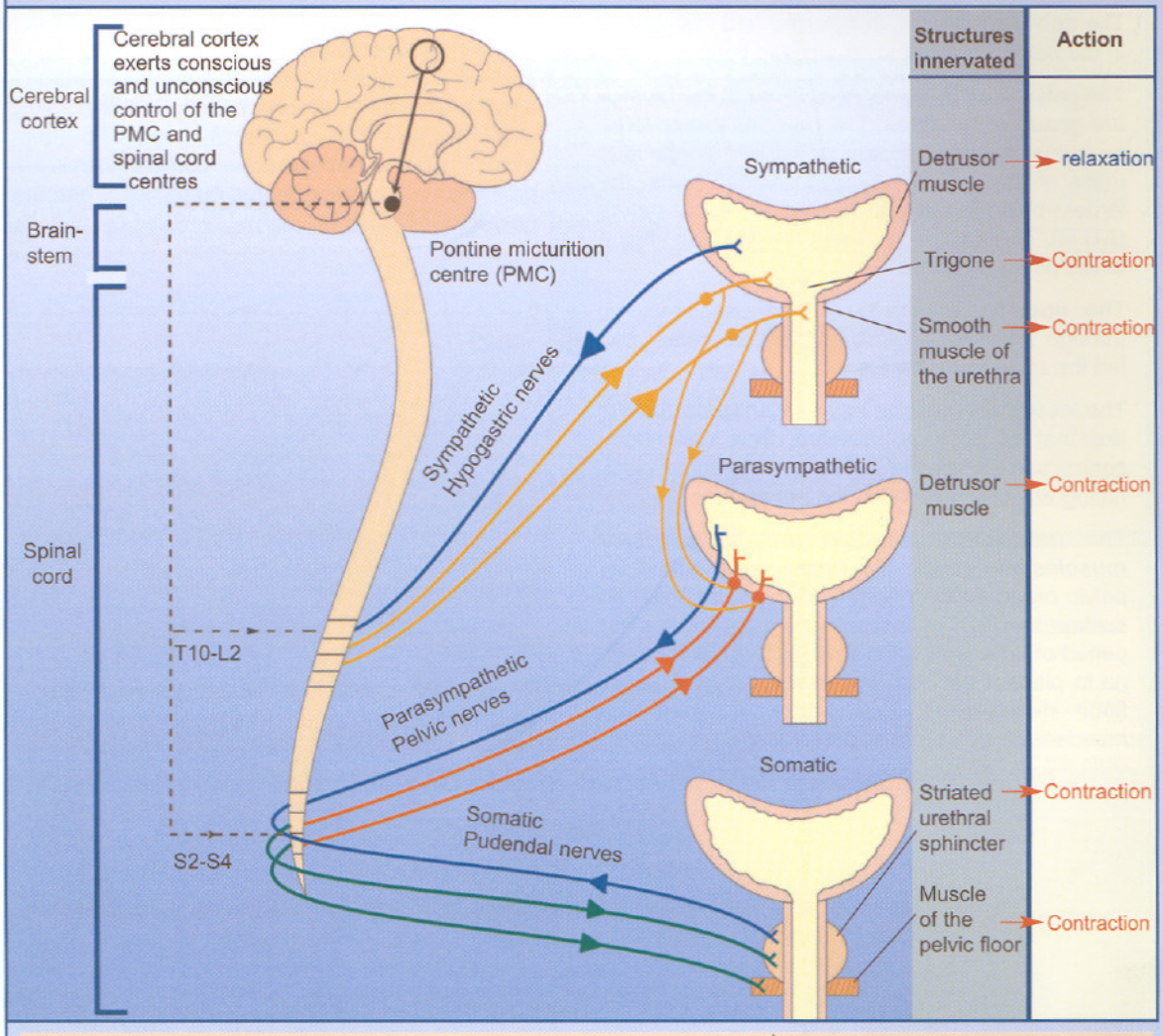
Innervation of the LUT

I Peripheral and spinal innervation of the LUT



The peripheral and spinal innervation of the LUT involves ***sympathetic, parasympathetic,*** and ***somatic*** afferent and efferent nerves and their ***spinal centres*** as illustrated.

The ***sympathetic*** nerves originate in the ***thoraco-lumbar*** spinal cord and travel through the ***hypogastric*** nerves. ***Action***: contraction of the smooth muscle of the urethra and bladder base and inhibition of detrusor contraction through an action on parasympathetic ganglia.

The ***parasympathetic*** (pelvic) nerves emanate from the ***sacral spinal cord*** (S2-S4). This segment plays an important role in the coordination of micturition and is referred to as the "***spinal micturition centre***". These fibres travel in the pelvic nerves. ***Action***: contraction of the detrusor.

The ***somatic motor innervation*** to the striated urethral sphincter originates in a circumscribed region of the sacral spinal cord, ***Onuf's nucleus*** and travels in the ***pudendal nerve***. Direct sacral fibres innervate the levator ani. ***Action***: contraction of urethral external sphincter.

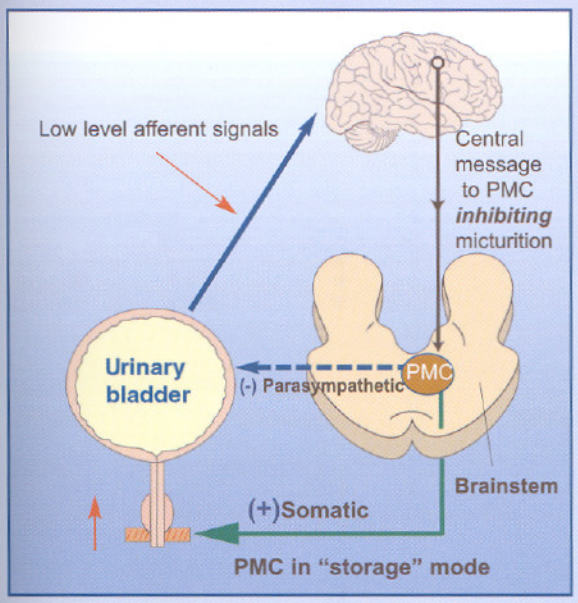
Afferent sensory nerve fibres (blue) coursing along the ***same nerves*** send sensory signals from the bladder wall and the urethra to the ***spinal cord.*** These nerves ***connect*** with structures in the ***brainstem*** and the ***brain.*** The sensory fibres detect the ***degree of stretch*** in the bladder wall and also carry the sensations of ***temperature*** and ***pain stimuli.***

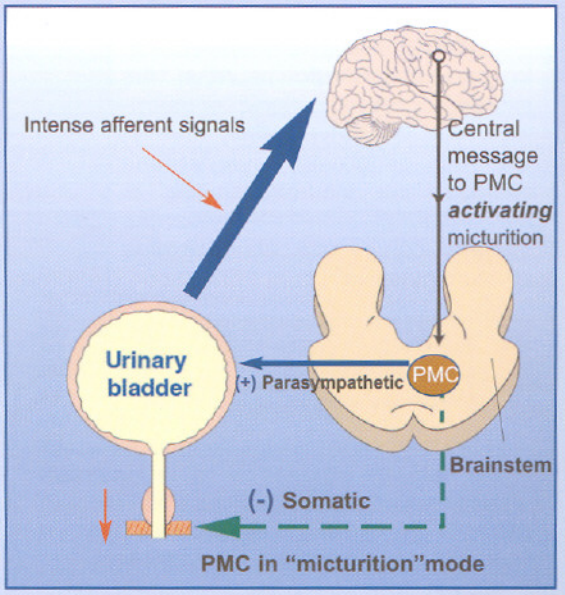
Innervation of the LUT

II High Central Innervation

1 Pontine Micturition Centre (PMC)

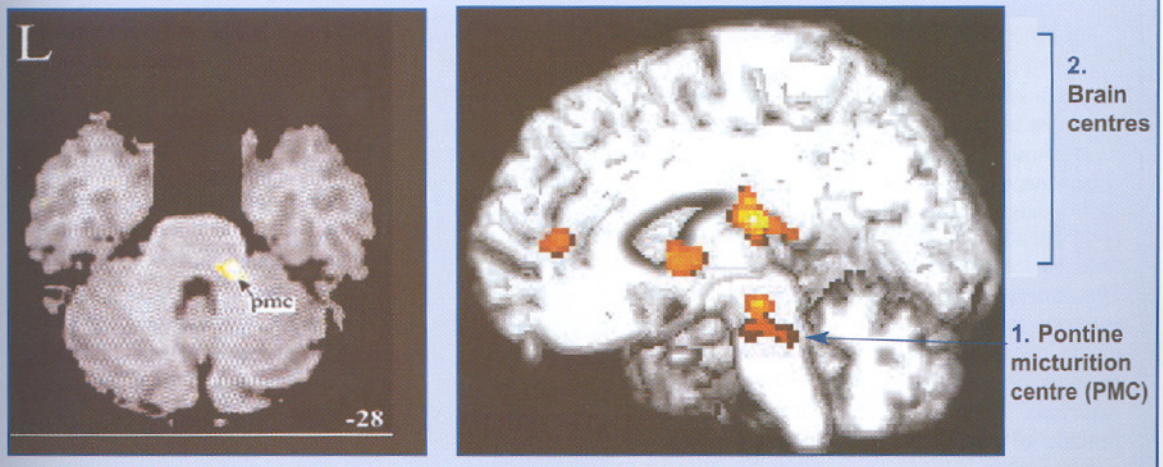
The Pontine Micturition Centre (PMC), located in the **brainstem**, coordinates the micturition process. PMC is under the control of the brain centres which, depending on the ***intensity*** of afferent signals, may switch the PMC to the ***"storage" mode*** or the ***"micturition" mode.*** In the ***first case,*** the PMC induces inhibition of the parasympathetic innervation and activation of the somatic nerves ; in the ***second case,*** the PMC induces activation of the parasympathetic innervation with contraction of the detrusor and inhibition of the somatic nerves, leading to relaxation of the urethral striated sphincter.





2 Brain centres (cortex, limbic system, hypothalamus, thalamus)

They exert conscious and unconscious ***control*** of ***PMC*** and ***spinal centres.*** These centres can be shown on a PET scan of the brain. ***Higher brain centres*** are critical to ***delay voiding*** until it is socially convenient. This process is achieved by ***inhibitory influences*** over the ***PMC*** arising from the prefrontal cortex and the hypothalamus.



Pontine micturition centre (PMC) and brain centers (PET Scan)