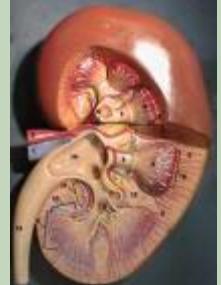


Chronic Kidney Disease

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What is Chronic Kidney Disease (CKD)?



- Kidney damage for 3 months or more
- Structural / functional abnormalities
- GFR normal or decreased
- Manifesting as –
 - pathological abnormalities
 - markers of kidney damage - blood, urine, imaging

Classification of CKD

Stage	Description	GFR ml/min
1	Normal GFR + other evidence of CKD*	>90
2	Mild Impairment	60-89
3	Moderate Impairment	30-59
4	Severe Impairment	15-29
5	End Stage Kidney Disease (ESKD)	<15 or on dialysis

- * persistent microalbuminuria
- persistent proteinuria
- persistent haematuria
- structural abnormalities of kidneys
- biopsy-proven chronic GN

Estimating GFR

- Cockcroft-Gault Equation –
 - using serum creatinine, age, weight & sex
- 4-variable Modification of Diet in Renal Disease (MDRD) equation
- CKD EPI equation

- eGFR generally more accurate than measured GFR (24 hour creatinine clearance)
 - no collection problems

Causes of CKD



- *Congenital & Inherited* – PCKD
- *Glomerular Disease* – Primary GN
Secondary GN → **DM, SLE**
- *Vascular Disease* – **HPT**
- *Tubulo-interstitial Disease* –
nephritis, reflux, TB, Myeloma
- *UT Obstruction* – calculi, prostatic disease

Epidemiology of CKD



- 60 million people worldwide have some degree of CKD
- USA – CKD prevalence is 11% of adult population
- Worldwide incidence & prevalence have doubled over last decade → Reaching epidemic proportions
- Probably reflects increasing incidence of **DM, HPT & ageing** of populations

CKD in Sri Lanka



- Diabetes & Hypertension increasing
- North Central province – CKD due to unknown aetiology (?fluoride, pesticides, heavy metals, snake bite)
- Prevalence of CKD not known
- Set to increase in future

History

- Duration of symptoms
- Drugs – NSAIDs, ayurvedic preps
- Past medical & surgical history – DM, HPT
- Family history of renal disease – PCKD
- Any previous test results – UFR, s.creatinine

Symptoms

- Early stages → asymptomatic
- Usually become symptomatic when
 $\text{s.urea} > 40 \text{ mmol/l}$
- Initially vague symptoms – malaise, lethargy, LOA, insomnia
- Itching
- Nausea, vomiting, diarrhoea
- Nocturia, polyuria

Symptoms

- Oedema – peripheral, pulmonary
- Paraesthesia, ‘restless legs’ syndrome
- Metabolic bone disease - bone pain, tetany
- Anaemia
- Amenorrhoea/ impotence

- Late (CKD stage 5) –
mental slowing, clouding of consciousness, fits
myoclonic twitching

- Terminal - oliguria

Signs

- Short stature – if CKD since childhood
- Pallor
- Increased pigmentation
- Brown nails
- Scratch marks
- Fluid overload signs → oedema, pleural effusions
- Pericardial rub
- Flow murmurs → regurgitation
MR, AR, PR
- Rarely – peripheral sensory loss



Anaemia

- Pallor
- Lethargy
- Breathlessness on exercise

Platelet abnormality

- Epistaxis
- Bruising

Skin

- Pigmentation
- Pruritus

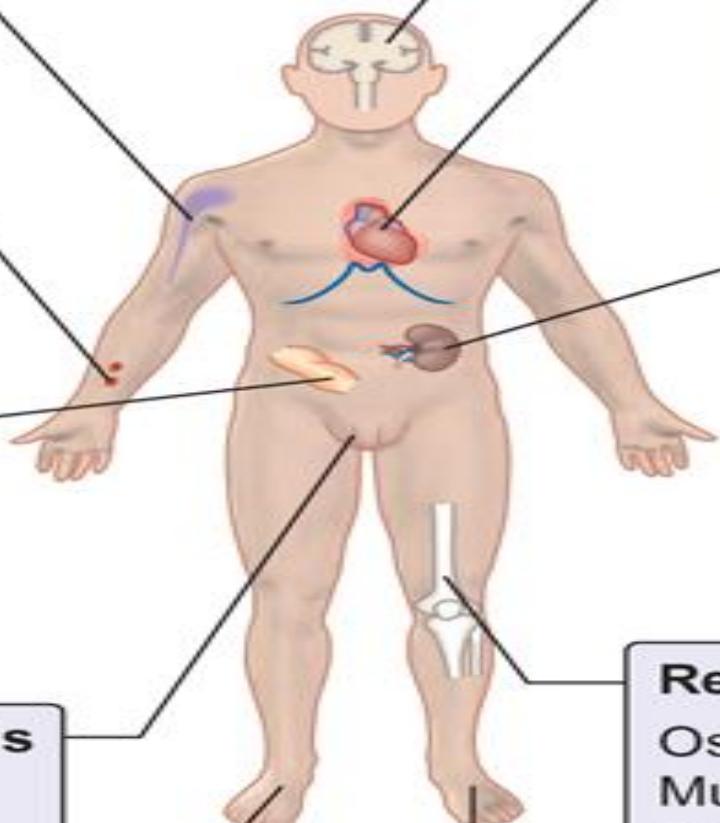
GI tract

- Anorexia
- Nausea
- Vomiting
- Diarrhoea

Endocrine/gonads

- Amenorrhoea
- Erectile dysfunction
- Infertility

Polyneuropathy



CNS

- Confusion, coma, fits (severe uraemia)

CVS

- Uraemic pericarditis
- Hypertension
- Peripheral vascular disease
- Heart failure

Renal

- Nocturia
- Polyuria
- Salt and water retention

Oedema

Renal osteodystrophy

- Osteomalacia
- Muscle weakness
- Bone pain
- Hyperparathyroidism
- Osteosclerosis
- Adynamic bone disease

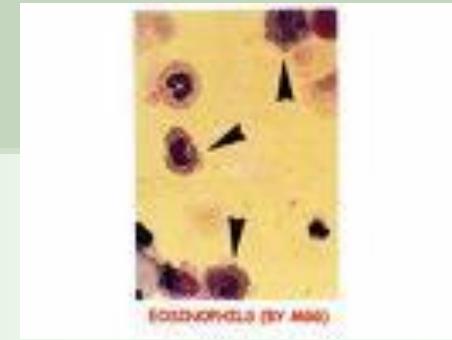
- Kidneys usually NOT palpable - exceptions
- Always do PV/PR – obstruction
- Look for signs of underlying disease –
vasculitic rashes, diabetic & hypertensive
retinopathy
- PVD with renal artery stenosis
- Check BP – lying & standing
- Check hydration status –
CVP, skin turgor, state of peripheral circulation

Method of Investigation

- Tests to –
 - confirm uraemia
 - determine underlying cause
 - assess complications
- Tests to determine progression
 - s.creatinine, BU, SE, creatinine clearance, FBC

Investigations

- Urinalysis –
RBC, protein, glucose
- Urine microscopy –
WBC, granular casts, Eosinophils
RBC, red cell casts
- Urine biochemistry –
creatinine clearance
24-hour urine protein
osmolality, electrophoresis
- Serum biochemistry –
urea
creatinine
electrolytes
protein electrophoresis



More Investigations

- ESR
- FBC
- Blood picture
- Arterial Blood Gas – PH, Bicarbonate
- Calcium & phosphate
- FBS, HbA1c
- Urine culture, ASOT
- Hepatitis B & C status, HIV status
- Complement levels
- Autoantibodies – ANA, dsDNA, ANCA



Imaging

- Chest X-ray –
cardiac size, effusions
- X-ray KUB –
stones, nephrocalcinosis
- US Scan – must be done in all
to exclude hydronephrosis
renal sizes, cysts
- *IVU, CT scan, MRI, Angiogram*



■ Renal Biopsy

Must if unexplained renal failure with normal sized kidneys

Suspected RPGN – do biopsy soon

■ ECG & Echocardiogram

Complications of Chronic Kidney Disease

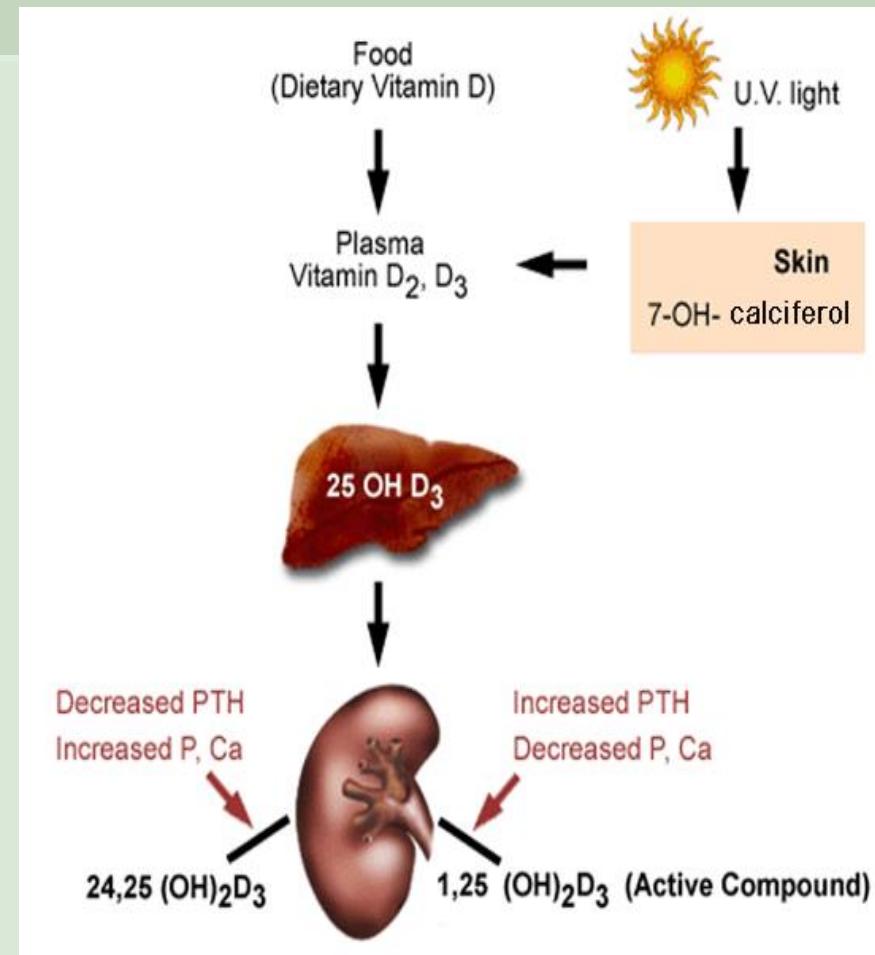
- **Anaemia**
- **Renal osteodystrophy**
- **Cardiovascular disease**
- Skin
- GIT
- Metabolic
- Endocrine
- Muscle dysfunction
- Neurological

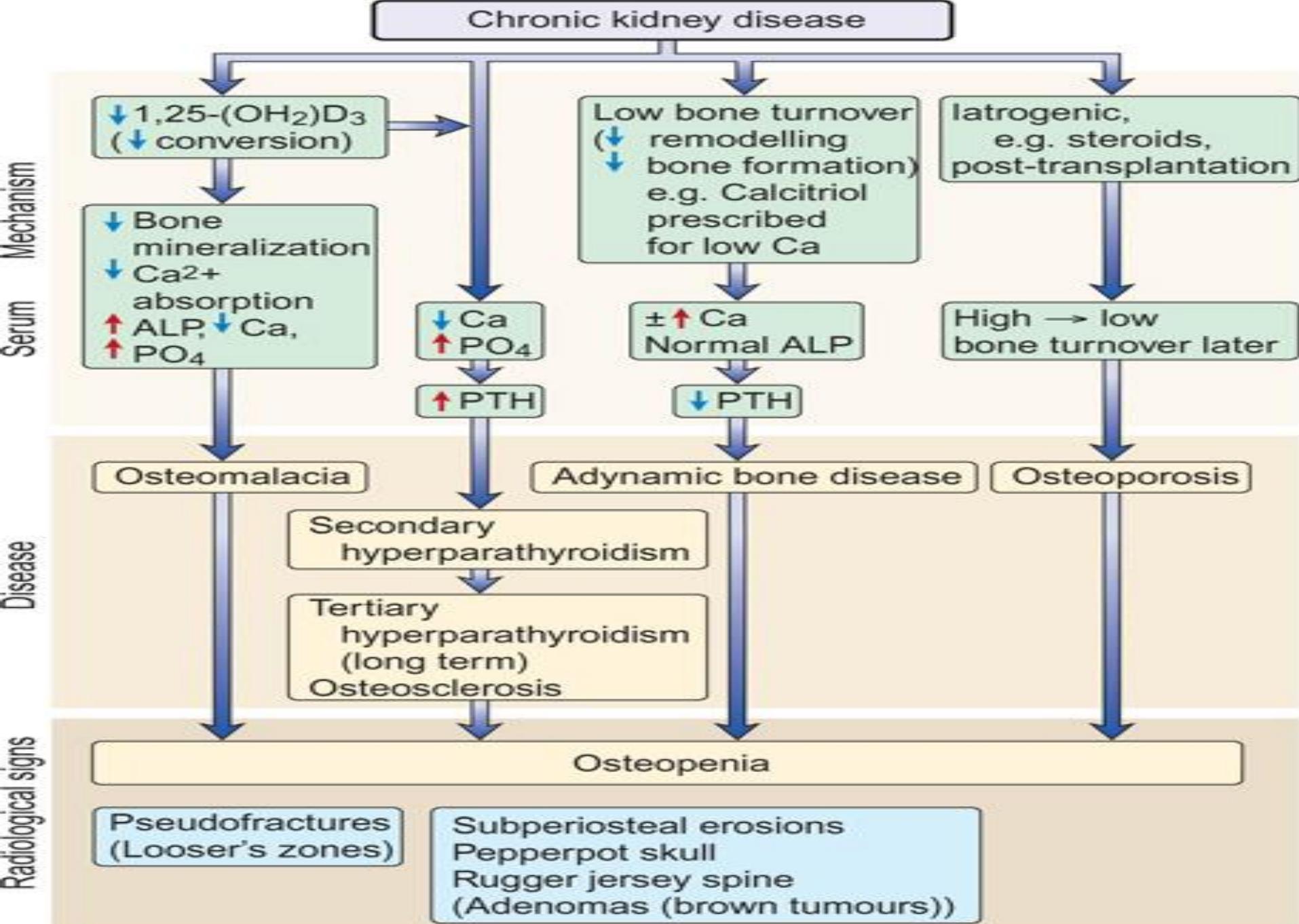
Causes of Anaemia in CKD

- Erythropoietin deficiency
- Bone marrow toxins
- Bone marrow fibrosis
- Haematinic deficiency
- Increased RBC destruction
- Abnormal red cell membranes
- Increased blood loss
- ACE inhibitors

Renal Osteodystrophy

- Hyperparathyroid bone disease
- Osteosclerosis
- Osteomalacia
- Osteoporosis
- Adynamic bone disease
- Many patients clinically asymptomatic – high risk of fracture



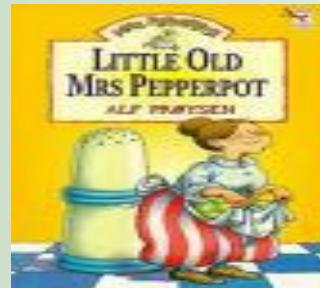


Hyperparathyroidism

- ↓ renal production of 1 α -hydroxylase
- ↓ 1,25 (OH)₂ D₃ → ↑ PTH release
- Gut calcium mal-absorption
- ↓ renal phosphate excretion
- ↑ osteoclastic activity, cyst formation & bone marrow fibrosis → *osteitis fibrosa cystica*
- ↑ ALP

X-rays in Hyperparathyroidism

Subperiosteal erosions



Pepperpot skull



Brown tumours

Osteosclerosis



- Increased bone density
- Due to long standing hyperparathyroidism
- ‘Rugger jersey’ spine on X-rays



Osteomalacia

- Deficiency of 1,25 (OH)₂ D₃ & hypocalcaemia → impaired osteoid mineralization
- Aluminium inhibiting osteoblasts
- Low/normal ALP
- ‘Looser zones’ on X-rays
- Causes rickets in children



Adynamic bone disease

- Depressed bone formation & resorption
- Pathogenesis unclear
- Many renal failure patients have ‘mixed’ bone disease – hyperparathyroidism & osteomalacia

Cardiovascular disease

- **Greatly increased risk of CVD –**
MI, CCF, sudden cardiac death, stroke
- Coronary artery calcification
- **Hypertension**
- **Cardiac hypertrophy**
due to HPT, anaemia & obesity
- Systolic & diastolic cardiac dysfunction

Cardiovascular disease

- Vascular calcification in all vessels –
↑ atherosclerosis risk
- Hyperparathyroidism contributes



- **Pericarditis** –
due to Uraemia – severe uraemia or
under-dialysis
Dialysis – intercurrent illness



- **Hypercholesterolaemia** –
Increase CVD risk
Treated with statins

Skin Disease

- Pruritus

Common

Due to – retention of nitrogenous waste products

hypercalcaemia

hyperphosphataemia

↑ CaXPO₄ product

hyperparathyroidism

iron deficiency



- Dry skin

- Eczema (sp near AV fistula)

- PCT & Pseudo-porphiria



GI Diseases

- Reflux oesophagitis
- Peptic ulceration
- Acute pancreatitis
- Constipation (sp in CAPD)

Gout



- Due to urate retention
- NSAIDs better avoided – nephrotoxic
- Acute attack → Colchicine
- Prophylaxis → Allopurinol (at reduced dose)

Endocrine Abnormalities

- Hyperprolactinaemia → galactorrhoea
- ↑ LH
- ↓ Testosterone → impotence
- Absence of normal cyclical changes in female sex hormones → oligo/amenorrhoea
- GH abnormalities
- Thyroid hormone abnormalities

Nervous System Disease

- Severe uraemia → depressed cerebral function, convulsions, tremors, myoclonus
- Dialysis disequilibrium – due to cerebral swelling
- Dialysis dementia – due to aluminium
- Carpal tunnel syndrome – due to amyloidosis
- ‘Restless legs’ syndrome - in uraemia
- Polyneuropathy

Progression of CKD

- CKD due to any cause, once established, will progress to ESKD
- Rate of progression varies –
Depends on - underlying disease
 hypertension
 proteinuria
- Good DM & HPT control
- Use of ACE Inhibitors

Initial Management

- **Recognize acute kidney injury**

Rapid deterioration of renal function over hours or days

Requires emergency treatment

ALL patients with newly detected abnormal renal function assumed to have AKI until proven otherwise – many will have CKD

- **Treat underlying cause of CKD if possible**

Management of CKD

- Control BP
- Correct hyperkalaemia & acidosis
- Normalize calcium & phosphate
- Diet & fluid restrictions
- Drug therapy
- Correct anaemia
- Dialysis
- Transplantation

Blood Pressure Control

- Target – <140/90
- ACE Inhibitors, ARBs
- Calcium channel blockers
- Diuretics
- Many require multiple anti-hypertensive agents
- Good BP control will prevent / reverse LVH

Biochemical Abnormalities

■ **Hyperkalaemia –**

- restrict dietary potassium
- stop potassium-retaining drugs
- emergency management
- ion-exchange resins
- dialysis

■ **Acidosis –**

- sodium bicarbonate supplements
- calcium carbonate
- dialysis

Calcium & Phosphate Management

- Treat ↓ calcium & ↑ phosphate
- Check PTH regularly
- Restrict dietary phosphate

- Oral **calcium carbonate**
- Aluminium containing gut phosphate binders – short term only
- **Sevelamer** – gut phosphate binder
- **Calcitriol**
- Vitamin D analogues – **alfacalcidol**
- **Calcimimetics**

(vitamin D may worsen hyperphosphataemia)

TOP 10 CALCIUM FOODS

DrAxe.com

1 Raw Milk



300 mg
(30% DV)
1 CUP

2 Yogurt or Kefir



300 mg
(30% DV)
6 OZ

3 Kale (cooked)



245 mg
(24% DV)
1 CUP

4 Cheese



224 mg
(22% DV)
1 OZ

5 Sardines (with bones)



217 mg
(21% DV)
2 OZ

6 Broccoli (cooked)



93 mg
(9% DV)
1 1/2 CUPS

7 Okra



82 mg
(8% DV)
1 CUP

8 Almonds



76 mg
(8% DV)
1 OZ

9 Bok Choy



74 mg
(7% DV)
1 CUP

10 Watercress



41mg
(4% DV)
1 CUP

What are high phosphorus foods?

- Dairy products such as milk, cheese, custard, cottage cheese, yogurt, ice cream, pudding



- Nuts, seeds, peanut butter



- Dried beans and peas such as baked beans, black beans, chick peas, garbanzo beans, kidney beans, lentils, limas, northern beans, pork and beans, split peas and soybeans



- Bran cereals, whole grain products



- Beverages such as cocoa, ale, beer, chocolate drinks, and dark cola drinks



What are low phosphorus foods?

- Fresh fruits such as apples, apricots, blackberries, grapes, tangerines, pears, peaches, pineapple, plums and strawberries



- Fresh vegetables such as cauliflower, carrots, cucumber, celery, green beans and broccoli



- Popcorn, crackers



- Rice cereal



- Sherbert



- Coffee or tea without milk, light-colored sodas (such as ginger ale), fruit juices

Dietary Restrictions

- Reduced potassium & sodium
- Low phosphate diet
- Advanced disease – reducing protein intake may delay symptoms of uraemia but may cause malnutrition
- Avoid fluid depletion & overload
- Majority with moderate disease do NOT need fluid restriction

High Potassium Foods

FRUITS



Oranges



Orange Juice



Bananas



Apricot



Kiwi



Pear



Nectarine



Cantaloupe/
Melon



Dried Fruit: Dates,
Figs, Prunes &
Prune Juice



VEGETABLES



Dried Beans,
Peas & Lima Beans



White & Sweet
Potato (baked,
boiled, mashed)



French Fries



Potato Chips



Mushrooms



Avocado



Pumpkin



Asparagus



Tomato



Winter Squash

OTHER



Peanuts, Almonds & Pecans



Milk



Coffee, Cocoa



Tomato Sauce/
Spaghetti Sauce



Salt
Substitute



Chocolate

Use of Drugs in CKD

- Avoid nephrotoxic drugs –
tetracyclines, NSAIDs
- Caution when using drugs excreted by kidneys –
check levels – Gentamicin
- Refer BNF if in doubt, *sp in advanced disease*

Management of Anaemia



- Investigate & correct treatable causes
 - gut blood loss
- **Haematenics** – iron, B12, folate
- **Synthetic Erythropoetin therapy** –
 - using recombinant human erythropoetin
 - given sc or iv 3 X week
 - target Hb 10-12 g/dl
 - may need iv iron supplements
 - expensive, may ↑ BP

Management of Anaemia

- Correcting anaemia improves quality of life, exercise tolerance, sexual & cognitive functions & LVH
- **Avoid blood transfusions –**
sensitization to HLA Ag is a barrier to kidney transplantation

Renal Replacement Therapy in ESKD

- **Refer to Nephrologist early –**
 - CKD Stage III
 - rapid progression
- Age is not a barrier to RRT, if patient is generally fit
- Pre-dialysis counseling
- Creating AV fistulae
- Options – Haemodialysis
 - Peritoneal dialysis
 - Kidney transplant

Summary

- CKD increases in prevalence exponentially with age
- Most common causes - DM & vascular disease
- Early CKD → all do NOT progress to ESKD
but have increased risk of CVD
- Progression of CKD is associated with proteinuria & uncontrolled HPT

Summary

- Recognize AKI
- Treat underlying causes of CKD
- Treat complications of CKD
- RRT