NEPHROLOGY & RENAL DISEASES

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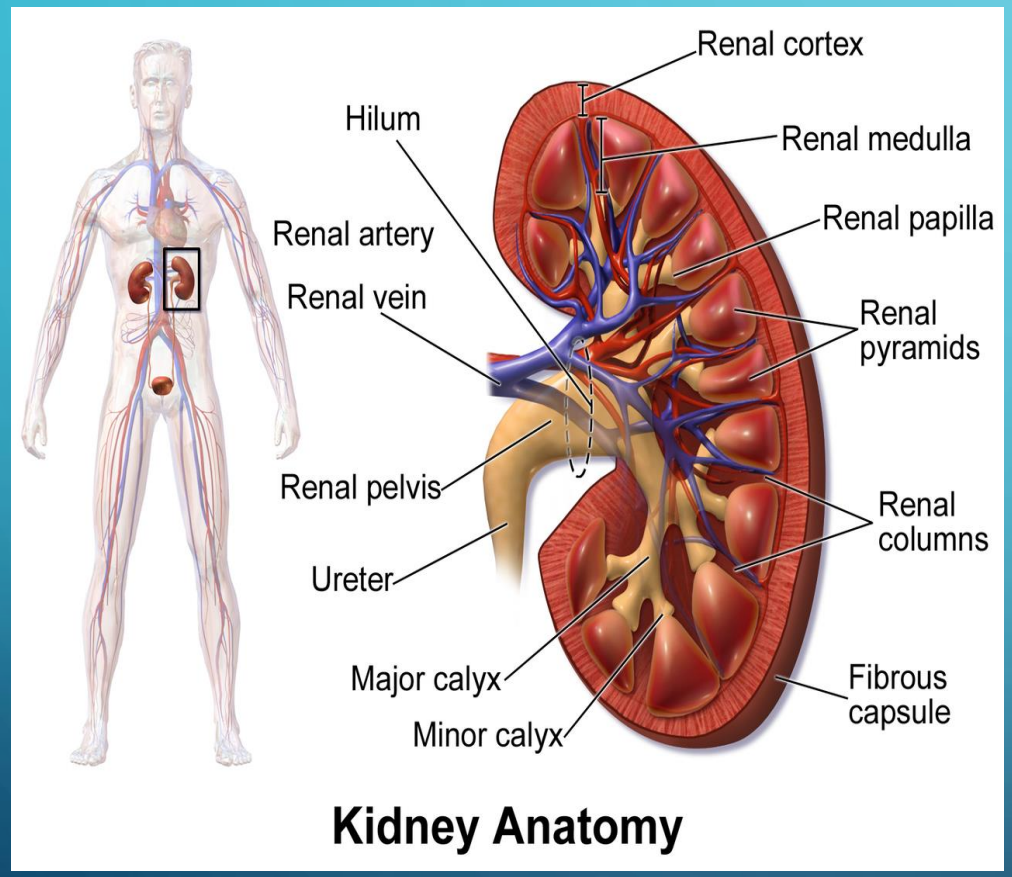
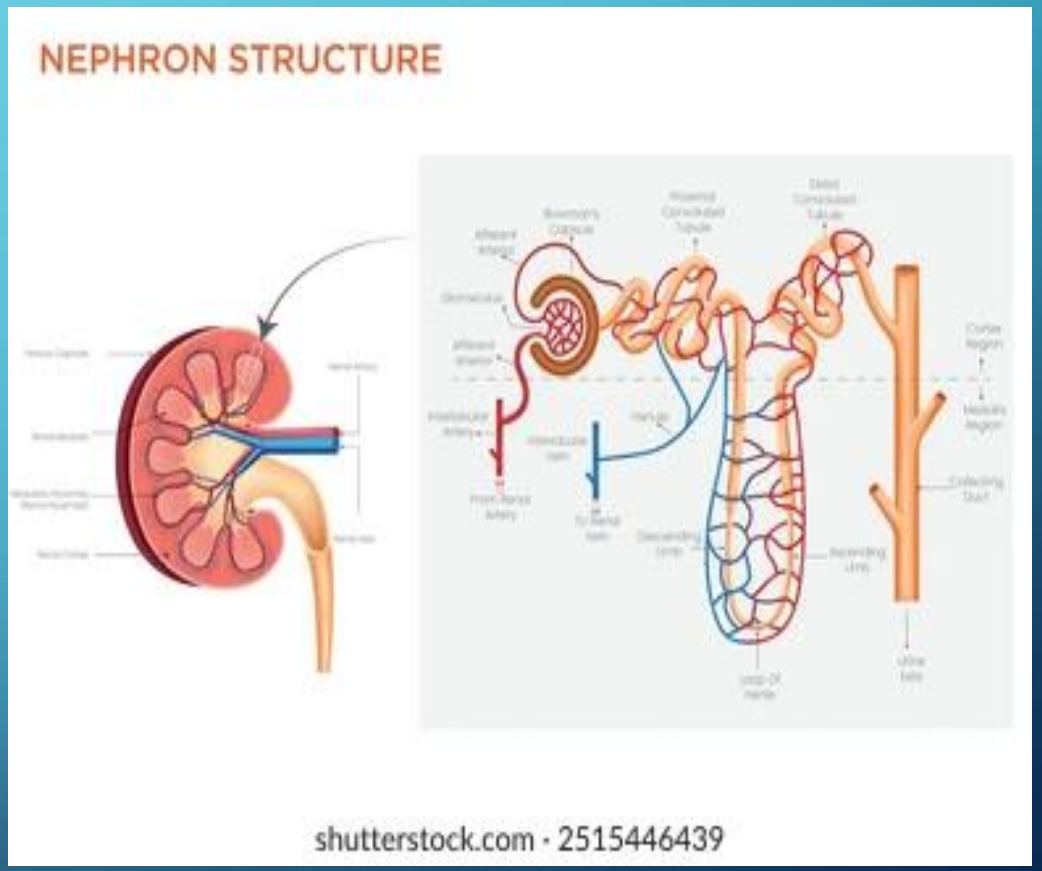
ANATOMY & PHYSIOLOGY

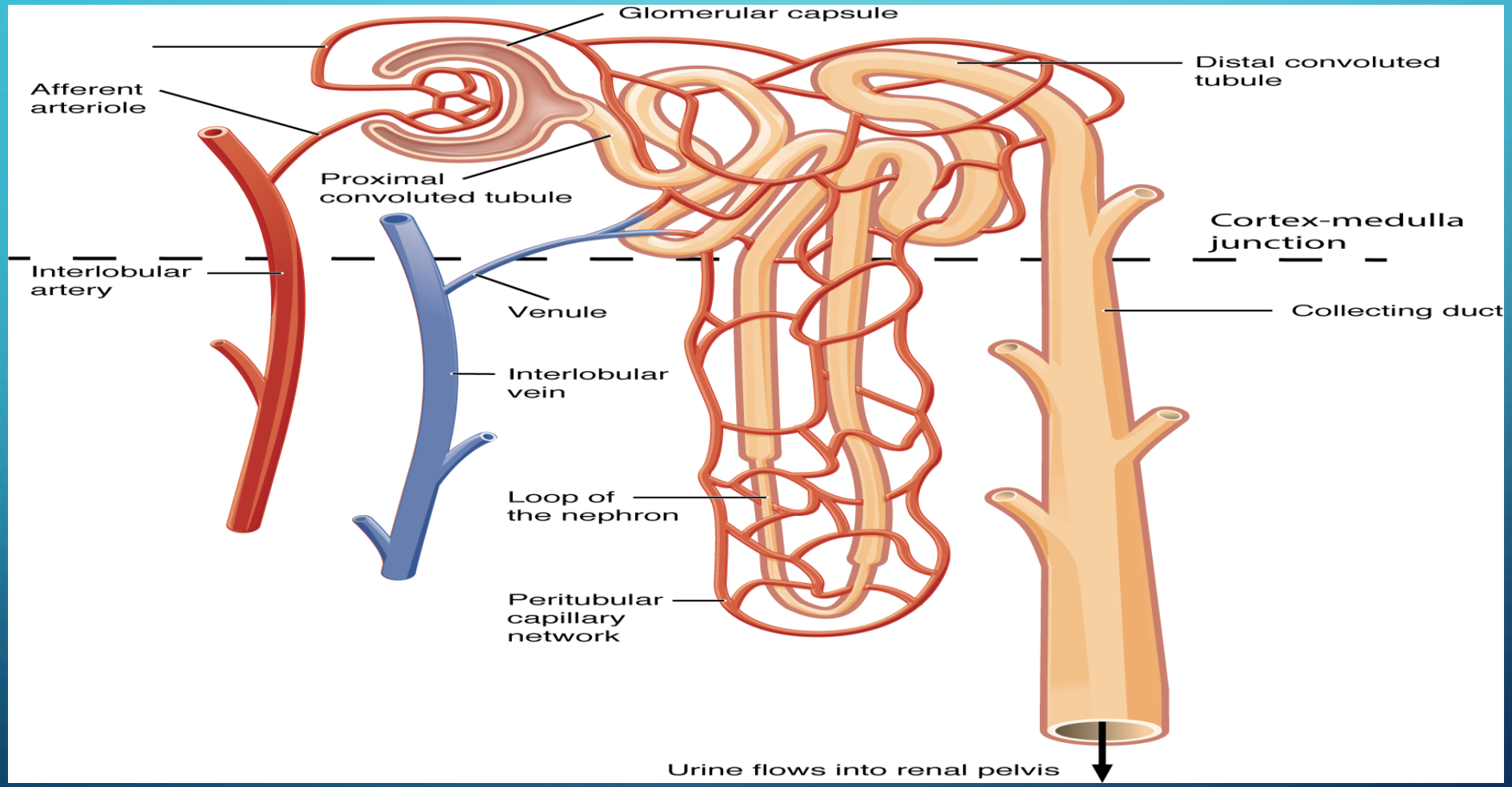
- 2 kidneys each contains 1 million nephron, which is the basic functional unit of the kidney. Each nephron is composed from :
- 1-Bowmnans capsule.(Glomerulus , with its afferent , efferent arterioles , & glomerular membranes & space).
- 2-Proximal convoluted tubule.
- 3- Loop of Henle (thick & thin portions.
- 4-Distal convoluted tubule.
- 5-Collecting duct.
- The functions of the kidneys are;
- 1-Excretion of waste products of metabolism (urea, creatinine, uric acid, drugs & toxins).
- 2-Activation of vitamin D . By 1 hydroxylation of 25 –hydroxycholecalciferol to form (1,25 D3).
- 3-Control of hematopoiesis , through production of erythropoietin .
- 4-Control of internal milieu of normal acid base & electrolyte of the blood.

ANATOMY & PHYSIOLOGY





THE STRUCTURE OF THE NEPHRON



FUNCTIONAL ANATOMY & PHYSIOLOGY

- Each kidney is 11-14cm length located retroperitoneally, & both kidneys receive almost 25% of the cardiac output. Both kidneys move down by inspiration .
- The glomerulus can not filter large molecules (such as albumin , 67kDa or larger) . Smaller size molecules are filtered easily such as creatinine, glucose.
- Glomerular blood flow is controlled by local production of prostaglandins which mediate vasodilatation (which is blocked by NSAIDs), while renin production by the juxtaglomerular apparatus , causes vasoconstriction, such in cases of hypotension, with reduced glomerular perfusion. It is also produced by sympathetic stimulation & low sodium concentration in the distal convoluted tubule fluid.
- Renin cleaves angiotensinogen to angiotensin I , which is further cleaved to angiotensin II, by ACE. (angiotensin converting enzyme) . The inhibition of this pathway is the basic mechanism for certain antihypertensive drugs. (ACEIs).
- The renin –angiotensin system have important role in pathogenesis & treatment modalities for hypertension & heart failure patients.

CLINICAL PRESENTATIONS IN RENAL DISEASE.

- The clinical manifestations of renal & urinary tract diseases are:
- 1-Oliguria\anuria. 2-Haematuria. 3-Proteinuria. 4-Oedema.
- 5-Hypertension. 6-Dysuria. 7-Polyuria & frequency. 8-Nocturia.
- 9-Urinary incontinence.
- Some of these manifestations could occur due to extra-renal causes, such as oedema , which can occur in cardiac , hepatic & hypoalbuminic conditions.
- Hematuria can occur in renal & extra- renal conditions, & for renal hematuria , we have to know the source of bleeding either from the upper or lower urinary tract sources (renal hematuria is characterized by dysmorphic RBCs & RBC casts.
- Sometimes red colored urine is not due to bleeding , & could be due to intravascular hemolysis (hemoglobinuria) or muscle destruction (myoglobinuria) , or even due certain dyes (beetroot).

URINE COLOR


What Urine Color Says
About Kidney Problem
Light Yellow
Yellow
Dark Yellow
Amber
Brown
Red


WHAT THE COLOR OF YOUR URINE SAYS ABOUT YOUR HEALTH:
KidneyCare
TRANSPARENT
PALE YELLOW
TRANSPARENT YELLOW
DARK YELLOW
BROWNISH ORANGE
PINKISH RED
BLUE OR GREEN
FOAMY
DARK RED, BROWN OR PURPLE
+91 1234567890

GROUPS OF RENAL & URINARY TRACT DISEASES

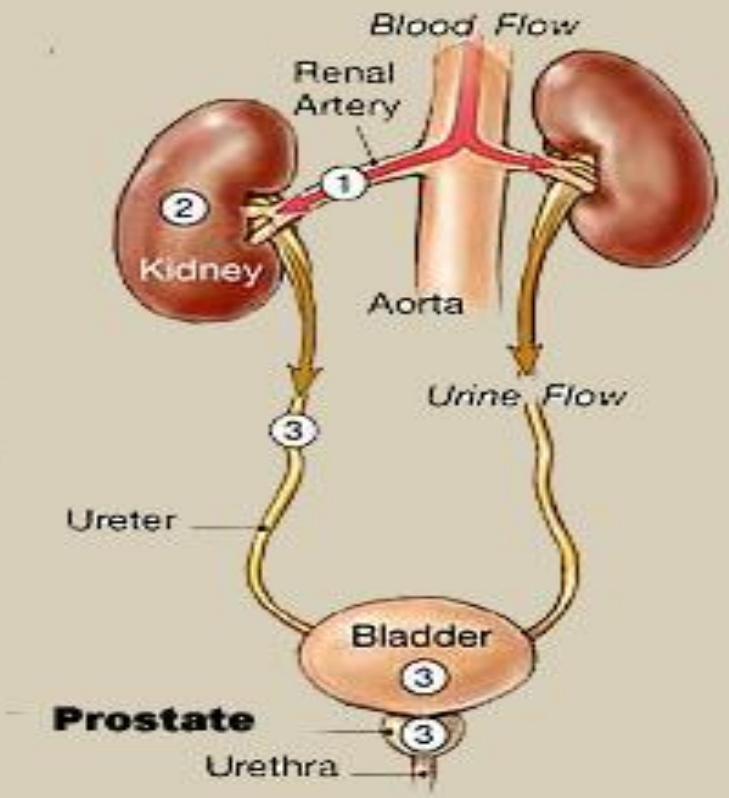
- The UT disorders are classified generally into:
- 1-Glomerular diseases: different types of glomerulonephritis.
- 2-Tubulo-interstitial diseases: including obstructive, crystal induced types.
- 3-Genetic diseases: thin membrane diseases, Alport disease.
- 4-Renal vascular diseases: renal vein thrombosis, renal artery stenosis.
- 5-Renal involvement in systemic diseases: in metabolic, malignant diseases.
- 6-Acute kidney injury: due to toxins & drugs.
- 7-Chronic renal diseases: usually as the end result of different etiologies, & usually needs some kind of renal replacement therapy (hemodialysis or peritoneal dialysis).

ACUTE KIDNEY INJURY

- Acute kidney injury (AKI) , previously known as acute renal failure, is not a diagnosis, it rather describes the situation where there is a sudden & often a reversible loss of renal function, which develops over days or weeks & it is usually accompanied by reduced urine volume. The causes could be:
- 1-Pre-renal : when perfusion to the kidney is reduced (shock state).
- 2-Renal : the primary insult affects the kidney itself.
- 3-Post-renal : due to obstruction to urine flow at any point from the tubule to the urethra.
- In AKI due to pre-renal cause, if the reduction in perfusion with reduced GFR, is not corrected at proper time, it can cause renal injury in the form of acute tubular necrosis (ATN). It is caused by damage to tubular basement membrane seen on histologically.

CAUSES OF ACUTE KIDNEY INJURY

Causes of Acute Renal Failure



1 Prerenal
Sudden and severe drop in blood pressure (shock) or interruption of blood flow to the kidneys from severe injury or illness

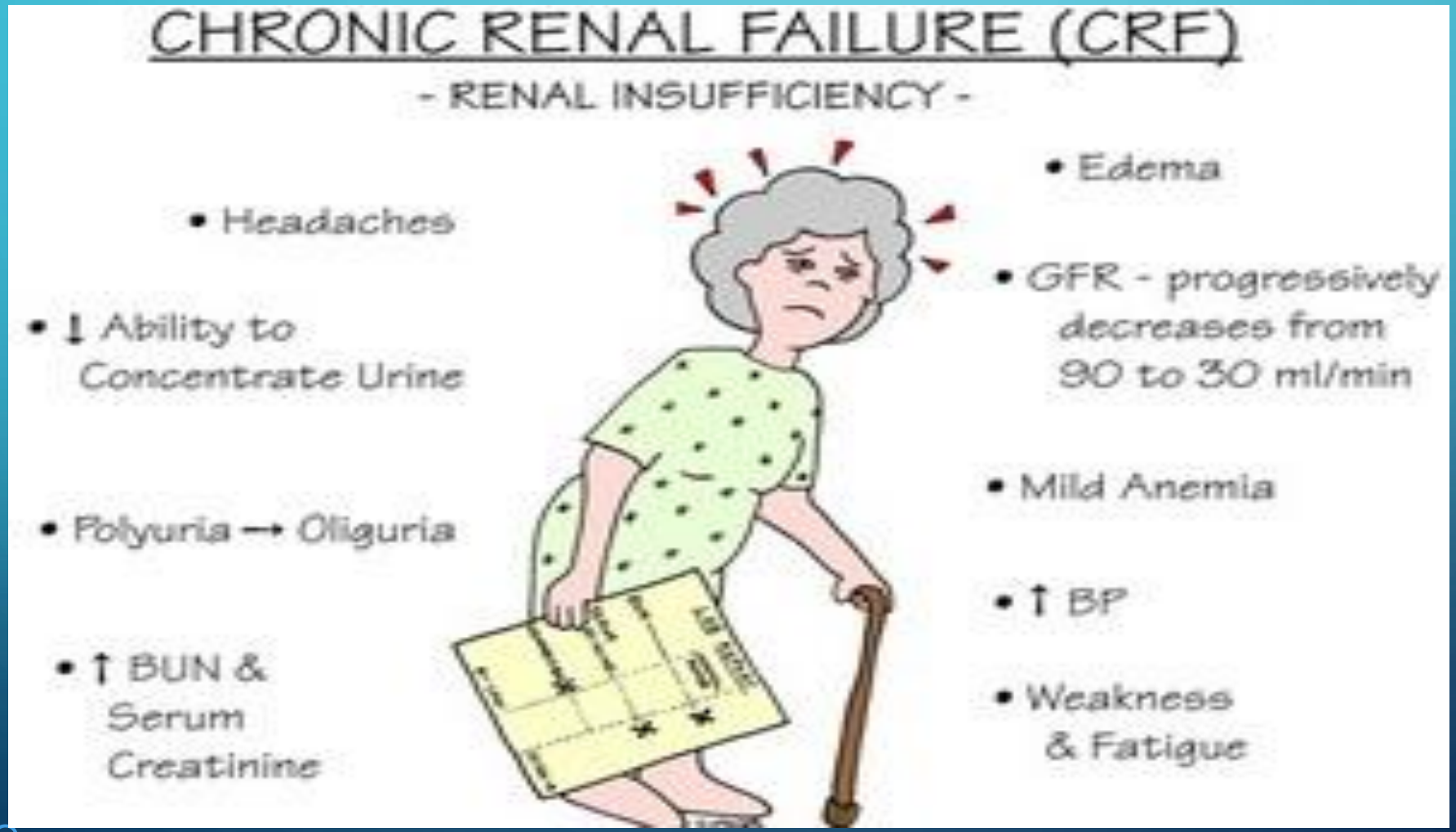
2 Intrarenal
Direct damage to the kidneys by inflammation, toxins, drugs, infection, or reduced blood supply

3 Postrenal
Sudden obstruction of urine flow due to enlarged prostate, kidney stones, bladder tumor, or injury

COMMON CAUSESES OF CHRONIC KIDNEY DISEASES

- 1-Diabetes mellitus . (20-40%).
- 2-Interstitial diseases . (20-30%).
- 3-Glomerular diseases . (10-20%).
- 4-Hypertension . (5-20%).
- 5-Systemic inflammatory diseases . (5-10%).
- 6-Reno-vascular diseases . (5%).
- 7-Hereditary & congenital diseases . (5%).
- 8-Other unknown . (5-20%).

CHRONIC RENAL FAILURE PATIENTS



GRADES OF CRF & DIABETIC KIDNEY DISEASE

G1	Normal or high	≥90
G2	Mildly decreased	60-90
G3a	Mildly to moderately decreased	45-59
G3b	Moderately to severely decreased	30-44
G4	Severely decreased	15-29
G5	Kidney failure	<15

Risk of CKD progression, frequency of monitoring, and referral to nephrology according to GFR (G) and albuminuria (A)				Albuminuria categories Description and range		
				A1	A2	A3
				Normal or modest increase in UACR	Microalbuminuria	Microalbuminuria
				UACR <30 mg/g	UACR 30-300 mg/g	UACR >300 mg/g
GFR categories (ml/min/1.73 m²) Description and range	G1	Normal or high	≥90	Screen	Treat (PM)	Refer and treat (PM)
	G2	Mildly decreased	60-89	Screen	Treat (PM)	Refer and treat (PM)
	G3a	Mildly to moderately decreased	45-59	Treat (PM)	Treat (PM)	Refer and treat (FM)
	G3b	Moderately to severely decreased	30-44	Refer and treat (PM)	Refer and treat (FM)	Refer and treat (FM)
	G4	Severely decreased	15-29	Refer and treat (FM)	Refer and treat (FM)	Refer and treat (FM)
	G5	Kidney failure	<15	Refer (FM)	Refer (FM)	Refer (FM)

Low risk of progression: no other markers of kidney disease, no CKD
Increased-to-high risk of progression: caution, PM
Very high risk of progression: caution, FM based on rate of disease progression and clinical stability of the patient

RENAL REPLACEMENT THERAPY

- 1-Hemodialysis: by creating A-V shunt before initiation of hemodialysis, synthetic (PTFE) or central venous catheters could be used, for short term.
- 2-Hemofilteration: In which large volume fluid could be removed across porous semipermeable membrane, under pressure.
- 3-Hemodiafilteration: combines hemodialysis with large volume ultrafiltration over 3-5 hour treatment.it uses large-pore membrane to remove medium-sized molecules (myoglobin or cytokines).
- 4-Peritoneal dialysis: mainly for CKD , though sometimes in AKI.
- 5-Renal transplantation: it needs HLA matched , ABO compatible donor.

INVESTIGATIONS OF NEPHROLOGICAL & UT DISORDERS

1-General urine examination: simple, bedside initial investigation testing for the volume, color, SG, sugar, protein, crystals, bacteria, RBCs & WBCs , presence of casts.

2- Blood biochemistry , acid-base & electrolyte level: usually are the initial & most important investigations used to assess the renal function. Bl.urea, S.creatinine, acid-base deficit & electrolyte level (K+, Na+ , Mg+2 & Ca+2) , with GFR (glomerular filtration rate) estimation. These tests also used for follow up of the patients.

3-Imaging studies: including ultrasound to assess the size , structure (polycystic kidney, renal Ca), presence of stone or obstructive uropathy are among the most important applications. Other imaging modalities such as contrast radiology (IVU), CT, MRI are also important tools for structural assessment of the kidneys , ureters, bladder & prostate . Renal angiography is used for detection of renal artery stenosis.

4- Renal biopsy: is important in cases of proteinuria for proper diagnosis of different types of glomerulonephritis, & for cases of graft-rejection.