The Urinary System

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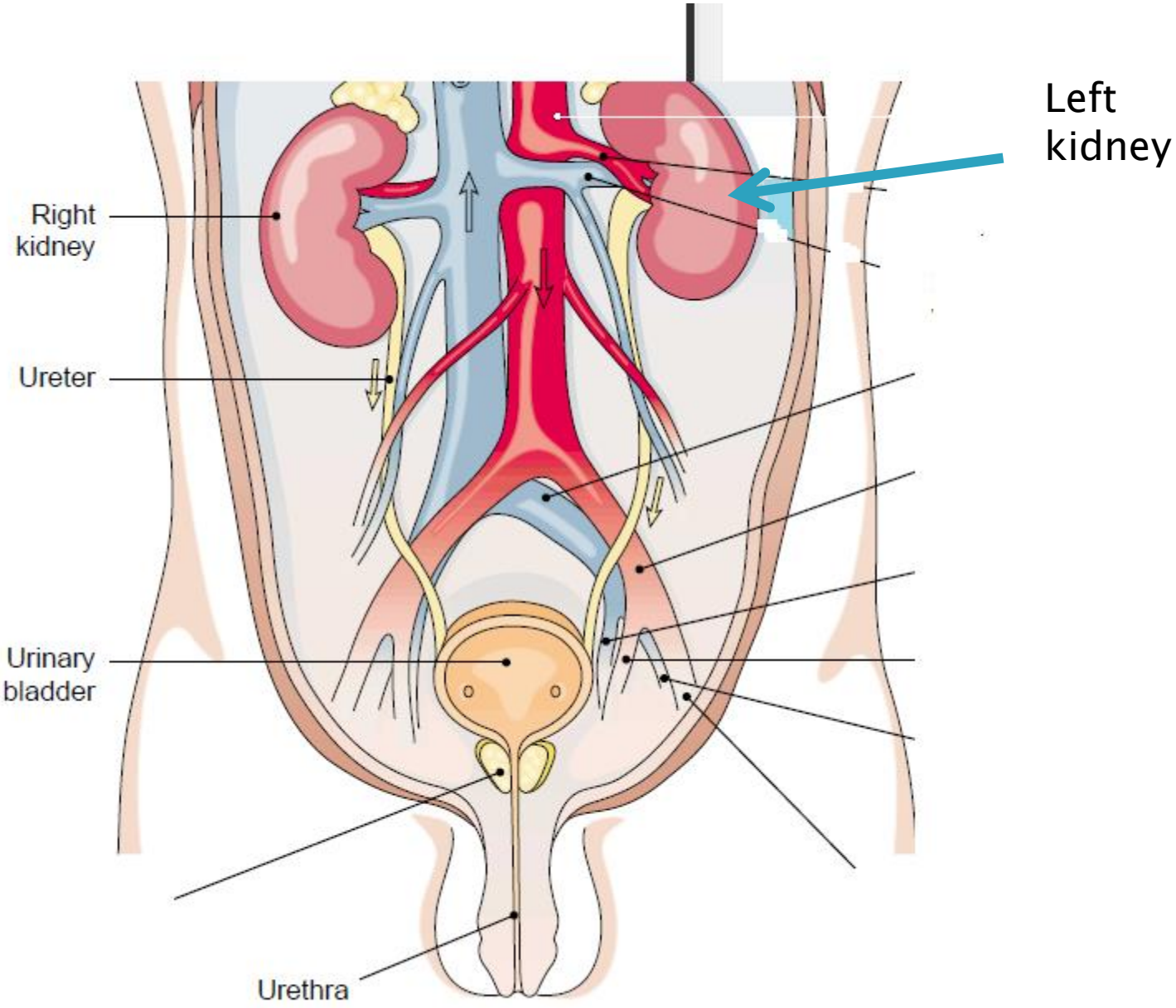
- The urinary system consists of:
- Two kidneys
- Two ureters
- The urinary bladder
- A urethra

- This system forms and eliminates urine, which contains metabolic waste products.
- This system has critical importance in maintaining the state of internal balance known as homeostasis.


Left kidney
Right kidney
Ureter
Urinary bladder
Urethra

The Kidney

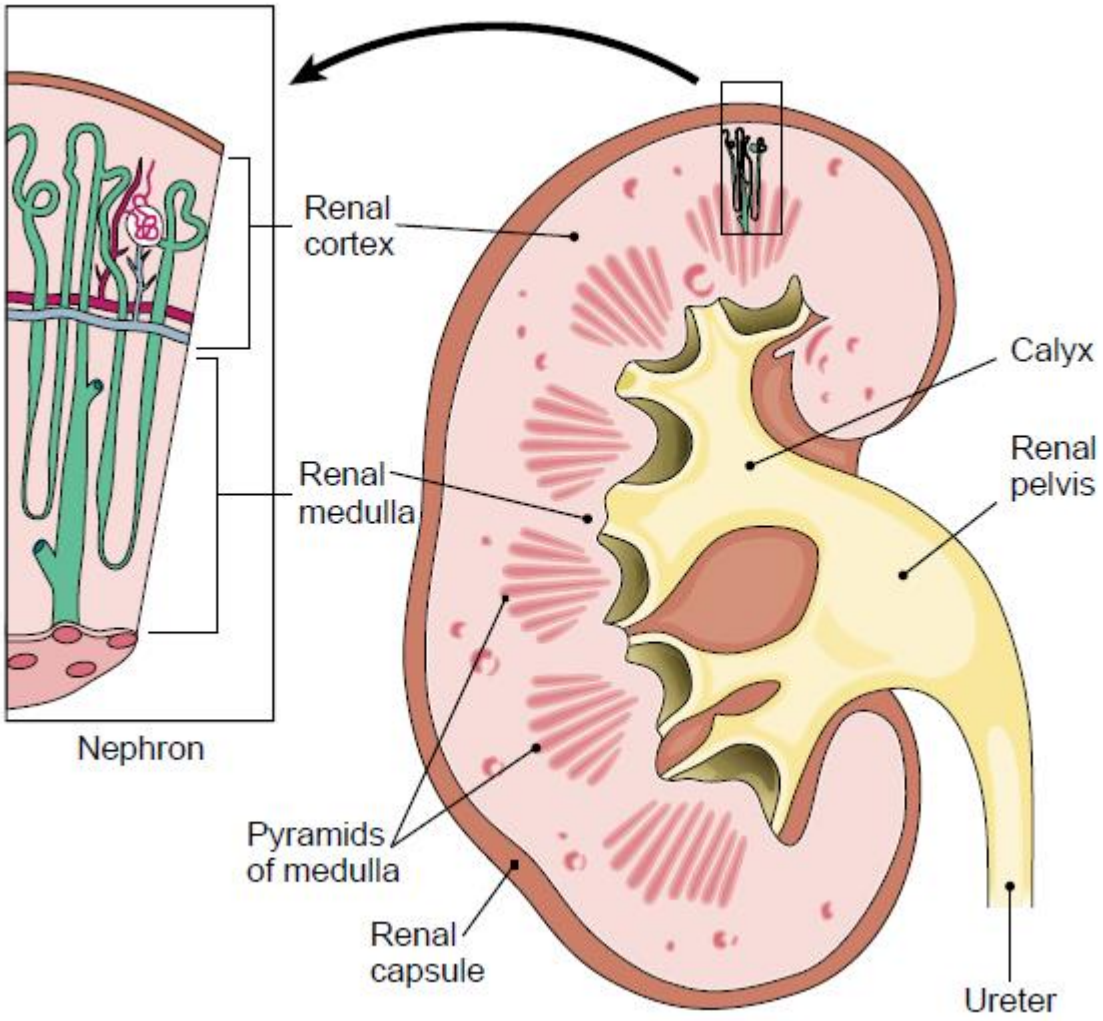
- The kidneys are located behind the peritoneum in the lumbar region. On the top of each kidney rests an adrenal gland.
- Each kidney is encased in a capsule of fibrous connective tissue overlaid with fat.
- It has an outer region, the renal cortex, and an inner region,
- the renal medulla which is divided into triangular sections, each called a pyramid.

The Kidney

- The pyramids have a lined appearance because they are made up of the loops and collecting tubules of the nephrons, the functional units of the kidney.
- Each collecting tubule empties into a urine-collecting area called a calyx (from the Latin word meaning “cup”).
- Several of these smaller minor calyces merge to form a major

calyx.

- The major calyces then unite to form the renal pelvis, the upper funnel-shaped portion of the ureter.


Renal cortex
Renal medulla
Nephron
Calyx
Renal pelvis
Pyramids of medulla
Renal capsule
Ureter

The Nephrons

- The tiny working units of the kidneys are the **nephrons.**
- At the beginning of the tubule is the cupshaped

Bowman capsule, which is part of the blood-filtering device of the nephron.

- The tubule then folds into the proximal convoluted tubule, straightens out to form the loop of Henle, coils again into the distal convoluted tubule, and then finally straightens out to form a collecting tubule.

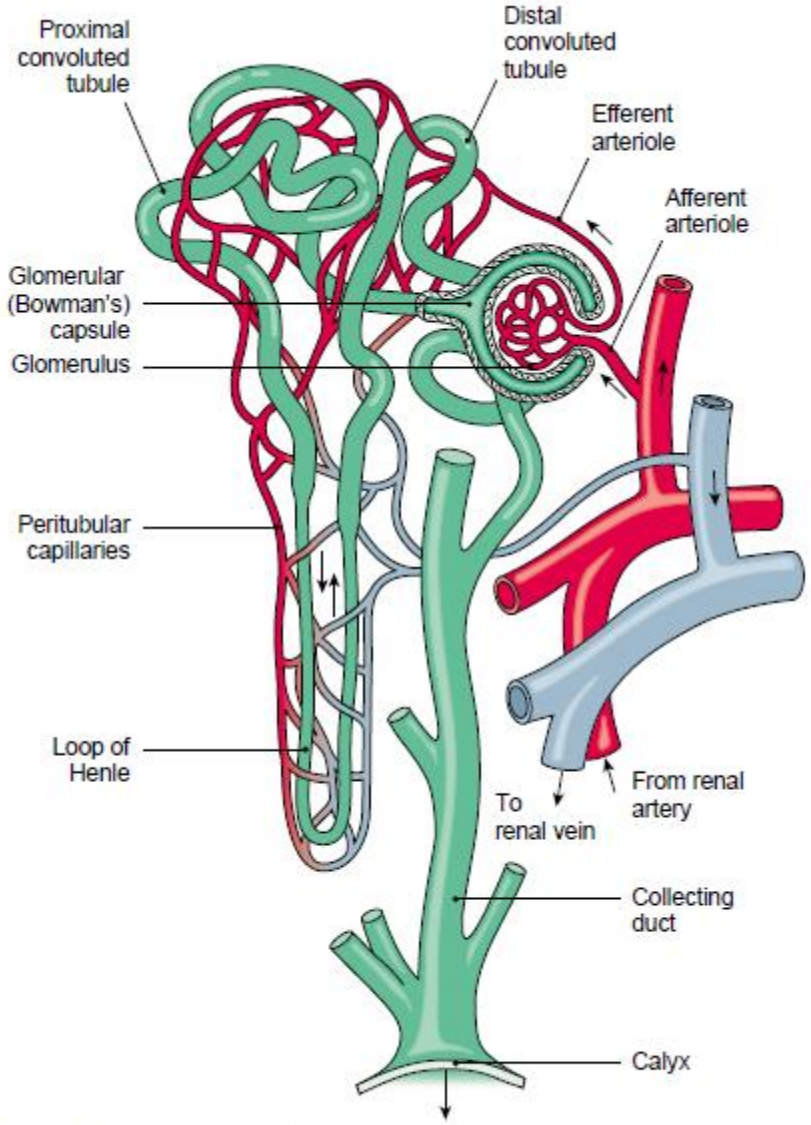


FIGURE 13-3. A nephron and its blood supply.

Removal of Urine

- Urine is drained from the renal pelvis and carried by the ureter to the urinary bladder .
- Urine is stored in the bladder until fullness stimulates a reflex contraction of the bladder muscle and expulsion of urine through the urethra.
- The female urethra is short (4 cm; 1.5 in) and carries only urine. The male urethra is longer (20 cm; 8 in).
- The voiding (release) of urine, technically called micturition or urination, is regulated by two sphincters (circular muscles) that surround the urethra:

* The upper sphincter, just below the bladder, functions involuntarily.
* The lower sphincter is under conscious control.

TABLE 13-1 Roots for the Kidney

ROOT	MEANING	EXAMPLE	DEFINITION OF EXAMPLE
ren/o	kidney	infrarenal *in-fra-RĒ-nal*	below the kidney
nephr/o	kidney	nephrosis *nef-RŌ-sis*	any noninflammatory disease condition of the kidney
glomerul/o	glomerulus	juxtaglomerular *juks-ta-glō-MER-ū-lar*	near the glomerulus
pyel/o	renal pelvis	pyeloplasty *pī-e-lō-PLAS-tē*	plastic repair of the renal pelvis
cali-, calic-	calyx	calicectasis *kal-i-SEK-ta-sis*	dilatation of a renal calyx

TABLE 13-2 Roots for the Urinary Tract (Except the Kidney)

ROOT	MEANING	EXAMPLE	DEFINITION OF EXAMPLE
ur/o	urine, urinary tract	urosepsis *ū-rō-SEP-sis*	generalized infection that originates in the urinary tract
urin/o	urine	urination *ū-ri-NĀ-shun*	discharge of urine
ureter/o	ureter	ureterostenosis *ū-rē-ter-ō-ste-NŌ-sis*	narrowing of the ureter
cyst/o	urinary bladder	cystotomy *sis-TOT-ō-mē*	incision of the bladder
vesic/o	urinary bladder	intravesical *in-tra-VES-i-kal*	within the urinary bladder
urethr/o	urethra	urethroscopy *ū-rē-THROS-kō-pē*	endoscopic examination of the urethra

tubular reabsorption *TŪB-ū-lar rē-ab-SORP-shun*	The return of substances from the glomerular filtrate to the blood through the peritubular capillaries
urea *ū-RĒ-a*	The main nitrogenous (nitrogen-containing) waste product in the urine
ureter *Ū-rē-ter*	The tube that carries urine from the kidney to the bladder (root *ureter/o*)
urethra *ū-RĒ-thra*	The tube that carries urine from the bladder to the outside of the body (root *urethr/o*)
urinary bladder *Ū-ri-nar-ē BLAD-der*	The organ that stores and eliminates urine excreted by the kidneys (root *cyst/o*, *vesic/o*)
urination *ū-ri-NĀ-shun*	The voiding of urine; micturition
urine *Ū-rin*	The fluid excreted by the kidneys. It consists of water, electrolytes, urea, other metabolic wastes, and pigment. A variety of other substances may appear in urine in cases of disease (root *ur/o*).

micturition *mik-tū-RISH-un*	The voiding of urine; urination
nephron *NEF-ron*	A microscopic functional unit of the kidney; working with blood vessels, the nephron filters the blood and balances the composition of urine
renal cortex *RĒ-nal KOR-tex*	The outer portion of the kidney
renal medulla *me-DUL-la*	The inner portion of the kidney; contains portions of the nephrons and tubules that transport urine toward the renal pelvis
renal pelvis *PEL-vis*	The expanded upper end of the ureter that receives urine from the kidney (root *pyel/o*, from the Greek word for pelvis, meaning "basin")
renal pyramid *PIR-a-mid*	A triangular structure in the medulla of the kidney composed of the loops and collecting tubules of the nephrons
renin *RĒ-nin*	An enzyme produced by the kidneys that activates angiotensin in the blood

Clinical Aspects of the Urinary System

1-Infections:

- Organisms that infect the urinary tract generally enter through the urethra and ascend toward the bladder.
- Infection of the urinary bladder produces cystitis. The infecting organisms are usually colon bacteria carried in
- feces, particularly Escherichia coli. Cystitis is more common in females than in males because the female urethra is shorter than the male urethra.
- An infection that involves the kidney and renal pelvis is termed pyelonephritis.
- Signs of pyelonephritis include dysuria, painful or difficult urination, and the presence of bacteria and pus in the urine, bacteriuria and pyuria, respectively.
- Urethritis is inflammation of the urethra.

2-Glomerulonephritis

- Although the name simply means inflammation of the kidney and glomeruli, **glomerulonephritis** .
- The symptoms are:

1- Hypertension AND edema.

2- **Oliguria**, the passage ofsmall amounts of urine

3- **Hematuria,** blood in the urine.

4- **Proteinuria,** protein in the urine.

5- Blood cells may also form into small molds of the kidney tubule, called **casts**, which can be found in the urine

6- In such cases, urea and other nitrogen-containing compounds accumulate in the blood, a condition termed **uremia**.

3-Acute Renal Failure

- Injury, shock, exposure to toxins, infections, and other renal disorders may cause damage to the nephrons, resulting in acute renal failure (ARF). There is rapid loss of kidney function with oliguria and accumulation of nitrogenous wastes in the blood.

1-Failure of the kidneys to eliminate potassium leads to **hyperkalemia**, along with other electrolyte imbalances and acidosis.

2- When destruction (necrosis) of kidney tubules is involved, the condition may be referred to as acute tubular necrosis (ATN).

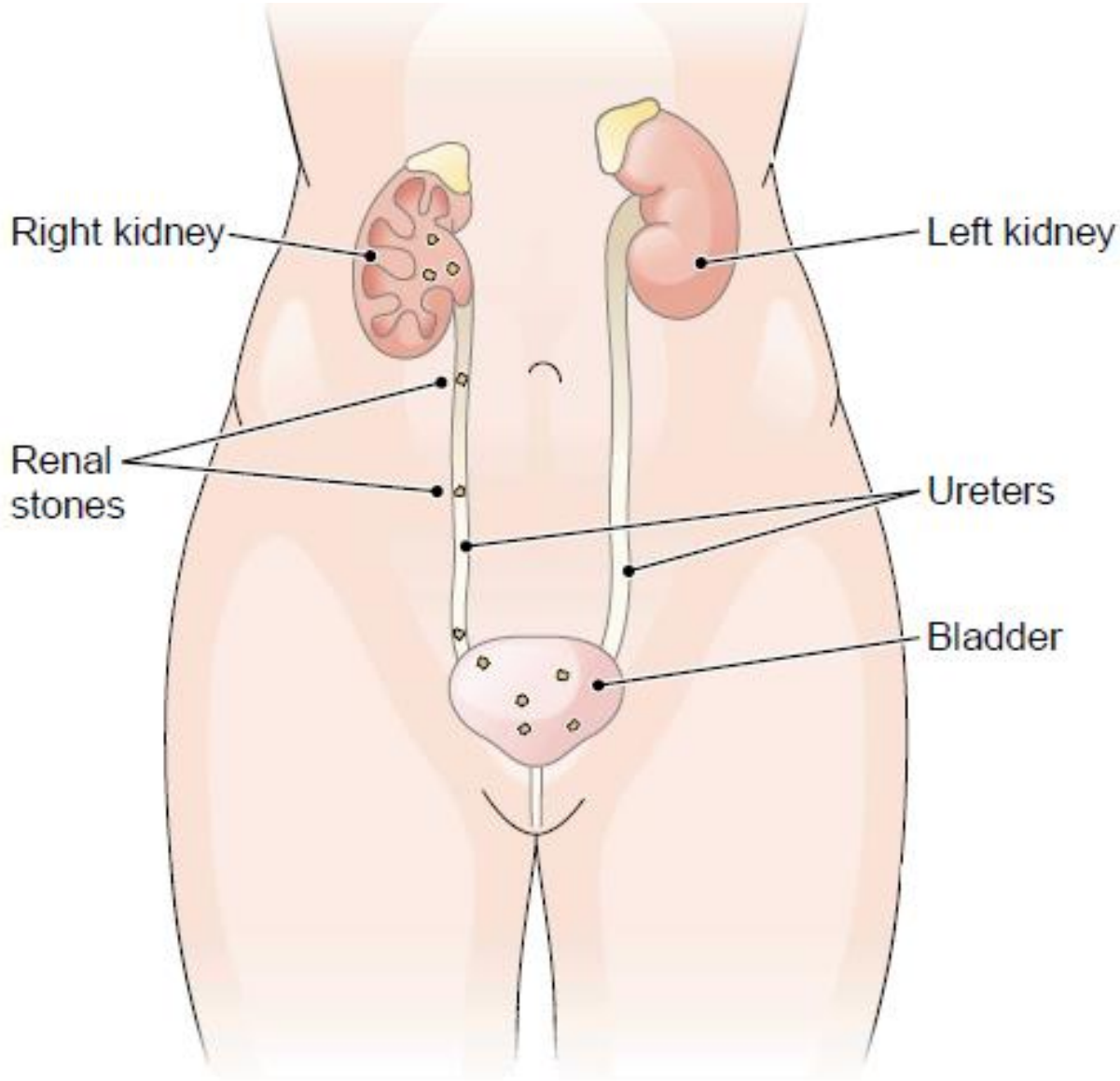
Renal failure may lead to a need for kidney **dialysis or, ultimately, **renal transplantation**.

**Dialysis refers to the movement of substances across a semipermeable membrane; it is a method used for removing harmful or unnecessary substances from the body when the kidneys are impaired or have been removed .

- In **hemodialysis**, blood is cleansed by passage over a membrane surrounded by fluid (dialysate) that draws out unwanted substances.
- In **peritoneal dialysis**, fluid is introduced into the peritoneal cavity.

4-Urinary Stones

- Urinary lithiasis (condition of having stones) .
- The stones generally form in the kidney and may move to the bladder, this results in great pain, termed renal colic.
- Hydronephrosis (collection of urine in the renal pelvis).
- They may be removed surgically, in a lithotomy, or by External shock waves are used to crush stones in the urinary tract in a procedure called extracorporeal (outside the body) shock wave lithotripsy (crushing of stones).


Right kidney
Left kidney
Renal stones
Ureters
Bladder

5-Cancer

- A key symptom is sudden, painless hematuria.
- Often the cancer can be seen by viewing the lining of the bladder with a cystoscope.
- A cystectomy (removal of the bladder) may be necessary.

Urinalysis (UA)

- is a simple and widely used method for diagnosing disorders of the urinary tract.

- In a routine urinalysis, the urine is grossly examined for color and turbidity (a sign of bacteria); specific gravity (a measure of concentration) and pH are recorded; test are performed for chemical components such as glucose, ketones, and hemoglobin;

- **Catheterization**: Introduction of a tube into a passage, such as through the urethra into the bladder for withdrawal of urine.
- **Hyperkalemia** :Excess amount of potassium in the blood.
- **Oliguria**: Elimination of small amounts of urine
- **Renal transplantation** :Surgical implantation of a donor kidney into a patient

Good luck for ALL