
Neurovascular Supply and Lymphatic Drainage of Male Reproductive Organs

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Learning Objectives

- Arterial supply
- Draining venous tributaries
- Formation and supply of autonomic plexuses
- Lymphatic drainage

5.1 Introduction

The anatomical details of male reproductive organs also include their neurovascular supply and lymphatic drainage. Male reproductive organs are supplied by arterial branches of the abdominal aorta, and veins from these organs drain into the inferior vena cava. The nerve supply to male reproductive organs comes from various autonomic nerve plexuses. The lymphatics from these organs drain into lymph nodes present around the major blood vessels supplying them. We shall now discuss the anatomical details of the neurovascular supply and lymphatic drainage of male reproductive organs.

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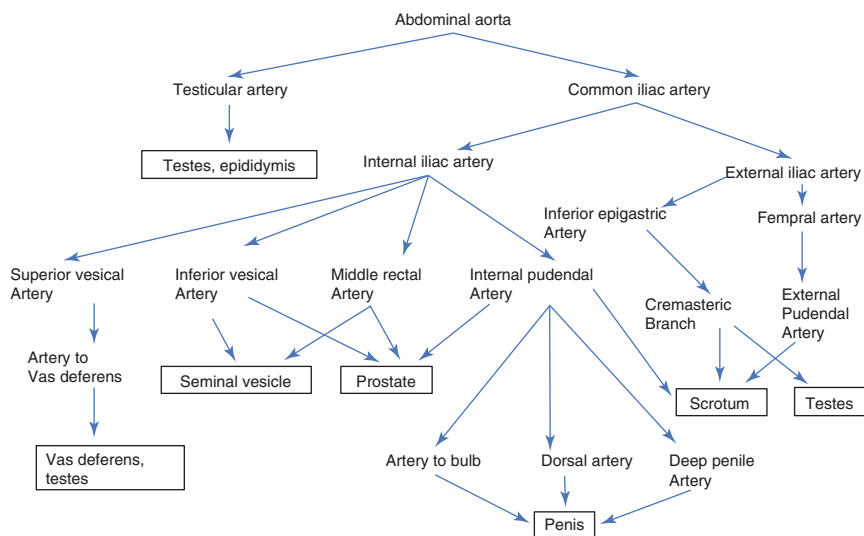


Fig. 5.1 Flowchart showing branches of the abdominal aorta supplying male reproductive organs

5.2 Arterial Supply

The arterial supply to male reproductive organs comes from the branches of the abdominal aorta. The aortic branches are described as anterior, lateral, and dorsal branches. The anterior and lateral branches supply the organs, whereas the dorsal branches supply mainly the body wall. The gonadal arteries are the lateral branches, and the common iliac arteries are terminal branches of the abdominal aorta which supply male reproductive organs (see Figs. 5.1, 5.2, 5.3, and 5.4).

In males, gonadal arteries are the testicular arteries arising from the lateral aspect of the aorta below the origin of renal arteries. Each artery passes obliquely downward to reach the deep inguinal ring, then passes through the inguinal canal, and finally comes out of the superficial inguinal ring. The artery further descends and divides into several branches which supply the testis and epididymis (Standring 2005a). The abdominal aorta divides into common iliac arteries. Each common iliac artery divides into the external and internal iliac artery. The external iliac artery gives the inferior epigastric artery which further gives a cremasteric branch that supplies the testes and scrotum. Then, external iliac artery continues as femoral artery. The femoral artery gives a branch external pudendal artery that supplies the scrotum (Standring 2005a, b).

The internal iliac artery supplies pelvic organs including reproductive organs. The internal iliac artery divides into the anterior and posterior trunk. The branches of the anterior trunk which supply male reproductive organs are superior vesical, inferior vesical, middle rectal, and internal pudendal. The internal pudendal arteries give scrotal branches that supply the scrotum and provide arterial supply to the penis. Each internal pudendal artery gives the following branches: artery to the bulb of the penis which supplies the urethral bulb, the posterior portion of the corpus cavernosum and the bulbourethral gland, the deep penile/corpus

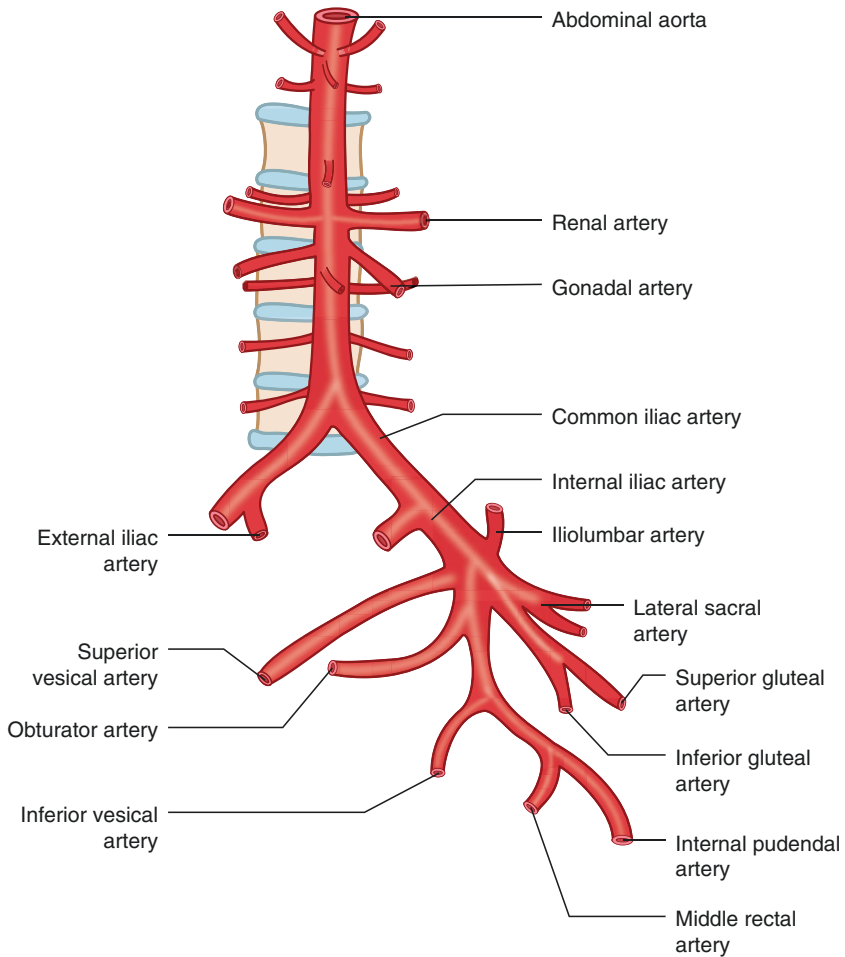


Fig. 5.2 Schematic diagram showing branches of the abdominal aorta supplying male reproductive organs

cavernosal artery which supplies the corpus cavernosum, and, finally, the dorsal artery of the penis which supplies the penile skin, glans penis, and corpus spongiosum (Standring 2005c). The deep penile artery runs in the middle within the corpus cavernosum and gives perpendicular branches called helicine arteries that open in the cavernous sinusoidal space (Krane et al. 1989). During erection, the deep penile artery dilates to twice its diameter as compared to its flaccid state.

The inferior vesical, internal pudendal, and middle rectal arteries supply the prostate (Standring 2005d). All the branches perforate the prostate gland along a posterolateral line extending from its base to apex. The inferior vesical and middle rectal arteries supply the seminal vesicles. Artery to vas deferens is a branch usually from the superior vesical artery; it may also be the branch from the inferior vesical artery. Artery to vas deferens supplies the vas deferens and testes (Standring 2005e).

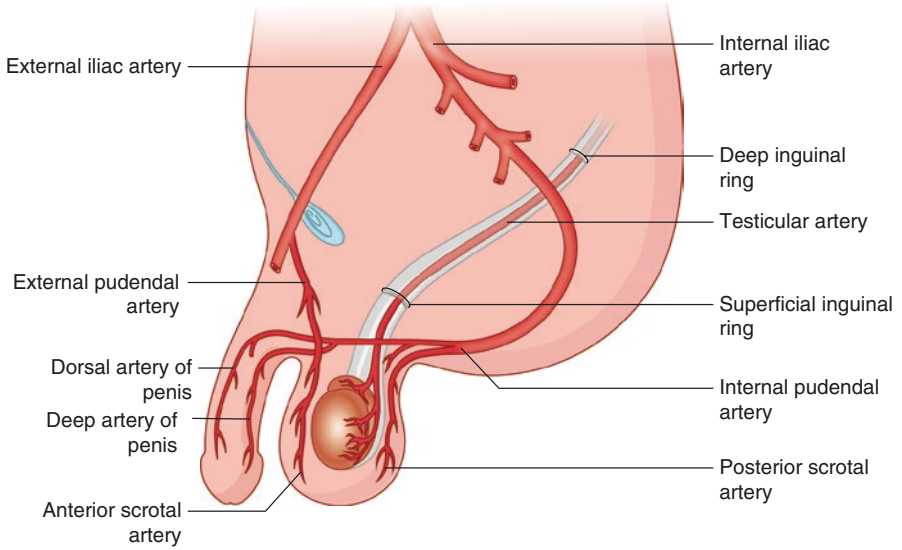


Fig. 5.3 Schematic diagram showing arteries supplying the testis, scrotum, and penis

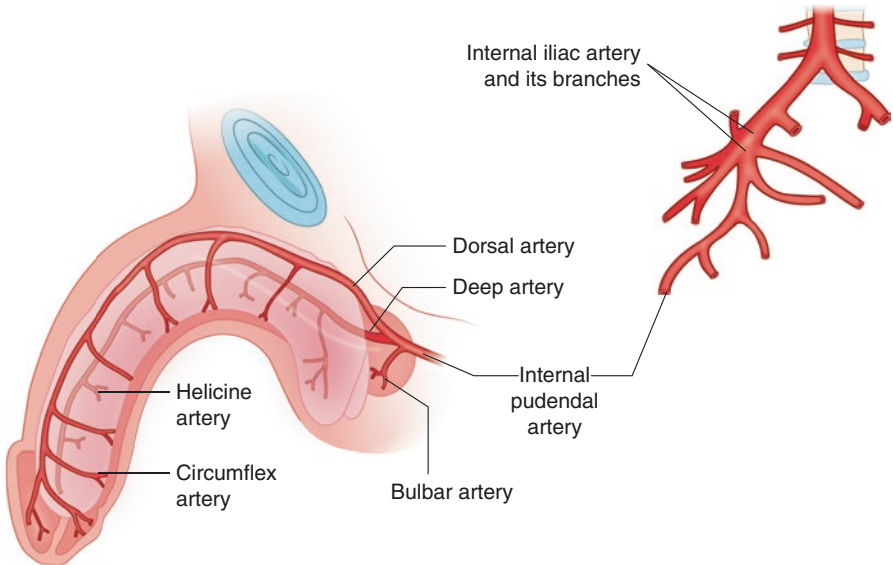


Fig. 5.4 Schematic diagram showing arteries supplying the penis

5.3 Venous Drainage

The veins draining the areas below diaphragm open into the inferior vena cava which conveys blood to the right atrium. The veins draining male reproductive organs and opening into the inferior vena cava are the right testicular vein and common iliac veins. Testicular veins after draining the testis and epididymis form the pampiniform plexus. On reaching the inguinal canal, plexus drains into 3–4 veins. In the abdomen, these veins join and form two veins which ultimately form a single vein. The left testicular vein drains into the left renal vein, whereas the right testicular vein drains into the inferior vena cava (Standring 2005a).

The penis is drained via the superficial and deep venous systems. The skin of the penis is drained by the superficial system of veins, which gives rise to a single superficial dorsal penile vein that eventually drains into the external pudendal, saphenous, and femoral veins; and finally into the external iliac vein. The deep venous system drains the corpora cavernosa, the corpus spongiosum, and penile urethra. The subtunical venules drain the three corporal bodies. The venules interdigitate through cavernous spaces and form subtunical plexus. The plexus drains into emissary veins which penetrate the tunica albuginea. Emissary veins then drain into circumflex veins. The circumflex veins drain into a single deep dorsal vein. The deep dorsal vein empties into the internal pudendal veins and ultimately into the prostatic venous plexus (Standring 2005c). The draining veins form a plexus along the anterolateral aspect of the prostate. The prostatic plexus ultimately drains into the vesical plexus. The veins from seminal vesicles and vas deferens also drain into the vesical venous plexus from where the veins drain into the inferior vena cava through inferior vesical veins (Standring 2005d, e). The venous blood coming from prostate may drain from internal iliac veins into the internal vertebral venous plexus through lateral sacral veins. This may be the route of prostate cancer spread to vertebral bodies or to the skull bones. The veins from the scrotum drain into internal and external pudendal veins and into inferior epigastric veins (Standring 2005b; see Figs. 5.5, 5.6, 5.7, and 5.8).

5.4 Nerve Supply

The branches of autonomic plexuses supply the male reproductive organs. The thoracic spinal segments (T10–T12) form aortic and renal plexuses which give origin to testicular nerves. These nerves pass through the spermatic cord and supply testes (Standring 2005a).

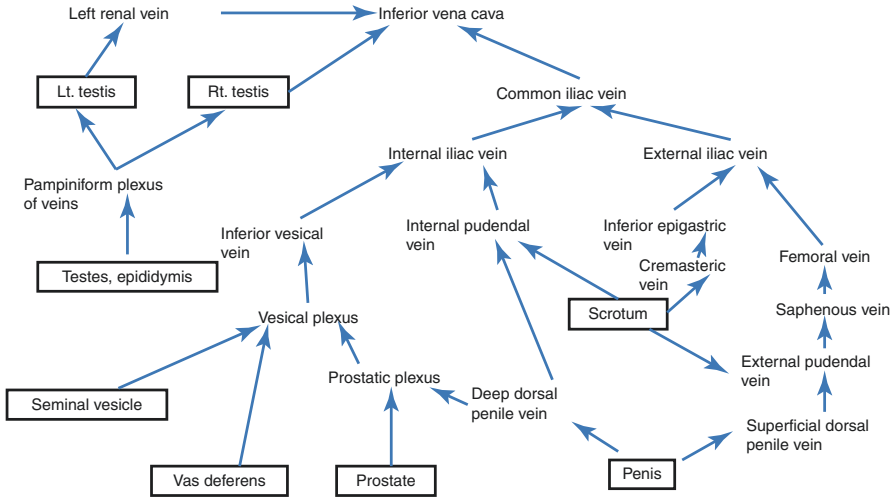


Fig. 5.5 Flowchart showing venous drainage of male reproductive organs

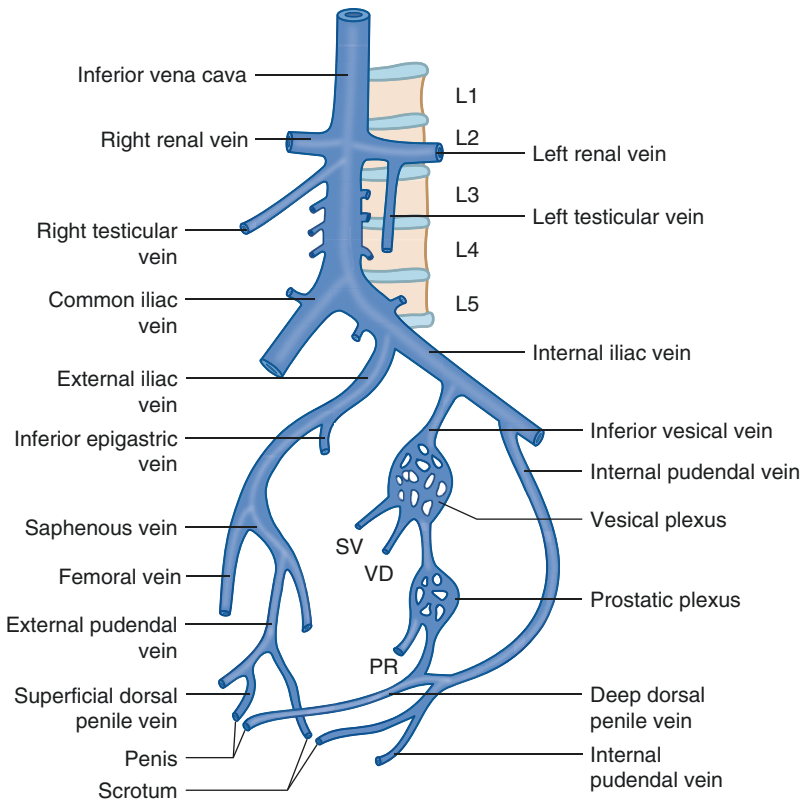


Fig. 5.6 Schematic diagram showing venous drainage of male reproductive organs. L1–L5 lumbar vertebrae, SV seminal vesicle, VD vas deferens, PR prostate

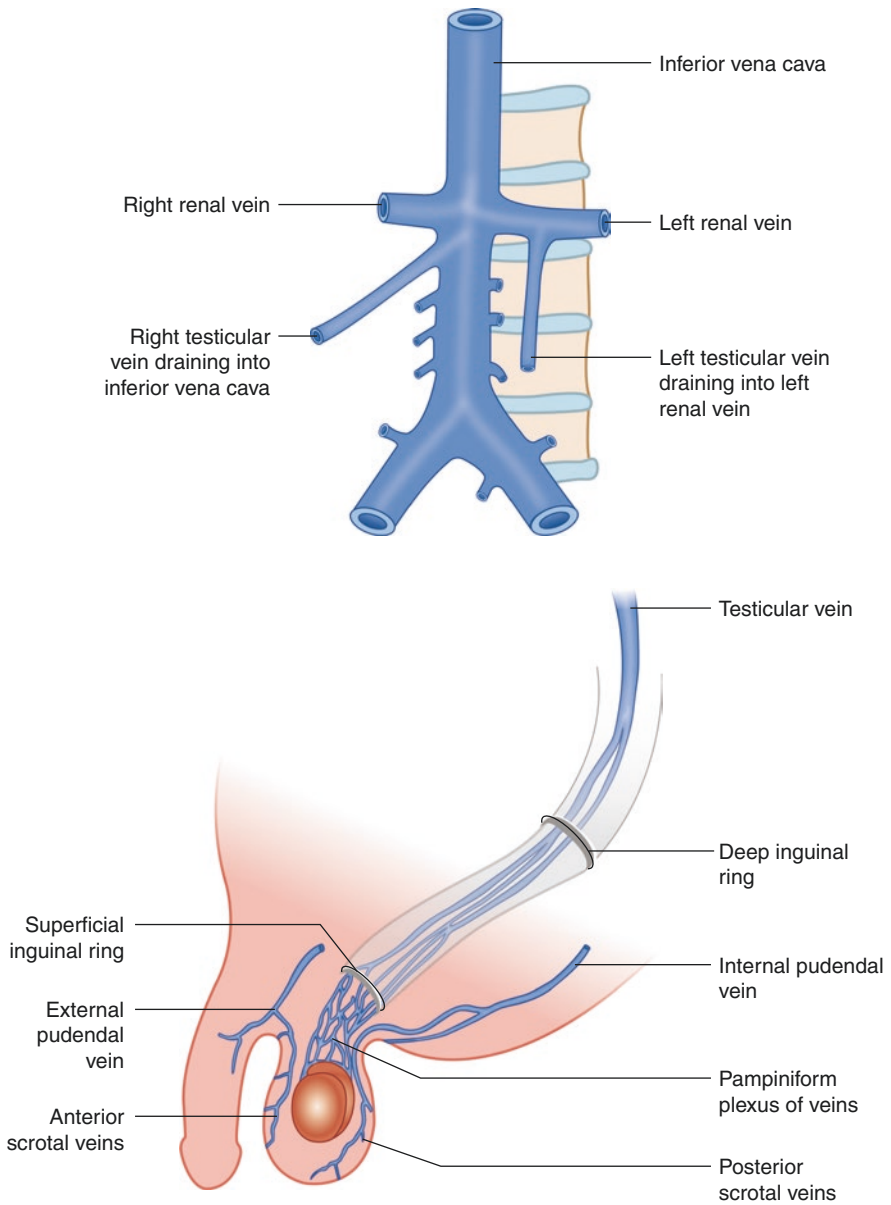


Fig. 5.7 Schematic diagram showing venous drainage of the testis and scrotum

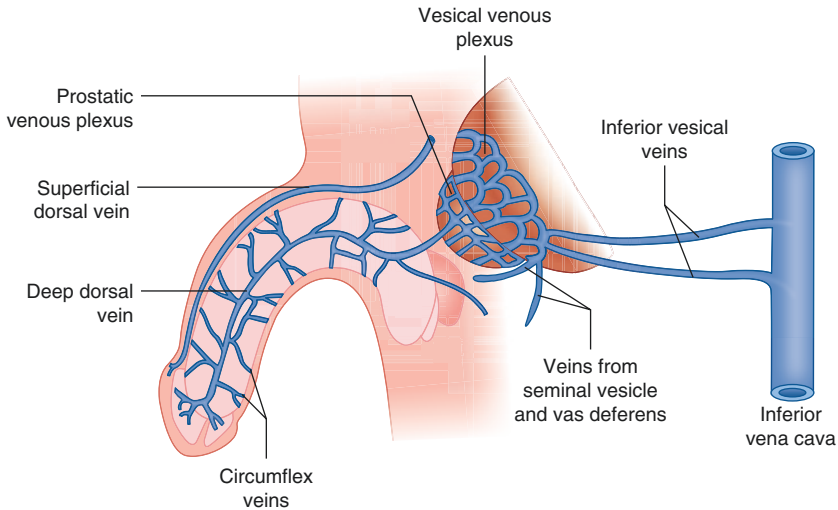


Fig. 5.8 Schematic diagram showing venous drainage of the penis

Both the sympathetic and parasympathetic components give innervations to male reproductive organs. The thoracolumbar region of spinal cord (T_{11} – L_2) provides sympathetic outflow from where the preganglionic cholinergic fibers pass to the sympathetic chain ganglia (see Fig. 5.9). The postganglionic adrenergic fibers then pass through the lumbar splanchnic nerves to reach the inferior mesenteric plexus which is present around the origin of the inferior mesenteric artery. The fibers then pass to the superior hypogastric plexus which is present in front of aortic bifurcation. The superior hypogastric plexus is formed by the sympathetic fibers from lower two lumbar splanchnic nerves and parasympathetic fibers from the branches of pelvic splanchnic nerves through hypogastric nerves. Pelvic splanchnic nerves carry fibers from sacral segments 2, 3, and 4. The fibers then reach the inferior hypogastric or pelvic plexus which is present just medial to the internal iliac vessels and posterolateral to the prostate and seminal vesicles. Inferior hypogastric plexus is formed by the sympathetic fibers from the left and right hypogastric nerves and parasympathetic fibers from pelvic splanchnic nerves. The plexus may also receive branches from lowest lumbar and sacral splanchnic nerves. The postganglionic branches from pelvic plexus supply the prostate, vas deferens, seminal vesicles, and penis (Hollinshed 1966; Standring 2005f). In the penis, the postganglionic adrenergic fibers supply penile arteries, veins, and cavernosal muscles. This causes vasoconstriction and muscle contraction leading to detumescence following orgasm. Penile innervation is also regulated by the supraspinal centers and spinal parasympathetic pathways. The important supraspinal centers for sexual function and penile erection are the medial preoptic area (MPOA) and paraventricular nucleus (PVN) of the hypothalamus and the hippocampus (Sachs and Meisel 1988; Marson et al. 1993). The outflow fibers from MPOA project through the medial forebrain bundle, midbrain tegmental region, and substantia nigra. The projecting nerve fibers then enter the parasympathetic sacral and sympathetic thoracolumbar spinal centers controlling erection (Mc Kenna 1998).

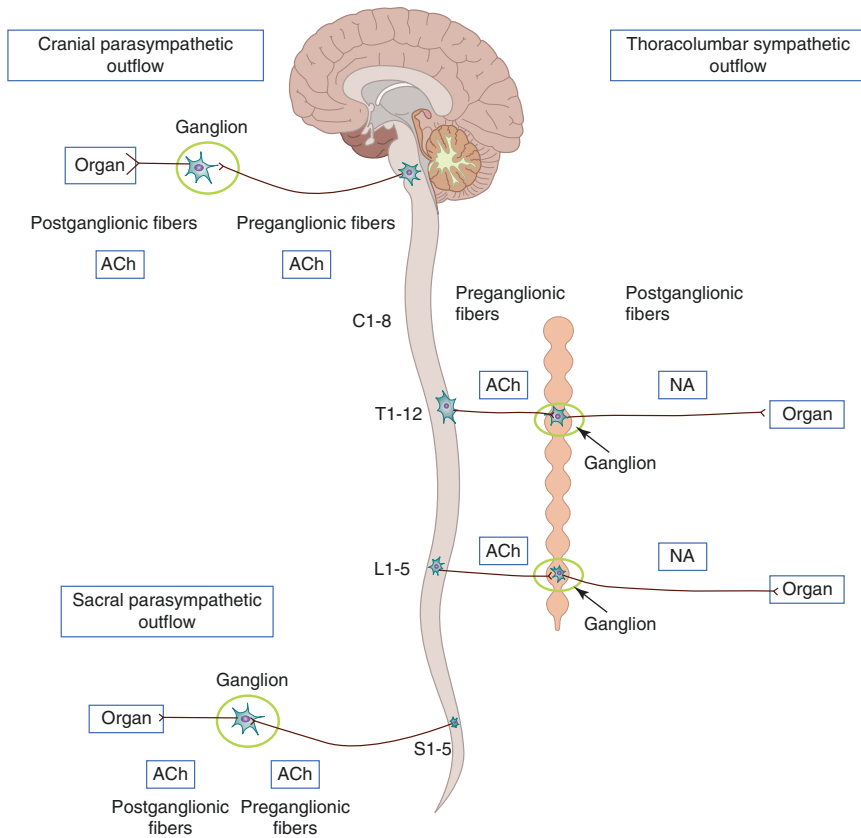


Fig. 5.9 Schematic diagram showing neurons and neurotransmitters of the autonomic nervous system. *Ach* acetylcholine, *NA* noradrenaline, *C1–C8* cervical segment, *T1–T12* thoracic segments, *L1–L5* lumbar segments, *S1–S5* sacral segments of the spinal cord

The parasympathetic fibers after originating from the intermediolateral gray matter of sacral 2 to sacral 4 spinal cord segments leave the spinal cord as preganglionic pelvic splanchnic nerves and run in the retroperitoneal space toward the prostate and perineal membrane. These preganglionic cholinergic fibers join the pelvic or inferior hypogastric plexus. The details of formation of this plexus are already discussed in the previous section. From this plexus, the postganglionic cholinergic fibers arise which form the cavernous nerves. Cavernous nerves supply the erectile tissue of the penis. The rich cholinergic innervations to the vessels lead to vasodilatation and muscle relaxation. This causes increased blood flow into the penis and penile erection (Standing 2005c). The penis is also innervated by somatic nerves. The somatic sensations from the glans, skin over the shaft of the penis, and urethra are carried by dorsal nerves of the penis which join the fibers of the pudendal nerve. The pudendal nerve fibers then enter the sacral 2 to 4 spinal cord segments. Fibers then ascend in the spinal cord and synapse in the thalamus and eventually terminate in the contralateral primary sensory cortex. The somatomotor supply to the penis comes from the sacral 2 to 4 spinal segments. The nerve fibers travel in sacral nerves to join the pudendal nerve. Pudendal nerve then

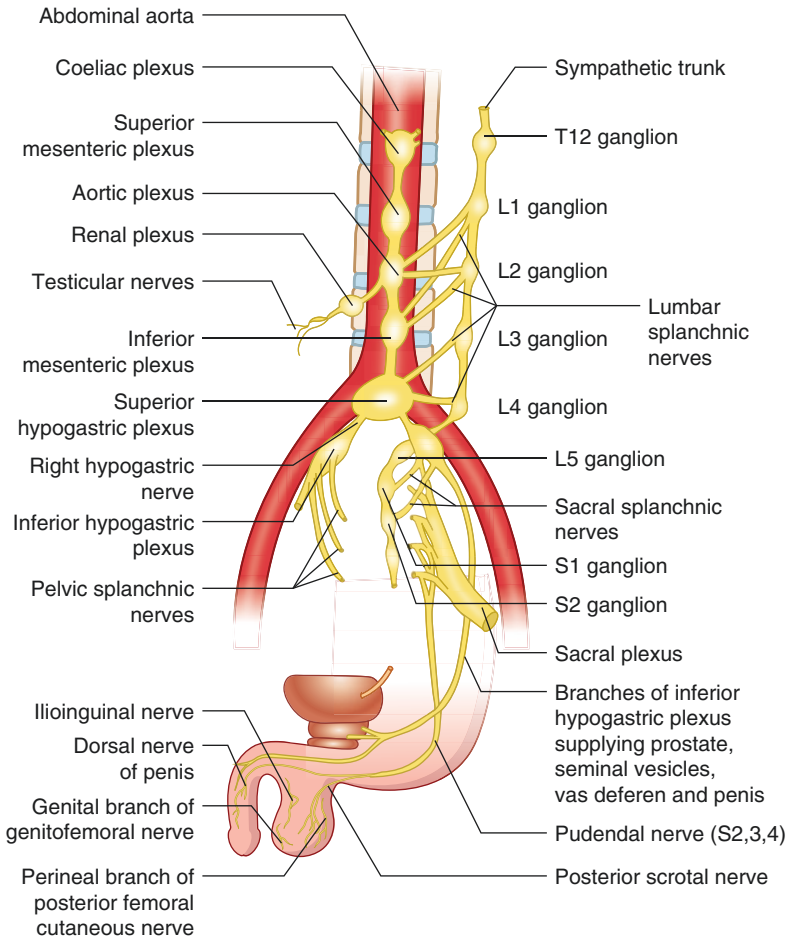


Fig. 5.10 Schematic diagram showing nerve supply of male reproductive organs. *T12* 12th thoracic ganglion, *L1–L5* lumbar ganglia, *S1–S2* sacral ganglia, *S2, S3, S4* sacral 2–4 spinal nerves

innervates the bulbospongiosus and ischiocavernosus muscles (Goldstein 1988). The contraction of ischiocavernosus muscle produces erection, whereas the rhythmic contraction of bulbospongiosus facilitates ejaculation (Mc Kenna 1998).

Pudendal nerve is formed by the anterior division of sacral 2, 3, and 4 spinal nerves. The pudendal nerve gives posterior scrotal nerves which supply the scrotum. The scrotum is also innervated by the ilioinguinal nerve (L1), genital branch of genitofemoral nerve (L1, L2), and perineal branch of posterior femoral cutaneous nerve (S2, S3) (Standring 2005b, see Fig. 5.10).

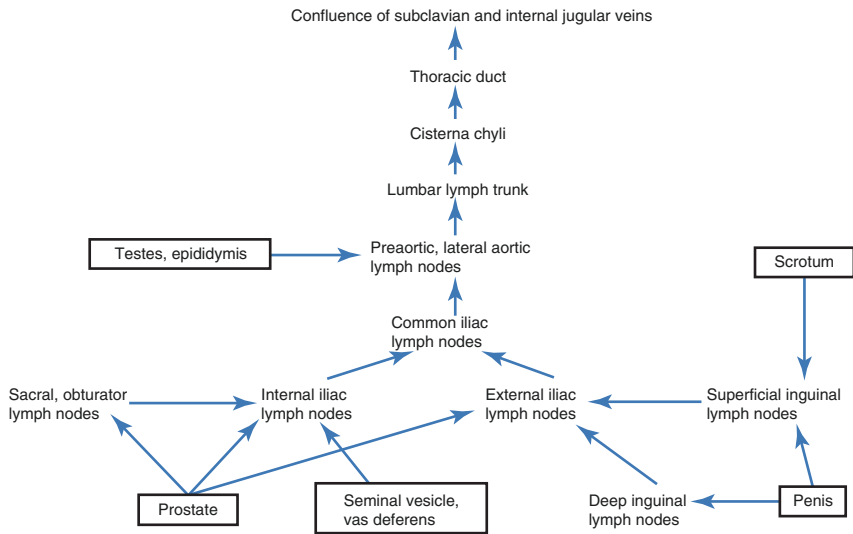


Fig. 5.11 Flowchart showing lymphatic drainage of male reproductive organs

5.5 Lymphatic Drainage

The lymphatic system consists of lymphoid organs like lymph nodes, spleen, thymus, tonsils, and lymphatic vessels. Lymph is the extravasated tissue fluid having plasma proteins and cells. Lymph is first collected by the lymphatic capillaries which drain them to the collecting vessels that carry lymph to the regional lymph nodes. The lymph nodes are connected to the lymphatic trunks which ultimately drain lymph into venous system. The lymph nodes are arranged around the corresponding vessels. The major part of lymph from male reproductive organs is drained to the internal iliac group of lymph nodes; some lymphatics also drain into the external iliac, sacral, and obturator, inguinal, and aortic group of lymph nodes (see Fig. 5.11).

The lymphatics from testes ascend in the spermatic cord and end in lateral aortic and preaortic group of lymph nodes (Standring 2005a). The skin of the penis is drained by the lymphatics accompanying the external pudendal vessels to the superficial group of inguinal lymph nodes. The lymphatics from the glans penis drain into the deep group of inguinal lymph nodes and external iliac lymph nodes. The lymphatics from the penile part of the urethra and the erectile tissue of the penis drain into the internal iliac lymph nodes (Standring 2005c). The lymphatic vessels from the scrotum drain into the superficial group of inguinal lymph nodes (Standring 2005b). Prostate lymphatics from the anterior surface drain into the internal iliac lymph nodes; lymphatics from the posterior surface drain into the external iliac lymph nodes; and lymphatics also drain into the sacral and obturator group of lymph nodes (Standring 2005d). Lymphatics from seminal vesicles and vas deferens drain into the iliac group of lymph nodes (De Krester et al. 1982; Standring 2005e; see Fig. 5.11).

Key Questions

- Name the branches of the abdominal aorta.
- Discuss briefly the arterial supply of testis.
- Name the arteries supplying the penis.
- Discuss briefly the venous drainage of testis.
- Describe the superficial and deep venous systems of the draining penis.
- Draw a flowchart showing lymphatic drainage of male reproductive organs.
- Write briefly the formation of the superior and inferior hypogastric plexus.
- Name the structures innervated by the pudendal nerve.
- Discuss the neural pathway mediating penile erection.

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