



Renal Block

Physiology Team

## 8<sup>th</sup> Lecture

### Micturation and kidney disease

**This Lecture is Done By:**

Dalal Alqadi  
Ali AL-Kahtani



**Organized By :** Suliman AL-Shammari

## What is micturition?

Urination; voluntary emptying of the bladder when it becomes filled through the micturition reflex in spinal cord (facilitated or inhibited by cerebral cortex)

## Ureters & Urine Transport:

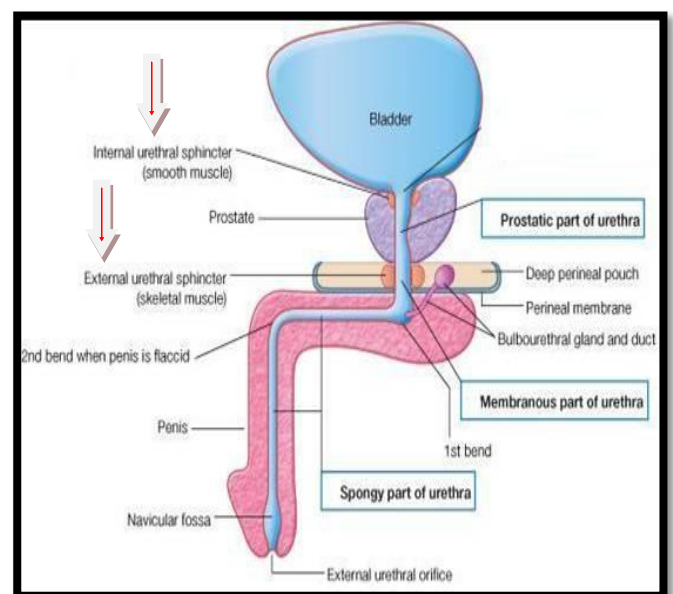
- Urine is transported to bladder by the two ureters
- Ureters have regular peristaltic contractions (continuous wave like muscular contractions forcing urine to move in one direction which is downward) 1-5 cm/min
- Ureters enter bladder wall obliquely where functional sphincters are located, to prevent urine reflux (VUR) from the bladder.

## Urinary bladder:

- The bladder muscle (detrusor; a smooth muscle) arranged in spiral circular (one layer in the middle) and longitudinal (two layers inner + outer)
- Those muscles form a muscle bundle around the urethra (internal sphincter)
- External sphincter (a ring-like muscle) is made of skeletal muscle i.e. you can control it.

**Reflex arc:** is a neural pathway in which sensory neurons do not pass directly into the brain, but synapse in the spinal cord and send reflexes (responds) to the same site which had sent the sensory message. For micturition there are somatic & autonomic innervation.

### Spinal cord & reflex arc



## Autonomic Innervation:

### • Parasympathetic:

- pelvic nerve S1,2,3
- innervate the body of bladder
- afferent sends information about wall stretch to spinal center (S2,3)  
→ thus causes bladder to contract.
- Parasympathetic innervation is the one responsible for **excretion** (rest & digest)

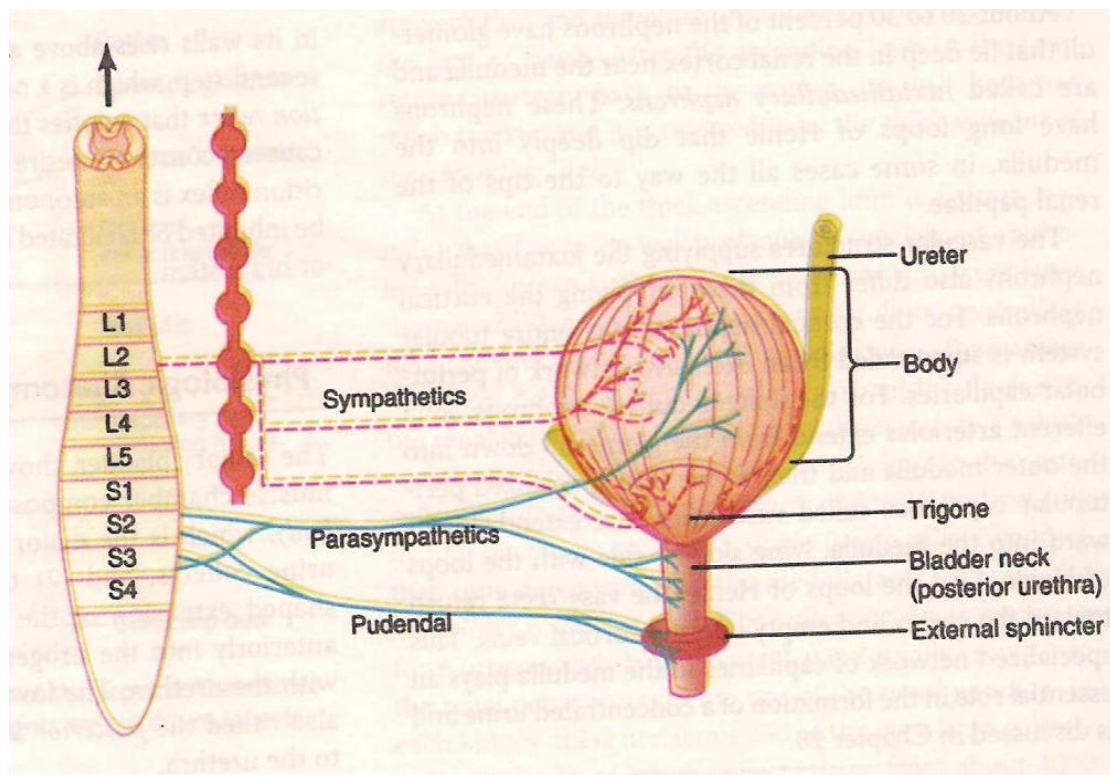
### • Sympathetic:

- hypogastric nerve L1,2,3
- innervate the body and the neck (internal sphincter IS),
- efferent nerves inhibit bladder contraction ( $\beta$ ) and activate IS ( $\alpha$ )
- sympathetic innervation is the one responsible for **inhibition** of urination (fight or flight)

However, the urination reflex is controlled by the higher center in brain (you feel the full bladder but you decide to stay where you are) but this is up to certain limits..

## Somatic Innervation:

- pudendal nerve S2,3,4
- innervate external sphincter only i.e. voluntary.



## Physiology of micturition:

- It is a spinal reflex facilitated or inhibited by higher brain centers
- Distension of bladder stimulates stretch receptors in the bladder wall → afferent sends info.
- reflex contraction of the bladder and relaxation of internal and external sphincters, notice external sphincter relaxes when you (the brain) decide.

## Micturition Reflex:

- **During filling phase → detrusor muscle is relaxed**
  - Both sphincters are contracted (sympathetic action)
- **This reflex is released by removing inhibitory impulses from the cerebral cortex.**

## Urinary Bladder pressure Vs Volume:

**Phase I:** Initial slight rise in pressure with increase in urine volume from 0 to 50 ml , this increase in pressure is because the bladder was empty completely and not yet expanded.

**Phase II:** A minimum increase in pressure with increases in urine volume from 50 to 400 ml due to bladder distension. At urine volume of 150-200 ml there is an urge to void urine, **here the bladder has already expanded**

**Phase III:** Sudden sharp rise in pressure as the micturition reflex is triggered (sense of fullness at about 400mL). ↑400ml urine you cannot keep it up because of the very high pressure in bladder.

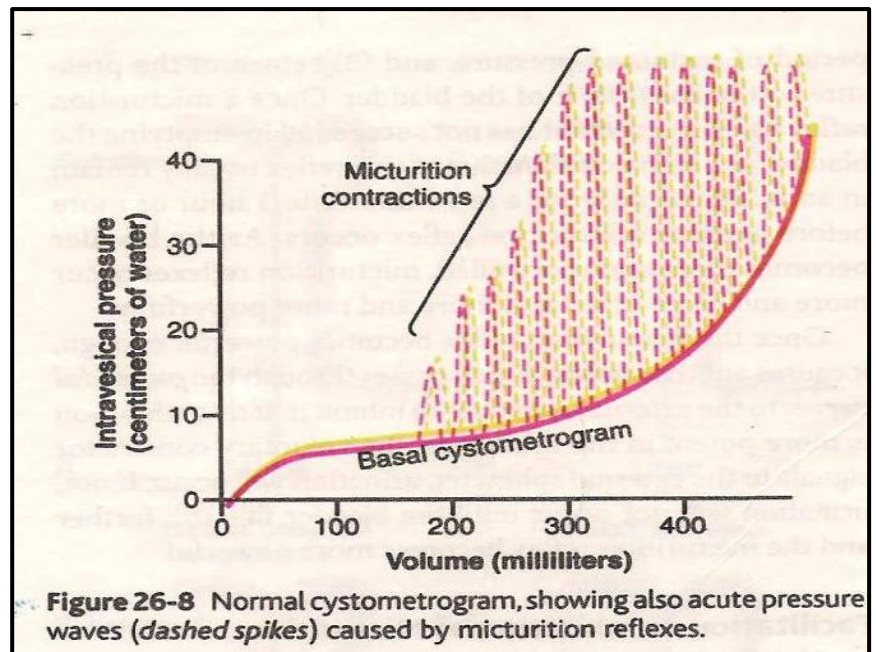
**So, our control can keep urine in range of 50-400mls.**



**Cytometrogram:** records intravesical pressure (inside bladder) change during filling phase.

**The curve shows:**

- 1- a. initial slight rise in pressure when the 1st increment in volume is produced.
- b. a long nearly flat segment as further increments are produced (urge to void at about 150 mL)
- 2- A sudden, sharp rise in pressure as the micturation reflex is triggered (sense of fullness at about 400mL).



## Abnormal Micturation:

- **Interruption of afferent nerves**

**Causes:** tabes dorsalis and long standing DM

Tabes dorsalis interruption of dorsal roots → reflex contraction of the bladder is lost → bladder wall is thin and distended and hypotonic → there are some contractions due to intrinsic response in the muscle → dripping of urine.

- **Interruption of both afferent and efferent (pelvic tumor)**

**Causes:** tumors of the cauda equina and filum terminale

Tumors → bladder is flaccid (bladder loses its flexibility) and distended → shrunken and hypertrophied

- **Spinal cord transection**

During shock, the bladder is flaccid → over filled bladder → urine dribbles (overflow incontinence) → spinal reflex for emptying will resume with no voluntary control (the urinary bladder fills and empties on its own).

## Renal failure:

	Acute renal failure	Chronic renal failure
Properties	<p>Kidney stop working suddenly</p> <p>May recover (reversible)</p> <p>Oliguria</p> <p>Anuria</p> <p>azotemia</p>	<p>Progressive loss of function</p> <p>Symptom appear after loss of 70%</p> <p>Disorders of blood vessel, glomeruli, tubules interstitium and lower tract</p> <p>Can leads to end stage renal failure</p> <p>Need dialysis</p>
causes	<p><b>Prerenal:</b> decrease blood supply to the kidney e.g heart failure, sever hemorrhage</p> <p><b>Intrarenal:</b> glomerulonephritis, tubular necrosis (ischemia, toxin, medication)</p> <p><b>Postrenal:</b> obstruction by stones (calcium, urate or cystine)</p>	<p>diabetes mellitus,</p> <p>hypertension</p> <p>Atherosclerosis</p> <p>Chronic glomerulonephritis</p> <p>Interstitial nephritis</p>

## In renal failure:

- **Water retension (edema):** the kidneys are no longer able to filter fluid out of the blood and turn it into urine.
- **Uremia:** elevated urea
- **Azotemia:** elevated urea and creatinine
- **Acidosis:** resulting from the accumulation of sulfates, phosphates and organic acids
- **Anemia:** caused by decreased secretion of erythropoietin.
- **Ostomalcia:** faulty metabolism of vitamin D
- **Hypocalcemia:** caused by failure to synthesize the active form of Vitamin D

## ABNORMALITIES OF URINE AND ITS CONSTITUENTS :

<b>Polyuria</b>	large urinary volume in 24 hrs
<b>Oliguria</b>	diminished urine volume per 24 hrs ( less than 300ml of urine formation per day)
<b>Anuria</b>	negligible urine per day
<b>Nocturia</b>	frequent micturation in night
<b>Haematuria</b>	presence of RBCs in urine eg menstruation
<b>Proteinuria</b>	presence of protein in urine (less than 150mg per day is normal)
<b>Glycosuria</b>	presence of glucose in urine
<b>Ketonuria</b>	presence of ketone bodies in urine.
<b>Dysuria</b>	Feeling of burning or pain during urination.
<b>Myoglobinuria</b>	presence of myoglobin in the urine,due to destruction of muscle