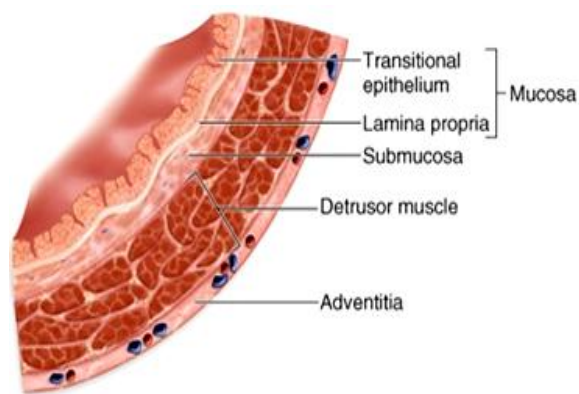




**Anatomy of the lower urinary tract:**

- Urine which is formed by filtration in renal tubules will be passed through the ureters to reach the urinary bladder where it will be stored until the bladder becomes distended. This is going to stretch the detrusor muscle of the bladder and send signals through pelvic nerve initiating the process of micturition.
- The image shows the composition of the wall of urinary bladder.



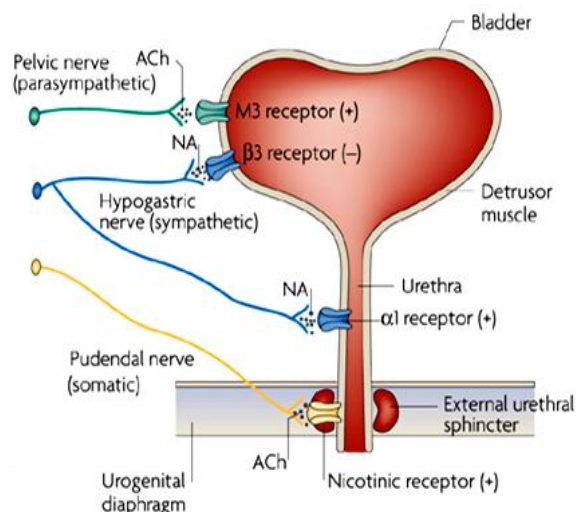
**The ureters (الحالبين):**

- Pacemakers which are present in the walls of calyces produce peristaltic waves (1-5/minute) which move urine from calyces to urinary bladder.
- Ureters enter urinary bladder in an oblique fashion and this creates a physiological valve which prevents the reflux of urine back to kidneys (no hydronephrosis).

**Innervation of urinary bladder:**

- **Detrusor muscle or urinary bladder has two receptors:**

- ✓ M3-receptor which is innervated by the pelvic nerve (parasympathetic S2-S4): if it is stimulated, this will result in contraction of the muscle to initiate the process or micturition.
- ✓ β3-receptor which is innervated by the hypogastric nerve (sympathetic T11-L2): if it is stimulated, this will oppose the effect of pelvic nerve and cause relaxation of bladder wall.



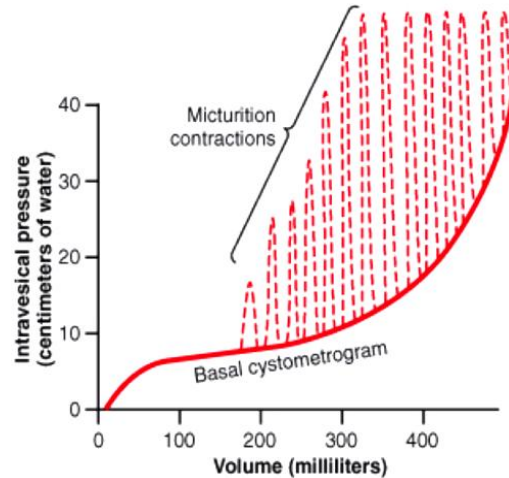
- Internal urethral sphincter has α1-receptor which is innervated by the hypogastric nerve (sympathetic): if it is stimulated, this will result in contraction of the sphincter preventing urination.
- External urethral sphincter has a nicotinic receptor which is innervated by the pudendal nerve (S2-S4): if it is stimulated, this will result in relaxation of the sphincter permitting voiding.

**What are the functions of urinary bladder?**

- Storing 400-500 ml of urine.
  - Ability to accommodate various volumes without a change in intraluminal pressure.
  - Ability to initiate and sustain a contraction until the bladder is empty.
  - Voluntary initiation or inhibition of voiding.
- When bladder is full, this will be sensed via stretch receptors which are present in the wall of the bladder. **These receptors will send afferent signals through the pelvic nerve which contains two types of nerve fibers:**
- Myelinated A-δ fibers with activation threshold of 5-15 mmHg.
  - Unmyelinated C fibers which have high mechanical threshold and transmit information of discomfort and pain.

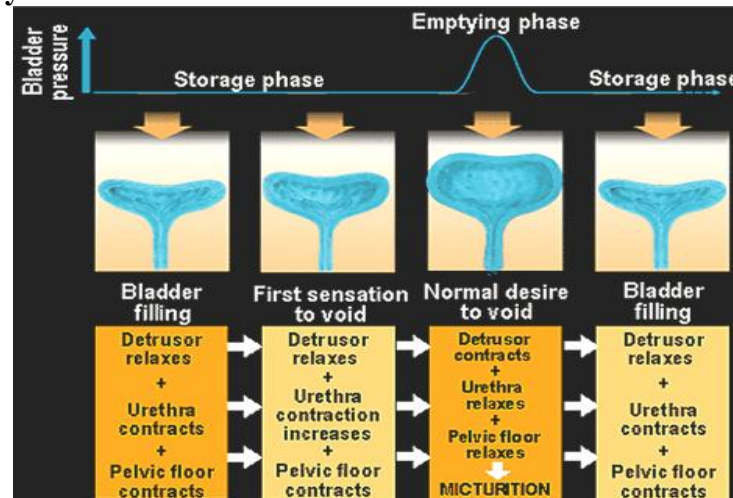


- **When urinary bladder is partially filled**, detrusor muscle will contract generating acute increase in pressure. Then, contractions will relax spontaneously and pressure will fall back to baseline. As the bladder continues to fill, contractions will be more frequent and powerful.



- **The micturition reflex:**

- Increased volume of urine in urinary bladder causes stretching.
- Stretching will generate signals in endings of afferent neurons that are present in the bladder wall.
- This will activate the spinal micturition center.
- Detrusor muscle will contract, bladder neck will open and external sphincter will relax.
- **Micturition cycle:**



- **Abnormalities of micturition:**

- **Sacral dorsal roots (sensory fibers) are:**
  - ✓ Interrupted by a disease known as tabes dorsalis → all reflex contractions of the bladder will be abolished → bladder becomes distended, thin-walled, hypotonic and flaccid. In this condition, bladder fills to the capacity and overflows few drops at a time through the urethra (overflow dribbling).
- **Spinal cord transaction (automatic bladder):**
  - ✓ The spinal cord damage is above the sacral regions.
  - ✓ **Spinal shock:**
    - ❖ Flaccid unresponsive bladder.
    - ❖ Bladder becomes overfilled and exhibit sporadic voiding (overflow incontinence).
    - ❖ Catheterization required.



- ✓ Recovery:
  - ❖ Voiding reflex is re-established but with no voluntary control.
  - ❖ Bladder capacity often reduced.
  - ❖ Reflex hyperactivity → spastic neurogenic bladder.
  - ❖ Whenever, the bladder is filled with some amount of urine, there is automatic evacuation of the bladder.
- **Uninhibited neurogenic bladder:**
  - ✓ Due to a lesion in some parts of brain stem (interrupting most of the inhibitory signals), there is continuous excitation of spinal micturition centers by the higher centers.
  - ✓ There is uncontrollable micturition. Even a small quantity of urine collected in bladder will elicit the micturition reflex increasing the frequency of micturition.