

Approach to Chronic Kidney Disease

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تأليف

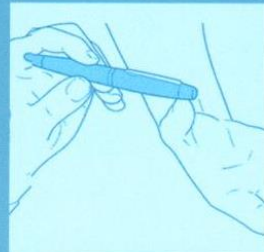
نيكولاس ج. تالي سيمون أوكونر

كتاب الفحص

الإكلينيكي الجيبي

ترجمة

أ.د. جمال بن صالح الوكيل



جامعة الملك سعود

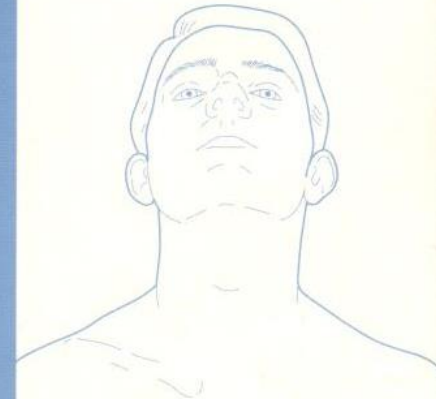
النشر العلمي والمطابع



NICHOLAS J TALLEY
SIMON O'CONNOR

POCKET CLINICAL EXAMINATION

SECOND EDITION



Chronic Kidney Disease

Objective

- Epidemiology of CKD
 - Definition of CKD
 - Classification
 - Symptoms, signs and complications
 - Management of CKD

What is the prevalence of chronic kidney disease?

- a. From 1 % to 3 %
- b. From 10% to 16%
- c. From 5 % to 8%
- d. Age dependent

Prevalence of CKD

- **CKD in aged ≥ 20 yrs is $>10\%$ - 16%**
- **The prevalence of CKD increases with age:**
- **4% at age 29-39 y**
- **47% at age >70 y**
- **The majority of cases are stage 3**
- **mortality in patients with CKD was 56% greater than that in patients without CKD.**
- **The 5-year survival rate for a patient undergoing long-term dialysis in the United States is approximately 35%**

Patients in replacement therapy in SA in 2016

Tx. Pts 2017 11,509

Total HD Pts. 2017 18270

Year : 2018 | Volume : 29 | Issue :
4 | Page : 1012-1020

In 2017, Peritoneal Dialysis a total of 1,389 patients

2016 Total No 26225 pt

2017 Total No 31168 pt

mean total cost of dialysis per patient per year was 46,332 USD (173,784 SR)

Total 1,215,056,700 SR *

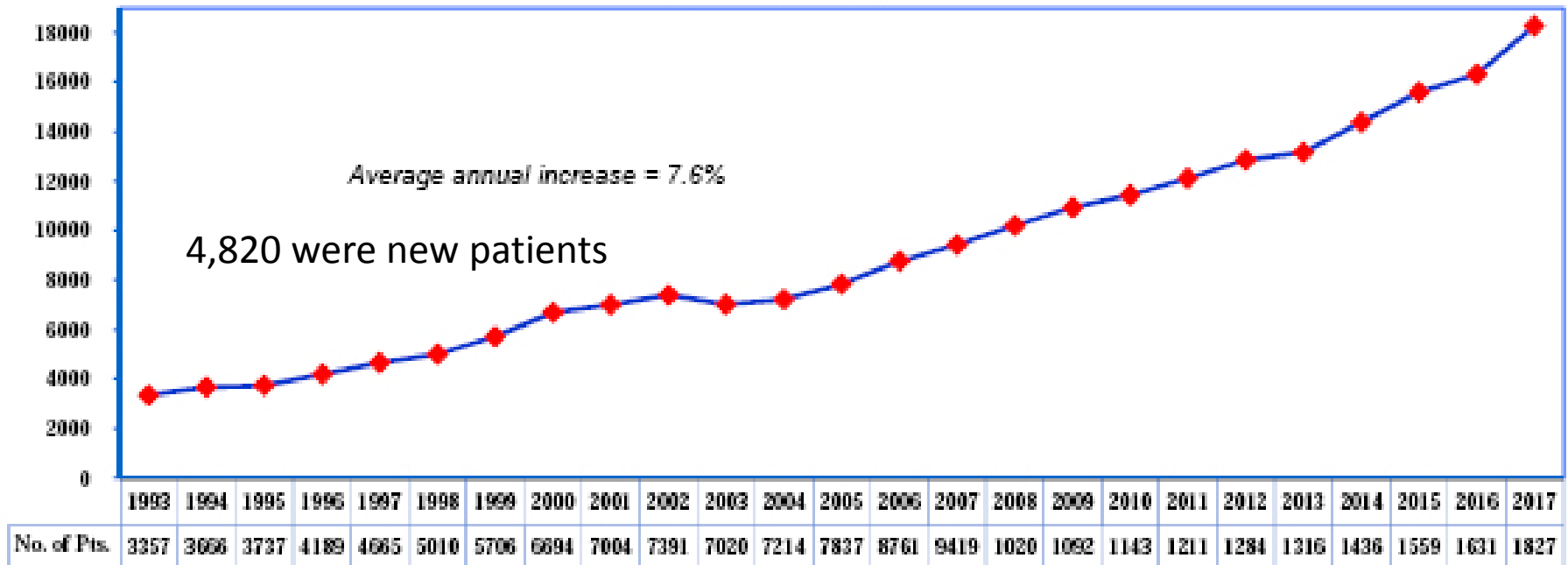
Kalid Al Saran, Alaa Sabry

*audi J Kidney Dis Transpl 2012;23(1):78-82

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4.7% increase in new hemodialysis patients. in 2016

Dialysis Population - Net Annual Increase 1993 - 2017



- Dialysis in the Kingdom of Saudi Arabia. Saudi J Kidney Dis Transpl [serial online] 2018 [cited 2020 Mar 17];29:1012-20. Available from: <http://www.sjkd.org/text.asp?2018/29/4/1012/239666>

Risk Factors CKD

Which of following are risk factors for CKD (more than one answer)??

- TB infection
- History of colon cancer
- Smoking
- History of SLE
- Obesity

Risk Factors CKD

Diabetes Mellitus 30%

Hypertension 25%

Old age 50%

Low GFR
AKI

Obesity

Cardiovascular
disease

NSAID

Family History

Smoking

Cause of Renal Failure	N	%
Diabetic Nephropathy	6535	40%
Hypertensive Nephropathy	6211	38%
Unknown Etiology	1100	7%
Primary Tubulo Interstitial Disease	491	3%
Obstructive Uropathy	339	2%
Hereditary Renal Disease	279	2%
Congenital Malformation	271	1.6%
Vasculitis	215	1%
Primary Glumerular Disease	128	1%
Pregnancy Related	73	0.4%
Others	673	4%
Total	16,315	100%

Table 4.8. Causes of end-stage renal disease in HD patients 2016

chronic Kidney disease can be diagnosed ??

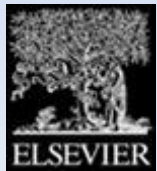
- a. If the patient have ultrasound shows scaring in the kidney
- b. If patient have only proteinuria but normal serum Cr
- c. If the patient have high serum creatinine.
- d. If the patient have proteinuria and hematuria with low eGFR



Kidney International Supplements 2017 7, 1-59DOI: (10.1016/j.kisu.2017.04.001)

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Kidney damage

Structural abnormalities

Structural abnormalities detected by imaging

Abnormalities detected by histology
History of kidney transplantation

Functional abnormalities

Albuminuria
Electrolyte and other abnormalities
Urine sediment abnormalities
tubular disorders

GFR < 60
ml/min/1.73 m²

for ≥ 3 months

Staging of chronic kidney disease depend on ?

- a. Measurement of serum creatinine
- b. Measurement creatinine clearance
- c. Estimated GFR
- d. Urine albumin creatinine ratio
- e. Causes of chronic kidney disease

KDIGO recommendation -classified based on:(CGA)

- Cause
- **Stage of CKD** (GFR category)
- Albuminuria category

KDIGO recommendation -classified based on:(CGA)

- Cause
- **Stage of CKD** (GFR category)
- Albuminuria category

CKD Classification

Estimation and Measurement of GFR

Estimate and/or Measure GFR

Filtration Markers (Endogenous)

Creatinine Clearance (CrCl)

Cystatin C
Polypeptide
chain of 120 amino acids

eGFR equations
eCKD- EPI cr
eCKD-EPI-cyc

[Chronic Kidney Disease Epidemiology
Collaboration \(CKD-EPI\)](#)

[Modification of Diet in Renal Disease \(MDRD\)
Study equation](#)

Calculators



National **Kidney** Foundation™

CKD-EPI Creatinine Equation

Preferred method

MDRD Study Equation

CKD-EPI Cystatin and Creatinine 2012 Equation

Cockcroft-Gault Formula

Revised Bedside Schwartz Formula

For ages 1 - 17



National Kidney Foundation™

Press Here for Clinical Use and Formula

S_{cr}:

mg/dL

Age:

years

Gender:

Male

Female

Race:

Black

Other

eGFR:

Clear All

mL/min/1.73 m²

CKD – EPI Calculation

Calculators CKD-EPI



National Kidney Foundation™

Press Here for Clinical Use and Formula

S_{Cr}: 100 umol/L

Age: 65 years

Gender: Male Female

Race: Black Other

eGFR: 68 mL/min/1.73 m² Clear All

Calculators CKD-EPI



National Kidney Foundation™

Press Here for Clinical Use and Formula

S_{Cr}: 100 umol/L

Age: 65 years

Gender: Male Female

Race: Black Other

eGFR: 51 mL/min/1.73 m² Clear All

Staging

The stages of CKD are classified as follows

- **Stage 1:** Kidney damage with normal or increased GFR (>90 mL/min/1.73 m²) **Normal or high**
- **Stage 2:** Mild reduction in GFR (60-89 mL/min/1.73 m²) **Mildly decreased***
- **Stage 3a:** Moderate reduction in GFR (45-59 mL/min/1.73 m²)
- **Stage 3b:** Moderate reduction in GFR (30-44 mL/min/1.73 m²)
- **Stage 4:** Severe reduction in GFR (15-29 mL/min/1.73 m²)
- **Stage 5:** Kidney failure (GFR < 15 mL/min/1.73 m² or dialysis)

Stages of chronic kidney disease



- The majority of cases are stage 3

KDIGO recommendation -classified based on:(CGA)

- Cause
- Stage of CKD (GFR category)
- Albuminuria category

Albuminuria categories as follows:

*note that where albuminuria measurement is not available, urine reagent strip results can be substituted

Albuminuria categories in CKD

Category	AER (mg/24 hours)	ACR (mg/mmol)	ACR (mg/g)	TERMS
		approximate	equivalent	
A1	< 30	<3	<30	Normal to mildly increased
A2	30-300	3-30	30-300	Moderately increased*
A3	>300	>30	>300	Severely increased**

*Relative to young adult level

** Including nephrotic syndrome (albumin excretion usually > 2200 mg/24 hours [ACR .2220/g; >220 mg/mmol])¹

**Prognosis of CKD by GFR
and albuminuria categories:
KDIGO 2012**

**Persistent albuminuria categories
description and range**

A1

Normal to
mildly
increased

<30 mg/g
<3 mg/mmol

A2

Moderately
increased

30–300 mg/g
3–30 mg/mmol

A3

Severely
increased

>300 mg/g
>30 mg/mmol

**GFR categories (mL/min/1.73 m²)
description and range**

G1

Normal or high

≥90

G2

Mildly decreased

60–89

G3a

Mildly to moderately
decreased

45–59

G3b

Moderately to
severely decreased

30–44

G4

Severely decreased

15–29

G5

Kidney failure

<15

Notes: Green indicates low risk (if no other markers of kidney disease, no CKD); yellow indicates moderately increased risk; orange indicates high risk; red indicates very high risk. Reprinted with permission from Macmillan Publishers Ltd: *Kidney Int Suppl.* 2013;3:1–150. Kidney Disease Improving Global Outcomes (KDIGO). 2012 clinical practice guidelines for the evaluation and management of chronic kidney disease. Copyright © 2013.¹⁵

Abbreviation: CKD, chronic kidney disease.

History

- History of major complain
- History of present illness
 - Upper urinary tract
 - Lower urinary tract
 - **History of uremia**
 - Systemic review (arthritis ,ch infection ,hepatitis)
 - History of hypertension(cause, duration, control, medication, complication)
 - Diabetes Mellitus(type, duration, control, medication, complication)

History

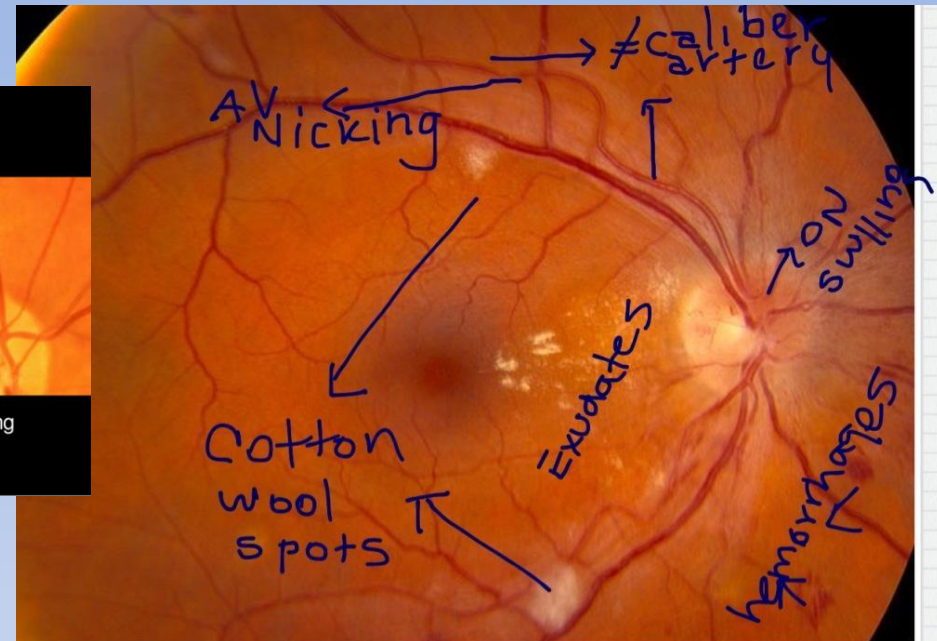
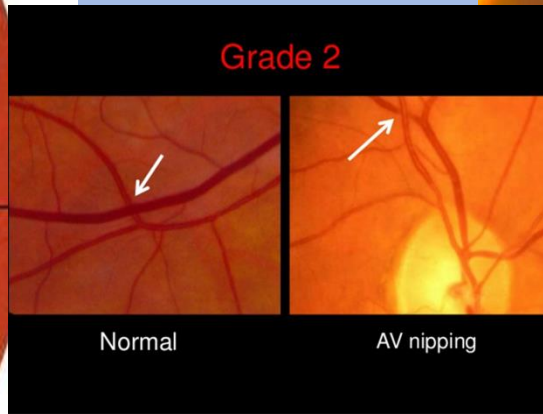
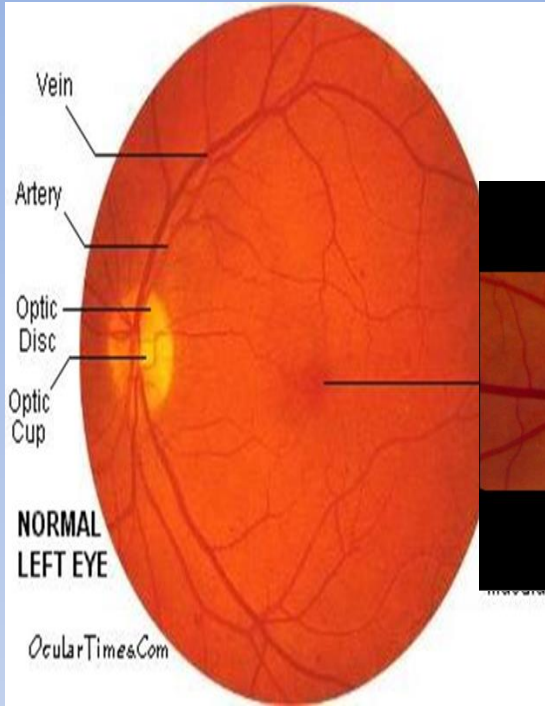
- Systemic review
- Past Medical illness+ hospitalization
- Surgical
- Medication
- Family
- Social
- Allergy+ medication side effect

Examination

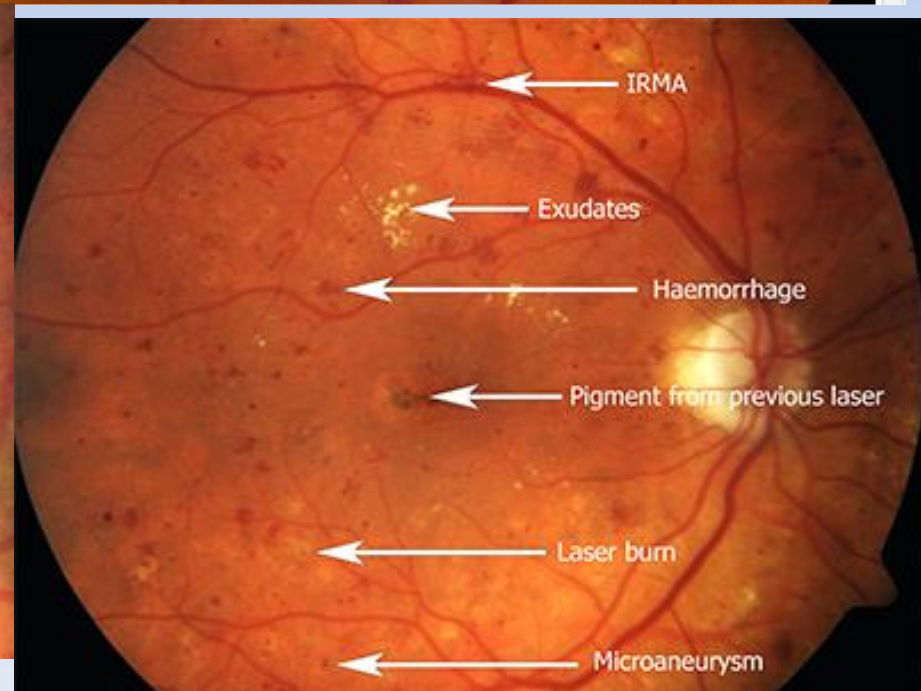
- General look
- Vital sign
- General examination
- Cardiovascular JVP
- Respiratory
- Abdominal
- CNS



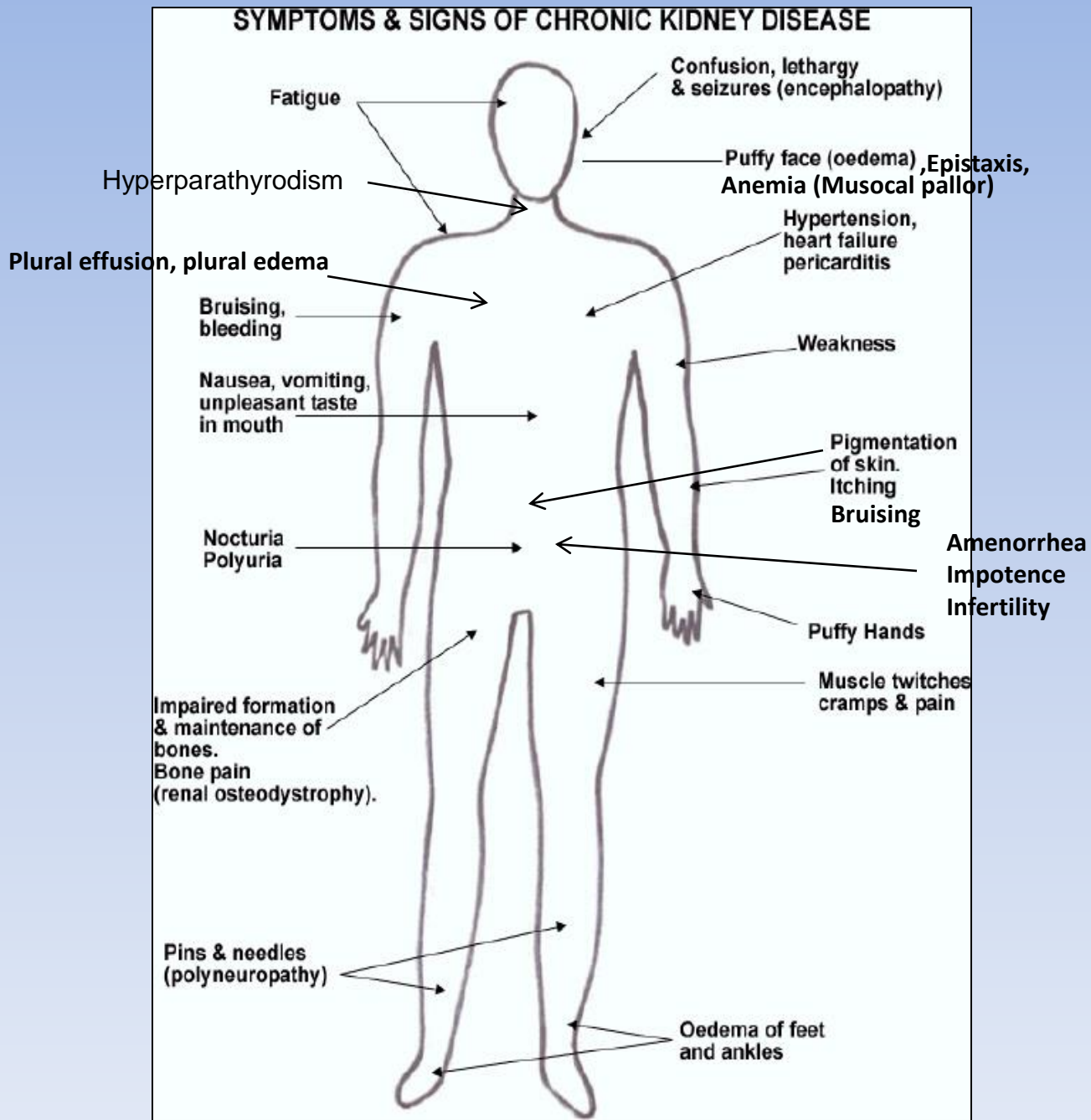
Fundus examination



Online Journal of Ophthalmology - www.cnjoph.com



Signs and Symptoms



Which of the following is essential investigation for CKD ?

- Urine electrolyte
- pT, PTT, INR
- Calcitonin & parathyroid hormones
- Kidney Biopsy
- Na,K,Ca, Phosphorus,urea and Cr

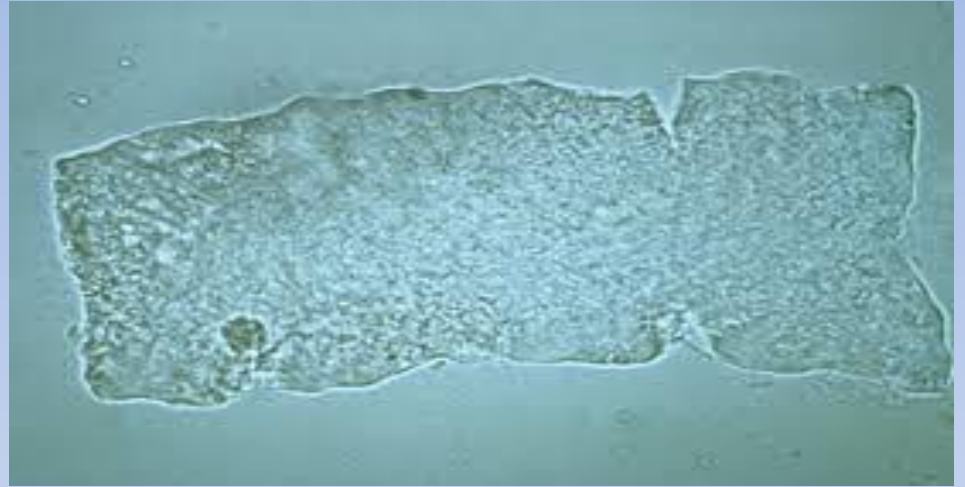
Investigations of CKD

- **Investigations of diagnosis of CKD**
- **Investigations *to diagnose the cause of CKD***
- ***Investigation to diagnosis the complications of CKD***

Investigations of CKD

Basic Laboratory to the diagnosis of CKD can include the following:

- Complete blood count (CBC)
- Biochemistries(Na, K, Urea, Cr, HCO_3 , Ca, PO_3 , Uric, Albumin, Alk ph)
- Urinalysis
- 24 hour urine collection Creatinine clearance and proteinuria
- Urine albumin:creatinine ratio
- Glucose
- Lipid profile: increased risk of cardiovascular disease



Investigations of CKD

Laboratory studies used in the diagnosis the cause of CKD

HbA1c

ANA

HBsAg

HCV.

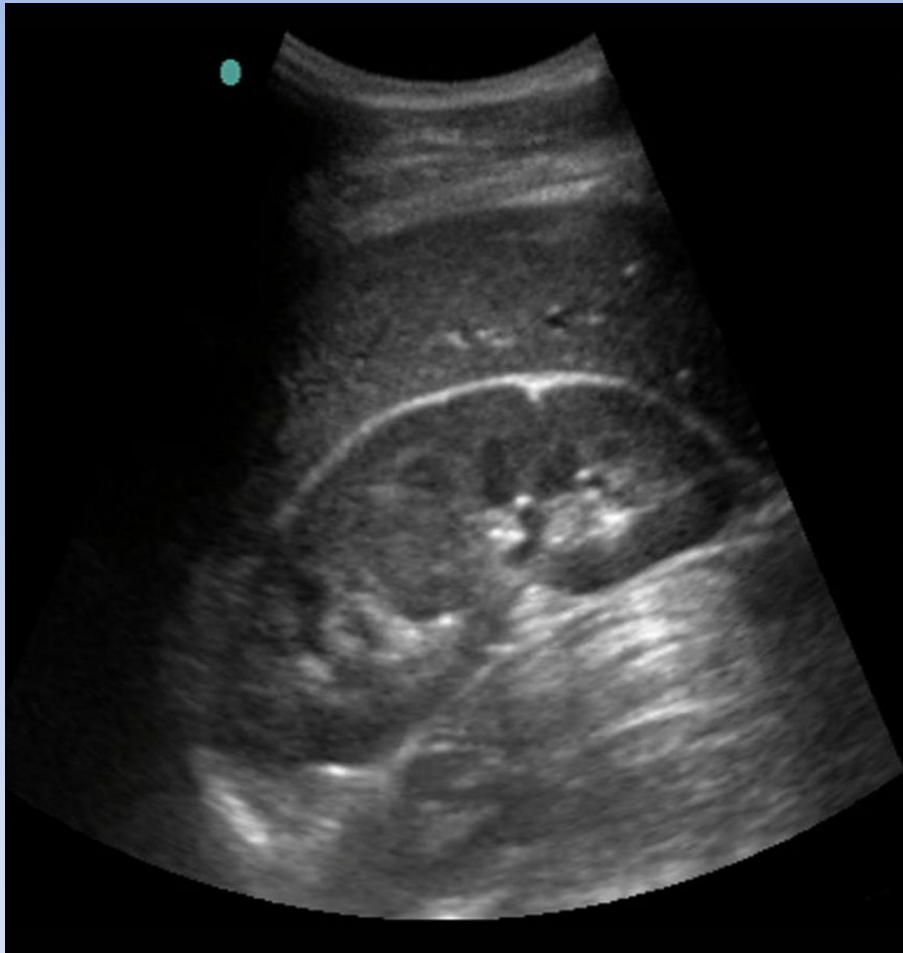
C₃,C₄

Renal Biopsy

CT, MRI, and Radionuclide Scans

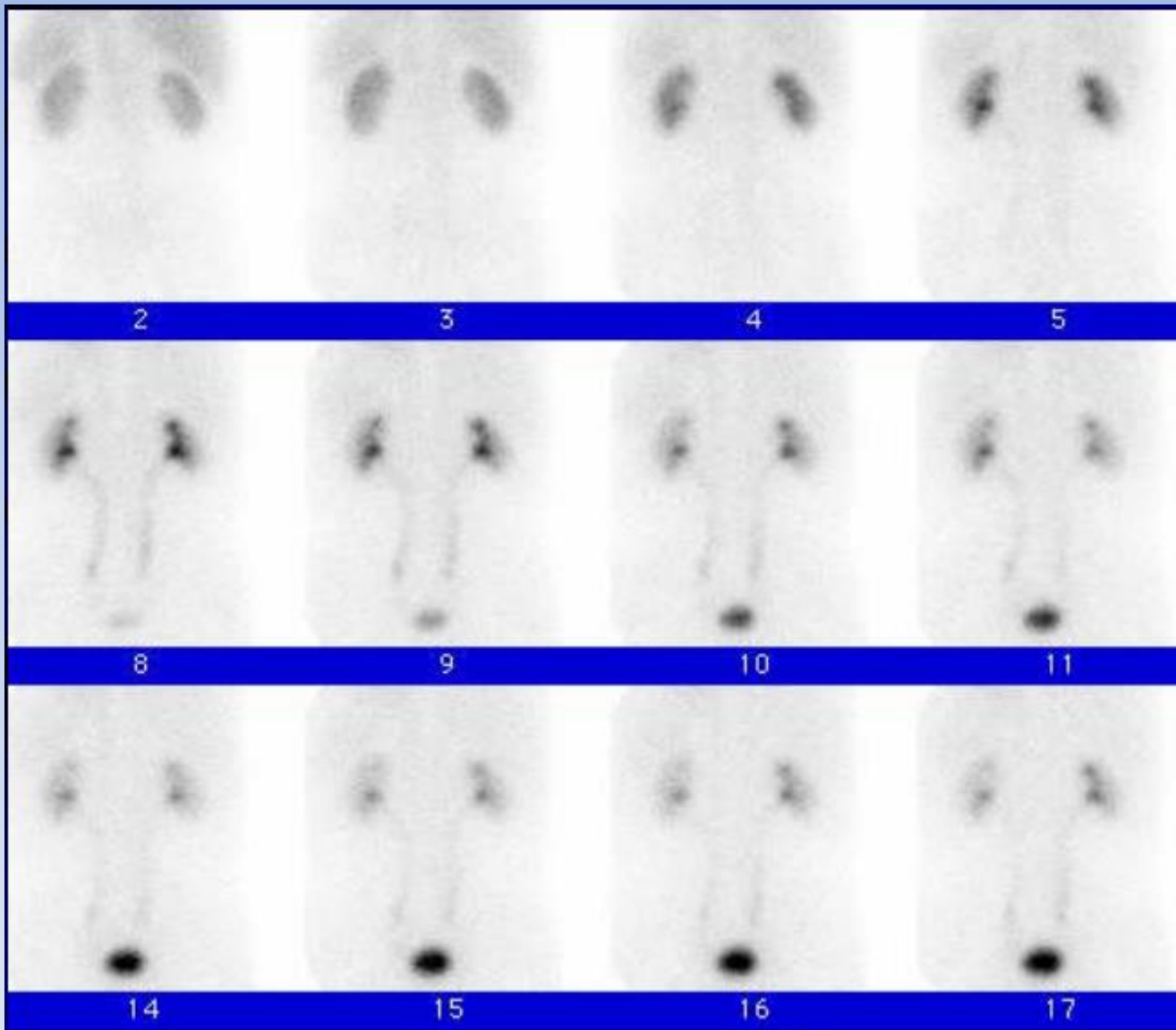
- Renal Ultrasonography : initial imaging
- CT, MRI: Intravenous (IV) should be avoided
-
- Radionuclide Scans: assist GFR & obstruction
 Tc^{99m} MAG3 and Tc^{99m} DTPA. **Tc^{99m} DMSA**

Investigation



Small w increase
echogenicity

- Normal size kidneys – 12 cm
- Normal Echogenicity



Investigation to the diagnosis the complications of CKD

PTH

VIT D₃

ECH

ECG

Diagnosis of CKD

- Different
 - ✓ Acute Kidney Injury form
 - ✓ CKD

Differentiating between acute and chronic kidney disease

Treatment of chronic kidney disease??

- a. The treatment usually able to cure chronic kidney disease
- b. Its slow progressive of chronic kidney disease
- c. It include treatment of hypertension and reduce proteinuria
- d. Alkalosis should be treated in chronic kidney disease

Prevention & Slow progress of CKD

Glycemic Control

BP control

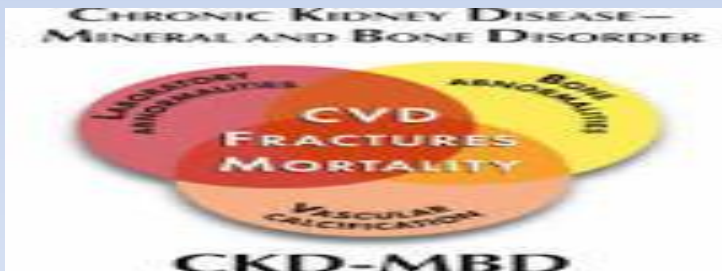
Proteinuria & RAAS

Diet
Protein, PO₃ & salt

Correct Acidosis

Avoid
Nephrotoxic Drug

Hyperlipidemia



Target Blood Pressure in CKD

$\leq 130/80$

Diabetics and Non-diabetics

Diabetics and Non-diabetics		
Albuminuria		Drug of choice
A1 <30 mg/d		CBC, Diuretic, RAAS
A2 >30 mg/d		ARB or ACE-I

No B-blocker

Reduce proteinuria

- Low salt diet
- Inhibit renin-angiotensin system (RAS) by Angiotensin-Converting-Enzyme Inhibitor (ACE Inhibition) or angiotensin-II-receptor blocker (ARB)

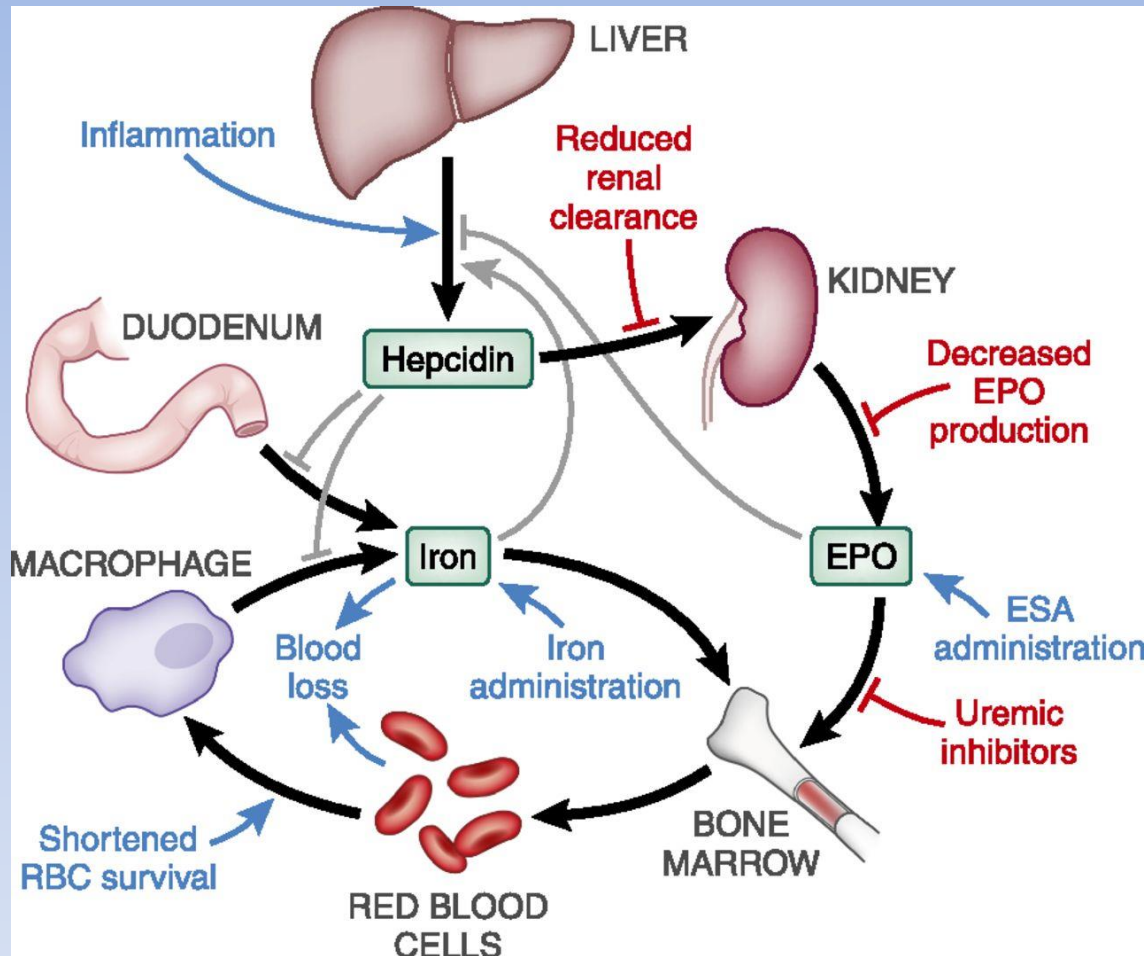
Renal Diet

- Low salt diet – 2.4-3 g/day
- Low potassium diet
 - (2g-2.5 g), half of normal intake
- Low protein diet - 0.6 to 0.8 g/kg per day
- Low phosphorous diet – 800 – 1000 mg/day
- Water intake – daily water intake 1.5-2 L
- Restricted Magnesium

Treatment of Complications

- **Volume overload:**
 - restrict SALT
 - loop diuretics
- **Metabolic acidosis:**
 - oral alkali supplementation

Anemia in CKD



Causes
Decrease EPO
Increase Hepcidin- iron
Bone marrow suppression
Shortened RBC survival



In chronic diseases, high **hepcidin** production inhibits iron release from macrophages and intestinal absorption of iron. This consequently induces an **anemic** condition.

Treatment of anemia

- **Anemia**: *hemoglobin level* ↓10 g/dL –
check iron -iron Tablet or IV
erythropoiesis-stimulating agents (ESAs)
 - ✓ epoetin alfa
 - ✓ darbepoetin alfa
 - ✓ Methoxy polyethylene glycol-epoetin
beta(Mircera)

Hyperkalemia

- Cause :
- Reduce GFR
- ARBs (angiotensin II receptor blockers). ...
- ACE (angiotensin converting enzyme) inhibitors. ...
- Spironolactone
- High K diet

Asymptomatic & weakness & Arrhythmia

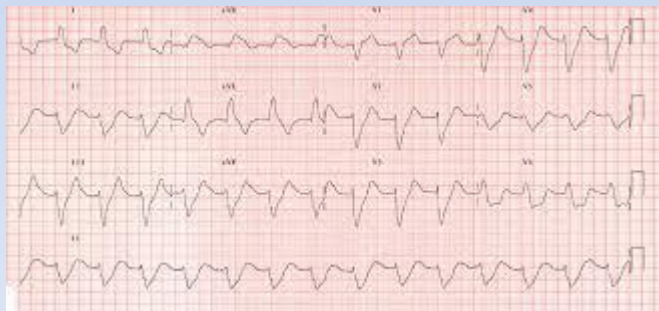
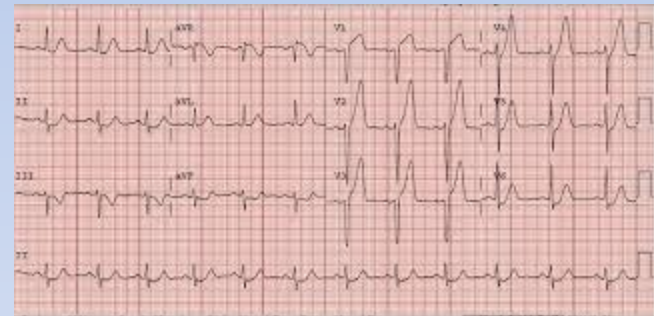
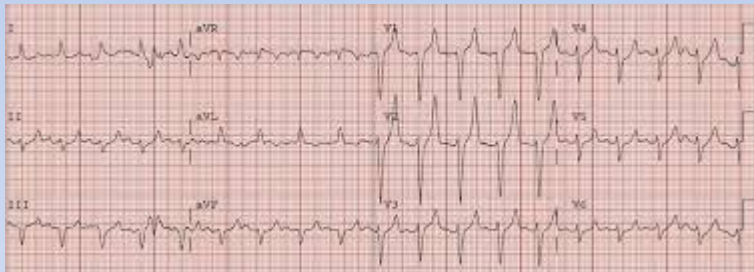
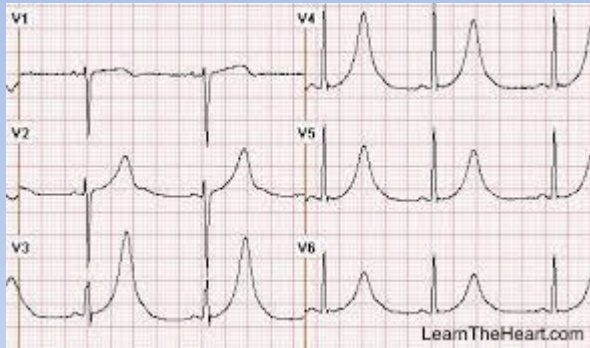
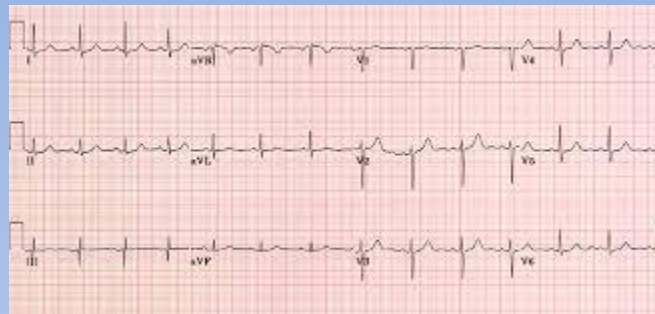
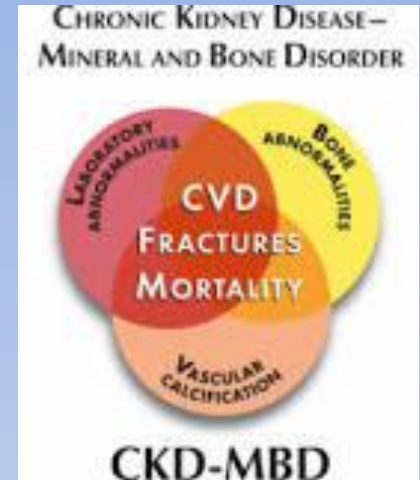


Table 1. Emergency management of acute hyperkalemia

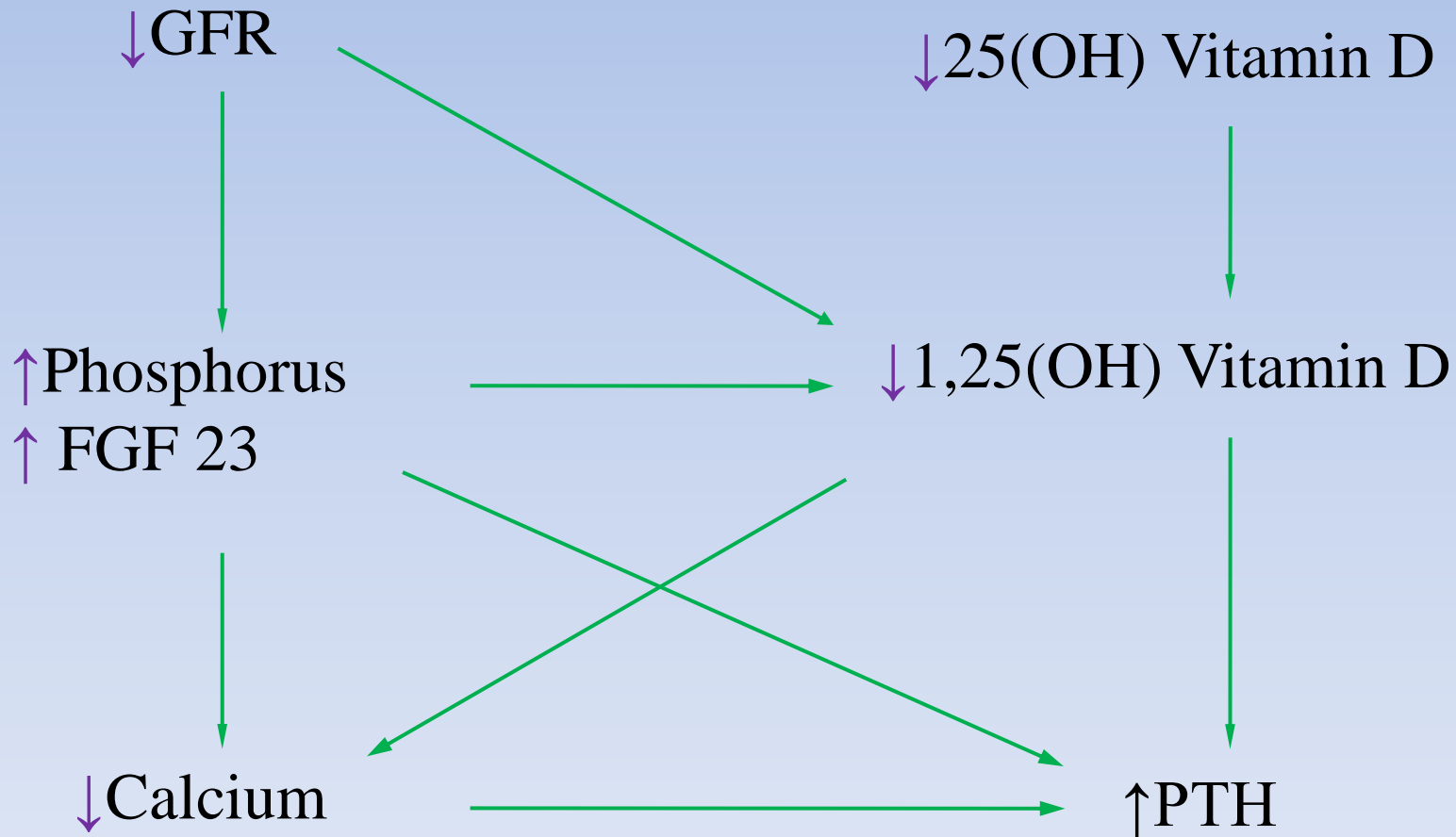
<i>Medication</i>	<i>Response Type</i>	<i>Onset of action</i>	<i>Duration of action</i>	<i>Mechanism of action</i>	<i>Expected decrease in potassium level</i>
Calcium gluconate	rapid	1-2 min	30-60 min	Protect cardiomyocytes	
Glucose + insulin	intermediate	10-20 min	2-6 hours	Shift potassium intracellularly	0.5-1.5 mEq/L (dose dependent)
Beta-agonist	intermediate	3-5 min	1-4 hours	Shift potassium intracellularly	
Sodium bicarbonate	intermediate	30-60 min	2-6 hours	Shift potassium intracellularly	
Exchange resin	delayed	2-6 hours	4-6 hours	Elimination of potassium from the body	
Furosemide	delayed	5-30 min	2-6 hours	Elimination of potassium from the body	
Hemodialysis	delayed	immediate		Elimination of potassium from the body	1mmol/L in the first 60 min and total of 2mmol/L by 180 min

CKD MBD indicate

- a. Change in calcium & phosphate & parathyroid hormone, Vit D
- b. change in the bone metabolize and mineral
- c. Indicate change in the extra skeletal calcification and vascular, valvular calcification



Mineral abnormalities of Chronic Kidney Disease (CKD)



Renal osteodystrophy

- high bone turnover disease related to secondary hyperparathyroidism (referred to as osteitis fibrosa cystica),
- low turnover disease (referred to as adynamic bone disease),
- osteomalacia (low turnover disease accompanied by undermineralized bone tissue)
- Osteoporosis
- mixed disease where features of both high and low bone turnover disease are present

High bone turnover disease

- osteitis fibrosa cystica),



AP radiograph of the hand in a 66-year-old woman with primary hyperparathyroidism owing to parathyroid adenoma shows subperiosteal bone resorption (arrows) along the radial aspect of 2nd, 3rd, and 4th middle phalanges.



- a. extra skeletal calcification and vascular, valvular calcification

CKD-MBD

- **Hyperphosphatemia**

- ✓ dietary phosphate restriction
- ✓ dietary phosphate binders (Ca Carbonate, Ca Acetate, Sevelamer, lanthanum)

- **Hypocalcemia**

- ✓ calcium supplements with or without calcitriol

- **Hyperparathyroidism**

- ✓ Calcitriol
- ✓ vitamin D analogs

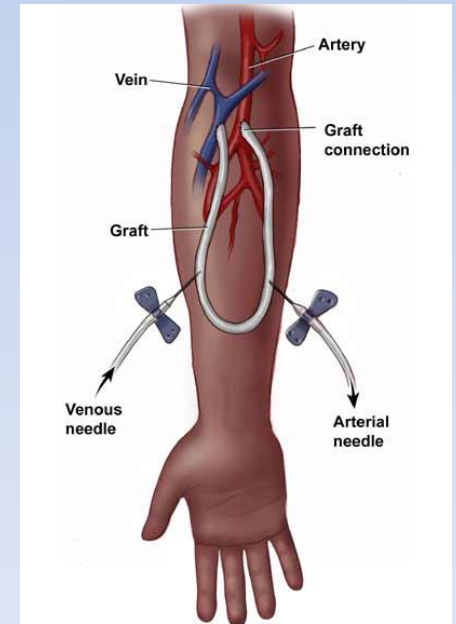
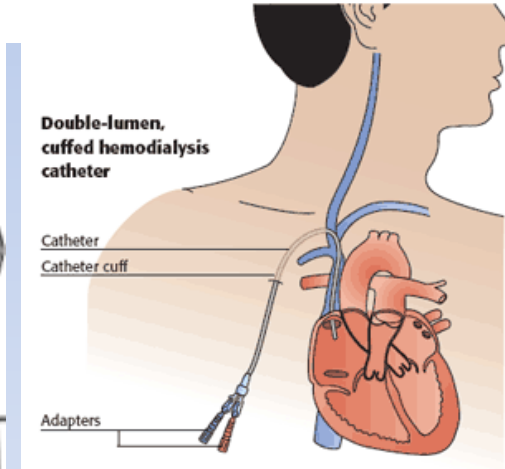
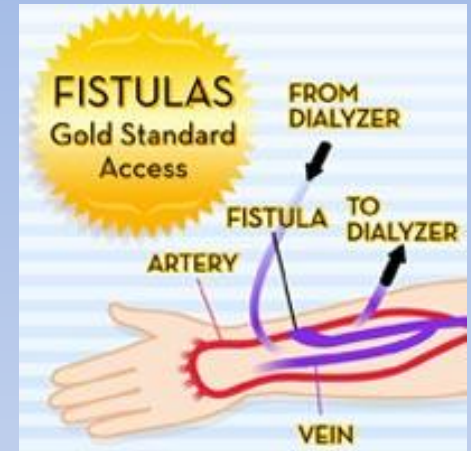
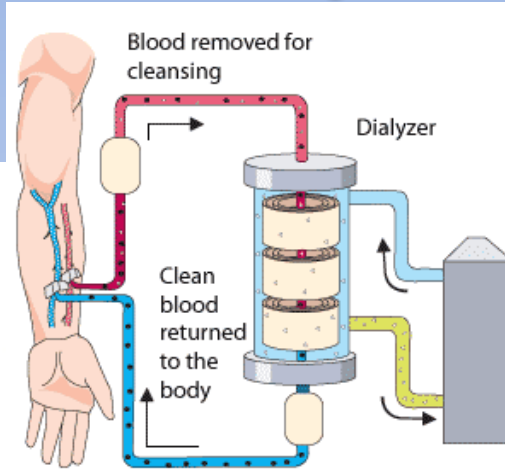
Treatment of Complications

- **Uremic manifestations:**
 - Long-term renal replacement therapy
 - ✓ hemodialysis
 - ✓ peritoneal dialysis
 - ✓ renal transplantation

Indications for renal replacement therapy

- Severe metabolic acidosis
- Hyperkalemia
- Intractable volume overload
- Pericarditis
- Uremic Symptoms
 - ✓ Encephalopathy
 - ✓ Failure to thrive and malnutrition
 - ✓ Peripheral neuropathy
 - ✓ Intractable gastrointestinal symptoms
- In asymptomatic patients
 - ✓ GFR of 5-8 mL/min/1.73 m²

Hemodialysis



Peritoneal Dialysis

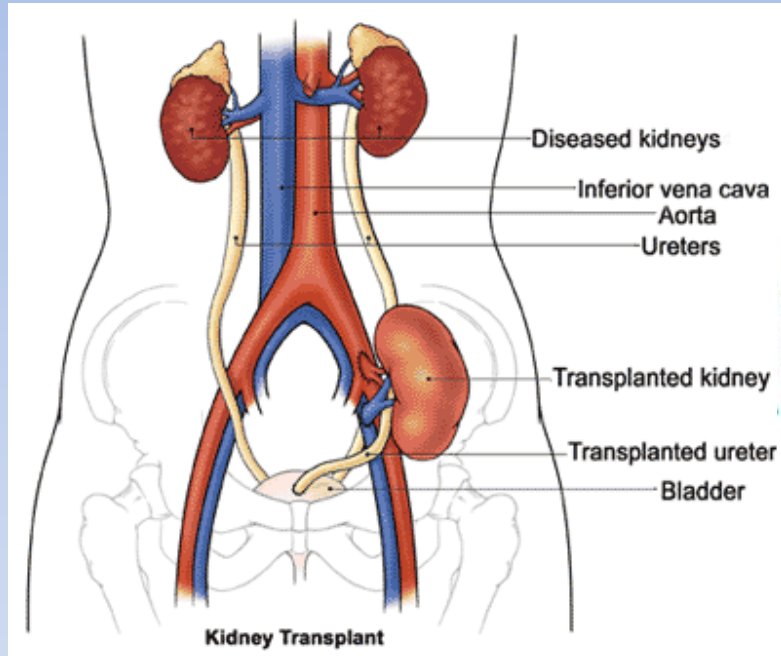


Renal Transplantation

Living related donors (LRD)

Living unrelated donors (LURD)

deceased organ donors



Renal Transplant
Medication

Renal Transplant
Rejection & infection

✓ Better quality of life, less mortality, can be before HD



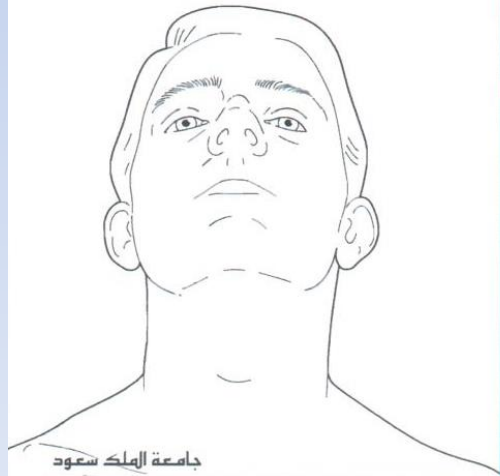
تأليف

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