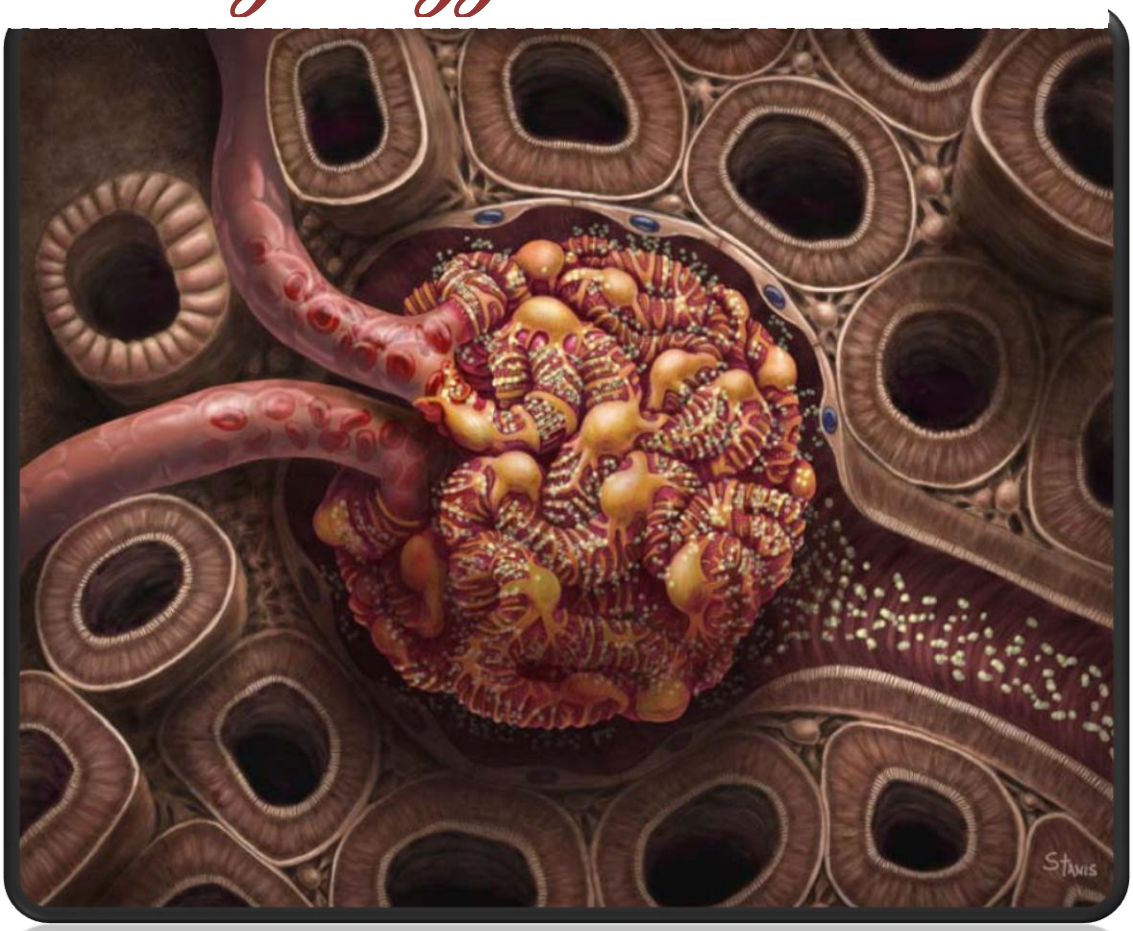
Physiology Team 431



Team leaders

- Mohammed Asiri
- Nour Al-Khawajah

- Yafa Al-shamlan
- Sara Al-anazy
- Lama Mokhlis
- Tmader alaofi
- Hayfa alabdulkareem
- Dalal fatani
- Jomanah alshammari
- Shehanah alomair
- Alaa Al-anazi
- Ghaidah Al-sugair
- Manar aljebreen
- Rand Al-hwil
- Afnan Al-hargan

- Abdullah Al-Towim
- Khalid Al Mohaimedi
- AbdulRahman Al-Bakr
- Fahad Al-showishi
- Saad Al-Mdemig
- Mohammed Al Numeir
- Majid Al-Oriny
- Abdullrahman Alshahrani
- Tariq Al-Otaibi
- Abdulmalik Almufarrih
- Abdulaziz Al-hamad
- Ahmed Almarzuqi
- Nasser Al-moosa
- AbdulRahman Al-sharidah

Micturation and kidney diseases

Steps of micturatiom

1. Filling of bladder.
2. Micturition reflex. (start feeling bladder is full)
3. Voluntary control.

Micturation:

Voluntary emptying of the bladder when it is filled under the control of mictuation reflex.

Peristalsis: Successive waves of involuntary contraction along the walls of a hollow muscular structure to force the contents to move.

Ureters & Urine Transport:

•Urine transport to bladder by two ureters.

•Ureters has regular peristaltic contraction 1-5 /min :

*1-5 contractions per minute *painful in patient with ureter stones

•Ureters enter bladder wall obliquely (functional sphincter) which will prevent urine reflux from the bladder to the ureter again.

Urinary bladder :

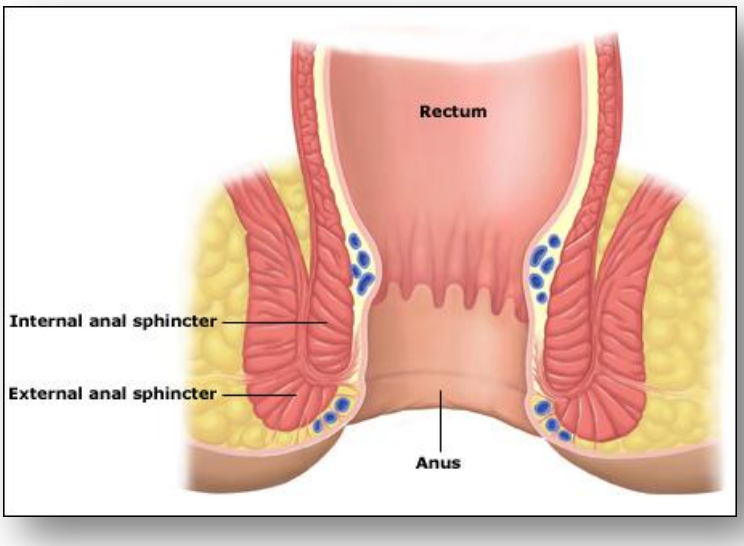
•Bladder muscle (known as detrusor muscle) arranges in spiral, circular and longitudinal *Three layers*

•These three layers of muscles will become bundled around the urethra to make the internal sphincter.

•External sphincter is made of skeletal muscle.

Internal sphincter: smooth muscle

External sphincter: Skeletal muscle



Reflux arc:

•it's a spinal reflex arc controlled by higher center

•Macturtion has Autonomic and somatic innervations.

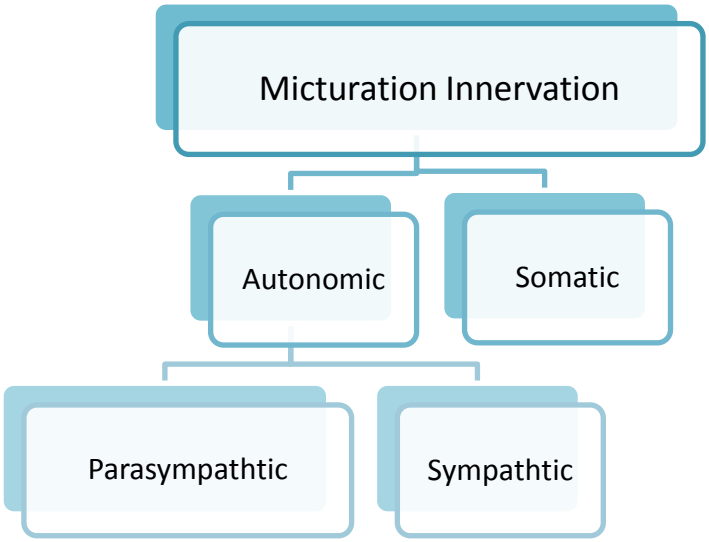
Reflux: Afferent and efferent

- Afferent joins the central (ex: spinal cord) and carries the information (sensory neuron)
- Efferent: causes the action (Motor neuron)

Spinal: the center is in the spinal cord

Controlled by Higher center

In the cerebral cortex.

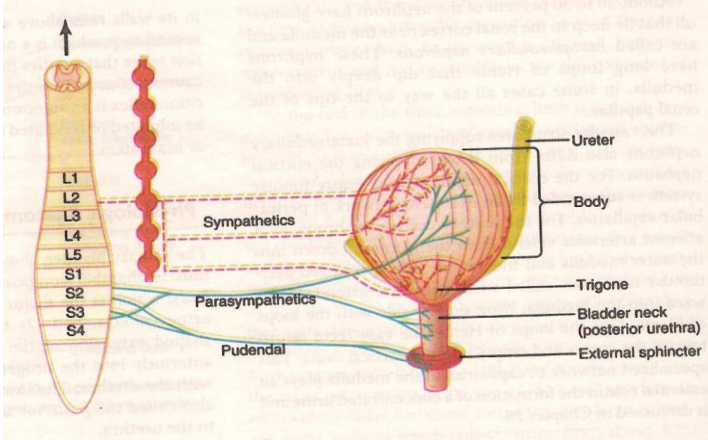


Autonomic :

Hypogastric nerve Stimulate mainly the blood vessels and have little to do with bladder contraction. minly sensory nerve fibers for fullness and pain

Autonomic innervation	Parasympathetic	Sympathetic
Carried by :	Pelvic nerve S1,2,3	Hypogastric nerve L1,2,3
Parts which are innervated :	Innervate the body of bladder	Innervate the body and the neck (internal sphincter IS)
Action:	Afferent sends information about wall stretch to spinal center (s2,3). Efferent causes bladder to contract.	Efferent: *Inhibits bladder contraction (β)(causes bladder relaxation) *activate internal sphincter (α) (causes IS contraction)
	Parasympathetic innervation is the one responsible for excretion (rest & digest)	sympathetic innervation is the one responsible for inhibition of urination (fight or flight)
	To remember: **P**arasympathetic ⟶ **P**assage of urine	**S**ympathetic ⟶ **S**torage of urine

Because the sympathetic is divided so each division has an



However, the urination reflux is controlled by a higher center in the brain up to certain limits .

EX: The bladder is full and you feel it but you can inhibit the micturation(the parasympathetic action) by the higher center because the time is not suitable.

Somatic :

PUDENDAL NERVE (somatic nerve) contain skeletal motor fibers transmitted through the to the **external bladder sphincter**. Comes from sacral segment

- Carried by Pudendal nerve S2,3,4
- Innervate external sphincter only (voluntary)

Physiology of Micturation:

- It is a spinal reflex facilitated or inhibited by higher brain centers.
- Distension of bladder stimulates stretch receptors in the bladder wall and this will cause reflex contraction of the bladder and relaxation of internal and external sphincters (notice external sphincter is under voluntary control because it's somatic)

Micturation Reflex:

*If the sphincters cannot be closed: whatever will come to the bladder will pass out (incontinent)

- During filling phase:
  - ✓ Detrusormuscle is relaxed.
  - ✓ Both sphincters are contracted (sympathetic action).
- This reflex is released by removing inhibitory impulses from the cerebral cortex.

Receptor during storage

1. Parasypathetic (cholinergic) receptor are inhibited, prohibiting derusor muscle contraction,
2. Sympathetic receptor are stimulated, resulting in:
   - Relaxation of beta controlled detrusor muscle and increased starch capacity of the bladder dome
   - Contraction of alpha controlled bladder neck. (internal sphincter)

Urinary Bladder pressure Versus Volume:

1.Phase I: Initial slight rise in pressure with increase in urine volume from 0 to 50 ml. (the pressure will increase because the bladder at that time is shrieked and fluid start entering the bladder so the pressure will raise)

2.Phase II: A minimum increase in pressure with increases in urine volume from 50 to 400 ml due to bladder distension. (the bladder will dilate so the pressure won't change much up to volume of 400) (The plaque phase)

*At urine volume of 150-200 ml there is an urge to void urine ⟶ (first sensation)

3.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.

Cystometrogram:

Cysrometrogram show relation of volume of bladder urine and intravesical pressure. Change in pressure is minimum until 300ml. after 300ml pressure start to increase and became out of control.

Micturation waves show feeling of bladder. We get first feeling a after 150ml but not that strong. After 300ml or more, maturation become more strong and we get intense feeling to go washroom

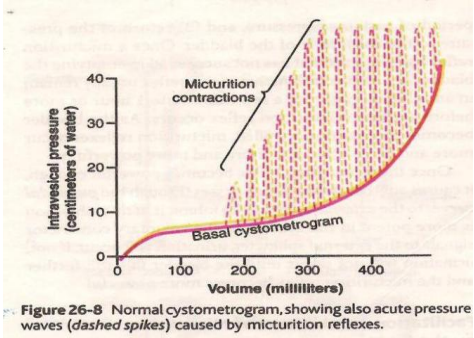


Figure 26-8 Normal cystometrogram, showing also acute pressure waves (*dashed spikes*) caused by micturition reflexes.

1.Interruption of afferent nerves or dorsal root (Tabes dorsalis):

- Reflex contraction of the bladder lost (one arm which is the afferent is lost)
- Bladder is distended, thin and hypotonic.
- Some contractions are present due to intrinsic response in the muscle.

Tabes dorsalis is a slow degeneration of the sensory neurons that carry afferent information

2.Interruption of both afferent and efferent (Ex:tumors):

- Bladder is flaccid and distended

Flaccid: paralysis

3.Spinal cord transaction: (car accident)

- **In the first two weeks(called spinal shock)** ⟶ complete shock to all the muscles below the transaction and it will become paralyzed (paralyzed and flaccid bladder) , incontinence flow of urine.
- **After the two weeks** ⟶ Spinal reflex for emptying will resume with no voluntary control.
  *when it's filled, it will send impulses to the spinal cord, efferent will cause contraction and urine will pass out. However, there is not higher control therefore when it's filled, micturation cannot be handled.

Renal failure :

	Acute renal failure	Chronic renal failure
Properties	*Kidney stop working suddenly *May recover	*Progressive loss of function *Symptom appear after loss of 70% *Disorders of blood vessel, glomeruli, tubules interstitium and lower tract *Can leads to end stage renal failure *Need dialysis
Causes	1.Prerenal: decrease blood supply to the kidney e.gheart failure, sever hemorrahge 2.Intrarenal:glomerulonephritis, tubular necrosis (ischemia, toxin, medication:gentamicin) 3.Postrenal: obstruction by stones(calcium,urate or cystine)	*diabetes mellitus *hypertension *Atherosclerosis *Chronic glomerulonephritis Interstitial nephritis

In renal failure:

- ✓ **Water retention (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:** low PH (The only source of getting rid of excess H+ is the kidney so if it's not working H+ will accumulate in the blood)
- ✓ **Anemia:** caused by decreased secretion of erythropoietin.
- ✓ **Ostomalcia:** deficiency of vitamin D .

Points mentioned in male slides

HIGHER CONTROL

The higher centers ordinarily keep the reflex partially inhibited except when micturition is desired.

•Higher center can prevent the reflex by tonic contraction of external bladder sphincter through the pudendal nerves until a convenient time.

•the cortical centers facilitate the sacral micturition center to initiate the reflex and inhibit external urinary sphincter so that urination can occur.

SUPRA SPINAL CONTROL

Micturition is a vesicovesical reflex which is facilitated and inhibited by higher cortical and pontine micturition center.

1. **PONTINE CENTER;**

A. A.L or lateral center;

Spinoreticular fiber synapse in the L nucleus of pons and then it activates ONUF'S NUCLEUS in the sacral spinal cord thereby closing tightly external urinary sphincter. This onuf'snucleus is situated in the anterior horn of the spinal cord and through the pudendal nerve it supplies the external urinary sphincter.

B. B.M: medial pontinecenter.

It projects to the intermediolateral column of the spinal cord. When stimulated it produces a decrease in urethral pressure and rise in the detrossor muscle pressure causing emptying of the bladder.

Note: pontine centers take 2-3 yrs. to develop hence there is automatic emptying of bladder.

•In adult 300-400 ml of urine normally required to initiate this reflex.

2. **HIGHER CORTICAL CONTROL**
    - **Cerebral cortex for example paramedian lobule present on the medial surface of frontal lobe.**
    - **Hypothalamus it is one of the highest center of autonomic control is also involved.**

Role of higher centers in micturition reflex.

- **Higher centers keep the micturition reflex partially inhibited except when micturition is desired.**
- **It prevents micturition even if micturition reflex is operating by tonic contraction of external sphincter (pudendalnerve) until a convenient time is found.**
- **When it is time to urinate cortical center can facilitate the sacral micturition centers to help and initiate a micturition reflex at the same time it inhibits the external urinary sphincter hence it is relaxed causing urination.**

Neurological bladder . clinical

	Site of lesion	result
Atonic (Lower moter neuron) **From spinal cord to organ**	Lesions of sacral segments of cord(conus medullaris) Lesions of sacral roots and nerves	Loss of detrusor contraction. Difficulty initiating micturation. Bladder distension with overflow. **flaccid bladder**
Hypertonic (Upper moter neuron) **Brain to spinal cord**	Pyramidal tract leaion in spinal cord or brain stem	Urgency with urge incontinence . Bladder sphincter incoordination .(dyssynergia) Incomplete bladder emptying **Spastic bladder**
corticdal	Post –central Pre-central frontal	Loss of awareness of bladder fullness. Difficulty intiating micturation. Inappropriate micturition. Loss of social control

Effects of Deafferentation

Damage Site: When the sacral dorsal roots (Afferents) are interrupted by diseases of the dorsal roots, such as tabes dorsalis and long standing DM

•Features:Reflex contractions of the bladder are abolished. The bladder becomes distended, thin-walled, and hypotonic, but some contractions occur because of the intrinsic response of the smooth muscle to stretch.

Effects of Denervation

Damage Site: When the afferent and efferent nerves are both destroyed, as they may be by tumors of the cauda equina or filum terminale,

•Feature: the bladder is flaccid and distended for a while. Gradually, however, the muscle of the "decentralized bladder" becomes active, with many contraction waves that expel dribbles of urine out of the urethra. The bladder becomes shrunkenand the bladder wall hypertrophied.

Effects of Spinal Cord Transection

Damage Site:Spinal Cord injuries (Paraplegia)

•Feature:During spinal shock, the bladder is flaccid and unresponsive. It becomes overfilled, and urine dribbles through the sphincters (overflow incontinence). After spinal shock has passed, the voiding reflex returns, with no voluntary control and no inhibition or facilitation from higher centers. Sometime voiding reflex becomes hyperactive called spastic neurogenic bladder. ABNORMALITIES OF MICTURITION

	ATONIC BLADDER	AUTOMATIC BLADDER
Lesion	Sensory nerve fibers from the bladder to the spinal cord are destroyed Crush injury to the sacral region of the spinal cord and tabes dorsalis	Spinal Cord Damage Above the Sacral Region resulting in Spinal shock
Feature	Bladder fills to capacity and overflows a few drops at a time through the urethra. This is called overflow incontinence	return of excitability of micturition reflex until typical micturition reflexes returns & then, periodic (but unannounced) bladder emptying occurs which may be controlled by scratching or tickling

Questions:

1)The parasympathetic innervation of the bladder is carried by:

a)L2,3,4

B)T1,2,4

C)S1,2,3

2)which of the following actions happen when the sympathetic is activated:

a)bladder contraction , sphincter relaxation

b)bladder relaxation, sphincter contraction

c)None of the above.

3)A person had a car accident and there was an injury in his spinal cord(L1,L2) after the initial phase of spinal shock, what happened to the bladder?

a)paralyzed and flaccid

b)Emptying with voluntary control

c)Loss of voluntary control

Answers: C-b-c

Useful video :

1- **http://highered.mcgraw-hill.com/sites/0072507470/student_view0/chapter26/animation__micturition_reflex.html**
2- **http://www.youtube.com/watch?v=v3PRC5H3_mw**