

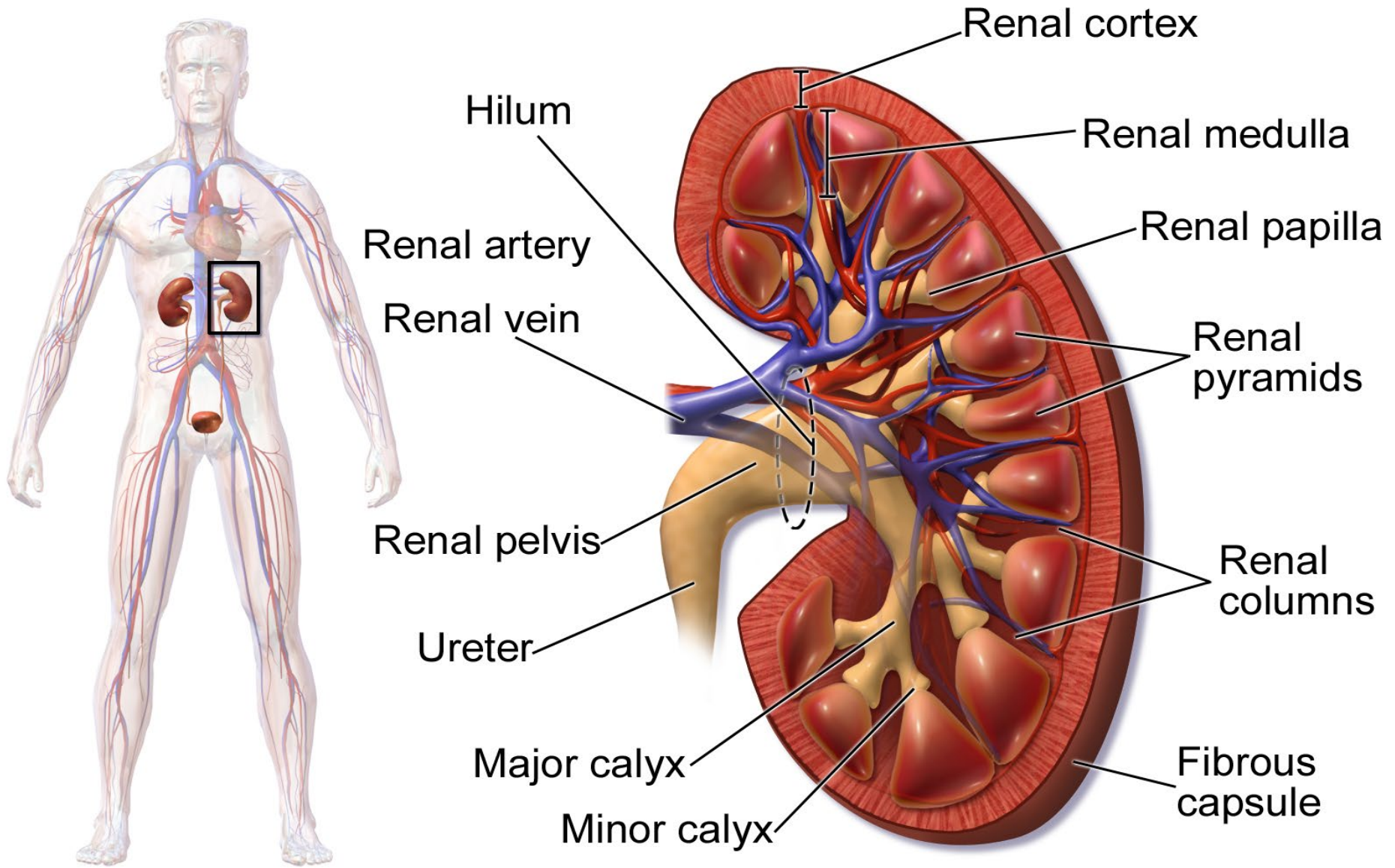
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Renal failure pathophysiology

The term renal failure means the inability of the kidneys to perform excretory function leading to retention of nitrogenous waste products from the blood.

Functions of the kidney

- . Blood **Electrolyte and volume regulation**
- . Excretion of **nitrogenous waste**
- . Elimination of exogenous molecules, for example, many **drugs**
- . Synthesis of a variety of hormones, for example, **erythropoietin**
- . Metabolism of low molecular weight proteins, for example, **insulin**



Kidney Anatomy

Equation/Formula

Cockcroft-Gault (mL/min)	Male: $[(140 - \text{age}) \times (\text{weight})]/72 \times \text{sCr}$ Female: $\text{GFR} \times 0.85$ BSA corrected: $\text{GFR}_{\text{cg}} \times (1.73/\text{BSA}) (= \text{mL/min}/1.73 \text{ m}^2)$
MDRD (mL/min/1.73 m ²)	Male: $170 \times (\text{sCr})^{-0.999} \times (\text{age})^{-0.176} \times (\text{sU})^{-0.170} \times (\text{sAlb})^{+0.318}$ Black male: $\text{MDRD} \times 1.180$ Female: $\text{MDRD} \times 0.76$ Black female: $\text{MDRD} \times 0.762 \times 1.180$
CKD-EPI (mL/min/1.73 m ²)	Male: $141 \times \text{minimum}(\text{sCr}/0.9, 1)^{-0.411} \times \text{max}(\text{sCr}/0.9, 1)^{-1.209} \times 0.993^{\text{Age}}$ Black male: $\text{CKD-EPI} \times 1.159$ Female: $141 \times \text{minimum}(\text{sCr}/0.7, 1)^{-0.329} \times \text{max}(\text{sCr}/0.7, 1)^{-1.209} \times 0.993^{\text{Age}} \times 1.018$ Black female: $\text{CKD-EPI (female)} \times 1.159$

Abbreviations: BSA, body surface area; CKD-EPI, Chronic Kidney Disease Epidemiology Collaboration; MDRD, Modification of Diet in Renal Diseases; Alb, serum albumin; sCr, serum creatinine; sU, serum uric acid.

According to the KDIGO criteria in 2012,

Acute kidney injury (AKI) can be diagnosed with any one of the following:

- (1) **Creatinine increase of 0.3 mg/dL in 48 hours,**
- (2) **Creatinine increase to 1.5 times baseline within last 7 days, or**
- (3) **Urine volume less than 0.5 mL/kg per hour for 6 hours.**

Chronic Renal Failure (CRF)

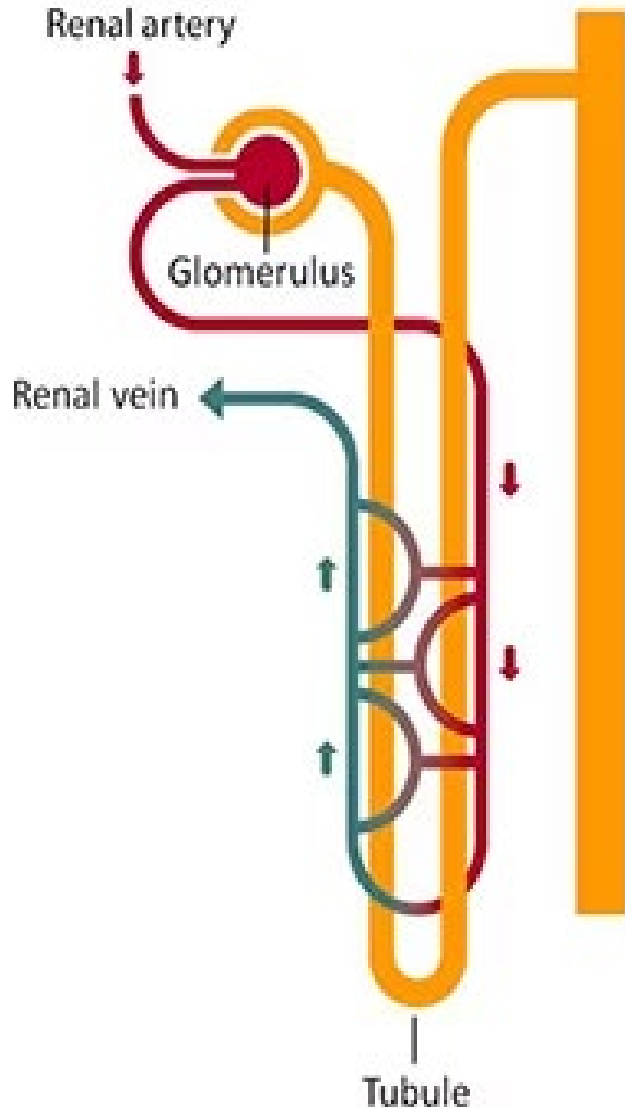
CRF or **chronic kidney disease (CKD)** is defined as a persistent impairment of kidney function.

abnormally **elevated serum creatinine for more than 3 months**

or calculated glomerular filtration rate (**GFR**) **less than 60 ml per minute / 1.73m².**

				mg/mmol	mg/mmol	mg/mmol
GFR Stages	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			

The Nephron



CKD grade classified

Grade 1: GFR > 90 **ml per minute / 1.73m²**

- . Grade 2: GFR =60 to 89
- . Grade 3a:GFR 45 to 59
- . Grade 3b: GFR 30 to 44
- . Grade 4: GFR 15 to 29
- . Grade 5: Less than 15

CAUSES OF ACUTE KIDNEY INJURY

Prerenal

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

- Blood loss
- Dehydration
- Heart failure
- Sepsis
- Vascular occlusion

Intrinsic Renal

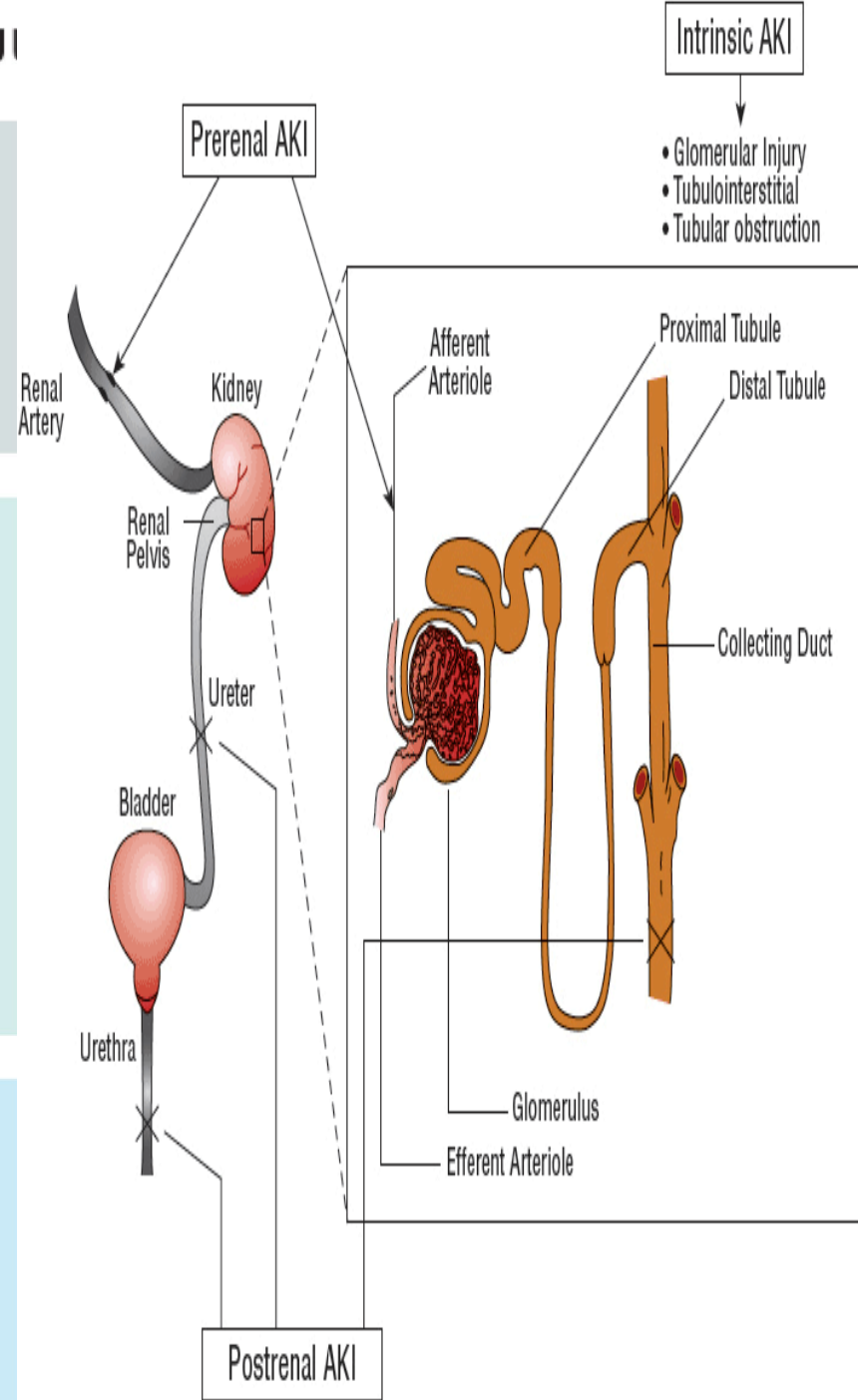
Direct injury to the kidneys by inflammation, drugs, toxins, infection, or reduced blood supply

- Acute tubular necrosis
 - Drugs
 - Toxins
 - Prolonged hypotension
- Glomerulonephritis
- Acute tubular necrosis
 - Drugs
 - Toxins
 - Autoimmune disease
 - Infection
- Small-vessel vasculitis

Postrenal

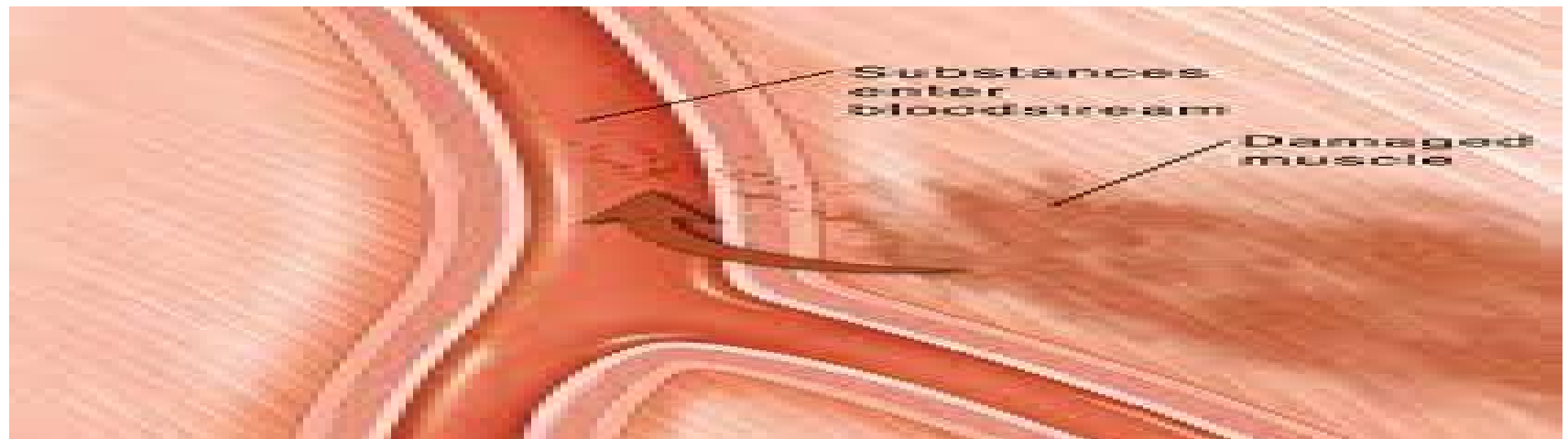
Sudden obstruction of urine flow due to enlarged prostate, kidney stones, bladder injury or tumor

- Benign prostatic hyperplasia
- Cervical cancer
- Meatal stenosis/phimosis
- Retroperitoneal fibrosis
- Prostate cancer
- Urinary calculi



Myoglobinuria, symptoms, test

Rhabdomyolysis



Chronic Renal Failure

- **Diabetes mellitus,**
- **Hypertension** is the second most frequent cause.
- **Glomerulonephritis.**
- **Polycystic kidney diseases.**
- **Renal vascular diseases.**
- **prolonged obstruction of the urinary tract, nephrolithiasis.**
- **Vesicoureteral reflux,**
- Recurrent kidney infections/ **pyelonephritis.**
- Unknown etiology.

CHRONIC RENAL FAILURE (CRF)

ESRD -END STAGE RENAL DISEASE

↓ 15 ml/min GFR



- Neurological
Weakness / Fatigue
Confusion

- Cardiovascular
↑ BP
Pitting Edema
Periorbital Edema
↑ CVP
Pericarditis

- Pulmonary
SOB
Depressed Cough
Thick Sputum

- GI
Ammonia Odor to Breath
Metallic Taste
Mouth / Gum Ulcerations
Anorexia
Nausea / Vomiting

- Psychological
Withdrawn
Behavior Changes
Depression

- Hematological
Anemia
Bleeding Tendencies
↑ Serum K

- Skin
Dry Flaky
Pruritus
Ecchymosis
Purpura
Yellow-Gray Skin Color

- Musculoskeletal
Cramps
Renal Osteodystrophy
Bone Pain

Hemodialysis

Evaluate access site for:
Patency & signs of infection
DO NOT take BP or obtain
blood samples from extremity
that has access site.

THANKS

