Definition:

• Renal injury (Proteinuria) and/or a GFR <60ml/min/1.73m.sq for more than 3 months.

• Prevelance: 18/million
STAGES OF CKD:

- **STAGE 1:** Kidney damage with normal or increased GFR.
  - GFR >90ml/min/1.73m.sq

- **STAGE 2:** Kidney damage with mild decrease in GFR.
  - GFR 60-89

- **STAGE 3:** Moderate decrease in GFR
  - GFR 30-59
• STAGE 4: Severe decrease in GFR.

• STAGE 5: kidney failure

• GFR 5-29

• GFR <15 or on dialysis
ETIOLOGY:

- YOUNGER THAN 5yrs OF AGE:
  1) Congenital abnormalities eg renal hypoplasia, dysplasia.
  2) Obstructive uropathy.
  3) Cortical necrosis.
  4) Congenital nephrotic syndrome.
  5) Prune belly syndrome.
  6) FSGS
  7) Polycystic kidney disease
  8) HUS
>5yrs of age:

1) Various forms of glomerulonephritis
2) Alport syndrome
3) Familial juvenile nephronophthisis
4) Metabolic disorders
   (cystinosis, hyperoxaluria)
5) Polycystic kidney disease
PATHOPHYSIOLOGY:

• HYPERFILTERATION INJURY:
Loss of nephrons $\rightarrow$ hypertrophy of remaining nephrons $\rightarrow$ increased glomerular blood flow $\rightarrow$ increased perfusion pressure $\rightarrow$ hyperfilteration $\rightarrow$ adverse effect on integrity of capillary walls.
PROTEINURIA:

- Direct toxic effect on glomerular capillary wall
- Recruits monocytes and macrophages → enhancing glomerular sclerosis and tubulointerstitial fibrosis.
UNCONTROLLED HYPERTENSION:
 Renal injury by arterial nephrocalcinosis
 Increased hyperfiltration injury

HYPERPHOSPHATEMIA:
 Calcium phosphate deposition in the renal interstitium and vessels

HYPERLIPIDEMIA:
 Oxidant mediated injury to glomeruli.
CLINICAL FEATURES

- Pallor, sallow face
- Edema, hypertension, hematuria
- Failure to thrive
- Short stature
- Bone and muscle pain
- Signs and symptoms of vol overload
LAB FINDINGS:

- Raised BUN and creatinine
- Hyperkalemia
- Hypocalcemia
- Hyperphosphatemia
- Metabolic acidosis
- Normocytic Normochromic anemia
- Proteinuria and hematuria
- Increased cholesterol and TGA
CALCULATION OF GFR:

- \( \text{GFR (ml/min/1.73m.sq)} = k \times \frac{\text{height (cm)}}{\text{serum creatinine (mg/dl)}} \)
- Value of \( K = 0.33 \) for LBW infants
- 0.45 for term AGA infants.
- 0.55 for children and adolescent females
- 0.70 for adolescent males
TREATMENT:

• Aims of treatment:

  1) replacing the absent / diminished renal function

  2) slowing the progression of renal dysfunction.
FLUIDE & ELECTROLYTE MANAGEMENT:

- Children with increased BP, edema or heart failure may require sodium restriction and diuretics.
- Patients with polyuria may require sodium supplementation.
- Hyperkalemia treated with restricted dietary potassium, Kaxylate, sodabicarbonate.
- Fluid restriction usually required only in patients on dialysis.
METABOLIC ACIDOSIS:

- Almost all children with CKD as a result of decreased net acid excretion.
- Bicitra (1 mEq Na citrate/ml)
- Sodabicarbonate tablets.
- Maintain serum bicarbonate levels > 22 mEq/L
NUTRITION:

- Optimal caloric intake in CKD is at least equal to RDA for age.
- Protein intake should be 2.5 g/kg/24hr.
- In infants, supplements may be added.
- NG intubation, gastrostomy, or overnight parenteral infusions may be needed if caloric intake remains inadequate and growth is suboptimal.
GROWTH:

- Children with CKD have growth hormone resistant state
- Treatment is by optimal caloric intake
- Effective treatment of anemia, metabolic acidosis and ROD
- Recombinant human growth hormone in initial dose 0.05 mg/kg/24hr subcutaneously.
RENAL OSTEODYSTROPHY:

- A wide spectrum of bone diseases seen in CKD patients.
- Most common in children is osteitis fibrosa cystica caused by secondary hyperparathyroidism.
- Characterized by muscle weakness, bone pain and fractures with minor trauma.
Pathophysiology:

- 50% decline in GFR $\rightarrow$ decreased functional renal mass $\rightarrow$ decreased production of activated vitamin D $\rightarrow$ decreased calcium absorption from gut $\rightarrow$ hypocalcemia $\rightarrow$ increased PTH $\rightarrow$ increased bone resorption.

- 20-25% of normal kidney func $\rightarrow$ loss of compensatory mech to enhance phosphate excretion $\rightarrow$ hyperphosphatemia $\rightarrow$ further hypocalcemia & increased PTH.
INVESTIGATIONS:

- Hypocalcemia
- Hyperphosphatatemia
- Increased Alkaline Phosphatase
- PTH normal or raised
- Radiographs show subperiosteal bone resorption with wide metaphysis.
TREATMENT:

- Low phosphorus diet and formulas.
- Phosphate binders to enhance fecal phosphate excretion.
- Vitamin D administration.
- 25-OH vit D below the normal range: treat with Ergocalcitol.
- Normal 25-OH D but increased PTH: treat with 0.01-0.05ug/kg/24hr of calcitriol.
ADYNAMIC BONE DISEASE:

• Associated with oversuppression of PTH bcz of widespread use of calcium and vit D.

• It is low turnover bone disease characterized by osteomalacia.
ANEMIA:

• CAUSES:

  1) inadequate Erythropoietin production in stage 3-4 CKD.
  2) Iron deficiency
  3) Folic acid & B12 deficiency
  4) Decreased erythrocyte survival.
Treatment of anemia:

- Recombinant human erythropoietin therapy should be initiated when the Hb falls below 10g/dl.
- 50-150mg/kg/dose subcutaneously 1-3 times weekly.
- All patients should receive oral or iv iron supplementation.
Benefits of rHuEPO therapy:

- Minimum blood transfusions
- Improved appetite
- Enhanced exercise tolerance
- Improved sleep.
- Improved well-being
- POTENTIAL COMPLICATIONS:
  - Iron deficiency, hypertension, seizures, thrombosis, pure red cell aplasia
HYPERTENSION:

• Caused by vol overload & excessive Renin production due to glomerular disease.

• TREATMENT:

1) Salt restriction (2-3 g/24hrs)

2) Diuretic therapy: hydrochlothiazide
   2mg/kg/24hr divided bid for stage 1-3 CKD.
   Frusemide 1-2 mg/kg/dose bid-tid drug of choice in stage 4 CKD
3) ACE inhibitors & ARBs are drug of choice for all patients with proteinuria bcz of their ability to slow progression to ESRD. Monitor RFTs & serum electrolytes while using these agents.

4) Ca channel blockers, beta blockers & centrally acting agents may be useful as adjunctive agents in resistant hypertension
IMMUNIZATIONS:

- Children with CKD should receive all standard immunizations.
- Yearly influenza vaccine
- Live vaccine should be with-held during treatment with immunosuppressive drugs.
- DRUG DOSE ADJUSTMENT: to minimize toxicity
END STAGE RENAL DISEASE (stage 5 CKD)

- The state at which renal replacement therapy becomes necessary for homeostasis & survival.

- **INDICATIONS OF DIALYSIS:**
  Fluid overload, electrolyte imbalance, acidosis, growth failure, & uremic sign symptoms.
  88% of infants & children upto 5 years receive peritoneal dialysis.
Peritoneal dialysis:

- It employs the patient's peritoneal membrane as a dialyzer.

ADVANTAGES:

- Ability to perform dialysis treatment at home.
- Technically easier specifically in infants.
- Less restrictive diet.
- Less expensive.
- Independence.
APD
HEMODIALYSIS:

- 54% of children older than 12 years are treated with hemodialysis.
- Dialyzer machine
- Access to circulation via surgically created AV fistula or subclavian/jugular catheter.
- Hospital procedure.
- 3 sessions /week.
THANK YOU!