RENAL PHYSIOLOGY

MICTURITION

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MICTURITION

It is the process by which the urinary bladder empties when it becomes filled

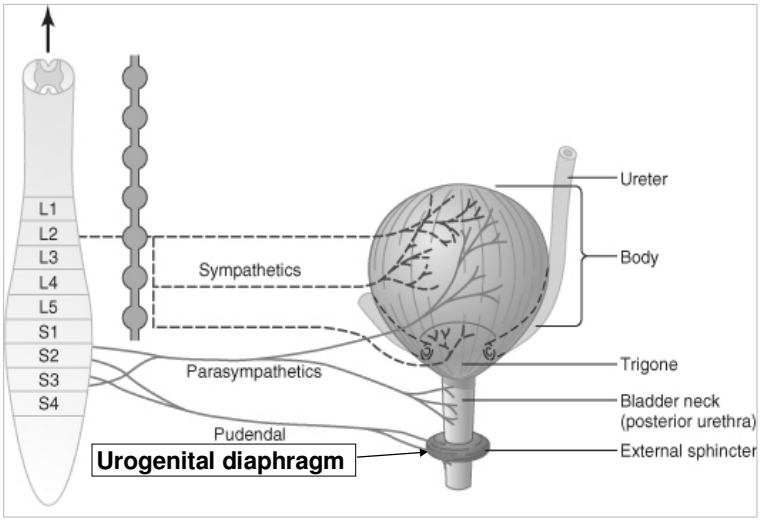
- **Filling of bladder.**
- **Micturition reflex.**
- **Voluntary control.**

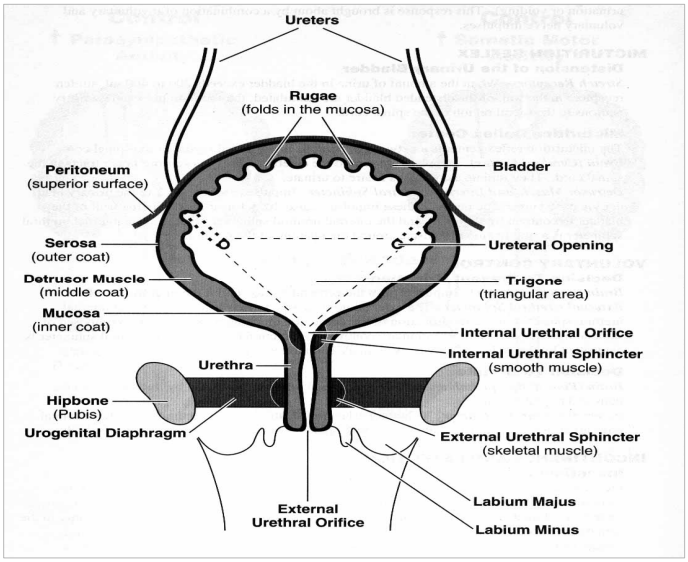
Physiologic Anatomy and Nervous Connections of the Bladder

- **Composed of**
  1. **Body**
  2. **Neck……..post urethra (stretch receptors)**
- **External sphincter.**
- **Pelvic diaphragm.**

A reservoir … adult … 250-400ml
DETRUSOR MUSCLE … pr can rise upto 40-60 mmHg.
Mucosa… RUGAE …TRIGONE

Nervous Connections of the Bladder





Nerve Supply

- **PELVIC NERVES** from sacral plexus mainly S2 and S3…both sensory and motor.The motor nerves transmitted in the pelvic nerves are **parasympathetic fibers**
- **PUDENDAL NERVE** contain skeletal motor fibers transmitted through the to the external bladder sphincter
- **SYMPATHETIC INNERVATION** from the sympathetic chain through the hypogastric nerves (L-2). Stimulate mainly the blood vessels and have little to do with bladder contraction. Some sensory nerve fibers for fullness and pain.

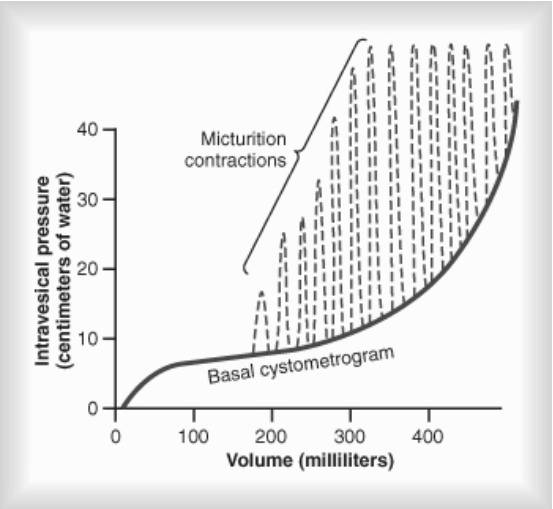
INNERVATION OF THE BLADDER

	Nerves	Characteristic	Function
1	Pelvic nerves (parasympathetic fibers) S-2 and S-3	Both sensory and motor nerve fibers	Contraction of bladder The sensory fibers detect the degree of stretch in the bladder wall
2	Pudendal Nerve	somatic nerve	Fibers that innervate and control the voluntary skeletal muscle of the sphincter
3	Hypogastric Nerves	sympathetic innervation (L2)	Stimulate mainly the blood vessels and have little to do with bladder contraction. Sensory nerve fibers of the sympathetic nerves also mediate the sensation of fullness and pain.

FILLING OF BLADDER AND ITS TONE...

- 0 … when empty.
- 30-50 ml … 5-10 cm of water.
- 200 – 300 ml … small additional rise of pr.
- Beyond 300 – 400 ml … pr rises rapidly.
- Micturition waves… acute pr peaks superimposed on the tonic pr changes can range from few to > 100 cm of water caused by micturition reflex.
- Cystometrogram.

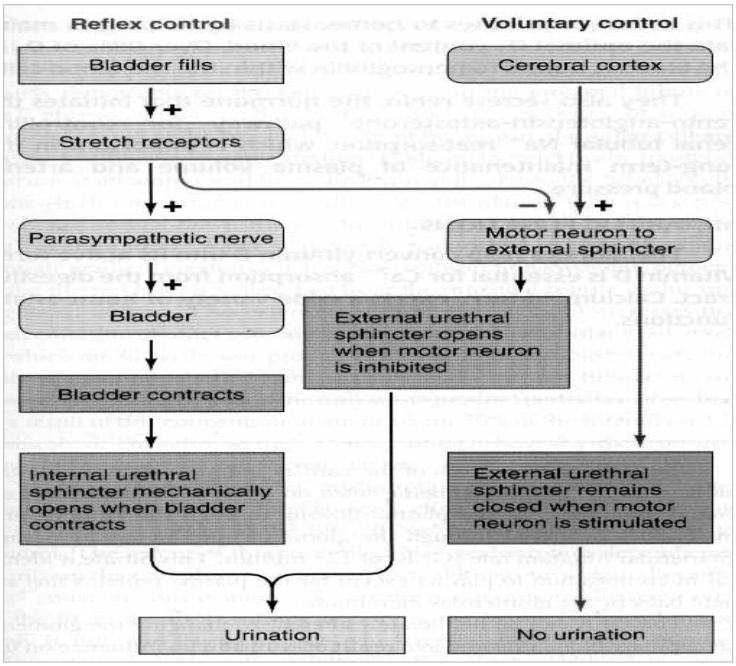
CYSTOMETROGRAM

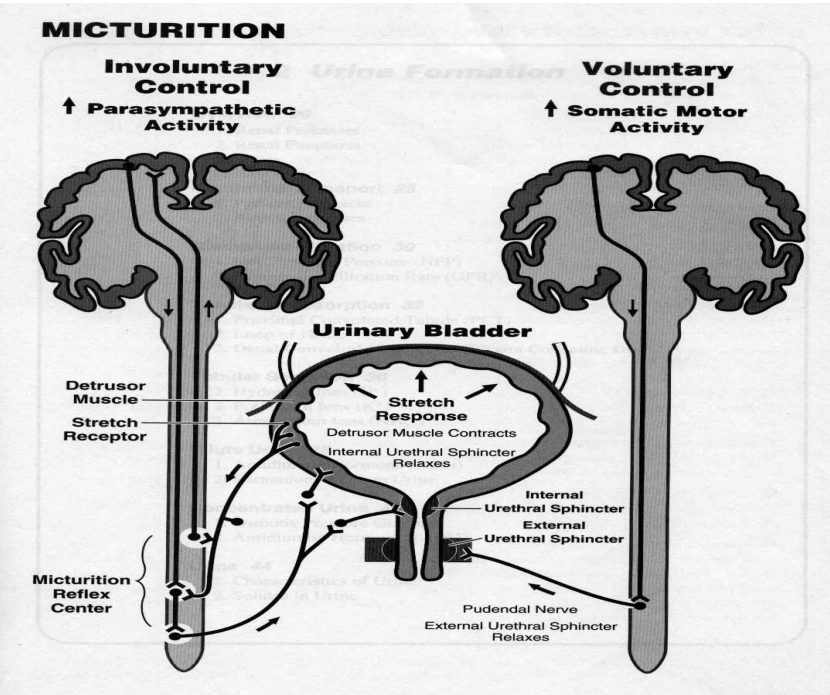


MICTURITION REFLEX

Micturition Reflex

- **Completely AUTONOMIC SPINAL REFLEX.**
- **When bladder only partially filled..relax spontaneously after a fraction of a min, Detrusor muscle contraction stops … pr falls to baseline.**
- **As bladder fills more… reflexes increase in frequency and intensity.**
- **Positive feedback mechanism.**





ABNORMALITIES OF MICTURITION

	ATONIC BLADDER	AUTOMATIC BLADDER
Lesion	Sensory nerve fibers from the bladder to the spinal cord are destroyed Crush injury to the sacral region of the spinal cord *and tabes dorsalis*	Spinal Cord Damage Above the Sacral Region resulting in Spinal shock
Feature	Bladder fills to capacity and overflows a few drops at a time through the urethra. This is called *overflow incontinence*.	return of excitability of micturition reflex until typical micturition reflexes returns & then, periodic (but unannounced) bladder emptying occurs which may be controlled by scratching or tickling

Uninhibited Neurogenic Bladder Caused by Lack of Inhibitory Signals from the Brain

INVESTIGATIONS

- EXAMINATION OF THE URINE
- CLEARANCE
- BLOOD AND QUANTITATIVE TESTS
- NUCLEAR SCANS
- IMAGING TECHNIQUES
- TRANSCUTANEOUS RENAL BIOPSY

Characteristics

Volume	1 – 2 liters (quarts) per day (influenced by many factors)
Color	Yellow or Amber (varies with concentration and diet)
Turbidity	Transparent when fresh (becomes cloudy)
Odor	Aromatic (becomes ammonia-like)
pH	Averages 6.0 (ranges between 4.6 and 8.0)
Specific Gravity	1.001 – 1.035 (denser than water)

Organic Solutes

Nitrogenous Wastes	Urea; Creatinine; Uric Acid
Hippuric Acid	Derived from Benzoic Acid
Indican	Derived from Indole
Ketone Bodies	Derived from Triglycerides

Inorganic Solutes

Cations	Sodium; Potassium; Ammonium; Magnesium; Calcium
Anions	Chloride; Sulfate; Phosphates

URINE COMPOSITION

pH	freshly voided urine is usually acidic (around pH 6), range=4.8 and 7.5
Colour	Bright Yellow & transparent
Specific Gravity	1.002 to 1.030
Volume	1-2 L per day
Albumin	20 μg of albumin per minute (30 mg in 24 hours)
Glucose	None

DISORDERS OF URINARY CONCENTRATING ABILITY

- **Failure to Produce ADH: "Central" Diabetes Insipidus.**
- **Inability of the Kidneys to Respond to ADH: "Nephrogenic" Diabetes Insipidus.**

DISORDERS OF URINARY CONCENTRATING ABILITY

- **Inappropriate secretion of ADH (SIADH)**

Conditions That Cause Large Increases in Blood Volume and Extracellular Fluid Volume

- Heart Diseases
- Increased Capacity of Circulation

Increases in Extracellular Fluid Volume but with Normal Blood Volume

- Nephrotic Syndrome
- Liver Cirrhosis