

# PHYSIOLOGY

## TEAM 432



### *LECTURE : 4*

### Micturition

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# OBJECTIVES

At the end of this lecture student should be able to describe:

- 1.Functions of ureters and bladder
- 2.Bladder innervation
- 3.Mechanism of micturition
- 4.Different component of urinary Cystometrogram
- 5.Examples of abnormal micturition
- 6.Symptoms and common causes of acute and chronic renal failure

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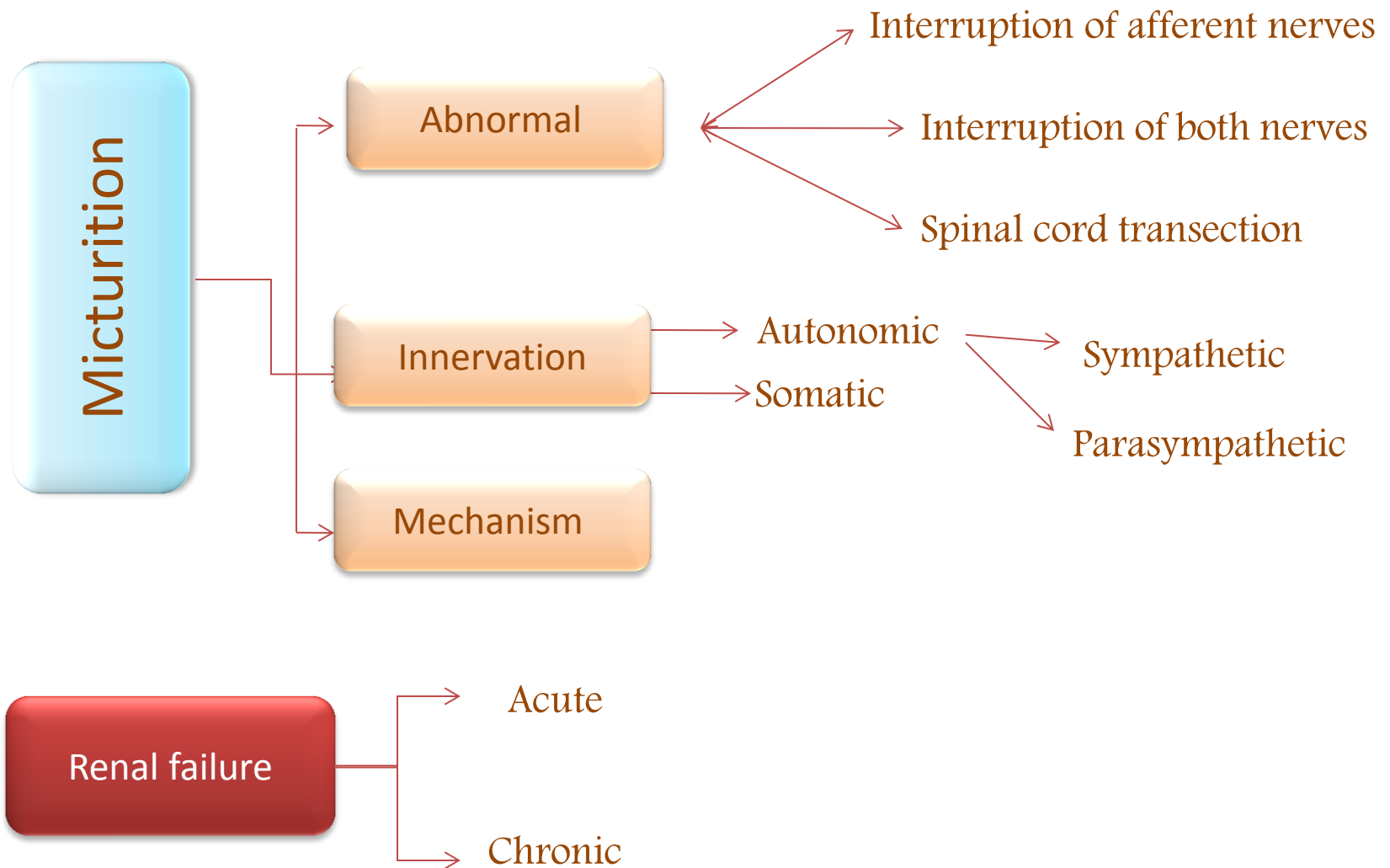
Slides



Important



# MIND MAP



# What does the micturition mean ?

Is the passing of urine from the urinary bladder through the urethra to outside the body

That action of passing urine

Urination

**Voluntary emptying of the bladder**

# Ureters & urine Transport

Urine transport from the kidney to bladder by 2 ureters

## \* Ureters has regular peristaltic contraction 1-5/min

Contraction and relaxation of muscles which propagates in a wave down the muscular tube.

\* Contraction followed by relaxation.

\*\* Painful in patient with ureter stones because the stones close the ureter while the peristalsis is still going on.

peristalsis is found in the contraction of smooth muscles of Intestine + Ureter

\* Ureters enter bladder wall obliquely (functional sphincter) prevent urine reflux from the bladder ( If the bladder contracts, it will directly close the ureters opening )

The ureter is not opening to bladder **directly, why**  
To prevent the urine from going back to ureter



# Urinary bladder

\* **Detrusor muscle** is a layer of the urinary bladder wall made of smooth muscle fibers arranged in three layers: spiral, circular and longitudinal bundles.

When the bladder is stretched, this signals the parasympathetic nervous system to contract the detrusor muscle. This encourages the bladder to expel urine through the urethra.

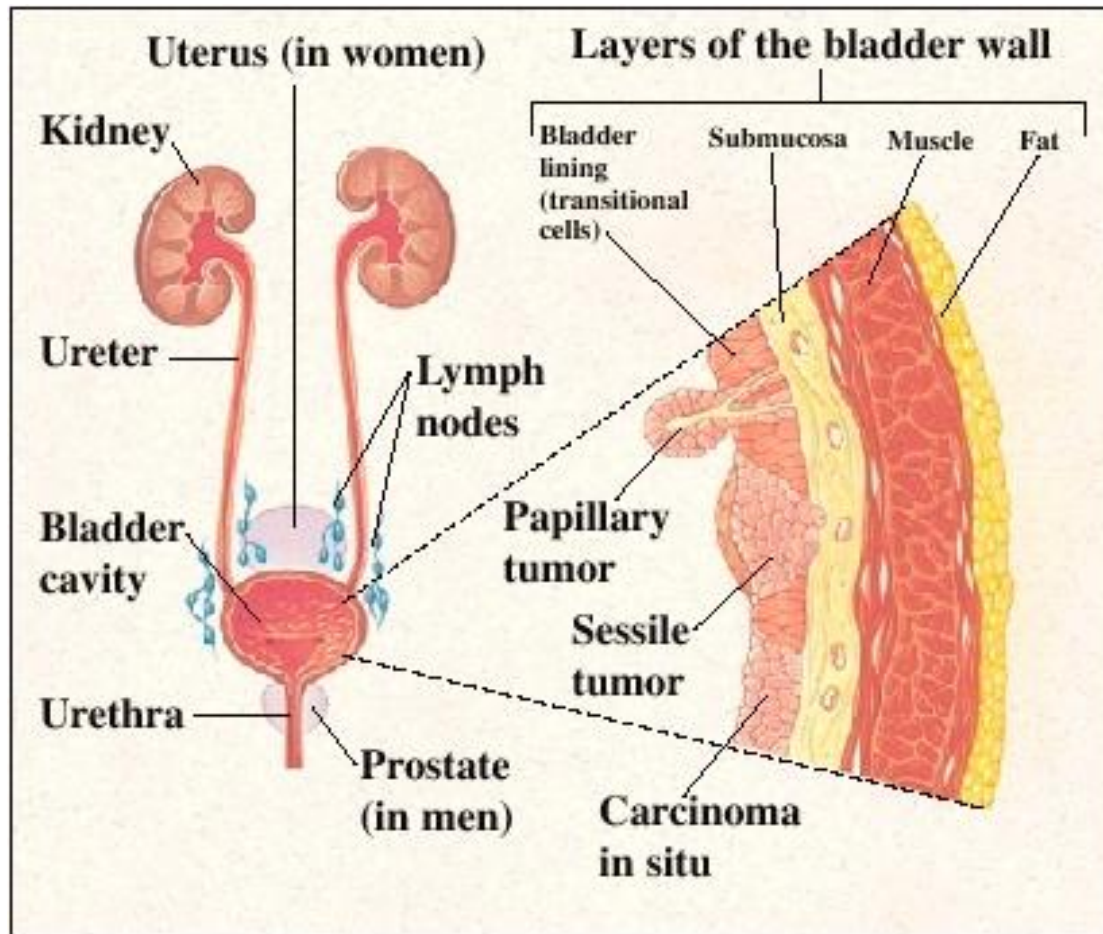
\* These three layers of **smooth** muscles become bundled **at the beginning and around the urethra** to make the ( **internal sphincter** ) .

\* **External sphincter** is made of **skeletal** muscle .

For the urine to exit the bladder, both the autonomically controlled internal sphincter and the voluntarily controlled external sphincter must be opened. Problems with these muscles can lead to incontinence.

- ✓ Internal sphincter: **Smooth** muscle, **Involuntarily**
- ✓ External sphincter: **Skeletal** muscle, **voluntarily**

# Urinary Bladder Wall





# Micturition

\* It is a **spinal reflex** that is controlled by higher center

**Spinal:** Derivative from the spinal cord

**Reflux :** **Through Afferent to spinal cord and Efferent to the organ**

**Afferent :** carries the information (**through sensory neuron**) from the muscles to the center ( Spinal Cord )

**Efferent :** carries the impulses back to muscle to cause the action (**through Motor Neuron**)

\* **Micturition has Autonomic and Somatic innervations**

Because we have two types of muscles, we have two types of innervations:

- Smooth muscle is innervated by Autonomic nerves.
- Skeletal muscle is innervated by Somatic nerves.



Autonomic innervation	Parasympathetic	Sympathetic
<b>Origin</b>	Pelvic S1,S2,S3	Hypogastric L1,L2,L3
<b>Innervated parts</b>	Body of bladder	Body and the neck of internal sphincter
<b>Stimulation (Afferent)</b>	bladder distention will stimulate stretch receptor in the bladder wall and send information about stretching to spinal center(s2,3)	
<b>Response (Efferent)</b>	bladder contraction	* Inhibition of bladder contraction ( $\beta$ ) $\rightarrow$ relaxation * Activation of internal sphincter ( $\alpha$ ) $\rightarrow$ IS contraction
<b>Net Result</b>	This action lead to start urination (micturition)	This action lade to stop urination (inhibit micturition)

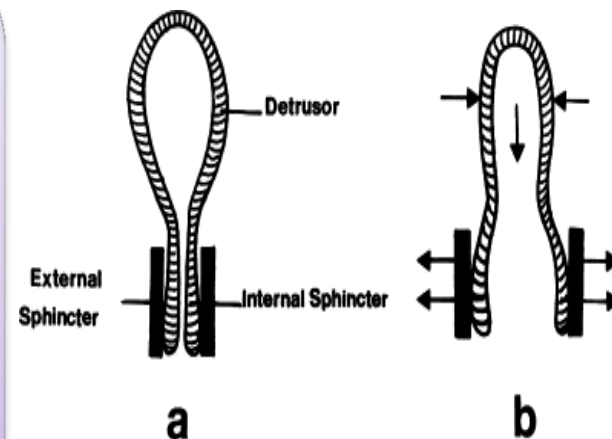


**Two different actions because of two different receptors**

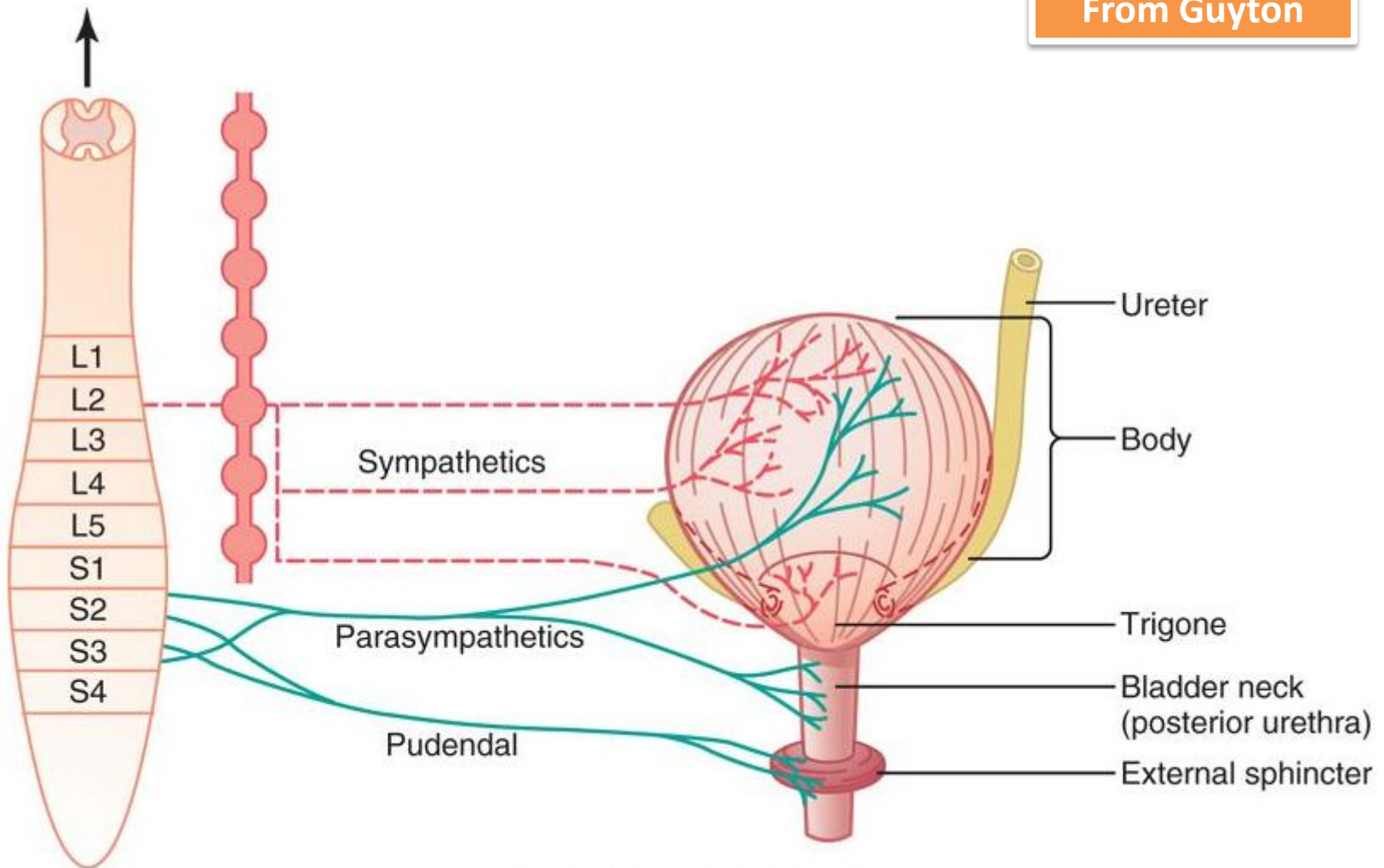
Innervation	Somatic
Origin	Pudendal nerve S2,S3,S4
Innervated parts	External Sphincter
Net Result (Action)	This action leads to stop and Prevent urination

Somatic innervation works on external sphincter according to the Autonomic action:

- When **Parasympathetic** start urination, somatic will cause **relaxation** in the external sphincter (B)
- When **Sympathetic** inhibit urination, somatic will cause **contraction** to the external sphincter (A)



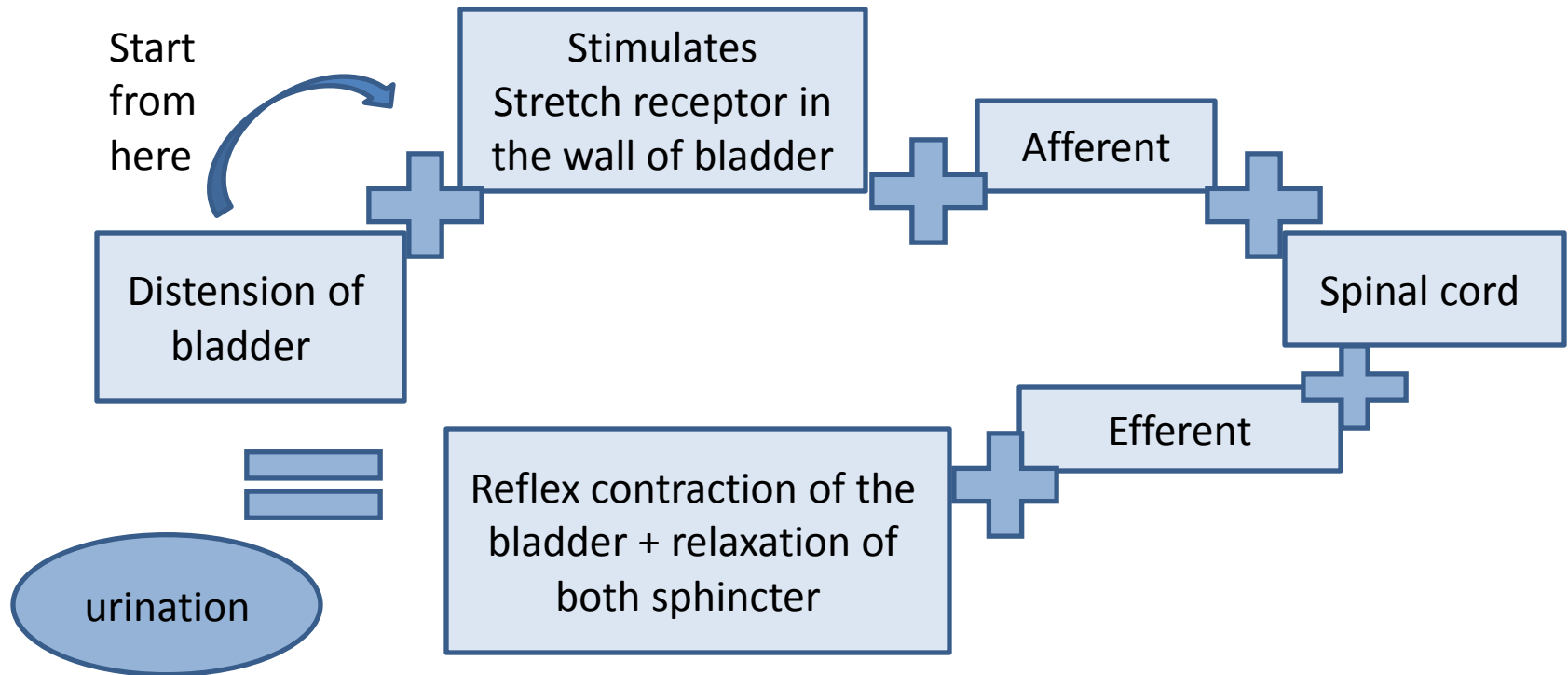
From Guyton



# Physiology of Micturition

\* Micturition is a spinal reflex facilitated or inhibited by higher brain centers.

Actually Micturition is inhibited all the time but when the person want to pass urine, inhibition effect of higher center is removed.  
That happens when fullness sensation starts.



# Facilitation or Inhibition of Micturition by the Brain

From Guyton

The micturition reflex is an autonomic spinal cord reflex, but it can be inhibited or facilitated by centers in the brain. These centers include (1) strong *facilitative* and *inhibitory centers in the brain stem, located mainly in the pons*, and (2) several *centers located in the cerebral cortex* that are mainly inhibitory but can become excitatory.

**The micturition reflex is the basic cause of micturition, but the higher centers normally exert final control of micturition as follows:**

1. The higher centers keep the micturition reflex partially inhibited, except when micturition is desired.
2. The higher centers can prevent micturition, even if the micturition reflex occurs, by tonic contraction of the external bladder sphincter until a convenient time presents itself.
3. When it is time to urinate, the cortical centers can facilitate the sacral micturition centers to help initiate a micturition reflex and at the same time inhibit the external urinary sphincter so that urination can occur.

*Voluntary urination* is usually initiated in the following way: First, a person voluntarily contracts his or her abdominal muscles, which increases the pressure in the bladder and allows extra urine to enter the bladder neck and posterior urethra under pressure, thus stretching their walls. This stimulates the stretch receptors, which excites the micturition reflex and simultaneously inhibits the external urethral sphincter. Ordinarily, all the urine will be emptied, with rarely more than 5 to 10 milliliters left in the bladder.

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**During filling phase (0-50 ml) :**

\* Detrusor muscle is **relaxed**.

\* Both sphincters are **contracted**.

( Sympathetic action on internal + Somatic action on external )

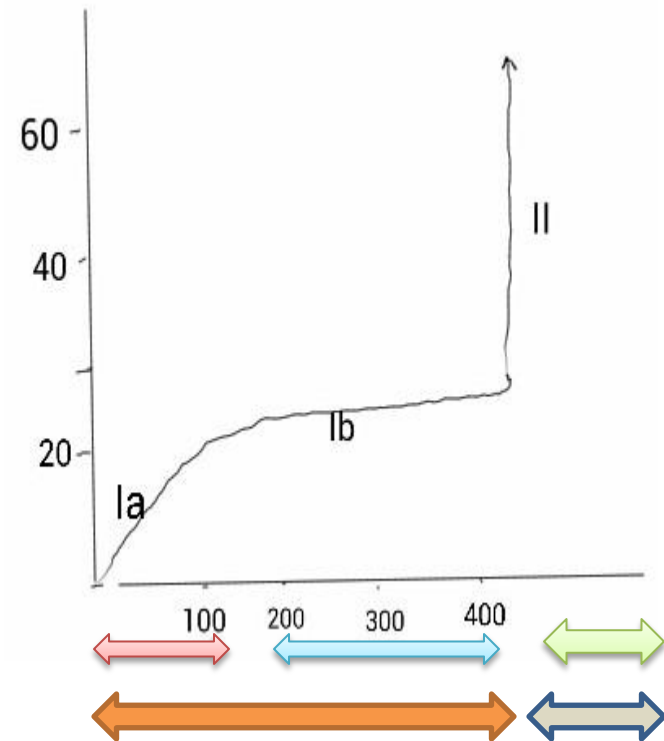
**At this stage, urine is produced but can be controlled**

**Reflex is released by removing inhibitory impulses from the cerebral cortex**

# Cystometrogram

**Cystometrogram** shows 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.



**Increase volume with pressure inside bladder**

**Bladder completely stretched which pressure is constant**

**Can be controlled to pass urine or not**

**Pressure increase with volume leading to start micturition reflex**



**Phase I: Initial slight rise in pressure with increase in urine volume from 0 to 50 ml. ( The pressure starts to increase because the bladder at that time is small and the fluid starts to enter the bladder )**

**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 plateau phase" )**

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

**Phase III: Sudden sharp rise in pressure as the micturition reflex is triggered ( Sense of fullness at about 400ml )**

**\*↑400 ml , you can't keep it up because of very high pressure in bladder. ( Our control can keep urine in range of 50-400ml )**

# Abnormal micturition

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

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

Disease of spinal cord effecting sensory nerve

having a lesser degree of tone or tension as in a “hypotonic muscle”.

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

- \* Bladder is **flaccid** and distended

paralysis because no efferent nerve cause contraction

# Abnormal micturition

## 3. Spinal cord transaction: (car accident)

\* **In the first two weeks (called spinal shock)**, complete shock to all the muscles below the transection and it becomes paralyzed (paralyzed and flaccid bladder), incontinence flow of urine.

\*\* 5 ml or 10 ml of Urine will pass directly without stimulation → incontinence

\* **After the two weeks**, Spinal reflex for emptying will resume with **no** voluntary control.

\*\* The problem with nerves is solved but still we don't have higher center to determine the suitable time for micturition which means when reaching around 400 ml, urine will pass directly → bladder of children

Renal failure	Acute renal failure	Chronic renal failure
<b>Time</b>	Kidney stop working suddenly	Progressive loss of function
<b>Causes</b>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Prerenal: ↓ Blood supply to the kidney e.g. HF + sever hemorrhage</li> <li><input type="checkbox"/> Intrarenal : ischemia, toxin, medication e.g. Glomerulonephritis + tubular necrosis</li> <li><input type="checkbox"/> Postrenal: obstruction by stones e.g. Calcium + urate + cystine</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Diabetes mellitus</li> <li><input type="checkbox"/> Hypertension</li> <li><input type="checkbox"/> Atherosclerosis</li> <li><input type="checkbox"/> Chronic glomerulonephritis</li> <li><input type="checkbox"/> Disorders of blood vessel, glomeruli, tubules interstitium and lower tract</li> <li><input type="checkbox"/> Interstitial nephritis</li> </ul>
<b>Notes</b>	* May recover	<ul style="list-style-type: none"> <li>➤ Symptom appear after loss of 70%</li> <li>➤ Need dialysis</li> <li>➤ Can leads to end stage renal failure</li> </ul>

# Symptoms of Renal Failure

**Edema**

**Water retention**

**Uremia**

**urea**

**Azotemia**

**creatinine, urea**

**Acidosis**

**PH**

**Anemia**

**RBC**

**Ostomalcia**

**Due to active Vitamin D**

# SUMMARY

**\*Micturition is Voluntary emptying of the bladder**

**\*Micturition has Autonomic and somatic innervations**

## ☐ To START Micturition:

- **Parasympathetic < pelvic nerve {S1,S2,S3}:  
1) contraction to bladder  
2) relaxation to internal sphincter**
- **Somatic < pudendal nerve S2,S3,S4 → relaxation to external sphincter**

## ☐ To STOP Micturition:

- **Sympathetic < hypogastric {L1,L2,L3}  
1) relaxation to bladder  
2) contraction to internal sphincter**
- **Somatic < pudendal nerve S2,S3,S4 → contraction to external sphincter**

✓ **Diabetes mellitus causes chronic renal failure by causing a disease to the micro vascular arteries → thickening of membrane → prone to eye, renal and heart diseases.**

helpful video ☺

[http://msjensen.cehd.umn.edu/1135/Links/Animations/Flash/0041-swf\\_micturition\\_re.swf](http://msjensen.cehd.umn.edu/1135/Links/Animations/Flash/0041-swf_micturition_re.swf)

# Some Questions

## 1: The micturition reflex:

- A) Can be stimulated or inhibited by higher centers in the brain.
- B) Is stimulated by increased pressure in the bladder.
- C) Can be stimulated by irritation of the bladder or urethra.
- D) All of these

## 2: Urine is expelled from the urinary bladder by:

- A) Excretion.
- B) Defecations.
- C) Micturition

## 3: The micturition reflex is centered in the:

- A) Medulla
- B) Sacral cord
- C) Hypothalamus
- D) Lumbar cord

## 4: Which of these is under voluntary control:

- A) Urethra
- B) Detrusor muscle
- C) Internal sphincter
- D) External sphincter

**Answers: D, C, B and D**



***THE END***

**If there are any problems or suggestions  
Feel free to contact:**

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***THANK YOU***

**Actions speak louder than Words**