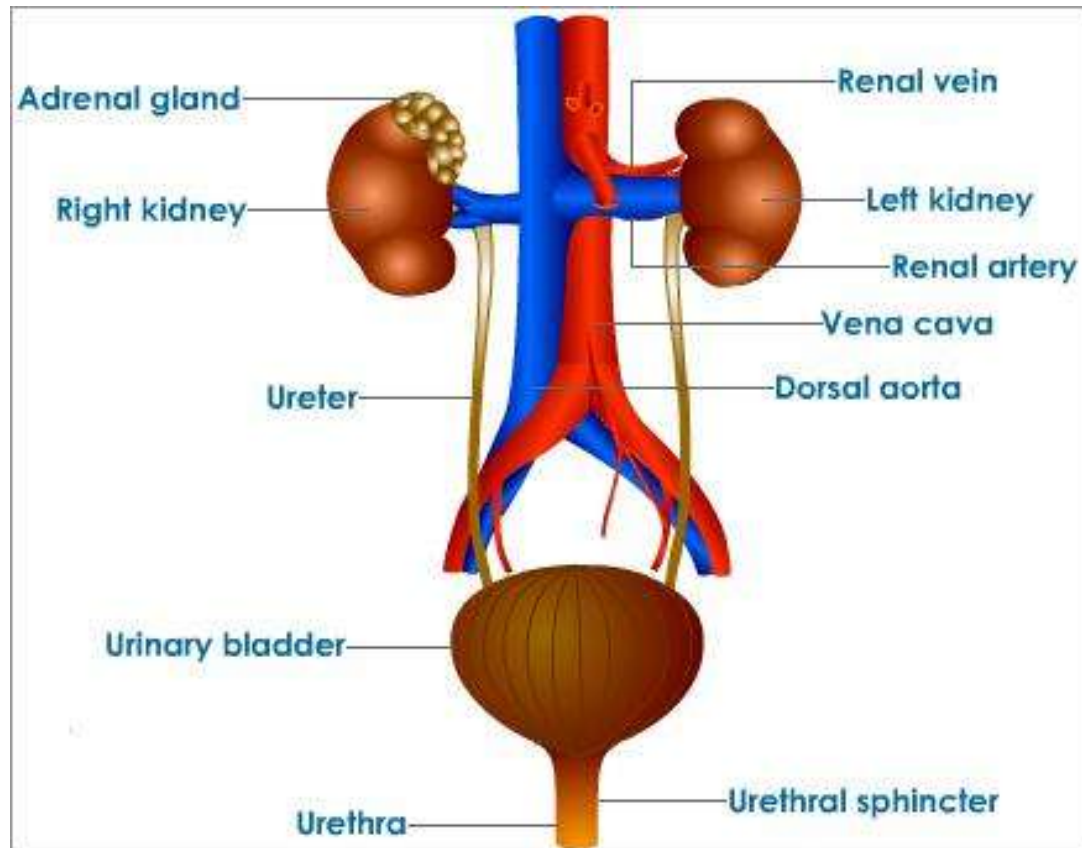


Chapter 9

The Urinary System



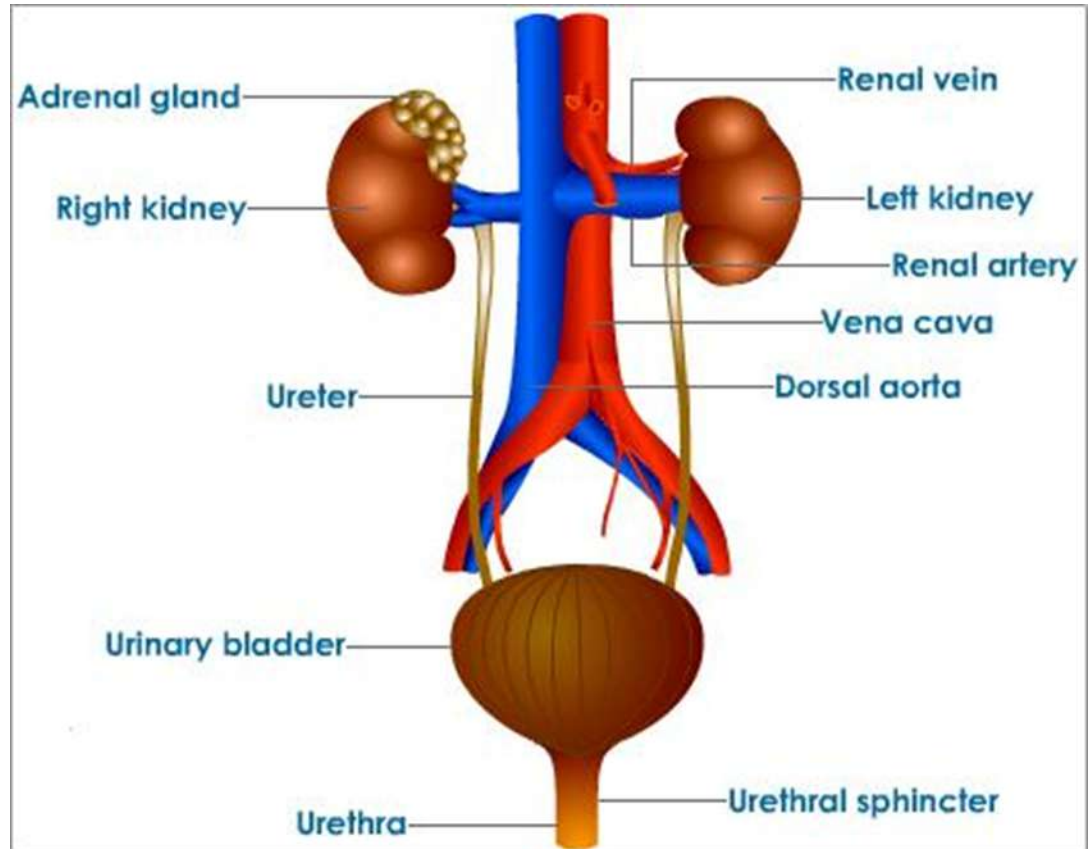
Functions of the Urinary System

The urinary system performs many functions important to maintaining **homeostasis**

- Maintenance of water, salts, and acids in the body
- Filters blood to remove **urea** and other waste materials from the bloodstream
 - **Urea** – the major waste product of protein metabolism
- Converts waste products and excess fluids into **urine** in the kidneys and excretes them from the body via the urinary bladder

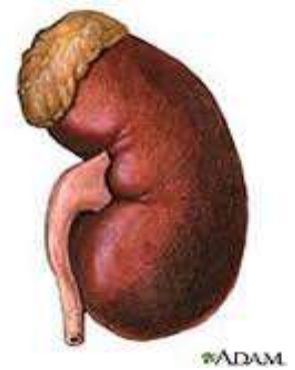
Structures of the Urinary System

- Kidneys
- Nephrons
- Renal Pelvis
- Ureters
- Urinary Bladder
- The Urethra



The Kidneys

Renal – pertaining to the kidneys



Filter blood constantly to remove waste products and excess water which are excreted as urine (95% water and 5% other wastes)

- 2 kidneys located retroperitoneally, one on each side of the vertebral column below the diaphragm consist of:

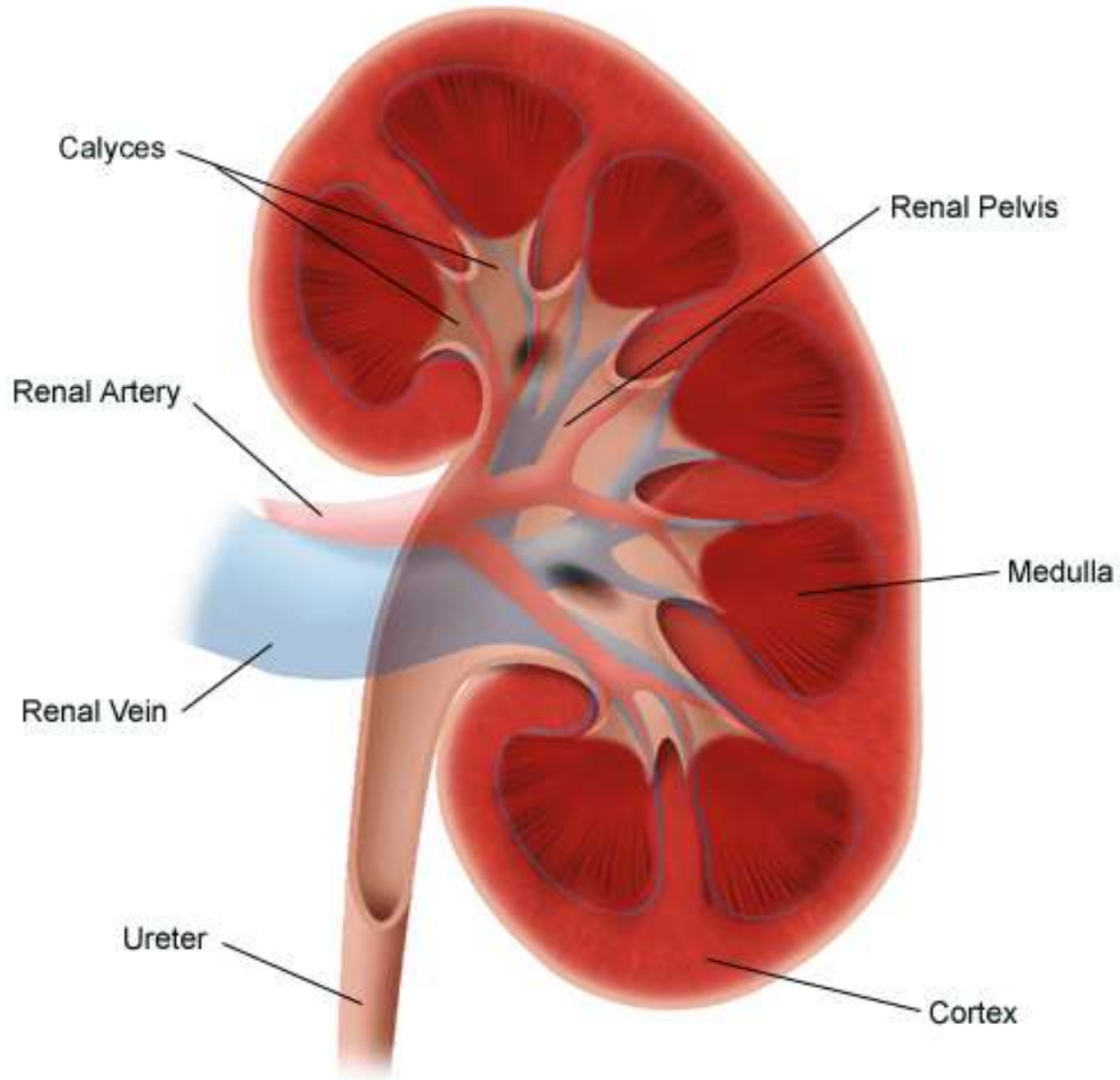
Renal cortex

- The outer region of the kidney
- Contains over 1 million microscopic units called nephrons

Medulla

- The inner region of the kidney
- Contains the urine collecting tubules

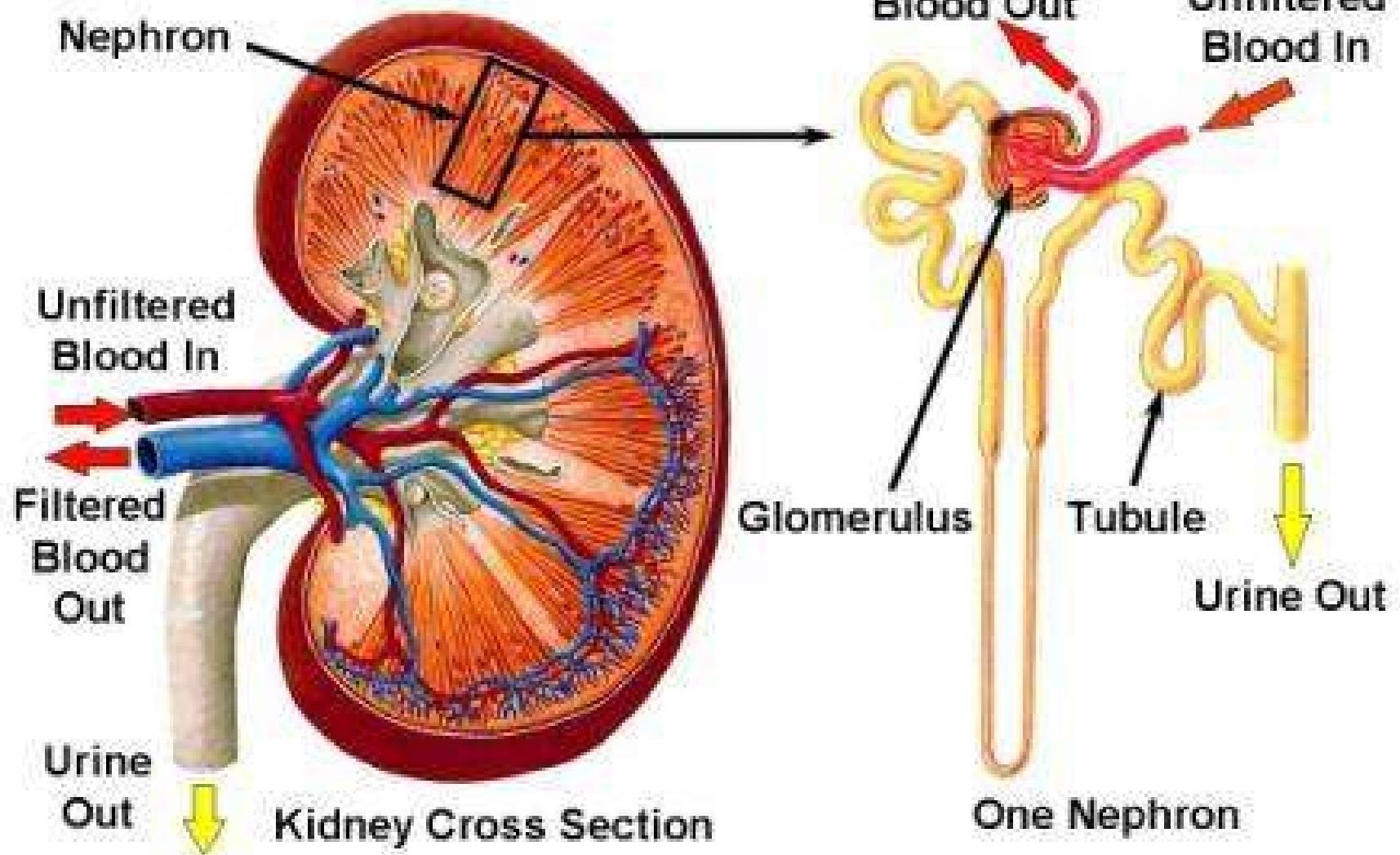
Anatomy of the Kidney



Nephrons

- The functional units of the kidneys
- Form urine by the process of filtration, reabsorption, and secretion
 - Reabsorption is the return of substances that were removed from filtration back to the bloodstream
- Each nephron contains a **glomerulus**
 - Cluster of capillaries surrounded by a cup-shaped membrane called the Bowman's capsule
- **Urochrome** – the pigment that give urine its normal yellow-amber or straw color
 - The color of urine can be influenced by normal factors such as the amount of liquid consumed and can also be changed by diseases and medications

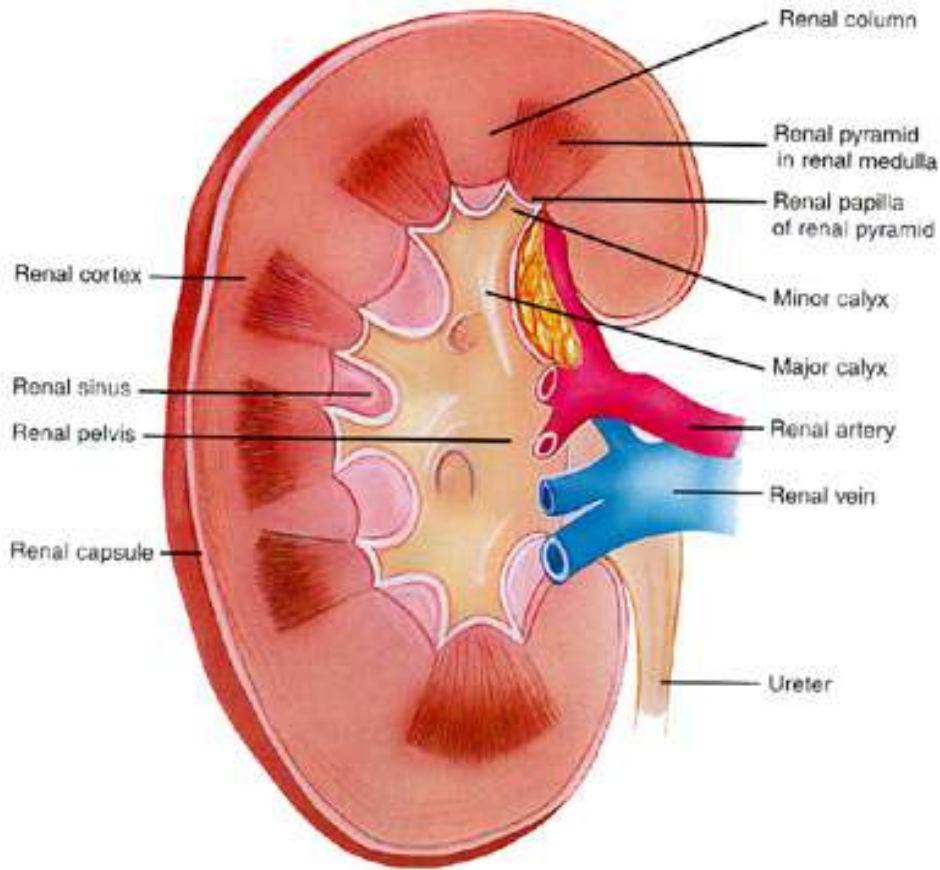
Parts of the Nephron



How is Urine Made?

- Blood enters the kidneys through the renal artery and flows into the nephrons
- After being filtered by the capillaries of the glomerulus, the blood leaves the kidney through the renal vein
- Waste products that were filtered out of the blood remain behind in the kidney where they pass through urine-collecting tubules
- Urine is then transported to the renal pelvis and collected in preparation for entry into the ureters

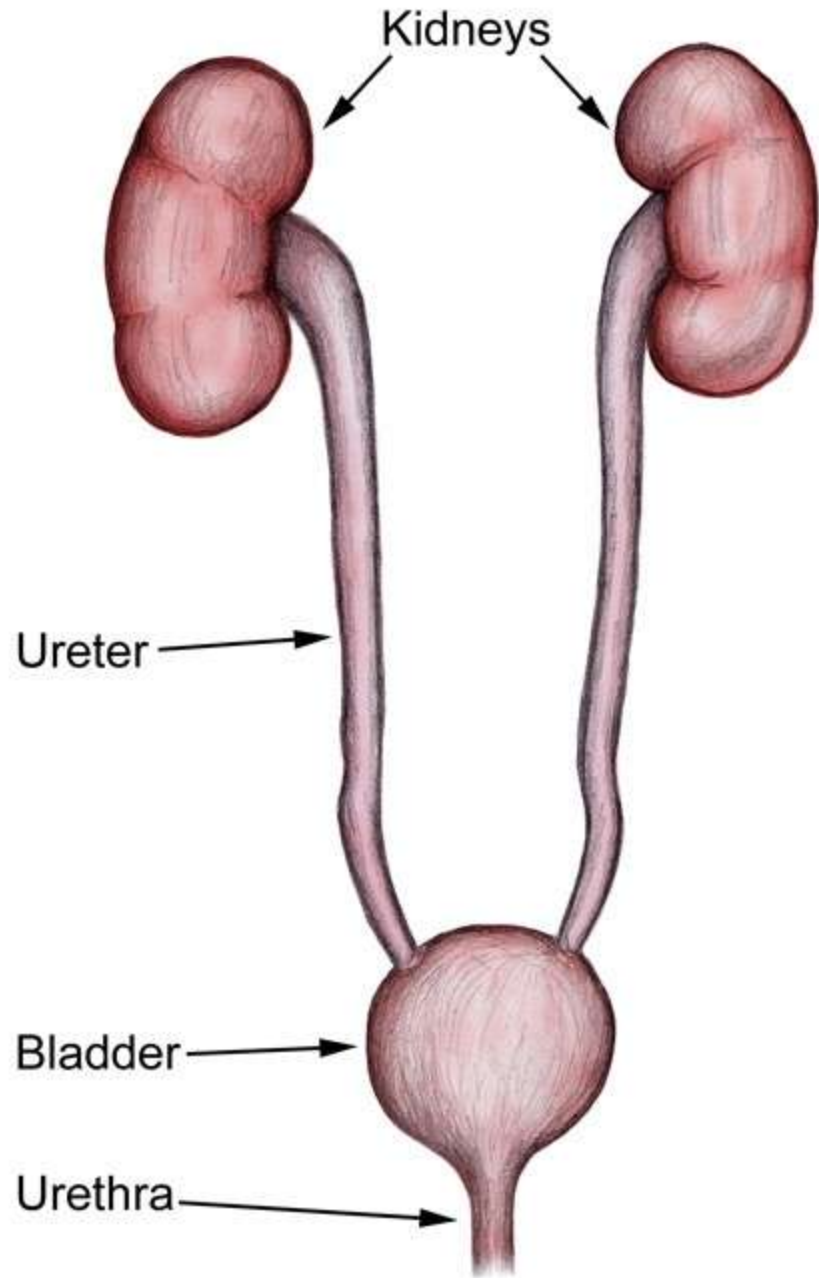
The Renal Pelvis



- Funnel-shaped area in each kidney that is surrounded by the renal cortex and medulla
- Newly formed urine collects here before flowing to the ureters

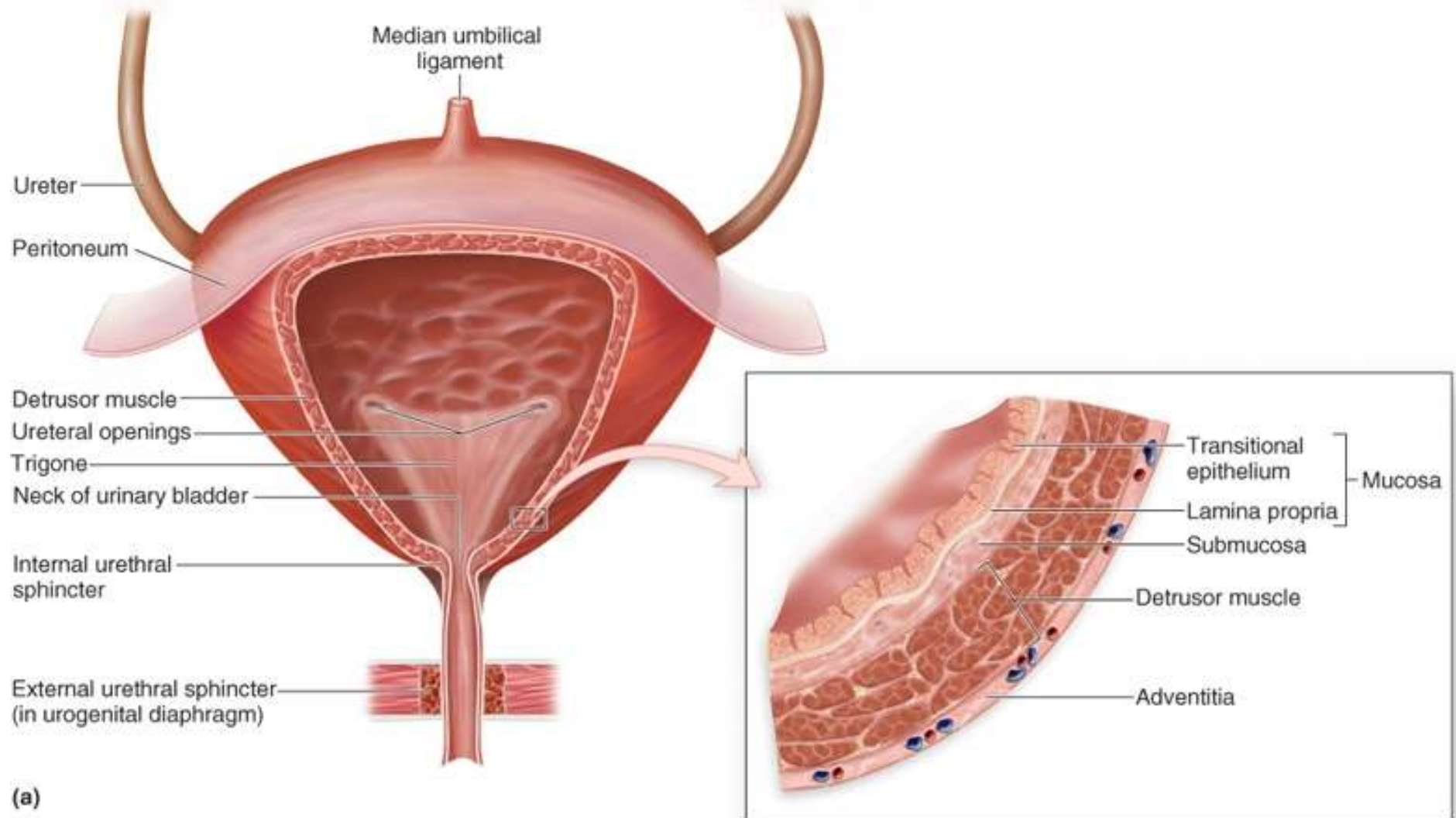
The Ureters

- 2 narrow tubes (10-12 inches each) that transport urine from each kidney to the bladder
- Peristalsis moves urine down each ureter into the bladder



The Urinary Bladder

- Hollow muscular organ that is a reservoir or holding tank for urine before it is excreted from the body
- Located in the anterior portion of the pelvic cavity behind the pubic symphysis
- Stores about 1 pint of urine
- Lined with *rugae* that allow it to expand and contract
- Trigone (try-gon) – smooth triangular area on the inner surface of the bladder located between the openings of the ureters and the urethra



The Urethra

- The tube extending from the bladder to the outside of the body
- 2 urinary sphincters (located at both ends of the urethra) control the flow of urine from the bladder into the urethra and out of the urethra through the **urethral meatus**
- The **urethral meatus** is the external opening of the urethra.

***meatus means external opening of a canal

What other meatus do we have that you can think of?

The Urethra

The **female urethra**

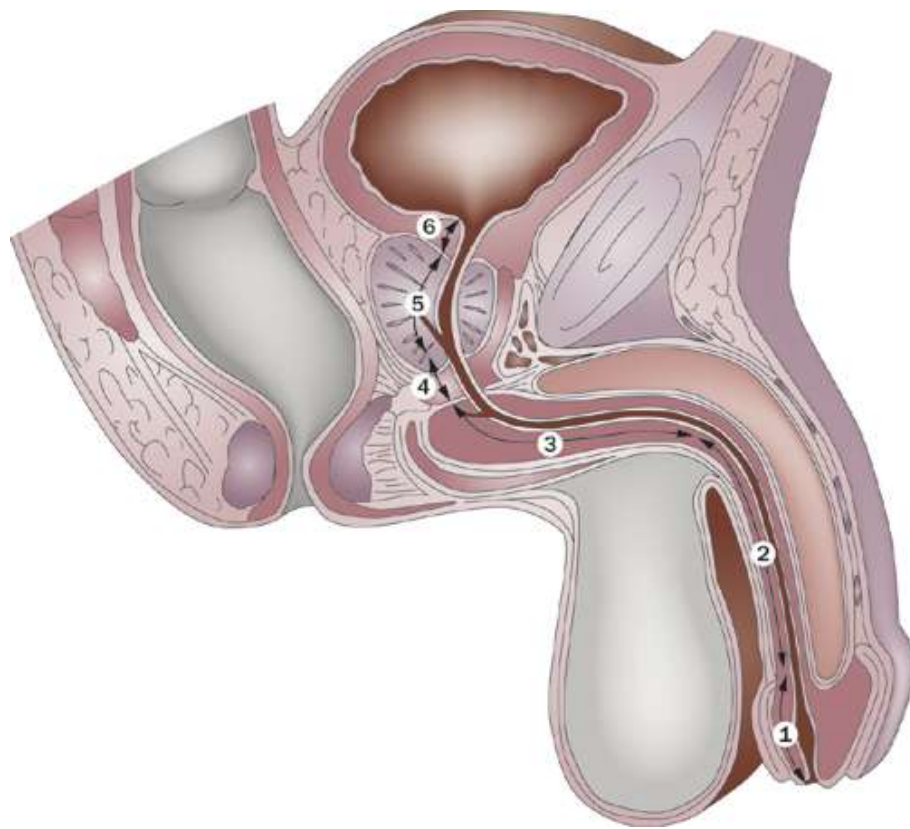
- Approximately 1-1/2 inches long and the urethral meatus is located between the clitoris and the opening of the vagina
- Transport only urine

The **male urethra**

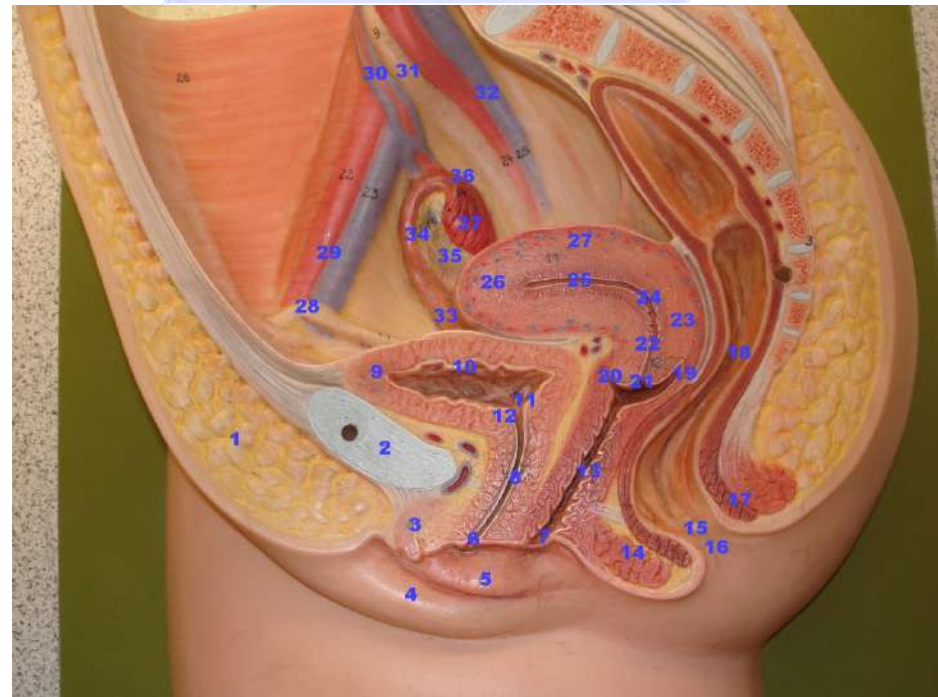
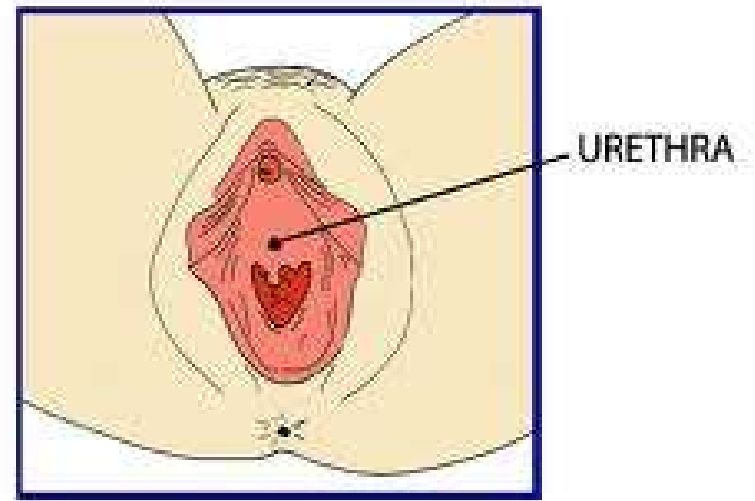
- Approximately 8 inches long and the urethral meatus is located at the tip of the penis
- Transports both urine and semen

The **prostate gland**

- Part of the male reproductive system
- Surrounds the urethra
- Most disorders of the prostate affect the male's ability to urinate



Male urethra



Female urethra

Urination

- Also known as *voiding or micturition* and is the normal process of excreting urine
- As the bladder fills with urine, pressure is placed on the base of the bladder, resulting in the urge to urinate
- Requires the coordinated contractions of the bladder muscles and relaxation of the sphincters, which forces urine through the urethra out through the urinary meatus

Renal Failure

- Also known as kidney failure is the inability of one or both kidneys to perform their functions
- The body cannot replace damaged nephrons, and when too many nephrons are destroyed, the result is kidney failure

Acute Renal Failure (ARF)

- sudden onset and characterized by uremia
- May be fatal if not reversed quickly
- Can be caused by many factors, including sudden drop in blood volume or blood pressure due to injury or disease

Chronic Renal Failure (CRF)

- The progressive loss of renal function, sometime leading to uremia
- Caused by conditions such as kidney disease, diabetes mellitus, or hypertension

Renal Failure

End Stage Renal Disease (ESRD)

- Refers to the latest stages of CRF
- Irreversible loss of the function of both kidneys
- Without dialysis or a kidney transplant, this condition is fatal

Uremia

- Toxic condition resulting from renal failure in which kidney function is compromised and urea is retained in the blood

Hemolytic uremic syndrome

- Condition where *hemolytic anemia* and *thrombocytopenia* cause ARF
- Can be the result of an E. coli infection in young children and the elderly

Nephrotic Syndrome

- Condition in which very high levels of protein are lost in the urine and abnormally low levels of protein are present in the blood
- Caused by damage to the glomeruli

Nephrosis

- any degenerative kidney disease causing nephrotic syndrome **without inflammation**

Nephropathy

- **Any** disease of the kidney
- **Includes both** degenerative and inflammatory conditions
 - Example: *Diabetic nephropathy* - a kidney disease characterized by hyperproteinuria, which is the result of the thickening and hardening of the glomeruli caused by long-term diabetes

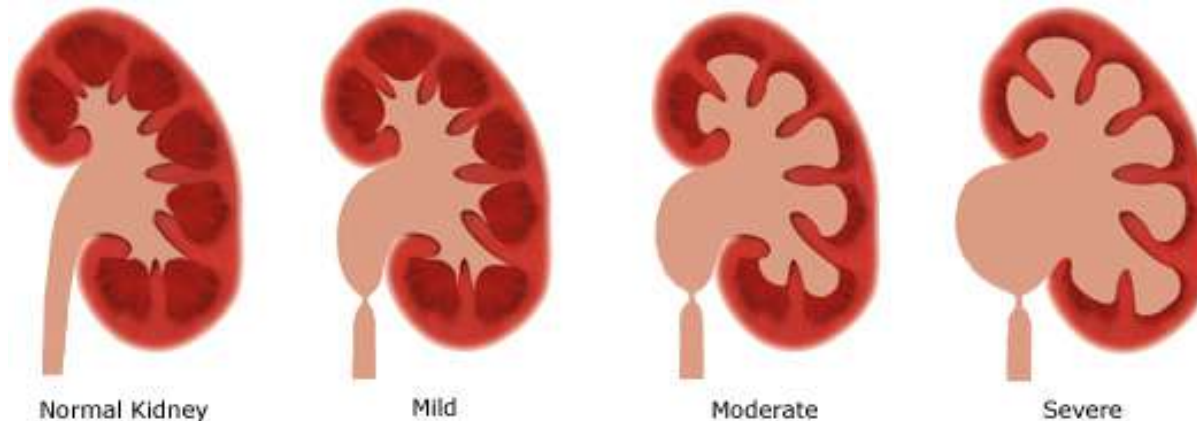
Common Characteristics of Nephropathic Diseases

- **Anuria** – the absence of urine formulation by the kidneys
- **Edema** – excessive fluid in the body tissues
- **Hyperproteinuria** – the presence of abnormally high concentrations of protein in urine
- **Hypoproteinemia** – the presence of abnormally low levels of protein in the blood

Pathology of the Kidneys

Hydronephrosis

- The dilation (swelling) of one or both kidneys
- Can be caused by problems associated with the back up of urine due to an obstruction such as a stricture in the ureter or a blockage in the opening from the bladder to the urethra, or in the urethra itself
 - A stricture is an abnormal band of tissue that narrows or completely blocks a body passage



Pathology of the Kidneys

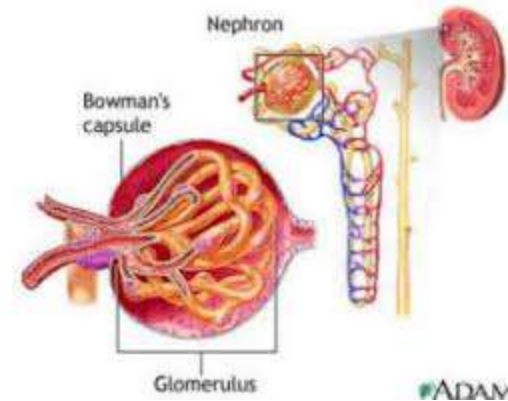
Nephrectasis

- The distention of the pelvis of the kidney

Where else have we seen the suffix –ectasis?

Clarification: Someone who has **hydronephrosis** may exhibit **nephrectasis**

Pathology of the Kidneys

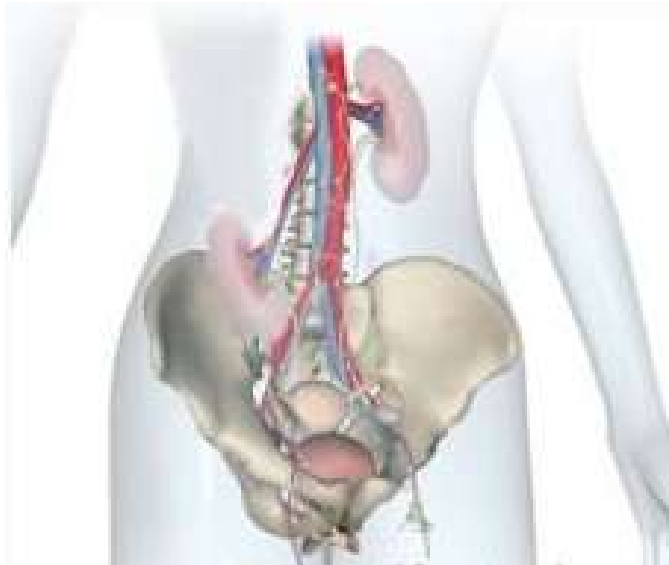


Glomerulonephritis – also known as *Bright's disease*, is a type of kidney disease caused by the inflammation of the glomeruli and causes RBC's and proteins to leak into the urine

You may see dark “rusty” urine (blood) or cloudy (protein)urine as an indication

Pathology of the Kidneys

Nephroptosis – also known as a *floating kidney*, it is the prolapse of a Kidney where the kidney slips or falls more than 2 vertebrae lower than where it should be. Often treated with **nephropexy**.



Pathology of the Kidneys

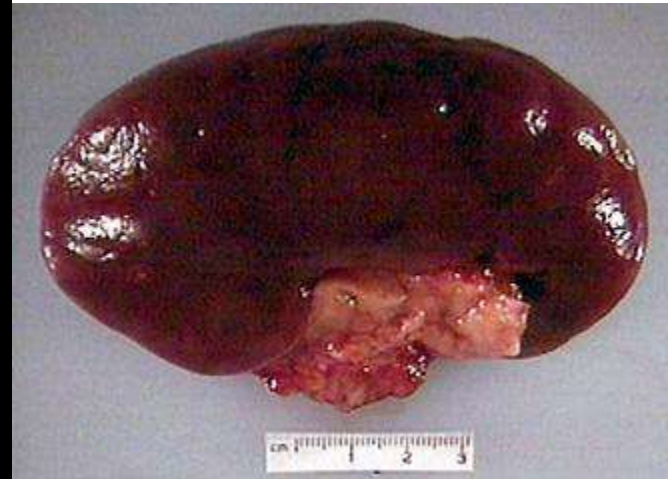
Nephropyyosis – similar to hydronephrosis, however, the renal pelvis is distended with pus

Polycystic kidney disease – genetic disorder characterized by the growth of numerous fluid-filled cysts in the kidneys. Slowly the cysts replace much of the mass of the kidney, which reduces kidney function and eventually leads to kidney failure

Polycystic Kidney Disease (PKD)



Polycystic Kidney



Healthy Kidney



- PKD can grossly enlarge the affected kidneys

Pathology of the Kidney

Wilms tumor

- Malignant tumor of the kidney
- Occurs in young children
- High cure rate when condition is treated promptly

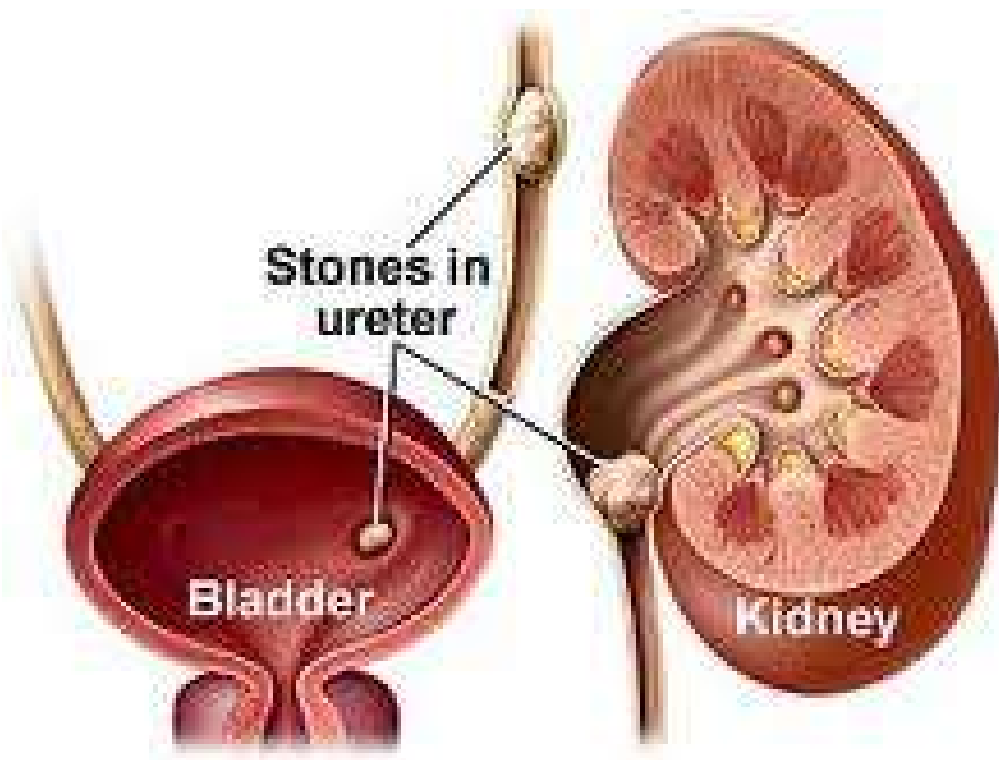
Renal Colic

- Acute pain in the kidney area that is caused by blockage during the passage of a kidney stone

Colic – means spasmodic pains in the abdomen

Stones (calculus)

- Abnormal mineral deposit that has formed in the body
- Vary in size from small sand-like granules to the size of marbles
- Named for the organ tissue they are located
- In the urinary system, they are formed when waste products in the urine crystalize



Nephrolith

Ureterolith

Cystolith

Nephrolithiasis – is the presence of stones in the kidney

As the stones travel with the urine, they are named for the location they become lodged



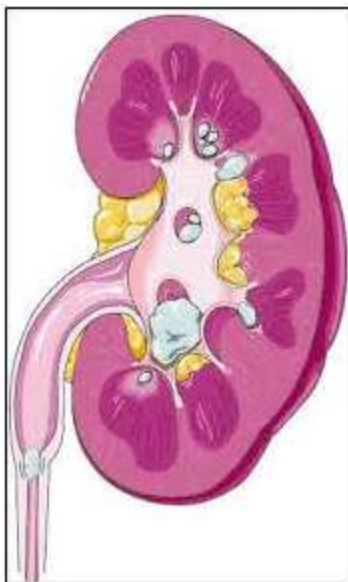
Agony



Pain



Misery



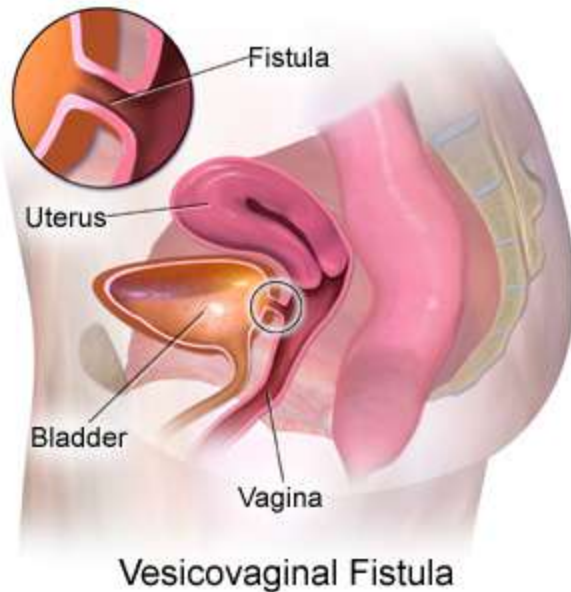
Final Thoughts...

- [Extracorporeal Shockwave Lithotripsy](#)
- What is the difference between **nocturia** and **nocturnal enuresis**?

A man with **BPH** may suffer from frequent urination. What is **BPH**? What does **hypertrophy** mean? What does **benign** mean? Which term from above would explain his poor night's sleep? This same man may suffer from **dysuria** due to **urethrostenosis**. Why?

Final Thoughts...

Vesicovaginal fistula



cystocele



What is a fistula?

Final Thoughts...

- A patient comes in c/o painful urination, frequency, nausea/vomiting, fever and back pain. What diagnostic procedure would you want to order to rule out a UTI? Given the patient's signs and symptoms, what condition do you think this patient has?

Answer: Urinalysis, and pyelonephritis

Final Thoughts...

- A mom comes in with her 8 month old daughter. The mom states that her daughter has a fever of 103.8 but has no other signs or symptoms. What initial test(s) would you want to order and why?

Answer: Urinalysis, to rule out a UTI. Possibly a KUB so see if there is any visible hydronephrosis

- Taking into consideration this child's age, what further test(s) might you want to order?

Answer: Voiding cystourethrogram in order to rule out urinary reflux back into the kidney.

Good news! The VCUG is negative which means that urine is not flowing back into the kidneys and they appear symmetrical and no signs of hydronephrosis. What advice would you give to the mom to help prevent future UTIs?