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RENAL PHYSIOLOGY ASSIGNMENT

Write a short note on Micturition

### **Micturition**

Micturition or urination is the process of expelling urine from the bladder. This act is also known as voiding of the bladder. The excretory system in humans includes a pair of kidneys, two ureters, a urinary bladder and a urethra. The kidneys filter the urine and it is transported to the urinary bladder via the ureters where it is stored till its expulsion. The process of micturition is regulated by the nervous system and the muscles of the bladder and urethra. The urinary bladder can store around 350-400ml of urine before it expels it out.

### **Stages of Micturition**

The urinary bladder has two distinct stages or phases:

- Resting or filling stage
- Voiding stage

### **Resting or Filling Stage**

It is in this phase of the bladder that the urine is transported from the kidneys via the ureters into the bladder. The ureters are thin muscular tubes that arise from each of the kidneys and extend downwards where they enter the bladder obliquely.

The oblique placement of the ureters in the bladder wall serves a very important function. The opening of the ureter into the urinary bladder is not guarded by any sphincter or muscle. Therefore, this oblique nature of opening prevents the urine from re-entering the ureters. At the same time, the main muscle of the urinary bladder, the detrusor muscle, is relaxing allowing the bladder to distend and accommodate more urine.

### **Voiding Stage**

During this stage, both the urinary bladder and the urethra come into play together. The detrusor muscle of the urinary bladder which was relaxing so far starts to contract once the bladder's storage capacity is reached.

The urethra is controlled by two sets of muscles: The internal and external urethral sphincters. The internal sphincter is a smooth muscle whereas the external one is skeletal. Both these sphincters are in a contracted state during the filling stage.

As mentioned earlier, the process of micturition is governed by both the nervous and muscular systems. Within the nervous system, the process is governed by the autonomous nervous system and the somatic system. Once the urinary bladder reaches its maximum capacity, the stretch receptors in the walls of the bladder send an impulse via the pelvic nerve to the brain via the spinal cord.

The micturition reflex is ultimately generated from the level of the spinal cord after it receives reflexes from the pontine region in the brain. Once the bladder and the urethra receive the signals to empty the bladder, the two sphincters relax and the detrusor muscle causes the contractions of the bladder.

Along with these muscles, the muscles of the abdomen also play a role by putting pressure on the bladder wall. This leads to complete emptying of the bladder.

## **Transport of urine into the bladder**

### **■Urine flow out of collecting duct**

- No change in composition during its flow in renal calyces & ureter

### **■Peristaltic contractions in ureter**

- initiated by pacemaker activity in renal calyces
- calyces contain specialized smooth muscle cells that generate spontaneous pacemaker potentials
  - unstable resting potential
- peristaltic waves sweep down the ureters
  - frequency 1 every 10 seconds – 2/3 minutes

- stimulated by parasympathetic nerves
- inhibited by sympathetic nerves
- forces urine into the bladder
  - normal tone of detrusor muscle prevents backflow of urine into ureter

## Higher Centers for Micturition

The higher centers keep the micturition reflex partially inhibited, except when desired/during urination. It can prevent micturition, even if the micturition reflex occurs, by tonic contractions of the external sphincter until it is convenient to urinate. When it is time to urinate, the cortical centers can facilitate the sacral micturition centers to help initiate the external urinary sphincter so that urination can occur.

Cerebral lesions (like tumors, Parkinsons, vascular accident) are known to affect the perception of bladder sensation and can result in voiding dysfunction (loss of control/dribbling)

### ■ Facilitatory areas

- Pons
- Posterior hypothalamus

### ■ Inhibitory areas

- Cerebral cortex
- Midbrain

## Micturition in young children

### ■ micturition is purely reflex

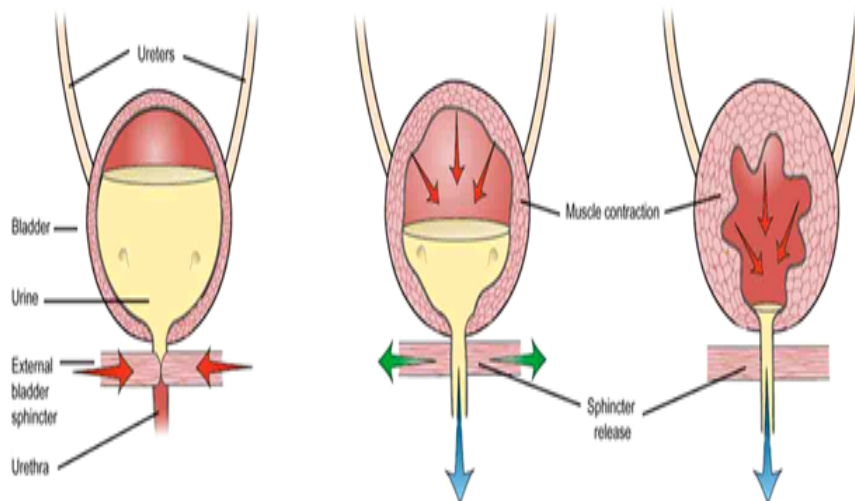
- occurs whenever the bladder is sufficiently distended

### ■ About 2 1/2 years old, it begins to come under cortical control

### ■ About 3 years old, complete control is achieved

- cortex takes over control

## Micturition Reflex – Process



■ Sensory signals from the bladder stretch receptors sent to spinal cord

■ Parasympathetic efferent fibers discharge

- produce 'micturition contractions'
- initially die out immediately, but with increasing pressure in bladder these become stronger & last longer & more frequently
- Reflex will not empty the bladder always
  - may become inhibited for a period of few minutes to one hour before another reflex occurs
  - 'self-regenerative'

■ Urination occur when

- powerful micturition reflex
- cortical inhibition removed
  - relax external sphincter
- relaxation of pelvic floor muscles
- Increase intra-abdominal pressure
  - by contracting abdominal muscles
- Relaxation of internal & external sphincters