

AKI

✓ Definition

✓✓

Abrupt ( $< 48$ ) ↑ creatinine equal or more than  $0.3 \text{ mg/dl}$

" " " " "  $\geq 50\%$  of Normal value

< urine out put  $< 0.5 \text{ mg/kg/hr}$  for  $\geq 6$  hrs

Acute interstitial Nephritis.

Definition ✓ "Form of intrinsic Renal failure that damages Tubules on an idiopathic basis" due to attacking of Antibodies & eosinophils attacking Tubules.

AKI - Acute

8028 9m

## Acute Kidney Injury.

D- A young labourer is brought to ER with semi-coma. His vital signs are as follows. Temp  $41^{\circ}\text{C}$ , Bp 80/50, Pulse 110/min. A catheter in the urinary bladder is inserted with 10 ml of urine in the urinary bag. The MO makes provisional diagnosis of heat stroke with acute kidney injury.

Define

D/Diagnosis, Types [ Pre-renal Failure  
Intrinsic renal Failure  
Post renal Failure

3 differentiating features Pre-renal and renal acute injury.

Rx - O2 Therapeutic measures.

Define:

Acute Kidney injury can be defined as

- ✓ Abrupt ( $< 48\text{ hrs}$ )  $\uparrow$  in creatinine  $\geq 0.3\text{ mg/dl}$
- or
- ✓ Abrupt ( $< 48\text{ hrs}$ )  $\uparrow$  in creatinine of  $\geq 50\%$
- ✓ Urine output of  $< 0.5\text{ mg/kg/hr}$  for  $> 6\text{ hrs}$

## Work up for AKI

① - History and Physical examination.

② - Urine evaluation

Urine output

Urine analysis

Urine sediments

Electrolyte and osmolality

③ - Fractional excretion of sodium

④ - Renal Ultrasound:

✓ To rule out obstruction

✓ To estimate the size of kidney

✓ to estimate chronicity of Kidney Disease

⑤ - Other workups:

Serologies - in glomerulonephritis

Renal Biopsy - if cause remain unclear

Q -

Pre-renal (AKI)

Renal (AKI)

Hyaline casts

- ① -

- Red-cell casts

- Dysmorphic cells

- Muddy brown casts

- White cells examp

Due to cardiac failure - ② -

sepsis

Blood loss

dehydration

Vascular occlusion

Due To

Glomerulonephritis

Small-vessel vasculit

Acute Tubular nec

## BUN:creatinine ratio

▶  $> 20:1$

$< 20:1$

$FE_{Na} < 1\%$

$> 2\%$

Urine Sodium  $< 20 \text{ mmol/L}$

$> 20 \text{ mmol/L}$

Urine osmolality  $> 500 \text{ mOsm/kg}$

$< 300 \text{ mOsm/kg}$

### ① → Pre-renal AKI management :-

Correct the underlying cause.

Hypovolemia - Restore blood volume

Monitoring central venous pressure.



(changes the force of stroke)

Inotropic agents is critically patients.

Correct metabolic acidosis

### ② → Renal AKI management :-

General:

✓ Correct underlying cause

✓ correct volume depletion - Restore blood volume

✓ Pt - septic → antibiotic

Monitor CVP

M. Acidosis  $R_1$

Complication

Hyperkalemia:

Calcium gluconate (cardio-protective)

Insulin + Glucose (  $K^+ \rightarrow$  cells)

Beta agonist - "

Ka yexalate - Remove K from body

H ✓  
A ✓  
P  
AD

Pulmonary Edema  
Sit up + High-flow oxygen by mask  
Venous Vasodilator (morphine)

Dialysis: Furosemide  
if no response urgent hemodialysis

Active Bleeding  
Fresh frozen plasma + platelets  
Bleed Transfusion - to maintain  
Hb > 10g/dl  
Desmopressin  
Hct > 30%  
↓  
↑ VIII activity.

Acute Dialysis:  
When non-responding to conventional  
Therapy.

Indication  
↔  
↓  
Acidosis  
Hyperkalemia > 7mmol/L  
Volume overload  
Uoemic encephalopathy  
Uoemic pericarditis

Q. 23 yr. old male was given ampicillin for upper respiratory tract infection which he took for 07 days. At the end of the course he returns to GP with increasing fatigue and tiredness. He is passing normal amount of urine. O/E Diffuse rash over Abdomin and Groin. Bp 145/95. Investigation creatinine 1.9 mg/dl. Urine shows few eosinophils casts protein +1

Q. A 25 yr. old man was seen in OPD with 05 days H/O Fatigue, nausea and vomiting, 02 weeks ago he developed upper respiratory tract infections for which he was given ampicillin for 05 days. Urine output is normal, no past medical history of HTN, DM or renal impairment. O/E, no fluid over-load, normal BP there is a maculopopular rash on Abdomin. Investigations urine reveals protein 1+, blood 1+, ↑ eosinophil count, Serum creatinine is 2.3 mg/dl.

Diagnosis - Acute Interstitial Nephritis.

Cause

D/D - same as ~~ACE~~ (Next Pg)

Investigation

02 drugs that causes similar

Treatment.

picture.

Cause : Drugs : Penicillins + Cephalosporins  
Sulpha Drugs - Furosamide  
thiazide diuretics.

Phenytoin

✓ Infections - Pyelonephritis.

✓ Autoimmune = SLE, Sjogren.

✓ Infiltrative  
↓  
Sarcoidosis.

Investigation: Fever, Rash, arthralgia  
Eosinophilia  
Eosinophiluria } Clinical

lab [ casts - RBCs  
WBCs, eosinophils  
BUN creatinine ratio < 20:1

D/D - Acute glomerulonephritis  
Acute Tubular Necrosis

Rx: same as Renal AKI

Ampicillin

U-RTI - Upper Respiratory Tract Infection.

↑ Eosinophilia + ↑ Proteinuria

Fatigue + Tiredness

CKD ✓✓

- ①. Age 45+
- ②. Long standing Diabetes - Now started having hypoglycemic attacks  
Hypertension
- ③. Puffiness of Face and ankles - More in morning
- ④. Extreme weak & lethargic
- ⑤. Pale complexion & generalized weakness
- ⑥. Gradually ↑ SOB.

✓ Define

✓ Mechanism of anemia

✓ Complication of CKD

✓ Metabolic Derangement + Mechanisms

✓ Management.



Q. Define :

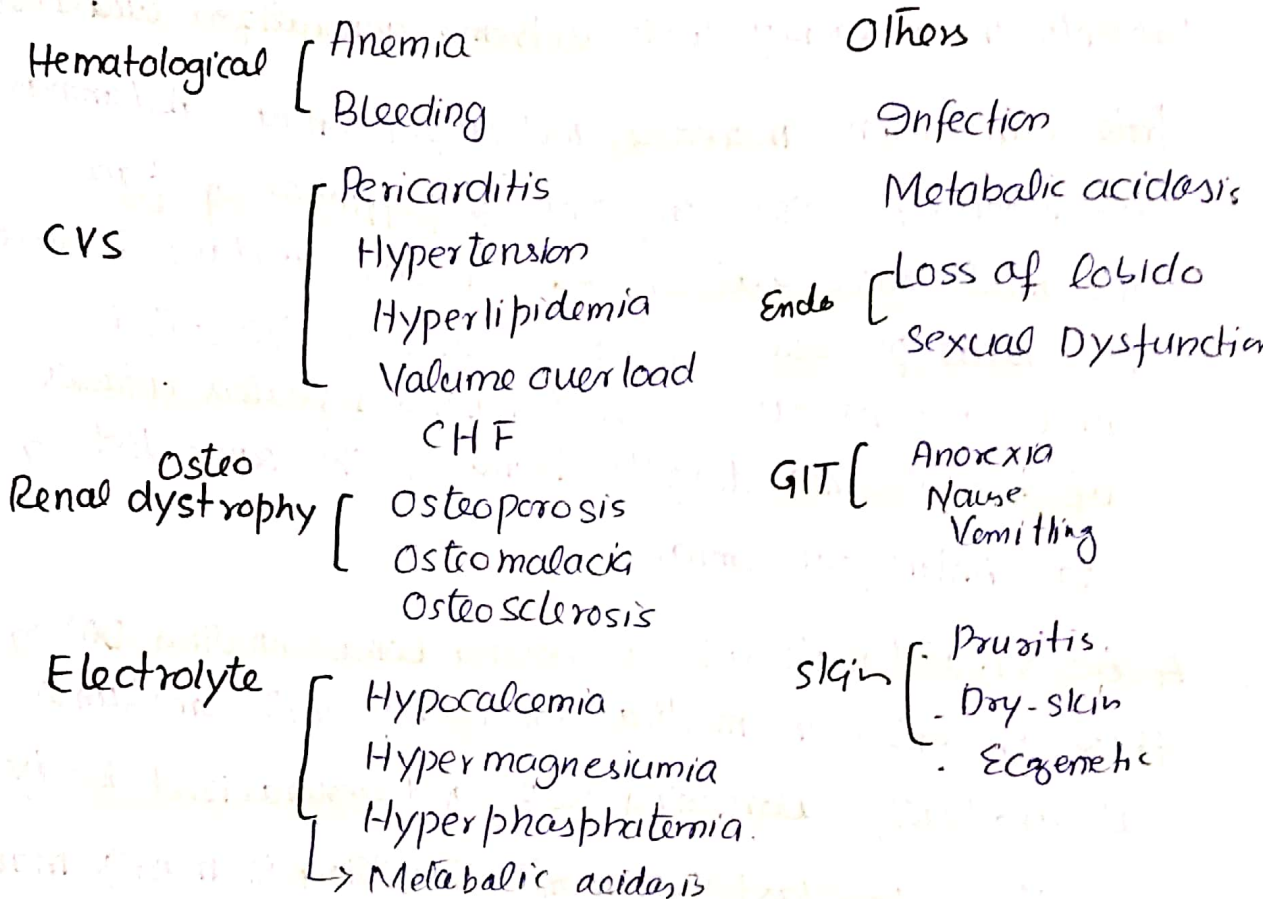
Irreversible deterioration in the Renal Function.

Q. Mechanism of Anemia

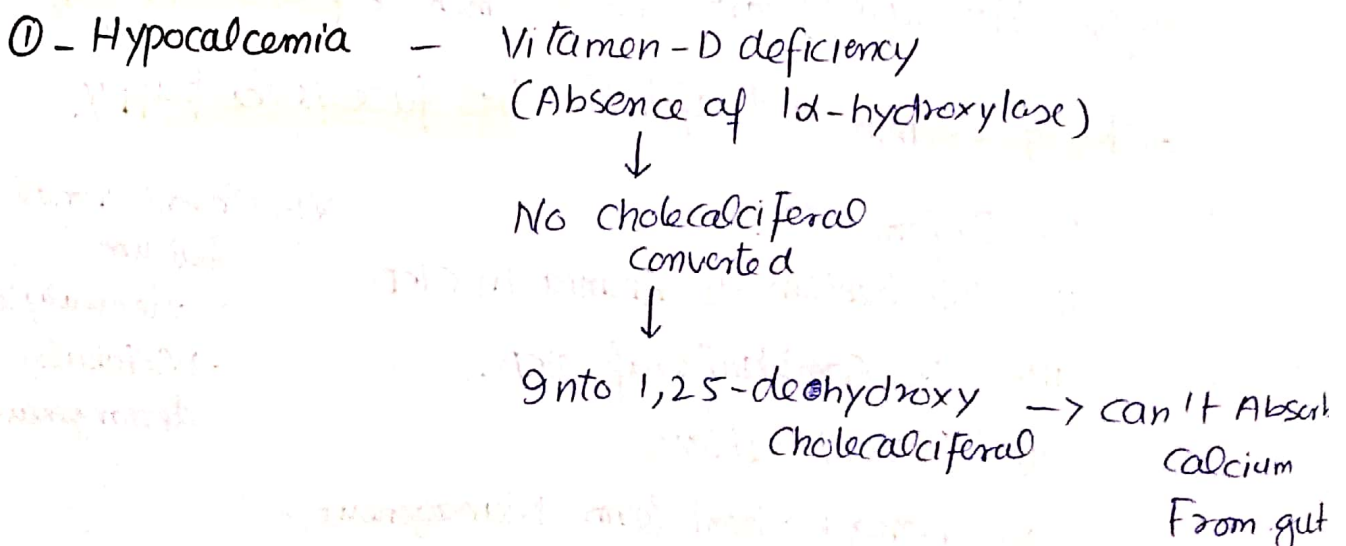
Loss of erythropoietin

↓ production of erythropoietin.

Q. Complication of CKD :



Q. Enlist and describe the electrolyte and metabolic derangements



## ②- Hyper-phosphatemia:

- ✓ Failure to excrete extra-phosphate from kidney
- ✓ PTH  $\uparrow$  -  $\uparrow$  phosphate from bones.

## ③- Hyper-magnesemia:

Due to hypocalcemia.

## ④ Metabolic acidosis:

- $\uparrow$  tissue catabolism
- $\downarrow$  Protein synthesis

## Investigations:

Blood. ✓ CBC

Urea and electrolyte

Urinalysis UCE

Quantification of proteinuria

} urine.

B ✓ Calcium, phosphate and PTH

B ✓ Albumin

B. ✓ HbA1c

Imaging [ ECG  
Renal ultrasound.

Small kidney = Chronic disease

Asymmetrical = Renovascular or developmental.

# Management :

## Short-term :

### General Measures

- Stop smoking
- Moderate protein intake
- Low-sodium
- Restrict - Potassium
- Restrict-Phosphate + Magnesium.

### Blood-pressure Control:

- ACE Inhibitors
- ARBs

### Control Diabetes : (of hyperglycemia)

- Exercise
- Avoid → oral hypoglycemic (Metformin) <sup>↑ of hypo-nerves give when hypoglycemia agent</sup>
- Control Diet
- Avoid sugar.
- is CI in some kidney condition

### Others :

- Anemia - Erythropoietin replacement
  - Iron-supplementation.
  - Hypocalcemia - Vitamin D + calcium replacement
  - Osteomalacia - "
  - Hyperphosphatemia - Oral phosphate binders.
  - Bleeding - Desmopressin
  - Metabolic acidosis - Sodium Bicarbonate
  - to keep  $\text{HCO}_3^- > 22 \text{ meq/l}$
- Hypermagnesemia  
↓  
Restrict Magnesium in Diet.

Pruritis = Dialysis

Arteriosclerosis = Dialysis

Endocrinopathies = Dialysis

Long-term :

Renal Transplant

Dialysis - Hemodialysis

- Peritoneal dialysis.

Hemo filtration.

General

CVS

Anemia

Bleeding

Electrolyte - Hypocalcemia

Hyperphosphatemia.

Hypermagnesemia.

Metabolic acidosis

Renal osteodystrophy

- osteomalacia.

GI - vomiting, Nausea

Infections

# =: Nephrotic Syndrome :-



Generalized  
Periorbital + face swelling + edema of lower +  
Morning limbs  
Masked proteinuria +++ , 8mg/dl 24hrs.  
Pallor

- ✓ Diagnosis
- ✓ Diagnostic criteria
- ✓ Causes
- ✓ Investigation
- ✓ Management.

Diagnosis

causes

Investigation. Lab+Procedures.

Treatment. - Initial - 03 Therapeutic steps  
Long-Term.

Diagnostic criteria.

Diagnosis → Nephrotic Syndrome

Diagnostic criteria →

Massive proteinuria ( $\geq 3.5$  gm <sup>daily loss</sup>)

Hypoalbuminemia (Plasma albumin  $< 3$  gm/dl)

Generalized edema.

Hyperlipidemia + lipiduria.

Causes :

✓ Primary Glomerular Disease.

Minimal change Disease

Membranous Glomerulopathy

MPF-GN Membranoproliferative Glomerulonephritis

FS-GN Focal segmental glomerulosclerosis

systemic :

Diabetes Mellitus

SLE

Amyloidosis

Cryoglobulinemia.

## Work up (Investigation)

- ✓ Urine analysis (Initial Test) <sup>Best</sup>
- ✓ Renal biopsy (Most accurate Test)
- ✓ Proteinuria (Protein Quantification) <sup>✓</sup>  
24-hour urinary protein
- ✓ Urine albumin : creatinine ratio  
↓  
Ratio of 2 = 2 gm of protein excreted over 24 hrs

## Treatment:

### General Measures:

Protein Supplementation

Diuretics for edema.

Rx hyperlipidoma with statins.

No Restriction.

### Specific Measures:

PDR Na  
APIS Th

ACE inhibitors or ARB's = ↓ Proteinuria ✓  
slows progression of disease.

✓  
Primary glomerular Disease  
Therapy = Steroid + immunosuppressive  
Therapy.

✓  
secondary glomerular Disease  
Therapy = Rx the underlying cause.

✓  
Infectious = Antibiotics

✓  
Thromboembolism = Anti-coagulation.

# Acute Pyelonephritis ✓✓

pg. 91M  
106

✓ Inflammation of Renal Parenchyma.

- High grade fever
- Pain in the right loin.
- Back pain
- Dysuria

→ Diagnosis

→ Difference b/w upper & lower UTI

→ Investigation.

→ Rx



# Acute Pyelonephritis.

Q. 25 yr old lady presents to OPD with high grade fever, chills, dysuria, back pain. O/E she is febrile with temp  $39.5^{\circ}\text{C}$  and tender in the right loin.

Diagnosis

Differentiate b/w U-UTI + L-UTI

Rx.

Q. Diagnosis: Acute Pyelonephritis.

Q. Upper UTI

Flank pain

Fever, chills

Nausea, Vomiting

Hematuria

Skin-hypersensitivity

Lower UTI

Urinary Frequency

Urgency

Lower-back pain

Abdominal pain

Hematuria.

Q. Investigation :-

Urine analysis  $\rightarrow$  CBC - leukocytosis ✓  
Plus cells in urine. ✓  
↑ Nitrites ✓  
Urine culture\*  
✓ Electrolyte  
✓ UCE

Q. Rx: Anti-pyretic (Fever)

High fluid intake (DU)

General

$\rightarrow$  Good Hygiene maintain

PC  $\rightarrow$  Potassium citrate For dysuria. (DU)

Antibiotics  $\rightarrow$  ciprofloxacin (infection)

Gentamycin

Ceftriaxone.



Case - 1

- ✓ Person brought to emergency in a confused state
- ✓ Slightly agitated
- ✓ 105 meq/L (Na<sup>+</sup>)
- ✓ Tonic clonic convulsion seizure, hyperreflexia

Case - 2

- Severe watery Diarrhea.
- 15-20 watery stool/24 hr.
- 04-05 episodes of vomiting
- Fever
- 110/Pulse, low volume.  
min
- BP 90/55

- ✓ Presentation
- ✓ Causes
- ✓ Investigation
- ✓ Rx.

## Presentation :-

Confusion

lethargy

Muscle cramps

Hyper-reflexia

seizures, coma or brainstem Hemiation.

## Causes of Hyponatremia:

### ① → Hypovolemic Hyponatremia

Kidney → Urinary  $\text{Na} > 20 \text{ mmol/L}$

★ ✓ Addison Disease

★ ✓ Diuretics

Diuretics phase of Renal-failure

Osmolar Diuretics

### Others

✓ Diarrhea ★

✓ Vomiting ★

✓ Fistulas ★

✓ Burns

✓ Small bowel obstruction

### ② → Euvolemic hyponatremia

SIADH

★ ✓ Psychogenic polydipsia

★ ✓ Hypothyroidism

★ ✓ Alcoholism.

### ③ → Hypervolemic hyponatremia

★ Congestive cardiac failure

★ Cirrhosis

★ Nephrotic syndrome

★ Renal-Failure.

Investigation :-

Urea and electrolyte ✓

Blood urea nitrogens.

BUN: creatinine ratio

ECG

CBC.

EEG.

Treatment :

According to Volume Status

Hypovolemia = Normal Saline

Euolemia = Water Restriction

Hypervolemia = Water restriction

Consider Diuretics

Cortisol replacement with adrenal insufficiency

Thyroid replacement with hypothyroidism

Hyponatremia = Hypertonic saline

↓ when pt has seizures

✓ Serum Na is  $< 120 \text{ mEq/L}$

N.

Chronic hyponatremia = Corrected slowly

$< 10 \text{ mmol/l/day}$

to prevent 'Central Pontine Myelinolysis'

↓

Paraparesis

Quadripareisis

Dysarthria

Coma.

Hypernatremia.

- Past- Streptococcal Glomerulonephritis ✓

Past-infectious Glomerulonephritis.

\* Masked Faced swelling.

- ①- UTI (Urinary Tract infection) History
- ②- RTI (Respiratory Tract infection) History
- ③- High Blood pressure
- ④- Blood in Urine
- ⑤- Protein + in urine.

✓ Organisms

✓ D/D

✓ Investigation.

✓ Rx.

Q. 22 yr old Male develops respiratory Tract infection. One day later, she notices blood in urine. O/E he is anuric. Bp is 115/90 mmHg. Serum creatinine is 1.0 mg/dl. Urine analysis shows protein +1 and blood 2+ in it.

Diagnosis

- Post-streptococcal glomerulonephritis

D/D

Investigation

Organism: Strept pyone  
β-hemolytic streptococci

Rx.

Q. 14 yr old boy. OPD. Hx of generalized body swelling more marked on face, generalized weakness and low grade fever. Passing smoky red + ↓ quantity of urine. O/E H/S pulse is 140/min regular and blood pressure is 140/90 mmHg. Acc to pt. there is no history of sore throat with high grade fever of 7-8 days ago. He is no. 3 siblings and no prev. Hx of any serious ailments except repeated UTI.

Diagnosis: Post-streptococcal glomerulonephritis

D/D: IgA Nephropathy

Goodpasture's syndrome

Wegner's granulomatosis.

Investigations:

Lab-Findings:

ASO Titers = Elevated

Serum C<sub>3</sub> = Decreased.

## Renal biopsy:

### ① - Light Microscopy

- ✓ • Hypercellular + Enlarged glomeruli
- ✓ • Enlarged Glomeruli
- ✓ • Leucocytic infiltration
- ✓ • Lumpy-bumpy appearance.

### ② - Electron Microscopy

- subepithelial humps.

### ③ - Florescence Microscopy

- Granular appearance.

## Treatment :-

- Supportive - 95% of cases resolve spontaneously.

✓ Antibiotics → - Penicillin

✓ Diuretics - Erythromycin

↓

Furosemide.

Dialysis → Procedure to remove waste and excess fluid  
✓✓  
blood.

Hemodialysis → Blood Purification Therapy

Used in ESRD

AKI

through Routes

Arteriovenous fistula (AVF)

Central venous catheter

Arteriovenous shunt (e.g. Scribner  
Shunt)

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9 M



# Dialysis

## Indication of Dialysis (04)

Types of dialysis with difference and special features., mechanism, complication.

### Indication :

- Metabolic acidosis
- Hyperkalemia  $> 7 \text{ mmol/L}$ .
- Volume over-load
- Uremic encephalopathy
- Uremic pericarditis.

Types : Hemodialysis  
Peritoneal dialysis.  
Hemofiltration.

### Hemodialysis:

Used in AKI (Acute Kidney Injury)  
ESRD (End-stage Renal Disease)

Mechanism : pt's blood is pumped through hemodialyser.

↓  
Bidirectional diffusion of solutes  
b/w blood and dialysate

↓  
across the semi-permeable membrane

Fluid removal  
via  
-ve (TMP)

Transmembrane  
pressure

Salt removal  
via  
(TMC)

Transmembrane  
concentration.

Complication: Hypotension  
Arrhythmias

Thrombosis

Stenosis

Aneurysm

Disequilibrium syndrome  
steal syndrome.

HATSAD

Hemofiltration: used in the Rx of AKI

Mechanism: Blood under pressure

↓  
Passes down one side of semi-permeable membrane

↓  
Water + solute pass across the membrane via TMP

change the filtrate gradient.

↓  
Replacement in infused fluid

Advantages

Less hypotension

Better volume control

Complication.

Expensive.

Takes longer time.

Peritoneal Dialysis:

Used in Rx of CKD

Mechanism → Through peritoneal cavity

↓  
Permanent silastic catheter inserted

↓  
2L sterile fluid (Isotonic)

↓  
wait 2-6 hrs.

↓  
Metabolic waste drain → Conc-gradient.

↓  
Fluid is then drain

Advantage: simple  
less costly  
performed at home

Complication: Peritonitis

Hemorrhage / Catheter/malnutrition.  
Bowel pain. inf ← Rep of time cycle