Anatomy of the male perineum, and reproductive organs

Dr. Munirah Batarfi
MD, MSc, & PhD
Pelvic peritoneum in male

- The pelvic viscera are located in the midline of the pelvic cavity.
- The bladder is anterior and the rectum is posterior.
- Other structures, such as vessels and nerves, lie deep to the peritoneum in association with the pelvic walls and on either side of the pelvic viscera.
The Male Reproductive System

**General structure:**
- The major components are a **testis**, **epididymis**, ductus deferens, and ejaculatory duct on each side, and the urethra and penis in the midline. In addition, three types of **accessory glands** are associated with the system:
  - a single **prostate**;
  - a pair of **seminal vesicles**; and,
  - a pair of **bulbourethral glands** (Cowper’s glands).
### The Male Reproductive System
(Cont’d)

**TABLE 5-5 Features of the Male Pelvic Viscera**

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urinary bladder</td>
<td>Lies retroperitoneal and has the detrusor muscle (smooth muscle) lining its walls</td>
</tr>
<tr>
<td>Prostate gland</td>
<td>Walnut-sized gland with five lobes (anterior, middle, posterior, right and left lateral); middle lobe prone to benign hypertrophy and surrounds the prostatic urethra</td>
</tr>
<tr>
<td>Seminal vesicles</td>
<td>Lobulated glands whose ducts join the ductus deferens to form the ejaculatory duct; secretes an alkaline seminal fluid</td>
</tr>
<tr>
<td>Rectum</td>
<td>Distal portion of the large intestine that is retroperitoneal</td>
</tr>
<tr>
<td>Rectovesical pouch</td>
<td>Recess between the bladder and rectum</td>
</tr>
<tr>
<td>Testes</td>
<td>Develop in the retroperitoneal abdominal wall and descend into the scrotum</td>
</tr>
<tr>
<td>Epididymis</td>
<td>Consists of a head, body and tail; functions in maturation and storage of sperm</td>
</tr>
<tr>
<td>Ductus (vas) deferens</td>
<td>Passes in the spermatic cord through the inguinal canal to join the duct of the seminal vesicles (ejaculatory duct)</td>
</tr>
</tbody>
</table>

**FIGURE 5-9** Male Reproductive Viscera

**FIGURE 5-10** Testis, Epididymis, and Ductus Deferens
Testes

- Paired oval glands measuring 2 in by 1 in.
- Surrounded by dense white capsule called Tunica Albuginea.
- Tesis is divided by septa into 200 - 300 compartments called lobules, each is filled with 2 or 3 seminiferous tubules where sperms are formed. The highly coiled seminiferous tubules are modified at each end to become straight tubules, which connect to a collecting chamber (the rete testis).
- Approximately 12-20 efferent ductules originate from the upper end of the rete testis, penetrate the capsule and connect with the epididymis.

Tunica Vaginalis:

- Piece of peritoneum that descended with testes into scrotal sac.
- Allows for easier movement of testes within scrotum.
Coverings of the testis

- The processus vaginalis (a hollow outgrowth of peritoneum) evaginates the fascial and muscular layers of the anterior abdominal wall as it extends into the scrotal swellings.
- This process creates the inguinal canal.
- A persistent processus vaginalis creates a potential pathway for herniation of abdominal contents through the inguinal canal and into the scrotum (indirect inguinal hernia).

**Hydrocele:**
A hydrocele is formed when there is peritoneal fluid in a persistent (i.e., patent) processus vaginalis.
Epididymis:

• Comma-shaped organ, 1.5 in. long, lies along the posterior border of each testis.
• Tail region continues as ductus deferens.
• Sinus of the epididymis separates it from the lateral surface of the testis.
• Site of sperm maturation & storage.
Blood Supply & L.D. of Testis & Epididymis

- During descent, the testes carry their vessels, lymphatics, and nerves, as well as their principal drainage ducts, the ductus deferens (vas deferens) with them.
- **Testicular artery:** branch of the abdominal aorta at L1-L2
- **Lymph drainage:** Para aortic LN at L1.
- **Pampniform plexus of veins** becomes reduced to a single vein as it ascends in the inguinal canal.
  - Rt. Testicular vein-----IVC
  - Lt. Testicular vein------Left renal vein

Varicocele is more on the left side??????
Spermatic cord

**Coverings:**
- the internal spermatic fascia: from the transversalis fascia,
- the cremasteric fascia with the associated cremasteric muscle: from the internal oblique muscle;
- the external spermatic fascia: from the aponeurosis of the external oblique muscle.

### TABLE 3.1.2 Structures within the spermatic cord.

<table>
<thead>
<tr>
<th>Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ductus deferens (vas deferens)</td>
<td>Muscular tube that conveys sperm from epididymis to ejaculatory duct</td>
</tr>
<tr>
<td>Testicular artery</td>
<td>Branch of abdominal aorta; supplies testis and epididymis</td>
</tr>
<tr>
<td>Pampiniform venous plexus</td>
<td>Vascular network that converges to form testicular vein(s)</td>
</tr>
<tr>
<td>Artery to ductus deferens</td>
<td>Branch of inferior vesical artery; supplies ductus deferens</td>
</tr>
<tr>
<td>Genital branch of genitofemoral nerve</td>
<td>Innervates cremaster muscle</td>
</tr>
<tr>
<td>Autonomic nerve fibers</td>
<td>Innervate smooth muscle in blood vessels, testis, ductus deferens, and epididymis</td>
</tr>
<tr>
<td>Lymphatic vessels</td>
<td>Drain lymph from testis and associated structures to lumbar and pre-aortic nodes</td>
</tr>
</tbody>
</table>
Table 2.6. Corresponding Layers of the Anterior Abdominal Wall, Scrotum, and Spermatic Cord
Ductus (Vas) Deferens

Pathway of 18 inch muscular tube.
- ascends along posterior border & medial aspect of epididymis.
- passes up through spermatic cord and inguinal canal.
- reaches posterior surface of urinary bladder.
- ends by forming the ampulla of the vas which unites with the duct of the seminal vesicle to form the ejaculatory duct.
- convey sperm along through peristaltic contractions of its muscular lining.
- **Vasectomy**: to produce infertility.

**Ejaculatory Ducts:**
- Formed from duct of seminal vesicle & ampulla of vas deferens
- About 1 inch long
- Adds fluid to prostatic urethra just before ejaculation
Scrotum

- Sac of loose skin, fascia & smooth muscle divided into two pouches by a septum.

- Skin contains **Dartos muscle** (smooth muscle: it receives innervation from postganglionic sympathetic nerve fibers arriving via the ilioinguinal nerve and the posterior scrotal nerve. The tone of this smooth muscle is responsible for the wrinkled (rugose) appearance of the scrotum. It acts to regulate the temperature of the testicles, which promotes spermatogenesis. It does this by expanding or contracting to wrinkle the scrotal skin.

- **Cremaster muscle** (skeletal muscle) in inguinal canal & scrotum. It raises and lower the testes. N.S. genitofemoral nerve (L1/L2).

- **Cremasteric reflex**: genitofemoral nerve (L1/L2).

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External male genitalia, ventral aspect

The skin of the abdomen and parts of the skin of the scrotum have been removed, and the body of the penis has been severed, revealing the internal structure of the penis. The layers of the spermatic cord and the coverings of the testis have been dissected on the right. (From Sobotta 2006.)
Scrotum (Cont’d)

<table>
<thead>
<tr>
<th>Layers of scrotum and spermatic fascia</th>
<th>Corresponding layer from anterior abdominal wall</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin</td>
<td>Skin</td>
<td></td>
</tr>
<tr>
<td>Dartos muscle and fascia</td>
<td>Superficial fascia</td>
<td>Smooth muscle</td>
</tr>
<tr>
<td>External spermatic fascia</td>
<td>External abdominal oblique aponeurosis</td>
<td></td>
</tr>
<tr>
<td>Cremaster muscle (fasca)</td>
<td>Internal abdominal oblique</td>
<td>Skeletal muscle</td>
</tr>
<tr>
<td>Internal spermatic fascia</td>
<td>Transversalis fascia</td>
<td></td>
</tr>
</tbody>
</table>

**FIGURE 3.1.2** Anterior view of scrotum showing the spermatic fasciae, spermatic cord, and testis.
Hydrocele and Varicocele

The most common cause of scrotal enlargement is Hydrocele, an excessive accumulation of serous fluid within the tunica vaginalis. An infection in the testis or epididymis, trauma, or a tumor may lead to hydrocele, or it may be idiopathic.

Varicocele: is an abnormal dilation and tortuosity of the pampiniform venous plexus. Almost all varicoceles are on the left side. This is perhaps because the left testicular vein drains into the left renal vein (which has a slightly higher venous pressure) rather than into the larger inferior vena cava (as the right testicular vein does). A varicocele is evident at physical examination when a patient stands, but it usually resolves when the patient is recumbent (bag of worms).
Accessory sex glands

- They secrete most of the liquid portion of the semen.
- Include:
  
  **Bulbourethral (Cowper’s) Glands:**
  - Secrete alkaline mucous.
  - Their ducts open in the spongy urethera.

  **Prostate Gland:**
  - Secretions to help motility of sperms.

  **Seminal Vesicles**
  - Secrete alkaline, viscous fluid, helps motility of sperms.

**Blood supply of seminal vesicle:**

- Branches of inferior vesical & middle rectal arteries.
- Veins drain into the internal iliac veins.
In men, the prostate gland is situated just above the pelvic floor.

It can be felt by digital palpation during a rectal examination.

The prostate is an unpaired accessory structure of the male reproductive system that surrounds the urethra in the pelvic cavity.

It lies immediately inferior to the bladder, posterior to the pubic symphysis, and anterior to the rectum.

The prostate is shaped like an inverted rounded cone with a larger base, which is continuous above with the neck of the bladder, and a narrower apex, which rests below on the pelvic floor.

The inferolateral surfaces of the prostate are in contact with the levator ani muscles that together cradle the prostate between them.

In men, puboprostatic ligaments blend with the fibrous capsule of the prostate, which surrounds the neck of the bladder and adjacent part of the urethra.
Prostate (Cont’d)

**TABLE 4.1.1** Anatomical relationships of the prostate.

<table>
<thead>
<tr>
<th>Direction</th>
<th>Related structure(s)</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>Pubic symphysis</td>
<td>Inferior part</td>
</tr>
<tr>
<td>Posterior</td>
<td>Ampulla of rectum</td>
<td></td>
</tr>
<tr>
<td>Superior</td>
<td>Urinary bladder, Seminal glands, Ampulla of ductus deferens</td>
<td>Palpable if distended, Palpable if enlarged</td>
</tr>
<tr>
<td>Inferior</td>
<td>Urethral sphincter and deep perineal muscles</td>
<td></td>
</tr>
<tr>
<td>Lateral</td>
<td>Levator ani</td>
<td></td>
</tr>
</tbody>
</table>

**FIGURE 4.1.2** Lobes and zones of the prostate. Hyperplasia of mucosal glands in the transitional zone is responsible for BPH. In contrast, most prostate cancers originate in the peripheral and central zones.
FIGURE 4.1.4 Vasculature of the prostate (posterior view). (A) Arterial supply (red) and venous drainage (blue) and (B) lymphatic drainage.
In men, the urethra is long, about 20 cm, and bends twice along its course.

Beginning at the base of the bladder and passing inferiorly through the prostate, it passes through the deep perineal pouch and perineal membrane and immediately enters the root of the penis.

The urethra in men is divided into preprostatic, prostatic, membranous, and spongy parts.

The spongy urethra is surrounded by erectile tissue (the corpus spongiosum) of the penis. It is enlarged to form a bulb at the base of the penis and again at the end of the penis to form the navicular fossa.

The two bulbourethral glands (Cowper’s glands) in the deep perineal pouch are part of the male reproductive system and their ducts passes inferomedially through the perineal membrane open into the bulb of the spongy urethra. The external urethral orifice is the sagittal slit at the end of the penis.

It is important to consider the different courses of the urethra in men and women when catheterizing patients and when evaluating perineal injuries and pelvic pathology.
The prostatic part of the urethra

- is 3-4 cm long.
- In this region, the lumen of the urethra is marked by a longitudinal midline fold of mucosa (the **urethral crest**). The depression on each side of the crest is the **prostatic sinus**; the ducts of the prostate empty into these two sinuses.
- Midway along its length, the urethral crest is enlarged to form a somewhat circular elevation (the **seminal colliculus**). The seminal colliculus is used to determine the position of the prostate gland during transurethral transection of the prostate.
- A small blind-ended pouch—the **prostatic utricle** opens onto the center of the seminal colliculus.
- On each side of the prostatic utricle is the opening of the **ejaculatory duct** of the male reproductive system. Therefore the connection between the urinary and reproductive tracts in men occurs in the prostatic part of the urethra.

The membranous part of the urethra is narrow and passes through the **deep perineal pouch**. During its transit through this pouch, the urethra, in both men and women, is surrounded by skeletal muscle of the **external urethral sphincter**.
Blood supply of Prostate

- **Arterial Supply of the Prostate**

  The prostatic arteries are mainly branches of the *internal iliac artery* especially the *inferior vesical arteries* but also the *internal pudendal* and *middle rectal arteries*.

- **Venous and Lymphatic Drainage of the Prostate**

  The veins join to form a plexus around the sides and base of the prostate. This *prostatic venous plexus*, between the fibrous capsule of the prostate and the prostatic sheath, drains into the *internal iliac veins*. The prostatic venous plexus is continuous superiorly with the *vesical venous plexus* and communicates posteriorly with the *internal vertebral venous plexus*. The lymphatic vessels terminate chiefly in the *internal iliac lymph nodes*, but some drainage may pass to the sacral nodes.

Prostatic venous plexus
Prostatic Carcinoma

Prostatic carcinoma is the most common visceral cancer in males and the second leading cause of death in men older than 50 years of age. (Lung cancer is first.) Primary lesions invade the prostatic capsule and then spread along the ejaculatory ducts into the space between the seminal vesicles and bladder.

The pelvic lymphatics and rich venous drainage of the prostate (prostatic venous plexus) facilitate the metastatic spread of the cancer to distant sites.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site</td>
<td>90% arise in outer glands (adenocarcinomas) and are palpable by digital rectal examination</td>
</tr>
<tr>
<td>Metastases</td>
<td>Regional pelvic lymph nodes, bone, seminal vesicles, bladder, and periurethral zones</td>
</tr>
<tr>
<td>Etiology</td>
<td>Hormonal (androgens), genetic, environmental factors</td>
</tr>
<tr>
<td>Prevalence</td>
<td>Increased in African-Americans and Scandinavians, few in Japan</td>
</tr>
</tbody>
</table>
Nerve supply of male reproductive system

• When the hypogastric nerves are joined by pelvic splanchnic nerves carrying preganglionic parasympathetic fibers from S2 to S4, the pelvic plexuses (inferior hypogastric plexuses) are formed.

• The inferior hypogastric plexuses, one on each side, give origin to the following subsidiary plexuses, which innervate the pelvic viscera:

1. the rectal plexus;
2. the uterovaginal plexus;
3. the prostatic plexus; and
4. the vesical plexus.
Penis

- Passageway for semen & urine.
- Its body is composed of three erectile tissue masses filled with blood sinuses.

Parts of the penis:
- Root
- Body (shaft)
- Glans penis
- Corona of the glans
- Prepuce
- External urethral orifice

The bulb and crura form the root of the penis, whereas the corpus spongiosum and the two corpora cavernosa compose the shaft of the penis. They are bound tightly together by the investing deep (Buck’s) fascia of the penis and a superficial (Dartos) fascia of the penis.
**Penis (Cont’d)**

**Erectile tissues**

- Two sets of erectile structures join to form the penis and the clitoris.
- A pair of cylindrically shaped corpora cavernosa, one on each side of the urogenital triangle, are anchored by their proximal ends to the pubic arch.
- These attached parts are often termed the crura (from the Latin for "legs") of the clitoris or the penis.
- The distal ends of the corpora, which are not attached to bone, form the body of the clitoris in women and the dorsal parts of the body of the penis in men.
- The second set of erectile tissues surrounds the openings of the urogenital system. In men, a single large erectile mass, the corpus spongiosum, is the structural equivalent to the bulbs of the vestibule, the glans clitoris, and the interconnecting bands of erectile tissues in women.
Features of the penis

TABLE 5-11 Features of the Male External Genitalia

<table>
<thead>
<tr>
<th>STRUCTURE</th>
<th>CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulb of the penis</td>
<td>Erectile tissue anchored to the perineal membrane, the bulb is the proximal part of the corpus spongiosum, covered by the bulbospongiosus skeletal muscle</td>
</tr>
<tr>
<td>Crura of the penis</td>
<td>Paired erectile tissues attached to the pubic arch that form the proximal part of the corpora cavernosa of the penis; covered by the ischiocavernosus skeletal muscles</td>
</tr>
<tr>
<td>Superficial transverse perineal muscle</td>
<td>A thin skeletal muscle extending from the ischial tuberosity to the perineal body; stabilizes the perineal body</td>
</tr>
</tbody>
</table>

TABLE 5-12 Features of the Penis

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root of the penis</td>
<td>Composed of the bulb, the proximal part of the corpus spongiosum, and the two crura, the proximal parts of the corpora cavernosa</td>
</tr>
<tr>
<td>Body of the penis</td>
<td>Covered by skin, the dartos fascia, and the deep (Buck’s) fascia of the penis, which envelops the corpora cavernosa and the corpus spongiosum, which contains the spongy urethra</td>
</tr>
<tr>
<td>Glans penis</td>
<td>The expanded distal end of the corpus spongiosum, where the spongy urethra expands (navicular fossa) and opens externally (external urethral meatus)</td>
</tr>
<tr>
<td>Prepuce (foreskin)</td>
<td>A thin, double layer of skin that extends over most of the glans penis (male circumcision removes this skin to expose the glans)</td>
</tr>
<tr>
<td>Suspensory ligament</td>
<td>Deep fascia that extends from the dorsum of the penis to the pubic symphysis</td>
</tr>
<tr>
<td>Fundiform ligament</td>
<td>Subcutaneous tissue that extends from the dartos fascia superiorly to the midline linea alba</td>
</tr>
</tbody>
</table>
Parasympathetic innervation from spinal cord levels S2 to S4 controls erection.

On each side, preganglionic parasympathetic nerves leave the anterior rami of the sacral spinal nerves and enter the inferior hypogastric plexus (pelvic plexus) on the lateral pelvic wall.

The two inferior hypogastric plexuses are inferior extensions of the abdominal prevertebral plexus that forms on the posterior abdominal wall in association with the abdominal aorta. Nerves derived from these plexuses penetrate the pelvic floor to innervate the erectile tissues of the clitoris in women and the penis in men.

Pelvic splanchnic nerves from spinal levels S2 to S4 control erection.
Blood supply of erectile tissue of the penis

By **internal pudendal artery branches:**
- Artery to the bulb of the penis,
- Urethral artery,
- Deep artery of the penis,
- Dorsal artery of the penis

Veins in the perineum generally accompany the arteries and join the **internal pudendal veins** that connect with the **internal iliac vein** in the pelvis. The exception is the **deep dorsal vein** which connects with the **plexus of veins** surrounding the **prostate** in men or **bladder** in women.
Lymph drainage of the male reproductive system

- Lymphatic vessels from deep parts of the perineum accompany the internal pudendal blood vessels and drain mainly into internal iliac nodes in the pelvis.

- Lymphatic channels from superficial tissues of the penis or the clitoris, scrotum and labia accompany the superficial external pudendal blood vessels and drain mainly into superficial inguinal nodes.

- The glans penis, the glans clitoris, labia minora, and the terminal inferior end of the vagina drain into deep inguinal nodes and external iliac nodes.

- Lymphatics from the testes drain to lateral aortic or lumbar nodes and pre-aortic nodes at approximately vertebral levels LI and LII. Therefore disease from the testes tracks superiorly to nodes high in the posterior abdominal wall and not to inguinal or iliac nodes.
Erectile function
- Occurs when a sexual stimulus causes the release of nitric oxide from nerve endings and endothelial cells of the corpora cavernosa, thus relaxing the smooth muscle tone of the vessels and increasing blood flow into the erectile tissues.
- As the erectile tissue becomes engorged with blood, it compresses the veins in the tunica albuginea so that the blood remains in the cavernous bodies.
- Erectile dysfunction can also occur from damage to the nerves innervating the perineum (e.g., a complication of prostatic surgery).
- Afferent impulses: the pudendal nerve (S2-S4, somatic fibers),
- Autonomic Efferent: to the cavernous vasculature is via the pelvic splanchnics (S2-S4, parasympathetic fibers).

Some of the probable causes of erectile dysfunction:
The superficial fascia (subcutaneous tissue) of the perineum includes a fatty and membranous layer (Colles fascia) similar to the anterior abdominal wall. **It is attached:**

- posteriorly to the perineal membrane and therefore does not extend into the anal triangle and,
- to the ischiopubic rami that form the lateral borders of the urogenital triangle and therefore does not extend into the thigh.
- In the lower lateral abdominal, it is attached to the deep fascia of the thigh just inferior to the inguinal ligament.
- It defines the external limits of the superficial perineal pouch, lines the scrotum or labia, and extends around the body of the penis and clitoris.

Because the membranous layer of fascia encloses the superficial perineal pouch and continues up the anterior abdominal wall, fluids or infectious material that accumulate in the pouch can track out of the perineum and onto the lower abdominal wall. This material will **NOT** track into the anal triangle or the thigh because the fascia fuses with deep tissues at the borders of these regions.
Urethral rupture

The commonest injury is a rupture of the proximal spongy urethra below the perineal membrane. Urine escapes through the rupture into the superficial perineal pouch and descends into the scrotum and onto the anterior abdominal wall deep to the superficial fascia.

In association with severe pelvic fractures, urethral rupture may occur at the prostatomembranous junction above the deep perineal pouch. The urine will extravasate into the true pelvis.

Urine Extravasation in the Male

Rupture of the male urethra can lead to urine extravasation into various pelvic or perineal spaces that are largely limited by the fascial planes.

<table>
<thead>
<tr>
<th>Injury site</th>
<th>Consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penile urethra, Buck's fascia intact</td>
<td>Localized swelling confined to penis</td>
</tr>
<tr>
<td>Penile urethra, Buck's fascia ruptured</td>
<td>Eventual collection of urine deep to Colles' fascia (superficial perineal fascia); perineum: superficial pouch; peris; scrotum: deep to dartos (superficial) fascia; lower abdominal wall: deep to Scarpa's fascia</td>
</tr>
<tr>
<td>Prostatomembranous junction</td>
<td>Potential injury with anterior pelvic fractures, which may lead to retroperitoneal hematoma and urine extravasation</td>
</tr>
</tbody>
</table>
Hypospadias:
Urethral opening on undersurface of penis
References:

• Gray's Anatomy for Students- Second edition

• Netter’s Clinical Anatomy, Second edition