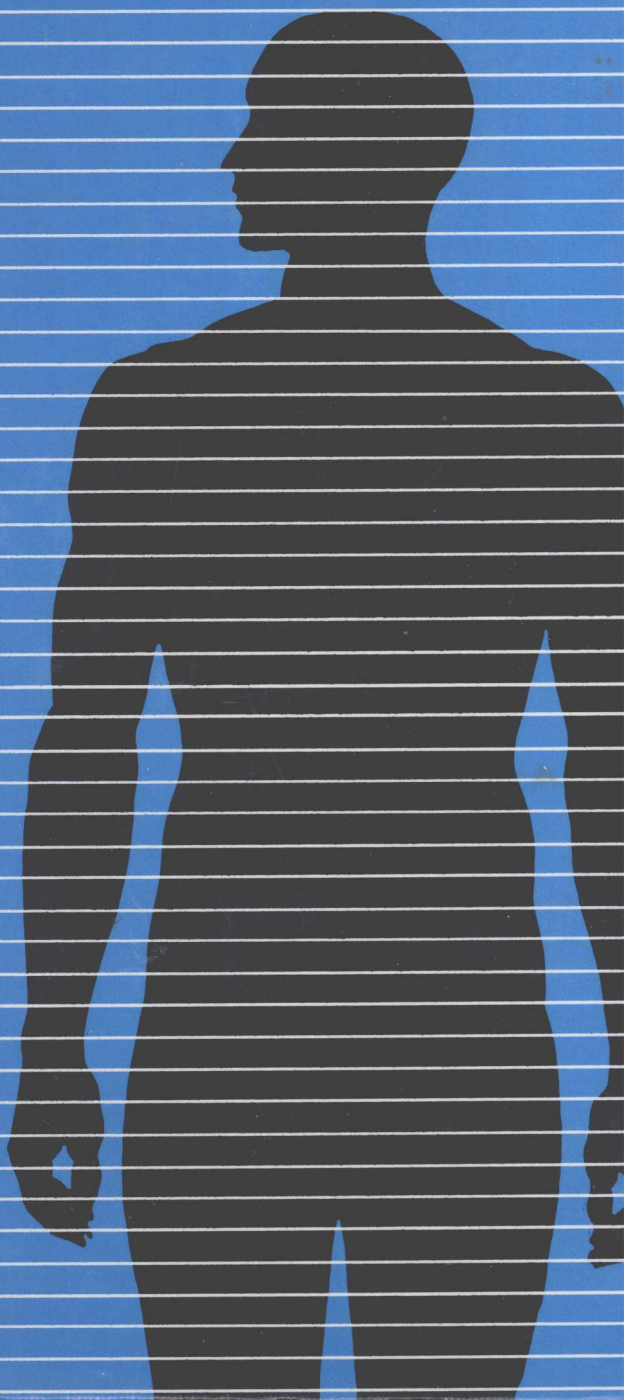
DISORDERS OF MALE SEXUAL FUNCTION

DROGO K. MONTAGUE



Disorders of Male Sexual Function

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PREFACE

Until the early 1970s impotence was believed to be primarily a psychological disorder. Strauss[1] in 1950 wrote: "Anything which interferes with the chain of reflexes required for the reproductive act in the male may give rise to impotence. In considerably more than 90% of cases the source of interference is psychic—hence the clinical label, 'psychosexual impotence.' The most common cause of interference is anxiety, which may be either conscious or unconscious, primary or secondary."

More than 15 years later, thinking had changed very little. *Cecil-Loeb Textbook of Medicine*[2] devoted only one paragraph to the subject of impotence and concluded: "When impotence is the principal complaint of a patient, it is usually the result of an emotional disturbance, in which case androgen therapy is valueless and at times may add to the psychic trauma." In his textbook *General Urology*, Smith[3] stated: "Various degrees of impotence in men are common, but it is rare to find definite organic cause for the complaints . . . . The cause of almost all these difficulties is psychogenic . . . Sexual problems in the male are difficult to treat and usually require more time and skill than the physician without psychiatric training can give."

Physicians of this era, because of a lack of knowledge concerning pathogenesis and an absence of effective therapy options, had little interest in male sexual problems. Treatment for these disorders usually consisted of empiric testosterone administration followed by psychiatric referral. Traditional psychotherapy for impotence, however, was often ineffective.

The introduction in the early 1970s of paired, intracorporeal penile implants (the inflatable Scott-Bradley-Timm prosthesis[4] and the semi-rigid rod Small-Carrion prosthesis[5]) together with sex therapy (couple-oriented behavior modification[6]) ushered in the modern era of male sexual medicine.

Today the man with a sexual problem has a much better chance of obtaining relief than his counterpart of 20 years ago. A better understanding of normal sexual function and the pathogenesis of various sexual disorders, specific tests to evaluate the multiple determinants of sexual function, and a variety of effective treatment options all lead to frequent resolution of these problems.

Urologists, psychiatrists, psychologists, internists, neurologists, vascular surgeons, radiologists, and gynecologists now often work together in multidisciplinary clinics to serve men, women, and couples with sexual problems. A new specialty of medicine that cuts across many traditional disciplines has developed.

The purpose of this text is to introduce male sexual problems to physicians, psychologists, nurses, and other health professionals who wish to become a part of this new, evolving specialty of medicine.

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DROGO K. MONTAGUE, M.D.

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PART ONE

General Considerations

CHAPTER 1

The Anatomy and Physiology of Normal Male Sexual Function

Eric A. Klein, M.D.

Few areas in medicine provoke more anxiety in otherwise healthy patients than their own sexuality. While these concerns are especially apparent in those patients specifically seeking help for sexual problems, the incidence of sexual difficulties or dysfunction has been reported to be as high as 50% in healthy men with satisfying sexual relationships.[1] It is therefore incumbent upon all primary care physicians, not simply those specialists treating patients with sexual dysfunction, to be able to obtain and document an accurate sexual history in a nonthreatening manner. An accurate and thorough sexual history will allow the clinician to reassure the patient when no dysfunction exists, to identify those problems worthy of further investigation, and to identify the appropriate lines of referral for treatment of specific disorders. Obtaining an accurate sexual history depends on an adequate understanding of normal sexual function and physiology. This chapter outlines the basic information relevant to the anatomy and physiology of normal male sexual and erectile function, the individual variability in male sexual response, and the effects of aging on male sexual function and erectile capacity.

ANATOMY

Human sexual response can truly be characterized as a total body response that includes sensory input and perceptions of sensation far removed from the primary anatomical sites of sexual contact. A detailed description of the anatomy of these primary sites is helpful in understanding sexual physiology. In the male, the primary sites are the penis and scrotum, or external genitalia, and the accessory sex organs, or internal genitalia.

External Genitalia

Penis

The penis is composed of three longitudinally placed corporeal bodies. The paired corpora cavernosa subserve erectile functions, while the single corpus spongiosum contains the urethra and serves both urinary and ejaculatory function (Fig 1–1).[2] On gross inspection the penis can be divided into a root and body (Fig 1–2). The root of the penis is that portion attached to the undersurface of the urogenital diaphragm and pubic arch and contains the proximal portions of the three corporeal bodies as well as their muscular investment (see Fig 1–2). The body, or pendulous portion, extends outward from the pubic arch forming the visible portion of the penis. The body of the penis is suspended proximally from the linea alba and symphysis pubis by the fundiform and suspensory ligaments (see Fig 1–1).

The corpora cavernosa are composed of a dense outer layer known as the tunica albuginea, which encloses a potential vascular space interspersed with trabeculae of connective and mus-

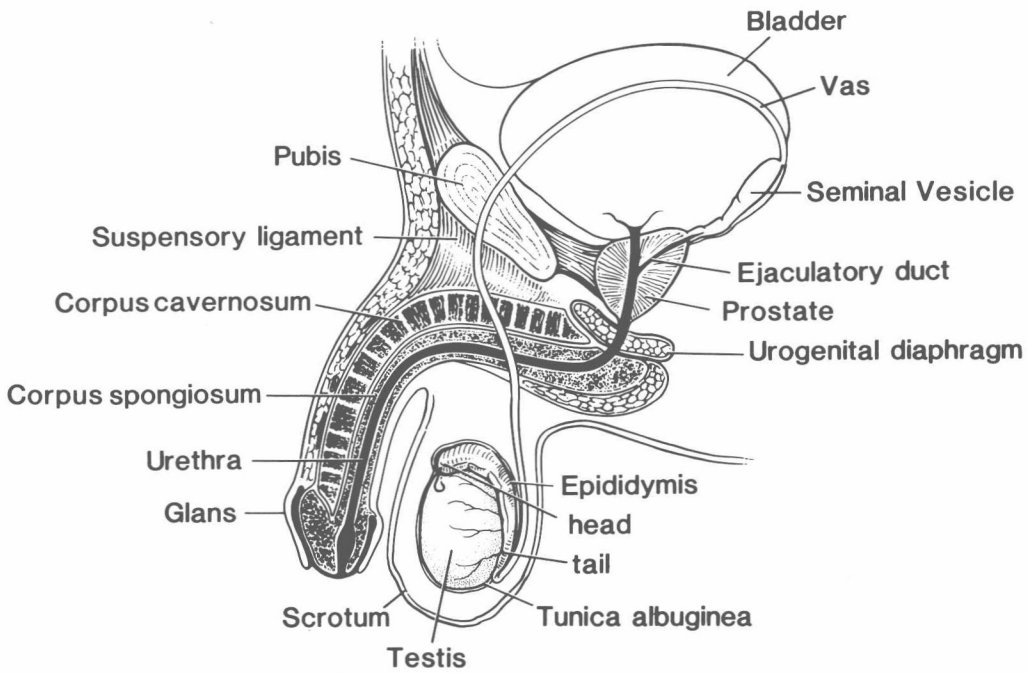

FIG 1–1.
Midsagittal section of male pelvis demonstrating internal and external genitalia and related structures.

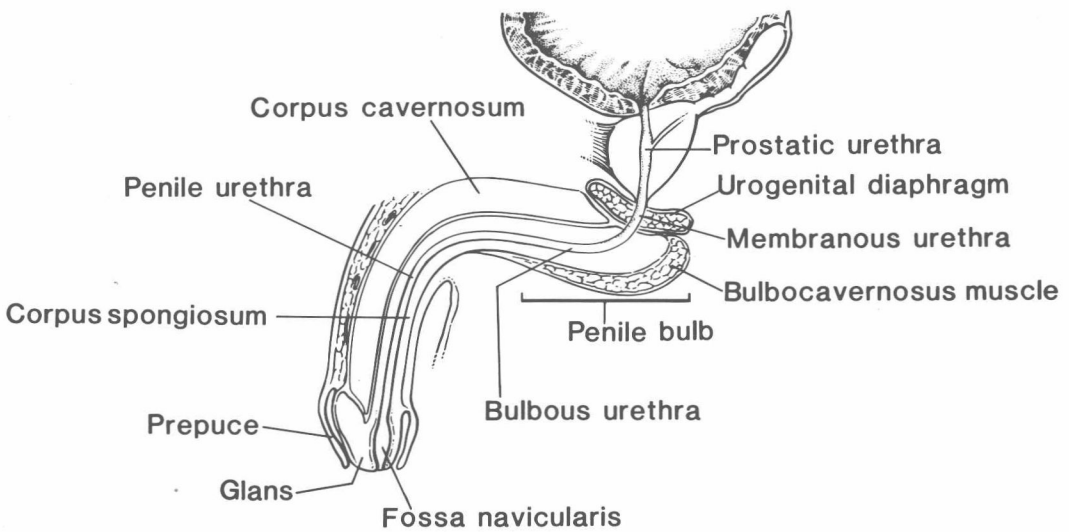

FIG 1–2.
Sagittal section of penis demonstrating anatomy of glans, corporeal bodies, and urethra.

cular tissue. The proximal two fifths of each corpus cavernosum, known as the crus (plural = crura), is attached to the inferior surface of the ischial ramus on each side. Each crus is covered by a corresponding ischiocavernous muscle. More distally, the crura meet in the midline and form the dorsal part of the penile body. At this level the corpora cavernosa share a common septum (Fig 1–3) that allows free vascular communication from side to side, so that they function as a common erectile unit.[2]

The corpus spongiosum is also composed of trabeculated connective and muscular tissue with a much finer interior network than the corpora cavernosa and is surrounded by a thin fascial membrane. Proximally the spongiosum arises in the midline of the superficial perineal space from the undersurface of the urogenital diaphram (see Fig 1–1). Here it is invested by the bulbocavernous muscle and together with the urethra forms the bulb of the penis (see Fig 1–2). The corpus spongiosum initially travels in the midline between the cura, then comes to lie ventrally in the body of the penis in the groove between the undersurface of the corpora cavernosa (see Figs 1–2 and 1–3). Distally, the corpus spongiosum expands to form the glans penis, which extends beyond the corpora cavernosa and forms a cap over their distal tips (see Fig 1–2). The expanded proximal edge of the glans is known as the corona, and the groove between the penile shaft and corona is the coronal sulcus.

The urethra traverses the entire length of the corpus spongiosum, emerging from the urogenital diaphragm and terminating as the urinary meatus in the glans (see Fig 1–2). The urethra is divided anatomically into anterior and posterior portions, with segments within each portion named according to surrounding structures. The posterior urethra extends from the vesical neck through the urogenital diaphragm and consists of prostatic and membranous portions. The membranous urethra is that portion actually traversing the urogenital diaphragm. The anterior urethra extends from the bulb to the urinary meatus and is divided by the attachment of the suspensory ligament into the bulbous urethra proximally and the pendulous (or penile) urethra distally. The pendulous urethra has a preterminal dilatation just proximal to the meatus known as the fossa navicularis.

The three corporeal bodies of the penis are surrounded by both a superficial and deep layer of fascia that are continuous with the fascia of the perineum (see Fig 1–3). The deeper layer,

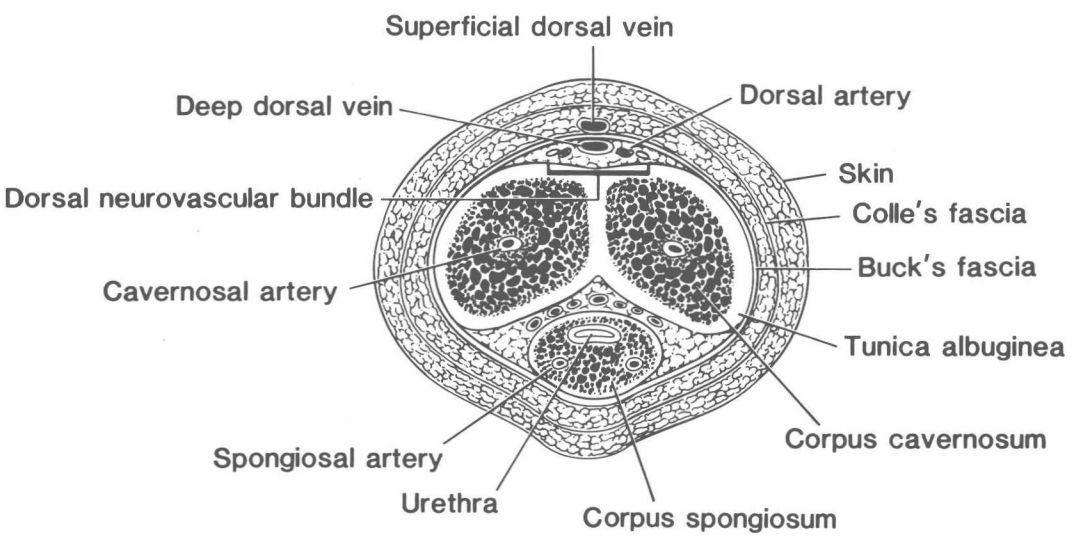

FIG 1–3.
Cross section of penis demonstrating fascial planes, vascular anatomy, and relationships of corporeal bodies.

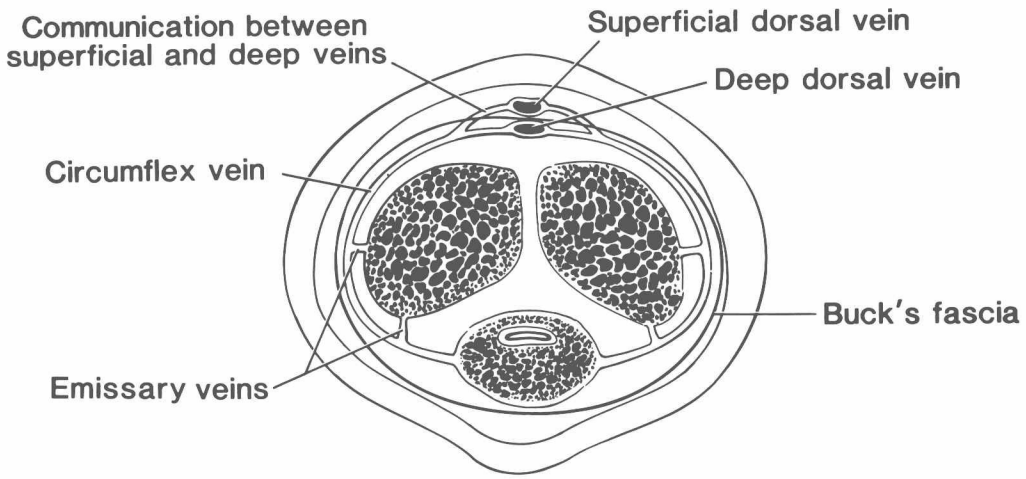

FIG 1–4.
Cross section of penis highlighting venous anatomy.

known as Buck's fascia, is thicker and more fibrous than the superficial layer and arises from the undersurface of the urogenital diaphragm. The superficial, or Colles' fascia, is continuous with Scarpa's fascia of the lower abdominal wall. Penile skin overlies the superficial fascia to which it is loosely attached, allowing free movement over the penile shaft during erection and intercourse. In uncircumcised males, the skin projects over the glans forming the prepuce or foreskin. The prepuce can be fully retracted past the corona onto the penile shaft to expose the whole glans in the normal postpubertal male. The prepuce serves no known sexual or urinary function, although some have suggested that uncircumcised males have greater tactile sensitivity of the glans because the intact prepuce protects it from constant stimulation by clothing.

The arterial supply of the penis is derived from the internal pudendal arteries, branches of the hypogastric arteries. Blood supply to the penis subserves both nutrient and erectile functions. After emerging from Alcock's canal in the ischiorectal fossa, the internal pudendal arteries pierce the urogenital diaphragm and become the penile arteries. Here they typically give off a short bulbar branch, then trifurcate into three paired terminal branches that traverse the length of the penis (see Fig 1–3).[2–4]

The spongiosal arteries course ventral to the urethra and terminate in the glans. They supply the urethra, corpus spongiosum, and glans. The deep or cavernosal arteries course longitudinally through each corpus cavernosum ending as helicine branches. These arteries are responsible for flow into the vascular spaces of the corpora cavernosa, causing engorgement of the spaces and leading to erection. Lastly, the dorsal arteries of the penis travel just under Buck's fascia, giving circumflex branches to both corpora cavernosa and corpus spongiosum. Along with the dorsal nerve and deep dorsal vein of the penis, the dorsal artery forms the neurovascular bundle of the penis (see Fig 1–3).

The venous drainage of the penis can be divided into superficial and deep systems (Fig 1–4). All of the tissue superficial to Buck's fascia is drained by the superficial dorsal vein into the saphenous, scrotal, or epigastric veins. The deep venous system has several components and drains into the pudendal plexus.[2] The urethral and bulbar veins drain the proximal corpus spongiosum and bulb. Short deep veins drain the crura of the corpora cavernosa directly into the pelvic plexus.[3] The deep dorsal vein, which runs between the dorsal arteries in the neurovascular bundle below Buck's fascia, drains the distal corpora cavernosa, spongiosum, and glans. The deep dorsal, bulbar, and urethral veins are connected via circumflex branches arising from emissary veins of the corpora cavernosa and corpus spongiosum (see Fig 1–4).[4] Some anastomoses

also exist between the deep and superficial dorsal veins.[2]

Several clinical examples serve to highlight the importance of understanding the detailed vascular structure of the penis. Obliteration of the internal pudendal artery by trauma or atherosclerosis can result in flow to the corpora cavernosa that is insufficient for erection.[5] Anomalous venous drainage of the corpora cavernosa can result in impotence by acting as a "leak" in an otherwise closed vascular system.[6–8] Lastly, the dual venous drainage of the corpus spongiosum and corpora cavernosa allows treatment of priapism resulting from venous stasis of one system by anastomosis with the other. These problems are addressed more fully in subsequent chapters.

Scrotum

The scrotum, housing the testes, hangs from the anterior triangle of the perineum between the root of the penis and the perineal body (see Fig 1–1). It protects the testes from injury and regulates testicular temperature. Most men also find gentle tactile stimulation of the scrotum pleasurable.

The scrotal wall is composed of three layers. The outer layer is skin containing an abundant supply of elastic and smooth muscle fibers. The middle, or dartos layer, consists of elastic connective tissue and smooth muscle fibers closely applied to the skin. The inner layer is a thin fascial layer derived from the spermatic fascia.

Some anatomical features of the scrotum are relatively constant between individuals. For unknown reasons, the right testis usually hangs slightly lower than the left. The scrotal skin is abundant with hair follicles and is usually more deeply pigmented than other areas of skin. In the midline, a more deeply pigmented or slightly raised vertical ridge known as the median raphe divides the scrotum into lateral halves. Other features of scrotal appearance are more variable, changing in response to various environmental and physiologic stimuli. The scrotal skin may appear thin, smooth, and shiny, the scrotal sac relatively larger, and the testes pendulous when the ambient temperature is high, such as during a shower or exercise. Conversely, the scrotum shrinks, the skin becomes thick and corrugated with rugae, and the testicular outline indistinct when exposed to cold or during sexual excitement. Both extremes of appearance are normal consequences of the action of the muscular and elastic fibers of the dartos and skin, which contract and relax to help maintain a constant testicular temperature and in response to sexual stimuli. Control of testicular temperature by ascent and descent into and out of the scrotum is also regulated by reflex activity of the cremasteric muscle fibers of the spermatic cord.

Internal Genitalia

Testes

The testes subserve a dual role in sexual function, endocrinologic and procreative. They are smooth-surfaced, ovoid structures that lie obliquely within the scrotum (see Fig 1–1). In an adult male, each testis averages 24 cc in volume[9] with dimensions of 4.5 × 2.5 × 3.0 cm. Estimates of testicular volume and size are best calculated with calipers or by comparison to plastic models of varying sizes (orchidometer).

The substance of the testes is contained within a covering of tunica albuginea. The bulk of the testes is composed of seminiferous tubules lined by Sertoli's cells and spermatogonia, which subserve procreative function. Within the interstitium is the endocrinologic portion of the testes, Leydig's cells, which produce the male hormone testosterone. Testosterone is necessary for libido, spermatogenesis, and cellular maintenance of the accessory sexual organs. The control of testosterone production is discussed subsequently.

Nutured by Sertoli's cells, the spermatogonia undergo maturation to spermatozoa within the lumen of the seminiferous tubules. From the tubules the spermatozoa are transported via the excurrent ducts (the rete testis and ductuli efferentes) into the epididymis.

Accessory Sexual Organs

The epididymis is a tightly coiled tube attached to the posterior surface of the testis along its long axis (see Fig 1–1). Anatomically, it is

divided into a head (globus major), which resides superiorly, a body, and an inferior tail (globus minor) and is continuous with the ductuli efferentes of the testis proximally. Distally, the tail of the epididymis is continuous with the vas deferens. The epdidymis serves as a repository for sperm maturation.

The vas deferens serves as a conduit for spermatozoa between the epididymis and posterior urethra. It is 2 to 3 mm in diameter and propels fluid by means of a thick muscular coat. The vas begins at the tail of the epididymis, traverses the inguinal canal and the spermatic cord, courses laterally along the pelvic sidewall and then medially behind the bladder ending medial to the seminal vesicles (see Fig 1–1). Terminally it is dilated and fusiform, forming the ampulla, where spermatozoa are stored prior to ejaculation.

The seminal vesicles are paired glandular organs located behind the prostate and bladder neck (see Fig 1–1). They secrete a nutritive fluid high in fructose content important for survival of spermatozoa outside of the male genital tract. The secretions of the seminal vesicles form the bulk of seminal fluid, accounting for 46% to 80% of the volume of each ejaculate.[10,11]

The ampulla of the vas joins the duct of the ipsilateral seminal vesicle to form the ejaculatory duct, through which semen is expelled into the prostatic urethra.

The prostate is a chestnut-sized and -shaped glandular and fibromuscular organ between the bladder neck and urogenital diaphragm (see Fig 1–1). Its sexual role has been the source of much misinformation among laymen,[12] particularly in regards to libido and potency. In reality, the prostate functions only as an accessory sexual organ, with its secretions constituting 13% to 32% of ejaculate volume.[11] In addition, the prostate houses the prostatic urethra into which the ejaculatory ducts open.

The bulbourethral or Cowper's glands are paired glands located in the urogenital diaphragm lateral to the membranous urethra. They secrete a milky-white or yellowish fluid into the bulbous urethra on sexual excitement. Appearance of this fluid often precedes the sensation of ejaculation and is therefore sometimes colloquially known as "pre-come."

The glands of Littre line the penile urethra and secrete a clear mucus on sexual arousal. Their only function is urethral lubrication.

Neuroanatomy

All elements of the neuraxis are important in normal sexual function. The central nervous system (CNS) houses subcortical structures responsible for basic sexual instinct and organs of sensory input that result in sexual excitation. In addition, the cortex generates and processes psychic stimuli that can facilitate or inhibit erectile response. The spinal cord contains the afferent and efferent limbs connecting the CNS and peripheral nervous systems, as well as lumbar and sacral reflex centers subserving erection, emission, ejaculation, and accessory gland secretion. The autonomic nervous system innervates all of the organs of sexual function and subserves the mechanism of erection. The somatic nervous system provides both tactile input from the external genitalia and motor innervation of the penile and perineal musculature.

Central Nervous System

Central nervous system control of sexual function arises from both cortical and subcortical centers. Much of the knowledge about the function of these centers is derived from the study of primates, which have presumed parallels in the mechanisms of human sexual function.[4,13]

The limbic system appears to be the primary central coordinating center for erection.[3,4] It consists of portions of the cortex surrounding the upper brain stem (the hippocampus, cingulate and parahippocampal gyri) and several subcortical nuclei including the hypothalamus, amygdala, and parts of the thalamus and basal ganglia.[14] As a whole, limbic system function is concerned with basic physiologic drives, emotion, and the integration of sensory and visceral function.[4]

The limbic system receives external sexual stimuli in the form of tactile, visual, auditory,

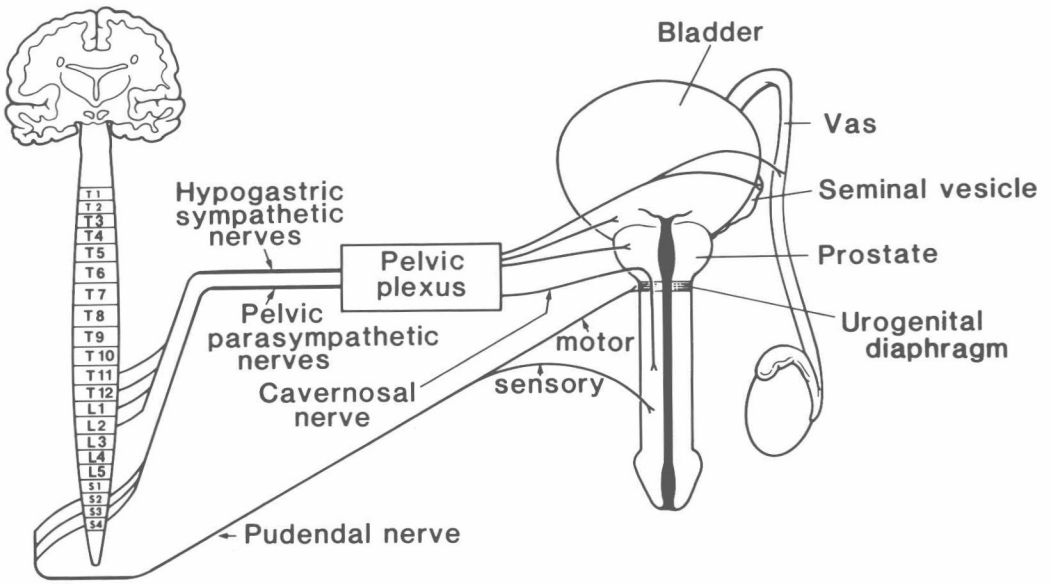

FIG 1–5.
Schematic diagram of innervation of internal and external genitalia.

and olfactory afferents. Internal stimuli in the form of psychic cortical input are also presumably integrated here. Following processing of relevant stimuli by unknown mechanisms, erectile centers, located primarily in the preoptic hypothalamic area, send efferent signals to the penis via the autonomic nervous system.[3, 15] The efferent pathway courses via the median forebrain bundle to the substantia nigra through the ventrolateral pons and descends in the lateral columns of the spinal cord to sympathetic and parasympathetic effector neurons in the thoracolumbar and sacral segments of the spinal cord.[3, 15]

The role of the CNS in sexual functioning is not limited to rote processing of internal neural stimuli. The range of observed human sexual behavior, individual variations in what is considered erotic, and the role of fantasy in sexual arousal make it clear that psychic phenomena play important roles in sexual behavior. Indeed, erections that occur in men with damage to the sacral parasympathetic centers controlling erection have been aptly named "psychogenic." Such erections arise from cortical sensory input in the form of auditory, olfactory, visual, or imaginative stimuli.[16]

The psyche can also display an inhibitory role in sexual function, as when a nonsexual stimulus (a physical or mental distraction) causes a loss of erection or decrease in arousal during sexual excitement. This role is further highlighted by the observation of decreased testosterone levels in males under severe stress.[17]

While all of the central mechanisms relating to sexual functioning are not fully understood, it appears that the hypothalamus plays a central role in controlling heterosexual behavior[15] through extensive neural connections with higher cortical and other subcortical structures and the modulation of pituitary hormones that control testosterone synthesis (discussed subsequently).

Innervation of the Penis

The autonomic innervation of the penis arises from the pelvic plexus, which also supplies autonomic input to other pelvic organs. The pelvic plexus contains both sympathetic and parasympathetic fibers and is located lateral to the rectum at the level of the prostate (Fig 1–5).[18] The sympathetic component arises from the thoracolumbar level (T-11 to L-2) of the spinal cord and reaches the pelvic plexus mainly via the hypogastric nerve. The parasympathetic