Chronic kidney disease in children

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DEFINITION

Structural or functional abnormalities of the kidneys for ≥3 months, as manifested by either:

1. Kidney damage, with or without decreased GFR, as defined by
    - pathologic abnormalities
    - markers of kidney damage, including abnormalities in the composition of the blood or urine or abnormalities in imaging tests
2. GFR <60 ml/min/1.73 m^2, with or without kidney damage

CAUSES

- < 5 year old
  1. **CONGENITAL ANOMALIES**- Renal hypoplasia, dysplasia, congenital nephrotic syndrome, prune belly syndrome, PCKD, RVT, cortical necrosis
  2. **OBSTRUCTIVE UROPATHY**- PUV, PUJ obstruction
  3. HUS

- > 5 year old
  1. Acquired- **GLOMERULONEPHRITIS**
  2. Inherited- Juvenile nephronophthisis, Alport syndrome

- All age groups
  1. **METABOLIC DISORDERS**- cystinosis, hyperoxaluria
  2. Inherited- Polycystic kidney disease

DIAGNOSIS

- INITIAL TESTS
- CAUSE?
  - Ultrasonography, MRI
  - Radionuclide studies
  - Renal biopsy- histological study
- GFR?
  - Modified Schwartz formula:

$$GFR = \frac{K * \text{Height (in cm)}}{\text{Serum creatinine (mg/dl)}} \qquad K = 0.413$$

- ALBUMINURIA?
  - PCR, ACR
  - 24 Hr urinary protein

- CKD according to GFR (ml/min/1.73m)

Stage 1	>90	kidney damage with normal of increased GFR
Stage 2	60- 89	kidney damage with mild decrease in GFR
Stage 3	30-59	moderate decrease in GFR
Stage 4	15- 29	severe decrease in GFR
Stage 5 on dialysis	< 15 or	Kidney failure

COMPLICATIONS

- GROWTH RETARDATION
  a. Malnutrition, anemia
  b. Metabolic acidosis
  c. Bone disease
  d. Resistance to growth hormone
  e. Reduced levels of sex hormones
- ANEMIA
  a. Lack of erythropoietin
  b. Uremia
  c. Iron and folate deficiency
  d. Hyperparathyroidism causing myelofibrosis

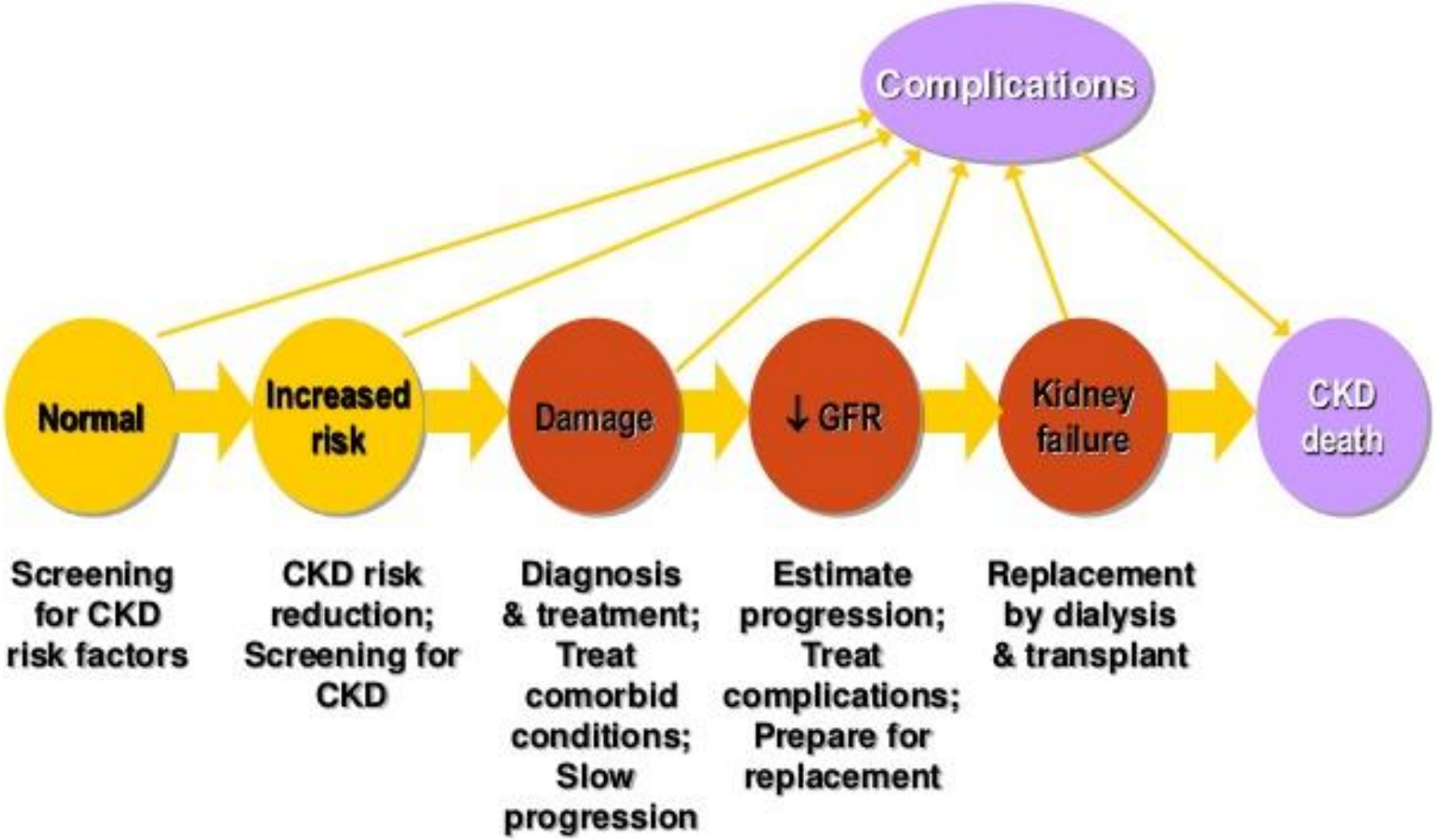
COMPLICATIONS

- MINERAL & BONE DISORDER (CKD-MBD)
  a. Decreased production of 1,25 DHD3
  b. Reduced excretion of Phosphorus
  c. Stimulation of PTH
  d. Adynamic lesions
  e. Metabolic acidosis
- METABOLIC ACIDOSIS
- HYPERKALEMIA
- NEUROLOGICAL ABNORMALITIES- Encephalopathy, hypotonia, truncal ataxia, peripheral neuropathy

COMPLICATIONS

- HYPERTENSION
- HYPERLIPIDEMIA
- INFECTIONS
- BLEEDING TENDENCY
- GLUCOSE INTOLERANCE
- PERICARDITIS, LEFT VENTRICULAR DYSFUNCTION

Stages in Progression of Chronic Kidney Disease and Therapeutic Strategies



RISK FACTORS FOR CKD

- VUR with recurrent UTI and renal scarring
- Obstructive uropathy
- Past H/O acute nephritis, nephrotic syndrome, HSP
- H/O renal failure in perinatal period
- Family H/O kidney disease
- Renal dysplasia or hypoplasia
- Low birth weight infants
- Diabetes, hypertension
- SLE, vasculitis

SLOWING PROGRESSION OF CKD

- Risk factors for progression of CKD:
  1. HYPERTENSION
  2. PROTEINURIA
- Target BP to be kept below 50th percentile, both systolic and diastolic.
- Treatment to be started when BP is consistently> 90th centile
- Target proteinuria <300 mg/ m^2/day @ at least 1g/day
- Drug of choice: ACE inhibitors or ARBs
- Dietary protein restriction- not recommended in children
- Control of hyperlipidemia (no data in children)
- Vitamin D analogs, Erythropoietin

LONG TERM MANAGEMENT

- NUTRITIONAL MODIFICATIONS:
  1. Supply RDA in normal children, 125% RDA in malnourished
  2. 55-60% carbohydrates, 30% fat, 10% proteins
  3. In top fed infants, use special formulae with high calorie, low Sodium and Phosphorus
  4. Use high biological value proteins, supplement extra 0.4g/kg/day children on haemodialysis and 0.8 on peritoneal dialysis
  5. If dyslipidemia present, restrict fats to <10%
  6. Supplement vitamins to maintain RDA, extra if on dialysis
  7. Restrict dietary phosphorus to 80-100% RDA
  8. Restrict salt intake to 0.8-1g/day in hypertensive

LONG TERM MANAGEMENT

- TREATMENT FOR GROWTH FAILURE:
  - Assesment of growth every 6 months in CKD children, 1-3 monthly in children with polyuria, severe malnutrition, growth failure and on dialysis
  - Recombinant Human Growth Hormone therapy 0.05mg/kg/day (30IU/ m^2 /week) S/C daily
  - Look for side effects- hyperglycemia, worsened MBD, Pseudotumor cerebri
- TREATMENT OF ACIDOSIS
  - Maintain serum HCO3 level of 20-22meq/l
  - Oral bicarbonate supplement @ 2-3meq/kg if level falls below15meq/l

LONG TERM MANAGEMENT

- MANAGING MINERAL BONE DISEASE:
  - Annual monitoring of serum Ca, P, and PTH in CKD stage2 onwards, 3-6 monthly in advanced disease
  - Step 1- normalise Phosphate level by dietary restriction (800-1000mmg/day), Calcium carbonate or acetate (P binder) 30-60mg/day
  - In case of hypercalcemia, Aluminium hydroxide or Sevelamer hydrochloride to be used as binder
  - Document Vitamin D deficiency, and then give therapeutic dose plus maintenance
  - Vitamin D analogs to be used in stage 5 CKD, persistent high PTH with normal Ca and Phosphorus
  - Orthopaedic interventions

LONG TERM MANAGEMENT

- EVALUATION & TREATMENT OF ANEMIA:
  - Check Hb% when clinically indicated in early CKD, annuallly in stage G3, semiannually in GFR<30 patients
  - Above stage 3, routine supplementation of Iron & Folic Acid
  - Evaluate for iron deficiency if anemic, start oral iron 2-6 mg/kg/day
  - Patient on haemodialysis- IV iron 1-2mg/kg/week
  - In refractory cases, start Erythropoietin @30-300U/kg/week followed by 60-600U/kg/week maintenance
  - Do not exceed Hb > 13g/dl

LONG TERM MANAGEMENT

- Treat AKI precipitating factors urgently
- Treat intercurrent infections promptly using antibiotics in renal doses, avoiding nephrotoxic drugs
- Immunisation- HepB, pneumococcal vaccines, annual influenza vaccines. *Live vaccines contraindicated after transplant
- Renal replacement therapy- Peritoneal dialysis or haemodialysis
- Renal transplant