

3rd
year



University of Jordan
Faculty of Medicine



Medical Committee
The University of Jordan

THE GENITOURINARY SYSTEM

Anatomy

2



Slides



Sheet



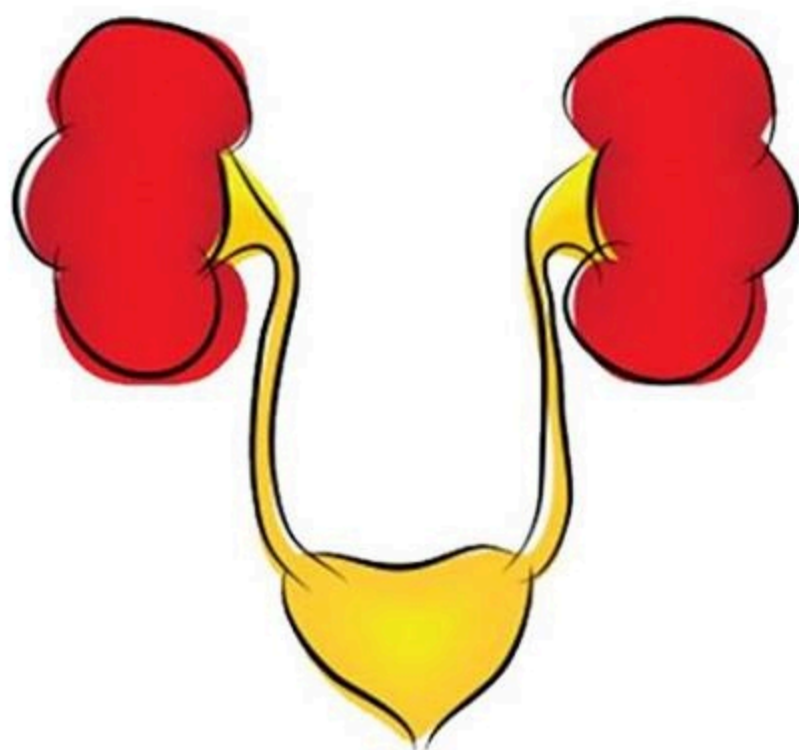
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Title: _____

Professor: Dr.Faraj Bustami

Date: 1/4/2015

Sheet written by:



Anatomy

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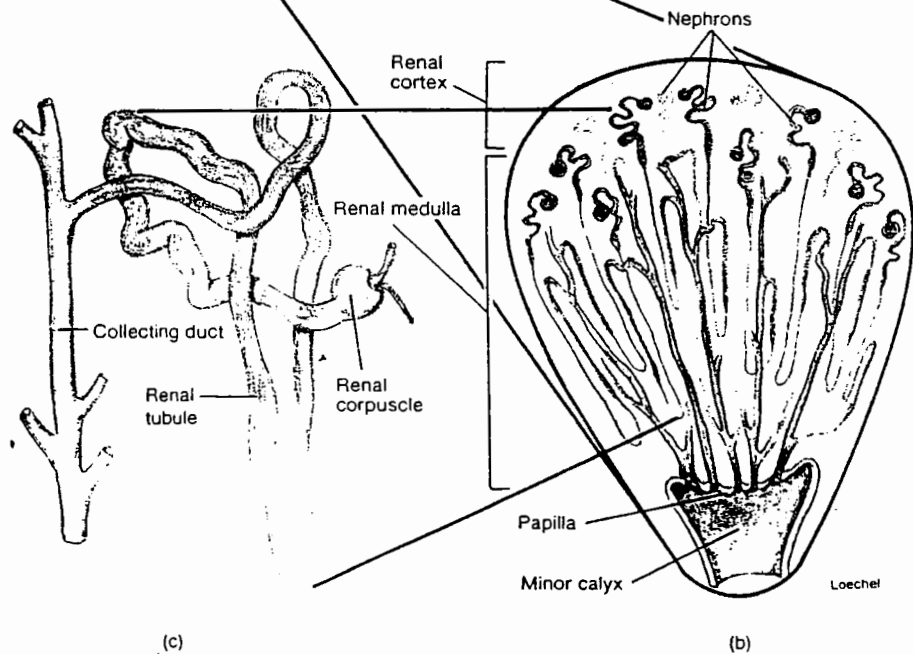
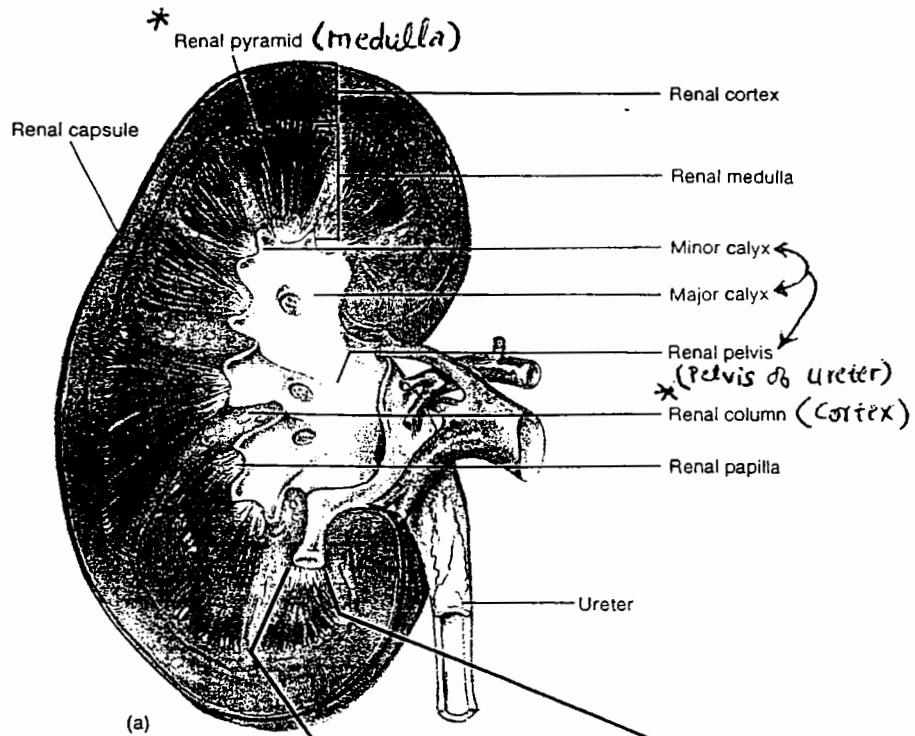
The Urinary System

Ofsustami

Figure 17.2

(a) A longitudinal section of a kidney; (b) a renal pyramid containing nephrons; (c) a single nephron.

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لطب السنة الثالثة طب بشري الجامعة الاردنية
الفصل الثاني 2009

KIDNEYS

(1.)

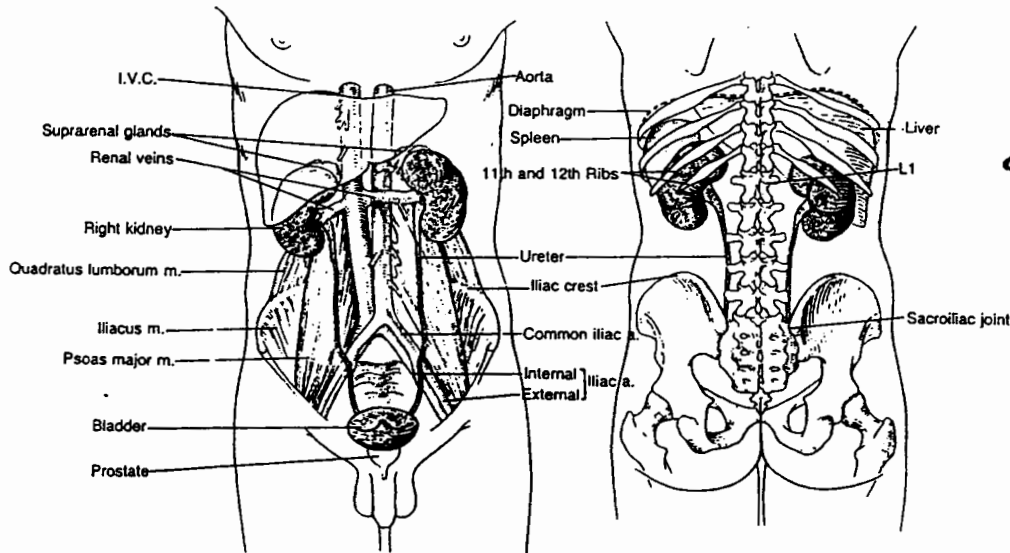


FIGURE 17-2. An anterior and posterior view showing relationship of urinary system to structures of the posterior abdominal wall.

Kidneys are situated on the Posterior abdominal wall one on each side of the vertebral column (the kidney lies opposite the 12th thoracic & upper 3 lumbar vertebrae)

The left kidney is slightly higher than the right kidney (because the liver is on the right side) → the left kidney reaches up to the 11th rib while the right kidney reaches only to the 11th space

on the average the kidney weighs 150 g. , it is 11 cm long , 6 cm broad & 3 cm thick.

The long axis of the kidney is directed downwards & laterally so that the upper poles are nearer to the median plane

In the fetus the kidney is lobulated & is made up of about 12 lobules → After birth the lobules gradually fuse so that in the adults the kidney is uniformly smooth. However evidence of foetal lobulation may persist.

External Features

The kidneys are reddish brown in colour. Each kidney has following features.

A. Two poles. (1) Upper pole is broad because it is compressed by the suprarenal gland; and (2) the lower pole is pointed.

B. Two borders. (1) Lateral border is convex; and (2) the medial border is concave, with hilus in the middle.

C. Two surfaces. (1) Anterior surface is irregular; and (2) posterior surface is flat. However, the anterior and posterior aspects of the kidney are identified by the arrangement of structures in the hilus. From before backwards these are the renal vein, renal artery and the renal pelvis.
(pelvis of ureter)

10 * { Transpyloric plane passes through the upper part of the hilus of right kidney, and through the lower part of the hilus of the left.

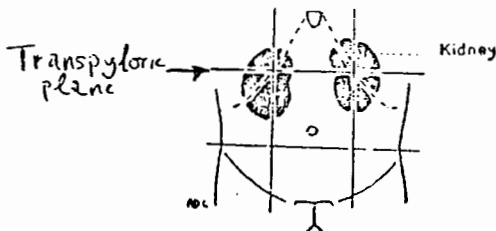
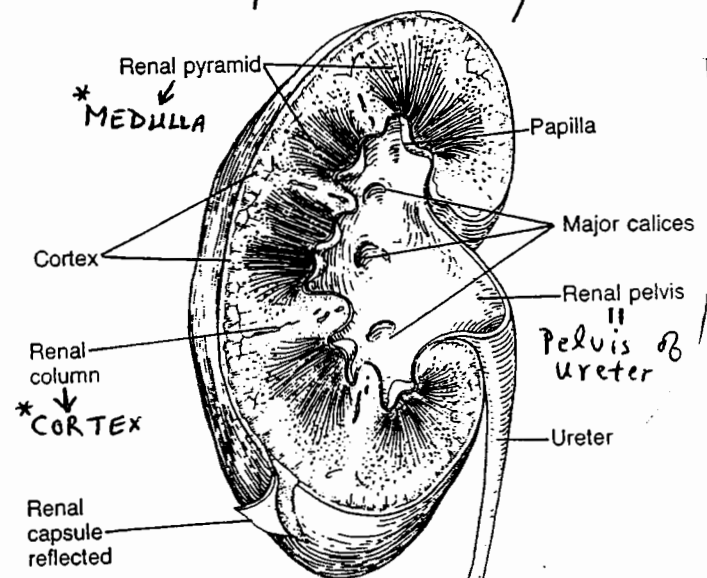
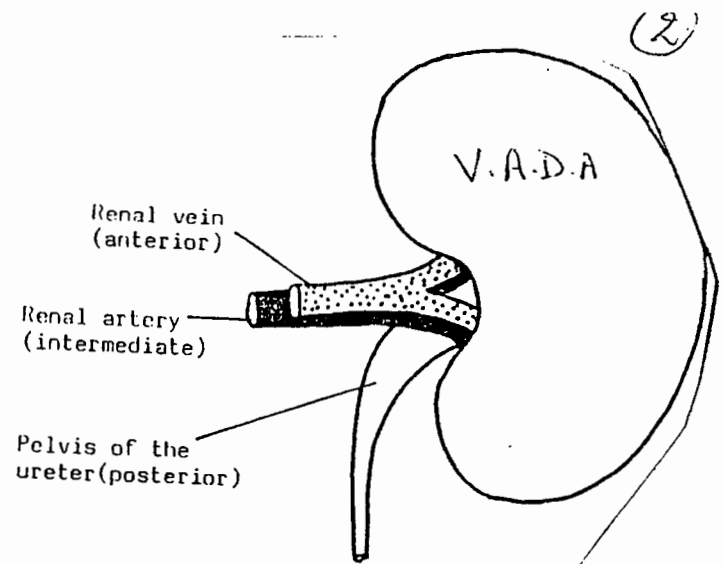


Fig. 271 Location of the kidneys.

Hilus leads into the renal sinus within the kidney. It contains: (a) branches of the renal artery; (b) tributaries of the renal vein; and (c) the renal Pelvis which divides above into 2-3 major calices, and these in their turn divide into 7-13 minor calices. Each minor calyx (G. kalyx = cup of a flower) ends into an expansion which is indented by 1-3 renal papillae, and is perforated by the collecting tubules which open on the summit of the renal papillae. The renal papillae are nipple-like projections from the wall of the renal sinus, and represent the apices of the renal pyramids.



Internal to the renal capsule, which is readily stripped off, the cortex of the kidney forms a complete peripheral layer and extends, in places, medially to reach the renal sinus. These extensions of cortex, the renal columns, are separated from one another by the renal pyramids, which constitute the medulla. Each pyramid has its base placed against the cortical layer and its apex projecting into the sinus as a renal papilla (Fig. 17-5).

On the average, each kidney contains ten renal pyramids, one or more of which empties into one of nine minor calices. The minor calices unite to form two or occasionally three major calices, the confluence of which forms the renal pelvis, or the superior dilated portion of the ureter. The medulla has a more striated appearance than the cortex and is deeper red in color. The cortex is granular and has a pale red color. This granular appearance is due to an immense number of kidney corpuscles.

The pelvis of the ureter is subject to considerable anatomical variations (Fig. 82); it may lie completely outside the substance of the kidney (even to the extent of having part of the major calyces extra-renal) or may be almost buried in the renal hilum. All gradations exist between these extremes. If a calculus is lodged in the pelvis of the ureter, its removal is comparatively simple when this is extra-renal and correspondingly difficult when the pelvis is hidden within the substance of the kidney.

Within the kidney, the pelvis of the ureter divides into two or three *major calyces* each of which divides into a number of *minor calyces*. Each of these, in turn, is indented by a papilla of renal tissue and it is here that the collecting tubules of the kidney discharge urine into the ureter.

(3)

(Stone)

Obstruction

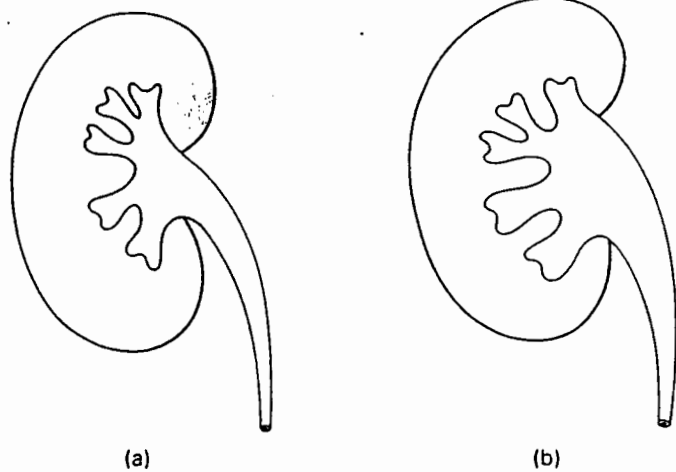


Fig. 82. Variations in the renal pelvis.
(a) The pelvis is buried within the renal parenchyma — pyelolithotomy difficult.
(b) The pelvis protrudes generously — pyelolithotomy easy.

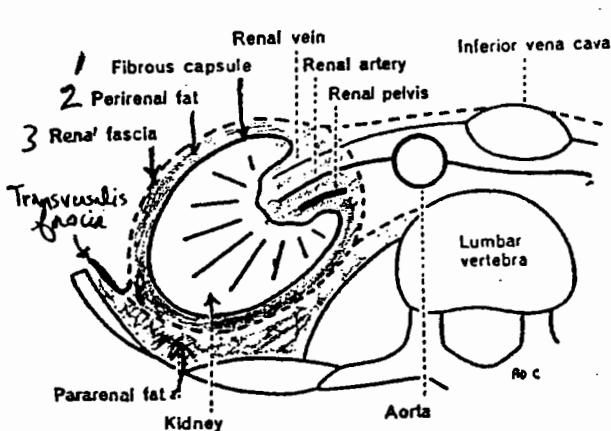


Fig. 273 Transverse section through the lumbar region showing the capsules of kidney.

The Kidney has the following coverings :

- ① fibrous capsule → Stripes readily from the normal Kidney surface but adheres firmly to a Kidney that has been inflamed
- ② perirenal fat → covers the fibrous capsule
- ③ Renal fascia → condensation of connective tissue outside the perirenal fat

Above → blends with fascia over diaphragm leaving a separate compartment for the suprarenal gland !!

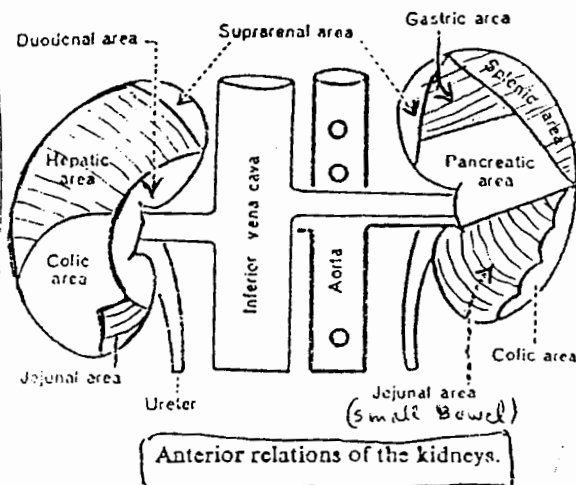
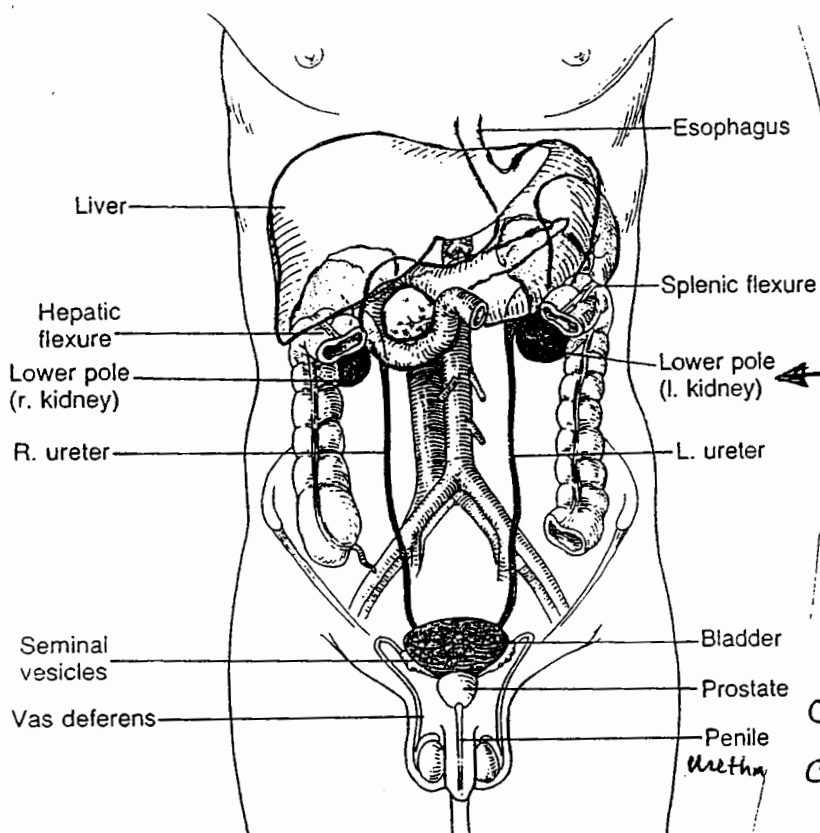
Medially → the fascia blends with the sheaths of aorta & ivc

Externally, it is continuous with transversalis fascia

inferiorly → Remains relatively open around ureter !!!

④ pararenal fat → forms part of retroperitoneal fat

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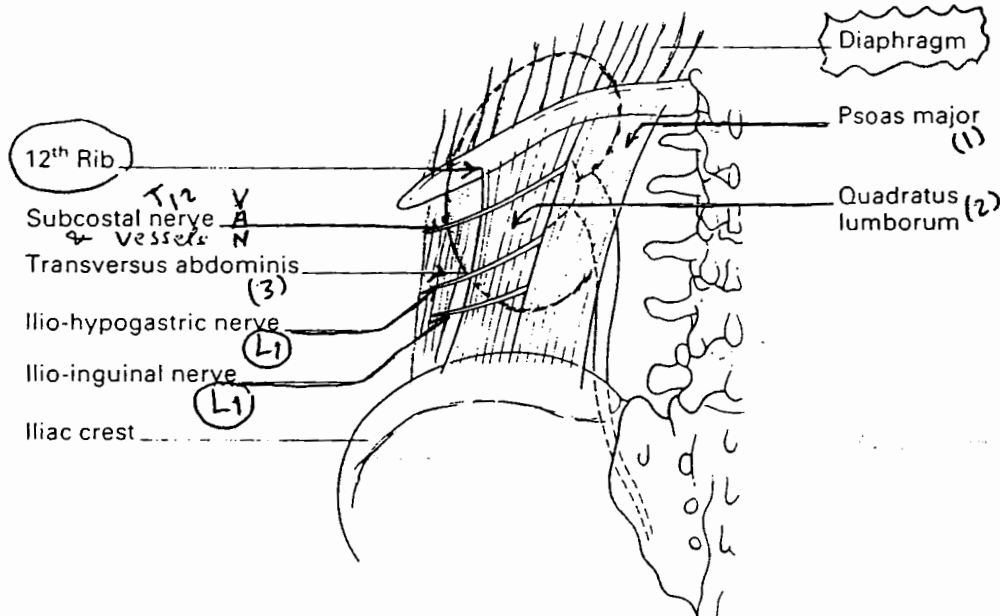


Kidneys are Retroperitoneal organs and are only PARTLY covered by peritoneum anteriorly

A. Anterior surface. Right kidney is related

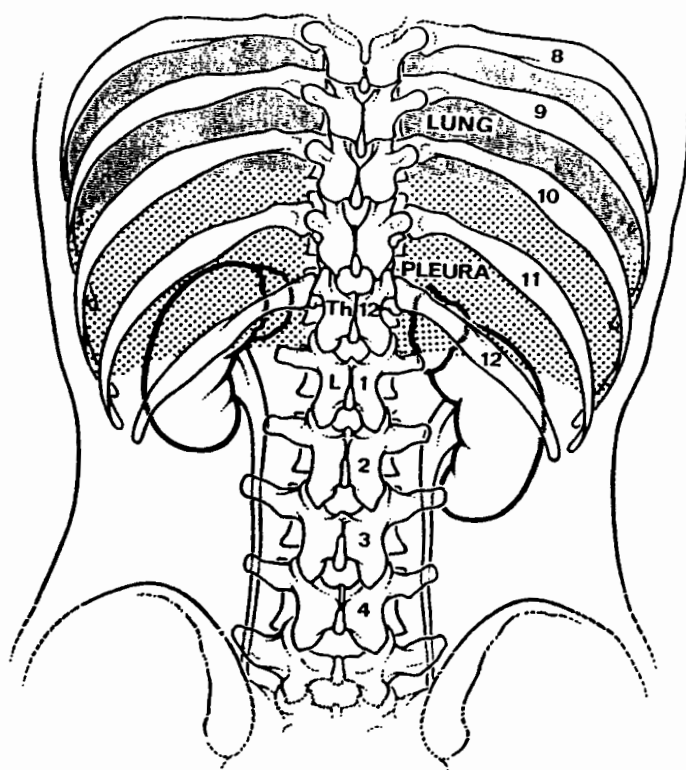
anteriorly to: (1) right suprarenal gland; (2) liver; (3) second part of duodenum; (4) hepatic flexure of colon; and (5) small intestine. Out of these the hepatic and intestinal surfaces are covered by peritoneum. The left kidney is related to: (1) left suprarenal gland; (2) spleen; (3) stomach; (4) pancreas; (5) splenic vessels; (6) splenic flexure and descending colon; and (7) jejunum. Out of these the gastric, splenic and jejunal surfaces are covered by peritoneum.

- Between Liver & Kidney is part of the Peritoneal cavity called - - - - -
- Between Stomach & Kidney is - - - - -
- Both Lt. Kidney & spleen lie posterior to the stomach & forms part of the "Stomach bed" what separates stomach & spleen ???



Posterior Relations of the Kidney

- Diaphragm & medial & lateral arcuate ligaments
- Quadratus lumborum (Trans. abdominis)
- Psoas major (small part)
- Subcostal vessels
- Nerves: subcostal, iliohypogastric, ilioinguinal
- Ribs(s)
 - Rt. Kidney is related to the 12th Rib
 - Lt. Kidney is related to 11th & 12th Ribs



Comment on the this diagram

What is the most important Posterior relation of the Kidneys?

The kidney is often approached surgically from behind, and it is important not to enter the pleural cavity.

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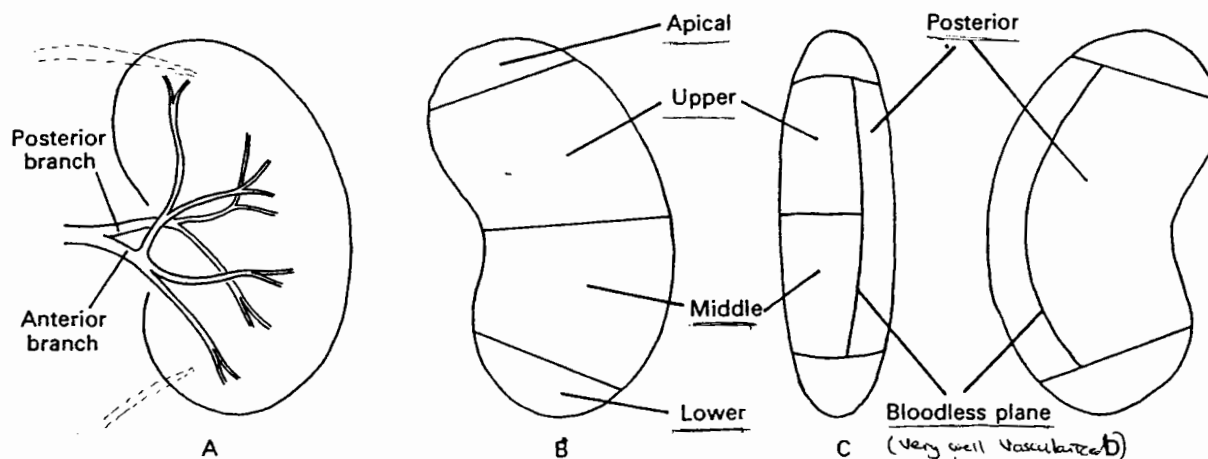


Fig. 5.49 Arterial segments of the left kidney. A shows branches of the renal artery; B, C and D indicate the segments as seen from the front, the lateral side and the back respectively. The posterior division of the artery supplies the posterior segment and the anterior division supplies the other four. There may be variations in the pattern of division but the segments are constant.

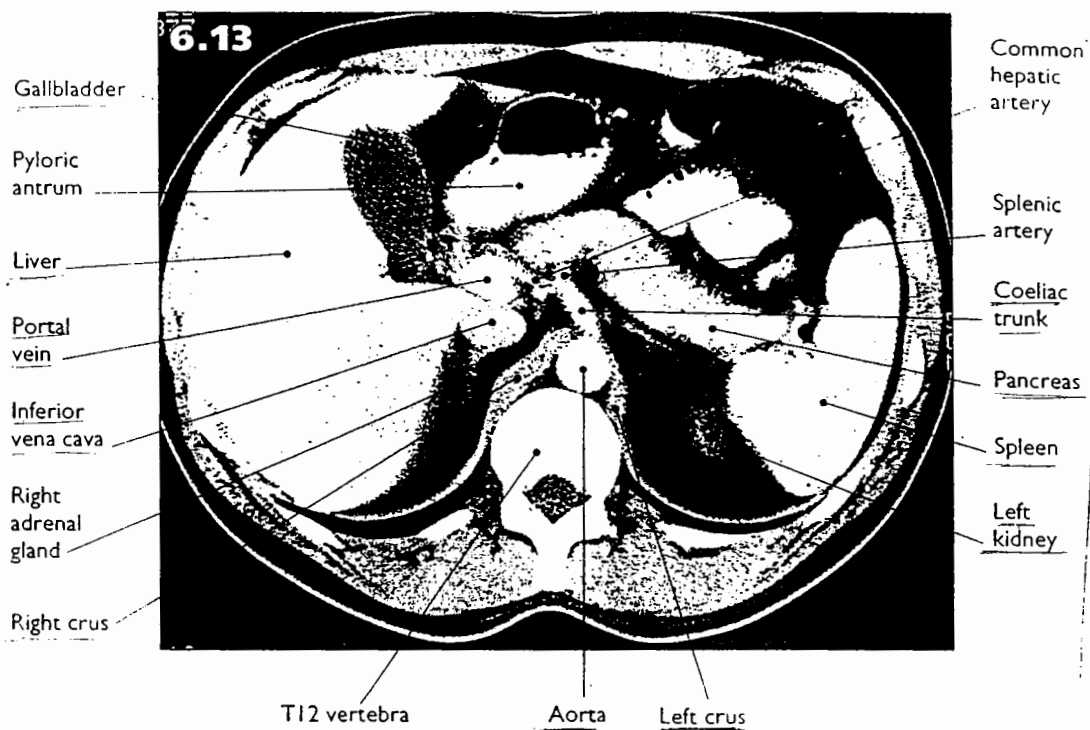
Blood supply and segments

The wide-bored renal arteries (p. 363) have a blood flow in excess of 1 litre per minute. They leave the abdominal aorta at right angles and lie behind the pancreas and renal veins.

Based on its blood supply, each kidney possesses five segments. In the region of the hilum the artery typically gives rise to an anterior and a posterior division (Fig. 5.49A). The posterior division supplies the posterior segment, while the anterior division gives branches that supply the apical, upper, middle and lower segments

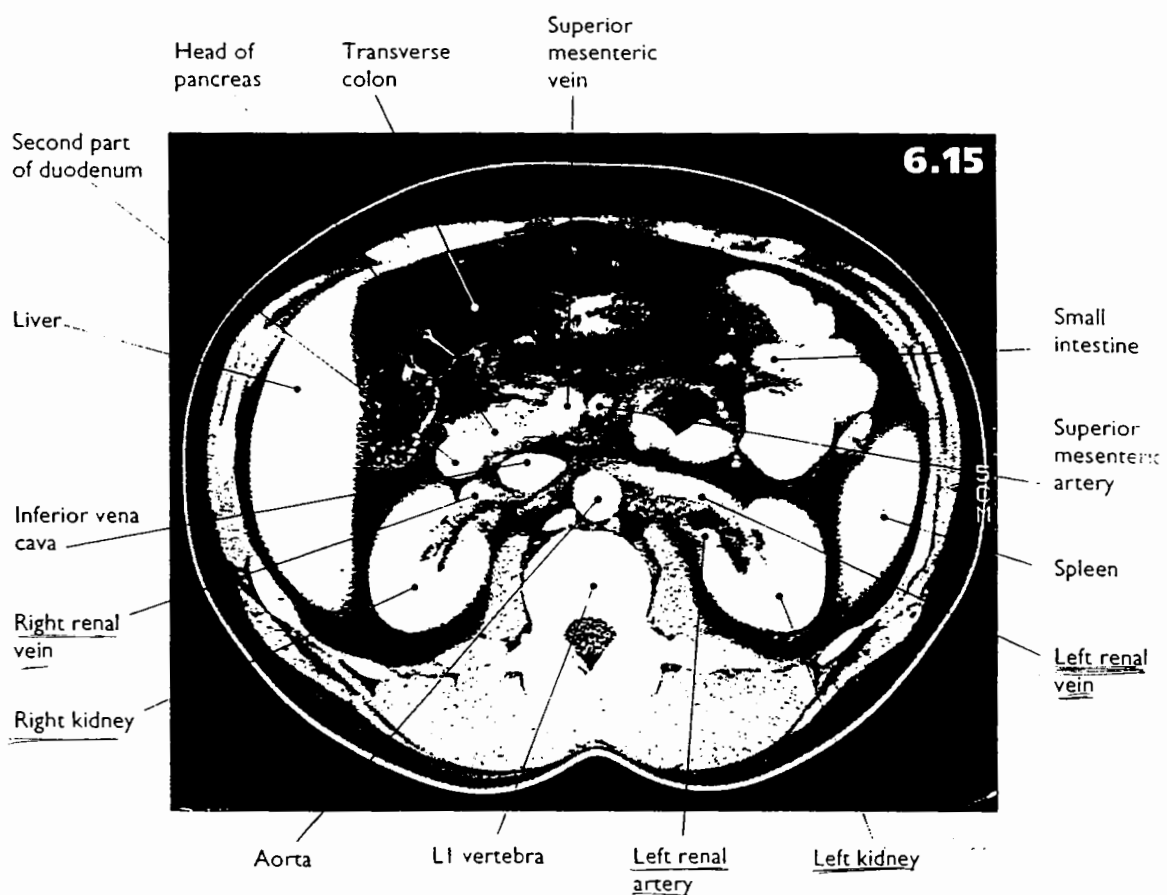
Remember → there are always 5 renal segments with NO collateral circulation between them i.e. Segmental arteries are END-ARTERIES

What is an aberrant (accessory) renal artery??



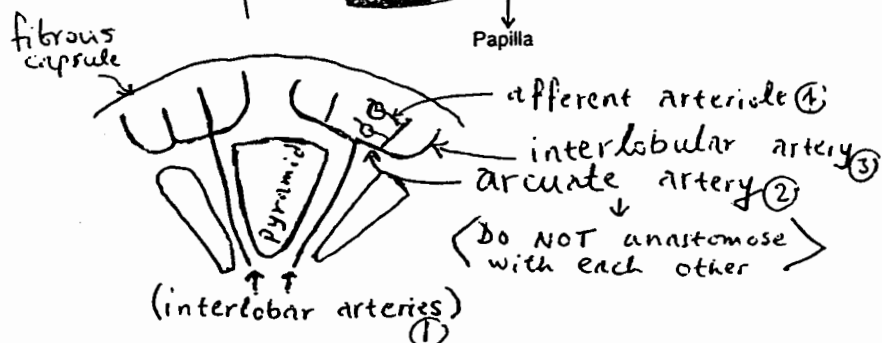
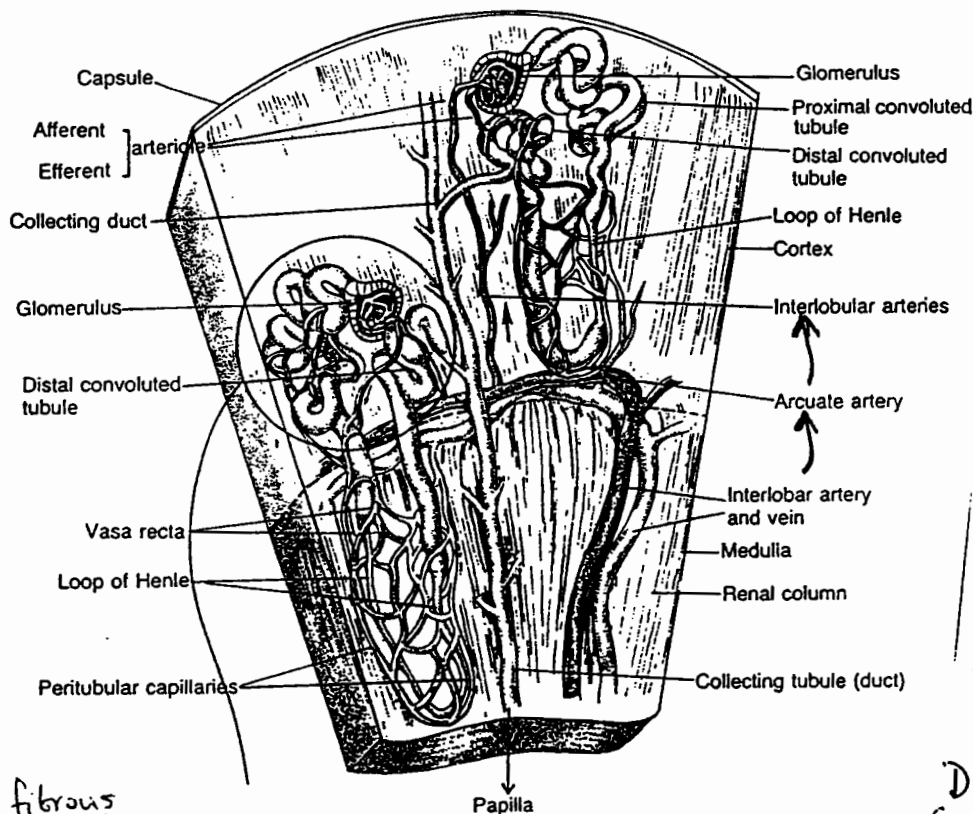
6.13. Axial computed tomograph of the upper abdomen at the level of the T12 vertebra, from below

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6.15. Axial computed tomograph of the upper abdomen at the level of the L1 vertebra, from below

Renal artery \rightarrow anterior & posterior divisions (7)
 \rightarrow 5 segmental arteries \Rightarrow Each segmental artery divides into LOBAR arteries (usually one for each pyramid) \Rightarrow Each lobar artery divides into 2-3 INTERLOBAR arteries (which run on each side of the pyramid) \Rightarrow At the corticomedullary junction the interlobar arteries divide dichotomously into ARCUATE arteries which arch over the bases of the pyramids \Rightarrow The arcuate arteries give off INTERLOBULAR arteries which run radially into the cortex giving off AFFERENT GLOMERULAR ARTERIOLES
 \rightarrow the EFFERENT GLOMERULAR ARTERIOLES divides soon to form Peritubular capillary plexus around the proximal & distal convoluted tubules of Stratum



Effluent arteriole of juxta medullary glomeruli
 \downarrow
 enters a pyramid & divides into 12-24 Vasa recta
 \downarrow
 breaks up to form capillary plexus around loops of Henle & collecting ducts
 \downarrow
 At the venous end the c-plexus gives rise to ascending vasa recta

\downarrow
 Descending vasa recta (arterioles) (+) ascending vasa recta (venules)
 form the basis of counter-current exchange & multiplier system

Ureters

Definition

Ureters are a pair of narrow, thick-walled muscular tubes which convey urine from the kidneys to the urinary bladder.

Position

(Retroperitoneal ←)
They lie beneath the peritoneum, closely applied to the posterior abdominal wall in upper part, and to the lateral pelvic wall in the lower part.

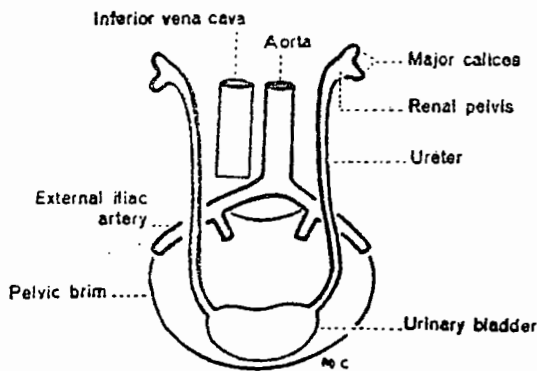


Fig. 279 The location of ureters on the posterior abdominal and lateral pelvic walls.

Dimensions

Each ureter is about 25 cm (10 in.) long, of which the upper half (5 in.) lies in abdomen, and the lower half (5 in.) in pelvis. It measures about 3 mm in diameter, but it is slightly constricted at three places (vide infra).

↓
The Ureter begins in the sinus of the kidney as a dilated part called the pelvis of ureter (formed by union of 2-3 major calyces into which open several minor calyces (10-12) that surround the renal papillae → (apices of the renal pyramids) ←

↓
The pelvis of ureter runs downwards along the medial border of the kidney to become the ureter proper at the lower end of the kidney

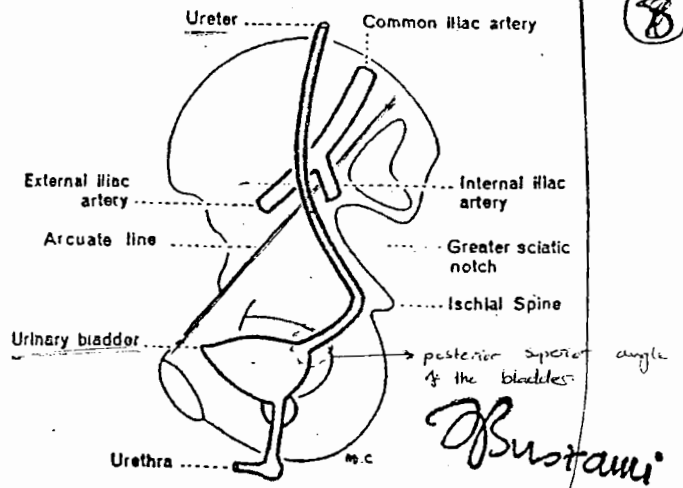


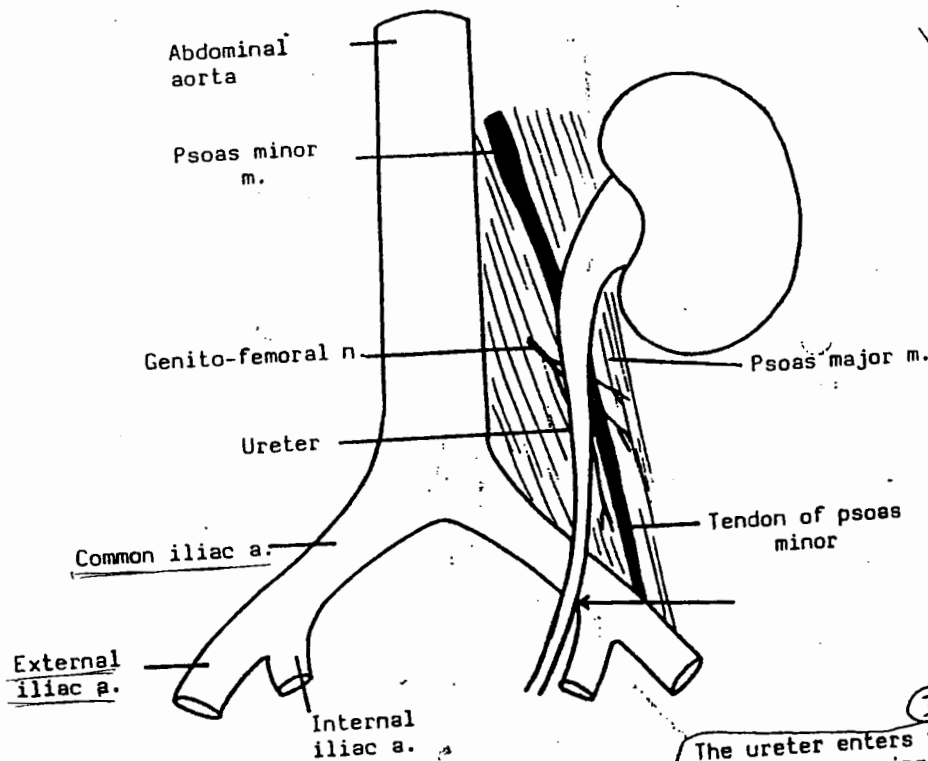
Fig. 280 General course of ureter in the pelvis.

↓
The Ureter descends with an inclination medially on the posterior abdominal wall BEHIND the peritoneum Opposite the tips of the lumbar transverse processes → It CROSSES the end of the Common iliac artery to enter the pelvis

↓
In the pelvis → It passes downwards & backward following the anterior margin of the greater sciatic notch → opposite the ischial spine it turns forwards & medially to reach the base of the urinary bladder → It passes obliquely in the wall of the bladder for 1 inch before it opens at the side of the trigone (Intramural part)

Normal Constrictions

Ureter is slightly constricted at three places: (1) at the pelvi-ureteral junction; (2) at the brim of the lesser pelvis; and (3) at its passage through the bladder wall.

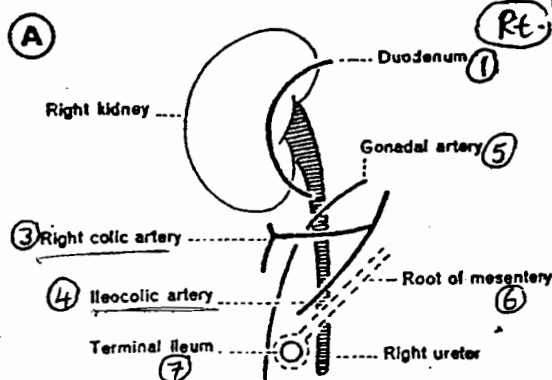


Posteriorly the Ureter lies on

- ① Psoas major muscle which separates the Ureter from the lumbar transverse processes
- ② genito femoral nerve (L1,2)

The ureter enters the pelvis by crossing the end of the common iliac or beginning of external iliac artery.

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Anterior relations of the Ureter
Rt. Ureter → Duodenum above (2nd part) Ileum below (& root of mesentery) and vessels inbetween (colic vessels & gonadal vessels)
Lt. Ureter → vessels (colic & gonadal) pelvic colon and its mesocolon (sigmoid colon)

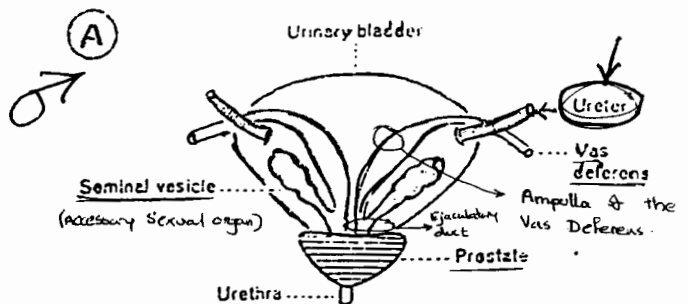
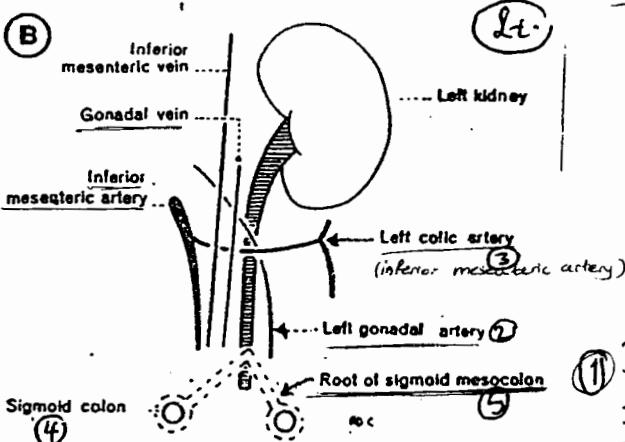
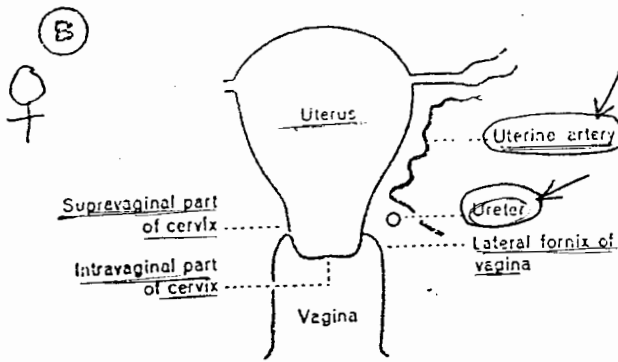


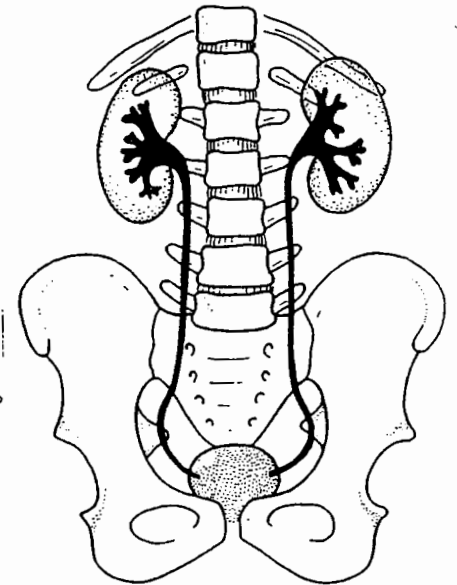
Fig. 281 Anterior relations of the abdominal part of ureters. (A) Right ureter; and (B) left ureter.

- ① Ductus deferens crosses the Ureter superiorly from the lateral to the medial side
- ② Seminal vesicle lies below & behind the Ureter



- ① Ureter lies about 2 cm lateral to the supravaginal part of cervix !!!
- ② Ureter runs slightly above the lateral fornix of vagina
- ③ Uterine artery lies first above and anterior to the ureter for a distance of 2.5 cm, then crosses it superiorly from lateral to medial side

4 In searching for a ureteric stone on a plain radiograph of the abdomen, one must imagine the course of the ureter in relation to the bony skeleton (Fig. 84). It lies along the tips of the transverse processes, crosses in front of the sacro-iliac joint, swings out to the ischial spine and then passes medially to the bladder. An opaque shadow along this line is suspicious of calculus. This course of the ureter is readily studied by examining a radiograph showing a radio-opaque ureteric catheter in situ.



I.V.P (U) Fig. 84. Drawing from an intravenous pyelogram to show the relationship of the ureters to the bony landmarks.

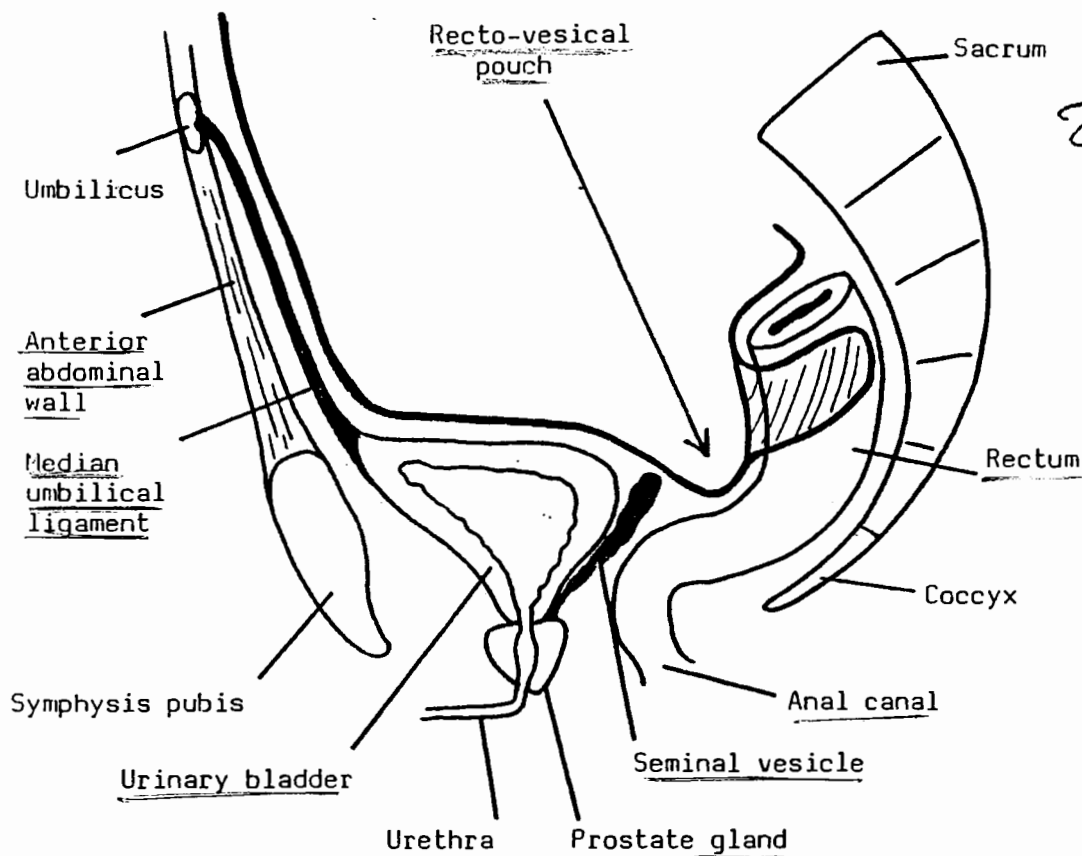
Blood supply of ureter - ① its upper part from Renal artery ② its middle part from aorta ③ its pelvic part from vesical & uterine vessels (internal iliac a.) → These blood vessels form a plexus on the surface of Ureter.

Nerve supply Ureter is supplied by sympathetic (T₁₀-L₁) & pain from the ureter is referred to dermatomes supplied by these segments

→ Pain referred from the kidney and extreme upper end of the ureter is normally felt on the back near the costovertebral angle. Pain from the middle and distal parts of the ureter usually is referred to the lower quadrant of the abdominal wall, genital areas, or even the inner aspect of the thigh.

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ARRANGEMENT OF THE PELVIC VISCERA IN MALE

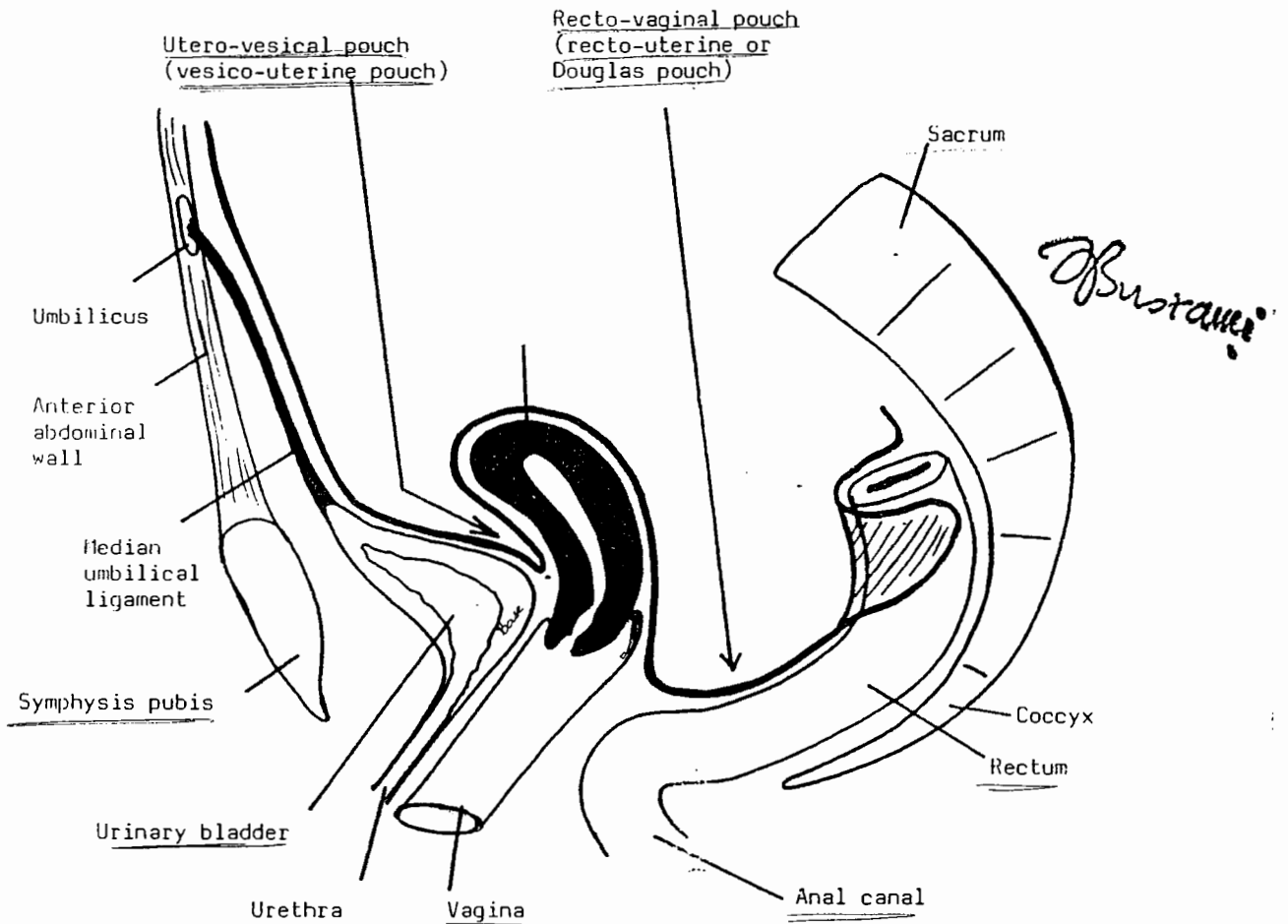


Sagittal section in the male pelvis

- Remember that the upper third of the rectum is covered by peritoneum on the front and sides; while the middle is covered by peritoneum only in front. The lower third of the rectum has no peritoneal covering.
- Reflection of peritoneum occurs from the front of the rectum at the junction of its middle and lower thirds on to the upper part of the base of urinary bladder, forming the rectovesical pouch.
- Remember that the urinary bladder in male is covered by peritoneum on its superior surface and upper part of its posterior surface (base of the bladder).
- Only the tip or upper end of the seminal vesicle is covered by peritoneum.
- The prostate gland and anal canal have no peritoneal covering.

ARRANGEMENT OF THE PELVIC VISCERA IN FEMALE

(12)



Sagittal section in the female pelvis

- The rectum has similar peritoneal coverings as in male.
- Reflection of peritoneum occurs from the front of the rectum at the junction of its middle and lower thirds on to the upper part of the posterior wall of vagina, forming the rectovaginal pouch (Douglas pouch).
- The peritoneum covers the back of the cervix, body and fundus of the uterus. Then, the peritoneum covers the front of the fundus and body only. Reflection of peritoneum occurs from the front of the uterus at the junction of the body and cervix onto the superior surface of the urinary bladder, forming the utero-vesical (vesico-uterine) pouch.
- In female, the urinary bladder is covered by peritoneum only on its superior surface.
- The upper fourth of the posterior wall of vagina is covered by peritoneum of the rectovaginal or Douglas pouch.
- The anal canal has no peritoneal covering.

• The bony pelvis (=Basin)
General

(A) Construction:

- * The pelvis consists of the 2 (right & left) **hip bones**, the **sacrum** and the **coccyx**... bound together by **de** and strong (**ligaments**).
- * **Behind**: each hip bone articulates with the **upper 3 pieces of the sacrum** at the **sacroiliac joints** while **in front**: the 2 hip bones articulate with each other at the **symphysis pubis**.

(B) Position:

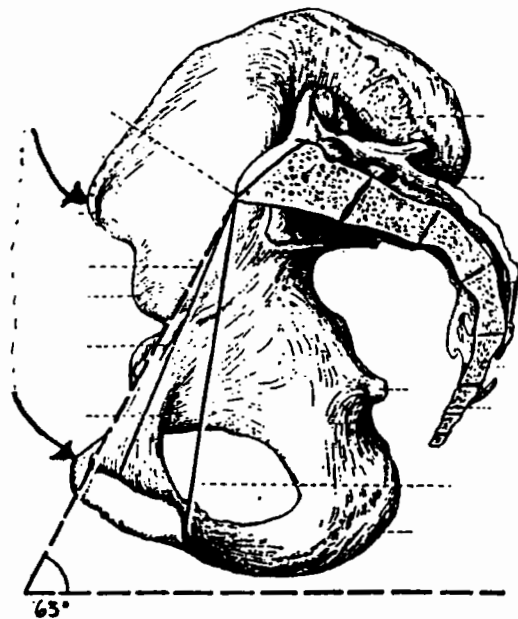
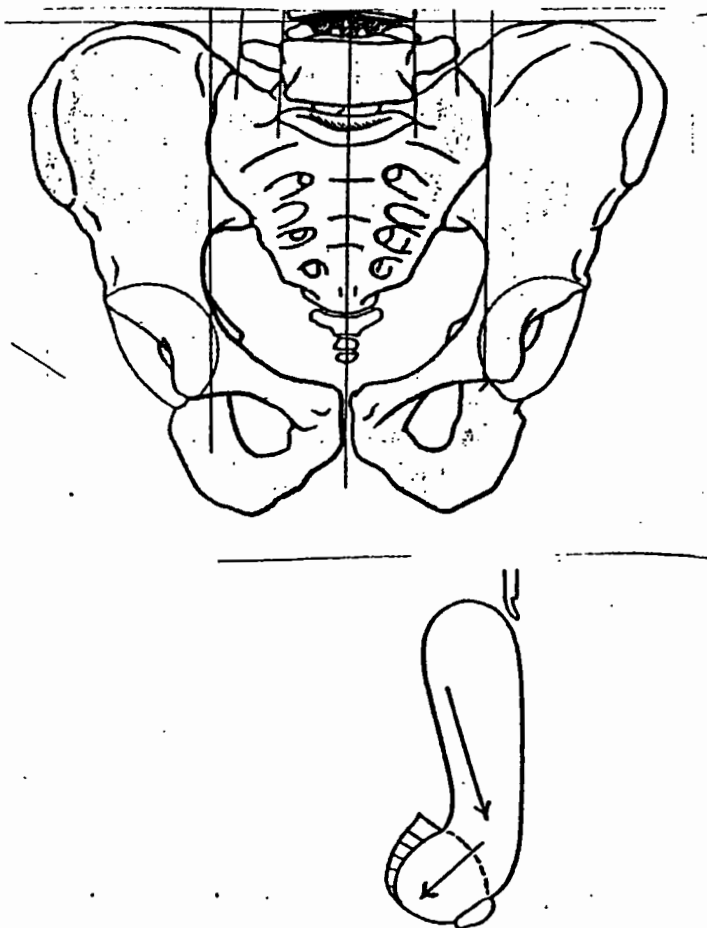
- * In the living body: the **pelvis is tilted forwards** in such a way that: (a) the **ant. sup. iliac spines**... (b) the **upper border of the symphysis pubis** lie on the **same coronal plane**.
- * To place the pelvis in this position, hold it against a wall in such a way that the ant. sup. iliac spines and the top of symphysis pubis touch the wall.
- * In the living body: the **plane of the inlet of the pelvis makes an angle of about 60 degrees with the horizon** plane drawn through the pubic crests and so the **posterior surfaces of the bodies of the pubic bones look more «upwards than backwards»**; this position helps the pubic bones to **sustain the downwards pressure of abdominal viscera**.

(C) The "inlet" of the pelvis:

and the division of the pelvic cavity into "true" pelvis and "false" pelvis:

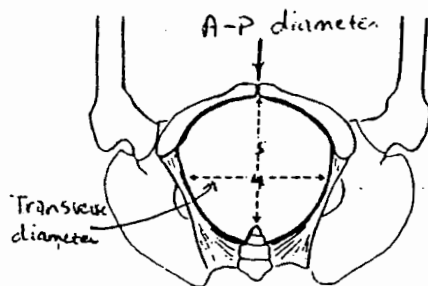
- * The "inlet" of the pelvis (**pelvic brim**) is the boundary line which divides the pelvic cavity into "false" pelvis (above the pelvic inlet) and a "true" pelvis (below it); in the same time it is considered boundary line between the "abdominal" and "pelvic" cavities.

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—: The pelvic cavity is almost set at a right angle to the abdominal cavity.

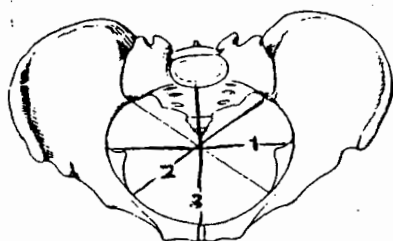
(14)



: Measurement of the pelvic "outlet".

At outlet → the antero-posterior diameter (A-P) is (5 inches) greater than the transverse diameter (4 inches)

Of Brim



: Pelvis; seen from above

- 1 = Transverse diameter (widest part of the brim)
 2 = oblique diameter (from the sacro-iliac joint to the ilio-pubic eminence)
 3 = A-P (antero-posterior) diameter from the sacral promontory to the top of the symphysis pubis

(E) The «outlet» of the pelvis:

- * The antero-posterior diameter of the outlet (5 inches) is greater than the transverse diameter (4 inches).

(F) Measurements of the «inlet», «mid-cavity» and «outlet» of the true pelvis:

These measurements can be easily remembered as follows (in inches):

	Antero-posterior	Oblique	Transverse
Inlet	4	4 1/2	5
Mid-pelvis	4 1/2	4 1/2	4 1/2
Outlet	5	4 1/2	4

Diameters of the «inlet»:

- The A-P diameter is measured from the sacral promontory to the top of the symphysis pubis.
- The oblique diameter is measured from the sacro-iliac joint to the ilio-pectineal (ilio-pubic) eminence of the opposite side.
- The transverse diameter is measured at the widest part of the brim of the pelvis (which is behind the centre).

Diameters of the «outlet»:

- The A-P diameter is measured from the lower end of the symphysis pubis to the tip of the coccyx.
 * N.B. The length of this diameter depends mainly on the degree of mobility of the sacro-coccygeal joint.
- The transverse diameter is taken behind the ischial tuberosities.

* The boundaries of the "inlet" of the pelvis are:

- (a) The promontory and the ant. border of the ala of the sacrum behind.
- (b) The arcuate or ilio-pectineal line (which extends from the ala of the sacrum to the pubic tubercle) on each side and
- (c) The pubic crest and the top of the symphysis pubis ... in front.

The post. $\frac{1}{2}$ of the ilio-pectineal line is formed by the ilium, the ant. $\frac{1}{2}$ is formed by the pubis; a rough elevation called the ilio-pectineal (= ilio-pubic) eminence marks the site of the union of the ant. and post. parts.

* The transverse diameter of the pelvic inlet (which is 5 inches) is greater than its antero-posterior diameter (which is 4 inches).

* The false pelvis (pelvis "major" or greater pelvis) is formed of: the ala of the sacrum and the iliac fossae on either side.

* The true pelvis (pelvis "minor" or lesser pelvis) is formed by:

The pelvic surfaces of the sacrum and coccyx behind.

The inner surface of the pubis, ischium and a small part of the ilium... in front & at the side.

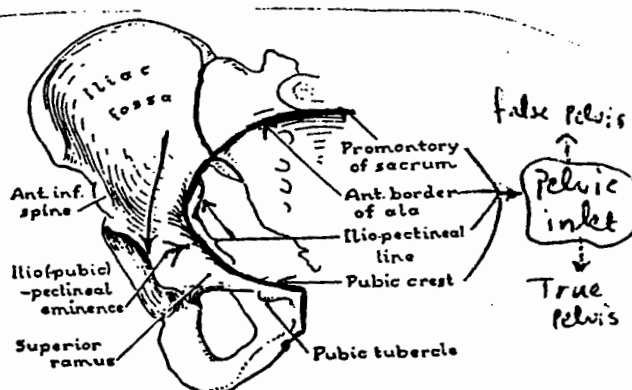
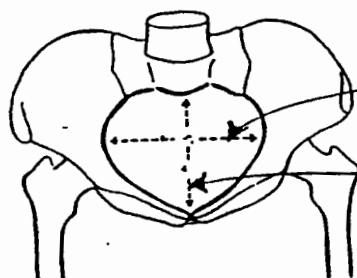


Fig. 364 The pelvis major (false pelvis) and the pelvic brim.



At the pelvic INLET → the transverse diameter (5 inches) is greater than the A-P (antero-posterior) diameter (4 inches)

Fig. 368: Measurement of the pelvic "inlet".

(D) The pelvic «cavity»:

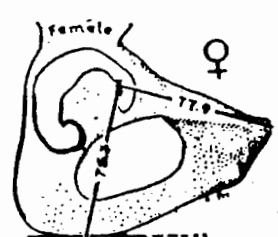
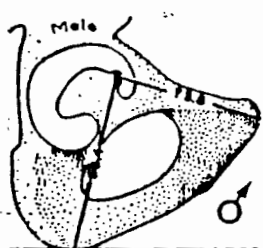
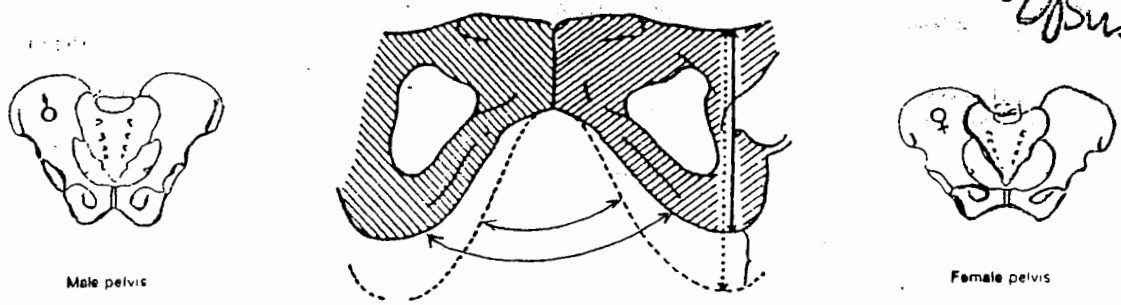
- * The cavity of the pelvis is a curved canal with a shallow anterior wall and a much deeper posterior wall.
- * The curvature of the pelvic cavity depends on the curvature of the sacrum (which differs in males and females).

The typical male sacrum shows a gradual curve which affects all its 5 segments to the same degree.

The typical female sacrum looks as if it has been bent sharply at the level of the 3rd sacral segment and is flat both above and below this bend.

There are 4 most important features to look for in trying to know the sex of a pelvis:

1. The degree of the subpubic angle.
2. The "size" of the acetabulum and the "distance" from the acetabulum to the symphysis pubis.
3. The relative size of the oval articular surface on the base of the sacrum to the size of the ala of sacrum. ($\frac{1}{4} - \frac{1}{2} - \frac{1}{4}$ in male and $\frac{1}{3} - \frac{1}{3} - \frac{1}{3}$ in female)
4. The "size" and the "angle" of the greater sciatic notch.



c. Hip joint	<p>♂ * Acetabulum is relatively large</p> <p>width of acetabulum is equal to the distance from its ant. margin to symphysis pubis.</p>	<p>♀ * Acetabulum is relatively small</p> <p>width of acetabulum is less than the distance from its ant. margin to symphysis pubis.</p>
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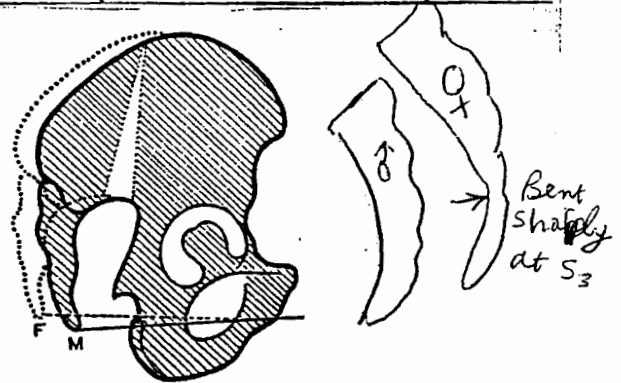
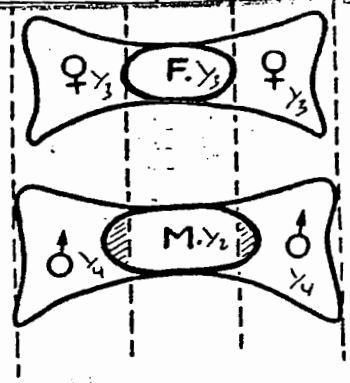


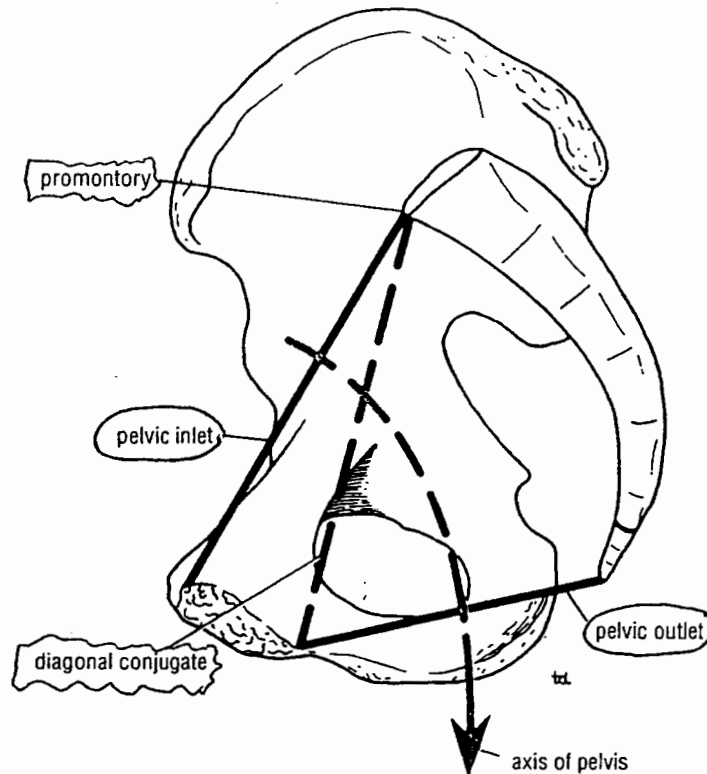
Fig. 386: Difference between base of sacrum in male and female.

- * Articular surface on base of sacrum is relatively small
- * Alae of sacrum are relatively long.

♀	ala	articular surface	ala
♀	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$

Fig. 389: The angle of the greater sciatic notch is greater in the female; the pelvic outlet is also greater in the female.

(17)



U Sustami

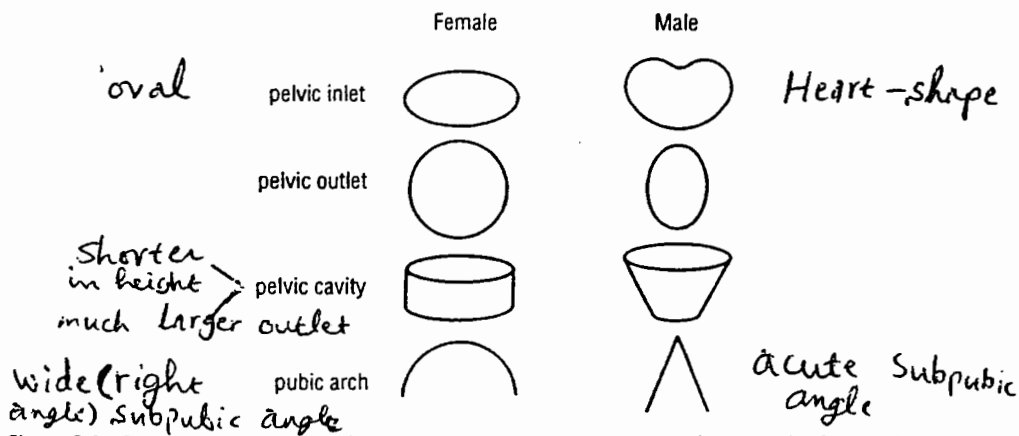
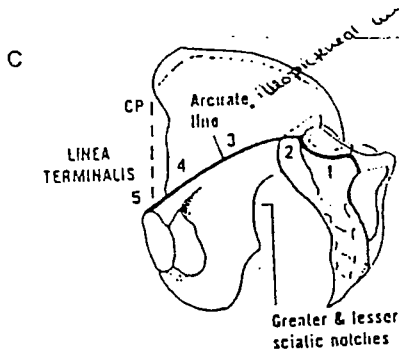


Figure 6-4 Pelvic inlet, pelvic outlet, diagonal conjugate, and axis of the pelvis. Some of the main differences between the female and the male pelvis are also shown.

on the whole the male pelvis is
 more massive
 of greater vertical height
 shows more marked areas of
 muscular attachment than ♀
 less wide



The differences in the true Pelvis can be summarized by stating that the male pelvis is more funnel-shaped than female → The result is that the female pelvis is shorter in height & has a much larger outlet than the male



1+2+3+4+5 = Linea terminalis (18)
or Pelvic inlet

- 1 = Promontory
- 2 = ala of sacrum
- 3 = medial border of the ilium (arcuate line)
- 4 = Pectineal line
- 5 = Pubic crest

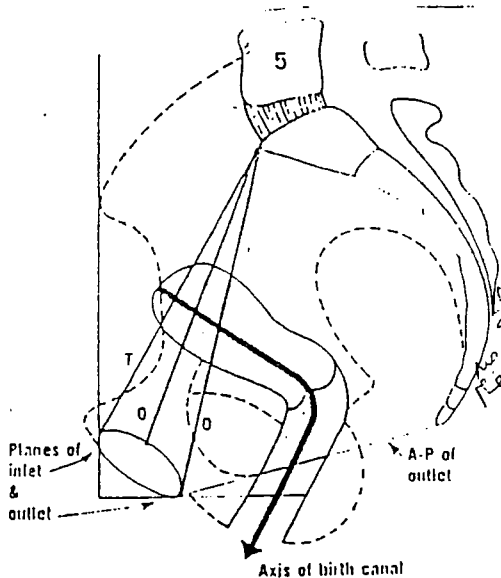


Figure 40-3. Median section of the pelvis, showing the planes of the inlet and outlet. The true (T), obstetrical (O), and diagonal (D) conjugate diameters are indicated. The axis of the birth canal, that is, the path taken by the fetal head in its passage through the pelvic cavity, can be seen to turn at the uterovaginal angle. 5, fifth lumbar vertebra.

The anteroposterior or conjugate diameter (true, T) passes from the upper margin of the Pubic Symphysis to the middle of the sacral Promontory.

The Obstetrical conjugate diameter from the BACK of the pubic symphysis to the sacral Promontory (is slightly shorter than the anteroposterior & is the minimal distance between the symphysis & promontory).

The DIAGONAL conjugate diameter is the ONLY diameter that can be measured per vaginam. It is the distance between the lower margin of the pubic symphysis & the sacral Promontory.

only diameter which

can be ascertained in the vagina

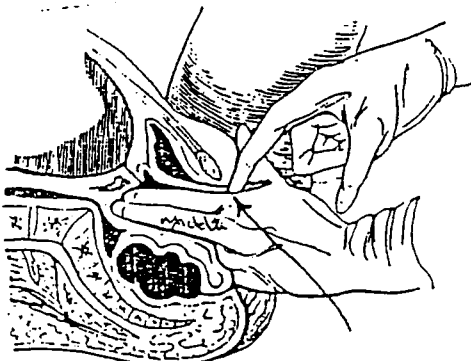


Figure 40-4. The middle finger measures the diagonal conjugate diameter. The "true" conjugate is about 1 to 2 cm less than the diagonal, and the obstetrical conjugate is about 1/2 cm less than the true. In the method illustrated, the indicated length on the index finger gives the true conjugate, because the index finger is about 1 1/2 cm shorter than the middle. (P. 114 Smout and Jacoby.)

if it didn't reach promontory then narrow

middle → diagonal

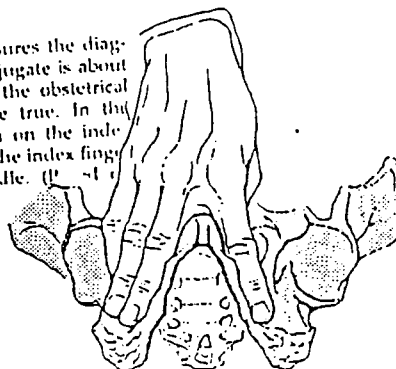
index → true 1 1/2 cm shorter than D

middle 1/2 < T

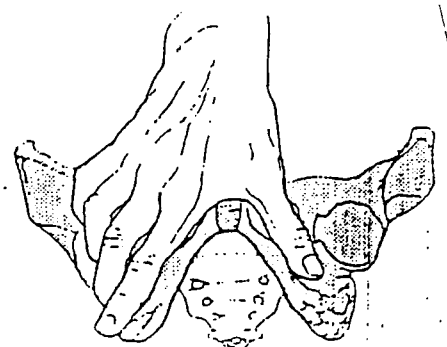


When the sacral promontory cannot be reached per vaginam, the anteroposterior diameter of the inlet is considered to be adequate for successful parturition. When this promontory can be palpated, the pelvis is regarded as contracted.

تضيق الحوض



MALE

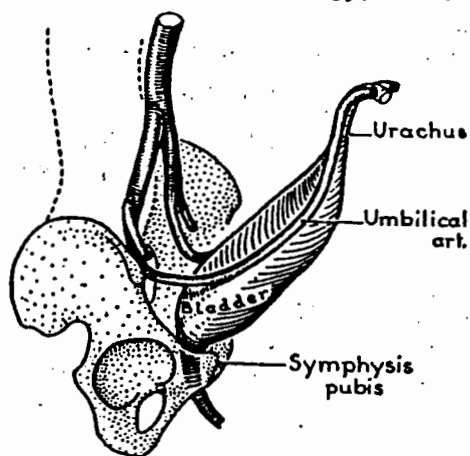


FEMALE

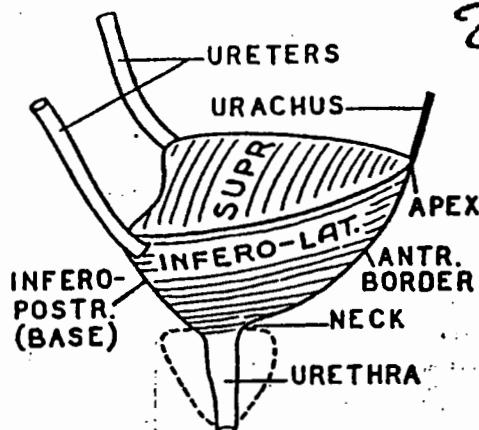
Figure 40-5. The subpubic angle in the female is nearly a right angle; that in the male is considerably less (about 60 degrees). When the vagina will admit three fingers placed side by side, the subpubic angle is adequate to permit proper extension of the fetal head after it has passed through the lower aperture.

URINARY BLADDER (U.B)

19



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



The bladder has: 4 "surfaces", 4 "angles" and 4 "ducts".

of Sustam:

The Urinary bladder is a pelvic organ in the adult but at birth the U.B is an abdominal organ, fusiform in shape & lies in the extraperitoneal tissue of the anterior abdominal wall → By the 6th year the pelvis enlarges enough to allow the bladder to sink down its cavity. In the adult the anatomy of the U.B depends to some extent on whether it is empty & contracted or full of urine or distended.

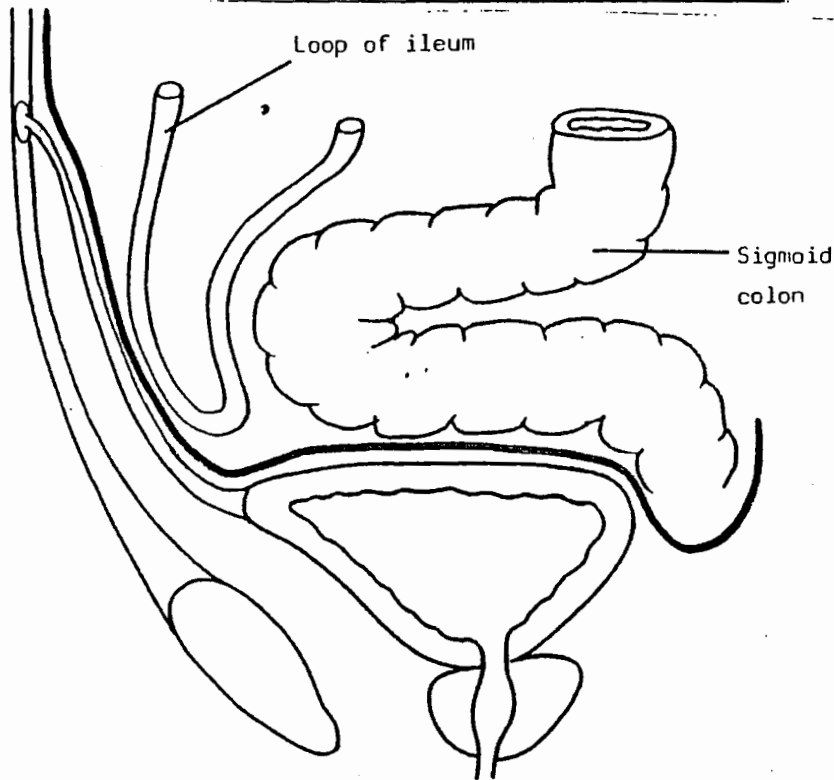
- The empty U.B has 4 surfaces, 4 angles & 4 ducts
- The 4 surfaces are the superior surface, 2 inferolateral surfaces & an inferoposterior surface or base. Each of the 4 surfaces has a triangular outline.
- The 4 angles of the bladder are:
 - a) anterior angle → apex of bladder → in front
 - b) inferior " → Neck of " → below
 - c) 2 postero-superior angles → behind & above
- The 4 ducts of the U.B are:
 - 2 Ureters
 - Urethra
 - Urachus

- The 2 Ureters are attached to the 2 Postero-superior angles
- the urethra is attached to the inferior angle (Neck)
- the urachus (median Umbilical ligament) is attached to the apex (ant. angle) & runs upwards behind the anterior abdominal wall to the umbilicus

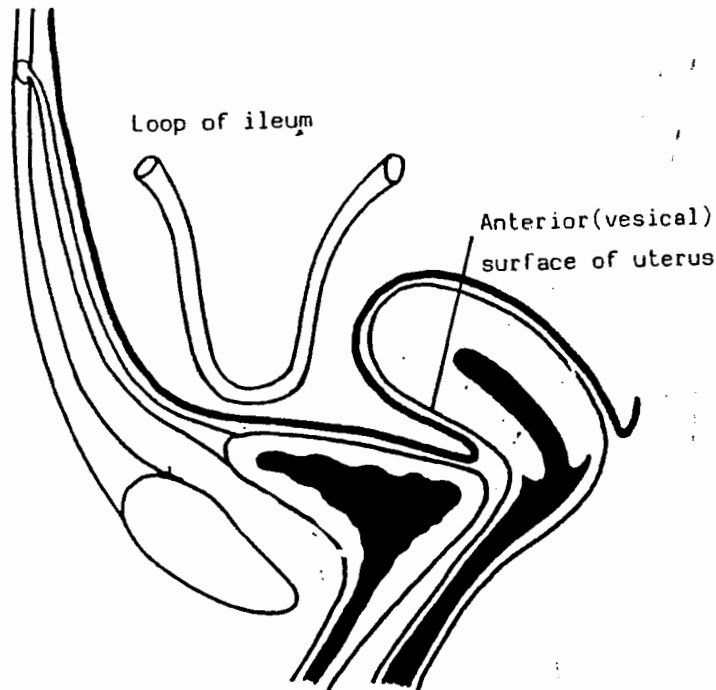
The relations of the 'sup.surface', 'base' and 'neck' are different in the 2 sexes (20)

(A) Relations of the superior surface: [Different in males and females]

- (1) In the male: it is related to coils of the pelvic colon and terminal coils of the ileum.
- (2) In the female: it is related to the uterus but is separated from it by the utero-vesical pouch. The utero-vesical pouch may contain some coils of intestine.



Relations of the superior surface of the bladder in male



Relations of the superior surface of the bladder in female

(21)

Relations of the sides (infero lateral surfaces) [Same in males and females]:

- * In front the sides lie in contact with the *retropubic pad of fat* and the "*bare*" *pubic bone*.
- * More posteriorly they become related to the *obturator internus* muscles (above) and *levator ani* muscles (below).

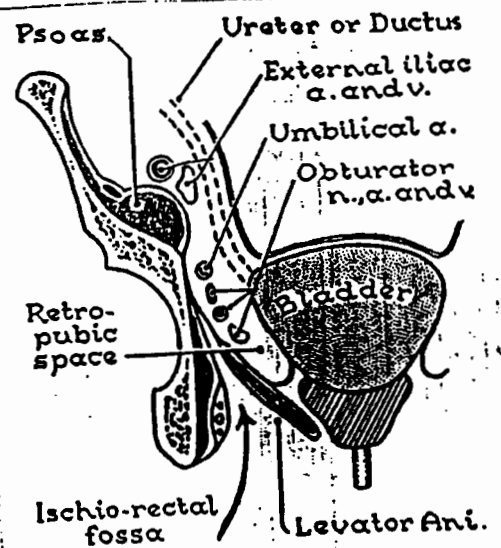
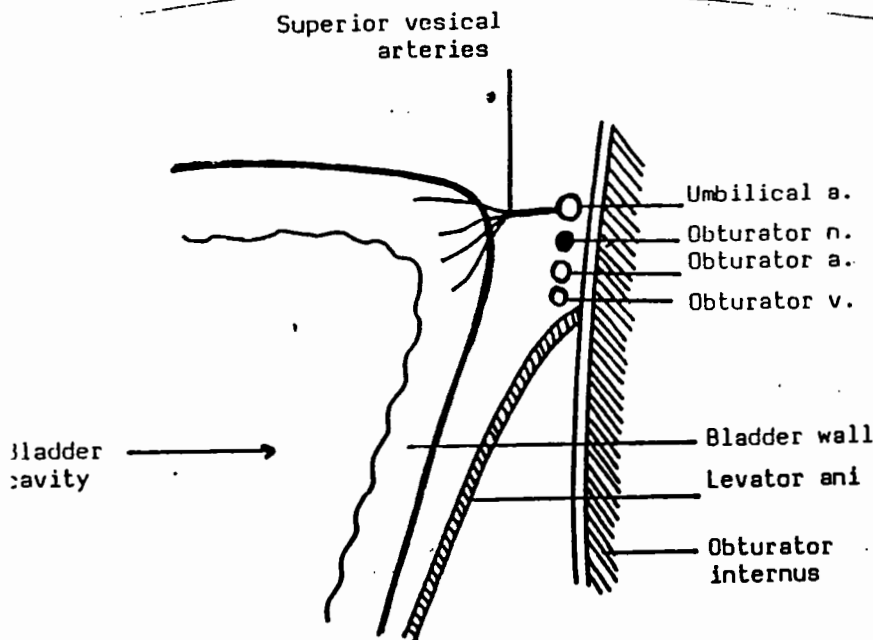
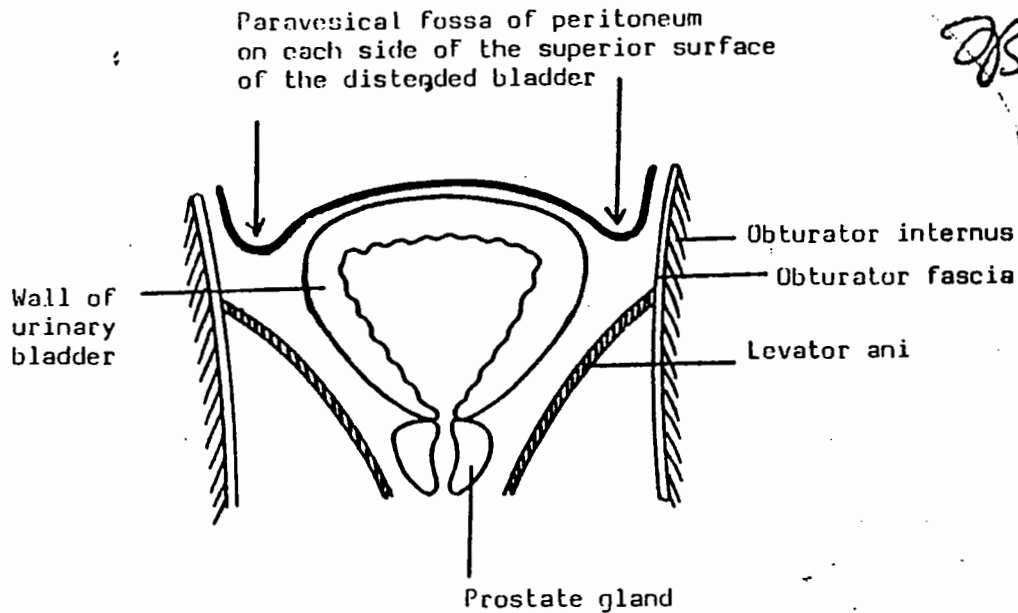


Figure 17.3. The side wall of the male pelvis on coronal section (diagrammatic).

Relations of the inferolateral surface of the bladder

(B) **Relations of the "base"** (infero-posterior surface): [Different in males and females]

(1) In the **male**: the base of the bladder is related to the **anterior surface of the rectum** but the rectum and bladder are separated from each other by the **2 vasa deferentia** and the **2 seminal vesicles**, which lie on the base of the bladder.

(2) In the **female**: the base of the bladder is related to the **anterior surface of the vagina**.
The **vagina** separates the bladder (in front) from the rectum (behind).

Basirani

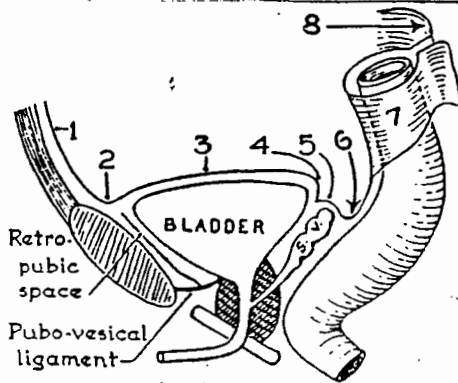


Fig. 299: Relations of the sup. surface, base and neck of the bladder in the "male".

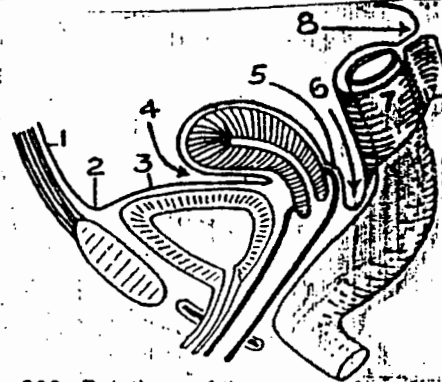
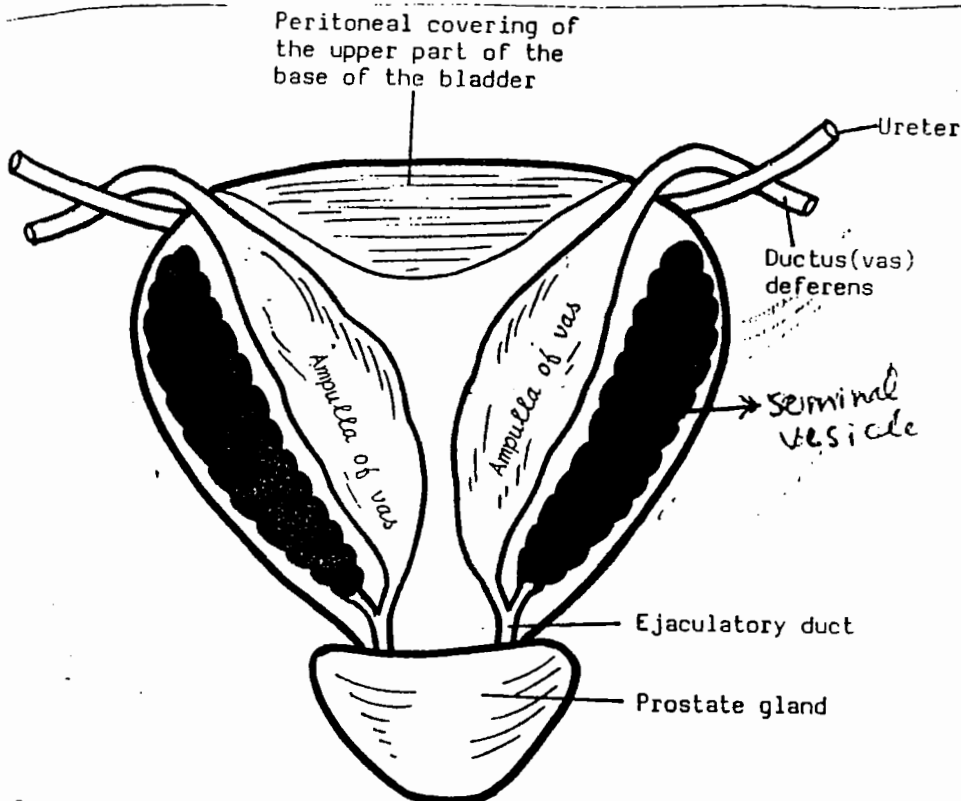
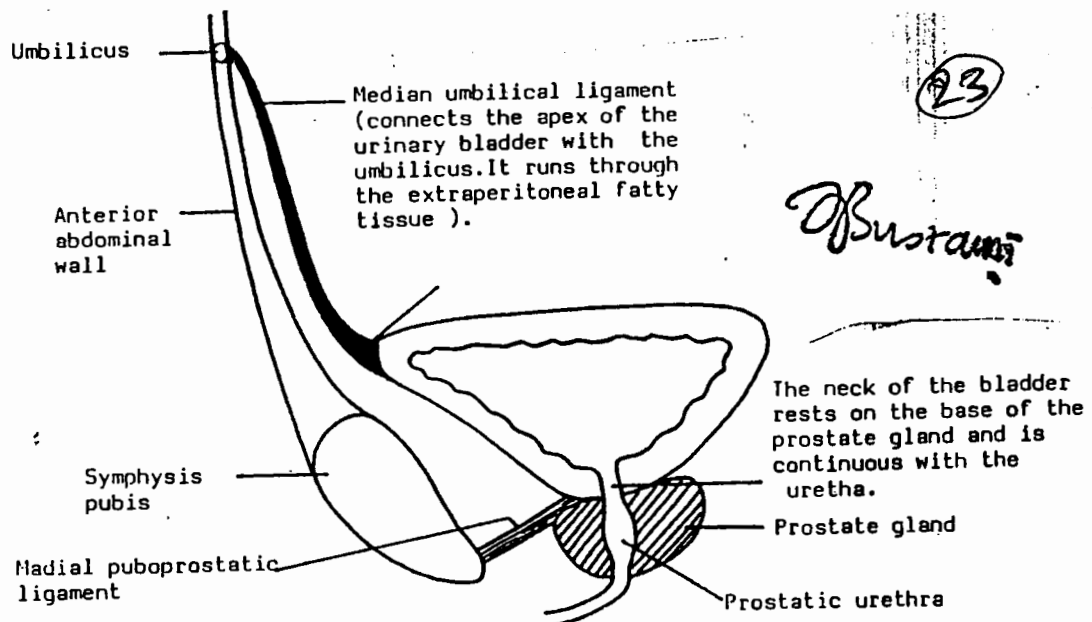


Fig. 300: Relations of the sup. surface, base and neck of the bladder in the "female".

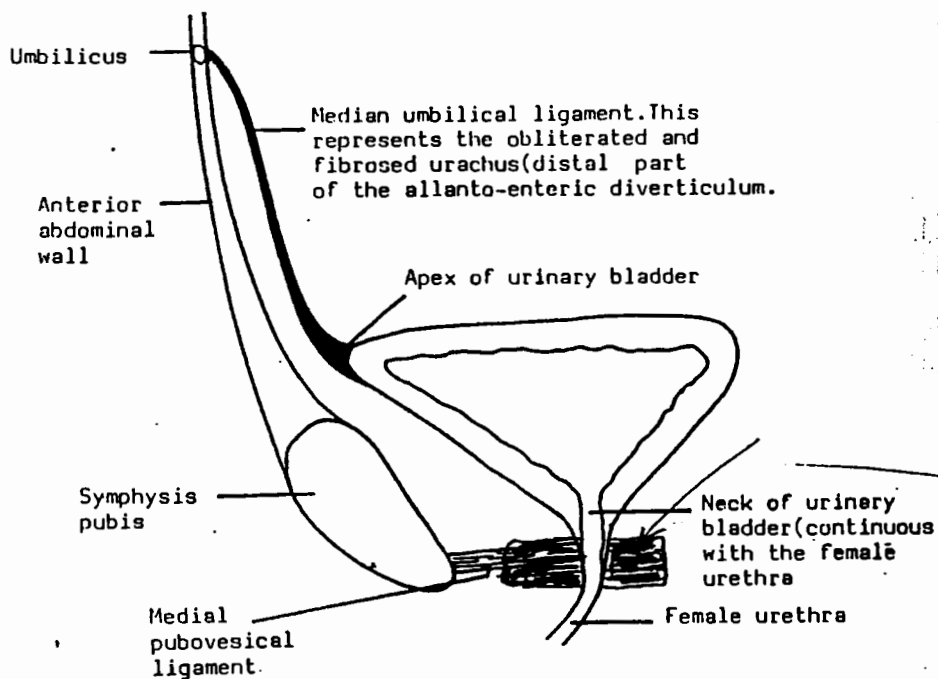
1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 refer to different parts of the peritoneum



Relations of the base of the urinary bladder in male



Apex and neck of the bladder in male



Apex and neck of the bladder in female

(C) Relations of the "neck": [Different in males and females]

- (1) In the male: the "neck" of the bladder lies on the prostate.
- (2) In the female: the bladder "neck" lies directly on the pelvic fascia.

Summary of the different relations of the bladder in males and females.

	Male	Female
Superior surface	coils of intestine	uterus
Base	rectum	vagina
Neck	prostate	directly on pelvic fascia

peritoneal relations of the bladder:

These relations are very important to know.

(a) In the "empty" bladder:

Only the superior surface and the upper $\frac{1}{2}$ inch of the base are covered by peritoneum and the "empty" bladder lies below the peritoneal floor of the pelvis.

(b) As the bladder "fills" with urine: it becomes larger and starts to rise from the pelvic cavity upwards into the abdomen peeling off (stripping) the peritoneum upwards from the lower part of the ant. abdominal wall and from the side walls of the pelvis. In this case the anterior part of the bladder comes in direct contact with the lower part of the ant. abdominal wall.

* This is an important fact to remember.

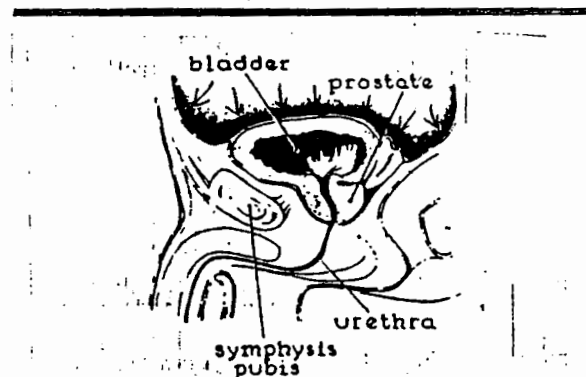


Fig. 301: The peritoneum covers the sup. surface of the bladder and the upper one cm of its base.

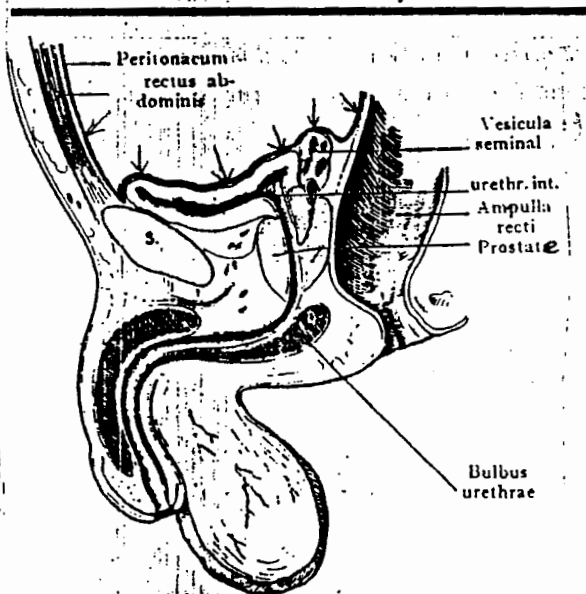


Fig. 303: The empty bladder lies below the "peritoneal floor" of the pelvis. Notice that the upper end of the seminal vesicle is "capped" with peritoneum.

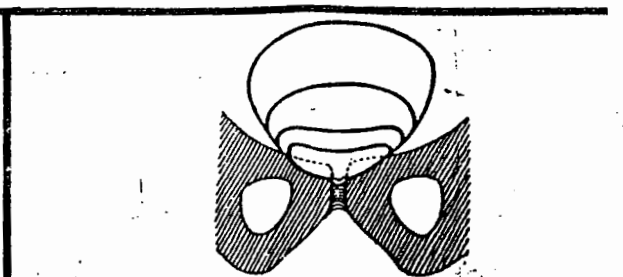


Fig. 302: As the bladder fills it rises from the pelvic cavity and "peels off" the peritoneum upwards.

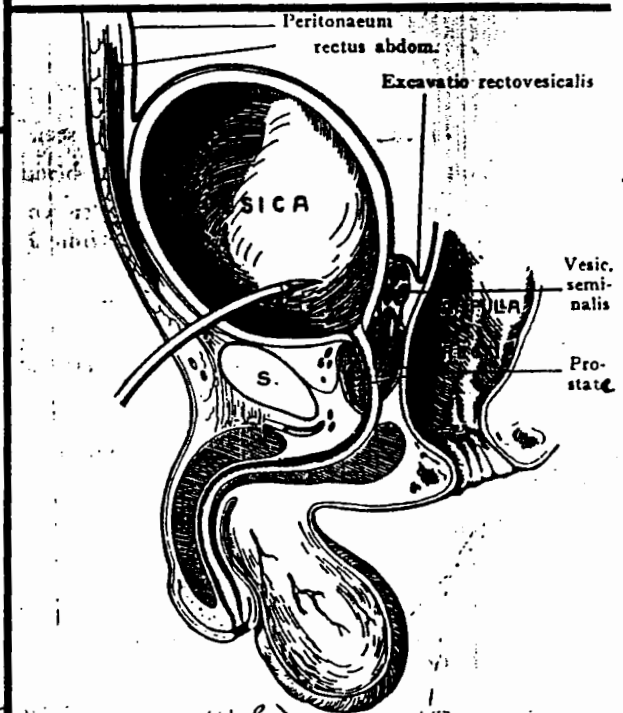


Fig. 304: As the bladder becomes full of urine, its ant. part comes in "direct" contact with the lower part of the ant. abdominal wall with no peritoneum in between.

ExtraPeritoneal introduction of a cannula into the U.B. in cases of chronic retention of urine

Ofustami

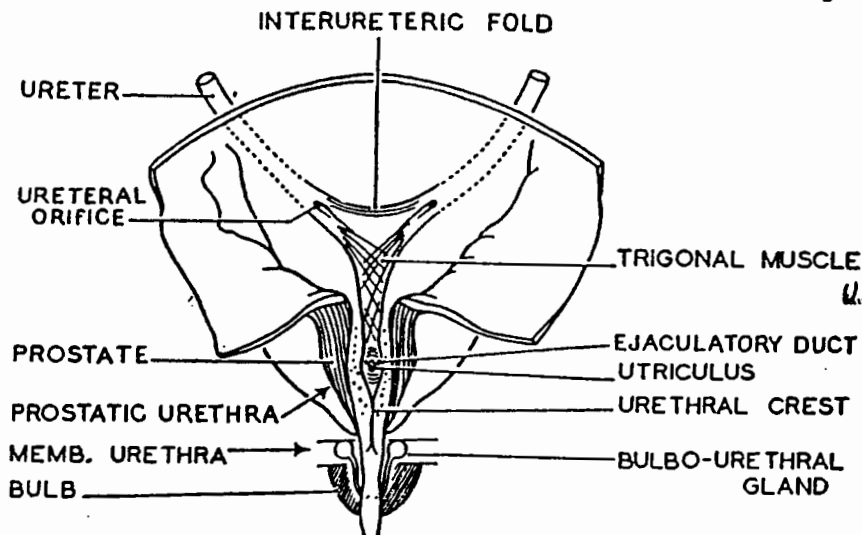
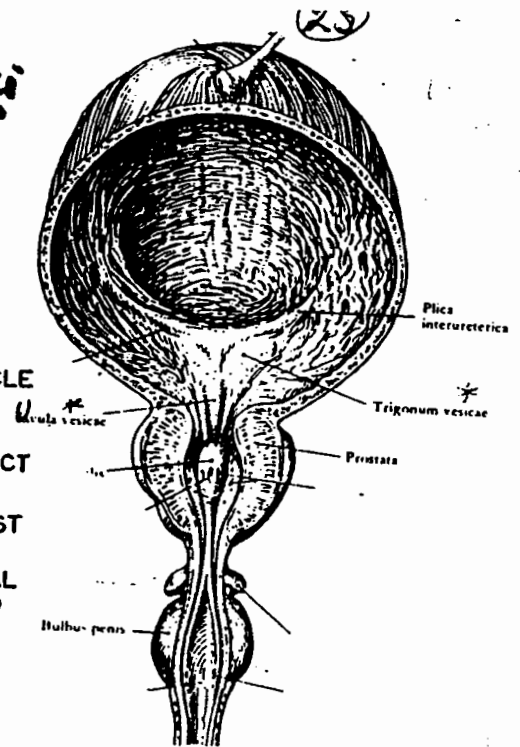


Figure 17.25. The trigone of the bladder and the prostatic urethra.



The inside (interior) of the urinary bladder:

- * In the "empty" bladder: the main part of the mucous membrane is *irregular* and thrown into *folds* called "rugose".
- * When the bladder becomes "full" of urine, this irregularity (rugosity) disappears and the mucous membrane becomes smoother.
- * However, the mucous membrane over an area called the *trigone* is *always smooth* even in the empty bladder; this is because the mucous membrane of the trigone is *adherent to the muscle of the bladder*.

What is the "trigone"?

It is a **triangular** area in the "inside" of the bladder which is bounded by the 3 openings: the 2 ureters and internal meatus (opening) of the urethra.

* The trigone from the inside corresponds to the "base" of the bladder from the outside.

- * Between the openings of the 2 ureters there is a raised fold of mucous membrane called the *interureteric ridge* (which is produced by a ridge of muscle beneath it).
- * A small rounded elevation called *uvula vesicae* lies immediately *behind* the opening of the urethra; it is caused by the underlying *"median lobe" of the prostate*.

Clinically important points:

1. Retention of urine in old age:

- * In old age due to *senile enlargement of the prostate*, the *"median lobe"* of the prostate becomes enlarged: this will cause urine to accumulate behind the *uvula vesicae* and retention of urine can easily occur in old age.
- * A *small degree* of enlargement of this median lobe results in a *large degree* of obstruction to the flow of urine into the urethra.

2. Cystoscopy:

The inside of the urinary bladder can be seen and examined by an instrument called the *cystoscope*:

- (a) You can see the three openings of the bladder: 2 ureters and internal urethral meatus.
- (b) In the *empty* bladder the distance between the openings of the 2 ureters is *one inch* but when the bladder is *distended* the 2 ureters become *2 inches* apart.

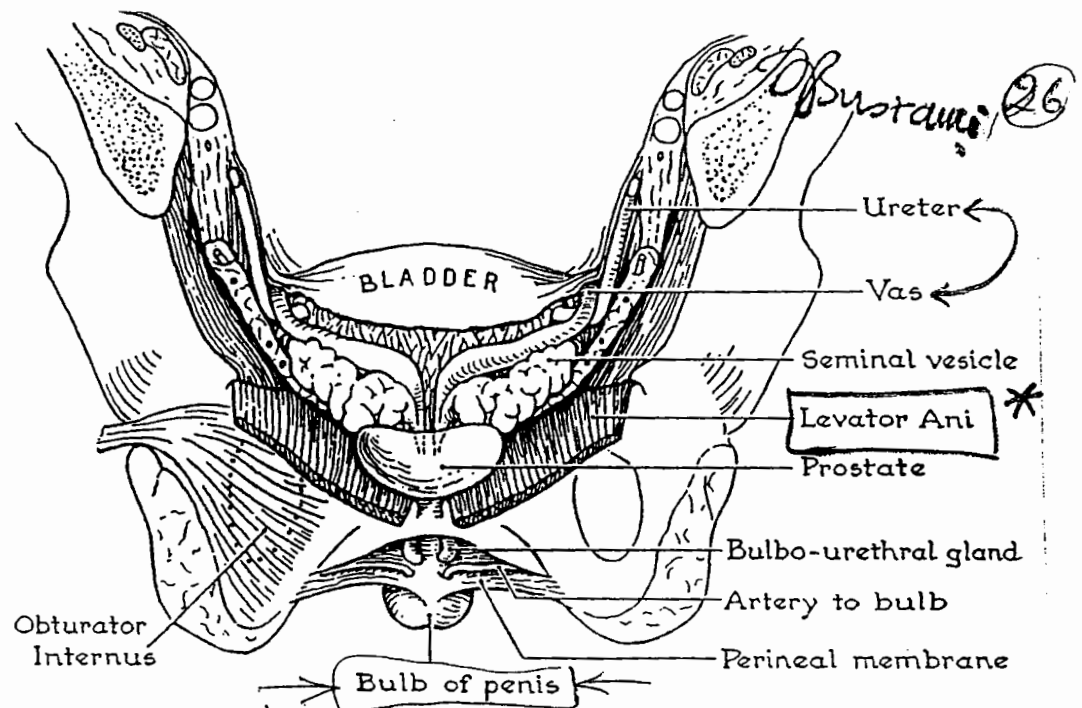


Figure 17.5. A coronal section of the pelvis to show the genitourinary organs from behind.

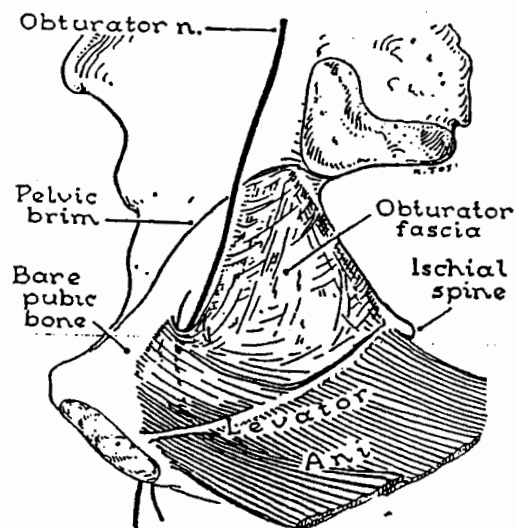


Figure 17.6. The side wall of the lesser pelvis divided into upper and lower (anterior and posterior) parts by the obturator nerve.

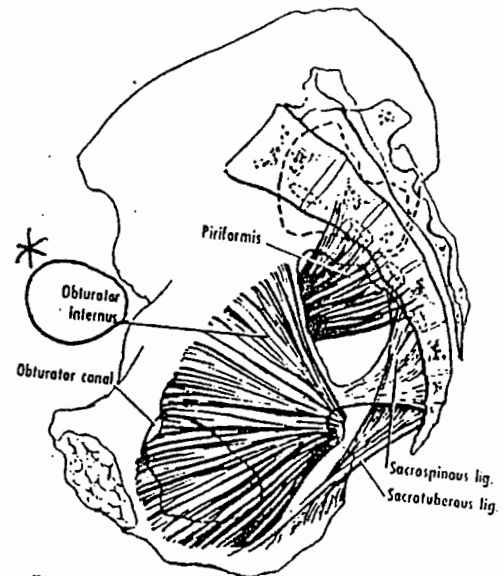


Figure 40-11. The muscles and ligaments of the lateral pelvic wall, pelvic aspect. (Based on Shellshear and Macintosh.)

Notice \rightarrow the 2 levator ani muscles form the **PELVIC FLOOR** \rightarrow above it pelvic cavity
 \downarrow below it \rightarrow Perineum, so the urinary bladder & the prostate are pelvic organs because they lie superior to levator ani. The bulb of penis (& the rest of its root) are perineal organs because they lie inferior to the levator ani muscles
 \rightarrow Levator Prostaticae !! these are the anterior fibres of the levator ani which supports the prostate (they correspond to sphincter vaginae in the female)

Ofustami

1. MALE URETHRA

Definition

Male urethra is a membranous canal for the external discharge of urine and seminal fluid.

Length and Shape

It is 18-20 cm long. In the flaccid state of penis, the long axis of urethra shows two curvatures, and therefore is S-shaped. In the erect state of penis, the distal curve is obliterated, and it becomes J-shaped.

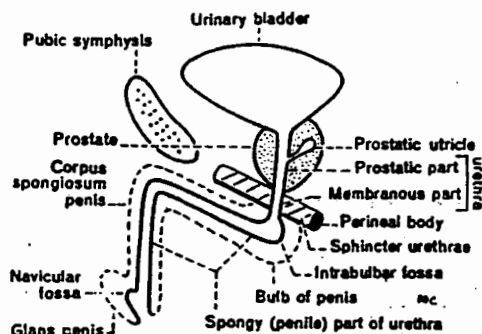


Fig. 325 Left view of a sagittal section through the male urethra showing its various parts.

Extent and Location

It extends from the internal urethral orifice in the neck of the bladder to the external urethral orifice at the tip of the penis. During its course it passes through the prostate, sphincter urethrae muscle, and the corpus spongiosum penis.

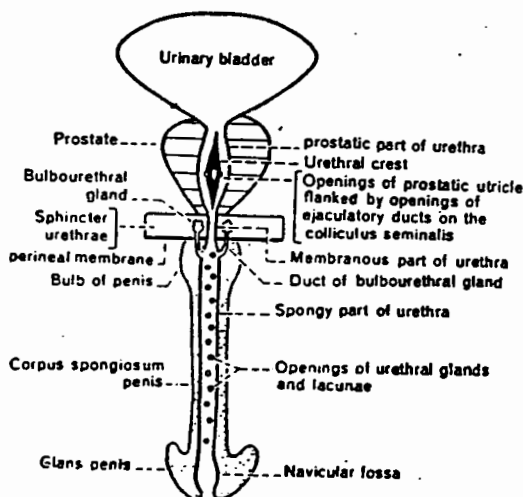


Fig. 326 Anterior view of the male urethra straightened and cut open.

Parts of Urethra

- A. *Prostatic part* passes through the prostate.
- B. *Membranous part* is surrounded by sphincter urethrae.
- C. *Spongy part* passes through the bulb and corpus spongiosum of penis.

A. Prostatic Part of Urethra (Fig. 322 B).

Length. 3 cm.

Course. It begins at the internal urethral orifice and runs vertically downwards through the anterior part of prostate.

Size. It is the widest and most dilatable part of male urethra, being widest in the middle and narrowest below where it joins the membranous urethra.

On transverse section, it is semilunar in shape, with its convexity directed forwards.

Features. The posterior wall (floor) of prostatic urethra presents: (1) *urethral crest* (veru montanum), a median longitudinal ridge of mucous membrane. (2) *Colliculus seminalis* is an elevation in the middle part of the crest, on which the slit-like orifice of prostatic utricle is situated. On each side or just within this orifice there are openings of the ejaculatory ducts. (3) *Prostatic sinuses* are two vertical grooves situated one on each side of the crest. Each sinus presents about 20-30 openings of the prostatic glands.

Prostatic utricle is a blind sac, about 6 mm long, which lies within the prostate. It is directed upwards and backwards between the median and posterior lobes of the prostate. It

Features. (1) Membranous urethra is surrounded by sphincter urethrae (external urethral sphincter). (2) Bulbourethral glands (of Cowper) are placed one on each side of membranous urethra, although their ducts open into the spongy part of urethra after piercing the perineal membrane. (3) Numerous urethral glands also open into it.

C. Spongy (Penile) Part of Urethra

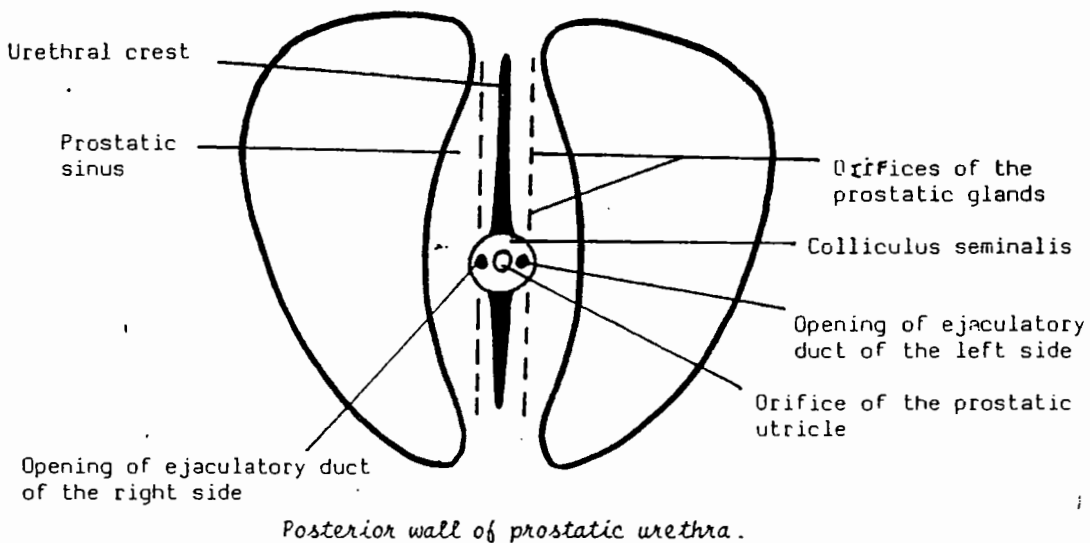
Length. About 15 cm.

Course. The fixed part of penile urethra runs forwards and upwards in the bulb of penis. It bends downwards in front of the lower part of pubic symphysis to continue as the free part of penile urethra in the corpus spongiosum penis. It terminates at the external urethral orifice situated at the tip of the glans penis.

Size. It is narrow with a uniform diameter of about 6 mm in the body of penis. It is dilated: (a) at its commencement, to form the intrabulbar fossa on the floor and sides; and (b) within the glans penis, to form the navicular (terminal) fossa on the roof and sides. External urethral orifice is the narrowest part of male urethra. It forms a sagittal slit about 6 mm long, and is bound on each side by a small labium.

On transverse section, the lumen is a transverse opening, except for the external urethral orifice which is vertical.

Features. (1) Ducts of bulbourethral glands open in the fixed part of penile urethra about 2.5 cm below the perineal membrane. (2) Except in the most anterior part, there are numerous orifices of the urethral glands (of Littré) facing forwards. (3) In addition, there



is homologous with the uterus (or vagina) of females.

B. Membranous part of Urethra

Length. 1.5 – 2 cm.

Course. It runs downwards and slightly forwards through the membranous urethrae, and pierces the perineal membrane about 2.5 cm below and behind the pubic symphysis.

Size. It is the narrowest (except for external urethral orifice) and least dilatable part of male urethra.

On transverse section, it is star-shaped (stellate).

are several small pit-like recesses or lacunae (of Morgagni) which open obliquely forwards. One lacuna in the roof of navicular fossa is largest, and is known as lacuna magna (sinus of Guérin). Lacunae receive openings of the urethral glands.

Sphincter

(28)_B

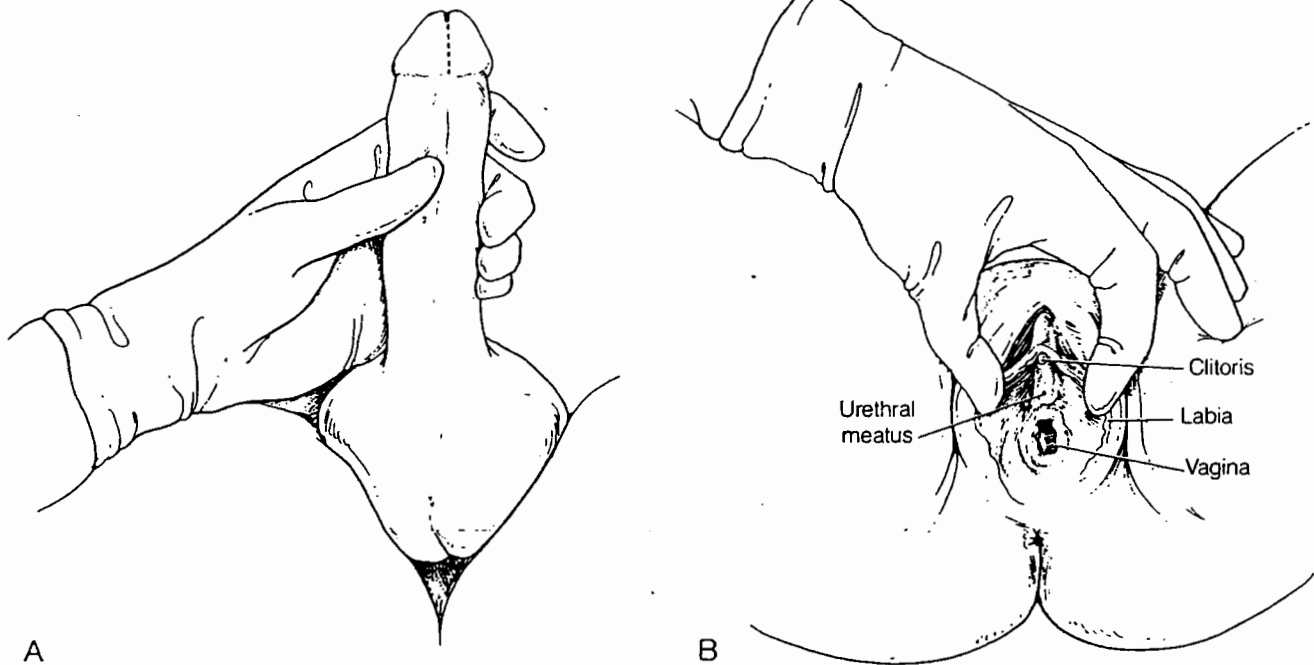


Figure 5.2. Foley catheter insertion. **A**, Penis is held straight upward to provide the straightest course of the urethra that will allow the Foley access to the urinary bladder. **B**, Anatomical relationship of the female urethra. With the hips abducted, a gloved hand spreads the labia to expose the urethra. The other hand prepares the area and inserts the lubricated catheter.

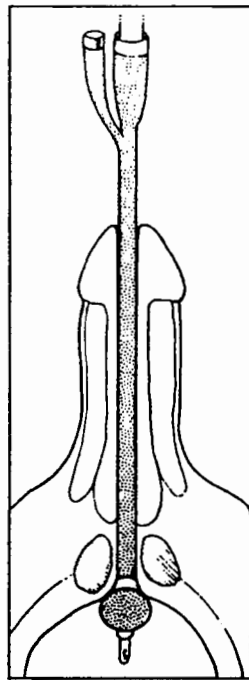


Figure 5.3. The Foley catheter is withdrawn until the balloon seats itself against the outflow tract. The catheter may be taped to the lower abdomen in males or the leg in females.

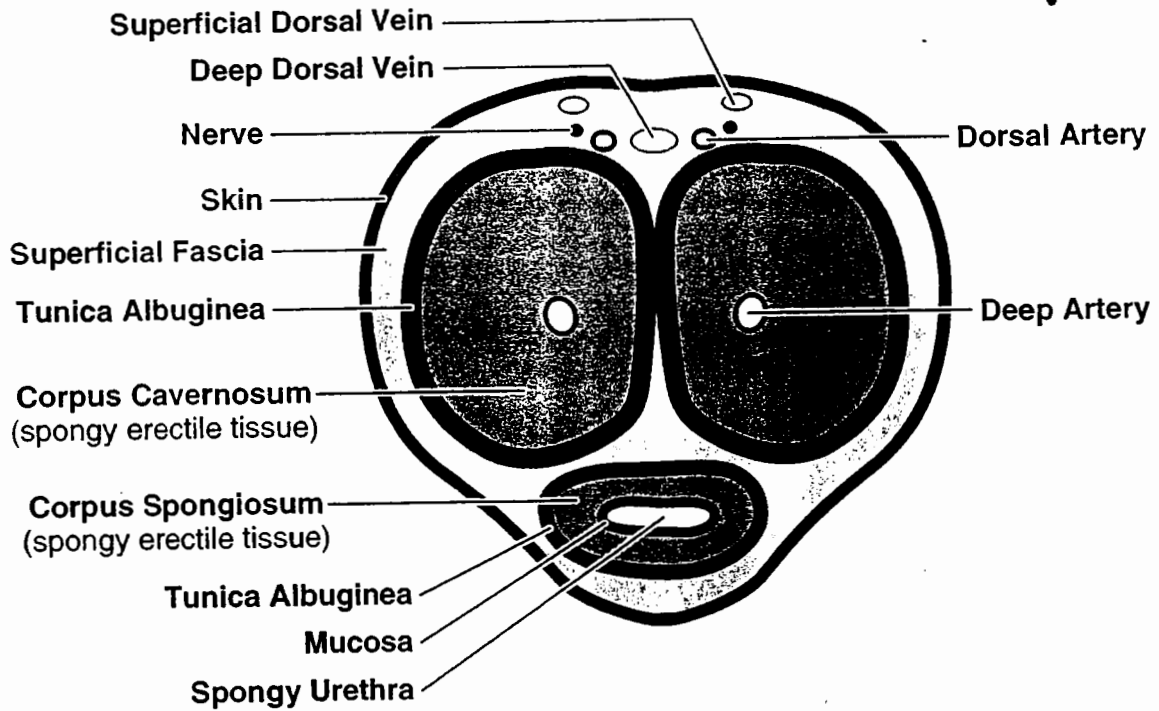
Sphincters of Urethra

1. *Internal urethral sphincter* or *sphincter vesicae* is involuntary in nature because it is supplied by sympathetic nerves (lower thoracic and upper lumbar). It controls the neck of the bladder and prostatic urethra above the opening of ejaculatory ducts. It is made up of a substantial collection of smooth muscle fibres, with a considerable admixture of elastic and collagenous fibres. Its role in micturition has become controversial. !

2. *External urethral sphincter* or *sphincter urethrae* is voluntary in nature because it is made up of (striated muscle fibres) and supplied by perineal branch of pudendal nerve (S2-4). It controls the membranous urethra and is responsible for the voluntary holding of the urine. Initiation of micturition is attributed to the relaxation of the pelvic floor, including the sphincter urethrae. However, others accord it to the detrusor muscle.

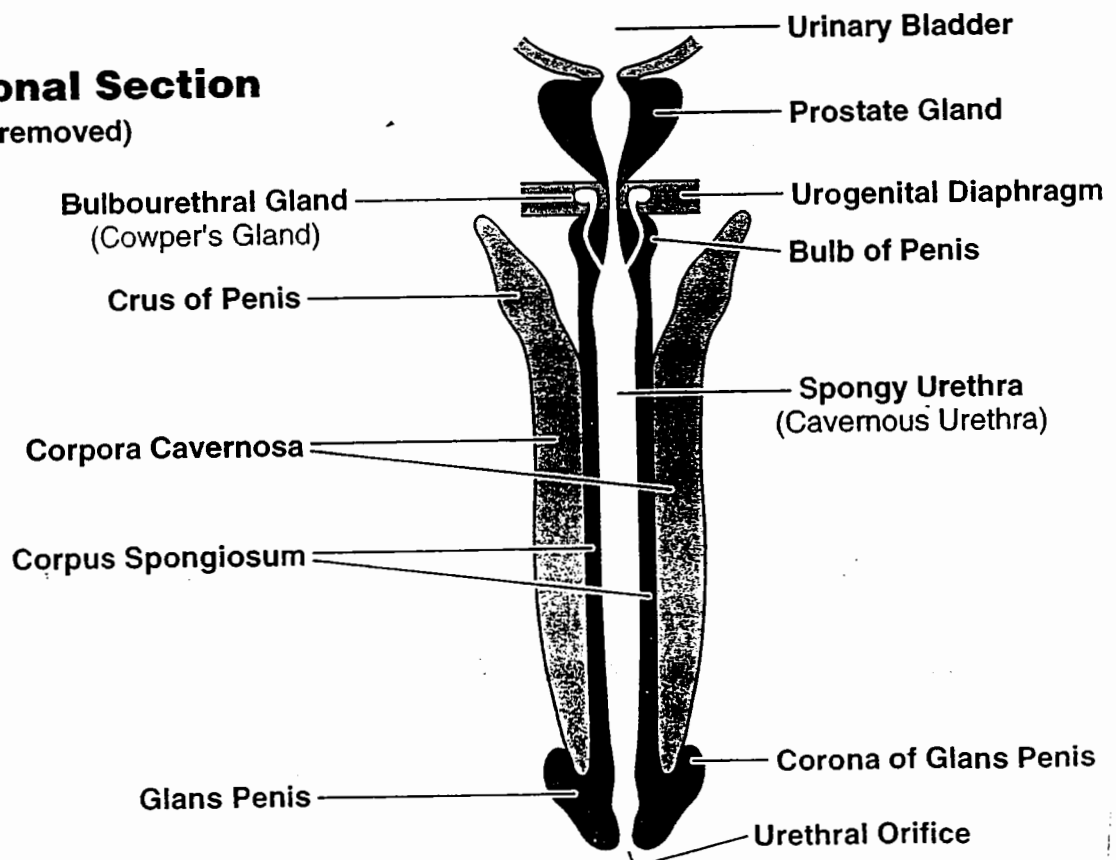
PENIS

Cross Section



Coronal Section

(Skin removed)



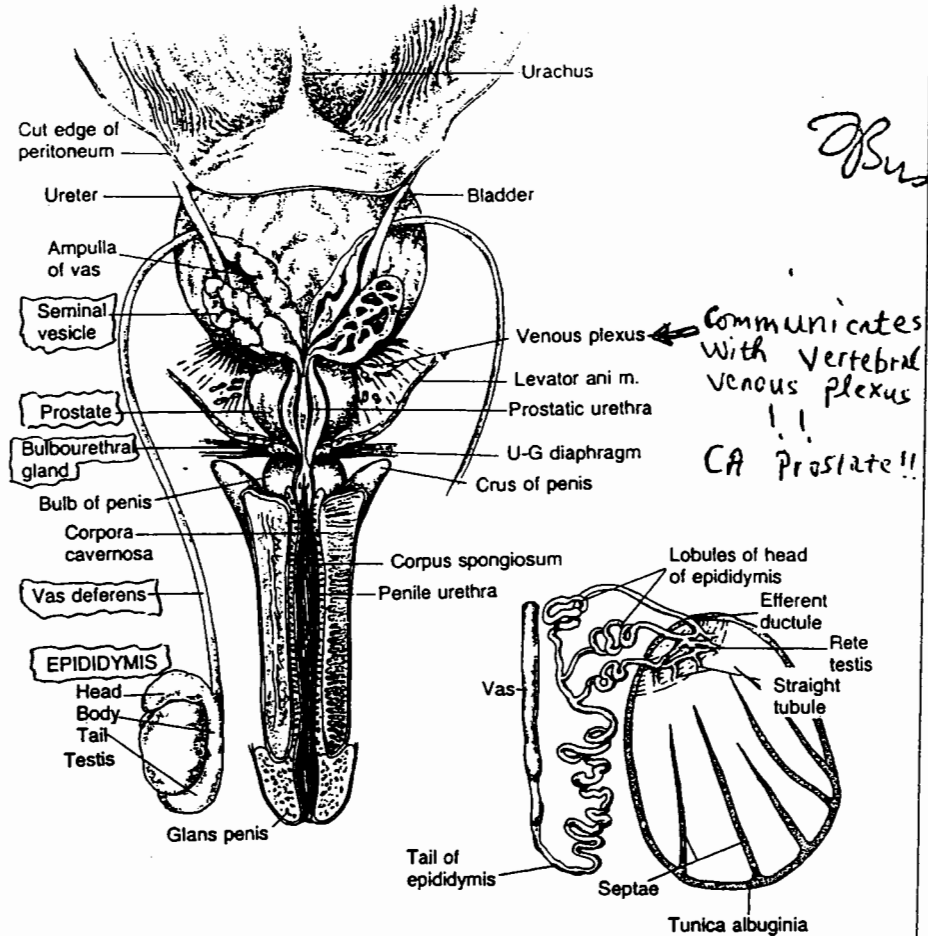


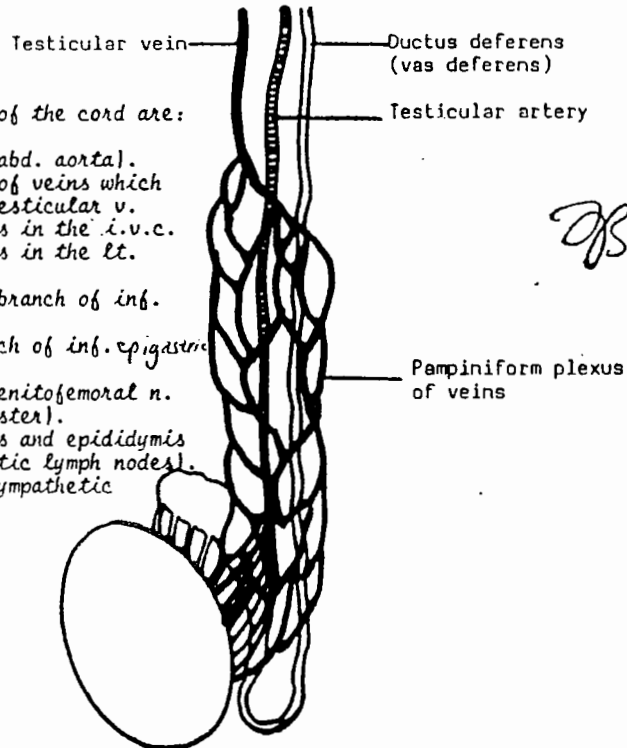
FIGURE 19-2. The major male reproductive organs viewed from behind. The vas, seminal vesicles, and the structures surrounding the urethra have been sectioned longitudinally. Note the reflection of peritoneum onto the superior surface of the bladder. The venous plexus surrounding the prostate gland is indicated. On the right side, the vas has been cut and the testis sectioned and enlarged to show internal architecture.

Male Reproductive System

إعداد الأستاذ الدكتور فرج البسطامي
طلبة السنة الثالثة طب بشري / الجامعة الأردنية
الغسل الثاني 2006

The main constituents of the cord are:

- 1- Ductus deferens.
- 2- Testicular a. (from abd. aorta).
- 3- Pampiniform plexus of veins which collects into the testicular v.
The rt. tes. v. ends in the i.v.c.
The lt. tes. v. ends in the lt. renal v.
- 3- A. of vas deferens (branch of inf. vesical a.)
- 6- Cremasteric a. (branch of inf. epigastric ~~vein~~ a.).
- 7- Genital branch of genitofemoral n. (supplies the cremaster).
- 8- Lymphatics of testis and epididymis (drain into the aortic lymph nodes).
- 9- A dense plexus of sympathetic fibers.



of Bustami

Main Constituents of the spermatic cord

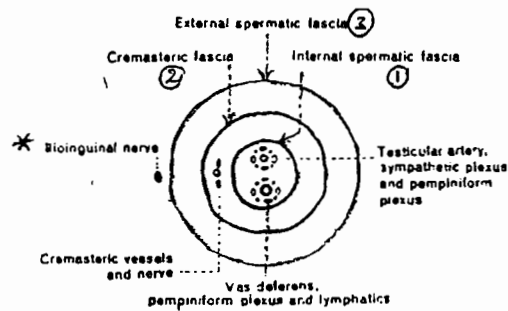
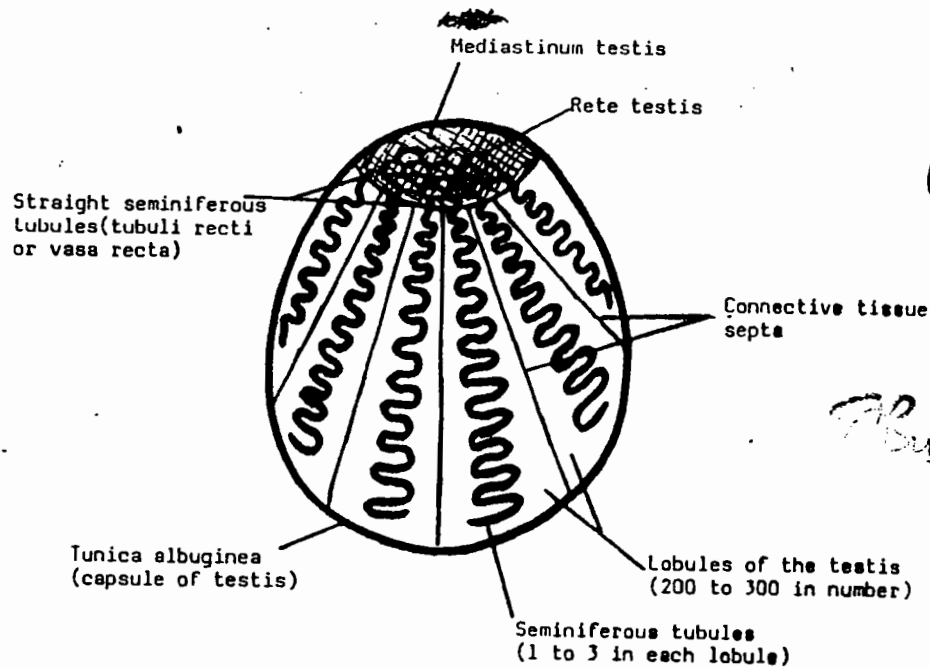


Fig. 159 Diagram of a transverse section of the spermatic cord.

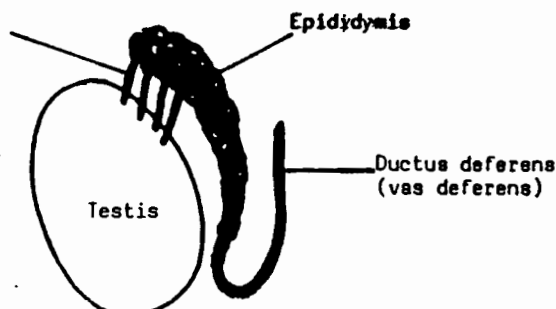
Coverings of spermatic cord. From within outwards these are as follows: (1) *Internal spermatic fascia*, derived from fascia transversalis; it covers the cord in its whole extent, (2) *Cremasteric fascia* is made up of cremaster muscle loops connected together by areolar tissue. It is derived from the internal oblique and transversus abdominis muscles, and therefore covers the cord below the level of these muscles. (3) *External spermatic fascia*, derived from external oblique aponeurosis, covers the cord below the superficial inguinal ring.



Transverse section in the testis

- Each lobule of the testis contains usually two (1-3) seminiferous tubules. Each tubule is about 2 feet or 60 cm. in length; and is highly coiled.
- Near the mediastinum testis the tubules of each lobule unite into a straight tubule. The straight tubules (tubuli recti or vasa recta) enter the mediastinum to form a network of canaliculi called the rete testis.

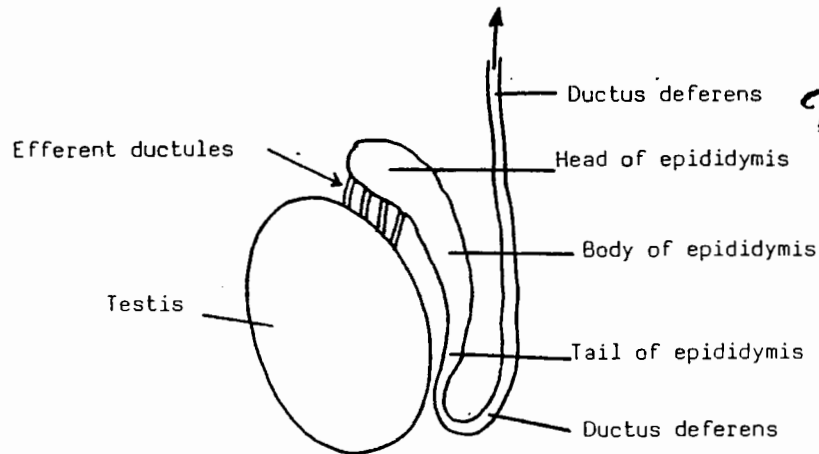
Efferent ductules
(vasa efferentia)



- From the upper part of the rete testis, about 15-20 short ducts arise. These are the efferent ductules or vasa efferentia. These unite in the head of epididymis into a single duct which is the canal or the duct of epididymis.
- The duct of epididymis is about 20 feet or 6 meters in length. It is highly coiled on itself, forming this oblong mass behind the testis. Its large upper part is called the head. Its middle part is called the body. Its tapering lower end is called tail of epididymis. The ductus or vas deferens arises from the tail of epididymis.

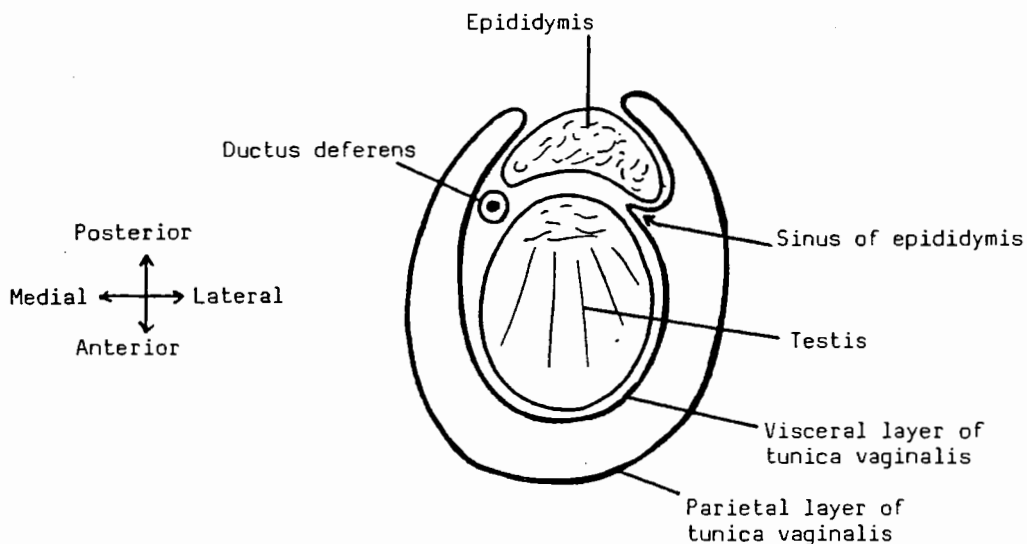
TESTIS AND EPIDIDYMIS

(33)



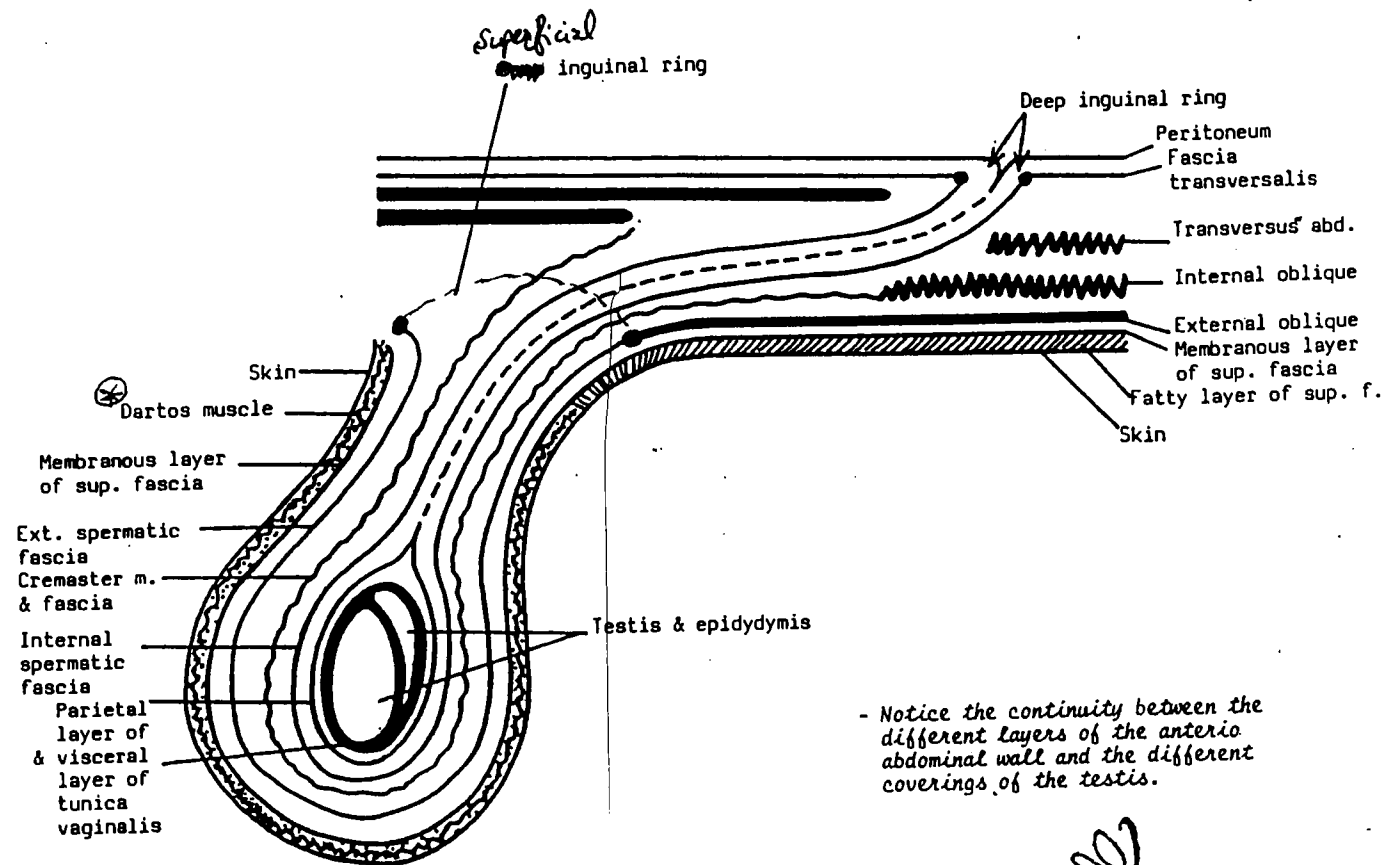
of Bustany

- Notice that the epididymis lies on the posterior border of the testis. The vas or ductus deferens arises from the tail of the epididymis, and ascends on the posterior border of the testis medial to the epididymis.



Transverse section showing the relations of the testis, epididymis and ductus deferens to the tunica vaginalis

- Notice that the front and sides of the testis are covered by the visceral layer of tunica vaginalis.
- Notice that the tunica vaginalis is invaginated laterally between the testis and the epididymis. This invagination is called the sinus of epididymis.
- Notice that the vas or ductus deferens is medial to the epididymis.



Coverings of the testis

- Notice the continuity between the different layers of the anterior abdominal wall and the different coverings of the testis.

imayong

(34)

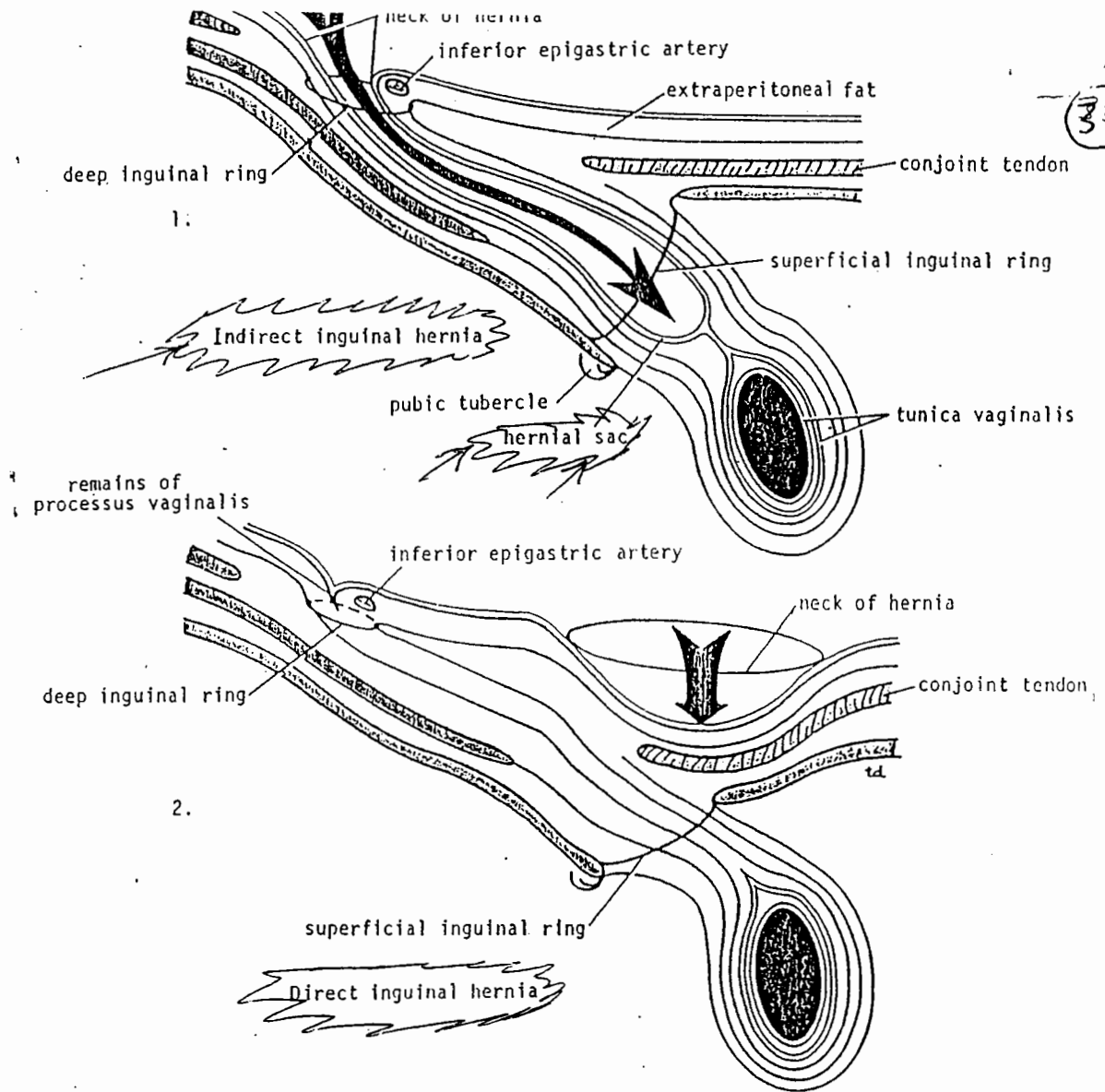


Fig. 32. (1) Indirect inguinal hernia and (2) direct inguinal hernia. Note that neck of indirect inguinal hernia lies lateral to inferior epigastric artery, and neck of direct inguinal hernia lies medial to inferior epigastric artery.

Ductus Deferens (Vas deferens) (36)

is a thick-walled muscular tube which transmits spermatozoa from epididymis to the prostatic urethra through the ejaculatory duct. It feels cord-like & has a narrow lumen except at the terminal ampulla (It is 18 inches - 45 cm - long)

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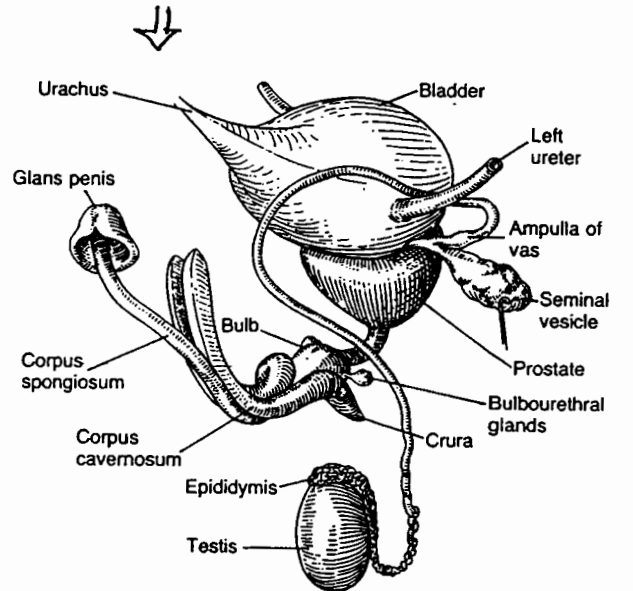


FIGURE 19-3. A lateral view of the lower end of the male genital and urinary tracts. The corpus spongiosum has been separated from the two corpora cavernosa. A seminal vesicle is retracted to show the junction with the vas to form an ejaculatory duct.

In its course the ductus deferens lies successively:

- ① on the posterior border of the testis
- ② in the spermatic cord which traverses the inguinal canal
- ③ in the greater pelvis
- ④ in the lesser pelvis

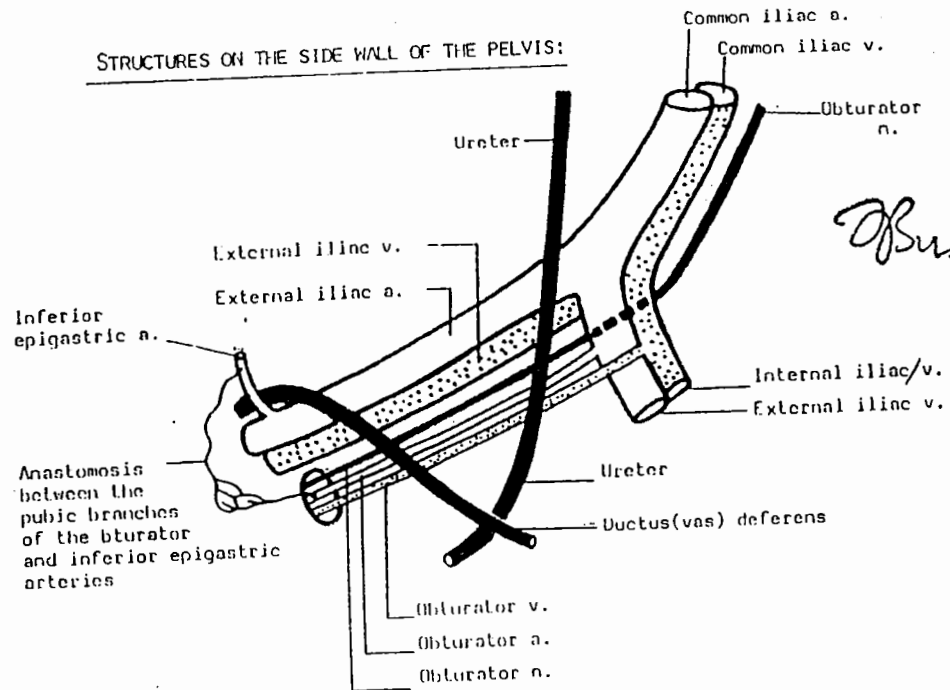
It begins as a continuation of the tail of epididymis

it ascends along the posterior border of the testis MEDIAL to the epididymis (at first it is very tortuous but gradually straightens) → it can be felt as a cord-like structure

It runs in the posterior part of the spermatic cord → runs upward to the superficial inguinal ring & then traverses the inguinal canal

In the greater pelvis → at the deep inguinal ring it leaves the spermatic cord & hooks around the lateral side of inferior epigastric artery

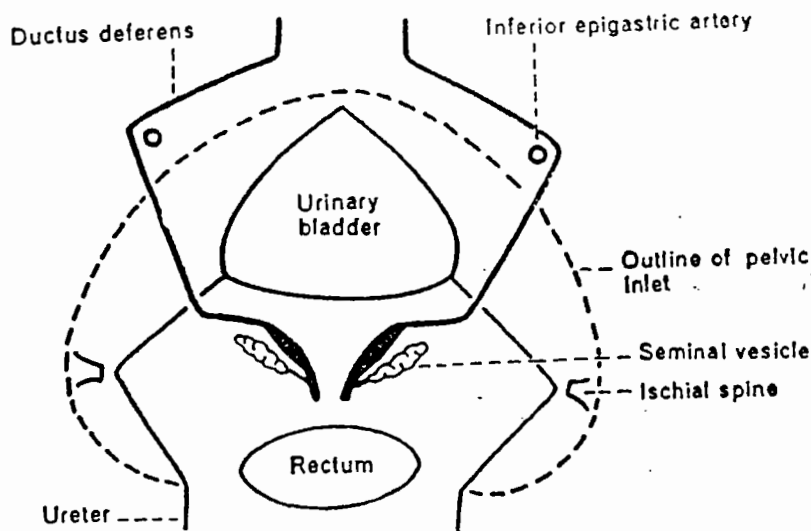
STRUCTURES ON THE SIDE WALL OF THE PELVIS:



→ it passes backward & medially across the external iliac vessels & enters the lesser pelvis

In the lesser pelvis → it runs downwards & backwards on the lateral pelvic wall Outside the peritoneum. Here it crosses the obturator nerve & vessels.

At the posterosuperior angle of the bladder it crosses above the end of the Ureter then runs downwards & medially on the base of the bladder in contact with the medial side of seminal vesicle → Here it is dilated to form the ampulla of ductus deferens → It ends behind the neck of the U-bladder in a narrow tube which joins the duct of seminal vesicle to form the ejaculatory duct



artery to the ductus deferens arises from the superior or inferior vesical arteries → it anastomoses with the testicular a.

Prostate

Definition

Prostate is an accessory gland of male reproductive system, which adds to the bulk of the seminal fluid, like the seminal vesicles and the bulbourethral glands. It is conical and firm, and lies below the neck of the urinary bladder, surrounding the commencement of male urethra (Fig. 302A). Its firmness is due to the dense fibromuscular stroma in which the complex glandular acini are embedded.

In females, it is represented by the paraurethral glands (of Skene).

Situation

Precisely the prostate lies in the lesser pelvis, below the neck of the urinary bladder, behind the lower part of pubic symphysis and upper part of pubic arch, and in front of the ampulla of rectum.

Shape, Size and Weight

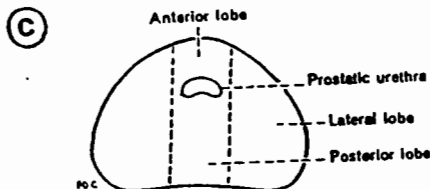
It resembles an inverted cone, measuring about 4 cm transversely at the base (width), 3 cm vertically (length), and 2 cm anteroposteriorly (thickness). It weighs about 8g.

Gross Features

Prostate has: (A) an apex directed downwards; (B) a base, (C) four surfaces, anterior, posterior and two inferolateral; and (D) five lobes, anterior, posterior, median (middle) and two lateral.

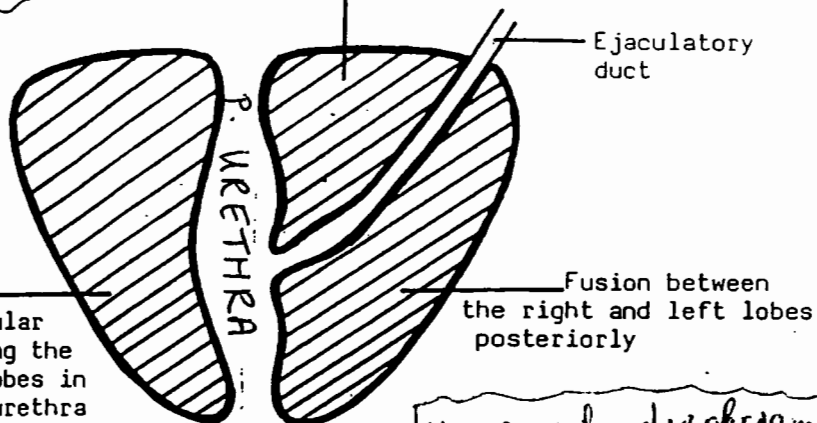
A. Apex

Apex is directed downwards, and rests on



Lobes in horizontal section

Isthmus
(a fibro-muscular band connecting the rt. and lt. lobes in front of the urethra)



Lobes of the prostate gland

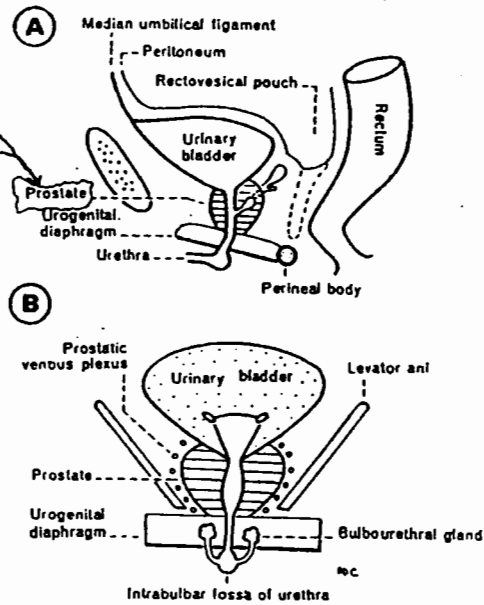


Fig. 321 Relations of the prostate gland. (A) Sagittal section through the male pelvic organs. (B) Coronal section through the urinary bladder and prostate.

the upper surface of the urogenital diaphragm. It is separated from the anal canal by the perineal body.

B. Base

Base is directed upwards, and is structurally

continuous with the neck of the bladder. The junction is marked by a circular groove which lodges veins of the vesical and prostatic plexuses.

Median lobe

(most important lobe)

- ① Inferior to the anterior fibres of levator ani
- ② formed of sphincter urethrae around membranous urethra
- ③ above the sphincter urethrae → sup. fascia of urogen. diaphragm
- ④ below it → inf. fascia of urogen. diaphragm

C. Surfaces

- ① **Anterior surface** is narrow and convex from side to side. It lies 2 cm behind the pubic symphysis, with retropubic fat intervening. Its upper part is connected to pubic bones by puboprostatic ligaments, and the lower end is pierced by the urethra.
- ② **Posterior surface** is triangular in shape, being flattened from side to side and convex from above downwards. It is separated from the rectum by the fascia of Denonvilliers. Near its upper border (in the depression) it is pierced on each side of the median plane by the ejaculatory duct. It is 4 cm from the anus, and can be easily palpated on digital examination through the rectum.
- ③ **Inferolateral surfaces** are related to the anterior fibres of levator ani (levator prostatae), separated by a plexus of veins embedded in its sheath.

D. Lobes

The urethra and the ejaculatory ducts traverse the prostate and divide it into 5 lobes, which represent the five groups of epithelial buds of its embryonic origin.

Anterior lobe is a small isthmus connecting the two lateral lobes in front of the urethra. It contains little or no glandular tissue and therefore seldom forms an adenoma.

Posterior lobe connects the two lateral lobes behind the urethra. It lies behind the median lobe and the ejaculatory ducts. Adenoma never occurs here, but the primary carcinoma is said to begin in this part.

Median (middle or prespermatic) lobe lies behind the upper part of urethra and in front of the ejaculatory ducts, just below the neck of the bladder. It produces an elevation in the lower part of the trigone of bladder, known as uvula vesicae. It contains much of glandular tissue and is the common site for an adenoma.

Lateral lobes lie one on each side of the urethra. It contains enough of glandular tissue which may form an adenoma in old age.

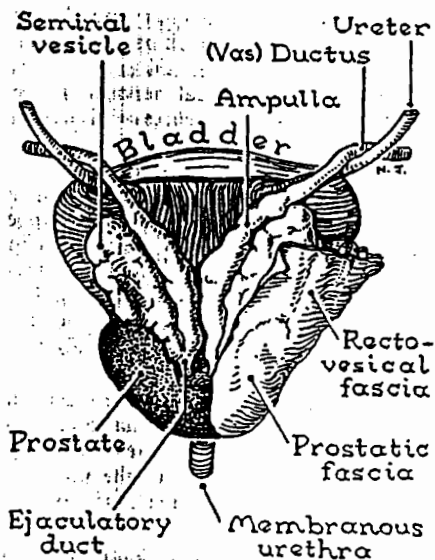
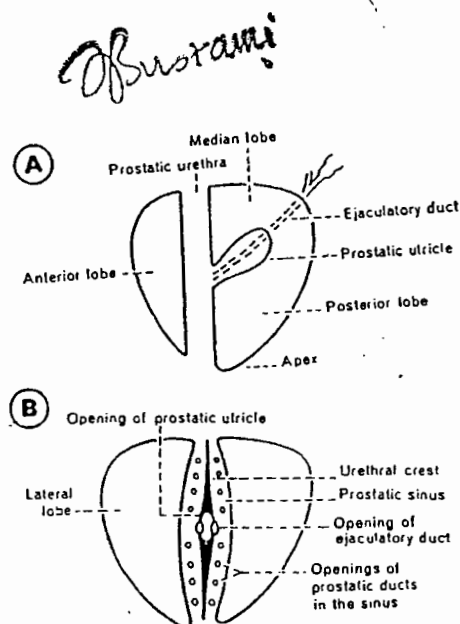


Figure 17.24. Posterior relations of the bladder.

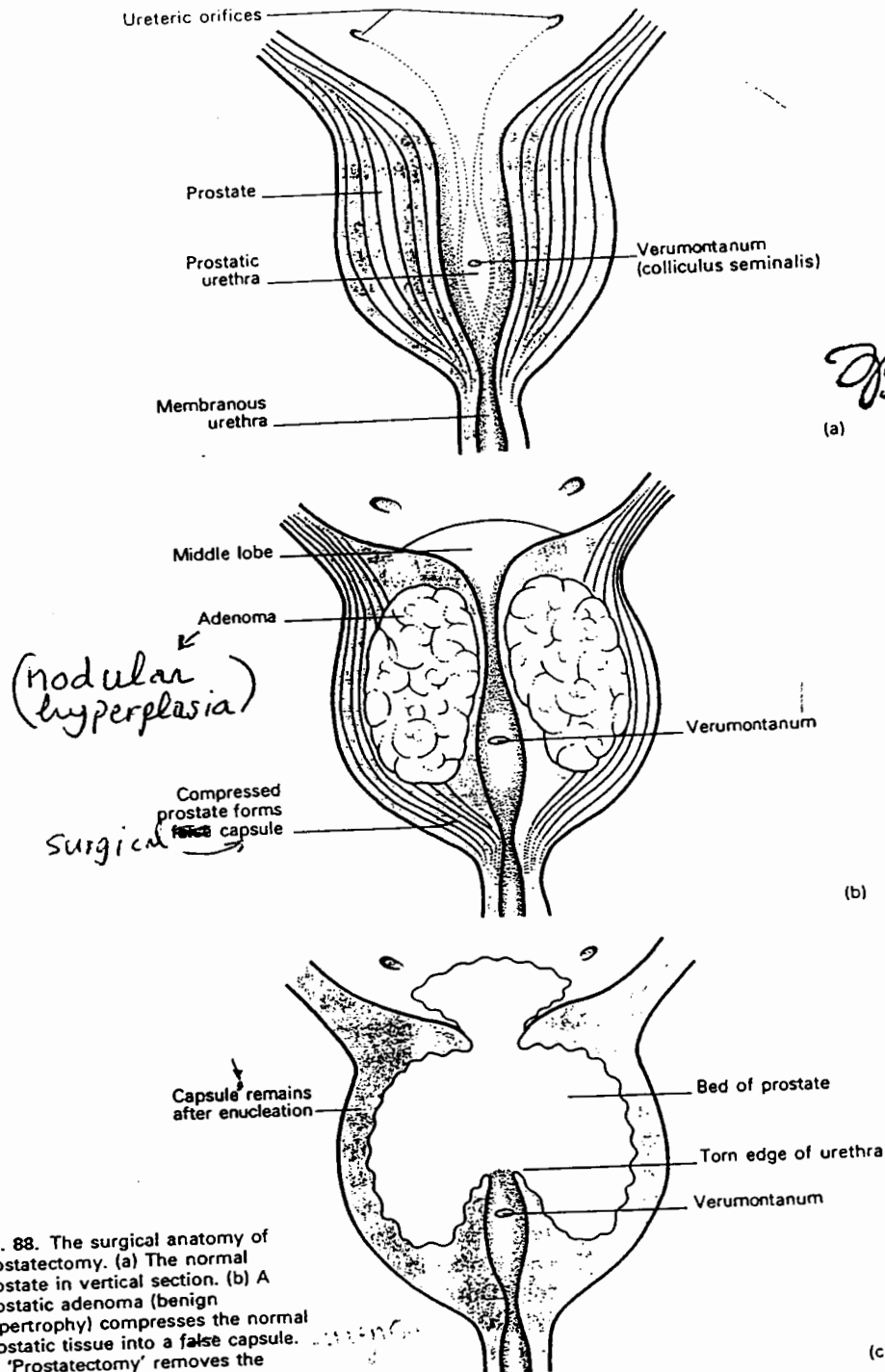


Fig. 88. The surgical anatomy of prostatectomy. (a) The normal prostate in vertical section. (b) A prostatic adenoma (benign hypertrophy) compresses the normal prostatic tissue into a false capsule. (c) 'Prostatectomy' removes the adenoma but leaves the capsule.

Capsules of Prostate

A. True capsule. It lies deep to the false capsule, and is formed by condensation of the peripheral part of the gland. It is fibromuscular in structure and is continuous with the stroma of the gland. It contains no venous plexus.

B. False capsule. It lies outer to the true capsule and is derived from the pelvic fascia. Anteriorly it is continuous with the puboprostatic ligaments. On each side, the prostatic venous plexus is embedded in it. Posteriorly it is avascular, and is formed by the rectovesical fascia of Denonvilliers. This is derived from the lower, obliterated part of rectovesical pouch which separated prostate from rectum during foetal life. Its origin is indicated by the central plane of cleavage. Others believe that rectovesi-

C. Surgical capsule !!

cal fascia is formed simply by condensation of loose areolar tissue.

Structures within the Prostate

(1) Prostatic urethra traverses the gland vertically at the junction of its anterior 1/3 with the posterior 2/3. (2) Prostatic utricle is a blind sac directed upwards and backwards. It opens at the middle of the urethral crest. (3) Ejaculatory ducts pass downwards and forwards, and open into the prostatic urethra on each side of the opening of prostatic utricle

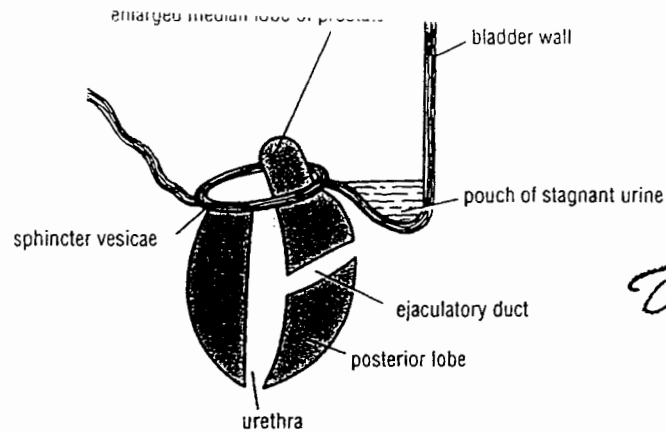
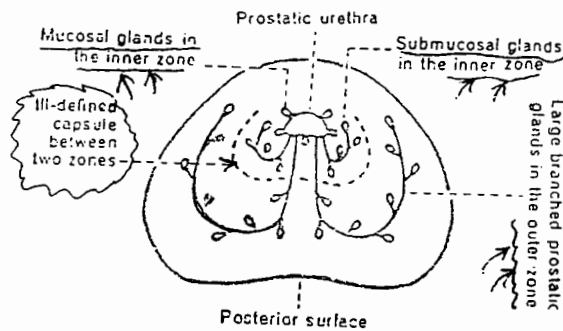


Figure 7-17 Sagittal section of a prostate that had undergone benign enlargement of the median lobe. Note the bladder pouch filled with stagnant urine behind the prostate.



→ There are 2 concentric zones separated by ill-defined irregular capsule (The zones are absent anteriorly) → The outer larger zone is composed of large branched glands and

(Horizontal section in prostate)

the inner smaller zone is composed of submucosal glands and a group of short simple mucosal glands surrounding the upper part of urethra. Remember the prostatic buds that arise from the mesodermal part of the prostatic urethra (i.e. posterior wall above the ejaculatory ducts) form the inner glandular zone while buds arising from the rest of the prostatic urethra (endoderm) form the outer glandular zone

↓
Nodular hyperplasia of the prostate arise mostly in the submucosal (transitional !!) and mucosal (periurethral) zones while most carcinomas arise in the peripheral (outer) zones

↓
 Remember the presence of DHT (dihydroxy testosterone) receptors on the prostate parenchymal cells !!. Age-related increase in estrogen levels may contribute to the development of nodular hyperplasia by increasing the expression of DHT receptors on Prostatic Parenchymal cells & thereby enhancing the effects of DHT.

Seminal Vesicles → 2 lobulated sacs, situated between the U-bladder & rectum. Each vesicle is about 2 inches long & is directed upwards & laterally

The lower narrow end[↓] forms the duct of the seminal vesicle which joins the ductus deferens to form the Ejaculatory duct. (42)

Seminal vesicles DO NOT form a reservoir for spermatozoa → Their secretion^(alkalizing) forms a large part of the seminal fluid (60%) → it is rich in fructose, citrate, prostaglandins & fibrinogen

↓
nutritive to
sperms (to form
ATP)

↓
① react with cervical mucus to make it more penetrable by sperms

② induce peristaltic contractions in the uterus & uterine tubes to propel the sperms up the tract

Prostate gland → Secretes a milky slightly acidic fluid (PH about 6.5) that contains ① Citric acid → used by sperms for ATP production via the Krebs cycle ② Several proteolytic enzymes such as prostate specific antigen (PSA), amylase & hyaluronidase → break down the clotting proteins from the seminal vesicles ③ acid phosphatase → unknown function. Prostatic secretions make up about 25% of the volume of seminal fluid

Bulbourethral glands = Cowper's glands about the size of peas. Located inferior to the prostate, on either side of the ~~membranous~~ ^{membranous} urethra within the urogenital diaphragm

& their ducts open into the spongy urethra. During sexual arousal they secrete alkaline fluid into the urethra that protects the passing sperms by neutralizing acids from urine in the urethra

⊕ Remember → epididymis is the primary location for the maturation & storage of sperms → they remain viable in the epididymis for months. At ejaculation sperms are expelled into the ductus deferens & then into the urethra → the ampulla of d.d. forms additional storage area for sperms.