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Question

Write short note on micturition.

Micturition (urination), the periodic emptying of the bladder, is a complex act involving both autonomic and somatic nerve pathways and several reflexes that can be either inhibited or facilitated by higher centers in the brain. The basic reflexes occur at the level of the sacral spinal cord and are modified by centers in the midbrain and cerebral cortex. However, in grown up children and adults, it can be controlled voluntarily to some extent. The functional anatomy and nerve supply of urinary bladder are essential for the process of micturition

Distention of the bladder is sensed by stretch receptors in the bladder wall; these induce reflex contraction of the detrusor and relaxation of the internal and external sphincters.

This reflex is released by removing inhibitory influences from the cerebral cortex. Fluid flow through the urethra reflexly causes further contraction of the detrusor and relaxation of the external sphincter.

Increased parasympathetic nerve activity stimulates contraction of the detrusor and relaxation of the internal sphincter. Sympathetic innervation is not essential for micturition. During micturition, the perineal and levator ani muscles relax, thereby shortening the urethra and decreasing urethral

resistance. Descent of the diaphragm and contraction of abdominal muscles raise intra-abdominal pressure and aid in the expulsion of urine from the bladder.

Micturition is, fortunately, under voluntary control in healthy adults. In the young child, however, it is purely reflex and occurs whenever the bladder is sufficiently distended.

At about age 2.5 years, it begins to come under cortical control, and, in most children, complete control is achieved by age 3 years. Damage to the nerves that supply the bladder and its sphincters can produce abnormalities of micturition and incontinence. An increased resistance of the upper urethra commonly occurs in older men and is a result of enlargement of the surrounding prostate gland. This condition is called benign prostatic hyperplasia (also called BPH**)**, and it results in decreased urine stream, over distention of the bladder as a result of incomplete emptying, and increased urgency and frequency of urination.

NERVE SUPPLY TO URINARY BLADDER AND SPHINCTERS

Urinary bladder and the internal sphincter are supplied by sympathetic and parasympathetic divisions of autonomic nervous system where as, the external sphincter is supplied by the somatic nerve fibers.

- **SYMPATHETIC NERVE SUPPLY**

Preganglionic fibers of sympathetic nerve arise from first two lumbar segments (L1 and L2) of spinal cord. After leaving spinal cord, the fibers pass through lateral sympathetic chain without any synapse in the sympathetic ganglia and finally terminate in **hypogastric ganglion.** The postganglionic fibers arising from this ganglion form the **hypogastric nerve,** which supplies the detrusor muscle and internal sphincter.

Function of Sympathetic Nerve

The stimulation of sympathetic (hypogastric) nerve causes relaxation of detrusor muscle and constriction of the internal sphincter. It results in filling of urinary bladder and so, the sympathetic nerve is called **nerve of filling.**

- **PARASYMPATHETIC NERVE SUPPLY**

Preganglionic fibers of parasympathetic nerve form the **pelvic nerve** or **nervus erigens.** Pelvic nerve fibers arise from second, third and fourth sacral segments (S1, S2 and S3) of spinal cord.

These fibers run through hypogastric ganglion and synapse with postganglionic neurons situated in close relation to urinary bladder and internal sphincter.

Function of Parasympathetic Nerve

Stimulation of parasympathetic (pelvic) nerve causes contraction of detrusor muscle and relaxation of the internal sphincter leading to emptying of urinary bladder. So, parasympathetic nerve is called the **nerve of emptying** or nerve of micturition.

Pelvic nerve has also the sensory fibers, which carry impulses from stretch receptors present on the wall of the urinary bladder and urethra to the central nervous system.

- **SOMATIC NERVE SUPPLY**

External sphincter is innervated by the somatic nerve called **pudendal nerve.** It arises from second, third and fourth sacral segments of the spinal cord.

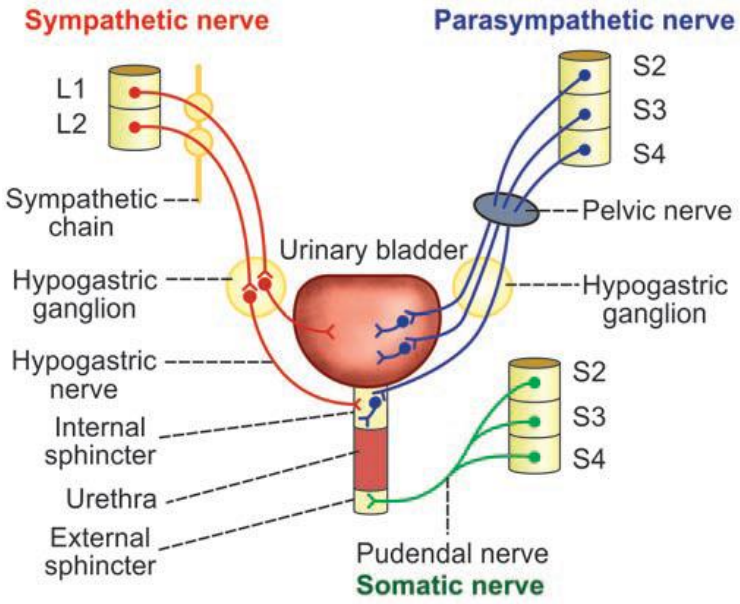


DIAGRAM OF THE NERVE SUPPLY TO URINARY BLADDER AND URETHRA

MICTURITION REFLEX

Micturition reflex is the reflex by which micturition occurs. This reflex is elicited by the stimulation of stretch receptors situated on the wall of urinary bladder and urethra. When about 300 to 400 mL of urine is collected in the bladder, intravesical pressure increases. This stretches the wall of bladder resulting in stimulation of stretch receptors and generation of sensory impulses.

Pathway for Micturition Reflex

Sensory (afferent) impulses from the receptors reach the sacral segments of spinal cord via the sensory fibers of pelvic (parasympathetic) nerve. Motor (efferent) impulses produced in spinal cord, travel through motor fibers of pelvic nerve towards bladder and internal sphincter. Motor impulses cause contraction of detrusor muscle and relaxation of internal sphincter so that, urine enters the urethra from the bladder.

Once urine enters urethra, the **stretch receptors** in the urethra are stimulated and send afferent impulses to spinal cord via pelvic nerve fibers. Now the impulses generated from spinal centers inhibit pudendal nerve. So, the external sphincter relaxes and micturition occurs.

Once a micturition reflex begins, it is **self-regenerative,** i.e. the initial contraction of bladder further activates the receptors to cause still further increase in sensory impulses from the bladder and urethra.

These impulses, in turn cause further increase in reflex contraction of bladder. The cycle continues repeatedly until the force of contraction of bladder reaches the maximum and the urine is voided out completely.

During micturition, the flow of urine is facilitated by the increase in the abdominal pressure due to the voluntary contraction of abdominal muscles.

Higher Centers for Micturition

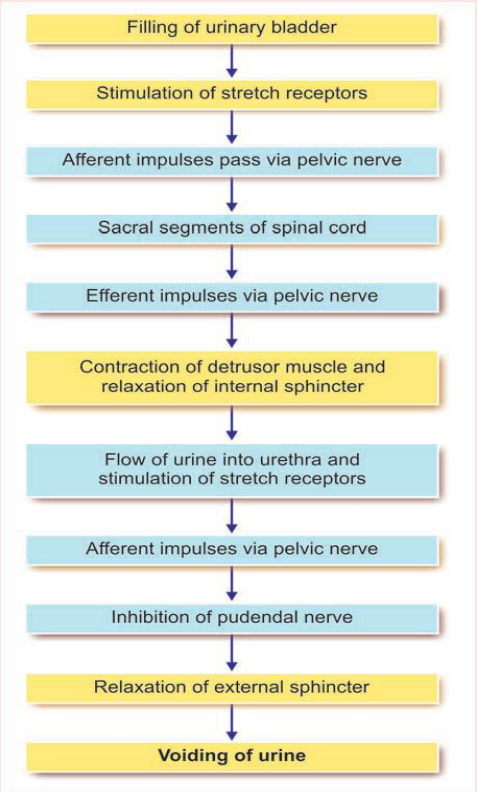
Spinal centers for micturition are present in sacral and lumbar segments. But, these spinal centers are regulated by higher centers. The higher centers, which control micturition are of two types, inhibitory centers and facilitatory centers.

<u>Inhibitory centers for micturition</u>

Centers in midbrain and cerebral cortex inhibit the micturition by suppressing spinal micturition centers.

Facilitatory centers for micturition

Centers in pons facilitate micturition via spinal centers. Some centers in cerebral cortex also facilitate micturition.



THE MICTURITION RELEX

ABNORMALITIES OF MICTURITION

- **Atonic Bladder – Effect Of Destruction Of Sensory Nerve Fibers**

Atonic bladder is the urinary bladder with loss of tone in detrusor muscle. It is also called **flaccid neurogenic bladder** or **hypoactive neurogenic bladder.** It is caused by destruction of sensory (pelvic) nerve fibers of urinary bladder. Due to the destruction of sensory nerve fibers, the bladder is filled without any stretch signals to spinal cord.

Due to the absence of stretch signals, detrusor muscle loses the tone and becomes **flaccid.** So the bladder is completely filled with urine without any micturition.

Now, urine overflows in drops as and when it enters the bladder. It is called **overflow incontinence** or **overflow dribbling.**

Conditions of Destruction of Sensory Nerve Fibers

1. Spinal injury: During the first stage (stage of spinal shock) after injury to sacral segments of spinal cord the bladder becomes atonic

2. Syphilis: Syphilis results in the degenerative nervous disorder called **tabes dorsalis,** which is characterized by the degeneration of dorsal (sensory) nerve roots. Degeneration of sensory nerve roots of sacral region develops **atonic bladder.** The atonic bladder in tabes dorsalis is called **tabetic bladder.**

- **Automatic Bladder**

Automatic bladder is the urinary bladder characterized by hyperactive micturition reflex with loss of voluntary control. So, even a small amount of urine collected in the bladder elicits the micturition reflex resulting in emptying of bladder.

This occurs during the second stage (stage of recovery) after complete transection of spinal cord above the sacral segments. During the first stage (stage of spinal shock) after complete transection of spinal cord above sacral segments, the urinary bladder loses the tone and
becomes atonic resulting in **overflow incontinence.**

During the second stage after shock period, the micturition reflex returns. However, the voluntary control is lacking because of absence of inhibition or facilitation of micturition by higher centers. There is hypertrophy of detrusor muscles so that the capacity of bladder reduces. Some patients develop hyperactive micturition reflex.

- **Uninhibited Neurogenic Bladder**

Uninhibited neurogenic bladder is the urinary bladder with frequent and uncontrollable micturition caused by lesion in midbrain. It is also called **spastic neurogenic bladder** or **hyperactive neurogenic bladder.** The lesion in midbrain causes continuous excitation of spinal micturition centers resulting in frequent and uncontrollable micturition. Even a small quantity of urine collected in bladder will elicit the micturition reflex.

- **Nocturnal Micturition**

Nocturnal micturition is the involuntary voiding of urine during night. It is otherwise known as **enuresis** or **bedwetting.** It occurs due to the absence of voluntary control of micturition. It is a common and normal process in infants and children below 3 years. It is because of incomplete myelination of motor nerve fibers of the bladder. When myelination is complete, voluntary control of micturition develops and bedwetting stops. If nocturnal micturition occurs after 3 years of age it is considered abnormal. It occurs due to neurological disorders like **lumbosacral vertebral defects.** It can also occur due to psychological factors. Loss of voluntary control of micturition occurs even during the impairment of motor area of cerebral cortex.