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**COURSE TITLE: PHYSIOLOGY**

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**ASSIGNMENT TITLE: RENAL PHYSIOLOGY**

**QUESTION:**

Write a short note on micturition.

**ANSWER:**

**SHORT NOTE ON MICTURITION**

 Micturition (urination) is the process of urine excretion from the urinary bladder

Most of the time, the bladder (detrusor muscle) is used to store urine. As it fills, the reggae distend and a constant pressure in the bladder (intra-vesicular pressure) is maintained. This is known as the **stress-relaxation** phenomenon.The ability to voluntarily control micturition develops from 2 years as the CNS develops.

**Micturition**

Micturition is also known as the voiding phase of bladder control and it is typically a short lasting event. Urinary flow rate in a full bladder is:

20-25ml/s in men

25-30ml/s in women

Whilst the capacity of the bladder varies from roughly 300-550ml, afferent nerves in the wall signal the need to void the bladder at around 400ml of filling.

The micturition cycle involves two phases: bladder filling/urine storage and [bladder emptying](https://www.sciencedirect.com/topics/medicine-and-dentistry/bladder-emptying)**. Bladder filling requires**

1. accommodation of increasing volumes at low intravesical pressure (compliance) and appropriate sensation,
2. the bladder outlet to be closed at rest and during increases in intra-abdominal pressure, and
3. the absence of involuntary [bladder contractions](https://www.sciencedirect.com/topics/medicine-and-dentistry/bladder-contraction).

 **Bladder emptying requires**

1. coordinated contraction of the bladder of adequate magnitude and duration,
2. lowering of resistance at sphincters, and
3. the absence of obstruction (e.g., enlargement of the prostate gland in the aging male may result in [bladder outlet obstruction](https://www.sciencedirect.com/topics/medicine-and-dentistry/bladder-outlet-obstruction), precluding efficient micturition). [Bladder dysfunction](https://www.sciencedirect.com/topics/medicine-and-dentistry/bladder-dysfunction) can then be clinically identified as a problem of filling or emptying or a combination of both, and the site of dysfunction may be the bladder, the [urethra](https://www.sciencedirect.com/topics/medicine-and-dentistry/urethra), or both.

The normal function of the bladder is to store urine until it has reached capacity and until it is socially acceptable to evacuate urine. Urine storage is accomplished at low pressures, measured as compliance. Compliance is calculated as the change in volume over the change in pressure. [Bladder compliance](https://www.sciencedirect.com/topics/medicine-and-dentistry/bladder-compliance) is a result of the viscoelastic properties of the bladder. The [bladder wall](https://www.sciencedirect.com/topics/medicine-and-dentistry/bladder-wall) contains [elastin](https://www.sciencedirect.com/topics/medicine-and-dentistry/elastin), which allows it to stretch without a subsequent increase in pressure. Typical adult [bladder capacity](https://www.sciencedirect.com/topics/medicine-and-dentistry/bladder-capacity) is approximately 350–450 ml. Compliance is also facilitated by sympathetic discharge primarily mediated through the β-adrenergic receptors within the bladder wall. This sympathetic tone operates directly at the level of the bladder musculature to facilitate storage. There is also sympathetic discharge at the level of the [autonomic ganglia](https://www.sciencedirect.com/topics/medicine-and-dentistry/autonomic-ganglion), which has an inhibitory effect on the parasympathetic postganglionic neurons, thus preventing detrusor contraction and facilitating urine storage. Loss of compliance may lead to renal insufficiency.

[Continence](https://www.sciencedirect.com/topics/medicine-and-dentistry/continence) is maintained through the action of the urinary sphincters. The internal sphincter, or the [bladder neck](https://www.sciencedirect.com/topics/medicine-and-dentistry/bladder-neck), is richly innervated with α-adrenergic receptors. During [bladder filling](https://www.sciencedirect.com/topics/medicine-and-dentistry/bladder-filling) this structure remains closed through constant sympathetic discharge via the hypogastric plexus. The external sphincter, composed of [striated muscle](https://www.sciencedirect.com/topics/medicine-and-dentistry/striated-muscle), also maintains a resting tone to maintain continence. It is believed that the fibers of the external sphincter are primarily of the slow twitch variety and thus can maintain tension for long periods of time. With rapid increases in intra-abdominal pressure, fast twitch fibers are recruited to contract and further increase the urethral resistance to avoid [urinary leakage](https://www.sciencedirect.com/topics/medicine-and-dentistry/urine-incontinence).

As the bladder fills, its [visceral afferents](https://www.sciencedirect.com/topics/medicine-and-dentistry/visceral-afferent) travel through the [peripheral nerves](https://www.sciencedirect.com/topics/medicine-and-dentistry/peripheral-nerve), ascending through the spinal cord to the pontine micturition center. It is at this level that a detrusor contraction is initiated. However, there are inhibitory signals from suprapontine centers (e.g., [prefrontal cortex](https://www.sciencedirect.com/topics/medicine-and-dentistry/prefrontal-cortex) and basal ganglia) that prevent the generation of a detrusor contraction until the bladder is full. At normal bladder capacity (350–450 ml), sensations of fullness are transmitted through detrusor [afferents, nerves](https://www.sciencedirect.com/topics/medicine-and-dentistry/afferent-nerve-fiber) that provide reflex excitation through the central nervous system to the motor innervation to the detrusor. The cortex releases its inhibition of the pontine micturition center. An efferent response travels through the spinal cord and through the [pelvic nerves](https://www.sciencedirect.com/topics/medicine-and-dentistry/pelvic-nerve), and a detrusor contraction occurs. The contraction is coordinated with the opening of the internal and external sphincters to allow free egress of urine outside the body. A normal detrusor contraction is of adequate strength and duration to empty the bladder completely in one coordinated contraction. After urine evacuation, the sphincters return to their closed state and the cycle resumes

**Regulation of Micturition**

 Passing of urine is under parasympathetic control. Bladder afferents signals ascend through the spinal cord and then project to the pontine micturition centre and cerebrum. Upon the voluntary decision to urinate, neurones of the pontine micturition centre fire to excite the sacral preganglionic neurones.

There is subsequent parasympathetic stimulation to the Pelvic Nerve(S2-4) causing a release of ACh, which works on M3muscarinic ACh receptors on the detrusor muscle, causing it to contract and increase intra-vesicular pressure. The pontine micturition centre also inhibits Onuf’s nucleus, with a resultant reduction in sympathetic stimulation to the internal urethral sphincter causing relaxation.

Finally, a conscious reduction in voluntary contraction of the external urethral sphincter from the cerebral cortex allows for distention of the urethra and the passing of urine. In the female, urination is assisted by gravity, while in the male, bulbospongiosus contractions and squeezing along the length of the penis helps to expel all of the urine.