Ejaculatory Dysfunction

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KEYWORDS

• Ejaculation • Anejaculation • Emission • Infertility • Electroejaculation

KEY POINTS

- The spinal ejaculation generator is located in the lower thoracic/upper lumbar cord and integrates the ejaculatory reflex arc.
- Knowledge of the neuroanatomy and neurophysiology is critical in understanding what therapies will and what therapies will not work for men with ejaculatory dysfunction.
- Penile vibratory stimulation (PVS) is the most appropriate first treatment option for men with a spinal cord injury level above the upper lumbar cord.
- Rectal probe electroejaculation is used for men refractory to or not appropriate for PVS (eg, anejaculation after retroperitoneal lymph node dissection).
- With a full armamentarium of treatments available, biologic paternity can be achieved in most men with ejaculatory dysfunction.

INTRODUCTION

Ejaculation is a complex biphasic process involving the coordination of an intricate sequence of neurophysiological events and the contraction of numerous muscle groups eventuating in the expulsion of the seminal fluid bolus through the urethra in an antegrade direction.[1] Ejaculation involves 2 distinct but interrelated actions: emission and ejaculation proper. Emission is the deposition of the seminal fluid constituents derived from the seminal vesicles, the vasa deferentia, and the prostate into the posterior urethra as the bladder neck and external urethral sphincter simultaneously close. Ejaculation proper then occurs with the antegrade rhythmic propulsion of this fluid through the urethra and out the penile meatus. These integrated and coordinated events have a central, single control mechanism. This article reviews the ejaculatory apparatus anatomy, the neurophysiologic control of ejaculation, and the diseases/disorders that may disrupt this most natural of functions. Finally, present and future treatment options are discussed.

ANATOMY OF THE EJACULATORY APPARATUS

The anatomic structures involved in ejaculation are the paired reproductive ductal structures derived from the mesonephric ducts (epididymides, vasa deferentia, seminal vesicles, and ejaculatory ducts), the bladder neck, the external urethral sphincter, the Cowper and Littre glands, the urethra, and the periurethral musculature.

Epididymis

The epididymis is a single, long, convoluted tubule that measures 3 to 4 m in total length, beginning as the caput (head) and continuing as the corpus (body) and tail (cauda).[2] Histologically, once distal

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to the caput, the epididymal tubule is lined by pseudostratified columnar epithelium of both ciliated and nonciliated types (reviewed by Belleannee and colleagues[3]). A surrounding network of myoepithelial cells is external to this basal epithelial layer and transitions into smooth muscle cells that are continuous with those of the vas deferens. Neural fibers reside in the peritubular connective tissue and are predominantly sympathetic in origin, being sparse proximally and denser distally. However, estrogen-dependent factors are also important in the basal peristaltic activity within the epididymis, including oxytocin and endothelin-1.[4]

Vas Deferens

The vas deferens measures 25 to 45 cm in length from its origin (transition from) the cauda epididymis to its junction with the seminal vesicle (the confluence of the 2 forms the ejaculatory duct complex). Emerging from the scrotum, the vas enters (external ring) transits and exits (internal ring) the inguinal canal. As it dives down toward the bladder base, heading for its linkage with the ipsilateral seminal vesicles, it spatially separates from the testicular artery and vein.[5] Most of the spermatozoa released during emission are stored within the ampullary region, approximately the last 5 cm. The vasal epithelium is lined by pseudostratified columnar epithelium, which may contain nonmotile stereocilia. The vas deferens has an outer, innervated layer, which supplies the inner trilaminar muscular wall (middle circular sandwiched between outer and inner longitudinal bands).[6] As reviewed by Westfall and Westfall[7] and Burnstock and Verkhratsky,[8] both divisions of the autonomic nervous system innervate the vas deferens; but the sympathetic system has the predominant role. Adrenergic nerve fibers have been found in all 3 muscle layers. Norepinephrine is the primary neurotransmitter, but other putative cotransmitters have been discovered, including vasoactive intestinal polypeptide (VIP), somatostatin, and leu-enkephalin.[9] Nonadrenergic noncholinergic purinergic nerve fibers have also been described in perivasal ganglionic cells.[8]

Seminal Vesicles

The seminal vesicles are lobulated structures that are situated lateral to the ampullary portions of the vas deferens.[2] Each seminal vesicle measures approximately 2 cm in width, 4 cm in length, and 1.5 cm in anteroposterior diameter in the nondilated state.[10] The seminal vesicles contribute 70% of the fluid to each ejaculate (20% from the prostate and 10% from the vasa). The normal semen volume ranges from 1.5 to 5 mL. The pH of the semen is alkaline (range 7.0–8.5). The adventitial lining is rich in blood vessels and terminal neurons. The seminal vesicles contain a very thin single muscle layer. The epithelial lining is pseudostratified columnar in nature and contains a large number of goblet cells. The alveolar arrangement within the seminal vesicles is variable from a single simple duct to a cluster of side ducts and sacs surrounding a short main central duct.[2] Innervation of the seminal vesicles is similar to that of the vasa deferentia via both parasympathetic and sympathetic connections. Recent data have also elucidated nitrergic-mediated signal transduction.[11,12]

Ejaculatory Ducts

Each ejaculatory duct originates at the junction of the ampullary vas and seminal vesicle and traverses the prostate in an oblique posteroanterior plane to terminate and empty in the prostatic urethra on the verumontanum.[13]

Bladder Neck

The bladder neck serves as a physiologic sphincter during emission and ejaculation. Contraction of the bladder neck, especially during emission, is under sympathetic neural control (alpha-1 adrenergic).[14]

External Urethral Sphincter

The external sphincter belongs to the transverse perineal muscle group and has somatic innervation. The external sphincter surrounds the urethra just distal to the verumontanum.

Perineal Periurethral Muscles

The bulbocavernosus muscle surrounds the corpus spongiosum and urethra and has its origin on the central perineal tendon. There are 3 distinct somatic reflex arcs, from the glans and anterior urethra (the bulbocavernosus reflex) and during ejaculation, all mediated via a branch of the perineal nerve (via the pudendal nerve, S2-4).[15,16] The ischiocavernosus muscle originates from the ischial tuberosity and has similar innervation to the bulbocavernosus.

NEUROPHYSIOLOGY OF EJACULATION

The process of ejaculation requires the coordination and integration of neural and muscular events in a highly sequenced fashion involving afferent and efferent nerve fibers in association with a spinal cord coordination center (spinal ejaculation