KIDNEY & MALE GENITALIA

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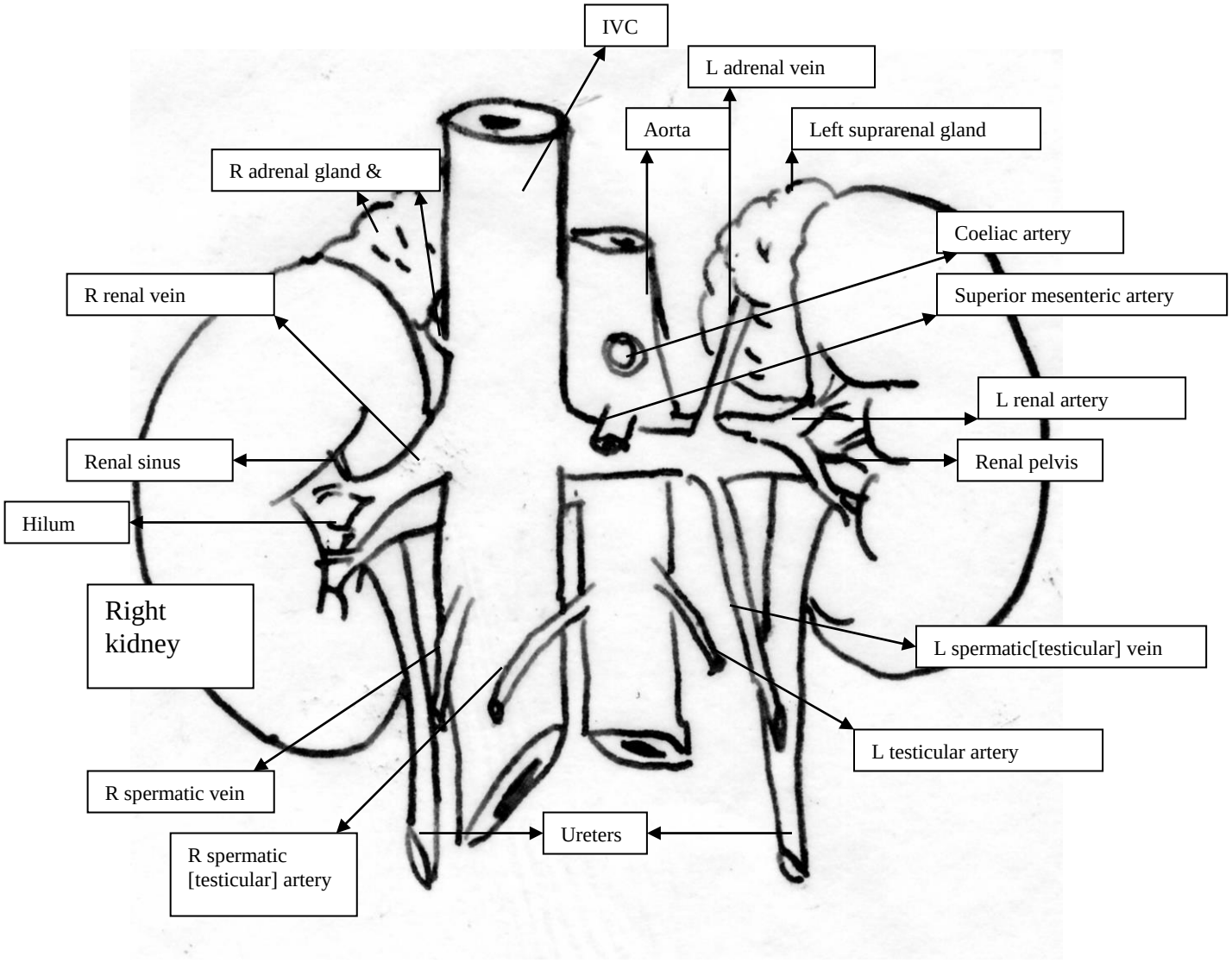


- ***The blood supply to the kidneys***

covering the psoas and quadratum lumborum and the **transversalis fascia**. Only inferiorly [caudally] it remains relatively open. For these reasons, blood or pus may progress downwards to the pelvis but not medially or to the opposite site. A rare condition is the **floating kidney** [hypermobile] which is able to move up and down within the fascial compartment.

RELATIONS

	Right hidney	**Left kidney**
• **Anteriorly**:	liver	stomach
	2nd part of duodenum	pancreas
	ascending colon	spleen
		descending colon

- **Medially**: right renal hilum

[from right to left] right ureter
inferior vena cava
right spermatic [testicular] vein
aorta
coeliac ganglion
coeliac plexus
sympathetic trunk
left spermatic vein
left adrenal vein
left renal hilum
left ureter

- **Superiorly** : diaphragm
suprarenal
- **Posteriorly:** sacrospinalis muscle
psoas and quadratus lumborum muscles
transversus abdominis
diaphragm
12^{th} rib
- **Inferiorly;** transversalis fascia
retroperitoneal fat
posterior peritoneum

The kidney comes in close relationship with 3 nerves:

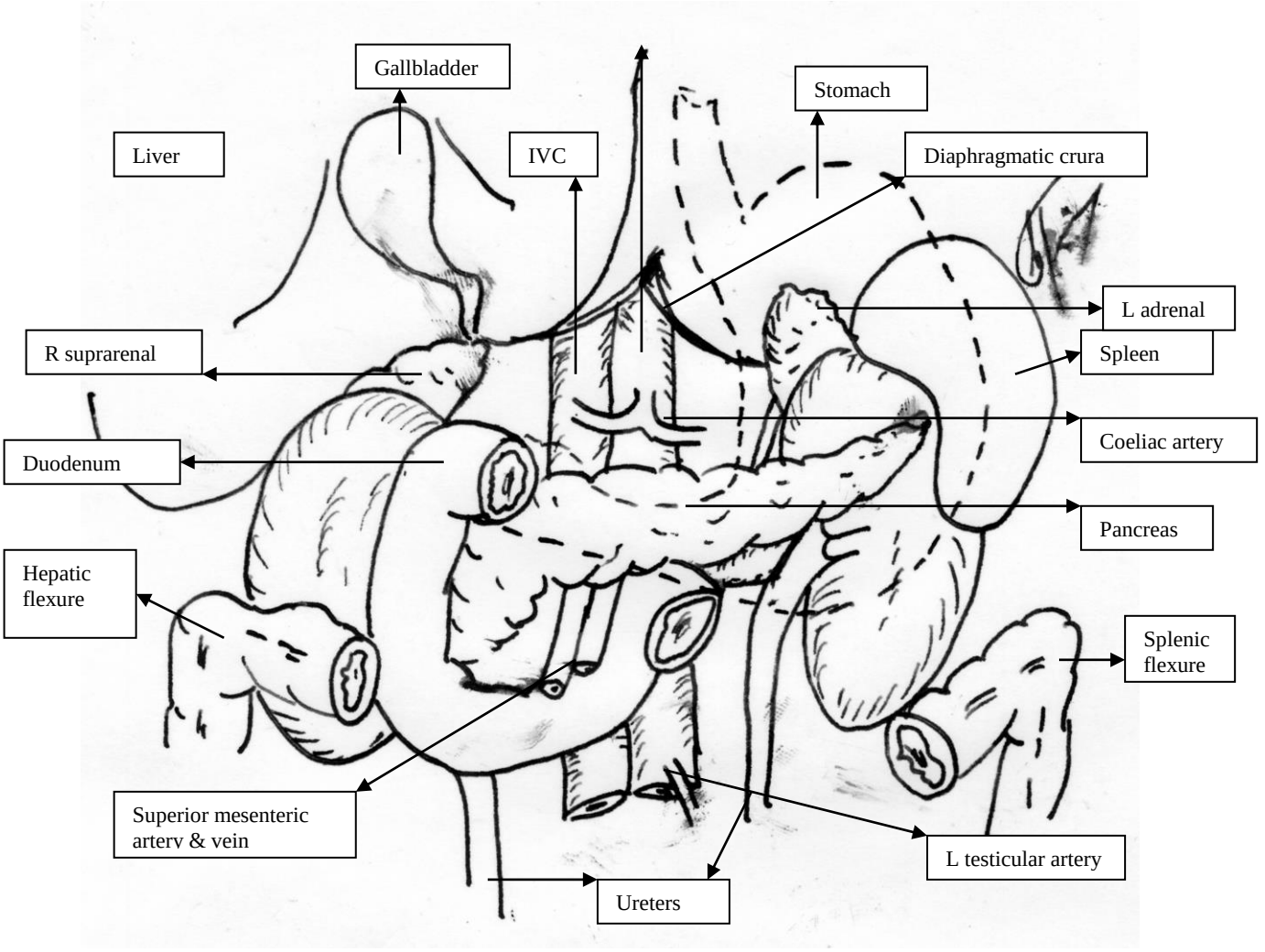
a. **Subcostal nerve** [T12] [and artery] lying on the transversus abdominis, above the upper renal pole
b. **Iliohypogastric nerve** [L1]
c. **Ilioinguinal nerve** [L1]

The latter two lie on quadratus lumborum, piercing the transversalis fascia at the lower pole of the kindey. They give motor twigs and lateral cutaneous branches; then they continue their course between the transversus abdominis and internal oblique muscles towards the inguinal canal.

EXPOSURE OF THE KIDNEY THROUGH THE LOIN

The incision is made halfway between the **12^{th} rib** and the **iliac crest**, extending posteriorly to the **lateral border of the erector spinae**. The **latissimus dorsi** and the **serratus postero-inferior**

Aorta



- ***The anatomic relations of kidneys***

[behind latissimus dorsi] are divided, identifying medially the **free posterior border of the external oblique** and the **lumbar triangle** which is formed by the lower border of serratus

anterior, the upper border of internal oblique and the lumbar fascia laterally. The floor of the triangle is formed by the **transversus abdominis** and its aponeurosis.
When the internal oblique and transversus are divided the peritoneum becomes visible and can be retracted medially. At the lateral borger of the incision lie the erector spinae and quadratus lumborum, covered by the lumbar and renal fascia, The **subcostal nerve** lies 1cm below the cosrtal margin and should be preserved. The bulk of the kidney is palpable within a fatty tissue cushion. The ureter is identified as it runs at the medial border of the psoas muscle.

THE URETER

25cm long with a thick muscular wall [this is why it shows a **worm-like movement** when stroked] and throughout its abdominal and upper pelvic course it adheres to the overlying peritoneum.

- **URETERIC [RENAL] PELVIS**

Has been described in the kidney section.

- **ABDOMINAL URETER**

Lies on the medial aspect of **psoas major**, which separates it from the **transverse vertebral processes** of L2-L5. The right ureter is covered by the 2nd part of the duodenum and then lies lateral to the inferior vena cava. It crosses the **iliac bifurcation** or the external iliac artery immediately after its origin and is crossed by the testicular, right/left colic vessels and then passes above the **pelvic brim**, behind the mesosigmoid and sigmoid colon on the left.

- **PELVIC URETER**

Runs on the **lateral pelvic wall**, in front and lateral to the **internal iliac artery**, crosses the **superior vesical artery** and runs lateral to the internal iliac vein. Just in front of the **ischial spine** it turns forwards and medially. In men, it lies above the **seminal vesicle** and is crossed by **the vas deferens** before entering the bladder. In women it passes above the **lateral fornix of the vagina**, 2.5cm lateral to the **supravaginal part of the cervix**, below the **broad ligament** and the **uterine vessels** which hook around the terminal ureter.

- **INTRAVESICAL URETER**

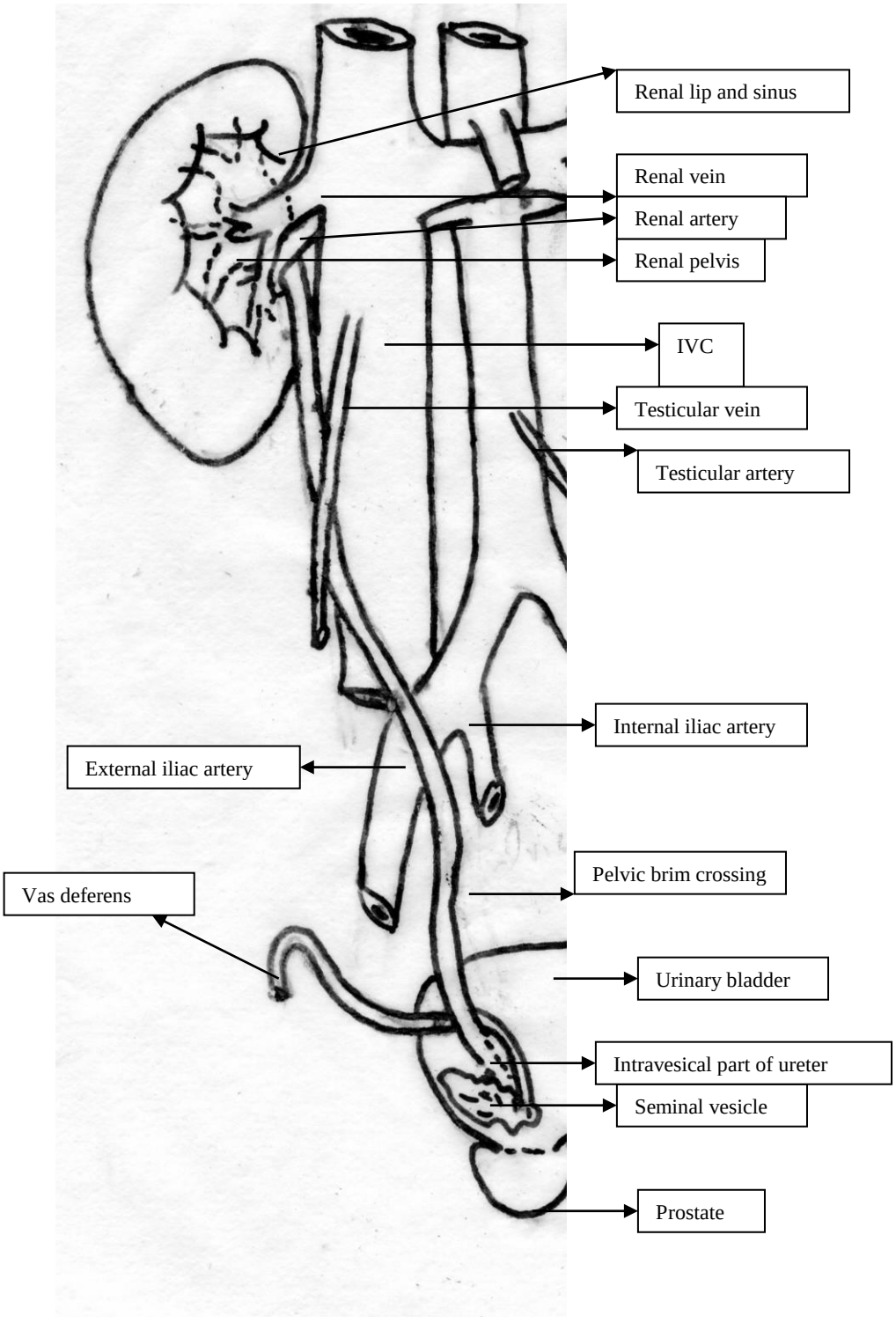
Has an oblique 2cm course within the bladder wall, which acts as a sphincteric valve-like mechanism [with the cooperation of the vesical muscle] to prevent reflux.

NARROWINGS

a. Junction of abdominal ureter to ureteric pelvis
b. Point crossing the pelvic brim
c. Ureteric orifice in the bladder [the narrowest]

BLOOD SUPPLY

1. Superior part: renal artery [and small twigs from the aorta and lumbars]
2. Most of abdominal ureter: testicular artery, common and internal iliac
3. Inferior part: vesical artery



- ***The course of ureter***

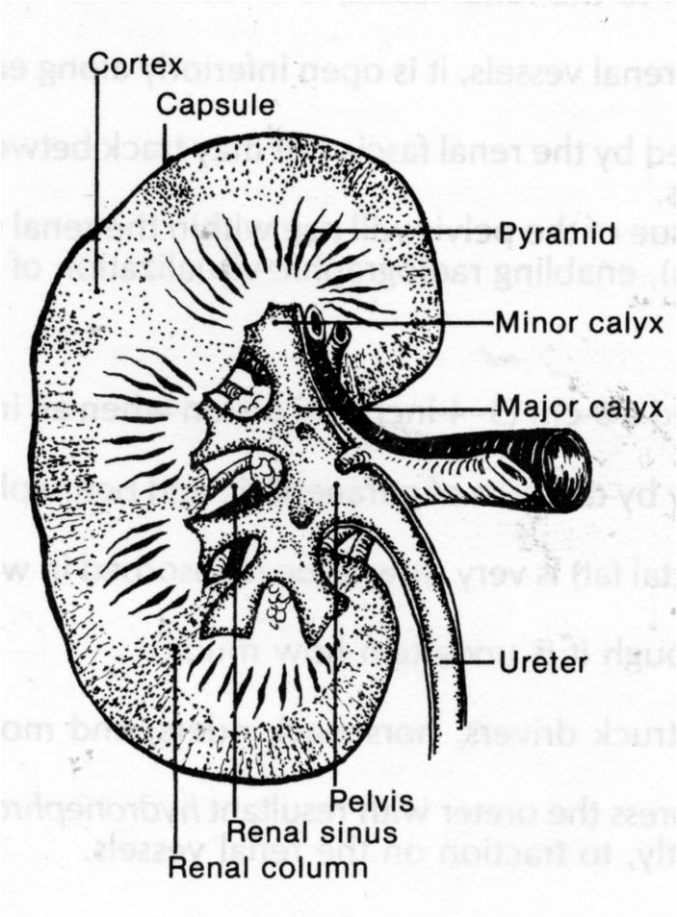
EMBRYOLOGY OF KIDNEY & URETER

Their origin is mesodermal. The first structure to appear is the **pronephros**, which later disappears but the distal part of its duct [**mesonephric - Wolffian duct**] receives tubules from the next organ to develop, the **mesonephros**. The latter also disappears but a diverticulum appears at the lower edge of the **mesonephric duct**, developing into the **metanephric duct**. A cap of tissue on top of it differentiates to become the **metanephros** which finally develops into glomeruli and proximal tubules [**renal cortex**]. The metanephric duct differentiates into collecting tubules, calyces, pelvis and ureter. The rest of the **mesonephric duct** loses its connection with the metanephric duct and atrophies in the female while in males it becomes the **epididymis** and **vas deferens**.
The kidney first develops into the **pelvis**, receiving blood from some twigs from the iliac arteries. Then it **migrates upwards**, perfused by a series of vessels originating between the hindgut [IMA] and midgut artery [SMA] which involute and obliterate when the renal artery appears.

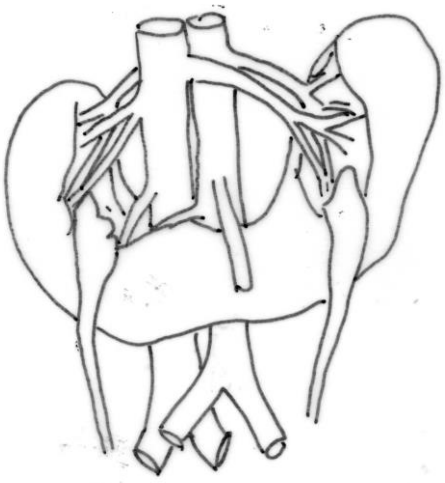
ANOMALIES
1. **Bifid renal pelvis**
2. **Aberrant renal arteries** [due to upward migration]
3. **Mid-aortic syndrome**
4. **Pelvic kidney**, without fatty capsule [failure of migration]
5. **Horseshoe kidney** [the left and right metanephric masses fuse at the midline]
6. **Congenital absence of kidney** [1:2500]
7. **Congenital polycystic kidney** [failure of the metanephros to link with some of the metanephric duct collecting tubules]
8. **Double, duplicated or bifid ureter** [<1%, due to presence of a double metanephric duct diverticulum; the upper ureter enters the bladder below the lower ureter]
9. **Retrocaval ureter**

THE URINARY BLADDER

The bladder is a vesicle having the capacity to lie comfortably with 250ml of urine. In young children [up to 3-4 years] it protrudes above the pelvis, being an abdominal, although extraperitoneal structure.
Its muscle coating has a **criss-cross arrangement** of the muscle fibers.The circular layers condense around the **internal orifice [meatus**] to form the **internal [involuntary] urethral sphincter**. The ureters enter from postero-superior surface and after transversing obliquely the bladder wall for a 3-4cm distance they open at the **ureteric orifices** which lie 2.5 cm apart [5cm during cystoscopy due to bladder distention by water to improve view]. The internal meatus and the two ureteric orifices form an area called the **ureteric triangle** [**trigone**] which is always smooth [the mucosa is adhered to the submucosa/muscle] while the rest of the inner surface of



- ***Normal kidney anatomy***



- ***Horseshoe kidney [in front of aorta & IVC]***

the bladder has **mucosal folds**, due to loose adherence of the submucosaq to the muscle coat. A fold, the **interureteric ridge** joins the two ureteric orifices.

BLOOD SUPPLY & DRAINAGE.

Is provided from the **superior** and **inferior vesical arteries**, branches of the **internal iliac artery**.

The **vesical veins** start from a **plexus** on the inferolateral surface of the bladder, draining into the **internal iliac vein**.

The lymphatics drain to the **iliac** and **para-aortic nodes**.

RELATIONS

- **Superiorly**:peritoneum
  coils of small intestine
  sigmoid colon
  uterus in females
- **Inferiorly**: prostate in males
  vesical and prostatic venous plexus
  pelvic fascia in females
- **Laterally**: levator ani
  obturator internus
- **Posteriorly**:

	In men	**In women**
	vas deferens	vagina
	seminal vesicles	supravaginal cervix
	retrovesical fascia [Dennonvillieres]	
	rectum	

- **Anteriorly**:pubis
  retropubic **space of Retzius** [fat filled]

THE URETHRA

MALE URETHRA

is 20cm long.

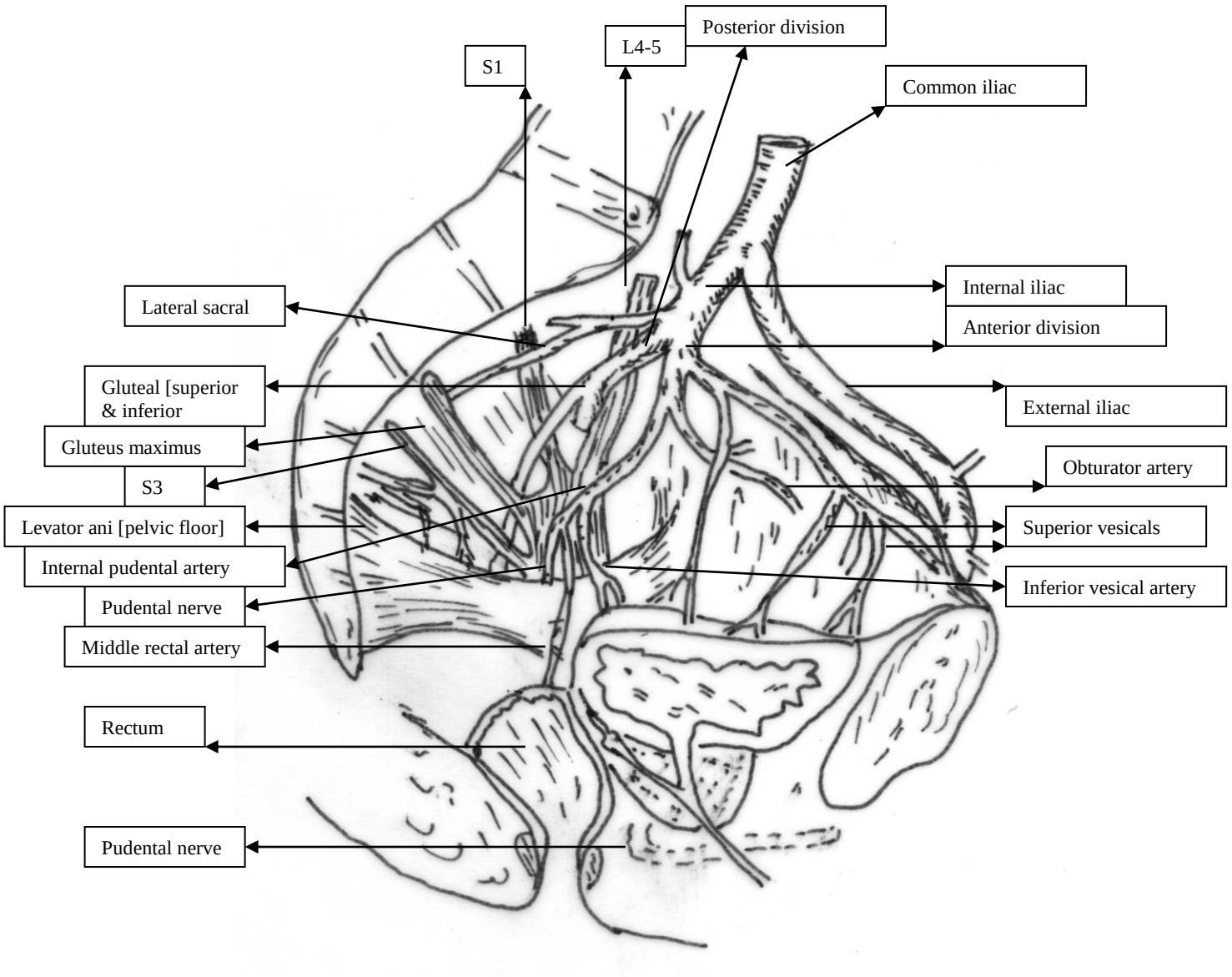
- **PROSTATIC PART**

3cm long, traversing the prostate.

The posterior wall forms an elevation [**urethral crest**] and two shallow depressions, the **prostatic sinuses**, where the **prostatic ductules** open. At the mid of the crest is a prominence, the **colliculus seminalis** or **verumontanum**, where opens a blind [sinus] tract, the **prostatic utricle**, originating from from the middle lobe of the prostate. On either sites of it open the **ejaculatory ducts**, formed by the union of the **seminal duct** and the **vas deferens**.

- **MEMBRANOUS PART**

Its length is 2cm and it pierces the **external urethral sphincter** [formed by the **deep transverse perineal muscle**] and the **urogenital diaphragm**, formed by a condensation of the **deep perineal fascia**.



- ***The urinary bladder with the blood supply from the internal iliac artery***

- **SPONGY URETHRA**

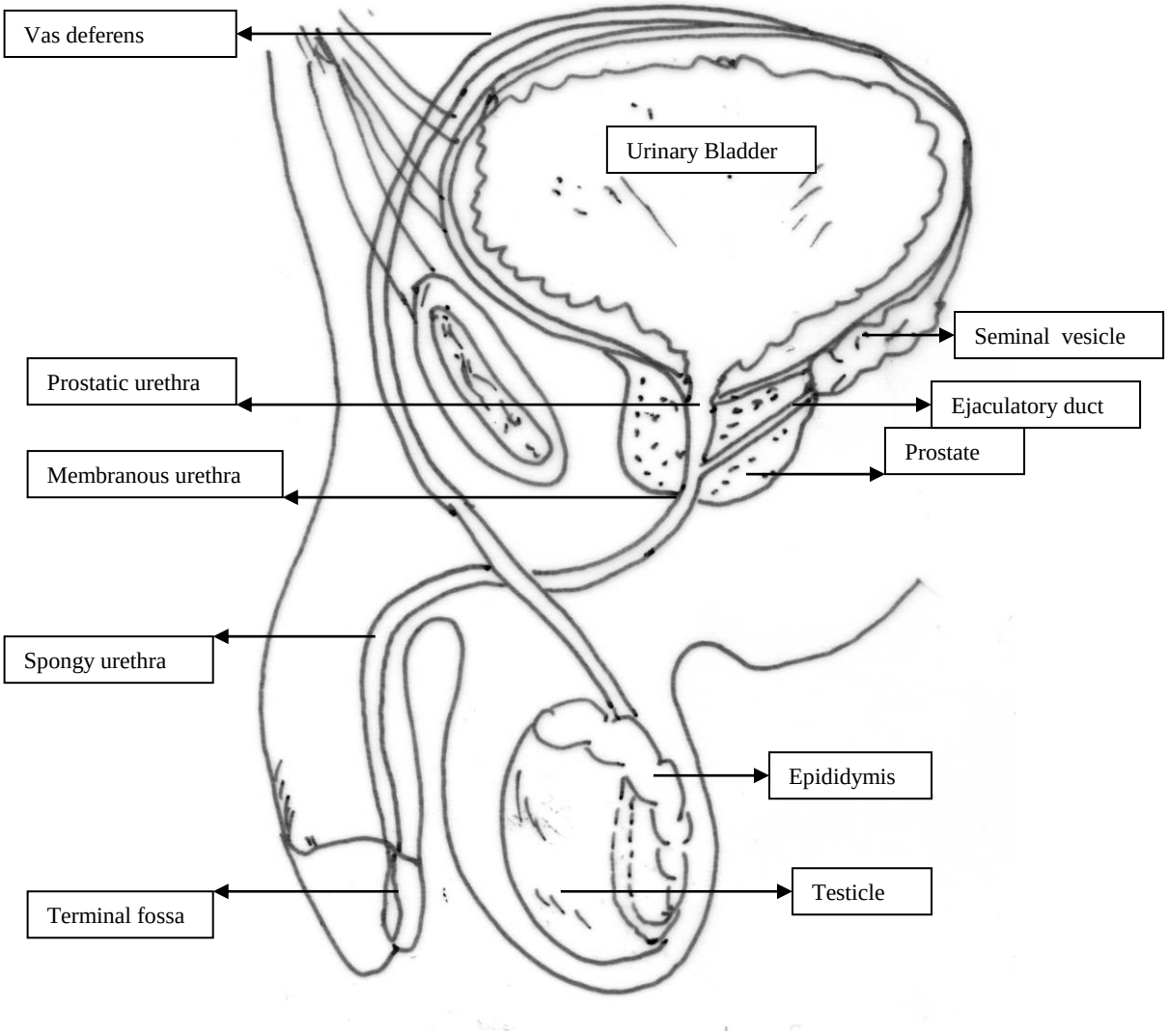
It is 15cm long and transverses the **corpus spongiosum** of the **penis**. At its distal end it forms a fossa [**terminal fossa**] bearing a mucosal fold, the **lacuna magna**. Has a narrow external orifice.

FEMALE URETHRA

Its length is 4cm and it opens 2.5cm behind the **clitoris**, lying in front of the **vagina**. The external sphincter is a weak, tenuous structure, so control depends on the internal sphincter.

THE URINARY MUCOSA

The urinary tract is lined by **transitional epithelium** [**uroepithelium**], from the renal pelvis as far as the entry of the ejaculatory ducts to the urethra. The rest of the urethra is lined by **columnar epithelium**, except at its termination, where it becomes **squamus**.



- ***The course of male uretrha***

THE MALE GENITAL ORGANS

VAS DEFERENS

Its length is **45cm**, the same as the distance from incisor teeth to cardia, the length of thoracic duct and spinal cord.
It arises from the **epididymis**, traverses the **scrotum**, passes trough the **inguinal canal** [accompanied by the **vas deferens artery**, a branch of the **inferior vesical artery**], passes the **pelvis at its lateral inner wall** [crosses the obturator nerve, artery and vein] up to the **ischial tuberosity** where it turns medially and attached to the **bladder** travels towards its base, crosses the ureter and at the posterior midline enters the **prostate** where it joins the **seminal duct** coming from the seminal vesicle [located posterolaterally] forming the **ejaculatory duct**.
Due to this complex anatomy there is a risk of epididymitis after prostatectomy.

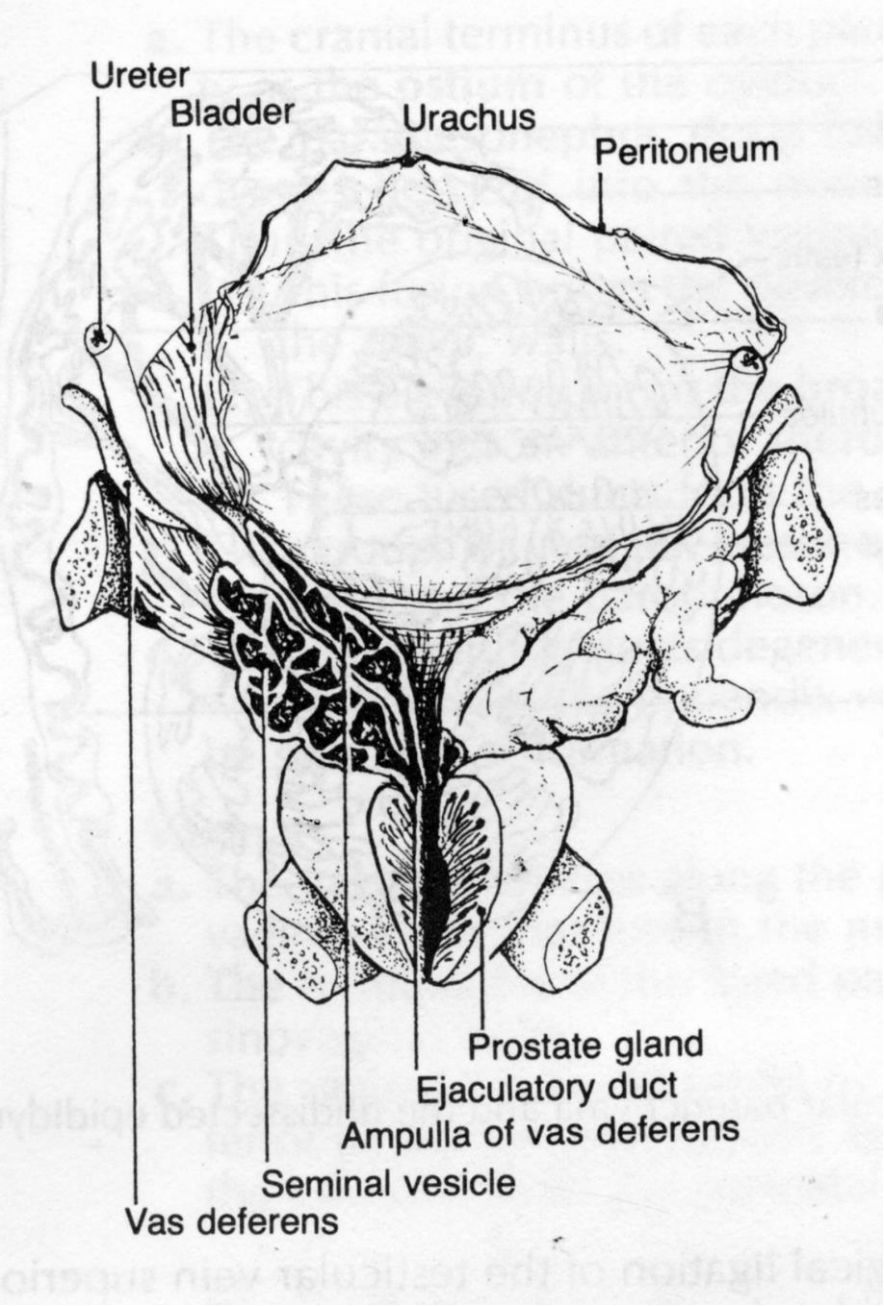
SEMINAL VESICLES

They represent **coiled tubes**, 5cm in length, lying on the posterolateral surface of **the base of the bladder** on either side. The **seminal duct** arises from each vesicle which joins the **vas deferens** within the prostate substance forming the **ejaculatory duct** which opens in the **prostatic urethra** on the side of the **urethral crest**.

THE PROSTATE GLAND

Is a pyramidal, fibromuscular organ, 3cm in diametre, surrounding the prostatic urethra.

- **RELATIONS**
  - **Superiorly**: neck of the bladder
    internal meatus
    prostatic and vesical venous plexus
  - **Inferiorly**: external sphincter of the bladder
    urogenital diaphragm
  - **Anteriorly**: pubis
    space of Retzius [retropubic]
    puboprostatic ligament [attached to the apex of the prostate]
  - **Posteriorly**: Denonvillieure's fascia
    rectum
    seminal vesicles
    vas deferens
  - **Laterally**: levator ani [puborectalis muscle]



- ***The prostate and seminal vesicles [on posterior aspect of bladder]***

- **CAPSULES**
- **True capsule**: thin fibrous sheath surrounding the gland
- **False**: extraperitoneal fascia. [The prostatic venous plexus lies onit]
- **Pathologic capsule**: It is a term to notify the presence of normal gland which is compressed around an enlarging adenoma and gives the false impression of capsule.

- **BLOOD SUPPLY**
- **Inferior vesical artery** [the third medial branch of the internal iliac artery], entering the gland from its side.
- **Prostatic venous plexus**, which receives the dorsal vein of the penis and drains into the internal iliac vein. There is also communication to the **prevertebral venous plexus** [**valveless vertebral veins of Bateson**] which lie in front of the vertebral bodies [this explains the high occurrence of vertebral metastases in prostatic cancer].

- **SURGICAL APPROACH TO THE PROSTATE**

1. **Transvesiaclly**
2. **Retropubically**
3. **Transperitoneally**
4. **Transurethrally**

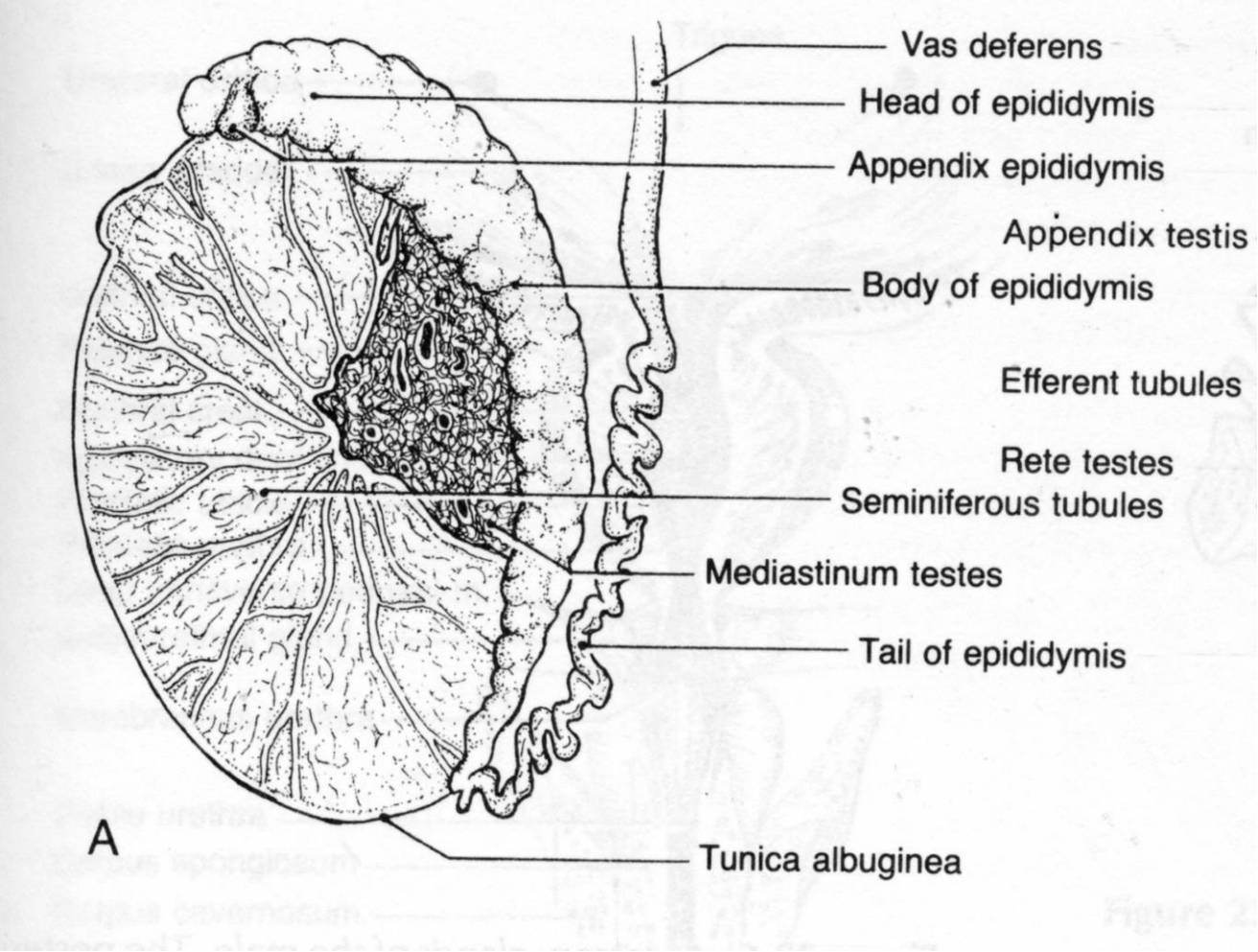
THE SCROTUM

Is a skin pouch that covers the testes [the left usually lies at a lower level], divided by a **median raphe** in two parts. The subcutaneous tissue does not contain fat but an involuntary muscle, the **Dartos muscle**. The latter and the superficial somatic fascia [**Colle's fascia**] form the **Dartos tunic**. It is incompletely divided in two compartments [left and right] by a **septum** which is incomplete superiorly []this is the reason why bilateral collections may develop when there is unilateral extravasation].
The subcutaneous scrotal tissue is continuous with the **abdominal wall fascia**, while the **spermatic fascia** is continuous with the **cremaster** and abdominal wall muscles [for this reason abdominal extravasations may gravitate to the scrotum]
Lymph drainage is to the **inguinal nodes**.

TESTIS & EPIDIDYMIS

- **STRUCTURE**

The **testis** contains 200-300 **lobules**, each one containing 1-3 convoluted **seminiferous tubules** [60cm in length]. The latter anastomose posterosuperiorly into a plexus, the **rete testis**, from which 12 **efferent ductules** arise. They join to form the **head of the epididymis**. They then fuse to a single convoluted tube which consists the **body and tail of epididymis**.

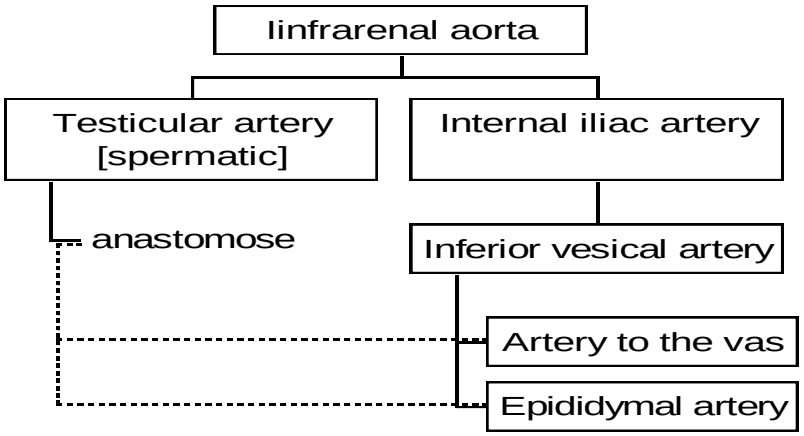

Vas deferens
Head of epididymis
Appendix epididymis
Appendix testis
Body of epididymis
Efferent tubules
Rete testes
Seminiferous tubules
Mediastinum testes
Tail of epididymis
A
Tunica albuginea

- ***The testis***

Each testis is contained within a fibrous capsule, the **tunica albuginea**; then is enclosed within **8 separate coverings**: tunica vaginalis [invagination of the peritoneum]
fat layer [continuous with preperitoneal fat]
internal spermatic fascia [continuous with transversalis fascia]
cremasteric fascia [cremaster muscle, internal oblique muscle]
external spermatic fascia [arising from external oblique muscle]
superficial somatic fascia [Colle's fascia]
Dartos muscle
skin

The **epididymis** lies on the posterosuperior border of the testis, forming a medial groove between itself and the testis, the **sinus epididymis**. Both epididymis and testis bear a small stalked body at their upper extremity, the **appendix testiculae** and **epididymae** [remnants of the **cyst of Morgagni**] which are susceptible to torsion.

- **BLOOD SUPPLY & DRAINAGE**



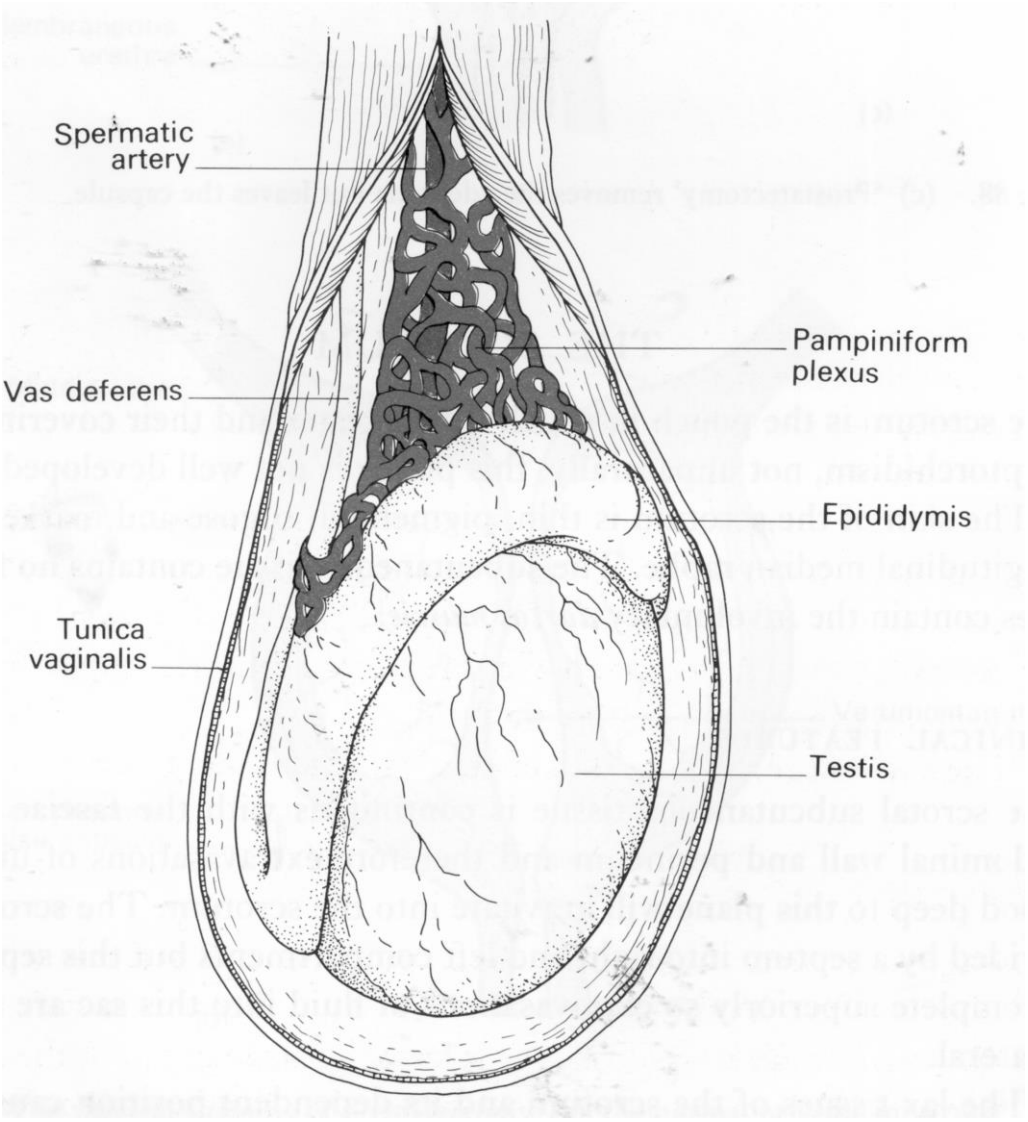
The veins form a **pampiniform plexus**, located between the vas and epididymis, which fuse above the inguinal canal to a single vessel the **testicular [spermatic] vein,** of which the right drains to the **inferior vena cava** while the left drains into the **left renal vein** at an acute angle [this is the reason for the incidence of varicocele on the left side].
The **lymphatics** accompany the testicular vessels and drain to the paraaortic nodes at the level of the renal arteries [while the scrotal lymphatics drain to the groin].

- **DEVELOPMENT**

The testis arises from the germinal ridge of the mesoderm and is formed on the posterior abdominal wall. The epididymis and vas deferens originate from the mesonephric duct and link with the testis.
As the testis enlarges migrates caudally, guided by a mesenchymal strand, the gubernaculum testis, and through the processus vaginalis of the peritoneum passes the inguinal canal to enter the scrotum. The processus vaginalis obliterates at about the time of birth.

ANOMALIES

1. Indirect inguinal hernia [patent processus vaginalis]
2. Congenital inguinal hernia [the testis forms part of the wall of the sac]



- ***The testicle with the coatings and the bllod supply [spermatic artery and spermatic vein formed by the pampiniform plexus]***

3. Failure to descend
4. Retraction of testis
5. Ectopic testis
6. Hydrocele [surrounds the testis]
7. Epididymal cyst [lies above and behind the testis]

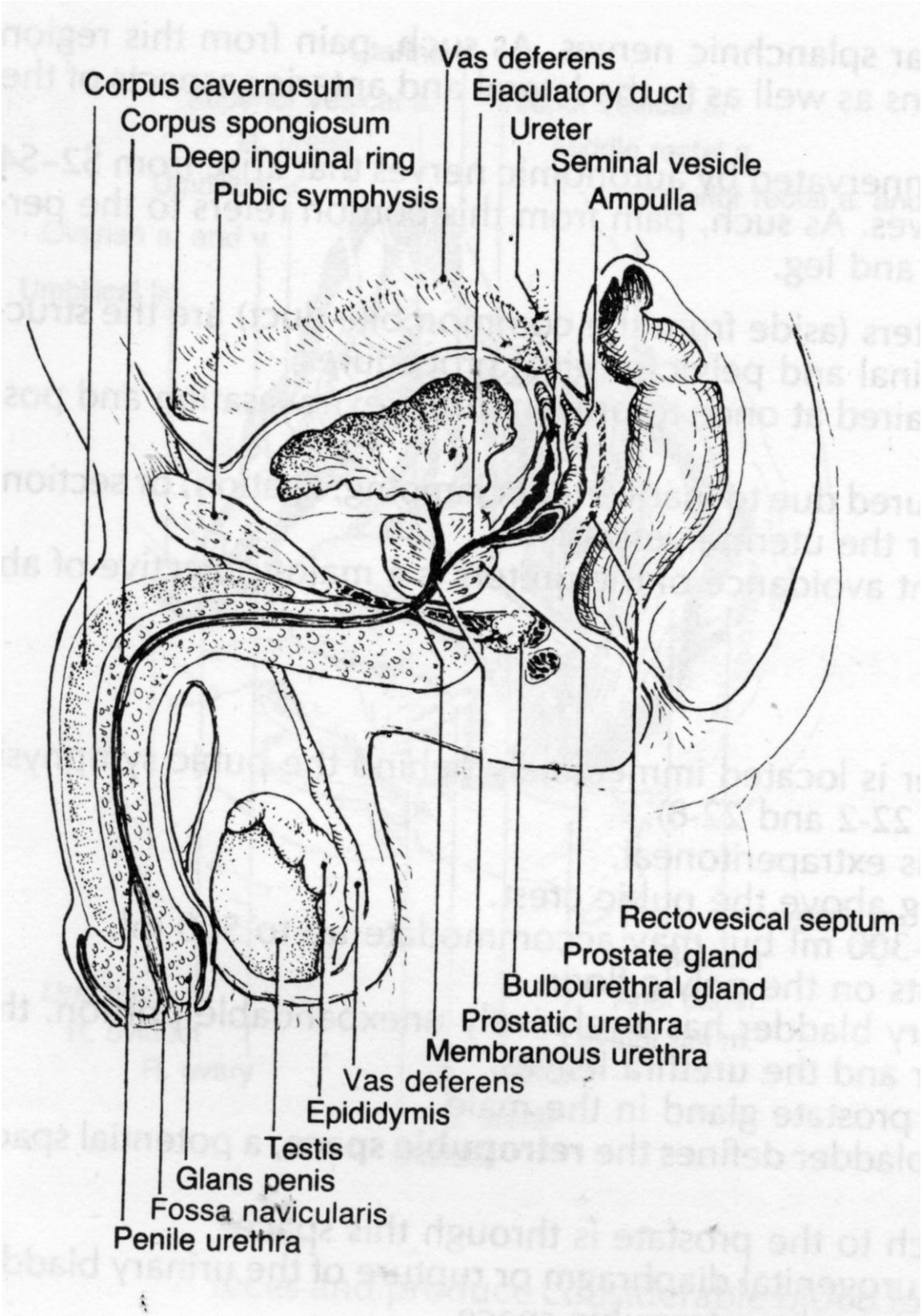
THE PENIS

Is formed by special **erectile tissue** which forms three tubular components: the **two crura** which lie anterosuperiorly are separated by the **septum penis** and each one contains the **corpus cavernosum** and the posteromedially **placed bulb** [starts as the **root of the penis**] which contains the **corpus spongiosum** and is transversed by the **urethra** [spongy part]. The corpus spongiosum enlarges at its termination, forming the **glans** and **corona penis**.
It is covered by 3 tubular envelopes:

1. **skin** [forms the **prepuce** and the **frenulum**]
2. **loose laminated areolar tissue**
3. **deep fascia** of the penis

Ligaments: **suspensory ligament** of penis [attached to the pubic symphysis]
perineal membrane, urogenital diaphragm, transverse perineal ligament

Blood supply is given by the **dorsal artery** of the penis [branch of the **internal pudental**] which gives an **artery for each crus** and an **artery to the bulb**.
The veins form the **dorsal vein** which drains in the **superficial iliac vein** while the corpus cavernosum and spongiosum drain to the **prostatic venous plexus**.
It is innervated by the **dorsal penile nerve**.



- ***The male genital organs***

THE FEMALE GENITAL ORGANS

THE VULVA [PUDENTUM]

- **LABIA MAJORA**: Hair prominent skin folds traveling from the mons pubis to the midline of the perineum.
  In the deep posterior part of labia majora lie the **bartholin glands**, pea-shaped, mucous secreting glands, draining by a 2.5cm duct in front of the hymen. Anteriorly, each gland is partially covered by the bulb of the vestibule, a mass of cavernous erectile tissue which passes forward to reach the root of cliroris.
- **LABIA MINORA**: They are lips of soft skin enclosed by the major labia. They split anteriorly to encircle the **clitoris** [forming the prepuce anteriorly and the frenulum posteriorly], while posteriorly they meet in a sharp fold, the **fourchette**. They enclose the **vestibule**, an area in which the **urethral** and **vaginal orifices** open. The latter is guarded in the virgin by athin mucosal fold, the **hymen** [if imperforated, the result will be **haematocolpos** during menses]. After coitus the hymen tears and after giving birth to a child only a few tags, the **multiforme carunculae** remain.
- episiotomy
  Is an incision in the perineum. Starts at the fourchette and extends 3cm mediolaterally on the right side. Skin, subcutaneous fat, vaginal epithelium, perineal body and superficial transverse perineal muscle are divided.

THE VAGINA

Surrounds the **cervix**, forming the anterior, posterior and lateral **fornices**, representing continuous gutters which are shallow anteriorly and deep posteriorly. The length of the vagina is thus 7.5cm prom its orifice to the cervix and 10cm till the dome of the lateral fornice.

- **RELATIONS**
- **Anteriorly**:base of the bladder and urethra
- **Posteriorly**: perineal body
  anal canal
  rectum
  peritoneum, covering the upper quarter of the vagina [rectouterine fold & pouch]
- **Laterally**: levator ani, pelvic fascia, uterus

- **BLOOD SUPPLY**

From the **internal iliac artery** via the following branches: **vaginal, uterine, internal pudental and middle rectal arteries**.
The veins constitute a **plexus** which fuse to the **vaginal vein**, draining to the **internal iliac vein**.