

PHYSIOLOGY OF MICTURITION

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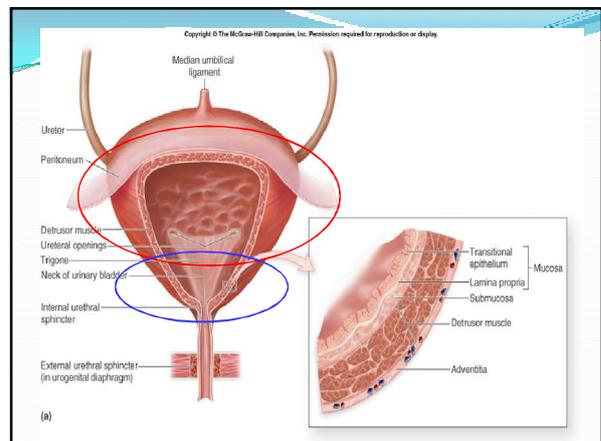
Micturition

process by which bladder empties.

1. bladder fills progressively
2. tension in its walls rises above a threshold level.
3. *micturition reflex* - empties the bladder .
if *fails*, causes conscious desire to urinate.

Physiologic Anatomy of Bladder

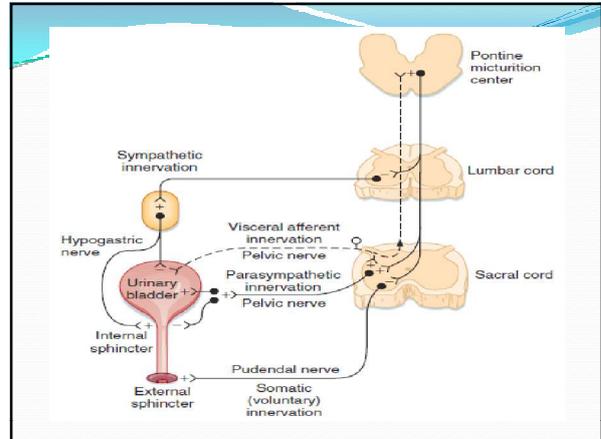
- two main parts
 - (1) *body*- urine collects
 - (2) *neck*- funnel-shaped
-posterior urethra



EFFERENT INNERVATION

Motor:-

1. Parasympathetic (S₂ to S₄)
 - Excitatory to detrusor muscle
 - inhibitory to internal urethral sphincter
2. Sympathetic (T₁₁ to L₂)
 - Excitatory to sphincter
 - inhibitory to detrusor muscle
3. Somatic nerve (S₂, S₃, S₄)
 - Pudendal nerves
 - Excitatory to External urethral sphincter

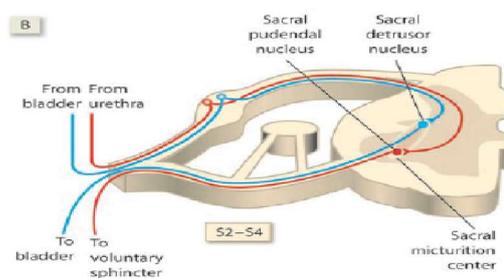


Sensory innervation

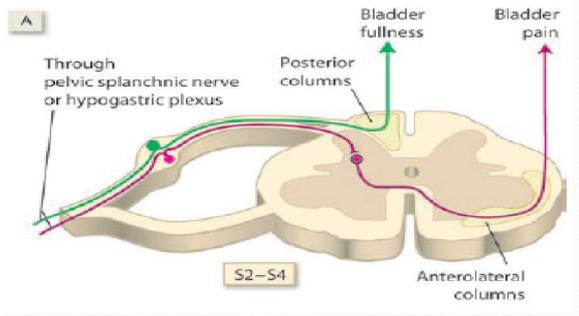
sensory:-

- Pelvic nerve
- Hypogastric nerve
- Pudendal nerve

The reflex arc for the micturition reflex.



Afferent pathway for conscious bladder sensations.



PHYSIOLOGY OF MICTURITION

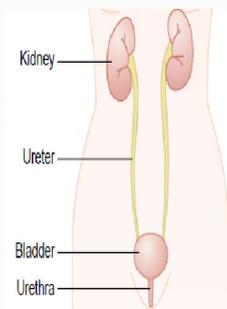
- Filling of urinary bladder and
- Emptying of urinary bladder.

FILLING OF URINARY BLADDER

- same composition
- stretches the calyces
- increases inherent pacemaker activity
- peristaltic contractions at 2 to 6 per minute
- intra ureteral hydrostatic pressure
- 0 to 5 cm H₂O at baseline ,
- 20 to 80 cm H₂O during peristalsis.

*peristaltic contractions-
parasympathetic stimulation-
enhanced*

by sympathetic stimulation- inhibited



EMPTYING OF THE BLADDER

- Micturition reflex,
- Voluntary control of micturition and
- Role of perineal and abdominal muscles in micturition.

Micturition Centers

1. sacral micturition center (S2-S4)

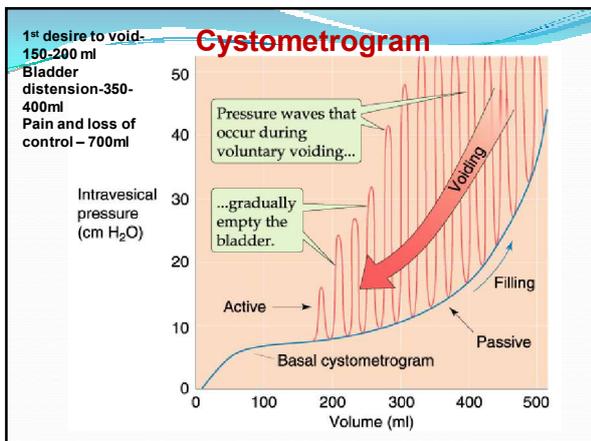
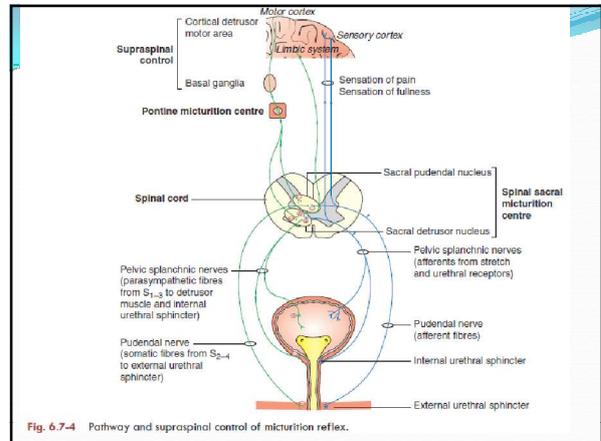
- Sacral detrusor nucleus
- sacral pudendal nucleus

2. Pons

- Pontine micturition center
- Pontine storage center

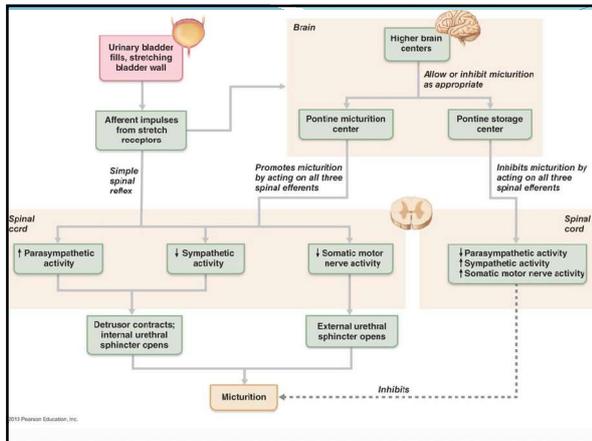
3. cerebral cortex

4. hypothalamus



Cystometrogram

Ia	Ib	II
Initial slight rise	Long flat segment	Sharp rapid rise
Produced by the 1 st increment of volume by about 50 ml.	Produced by further increase in volume up to 300-400 ml. $P=2T/R$	Produced by further increase in volume above 400 ml.



BLADDER INCONTINENCE

URGE INCONTINENCE	STRESS INCONTINENCE	OVERFLOW INCONTINENCE
<ul style="list-style-type: none"> • Increase urge • Hyperactivity of μ_3 receptors • Hypoactivity of β_2 receptors • DOC μ_3 blocker Oxybutynin 	<ul style="list-style-type: none"> • More in females • Mostly after parturition • Cause is sphincter damage • DOC α agonist Pseudoephedrine 	<ul style="list-style-type: none"> • μ_3 receptors hypoactive. • Automatic bladder • DOC μ_3 agonist Bethnechol

SUMMARY		
incontinence	detrusor	features
Detrusorinstability	Unstable detrusor	Frequent episodes Nocturnal wetting Small post voidal residual Intact reflexes Normal sensation
Stress incontinence	Inadequate sphincter	Upon straining Small to moderate volumes Rarely at night Small post voidal
Reflex incontinence	Autonomous bladder	No warning or ppt During day and night Moderate volume Reflexes intact Loss of control and sensation
Overflow incontinence		Distended bladder Loss of reflexes Post voidal residual
Functional incontinence	Inability to reach toilet due to illness	

Denervation/Hyperactive bladder

▪Cause:

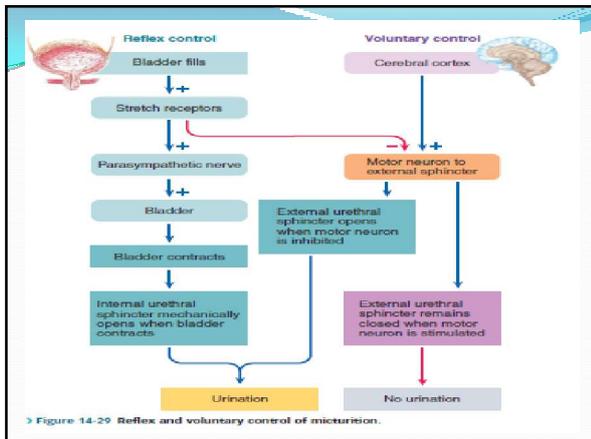
- Tumors of cauda equina / filum terminale
- Bladder flacid & distended
- Gradually, muscle of the 'decentralised bladder' becomes active and shows many contraction waves
- Dribbling of urine out of urethra
- Bladder becomes shrunken & bladder wall hypertrophied, denervation hypersensitivity increase tone, hypertrophy

Automatic bladder

Cause:

spinal cord damage above sacral region

- Higher center control is loss (voluntary control loss)
- Sacral micturition reflex centers are intact
- Suppression of micturition reflex during spinal shock due to loss of facilitatory impulses from brain
- reflex returns after spinal shock
- Bladder becomes overfilled, can't urinate voluntarily
- urine dribbles through sphincters
- overflow incontinence

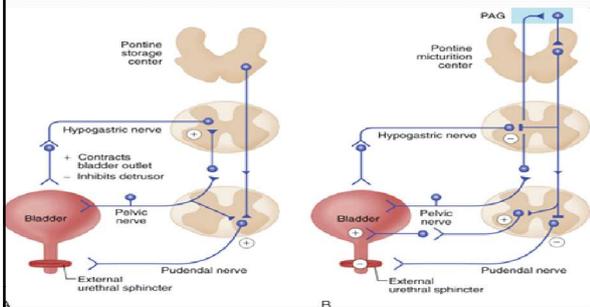


- micturition contractions'
- self-regenerative'

Micturition Reflex

A single complete cycle of:

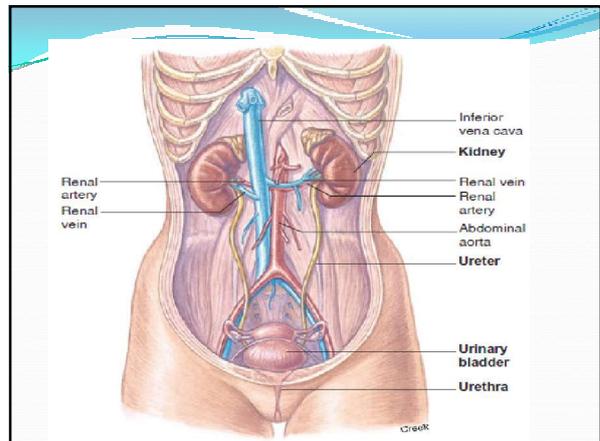
- Progressive & rapid increase of pressure
- A period of sustained pressure
- Return of the pressure to the basal tone of the bladder



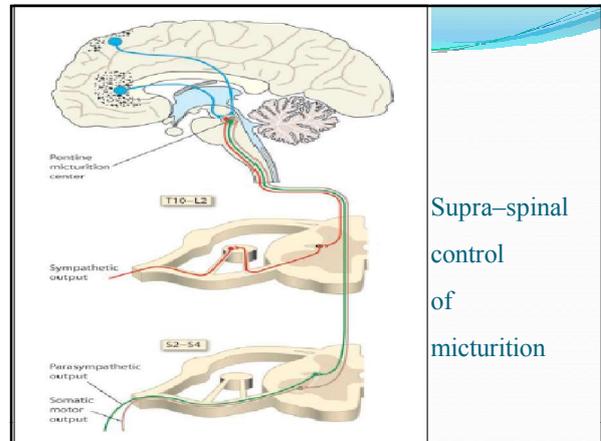
Filling of the Bladder

- **Physiological capacity-**
 - At birth - 20-50 mL
 - 1 year - 200 mL
 - young adult males - 600 ml
- physiological capacity is about twice that at which the first desire to void is felt.

1. Sensation of bladder distension and bladder pain. stretch receptors in bladder wall and posterior urethra distension or spasm of the bladder wall (pain)
 - Pelvic nerve and hypogastric plexus
 - Reach T₁₁ to L₂
 - Run in posterior column (distension) lateral spinothalamic tract (pain)
2. Urethral sensations
 - maximal bladder filling, reach the spinal cord via the pudendal nerve.
 - **In the spinal cord, fibres carrying urethral sensations**
 - travel in the dorsal column.



- Origin of fibres in spinal cord to urinary bladder
- **Parasympathetic: intermediolateral grey horn**
- **Sympathetic: intermediolateral grey horn**
- **Somatic/Pudendal: nucleus of ONUF /sacral pudendal nucleus in ventral horn**



internal sphincter-

Involuntary

Smooth muscle.

- keeps bladder neck and posterior urethra empty of urine.
- prevents emptying of bladder until the pressure in the body of bladder rises above a Critical threshold level.

external sphincter

voluntary

Skeletal muscle