ this mesentery is **V** shaped ((see the figure), and at the apex of this mesentery lies the ureter posteriorly,



↪ clinical correlation:

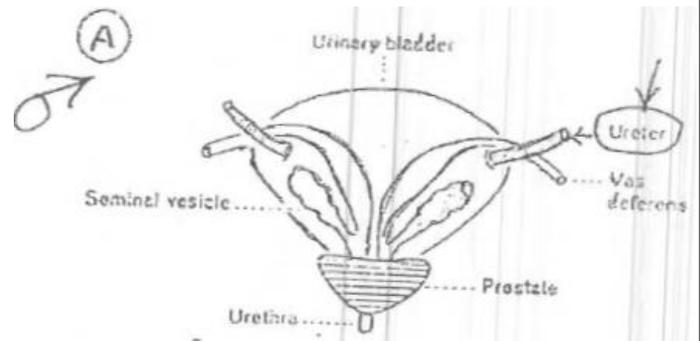
- when doing surgery to the sigmoid colon we should be careful not to damage the left ureter, usually during surgery we may mistakenly consider the left ureter as the colic artery, or gonadal vein or artery, to differentiate between the ureter and vessels we pinch or bend the structure and look for the peristalsis movement as it happens only in the ureter (because there's a lot of smooth muscles)

☞ the blood vessels anterior to the ureters on both sides are:

1. on the right: branches of the superior mesenteric artery (right colic artery, ileocolic artery) and the gonadal artery (branch of the aorta)
 2. on the left:
 - a. branches of the inferior mesenteric artery “artery of the hind gut”, and the left colic pass in front of it
 - b. medial to the ureter passes the gonadal artery (to testes or ovaries)
 - c. also inferior mesenteric and gonadal vein
-

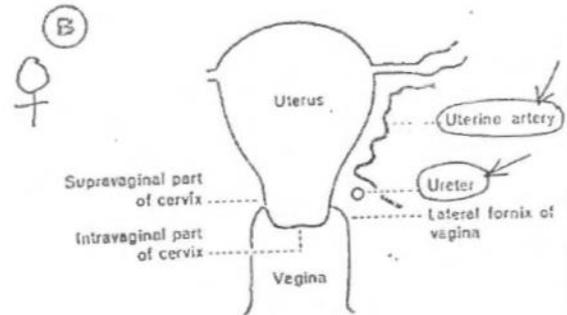
❖ another important relation of the ureter in males:

- near the end of the ureter at the posteriosuperior angle of the bladder, the vas deferens runs above it, in another word; the end of the ureter is crossed by the vas deferens
- the vas deferens transports the sperms from the testes into the ejaculatory duct
- the terminal part of the vas deferens behind the bladder dilates and forms a structure called the ampulla of vas which unites with the seminal vesicle
- to form the ejaculatory duct which runs through the prostate gland to unite with the prostatic urethra
- so during ejaculation in males the sperms with the seminal fluid run through the urethra, which means that the urethra transports both urine and the seminal fluid



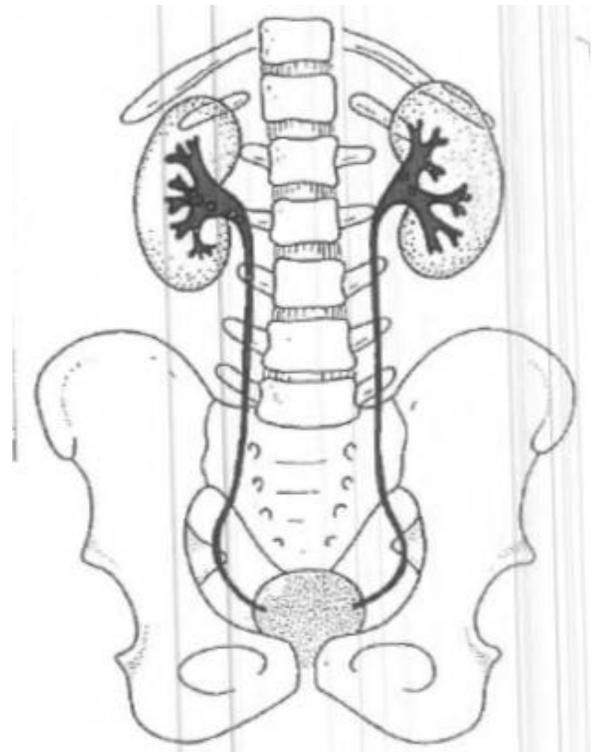
❖ in females there's also an important relation:

- the lower part of the uterus is the cervix and it has a vaginal and a supra-vaginal part
- the ureter passes 2 cm lateral to supra-vaginal cervix, and we can feel a stone in the ureter (if it was there) through the vaginal wall
- in the same area the ureter will be crossed by the uterine artery (the uterine artery crosses it superiorly),
- this important because these two structures might be ligated during hysterectomy (uterus removal), so we should lift the uterus to pull the uterine artery away from the ureter,
- and also after surgery we should check if there is urine coming out from the urethra normally.



KUB & IVU:

- In **KUB** “kidney, ureter, bladder” x-ray images we can't see the ureter or the calyces without injecting a dye,
- if we see a radio opaque (white color) structure then it might be a stone in the KUB, so to be sure a colored image should be taken to see if it's whether inside the ureter for example or not, this colored image is taken IV and it's called **IVU** “intra-venous urogram”



☞ Nerve supply to the ureter:

- The ureter has 2-3 layers of SM, innervated by the sympathetic system, and stimulation of the ureter cause peristalsis,
- The urine gets down to the bladder by peristalsis not gravity!
- If there was a stone in the ureter the peristalsis increase and causes great pain
- The pain is felt in the loin if the stone was in the kidney or the upper third of the ureter
- If it then descends to the middle and lower third the pain will be felt in the lower abdomen “groin”, inner aspect of the thigh, testes, and the external genitalia. (referred pain)

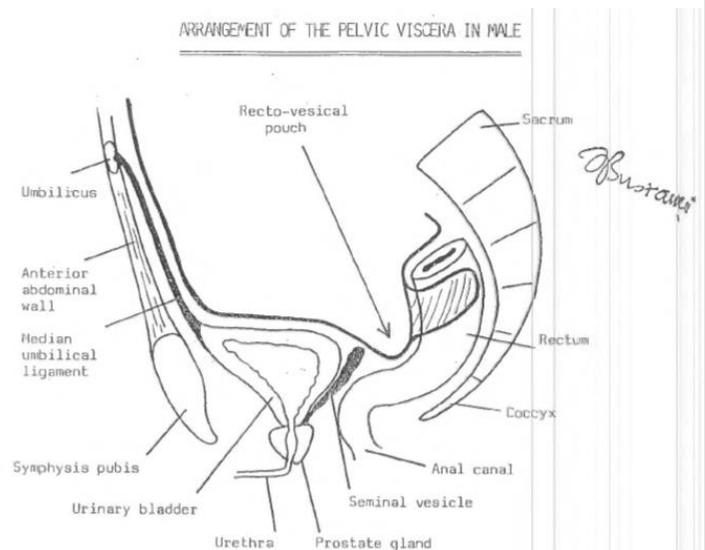
*note: it is a good sign if the pain is descending below as it indicates that the stone is moving downward.

- The nerve roots of the sympathetic innervation are from T10-L1
 - The L1 root also gives the iliohypogastric and ilioinguinal nerves to the lower abdomen, and this explains the referred pain there
-

☞ Arrangement of pelvic viscera

➤ in males:

- anteriorly behind the symphysis pubis is the bladder, and most posteriorly is the rectum, between them and behind the bladder is the seminal vesicle, which is a gland that adds the **seminal fluid** that contributes about **60%** of the total semen volume, and the **prostate** contributes about **25%**, and also the end of vas deferens (ampulla of vas)



▣ Peritoneum reflections in males:

- the upper third of rectum is covered by the peritoneum anteriorly and laterally
- the middle third is only covered anteriorly.
- The lower third of rectum which is called ampulla of rectum is not covered by peritoneum.
- The peritoneum will be reflected from the **junction** of the middle and lower third of rectum to the superior surface of the bladder, so most of the bladder is below the peritoneum and only the superior surface and a little area of the posterior surface is covered by it
- Also the superior part of the **seminal vesicle** is covered by the peritoneum.

- The peritoneum after covering the bladder will reflect to the anterior abdominal wall

- At the apex of the bladder the median umbilical ligament is attached

- below the neck of the bladder is the prostate gland
- inside the prostate is the beginning of the urethra which is called prostatic urethra
- if the prostate is enlarged, it will constrict the urethra, making it hard to urinate, **yet** the prostatic urethra is the widest and most dilatable part of the urethra

- so prostate enlargement effect is relatively low, and the enlargement must be very severe

- the anal canal has no relation with the peritoneum

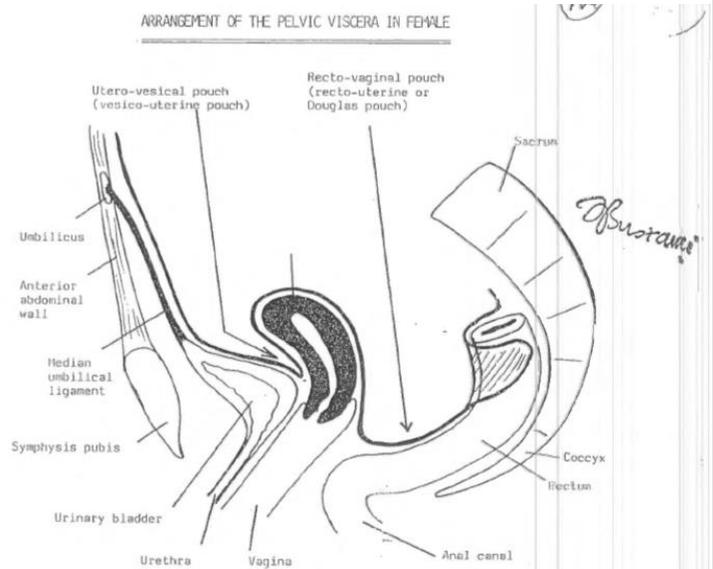
- between the rectum and the bladder is an area called **rectovesical pouch**

➤ In females:

- behind the pubic symphysis is the bladder, and the rectum is most posterior, between them is the vagina and uterus

▣ Peritoneum reflections in females:

- rectum relations are same as in males,
- upper third of the rectum is covered anteriorly and laterally
- middle third only anteriorly
- and lower third has no peritoneum around it,
- similar to males, at the junction of middle and lower third of rectum the peritoneum would be reflected covering the upper part of the vagina (the posterior fornix) and supra vaginal cervix, then body and fundus of uterus
- then comes to the anterior surface and cover the fundus and body but won't cover the cervix anteriorly!
- then it reflects from the uterus to the bladder forming the **utero-vesical pouch**,
- *the most important pouch in females is the **rectovaginal** pouch or **rectouetrine** pouch or **Douglas** pouch (three names -> one pouch), and it's important because if we insert an instrument in the vagina and pushed it through the posterior fornix, it will go to the peritoneal cavity
- the “rectovaginal pouch” means that the peritoneum covers part of the posterior vaginal wall



□ Relations of the vagina:

- the vagina has an anterior and posterior wall,
- the cervix pierces the vagina through the anterior wall, which makes the **anterior wall shorter than the posterior wall**

- if an illegal abortion was made by an unprofessional doctor, he may go straight through the posterior fornix to the peritoneal cavity because the cervix is angled not straight after the vagina.

- The base of the bladder and the urethra are attached to the anterior vaginal wall
- the urethra in females is about 4cm long
- vaginal prolapse (pulling of the vagina) which may happen due to many births will also pull the bladder and the urethra, which will lead to stress incontinence (laughing or coughing will lead to dropping of urine)

❖ Relations of the posterior vaginal wall:

- behind the lower 4th of the wall is the **perineal body** (pyramidal fibromuscular mass), which supports the posterior wall of the vagina
- so the posterior wall is stronger than anterior wall, and the anterior wall is more prone to prolapse.
- The middle two 4th, between them and the rectum is connective tissue
- the upper 4th is separated from Douglas pouch by peritoneum

✓ clinical correlation:

in the past, due to lack of care for pregnant women, the baby while being delivered may tear up the wall of the vagina anteriorly and posteriorly, and the tear may reach to the anal canal through the perineal body

- the urethral opening is in front of the vaginal opening

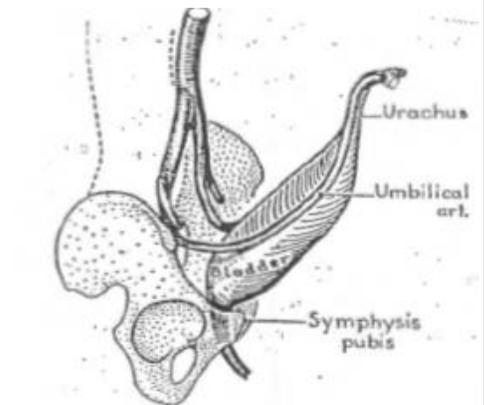
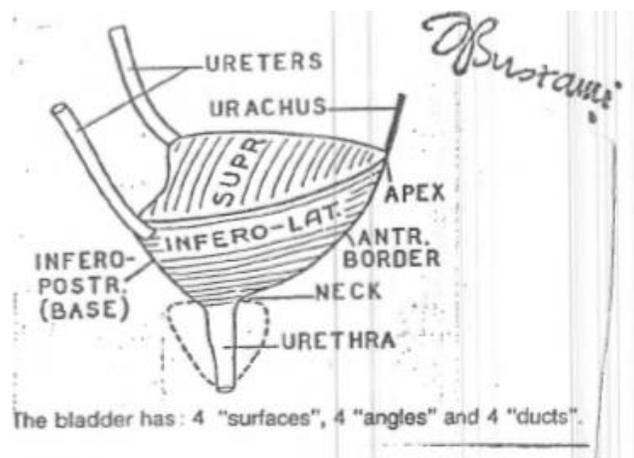
✓ clinical correlation:

old people will have atrophied vaginal opening and the nurse or doctor may mistake it for the urethral opening while placing a catheter to collect the urine post-operatively

- uterus's normal position is above the bladder, and called anteverted anteflexed uterus, we will talk about it more later on in the next lectures

🔗 The Urinary Bladder:

- the urinary bladder in the newly born is an abdominal organ, **fusiform** in shape, placed behind the anterior abdominal wall, because the pelvis is narrow, but still extra peritoneal!
- by the age of 6, the pelvis gets wider and the bladder descends to its normal place inside the pelvis
- the shape of the bladder depends on whether it's full or empty.
- when it's empty it will have 4 surfaces,
- the base (posteroinferior surface), superior and two inferiolateral surfaces
- the superior surface is the only part covered with peritoneum
- it has 4 angles:
 - anterior angle (apex), which is the point where the median umbilical ligament attached,
 - inferior angle or neck of bladder which



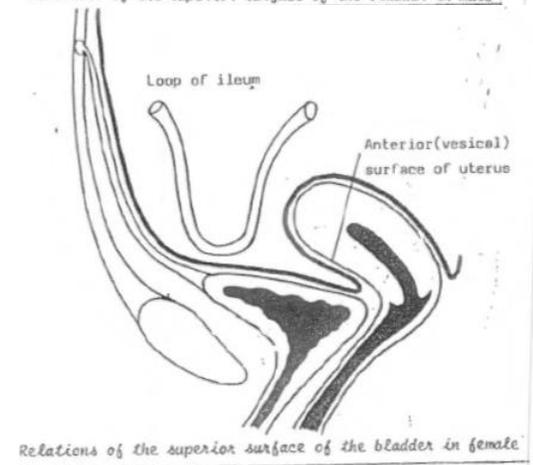
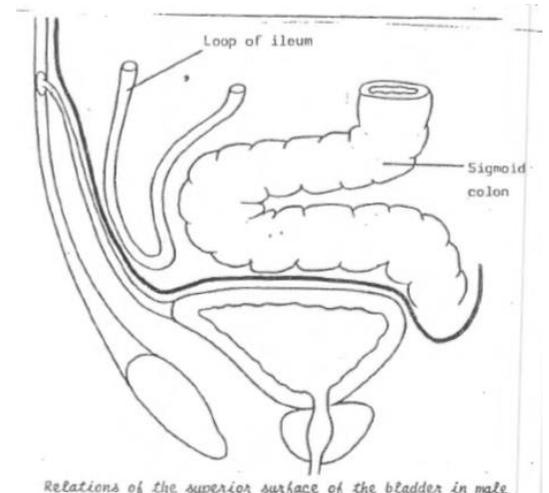
†: The bladder at birth lies in the abdomen and not in the pelvis.

lies on the base of prostate, from the neck of the bladder the urethra emerges (prostatic urethra), which is the widest and most dilatable part

- two posteriosuperior angles, where the ureters enter
- most of the bladder is below the peritoneum (peritoneum covers the superior surface only)

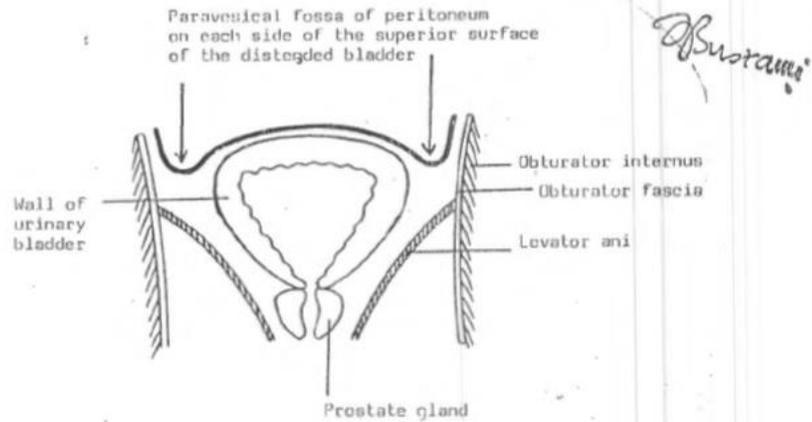
❖ Relations to the bladder

- superiorly:
 - in males there's the peritoneum, sigmoidal colon and terminal ileum.
 - while in female above the bladder there's the uterus and some small intestines
 - other relations of the bladder:
 - the inferiolateral surface lies behind the pubic bone
 - more posteriorly it's related to two muscles on both sides: obturator internus and levator ani
 - levator ani forms the pelvic diaphragm, above is the pelvic cavity and below it is the perineum, perineum is the area between the two thighs
 - above levator ani is the prostate and bladder
 - the anterior part of levator ani called levator prostate

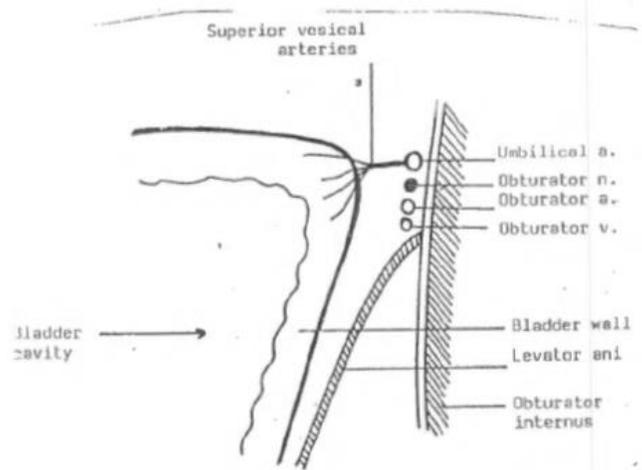


***there's three diaphragms in the body:**

1. the diaphragm that separates the thorax from abdomen
2. the diaphragm that separates the oral cavity from the neck (mylohyoid)
3. the pelvic diaphragm separates pelvic cavity from the perineum (levator ani)



- ❖ between the bladder and obturator internus there's an obturator fascia
- ❖ the part of the umbilical artery in that area gives branches to the bladder called **the superior vesical arteries**
- ❖ obturator nerve, artery and vein lie between the bladder and the obturator internus



Relations of the inferolateral surface of the bladder

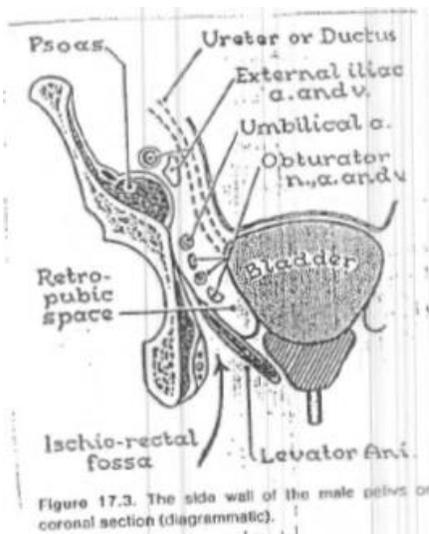


Figure 17.3. The side wall of the male pelvis on coronal section (diagrammatic).

sagittal section

REMEMBER:

- anterior wall of vagina is shorter than the posterior wall,
- the cervix is angled, while doing illegal abortion the doctor may go through the posterior fornix and pull the intestines instead of the fetus

- between the base of the bladder and the rectum are the **seminal vesicles**

- the terminal part of the vas deferens is the ampulla of (ductus deferens)
- the ampulla and the seminal vesicle unite in each side and form the ejaculatory duct

- so the prostate is pierced by:
 - a. prostatic urethra
 - b. two ejaculatory ducts one on each side

"the ejaculatory duct opens in the prostatic urethra"

- if we suspected a prostate enlargement in a patient we do a PR (per rectum)
- if it was enlarged but not due to cancer, it will be firm in consistency but not hard!
 - why will it be firm?
 - because it has high numbers of smooth muscles
 - if there was cancer in the prostate it will be hard (like a rock)

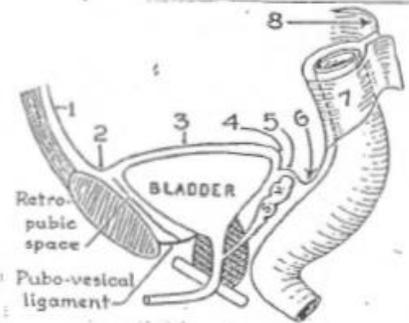
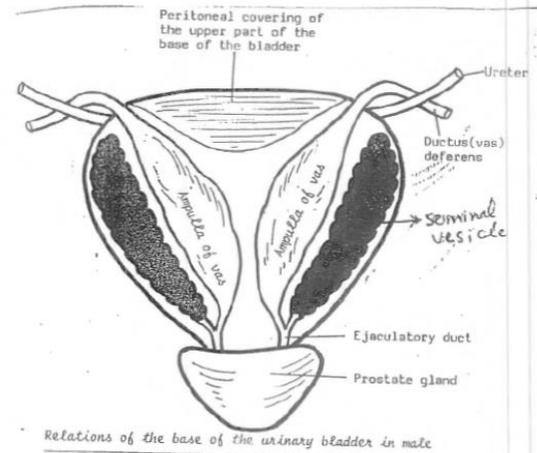


Fig. 299: Relations of the sup. surface, base and neck of the bladder in the "male".

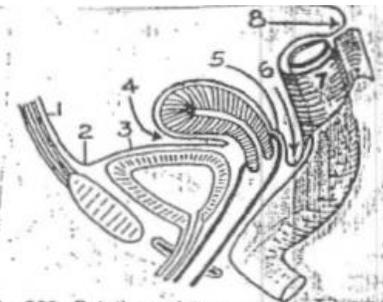
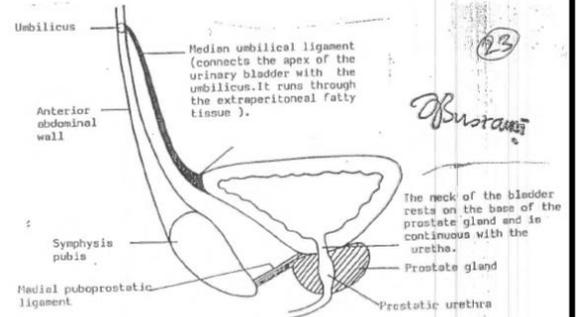


Fig. 300: Relations of the sup. surface, base and neck of the bladder in the "female".
1-2-3-4-5-6-7-8 refer to different parts of the peritoneum

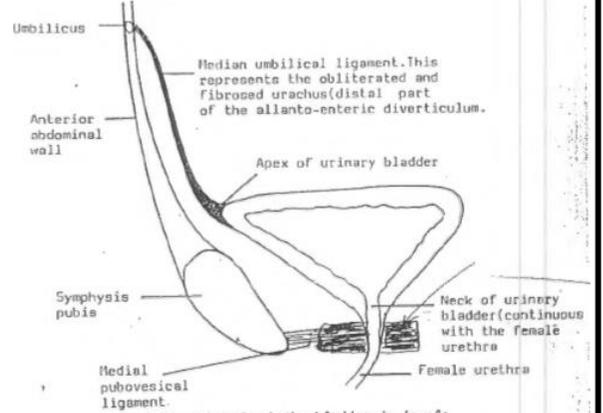
- neck of the bladder in males lies on the prostate as we said,
- but in females it lies on the pelvic fascia

- between the bladder and pelvic bone is a space called Retzius cave by surgeons (by anatomists it's called retro-pubic space)
- it was the area where we could reach the prostate in the past (old method)
- now we reach the prostate for benign cases through the urethra (new method)

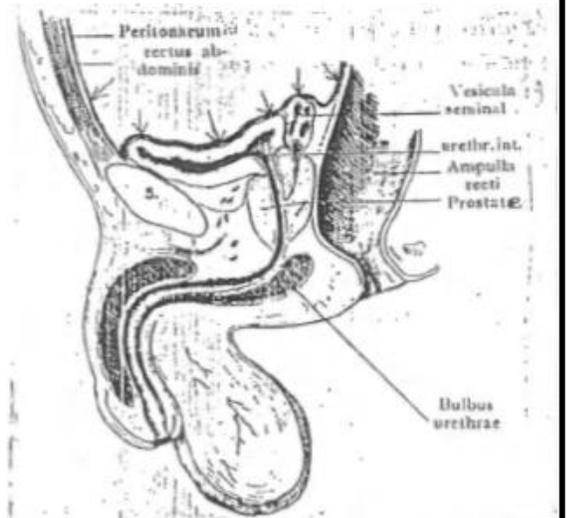
- the empty bladder is covered by peritoneum only from its superior part, when it comes distended it will push the peritoneum up and becomes behind the anterior abdominal wall with no peritoneum between,
- in this case we can insert a cannula without piercing the peritoneum if we couldn't place a catheter through the urethra (this approach is called suprapubic cystostomy)



Apex and neck of the bladder in male



Apex and neck of the bladder in female



303: The empty bladder lies below the "peritoneal floor" of the pelvis; Notice that the upper end of the seminal vesicle is "capped" with peritoneum.



Fig. 302: As the bladder fills it rises from the pelvic cavity and "peels off" the peritoneum upwards.

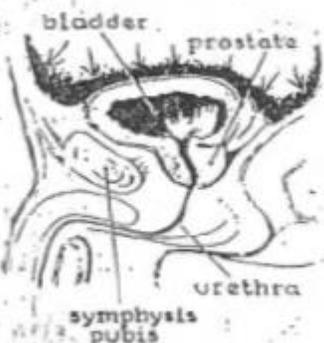


Fig. 301: The peritoneum covers the sup. surface of the bladder and the upper one cm of its base.



Bladder from the inside

- the inner part of the base is an area called the **trigon**
- the trigon has three openings, two of the ureters and one for the urethra
- in the beginning of the urethra we might see a prominence called uvula vesicae, which might close the internal urinary orifice, it emerges due to the prostate medial lobe enlargement as it may push the urethra inward to the bladder.
- if this uvula becomes enlarged it will gradually close the urethral opening
- the trigon is different from the rest of the bladder interior wall as it is the only part that is smooth, the rest has folds
- the trigon is smooth because the mucosa lies directly on the muscular layer beneath it and there's no connective tissue in between
- if we did a cystoscopy and the bladder was empty, the space between the ureter openings is 1 inch, if it was distended the space will be two inches
- by cystoscopy we can insert a cannula through the ureter, up to the kidney!

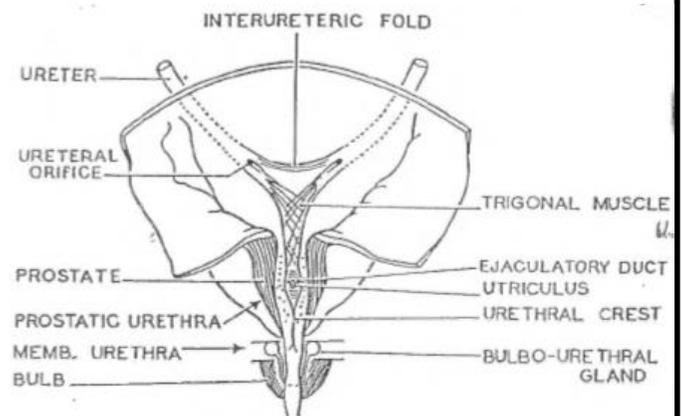
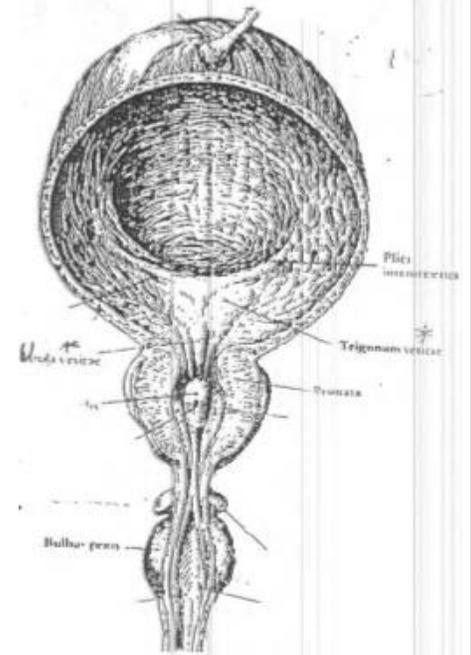


Figure 17.25. The trigone of the bladder and the prostatic urethra.

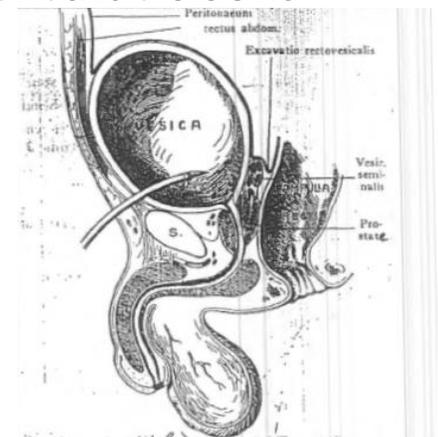


Fig. 304: As the bladder becomes full of urine, its ant. part comes in "direct" contact with the lower part of the ant. abdominal wall with no peritoneum in between.

Part of lecture 5, included in this sheet because it's related to it.

- the trigon is a sensitive area, if a stone reached it pain will be felt referred to the tip of the penis in males
- If you look at the urinary bladder from the inside, most of the mucus membrane is highly folded forming what we call rugosity, except for the area of the trigon
- The area of the trigon corresponds for the base of the bladder from the outside.
- Whether the bladder is empty or distended with urine, the trigon is smooth, unlike the rest of the bladder which has folds when empty while it becomes smooth when distended.
- The trigon is bounded by three openings, ureter, ureter and internal urethral orifice, the beginning of the urethra.
- The urethra enters the prostate and is then called prostatic urethra, then there is something called membranous urethra, then penile urethra
- Back to the trigon, the area of the trigon is very muscular and very sensitive, if a stone falls on it you will feel referred pain.
- At the apex of the trigon, opposite to the internal urethral orifice, behind this area is the medial lobe of the prostate, the prostate is composed of 5 lobes, when the medial lobe enlarges it causes a bulge called uvula vesici, when we hear the words uvula vesici, we immediately think of a bulge in the internal urethral orifice caused by enlargement of the median lobe.
- The bulge produces a pouch behind it, which contains residual urine, when the patient urinates not all the urine will be excreted, some residual urine will remain.

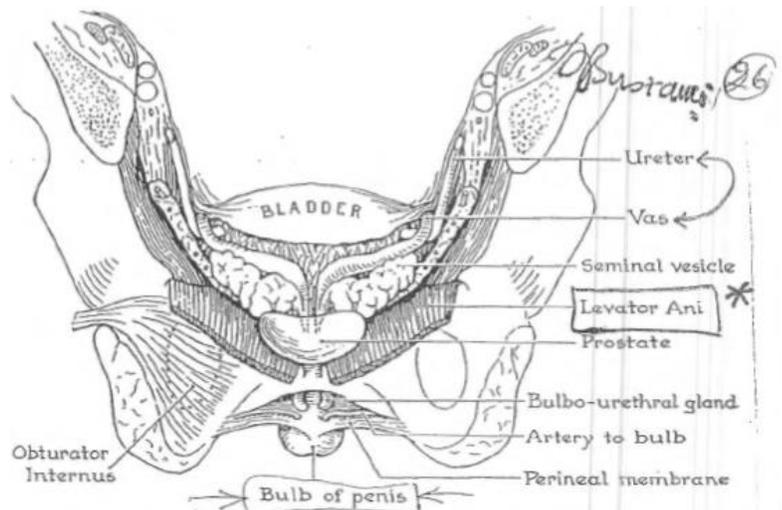


Figure 17.5. A coronal section of the pelvis to show the genitourinary organs from behind.

- The residual urine might cause an infection, which doesn't stay in the bladder, instead it will ascend through the ureters to the kidney, this is one of the reasons we fear enlargement of the prostate.

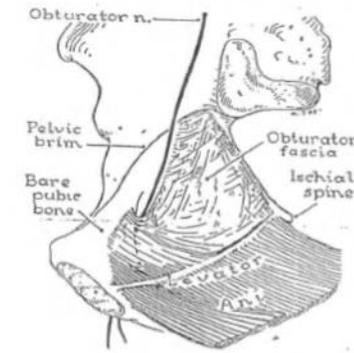


Figure 17.6. The side wall of the lesser pelvis divided into upper and lower (anterior and posterior) parts by the obturator nerve.

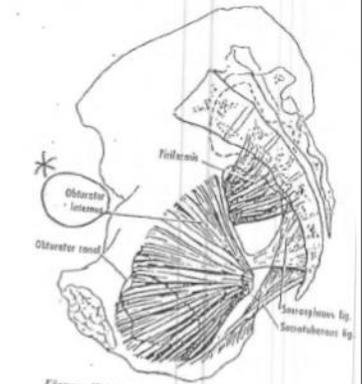


Figure 40-11. The muscles and ligaments of the lateral pelvic wall, pelvic aspect. (Based on Snell's Atlas.)

- The urinary bladder and the prostate are both pelvic organs, because they are above the levator ani.
- What's above the levator ani is the Pelvis. What's below the levator ani is the perineum. What separates the pelvis from the perineum is the pelvic diaphragm.
- what's the pelvic diaphragm? Levator ani on the right and the left.
- The first part of the urethra is inside the prostate, we call it the prostatic urethra, it's the widest and the most dilatable. The part that leaves the prostate is called the membranous urethra
- where does the membranous urethra pass? Through something called the urogenital diaphragm.
- where is the urogenital diaphragm located? Inferior to the anterior fibers of levator ani.
- how is it formed? It is formed by the membranous urethra surrounded by a muscle controlling the urination, we call this muscle sphincter urethri (external urethral muscle/sphincter), it's a voluntary muscle.
- Above the sphincter is a layer called the superior fascia of the urogenital diaphragm, below the sphincter is the inferior fascia of the urogenital diaphragm or the perineal membrane, the perineal membrane *بكون ماسك*
ال *بطرف ال* pubic arch



Done by: *Omar Saffar*

Le Fin.