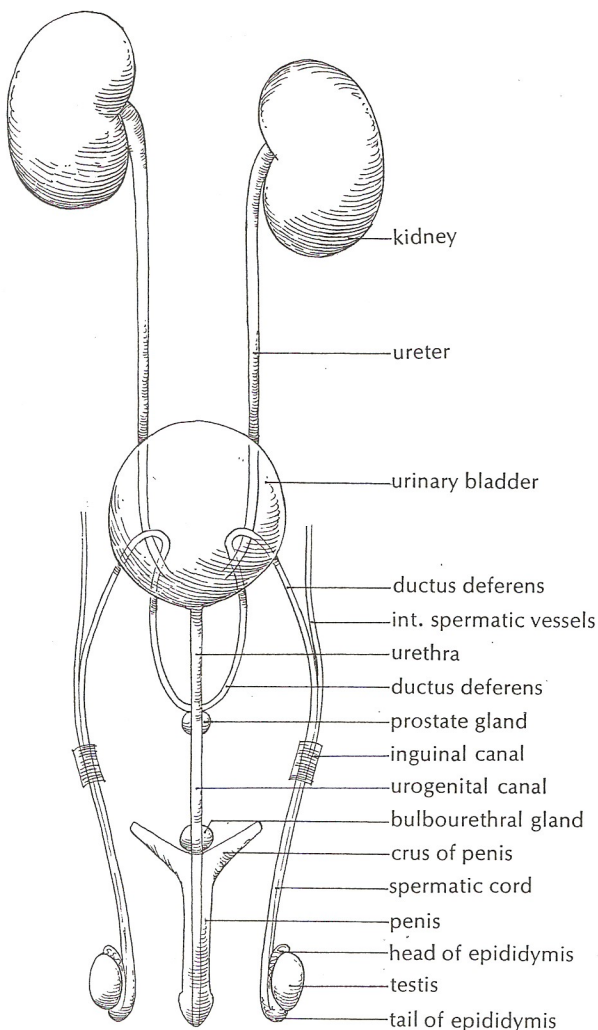


THE UROGENITAL SYSTEM

EXPOSURE OF KIDNEYS AND URETERS



After removing the liver and spleen, clear away fat, peritoneum, and connective tissue as necessary to identify the structures illustrated in Figure 39 if your specimen is a male, or in Figure 42 if your specimen is a female. Special care should be taken to preserve the internal spermatic vessels and the ureter, which are surrounded by fat and may be accidentally cut. Review the branches of the abdominal aorta and postcava as described on page 68.

The kidneys are retroperitoneal; they are situated on either side of the vertebral column about the level of the third to fifth lumbar vertebrae, and are surrounded by fat. The right kidney normally lies somewhat anterior to the left kidney. The ductless adrenal gland lies near the anterior end of the kidney.

The kidney is enclosed in a fibrous renal capsule which may be separated easily from its surface. Strip off the capsule, observing its attachment to the ureter and renal vessels. The central depression in the medial surface of the kidney is termed the hilus; the renal vessels and the ureter join the kidney at this point. Trace the ureters to the bladder, observing their relations to the uterine horns (in the female) and to the ductus deferens (in the male).

Remove both kidneys. Use a razor blade to make a series of thin parallel longitudinal sections of the left kidney, continuing until you reach the renal papilla. Arrange the sections in serial order. The kidney should resemble Figure 40.

Similarly, make a series of cross sections of the right kidney, identifying the structures illustrated in Figure 41.

The substance of the kidney consists of a superficial cortex and a deeper, darker-colored medulla. The central cavity of the kidney is the renal sinus. It contains fat, branches of the renal vessels, and the renal pelvis, a cup-shaped extension of the anterior end of the ureter. The renal papilla is a cone-shaped projection enclosed by the pelvis.

Near the hilus, the renal artery and vein divide into dorsal and ventral branches. Within the kidney each branch divides into five or more interlobar arteries and veins. Near the dividing line between cortex and medulla the interlobar arteries and veins are connected with each other by the arcuate arteries and veins.

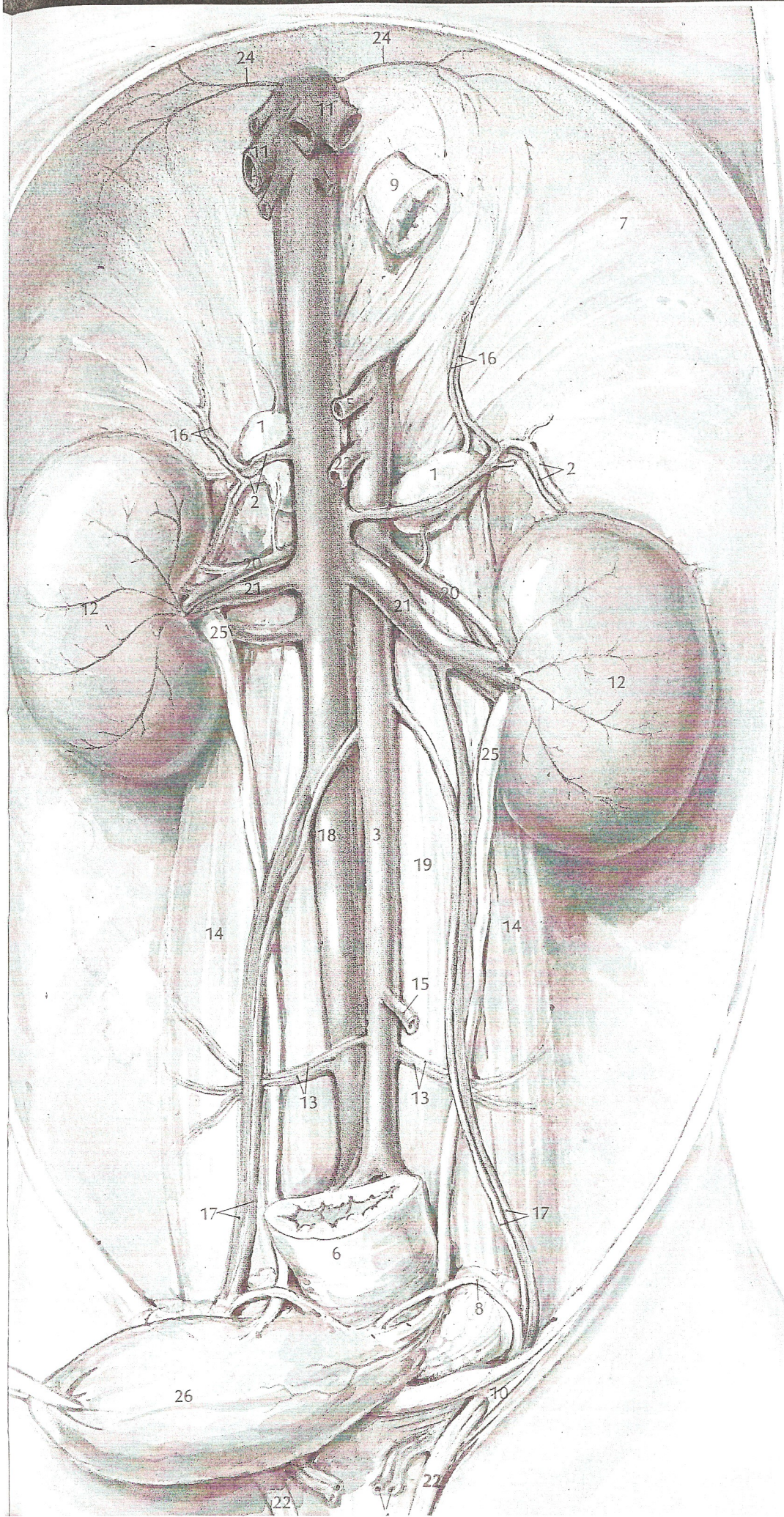


FIG. 39.
THE KIDNEYS AND
ABDOMINAL VESSELS
IN A MALE

- 1 adrenal gland
- 2 adrenolumbar artery
- 3 aorta
- 4 branch of deep femoral artery and vein
- 5 celiac artery
- 6 colon
- 7 diaphragm
- 8 ductus deferens
- 9 esophagus
- 10 external inguinal ring
- 11 hepatic veins
- 12 kidney
- 13 iliolumbar artery and vein
- 14 iliopsoas
- 15 inferior mesenteric artery
- 16 inferior phrenic artery and vein
- 17 internal spermatic artery and vein
- 18 postcava
- 19 psoas minor
- 20 renal artery
- 21 renal vein
- 22 spermatic cord
- 23 superior mesenteric artery
- 24 superior phrenic vein
- 25 ureter
- 26 urinary bladder

FIG. 40.
FRONTAL SECTION OF THE KIDNEY

- 1 arcuate artery and vein
- 2 cortex
- 3 dorsal branches of renal artery and vein
- 4 interlobar artery and vein
- 5 medulla
- 6 papilla
- 7 pelvis
- 8 ureter

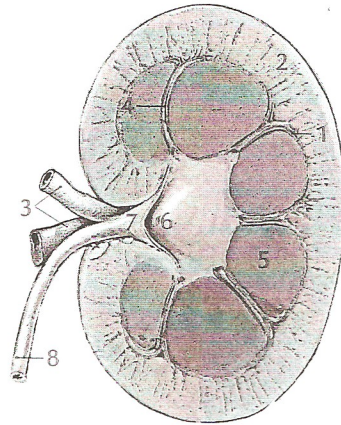
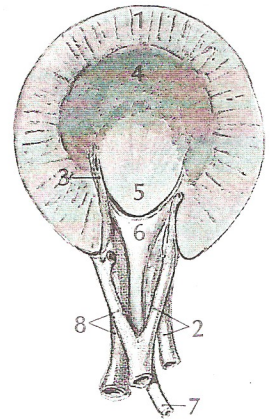


FIG. 41.
CROSS SECTION OF THE KIDNEY

- 1 cortex
- 2 dorsal branches of renal artery and vein
- 3 interlobar artery and vein
- 4 medulla
- 5 papilla
- 6 pelvis
- 7 ureter
- 8 ventral branches of renal artery and vein



NEPHRONS

Numerous small branches radiate from the arcuate vessels to supply the nephrons, microscopic tubules which constitute the functional units of the kidney. Each kidney contains several hundred thousand nephrons which follow an intricate course in the cortex and medulla. Urine, which is elaborated within the nephrons, drains into a series of collecting tubules which open onto the renal papilla.

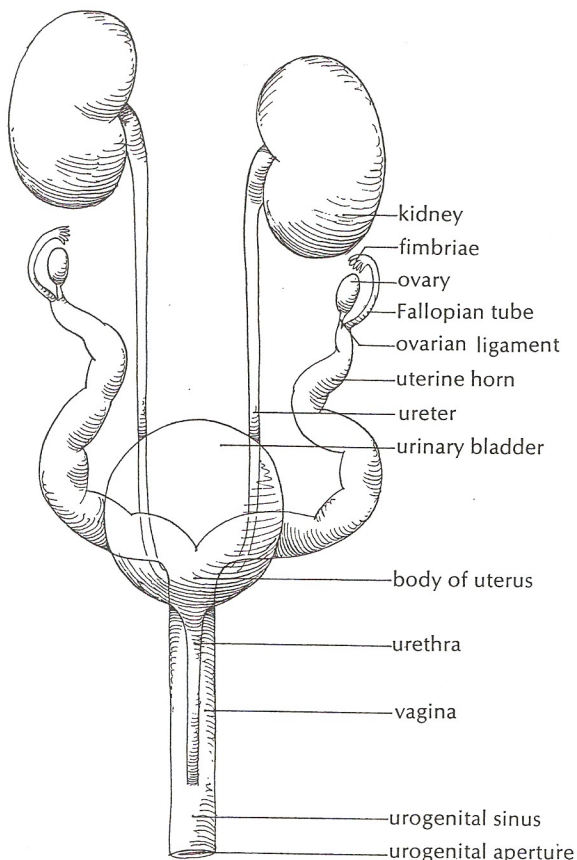
RENAL PYRAMID

The term *renal pyramid* is applied to the papilla and the conical mass of collecting tubules which open onto it. In the cat there is but one renal pyramid. In man there are about twelve, and the human renal pelvis forms subdivisions termed calyces, each of which embraces one or two papillae.

Trace the ureter caudally. Near the bladder it passes dorsal to the ductus deferens, turns ventrally, and enters the bladder.

The urinary bladder is a musculomembranous sac; it is retroperitoneal and is attached to the abdominal walls by peritoneal folds termed ligaments. The medial ligament passes from the ventral side of the bladder to the linea alba. The two lateral ligaments, which contain sizable fat deposits, connect the sides of the bladder to the dorsal body wall. The free anterior portion of the bladder is the vertex; the attached posterior portion is the fundus. In the male the space between the bladder and the rectum is termed the rectovesical pouch; in the female the space between the bladder and the uterus is termed the vesicouterine pouch. Posteriorly the bladder is continuous with the urethra, via which urine passes to the exterior. Make a ventral incision in the bladder and open it to see the openings of the urethra and the ureters on the inner wall of the bladder.

The skin of the penis forms a sheath termed the prepuce. Pull it back and observe the glans, or enlarged distal end of the penis, which in the cat is covered with minute horny papillae. The scrotum is a pouch of skin which encloses the testes. Remove it and observe that each testis is enclosed in a fascial sac. (Do not open the fascial sac at this time.)



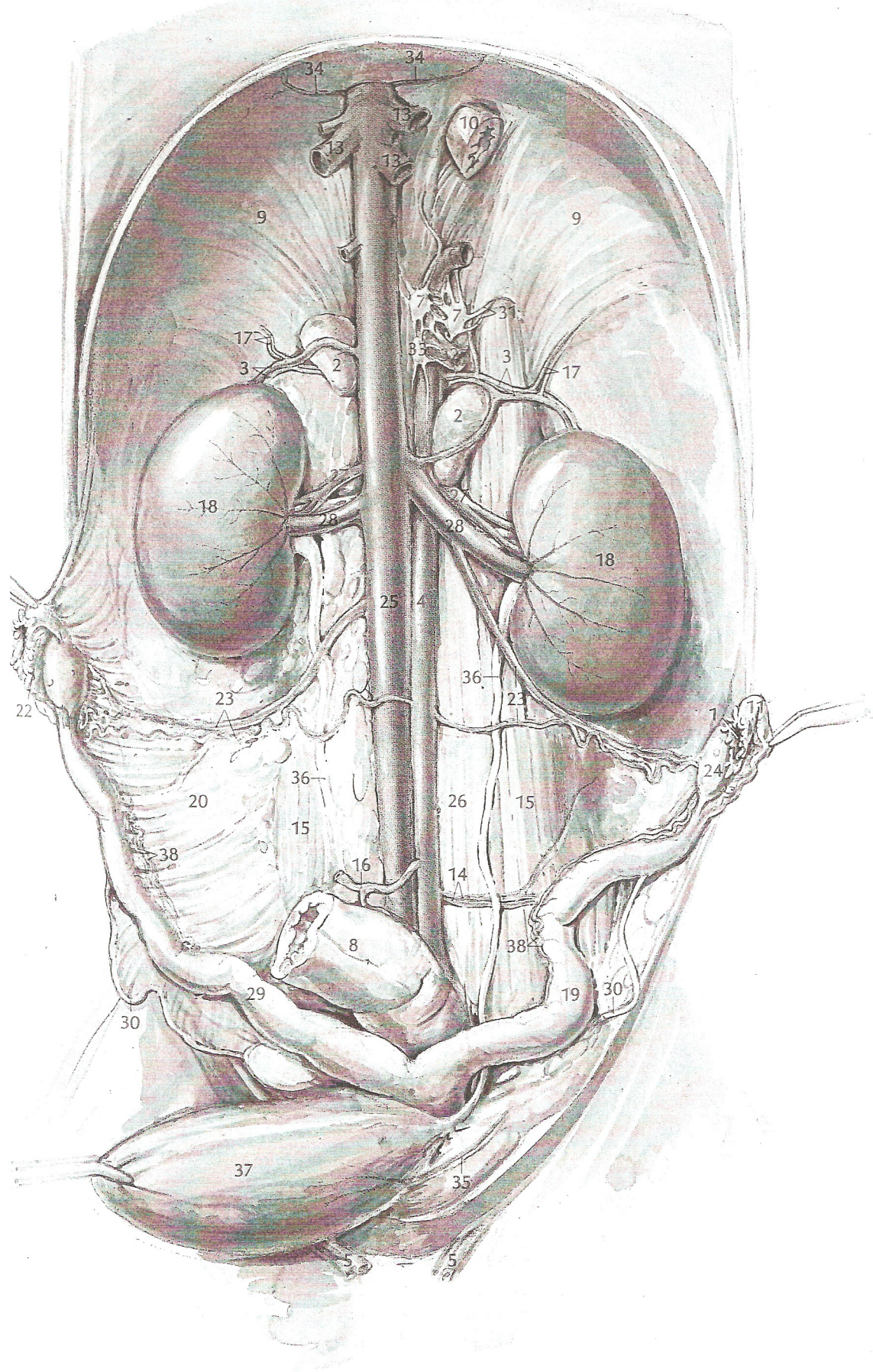


FIG. 42.
THE KIDNEYS, UTERUS,
AND ABDOMINAL VESSELS
IN A FEMALE

- 1 abdominal ostium of Fallopian tube
- 2 adrenal gland
- 3 adrenolumbar artery and vein
- 4 aorta
- 5 branches of deep femoral artery and vein
- 6 celiac artery
- 7 celiac ganglion
- 8 colon
- 9 diaphragm
- 10 esophagus
- 11 Fallopian tube
- 12 fimbriae
- 13 hepatic veins
- 14 iliolumbar artery and vein
- 15 iliopsoas
- 16 inferior mesenteric artery
- 17 inferior phrenic artery and vein
- 18 kidney
- 19 left uterine horn
- 20 mesometrium
- 21 mesovarium
- 22 mesosalpinx
- 23 ovarian artery and vein
- 24 ovary
- 25 postcava
- 26 psoas minor
- 27 renal artery
- 28 renal vein
- 29 right uterine horn
- 30 round ligament
- 31 splanchnic nerves
- 32 superior mesenteric artery
- 33 superior mesenteric ganglion
- 34 superior phrenic vein
- 35 umbilical artery
- 36 ureter
- 37 urinary bladder
- 38 uterine artery and vein

FIG. 43.
PELVIC PORTION OF THE MALE
UROGENITAL SYSTEM, LATERAL VIEW

- 1 anal sphincter
- 2 anus
- 3 aorta
- 4 bulbourethral gland
- 5 common iliac vein
- 6 crus of penis, cut
- 7 descending colon
- 8 ductus deferens
- 9 external iliac artery
- 10 fundus of bladder
- 11 glans
- 12 iliopsoas
- 13 penis
- 14 prostate gland
- 15 pubis
- 16 rectovesical pouch
- 17 rectum
- 18 right spermatic cord
- 19 sciatic nerve
- 20 testis within fascial sheath
- 21 thigh muscles, cut
- 22 ureter
- 23 urethra
- 24 urinary bladder
- 25 urogenital canal
- 26 urogenital opening
- 27 vertex of bladder



SPERMATIC CORD

The spermatic cord extends from the testis anteriorly to the abdominal wall. It is composed of the ductus deferens and the nerves, lymphatics, and vessels which supply the testis. Observe that the fascial sac of the testis continues as a thin covering around the components of the spermatic cord, and is continuous with the subcutaneous fascia and with the fascia of the external oblique muscle.

INGUINAL CANAL

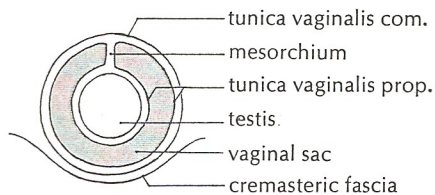
The ductus deferens and the internal spermatic vessels pass through the abdominal wall via the inguinal canal. The external opening of the inguinal canal is termed the external inguinal ring; the internal opening of the inguinal canal is termed the internal inguinal ring. From the internal inguinal ring the ductus deferens turns toward the bladder, crossing over the ureter and the lateral ligament of the bladder.

DISSECTION OF PELVIS

The remaining components of the male reproductive system can best be seen in a lateral view of the pelvis. Remove the left leg near the hip joint. Remove and save the left testis within

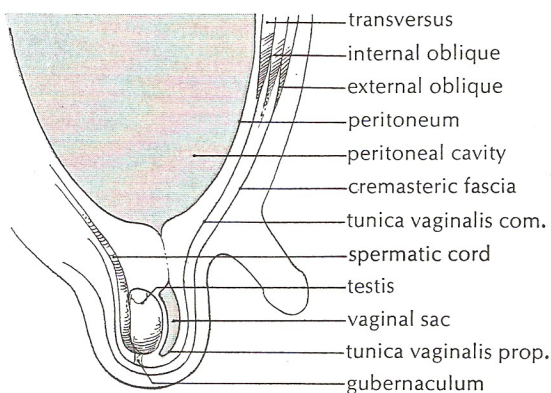
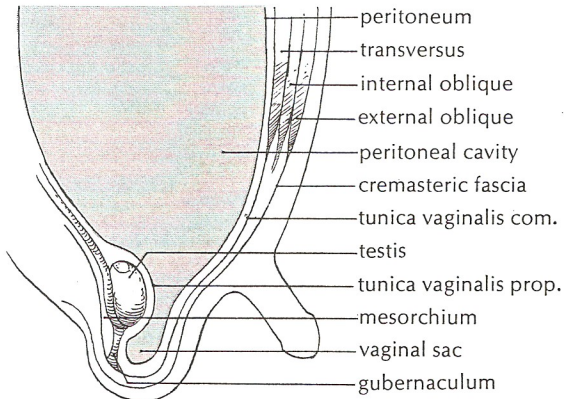
UROGENITAL CANAL

CORPORA CAVERNOSA



cross section of testis and tunics

DESCENT OF TESTES



intermediate stages in descent of testes

its fascial sac. Cut the pubic symphysis and cut the innominate bone above the acetabulum. Remove the cut portion of the innominate bone and clear away the pelvic muscles and connective tissue as necessary to identify the structures illustrated in Figure 43.

About the middle of the pubis the ductus deferens joins the urethra to form the urogenital canal, which extends to the urogenital opening at the end of the penis. Identify the prostate gland, near the union of the ductus deferens and the urethra. Paired bulbourethral glands open into the urogenital canal near the base of the penis.

Within the penis are two cylindrical structures termed corpora cavernosa; surrounding the urogenital canal is a similar, smaller structure termed the corpus spongiosum. These structures contain numerous blood sinuses which become distended during copulation. Near the pubic symphysis the two corpora cavernosa diverge, forming the right and left crura. Each crus is attached to the corresponding ramus of the ischium.

Cut a thin cross section of the spermatic cord and examine it under a dissecting microscope. Observe that it consists of a tubular external fascial covering within which the ductus deferens and the internal spermatic vessels are suspended by a mesentery-like fold. Make a cross section through the middle of the left testis. Observe that the testis is attached to the surrounding fascial sac by a similar mesentery-like fold, the mesorchium.

The components of the fascial sac which encloses the testis are illustrated at the left in a schematic view of two successive stages in the descent of the testis. Each testis originates as a retroperitoneal structure near the kidneys. During fetal life the testis descends posteriorly through the inguinal canal and into the scrotum. The fascial sac, which encloses the testis, is formed by an outpouching of the abdominal wall, and each layer of the fascial sac is derived from a layer of the abdominal wall.

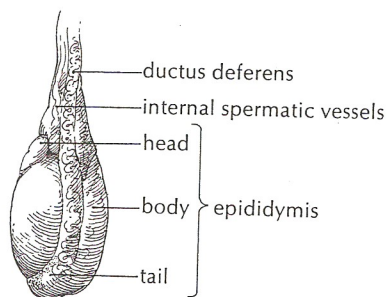
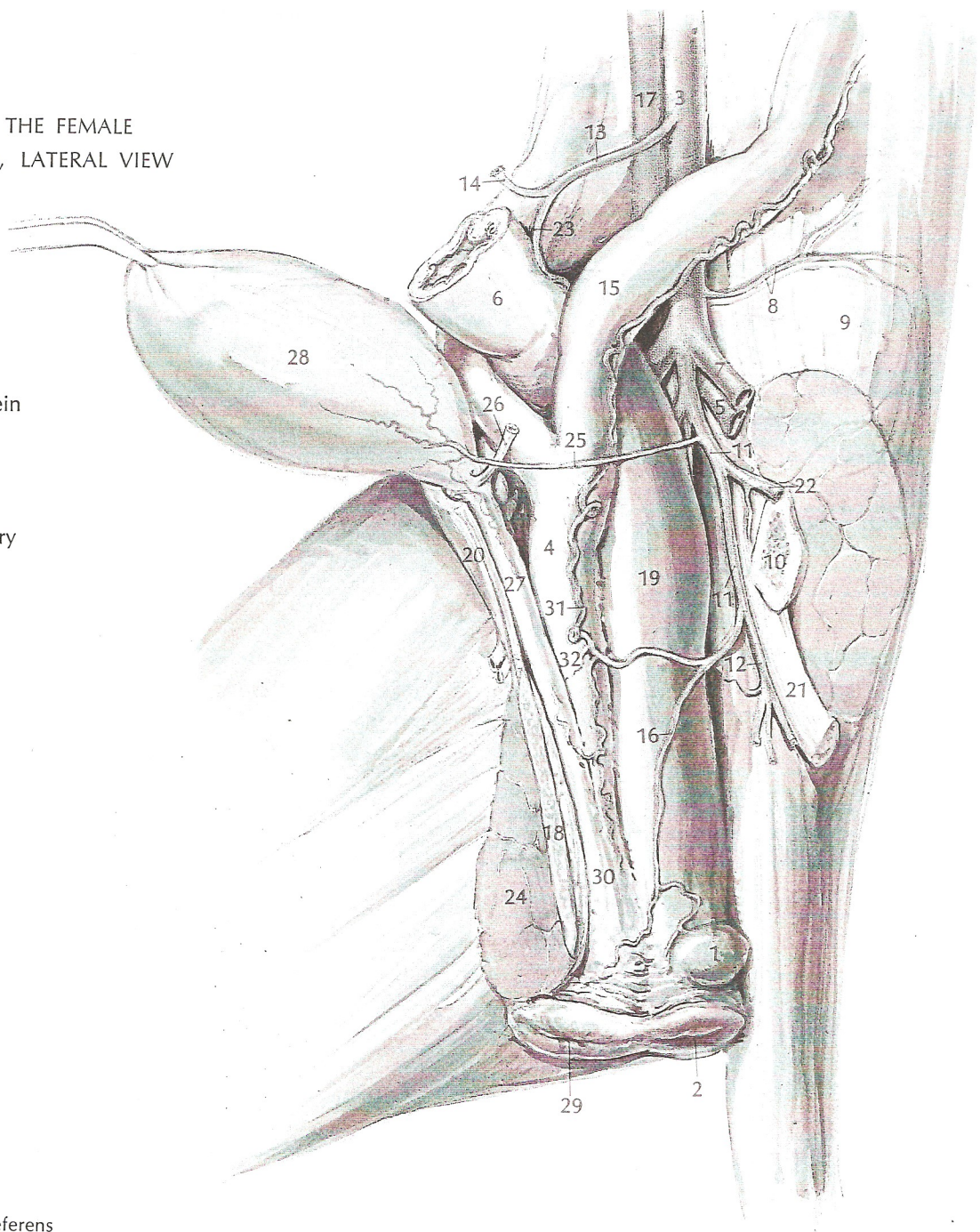
The cremasteric fascia is derived from the fascia of the external oblique and from the subcutaneous fascia of the thigh. It covers only the ventral surface of the spermatic cord, whereas the tunica vaginalis propria and the tunica vaginalis communis completely surround the cord. The tunica vaginalis communis is continuous with the fascia of the transversus muscle. The tunica vaginalis propria is continuous with the peritoneum. It forms a double fold around the testis and the components of the spermatic cord. It consists of a parietal layer, closely adherent to the tunica vaginalis communis, and a visceral layer, closely adherent to the testis, ductus deferens, and spermatic vessels.

Cut through the ventral side of the right fascial sac, exposing the testis. You have cut through the cremasteric fascia, the tunica vaginalis communis, and the parietal layer of the tunica vaginalis propria (these three layers are closely adherent and difficult to distinguish in gross dissection). The space surrounding the testis is the vaginal sac, an extension of the peritoneal cavity. The posterior end of the testis is attached to the fascial sac by a ligament, the gubernaculum, which is functional in the descent of the testes. It is homologous with the round ligament of the ovary.

Trim away the fascial sac from the testis and trace the ductus deferens toward the testis, noting its numerous convolutions. Near

FIG. 44.
PELVIC PORTION OF THE FEMALE
UROGENITAL SYSTEM, LATERAL VIEW

- 1 anal gland
- 2 anus
- 3 aorta
- 4 body of uterus
- 5 common iliac vein
- 6 colon
- 7 external iliac artery
- 8 iliolumbar artery and vein
- 9 iliopsoas
- 10 ilium
- 11 hypogastric artery
- 12 inferior gluteal artery
- 13 inferior mesenteric artery
- 14 left colic artery
- 15 left uterine horn
- 16 middle hemorrhoidal artery
- 17 postcava
- 18 pubis
- 19 rectum
- 20 rectus abdominis
- 21 sciatic nerve
- 22 superior gluteal artery
- 23 superior hemorrhoidal artery
- 24 thigh muscles, cut
- 25 umbilical artery
- 26 ureter
- 27 urethra
- 28 urinary bladder
- 29 urogenital aperture
- 30 urogenital sinus
- 31 uterine artery
- 32 vagina



right testis, medial view

OVARIES

the posterior end of the testis the ductus deferens is continuous with the epididymis, which appears as a flattened band lying along the dorsal side of the testis. The epididymis consists of an anterior portion, the head, a middle portion, the body, and a posterior portion, the tail. The head of the epididymis is connected to the testis by numerous efferent ductules (too small to see in gross dissection); they are continuous, via the convoluted ducts which make up the epididymis, with the ductus deferens.

The ovaries lie just posterior to the kidneys. They are suspended from the dorsal body wall by the mesovarium, a peritoneal fold continuous with the broad ligament. Another ligament, the ligament of the ovary, connects the ovary to the uterine horn. The lumpy appearance of the ovary is due to the presence, within the ovary, of Graafian follicles, each of which contains a developing ovum. The Graafian follicles may best be seen by removing one of the ovaries and cutting it in longitudinal section. Follicles which have discharged their eggs are termed corpora lutea; these will

FALLOPIAN TUBE

be seen best in pregnant animals.

The Fallopian tube conveys the ovum from the ovary to the uterine horn. Its anterior end forms a funnel-shaped opening (the abdominal ostium) fringed by small, irregular projections termed fimbriae. Trace the Fallopian tube around the anterior end of the ovary and observe that it passes dorsal to the ovary to join the uterine horn. The mesentery of the Fallopian tube is the mesosalpinx. It is continuous with the broad ligament, and forms a pocket within which the ovary lies.

UTERUS

The uterus is a Y-shaped structure consisting of a central body and two uterine horns. The horns lie along either side of the dorsal wall of the abdominal cavity. The body of the uterus lies between the bladder and the rectum, and is continuous posteriorly with the vagina.

BROAD LIGAMENT

Each uterine horn is supported by a peritoneal fold termed the mesometrium. The mesometrium, mesosalpinx, and mesovarium are continuous with each other, and together they constitute the broad ligament. Also continuous with the broad ligament is the round ligament, a thin fibrous band which extends from the uterine horn to the abdominal wall. The anterior end of each broad ligament forms a free concave border near the ovary, and its attachment to the dorsal body wall extends in a curved line from a point near the posterior end of the kidneys to the lateral ligament of the bladder. From this point the broad ligament extends into the pelvis, serving to hold the body of the uterus and the vagina to the pelvic wall.

The remaining components of the female reproductive system can best be seen in a lateral view of the pelvis. Remove the left leg near the hip. Cut the pubic symphysis and cut the innominate bone above the acetabulum. Remove the cut portion of the innominate bone and clear away the pelvic muscles and connective tissue. Preserve the branches of the hypogastric artery as far as possible, and identify the structures illustrated in Figure 44.

Near the anterior border of the pubis the body of the uterus is continuous with the vagina. The opening between the body of the uterus and the vagina is the external uterine orifice. The posterior portion of the uterus forms a small rounded projection, termed the cervix, at the uterovaginal junction. The vagina extends from the cervix to the urethral orifice. The urethra lies along the ventral surface of the vagina, opening into it at the urethral orifice. The urogenital sinus is the common passage formed by the union of the urethra and the vagina. It opens at the urogenital aperture, just ventral to the anus. On either side of the urogenital aperture are folds of skin termed the labia majora. The urogenital aperture and labia together constitute the vulva. Near the urogenital aperture, in the ventral wall of the urogenital sinus, is the clitoris, homolog of the penis.

Remove the uterus, vagina, and urogenital sinus, and open them by trimming away the dorsal portion as illustrated in the marginal diagram.

