Regulation of the Urinary Bladder
Chapter 26

Anatomy
1. The urinary bladder is smooth muscle lined internally by transitional epithelium and externally by the parietal peritoneum. Contraction of the smooth muscle empties the bladder.

2. The external urinary sphincter (skeletal muscle) controls movement of urine through the urethra.

Innervation
1. The parasympathetic division stimulates urinary bladder contraction. The parasympathetic division is responsible for controlling micturition (urination).

2. The sympathetic division inhibits bladder contraction and stimulates internal urinary sphincter contraction. It does not play a role in normal micturition. The sympathetic division is active during ejaculation, preventing retrograde ejaculation of semen into the urinary bladder. Females do not have an internal urinary sphincter.

3. The external urinary sphincter is tonically contracted as a result of stimulation from the brain. It can relax as a result of reflex activity or from voluntary motor control.

4. Higher centers in the pons and cerebral cortex can facilitate (EPSPs) or inhibit (IPSPs) the reflex center in the spinal cord.

Micturition Reflex
1. Filling of the bladder stimulates stretch receptors in the urinary bladder. A parasympathetic reflex causes contraction of the bladder.

2. If urine is pushed into the urethra, a second reflex is activated that inhibits the external urinary sphincter.

3. Stimuli from the stretch receptors reach the brain and awareness of the need to urinate occurs.

4. To go or not to go, that is the question.
   A. Urination occurs if the higher brain centers facilitate the micturition reflex and cause voluntary relaxation of the external urinary sphincter.
   
   B. Urination does not occur if the higher brain centers inhibit the micturition reflex and increase stimulation of the external urinary sphincter.

   C. In infants, the higher brain centers do not inhibit urination.
Illustration Will Be Provided in Lab

Somatic motor neurons stimulate external urinary sphincter

Parasympathetic neurons stimulate the bladder to contract

Awareness of the need to urinate

Stimulatory and inhibitory signals to the micturition reflex center

Tonic stimulation and voluntary control of external urinary sphincter

Pelvic nerves (S2-S4)

Urethra

External urinary sphincter

Pudental nerves (S2-S4)

Conus medullaris (end of spinal cord)

Dorsal root

Ventral root

Sensory neurons detect stretch
Disorders of Micturition
1. **Incontinence** is the inability to voluntarily control the external urinary sphincter. It can result from spinal cord injury, pregnancy, inadequate maturation (infants), and old age.

2. **Urinary retention** is an inability or difficulty in emptying the bladder. It can result from an enlarged prostate gland or anesthesia (inhibits smooth muscle activity). It is not uncommon that following surgery patients are catheterized until the bladder recovers.

Effect of Spinal Cord Injury on Micturition
1. Recall that injury to the spinal cord produces **spinal shock** - lack of facilitory impulses (EPSPs) from the brain results in depression of reflex centers. Thus reflexes are lost below the level of injury.

2. Often, the reflex centers "compensate" for the lack of facilitory impulses and become functional. Sacral reflex involving micturition and defecation return a few weeks following spinal cord injury.

Predict the effect of the following:
1. Transection of the spinal cord above the conus medullaris. Assume the patient has recovered from spinal shock. What effect does the injury have on the following conditions?
   A. The awareness of the need to urinate and the ability to voluntarily control urination?
   B. The ability of the urinary bladder to empty?
2. Damage to the conus medullaris. What effect does the injury have on the following conditions?
   A. The awareness of the need to urinate and the ability to voluntarily control urination?

B. The ability of the urinary bladder to empty?

3. Damage to the dorsal roots of the pelvic nerves (caused by syphilis or crushing injuries). What effect does the injury have on the following conditions?
   A. The awareness of the need to urinate and the ability to voluntarily control urination?

B. The ability of the urinary bladder to empty?
4. Decrease inhibitory signals to the reflex centers in the conus medullaris. What is the effect on the following conditions?
   A. The awareness of the need to urinate and the ability to voluntarily control urination?

   B. The ability of the urinary bladder to empty?