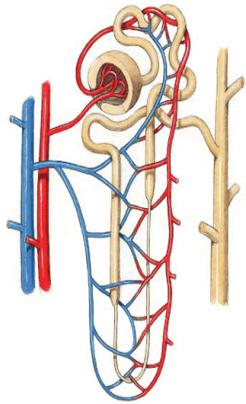


MICTURITION

Dr. Maha Saja
MBBS, MSc Physiology, PhD
Msaja@ksu.edu.sa
Office 89, level 2

Objectives

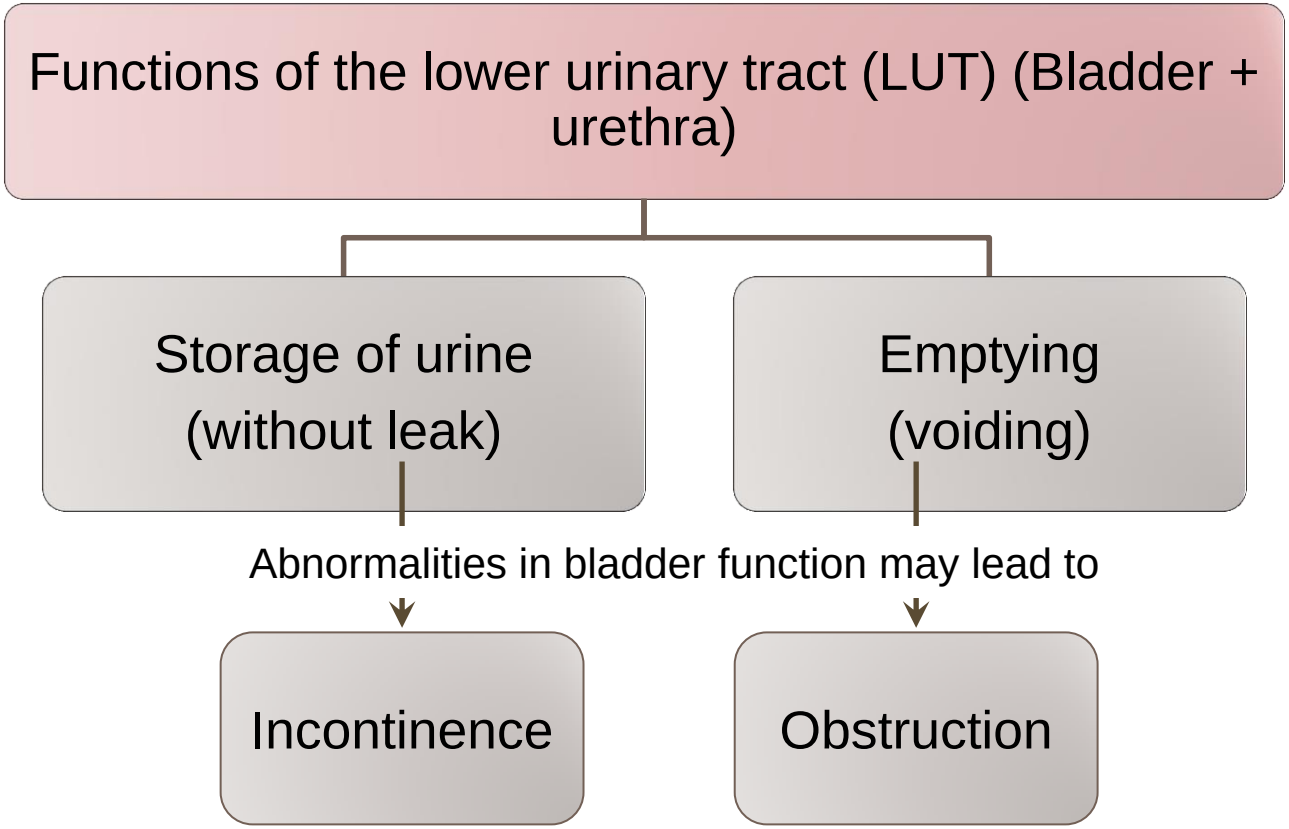
At the end of this session, students should be able to:

- Identify and describe the functional anatomy of the urinary bladder.
- Describe the mechanism of filling and emptying of the urinary bladder.
- Cystometrogram.
- Explain the neurogenic control of the micturition reflex and its disorders.

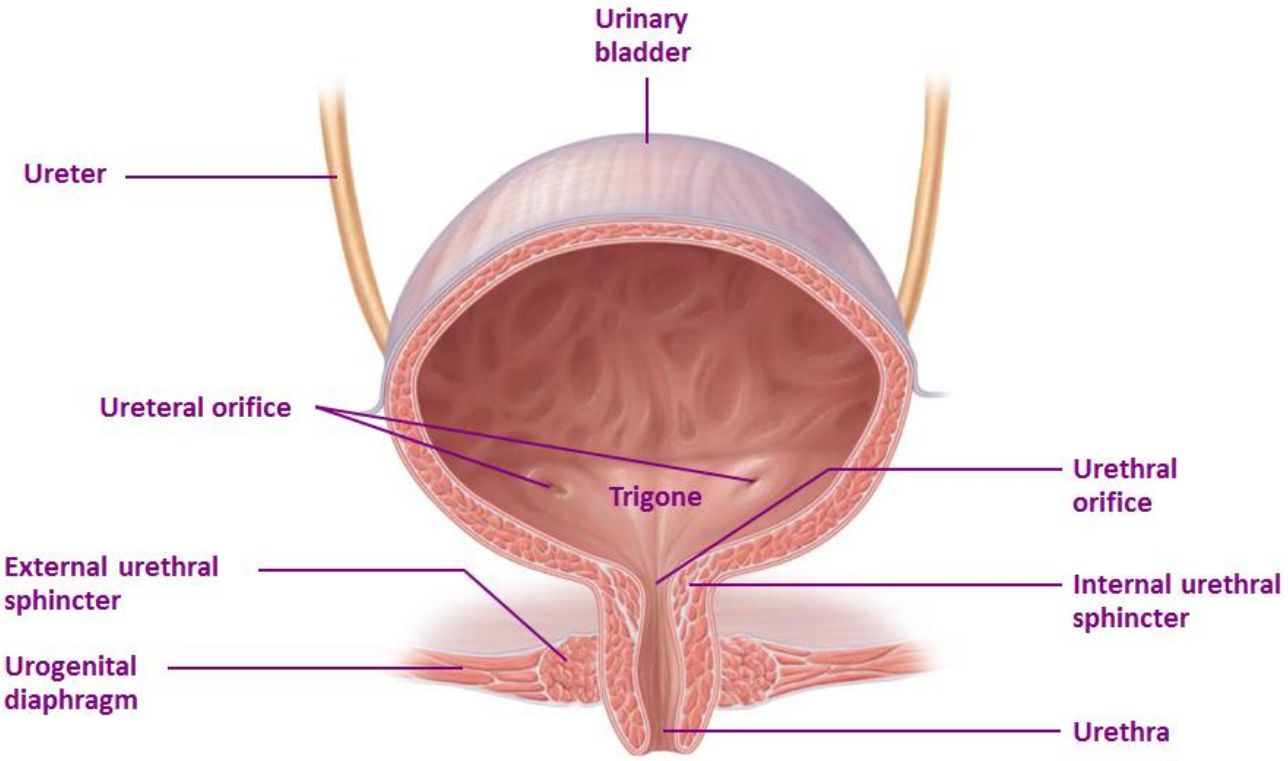
Introduction

What is meant by micturition?

- Micturition = the process by which the bladder empties itself when it becomes full.

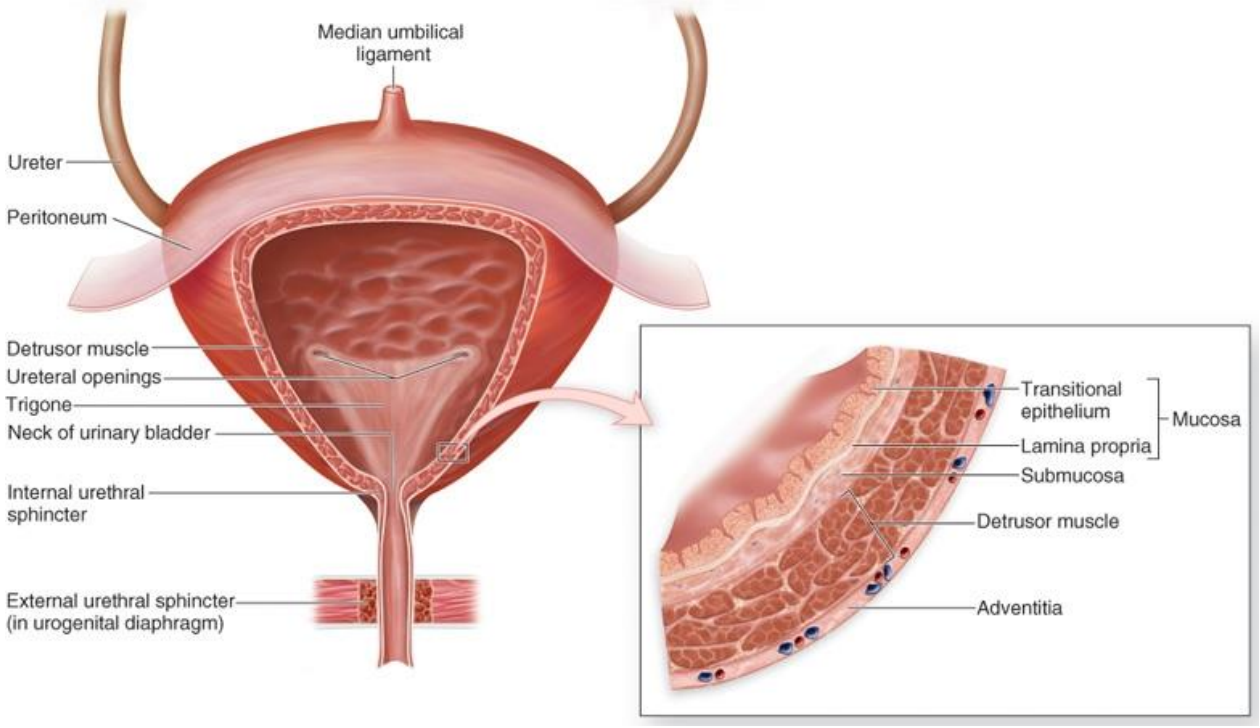


Functional Anatomy of the Bladder



- Bladder has two parts: body & neck.
- What is the trigone?
- How many sphincters are there and how are they different?

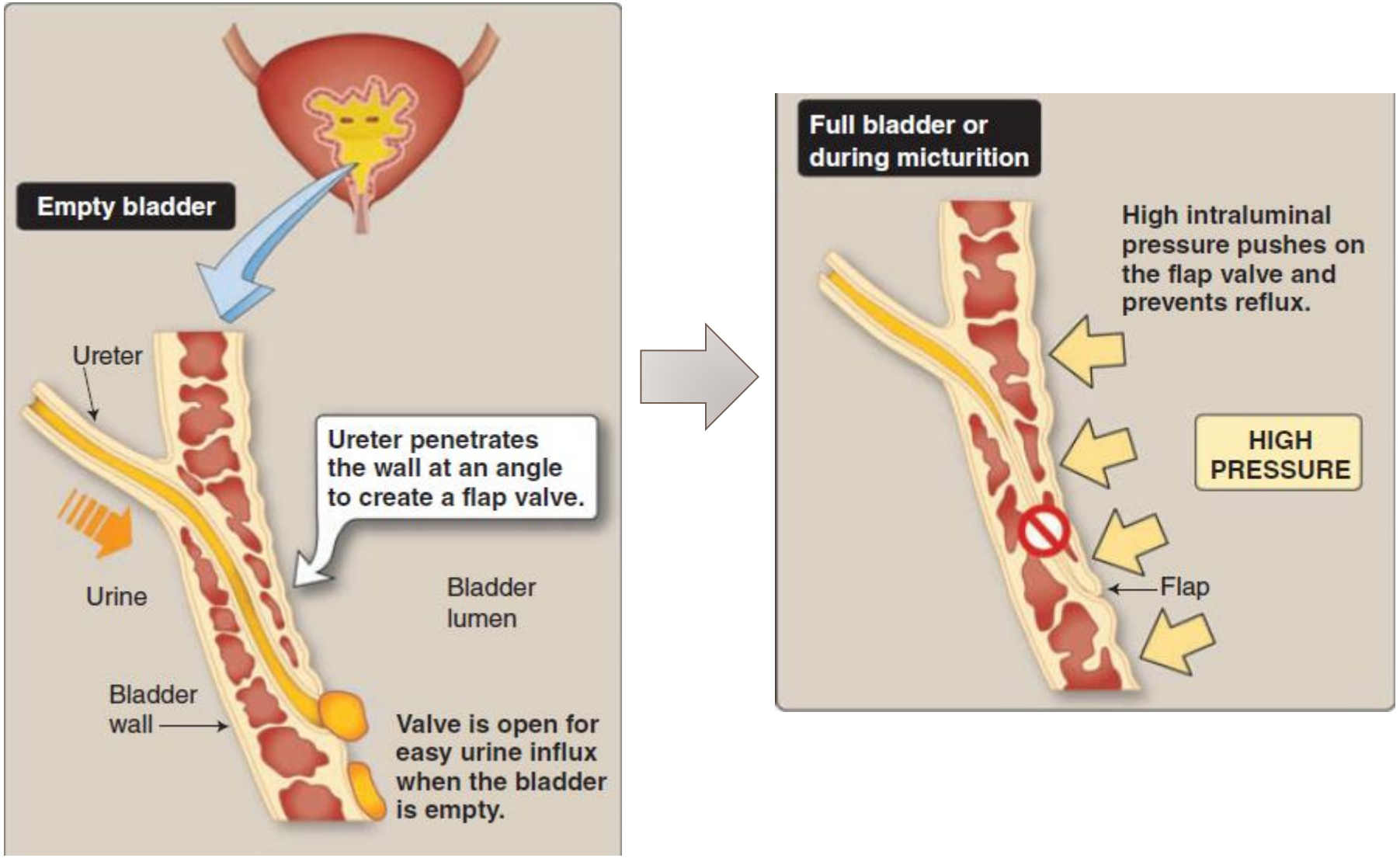
Functional Anatomy of the Bladder



Bladder wall has 4 layers;

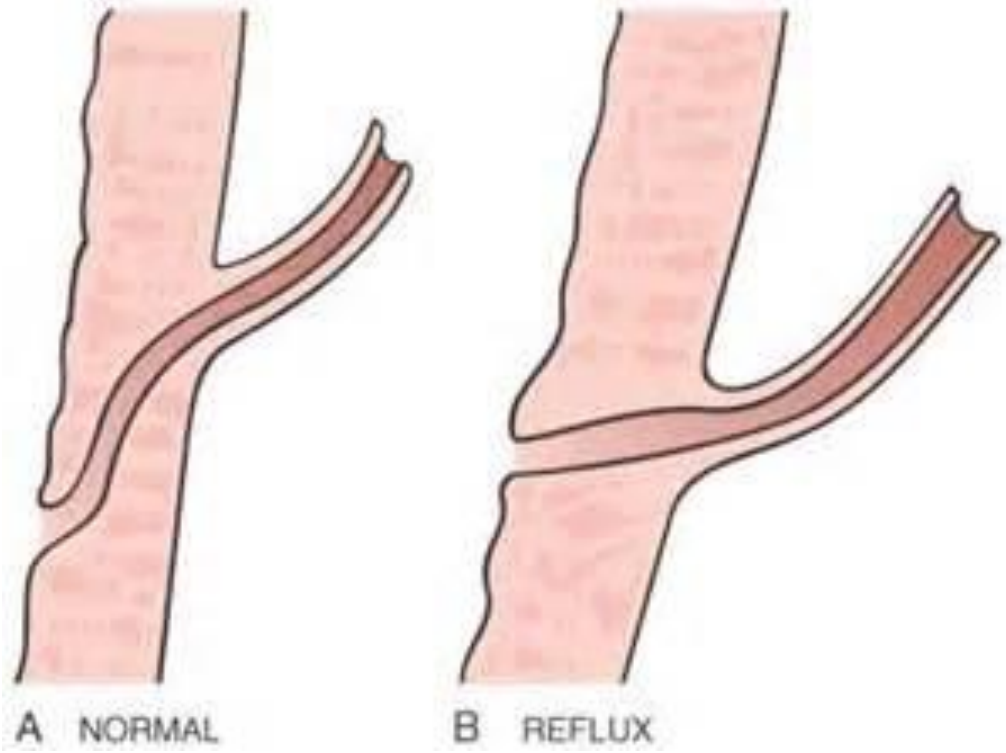
1. Mucosa → transitional epithelium → has folds “rugae”.
2. Submucosa → loose connective tissue.
3. Smooth muscle layer → Detrusor muscle → the main muscle of micturition.
4. Serosa

Ureterovesical Junction



(Preston R., Wilson T. Lippincott's illustrated reviews Physiology. 2013)

Ureterovesical Junction

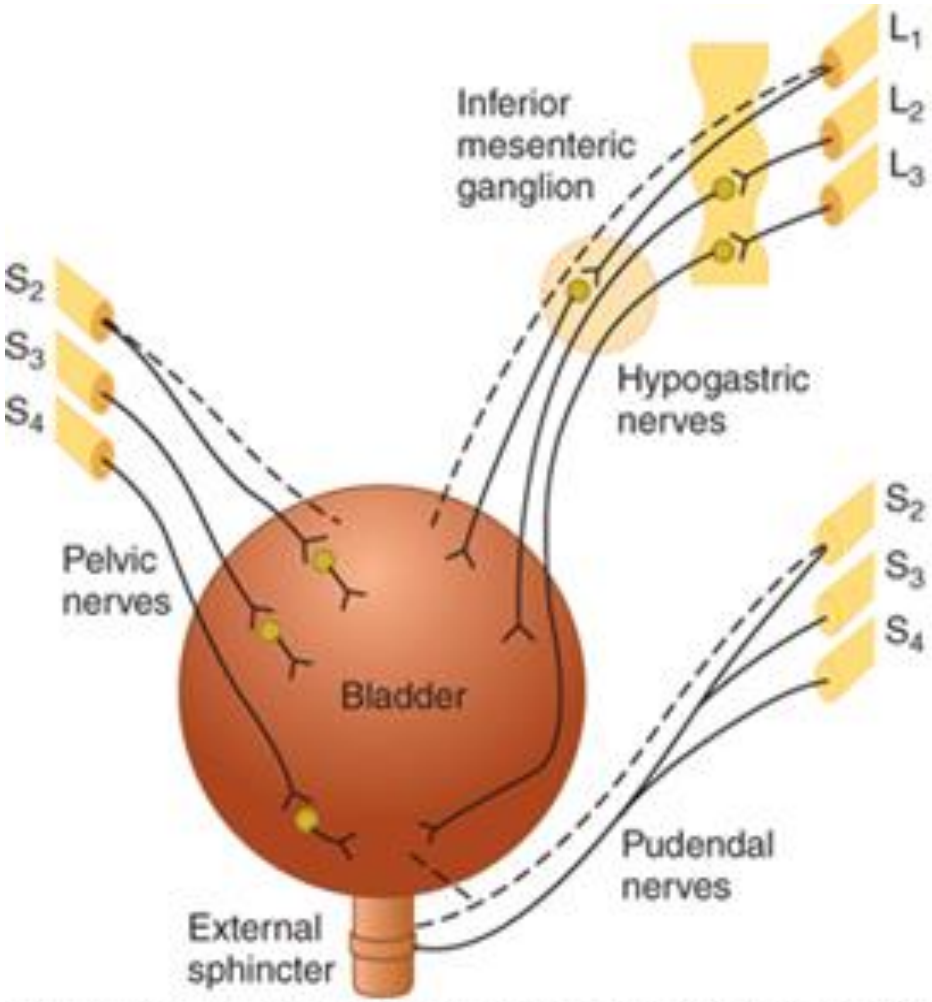


What happens if the distance that the ureter courses through the bladder wall is short?

Urine Transport from Kidney to Bladder

- Urine is transported through the ureters.
- Urine is propelled through the ureter and into the bladder by the help of peristalsis.
- Peristalsis is thought to be initiated by pacemaker cells in the renal pelvis.
- ***Sympathetic*** stimulation → ***inhibits*** peristalsis.
- ***Parasympathetic*** stimulation → ***enhance*** peristalsis.

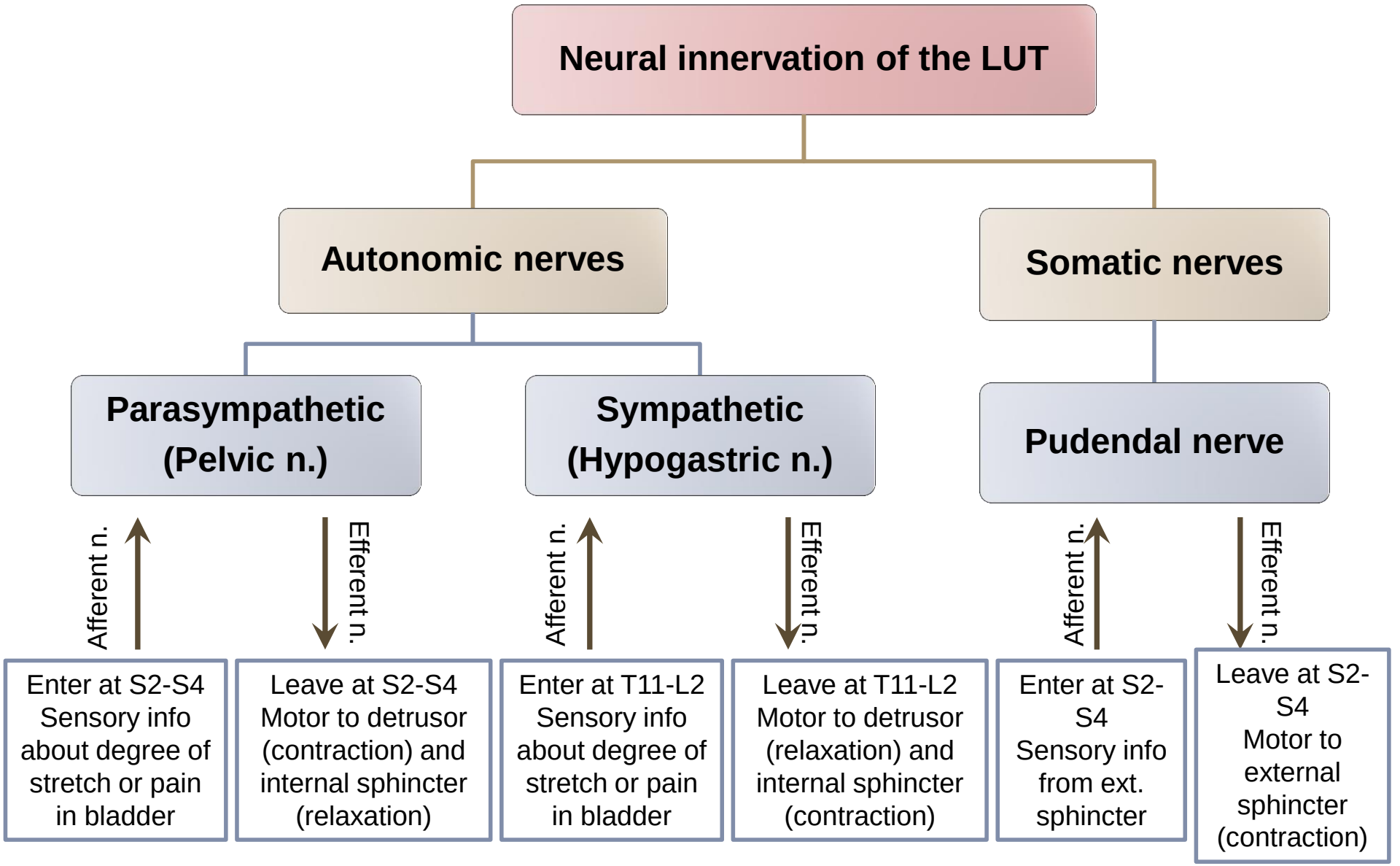
Neural Innervation of the bladder

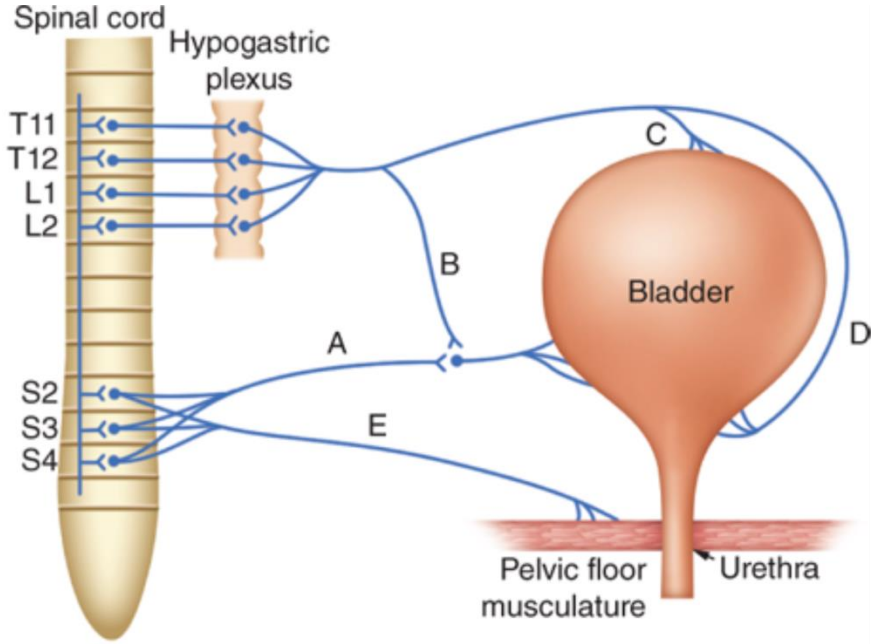


Nerve supply of the LUT:

- ***Somatic*** (S2-S4).
- ***Autonomic***
  - Parasympathetic (S2-S4).
  - Sympathetic (T11-L2).

Neural Innervation of the bladder





	TYPE OF NERVE	FUNCTION
A	Parasympathetic Cholinergic (nervi erigentes)	Bladder contraction
B	SYMPATHETIC	Bladder relaxation (by inhibition of parasympathetic tone)
C	SYMPATHETIC	Bladder relaxation (β adrenergic)
D	SYMPATHETIC	Bladder neck and urethral contraction (α adrenergic)
E	SOMATIC (pudendal nerve)	Contraction of pelvic floor musculature

Source: R.L. Kane, J.G. Ouslander, B. Resnick, M.L. Malone: Essentials of Clinical Geriatrics, Eighth Edition

Peripheral nerves involved in micturition.

The Micturition Reflex

- Emptying of the bladder when it becomes filled.
- It is a nervous reflex that can be facilitated or inhibited by higher centres.
- Occurs in two steps:
  1. Progressive filling of the bladder until a threshold is reached.
  2. At the threshold, a nervous reflex is initiated “micturition reflex” to empty the bladder.
- If the conditions for emptying are favourable → emptying will occur.
- If the conditions for emptying are unfavourable → reflex is inhibited, however, there is the conscious desire to urinate.

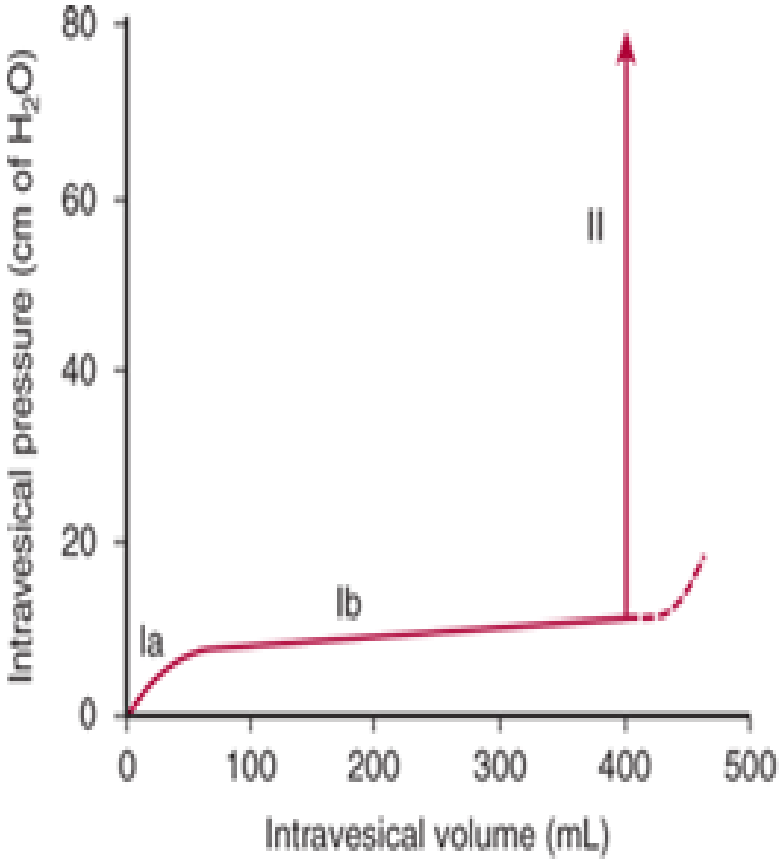
Filling of the Bladder-Bladder Tone

- ***Bladder tone*** = the relationship between bladder volume and pressure (intravesical pr.).

- The relationship between bladder volume and intravesical pressure can be studied using cystometry.

- The volume-pressure record is called a ***cystometrogram***.

The Cystometrogram



Three phases:

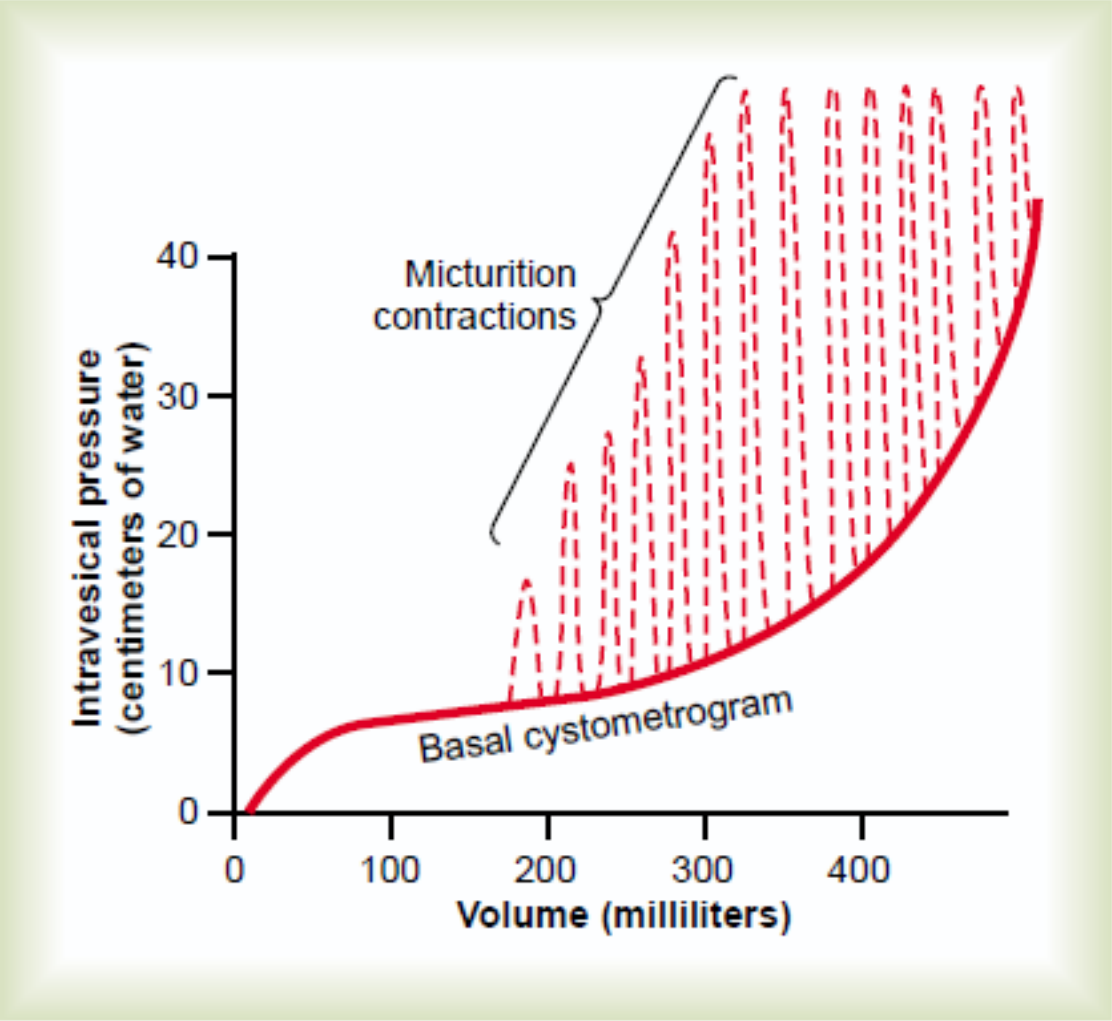
Ia = an increase in IVP (0 to ≈10 cm H_2O) at an initial increase in volume from 0 to ≈50ml).

Ib = filling of bladder from 50 to ≈400ml of urine causes no significant increase in IVP. ***Why??***

II = volumes > 400ml will cause a steep increase in IVP triggering the micturition reflex.

Source: Kim E. Barrett, Susan M. Barman, Scott Boitano, Heddwen L. Brooks: Ganong's Review of Medical Physiology, 25th Ed.
www.accessmedicine.com

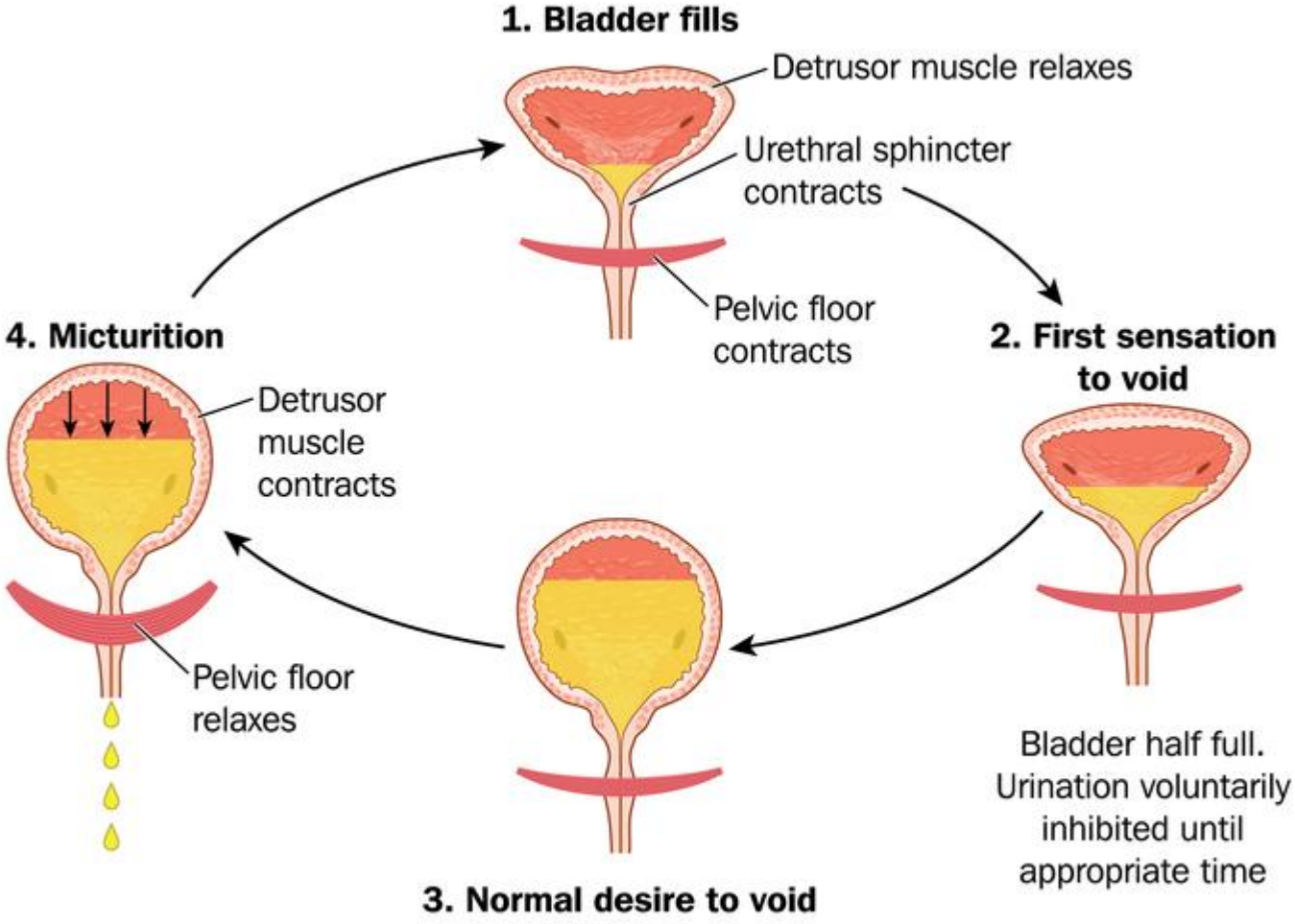
The Cystometrogram



- Superimposed on the basal cytometrogram are periodic sharp increases in IVP that may last a few seconds to more than a minute.
- These peaks are called “micturition waves”.. ***What are they caused by?***

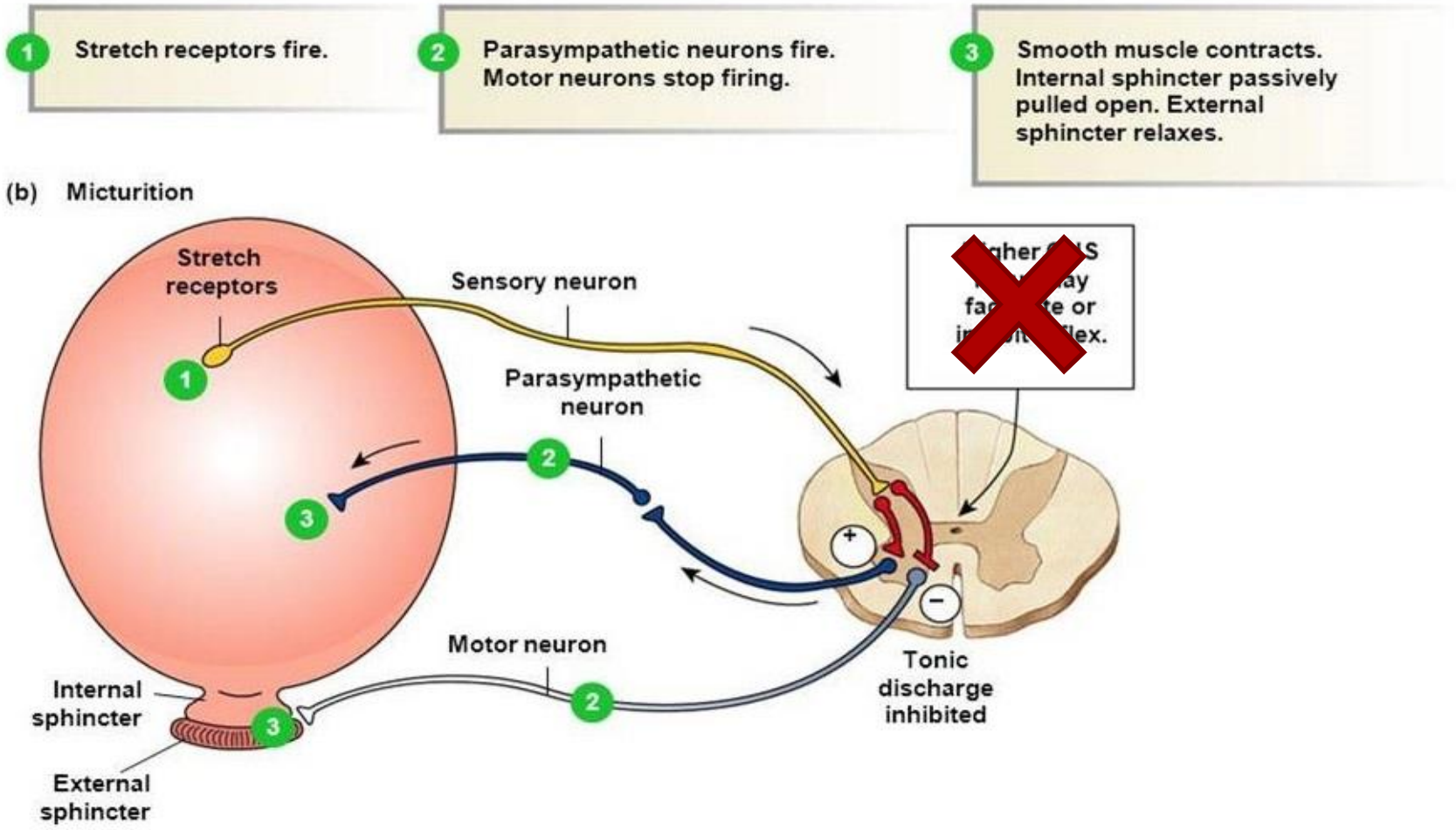
Bladder Sensations at Different Urine Volumes

- Urine volume of ≈ **150 –300 ml** ⇒ first urge to void.
- From ≈ **300 –400 ml** ⇒ sense of bladder fullness.
- From ≈ **400 –600 ml** ⇒ sense of discomfort.
- From ≈ **600 –700 ml** ⇒ sense of pain.
- **Micturition reflexes** start to appear at the first stage and progressively increase in intensity as the volume increases. Micturition reflexes can be voluntarily suppressed.
- At ≈ **700 ml** ⇒ break point ⇒ micturition can not be suppressed.


1. Bladder fills
Detrusor muscle relaxes
Urethral sphincter contracts
Pelvic floor contracts
2. First sensation to void
Bladder half full. Urination voluntarily inhibited until appropriate time
3. Normal desire to void
4. Micturition
Detrusor muscle contracts
Pelvic floor relaxes

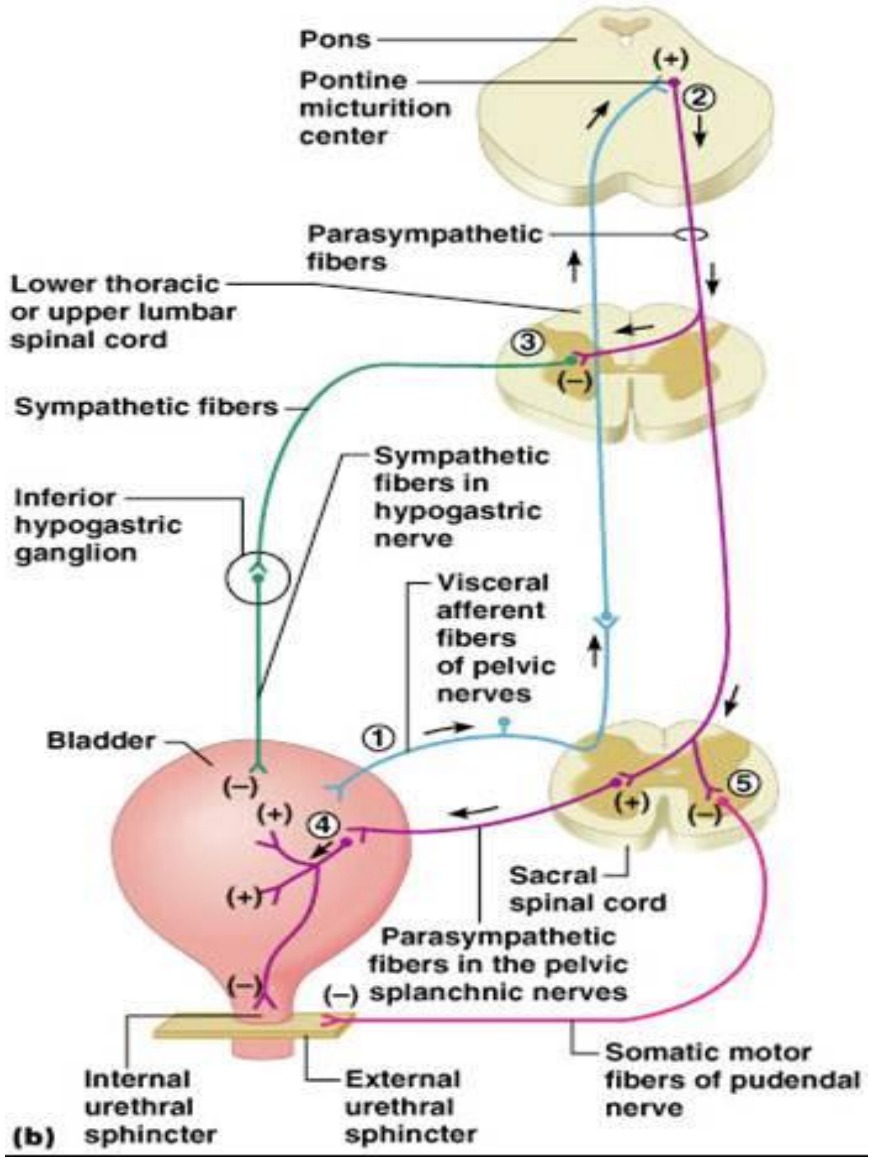
The Micturition Reflex-infants

- An autonomic spinal reflex.
- Involuntary-Not yet under higher CNS control.
- Between 2-3 years of age-they learn to control it and becomes voluntary.

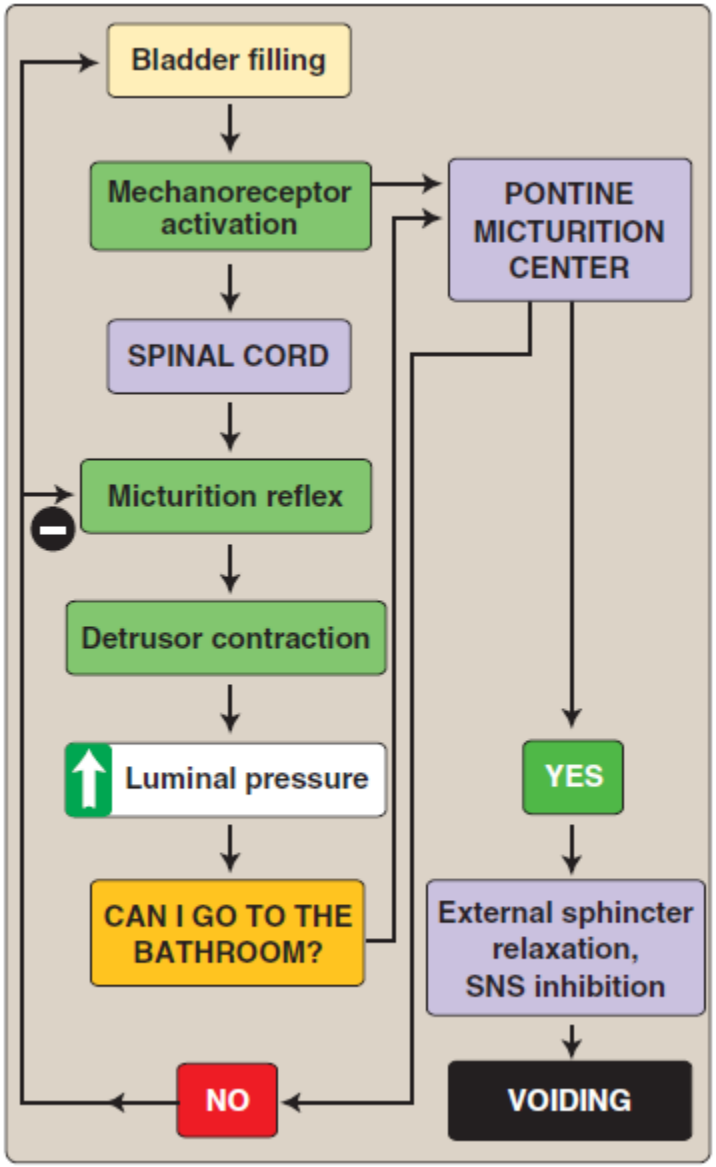


The Micturition Reflex-Adults

- An autonomic spinal reflex.
- Is controlled by higher CNS centres;
  - Brain stem (Pons).
  - Cerebral cortex.
- Control is either inhibitory or facilitatory.
- Voluntary.



The Micturition Reflex



Abnormalities in Micturition

1. **Lesions affecting the afferent sensory nerves:**

- Results in an ***atonic (flaccid)*** bladder.

- Injury of afferent nerves → loss of perception of bladder fullness + micturition reflex cannot be initiated → bladder overstretching → thinning of the wall and ineffective contractions.

- Retention of urine with overflow.

- Causes e.g. tabes dorsalis (syphilis),

Abnormalities in Micturition

2. Damage to spinal cord above the sacral region:

- The micturition reflex is intact, but lost higher center control.
- There are several phases:

Acute phase (Spinal shock) → **Recovery from spinal shock**

Loss of facilitatory impulses from CNS
↓
Micturition reflex is inhibited
↓
Bladder fills but cannot void (overflow incontinence)

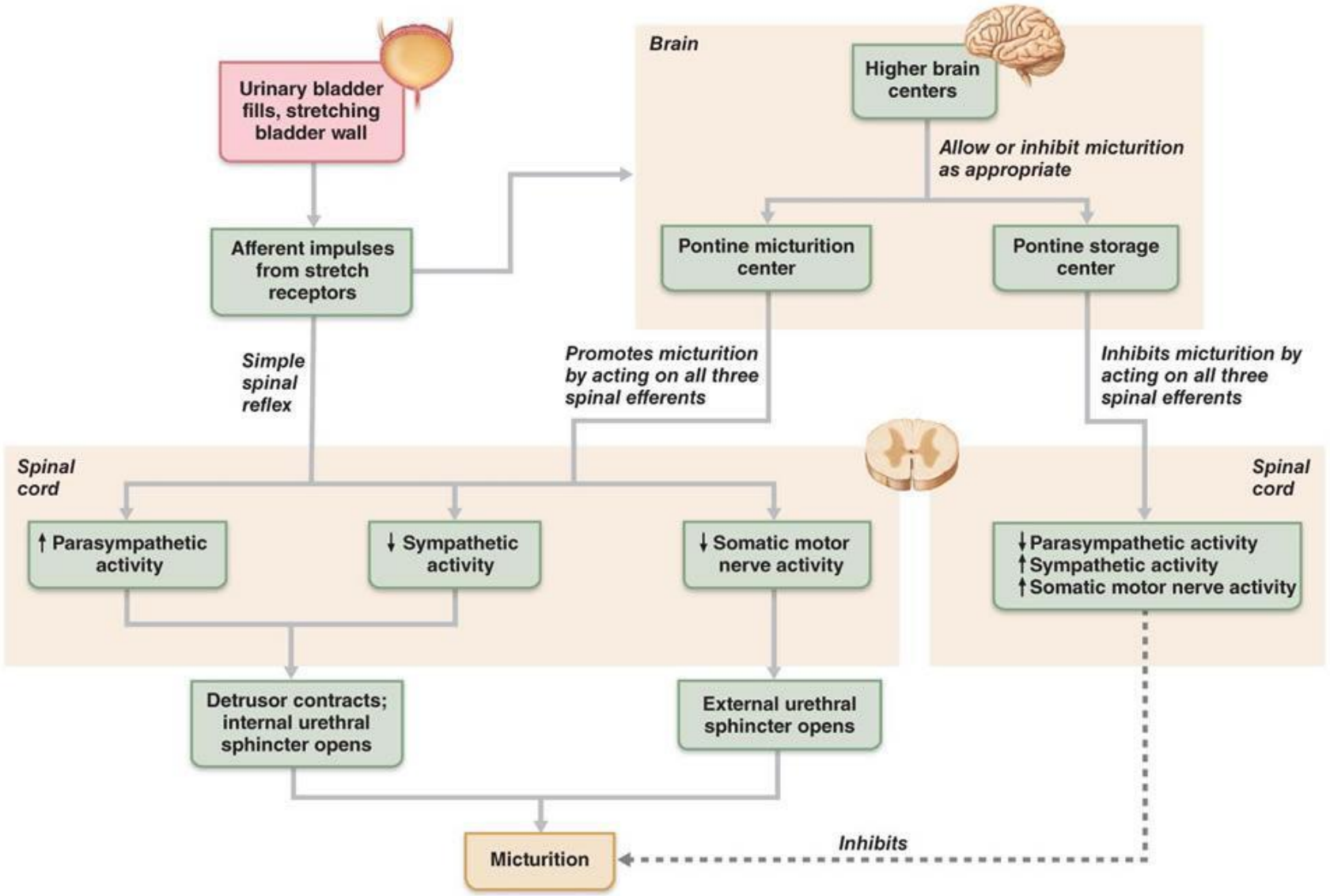
Micturition reflex recovers
↓
Not controlled by CNS
↓
Bladder fills and voids automatically (***Automatic bladder***)

Abnormalities in Micturition

3. Uninhibited neurogenic bladder:

- Causes frequent relatively uncontrolled micturition.
- Results from lesions to spinal cord or brain stem that mainly affects the inhibitory signals to spinal cord.
- This will cause a hyperactive detrusor muscle that will result in activation of micturition even at small urine volumes.
- Frequent urination of small volume of urine.

Summary



Thank you