Until recently the smooth musculature of the bladder and urethra was considered to be controlled by the parasympathetic division of the autonomic nervous system with very little influence by the sympathetic component. This concept has subsequently been modified following the results of numerous recent investigations using a variety of neurohistochemical, electron microscopic and immunologic techniques. Studies of the anatomy, physiology and pharmacology of the vesicourethral musculature in experimental animals and humans have provided a wealth of new information and it is now evident that the processes of urine storage and micturition are considerably more complex than was once believed. This chapter provides a summary of current knowledge on the structure of the human urinary bladder and urethra, including their extrinsic and intrinsic innervation.

Extrinsic Innervation of the Urinary Bladder and Urethra

Efferent sympathetic and parasympathetic fibres are conveyed to the bladder and urethra via the hypogastric and pelvic nerves respectively. These nerves also convey afferent (sensory) fibres to the spinal cord. The sympathetic fibres are derived from the lower two thoracic and upper two lumbar segments of the spinal cord. The parasympathetic fibres arise from the second to the fourth sacral segments of the spinal cord (the nervi erigentes or pelvic splanchnic nerves). The hypogastric and pelvic nerves of either side meet and branch to form the pelvic plexus which lies lateral to the rectum, internal genital organs and the bladder. That part of
each pelvic plexus specifically related to the urinary bladder is referred to as the vesical plexus of autonomic nerves and contains both sympathetic and parasympathetic ganglion cells together with occasional small intensely fluorescent (SIF) cells.

The parasympathetic neurons of the vesical plexus provide the cholinergic motor innervation to the musculature of the bladder wall and urethra. These neurons receive a preganglionic input not only from cholinergic (excitatory) axons, but also from noradrenergic (possibly inhibitory) nerve terminals.

Afferent impulses arising from sensory nerve endings in the wall of the bladder and urethra pass to the spinal cord via the pudendal, pelvic and hypogastric nerves. The pudendal nerve transmits sensation mainly from the urethral mucosa (in addition to that from the skin of the genital area and the anal canal) and also proprioceptive impulses from the striated muscle of the pelvic floor. The afferent pathway of the micturition reflex is carried in the pelvic nerves (Learmonth 1931), together with those afferents concerned with bladder mucosal pain and lower ureteric pain. The part played by the hypogastric nerves in relaying sensation from the lower urinary tract is not well defined. No alteration in bladder or urethral sensation occurs after presacral neurectomy (Learmonth 1931), although some sensation of fullness has occasionally been noted to be preserved after lower spinal injury (Head and Riddoch 1917).

**Structure of the Urinary Bladder**

The urinary bladder is a hollow muscular organ lined by a mucous membrane and covered on its outer aspect partly by peritoneal serosa and partly by fascia. The muscularis of the urinary bladder is formed of smooth muscle cells which comprise the detrusor muscle.

**Detrusor Muscle**

The muscle coat of the bladder is often described as consisting of three layers, the muscle fibres of the outer and inner layers tending to be orientated longitudinally, while those of the middle layer are circularly disposed. However, the constituent muscle bundles frequently branch and reunite with one another to form an interlacing meshwork so that discrete layers are not readily discernible (Fig. 1.1). Thus, from a functional viewpoint, the detrusor muscle comprises an integrated unit of interconnected muscle bundles which, on contraction, will cause a reduction in all dimensions of the bladder lumen (Gosling 1979; Gosling et al. 1983).

Posteriorly, some of the outer longitudinal muscle bundles extend over the bladder base and merge with the capsule of the prostate (in the male) or with the anterior vaginal wall (in the female). Other bundles extend onto the anterior aspect of the rectum to form the rectovesical muscle. Anteriorly, some outer longitudinal muscle bundles continue into the pubovesical ligaments and contribute to the muscular component of these structures.

The body and fundus of the bladder are supple, mobile and highly distensible, and are capable of expansion into the abdomen according to the volume of contained urine. In contrast, the bladder base, closely related to the genital tissues in both male and female, is relatively indistensible.

Elbadawi provides a more intricate description of the bladder base. The base detrusor is not separable from the body detrusor by any anatomical or histological boundary. The base region is sizable and well defined in the human bladder, and its junction with the urethra is easily identified by appreciable narrowing of the lumen. Continuing into the base region, the bundles of the body detrusor become organized as a ventral and a dorsal group of longitudinal bundles.

Two lateral, an outer anterior, and an inner anterior bundle constitute the ventral component of the base detrusor. Uniting across the ventral midline plane of the bladder neck, the right and left lateral bundles form the precervical arc. This is transversally orientated across the ventral aspect of the bladder neck, has a posterior concavity, and lies superficial to the detrusor loop. The outer anterior component is in part attached to the posterior surface of the public bone, but is largely inserted into the precervical arc. The inner anterior bundle is slender, suburothelial, and plexiform, and extends distally as the inner longitudinal fibres of the ventral urethral muscularis.

Dorsal longitudinal bundles of the base detrusor comprise a prominent posterior, and two less prominent posterolateral bundles. The posterior bundle is anchored in the posterior midline to the cranial aspect of the prostate gland, or the urethrovaginal septum, is in part inserted into the circularly orientated trigonal base detrusor, and provides some fibres to the lateral part of the external “layer” of the urethral muscularis. The posterolateral longitudinal bundles extend along the right and left sides of the posterior bundle, each splitting at the internal urethral orifice into a medial and a lateral moiety: the pars interna et pars externa of Gil Vernet (1968). The medial parts of the right and left posterolateral longitudinal bundles join the trigonal base detrusor; their lateral counterparts arch ventrally and join to form the detrusor loop. This is a stout, transversally orientated, horseshoe-shaped, smooth muscle loop which is concave dorsocephalically and is completed on the dorsal aspect of the base by the similarly circularly orientated trigonal base detrusor. Detrusor loop bundles spay out as caudal and cranial loops that lie, respectively, caudal and cranial to the precervical arc.

The trigonal component of the base detrusor is represented by a triangular muscular structure that lies in the dorsal bladder base between its outer longitudinal bundles and the uretero-