



4. Physiology of Micturition

Color index

- **Important**
- Further Explanation

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Recommended Videos!



DEAR GIRLS, IF YOU FIND ANY EXTRA INFO
PLEASE KNOW IT'S FROM MALES' SLIDES.
JUST **FOUCS ON WHAT'S WRETTIN IN RED**

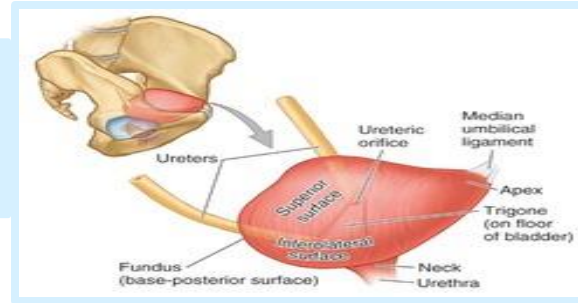
Please check out this link before viewing the file to know if there are any additions/changes or corrections. The same link will be used for all of our work [Physiology Edit](#)

The Urinary Bladder

A muscular bag that holds urine and forces it by contraction.

Location: in the pelvic cavity

Function: Temporary storage (container)

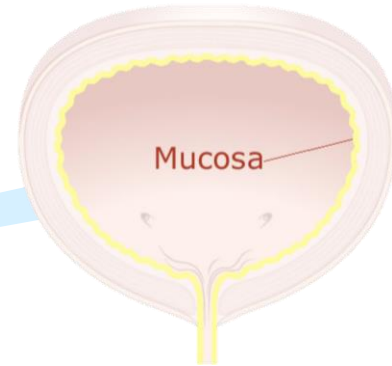


Anatomy:

- ✧ Pyramidal in shape
- ✧ Expands superiorly when its full into the abdominal
- ✧ 4 surfaces :
 - A) Base
 - B) Apex
 - C) Superior surface
 - D) 2 infrolateral surfaces

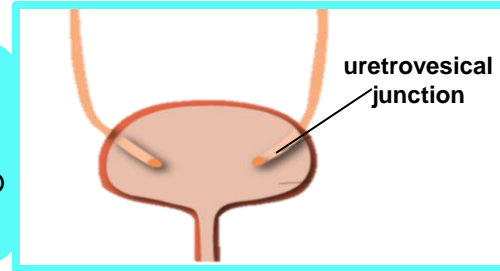
Mucosal lining:

loosly attached and folded except the base it's smooth and firmly attached (Trigone: the smooth area in bladder between the three openings)

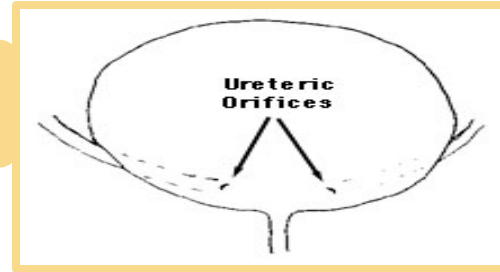


Anatomy of Urinary Bladder

The uretrovesical junction : between the ureters and the bladder we have a fibrou-muscular layer (sheath) ,called the **waldyer sheath** , it extends longitudinally and continues over the ureters to the trigone.



Uretral orifice : the site of termination of the ureters as they peirce the wall of the bladder wall obliquely

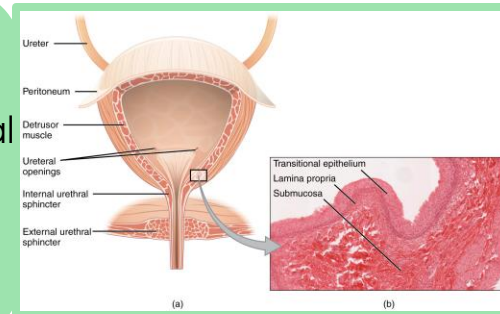


Note that the haitus in the detruser muscles of the bladder compress the ureters as they pass through the bladder and make them narrower

Mucosa: (Transitional epithelium)

Ragae is the foldings in the mucusa when the bladder is empty the ragae gets flattened out with a bit of change in the interviscal pressure

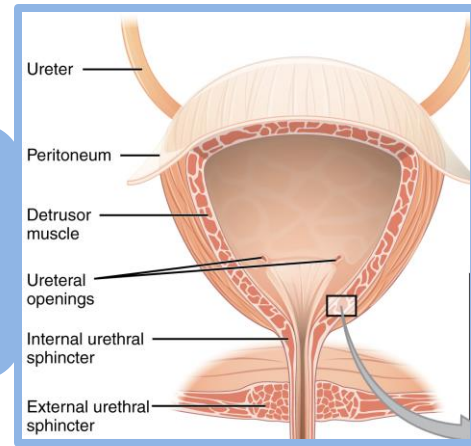
this mechanism results in the high compliance of the bladder so the bladder can take around 400 ml with a pressure change around 10 cm H₂O



Anatomy of Urinary Bladder

Muscle layer : (Detrusor muscle)

Which is a mixture of spiral and longitudinal fibers, they're interwoven in all directions around the bladder, **contraction of the detrusor muscle can increase the pressure in the bladder up to 40-60mmHg.**



Bladder neck : (funnel-like shape)

Extension of the bladder to the urogenital tract to join the external urethra.

The lower 2 or 3 cm of the bladder is called the **internal urethra (posterior urethra)**

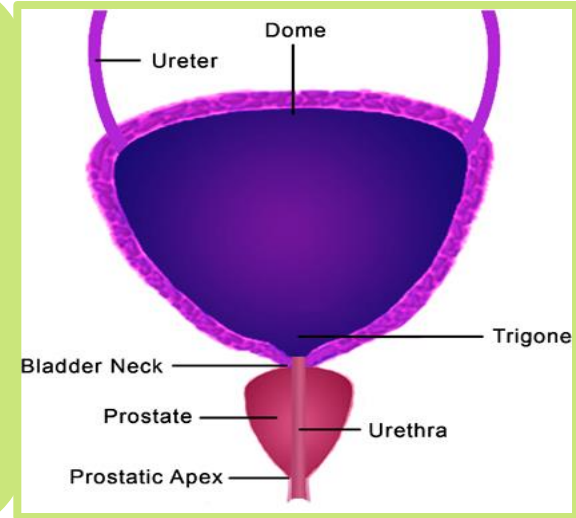
The conduit¹ for urine from the bladder to the outside

We have 3 muscular layers surrounding the urethra:

Inner
Longitudinal

Middle
Circular²

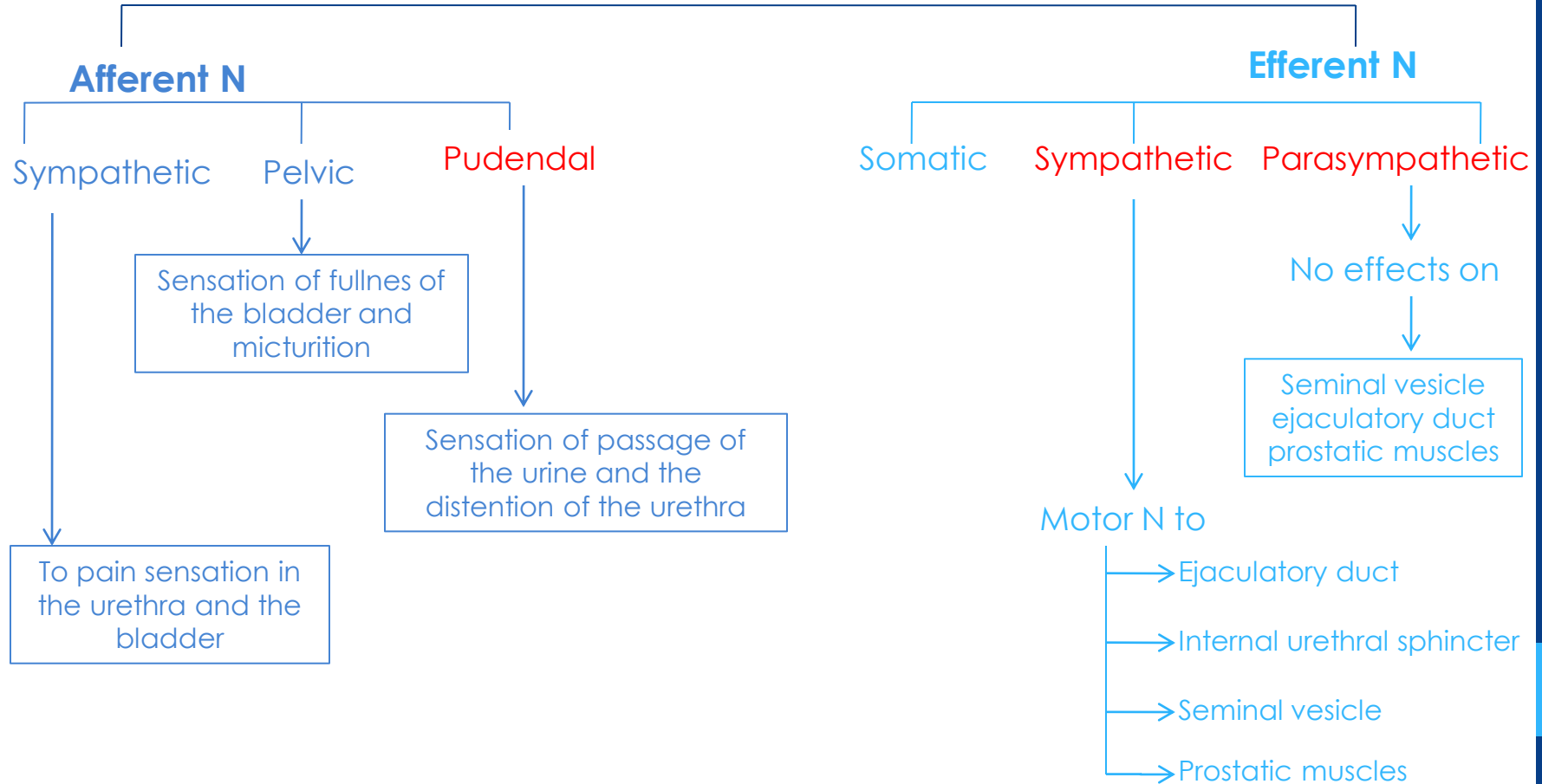
Outer
Longitudinal



1: A pipe or channel

2: Prevents the emptying of the bladder until the right time for micturation

Nerve Supply To Urinary Bladder

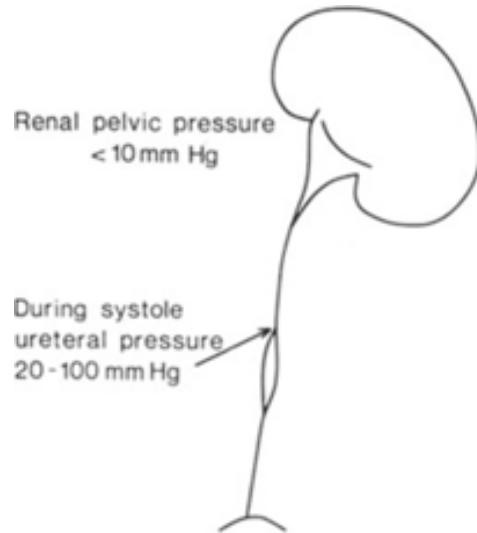


Getting Urine from The Kidney to The Outside

In **Renal Pelvis** there are **Electrical Pacemaker** cells → Initiate **peristaltic waves**¹ in the smooth muscle sheaths of the ureteral wall

The pacemaker cells seem to be stimulated by the **stretch of urine filling the pelvis.**

The Pelvis to Ureter is a **functional syncytium**²



The movement of the peristaltic wave is about 2-6 cm/sec, Traveling **from its origin at the pelvis down to the bladder**

WE NEVER FEEL THIS WAVES CONTRACTION, UNLESS THERE WAS AN OBSTRUCTION IN URETER (EG. STONES) THE CONTRACTION OF THE URETER WILL BE FELT AS SEVERE PAIN.

- 1: Radially symmetrical contraction & relaxation of muscles that propagates in a wave down a tube.
- 2: Connected to one another, like the entire tissue resembles a single, enormous muscle cell.

Getting Urine from The Kidney to The Outside cont.

Peristaltic waves propel the urine along the ureter

Generating a pressure from 2-5 cm H₂O up to 20-80 cm H₂O

Peristalsis is independent of nerve input.

But the action of Sympathetic nerves innervating the ureter may modify the force of peristalsis.

ENHANCED BY PARASYMPATHETIC AND INHIBITED BY SYMPATHETIC

The acute pain from the stones: is due to autonomic pain fibers in the ureter

Hydronephrosis

"WATER (URINE) INSIDE THE KIDNEY"



Interruption of the urine flow by an obstruction

Stops The Flow

↑Pressure

Urine back up through the ureter into the pelvis

↑Nephron & subcapsular hydrostatic pressure

Cystometrogram

A test that allows us to assess (نقييم) how your bladder and sphincter behave while you store urine and when you pass urine.

Cystometrogram give us a plot of: **I.V.P¹ (Y-Axis) against the volume (X-Axis)**

Read and follow on the figure...

● When its no urine in the bladder the pressure is 0

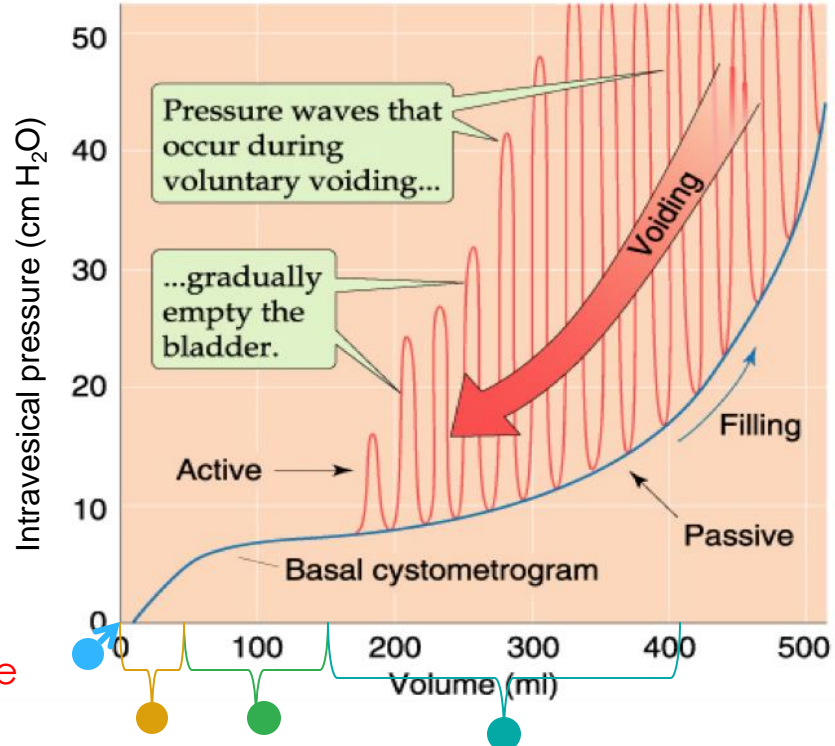
● **Stage IA:** Represents the start of filling **filling till 50ml** & small rise of IVP 10 cm H₂O

● **Stage IB:** It's stable line **filling from 50ml to 150ml** & the IVP almost constant

● **Stage II:** Strong increment of volume & IVP, **filling from 150ml to 400ml** & the IVP increased

This increase in volume and pressure increases the bladder tone triggering the micturation reflex

1: Intravesical pressure: the pressure exerted (المبذول) on the contents of the urinary bladder.



Cystometrogram cont.

In the urinary bladder :

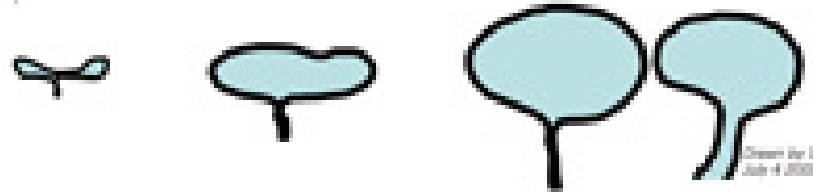
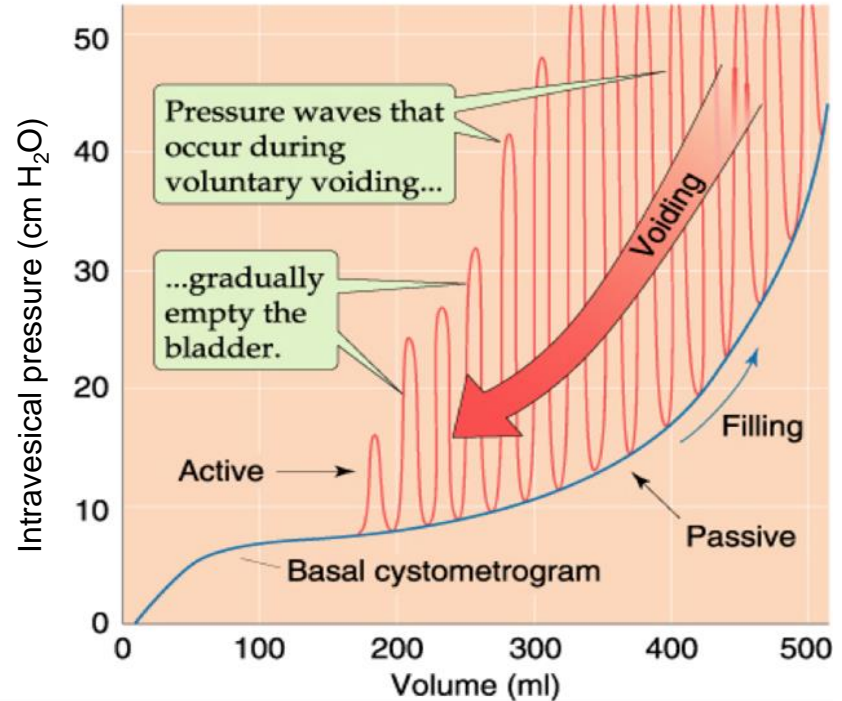
Tension on the wall
Volume
Radius
They all Increase

So there is little change in pressure until the organ is **filled**

Any increase in volume beyond this will Not be accommodated & is reflected by rapid rise of Pressure. **This explain stage II**

Why in stage IA only small volume increase the pressure but in stage IB large volume & it did not increase the pressure?

In stage IA volume and the tension increases **but the radius is not increasing** so there is a small rise of pressure. While in Stage IB **volume, radius & the tension increases**, Therefore pressure will be constant.



Micturition Reflexes

The micturition reflex is a complete autonomic spinal cord reflex, to get urine outside the body, that it can be inhibited or facilitated by higher brain centers

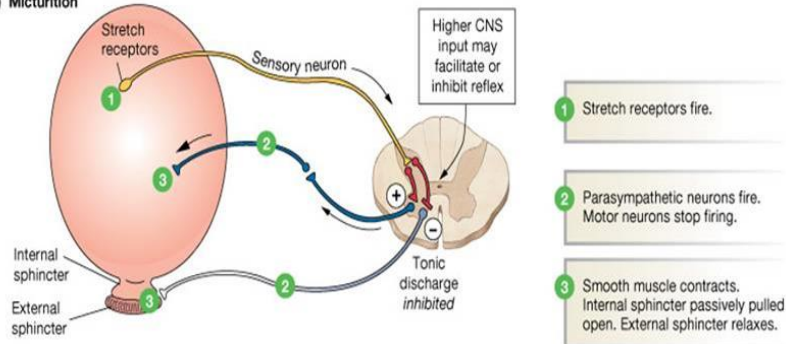
When the bladder begins to fill the stretch receptors send signals to the brain and sacral segment

The signal in sacral segment reflexively back again to the bladder **through the parasympathetic nerve.**

the signal in the brain Voluntary back again and it could inhibit the parasympathetic nerve

The parasympathetic nerve will make the smooth muscle of the bladder to contract and sphincters to relax so you **Empty the bladder**

(b) Micturition



keep the contractig of External sphincter Or relax the External sphincter & stimulate the parasympathatic nerve

Micturition Reflexes cont.

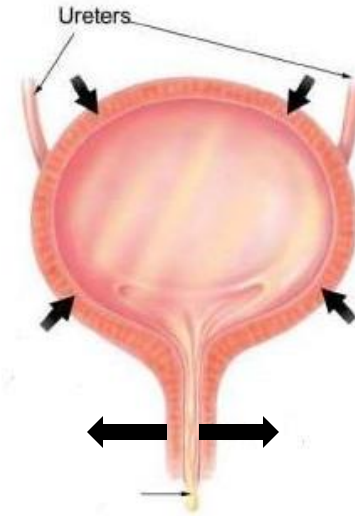
Stage	Urine Volume in Bladder	Sense	Comment
Stage 1	150 – 300 ml	First urge to void ¹ urine	Micturition reflexes can be voluntarily suppressed.
Stage 2	300 – 400 ml	Fullness	
Stage 3	400 – 600 ml	Discomfort	
Stage 4	600 – 700 ml	Pain	
Break Point	About 700 ml	Micturition can not be suppressed.	

Micturition reflexes start to appear at the **first stage**)150-300 ml (

Result

Contraction of urinary bladder wall

Relaxation of the internal & external urethral sphincters



Micturition

Unconditioned (Automatic)

✧ Infants

Because nerve tracts are not yet myelinated in infants.

Increase volume →
increase IVP → stretch
receptors stimulated →
signals go to the spinal
micturition centre in the S2,
S3 and S4 segments of the
spinal cord.

Conditioned (Voluntary)

✧ In adult

They can control it by the brain
The brain has centers called
higher centers
these center wether :

Facilitatory

- In pontine area.
- Posterior hypothalamus.
- Other cortical centers

Inhibitory

- In the midbrain

Mechanism of Voluntary Control of Micturition

Filling of the bladder beyond 300 -400 ml

Stretching of sensory **stretch receptors**

These sensory signals stimulate sacral segment

Which is consciously controlled by higher centers

Condition is Favorable

(+) of sacral micturition center.
(-) of pudendal nerves

Relaxation of external urethral sphincter

Contraction of anterior abdominal muscle

Contraction of diaphragm → ↑ Intra-abdominal P.

↑ Intravesical P.

Intensifies the micturition reflex → Urination

Condition is Unfavorable

Higher centers will **inhibit** the micturition reflex

(-) of sacral micturition center
(+) of pudendal nerves

Contraction of external urethral sphincter

Inhibit the micturition reflex → No urination

Disturbances (Abnormalities) of Micturition

Denervation of the afferent supply only such as in Tabes Dorsalis

Loss of the Urinary Bladder .sensations and reflex micturition



Some intrinsic responses of the smooth muscle are retained



The bladder becomes distended, thin walled & hypotonic (a tonic bladder)



There is retention with overflow.

Denervation of both afferent and efferent nerve supply such as in tumor or trauma

Abolished¹ reflexes



Increase in the intrinsic responses of the smooth muscles



Hypertonic bladder due to denervation hypersensitivity

— Decreased degradation of Ach.

— Decreased cholinesterase in the tissue

— Increased number of cholinergic receptors

Associated with uncontrolled periodic micturition

Disturbances (Abnormalities) of Micturition cont.

Spinal cord transaction (Above the sacral region) the spinal cord transaction consist of 3 stages:

1

Stage of spinal shock: caused by a sudden separation of the spinal centers from the higher centers that control them, this will cause the spinal centers **functionless for 2-6 weeks** *IT MAY STAY UP TO A MONTH*, and the **micturition reflex will be abolished**.



2

Stage of recovery: **Automatic micturition occurs** as soon as the IVP pressure rises to 15-20 cm water, this will cause micturition reflex, **but no voluntary control**



3

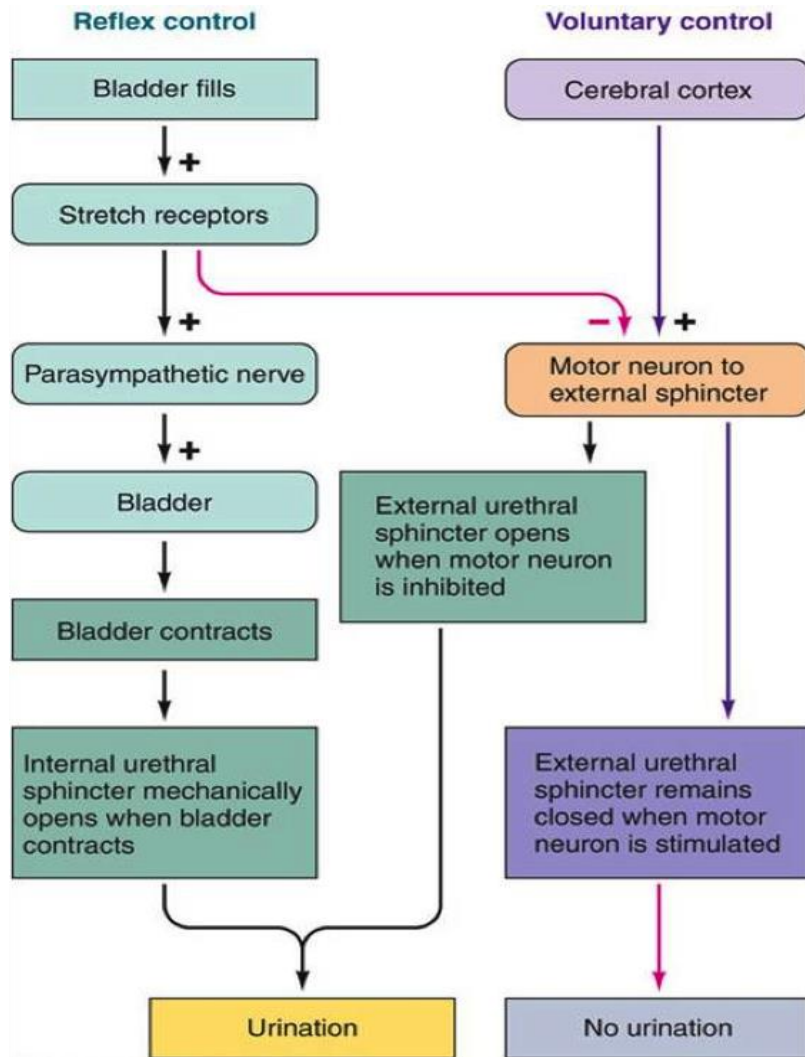
Stage of failure of recovery: This stage is caused by toxins and bacterial infection and will lead to **abolished micturition reflex**

How Micturition Take Place?

<ul style="list-style-type: none"> ↑ Interavesical pressure ↑ Bladder tone 	<p>Volume in bladder > 300 ml</p> <p>Pressure in bladder</p>
<p>Trigone area is very sensitive to expansion → once stretched → Signals the brain of its need to empty.</p>	
<p>Signals become stronger as the bladder continues to fill</p>	
<p>Detrusor muscles contracts → Voluntary contraction of abdominal muscles → Increases voiding</p>	
<p>Muscles of external urethral sphincter relax → Urine passes out</p>	
Urine Remaining in urethra	Females: empties by gravity
	Males: Expelled by contraction of bulbocavernos muscle
<p>Once the bladder empty we are back to “no tone” phase and the sphincters can close again</p>	

Reflex Control

Stimulus	Distension of bladder stimulates stretch receptors in bladder wall.
Afferent	Fibers in the pelvic nerves.
Center	Sacral segments S2,S3 and S4.
Efferent	Parasympathetic fibers to the bladder.
Response	Relaxation of the sphincters and contraction of bladder wall.



1- Which stage the first urge to void urine

- A. 1 STAGE
- B. 2 STAGE
- C. 3 STAGE
- D. 4 STAGE

2- Which of the following is not in the facilitatory center:

- A. cortical centers
- B. Posterior hypothalamus.
- c. In the mid
- D. In pontine area

3- The I.V.P during the early urine (50ml) filling is:

- A. 5cm H₂O
- B. 10cm H₂O
- C. cm H₂O
- D. 3cm H₂O

4- the efferent sacral segment reflex is carried by:

- A. Parasympathetic fibers
- B. Sympathetic fibers

5- first stimulation in the micturition reflex is when the:

- A. rine volume reaches 400ml
- B. B.Urine volume reaches 560ml
- C. Uine volume reaches 150ml
- D. Urine volume reaches 700ml

6- Voluntary control of the micturition reflex is present in:

- A. Adults
- B. Infants
- C. Adults and infants

7- The mucosal lining the base of urinary bladder is..

- A. Loosly attached and folded
- B. There is no attachment in the base of the bladder
- C. Smooth and firmly attached
- D. Its not smooth and firmly attached

THANK YOU FOR CHECKING OUR WORK!

BEST OF LUCK

Done By:

- ✧ Abdurrahman Askr
- ✧ Suhail Algamdi
- ✧ Abdurrahman Alharbi
- ✧ Abdullah Alfaleh
- ✧ Hadeel Alsulami
- ✧ Reem Labani
- ✧ Nouf Almasoud

