

# ACUTE KIDNEY INJURY

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# Definition of AKI

- Rapid deterioration of renal functions which occurs within hours or days
- Leads to failure in excretion of nitrogenous waste, excess water and derangement of electrolyte and acid-base homeostasis.

Usually presents with oliguria/anuria

Is a Medical emergency

# Epidemiology

- Common (5% of all medical & surgical admissions)
- Incidence increases with age
- Classification based on cause –
  - prerenal
  - renal (intrinsic)
  - postrenal

# CAUSES OF ACUTE RENAL FAILURE

## 1.Pre renal- impaired renal blood flow

40-80%

- Shock
  - Hypovolaemia
  - Septicaemia
  - Cardiogenic
- Hepato-renal syndrome

- In pre-renal renal failure , the renal parenchyma is undamaged.
- Renal function returns to normal once the underlying cause is corrected.
- If underlying cause remain uncorrected proceed to intrinsic renal damage and established AKI.

## 2. Post renal

6-10%

- Obstructive uropathy
  - Calculi
  - Prostatic hypertrophy
  - Pelvic malignancy eg. Carcinoma of the ovary etc

### 3. Renal Renal failure(Intrinsic renal disease)

25-40%

#### A. Tubules -Tubular necrosis

- When pre renal failure is not corrected quickly
- Nephrotoxins (drugs-aminoglycosides, snake venom, radiographic contrast media)

#### B. Glomerules – Acute Glomerulonephritis

#### C. Acute Pyelonephritis

D. Interstitium – Drugs, infections(*leptospirosis*),  
systemic diseases

E. Vascular- vasculitis, malignant hypertension,  
Haemolytic uraemic syndrome

# Systemic illnesses complicated by Acute Renal Failure

- Malaria
- Leptospirosis
- Snake bites
- Poisoning – paraquat
- Intra vascular haemolysis
- myoglobinuria
- DIC

# **CLINICAL PICTURE**

- 1.Oliguria/ Anuria**
- 2. Features of uraemia( nausea, vomitting, drowsiness, coma, convulsions)**
- 3. Features due to fluid overload( oedema, elevated JVP, pulmonary oedema.)**
- 4.Features due to metabolic acidosis.(tachypnoea, hyperventilation)**
- 5.Features of the underlying disease( lepto, SLE, snake bite).**

Usually associated with oliguria(  
 $\text{UOP} < 400 \text{ ml/24 hrs}$ )

Sometimes anuria, ( $\text{UOP} < 100 \text{ ml/24 hrs}$ )

Rarely ARF may occur with Normal urine output.

# 1.Features suggestive of Prerenal RF/Acute tubular necrosis RF

## ■ History –

- Fluid loss- dehydration(eg. Diarrhoea, vomitting etc.)
- Bleeding- severe haematemesis etc.
- sepsis (vasodilatation), septic shock
- severe heart failure, cardiogenic shock

## ■ Examination –

- features of dehydration, severe anaemia
- hypotension, cold clammy extremities
- weak rapid pulse
- low JVP (measure CVP)

# Differentiating Prerenal from Intrinsic

	Prerenal	Intrinsic
Urine specific gravity	> 1.020	< 1.010
<b>Urine osmolality (mOsm/kg)</b>	> 500	< 350
<b>Urine sodium (mmol/L)</b>	< 20	> 40
Fractional excretion of Na	< 1%	> 1%

## 2.Features of Postrenal ARF

Reversible with relief of obstruction

BUT

longer the delay → more long term damage

### ■ History & Examination

Prostatic disease → obstructive urinary symptoms, palpable bladder, hypertrophied prostate, residual volume

Ca cervix → vaginal exam

Renal stone disease → Renal colic, haematuria

### 3.Features to check for Intrinsic Renal Disease - ARF

- Recent throat infection (*post-streptococcal GN*)
- UTI- acute Pyelonephritis- Dysuria, Loin pain, fever
- Recently hospitalised - nephrotoxics (*ATN*)
  - aminoglycosides, radio-contrast

- Drug history (*AIN*) eg. *Penicillin, NSAID, Diuretics.*

Rash, fever, and arthralgia (*AIN*)

- Constitutional symptoms (*vasculitis*)
  - *arthralgia, rash, epistaxis, haemoptysis*

# Complications

- Pulmonary oedema, Generalized oedema
- Hyperkalaemia
- Metabolic acidosis
- Uraemic encephalopathy( convulsions, coma)

## Less common

- pericarditis, cardiac tamponade, hypertension
- GI bleeding (vomiting)
- Bruising
- Septicaemia

# Differential diagnosis

## Acute on chronic renal failure

When patients with CKD encounter an acute insult ( Dehydration, infection) can develop acute on chronic RF.

Features of chronicity are expected

Eg.

Hypertension, Anaemia, Bone pain, Pigmentation, polyuria

# Investigations

Done in order to confirm the diagnosis, exclude the differential diagnosis, identify the complications and underlying cause.

# Initial Ix

- Serum creatinine
- Blood urea
- Serum electrolytes
- UFR, Urine Culture,
- Urinary Na excretion/ urinary osmolality
  
- Full blood count / ESR/CRP
- RBS
- Blood culture
- LFT
- USS- abdomen
- ECG
- Chest X-ray (P-A)
- Arterial blood gas if indicated

## ■ USS - size of kidneys

Help to exclude Chronic Renal Failure  
( small kidneys)

Evidence of obstructive uropathy  
( large kidneys- hydronephrosis)

Help to identify the cause

Eg. Renal calculi, Enlarged prostate

## Further Ix

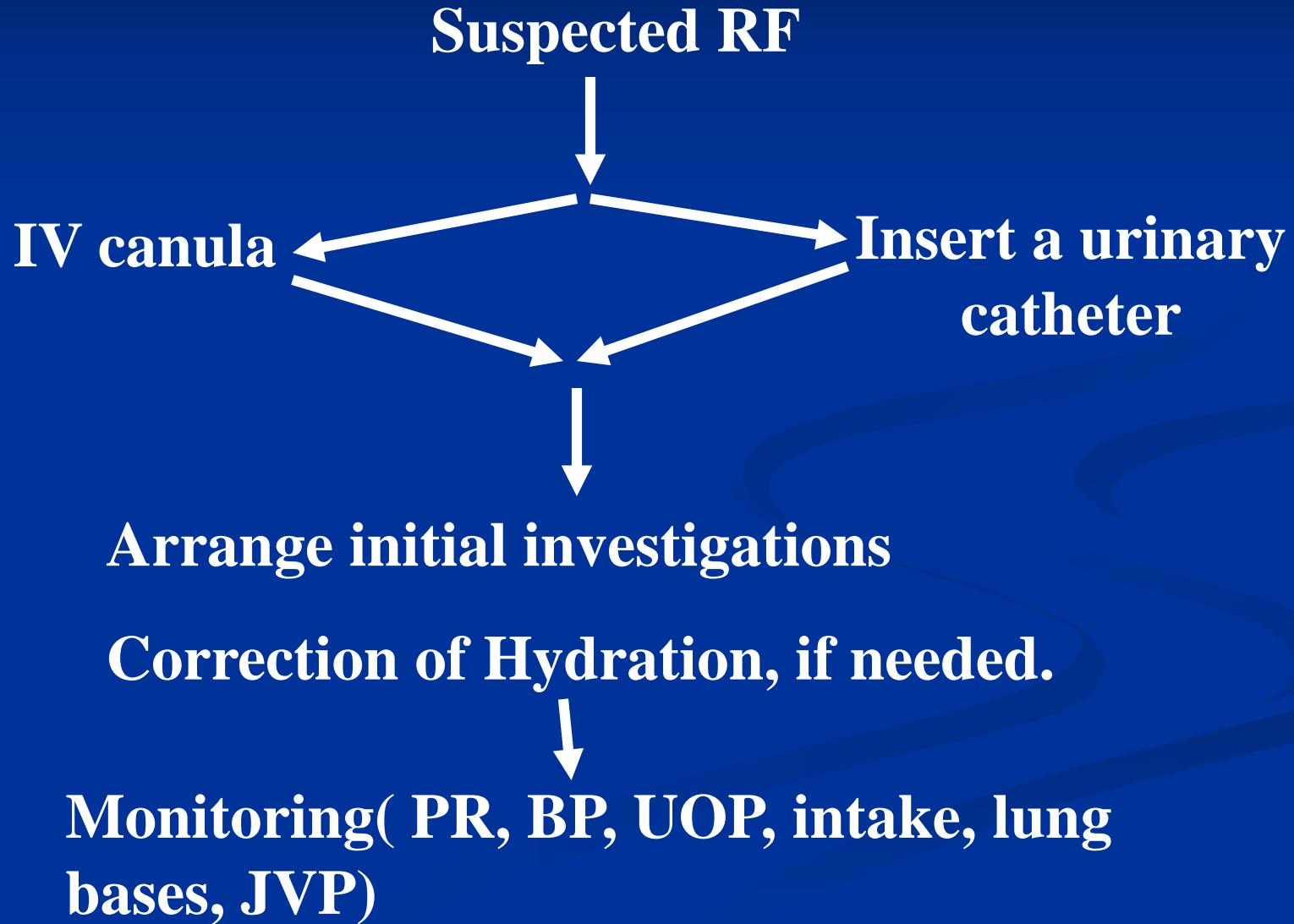
- Blood film
- Coagulation profile
- leptospira antibodies, ASOT
- ANF , ANCA
- Rarely renal biopsy

# Acute Renal Failure Management

# **Management**

- A. Initial step -**
  - I. Assessment and correction of hydration if necessary**
  - II. Treat complications**
  - III. Treat underlying cause**
- B. Established renal failure -**
  - I. Conservative**
  - II. Renal Replacement Therapy**
- C. Recovery phase Renal Failure**

# A. Initial step I- immediate management



# Initial Step II - look for complications which need to be Rx urgently

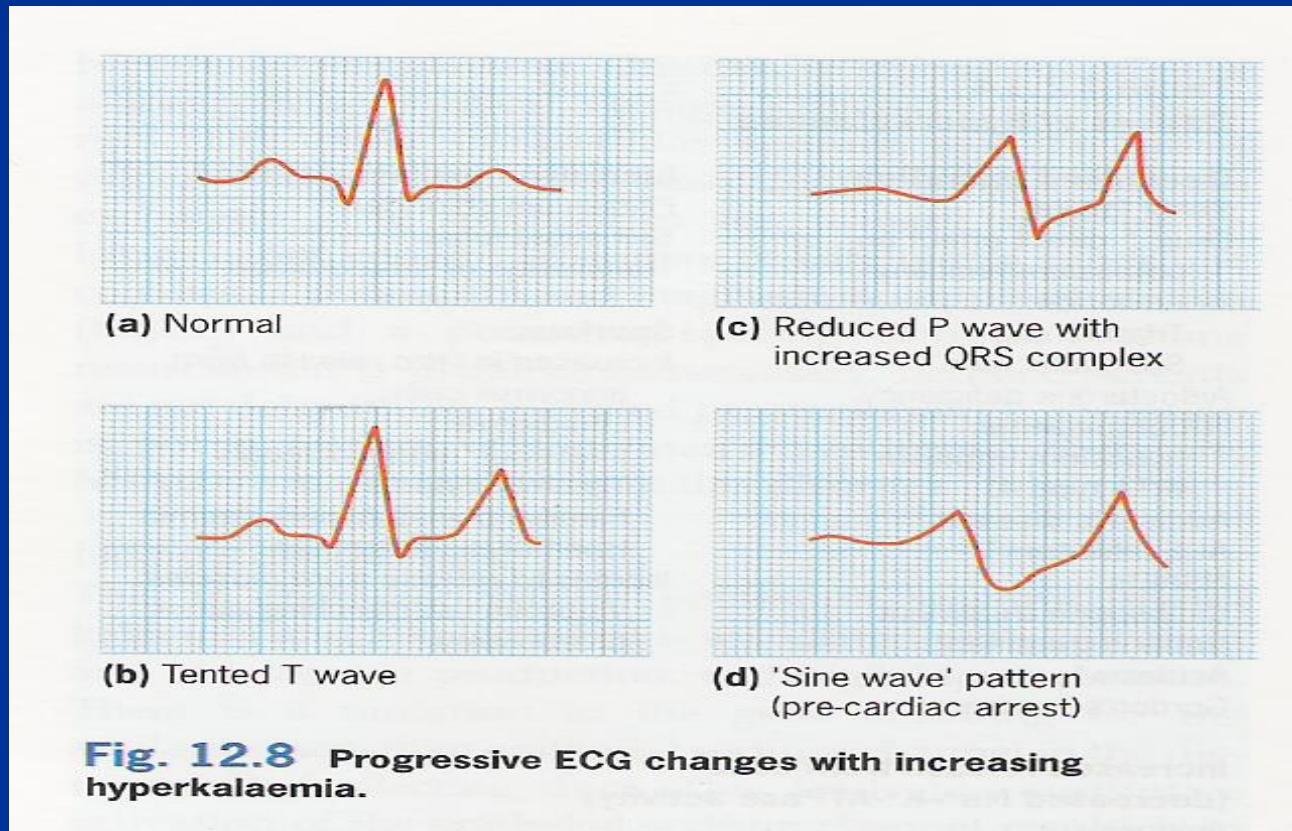
Hyperkalaemia

Metabolic acidosis

Pulmonary oedema

# Hyperkalaemia

- K > 6.5 mmol/l is life threatening – causes cardiac arrhythmias (VF)



# **Emergency Mx of Hyperkalaemia**

## **IMMEDIATE**

**Attach ECG monitor and IV access**

**Protect myocardium**

10 mL of 10% calcium gluconate IV over 5 mins

Effect temporary - repeat after 15 mins

**Drive K<sup>+</sup> into cells**

Insulin 10 units + 50 mL of 50% glucose IV over 10-15 mins, regularly check RBS & K<sup>+</sup>

Repeat SOS

*and/or correct acidosis (pH < 6.9) - infuse NaHCO<sub>3</sub> (1.26%)*

*and/or salbutamol iv (rarely)*

## **LATER**

**Deplete body K<sup>+</sup>**

Polystyrene sulphonate resins:

Haemodialysis or peritoneal dialysis

# Acidosis

- Severe metabolic acidosis with pH <7.2
- Impairs cardiac contractility
  - Induces bradycardia
  - Produces vasodilatation
  - Worsens hyperkalaemia
- Haemodialysis or haemofiltration
- iv sodium bicarbonate – may worsen salt-and-water overload

# Pulmonary Oedema

- IV opioids
  - diamorphine 2.5–5 mg
- IV nitrate infusion
  - GTN 50 mg in 50 ml 0.9% saline, at 2–20 ml/h keeping SBP>95
- Provoke diuresis
  - large doses of diuretics (frusemide 250 mg in 50 ml 0.9% saline over one hour, can be repeated)
- Venesection
- If no diuresis → dialysis or haemofiltration
  
- often due to excessive fluid resuscitation
- Anticipate if - known cardiac dysfunction, elderly, volume OK initially

# Indications for urgent Dialysis & Haemofiltration

- Severe hyperkalaemia
- Fluid overload with **pulmonary oedema**
- Severe symptomatic **uraemia**
  - blood urea  $>30\text{--}50 \text{ mmol/l}$
- **Complications** of severe uraemia
  - encephalopathy, pericarditis, neuropathy/myopathy
- Severe **acidosis** ( $\text{pH} < 7.1$ )
- Drug overdose with a **dialysable toxin**
  - Gentamicin, Lithium, Aspirin

# **Initial Step III**

## **Rx the underlying cause**

- Pyelonephritis – Rx antibiotics
- Leptospirosis – IV penicillin
- Nephrotoxic drugs – stop the drug
- Connective tissue disease- steroids
- Relief of obstruction

# B.Management of established ARF

## Conservative

1. Fluid management
2. Dietary management
3. Hyperkalaemia
4. Metabolic acidosis
5. Blood Pressure
6. Infection
7. Monitoring
8. Avoid Nephrotoxic drugs

## Dialysis

- Is indicated when severe Hyperkalaemia, acidosis or volume overload can't be controlled by conservative measures. Uraemic encephalopathy and pericarditis are additional indications.
- Patients with ARF should be evaluated daily to assess the need of dialysis.

# **Conservative Management**

## **FLUID BALANCE**

- Restrict daily intake 500cc+previous day loss
- Monitor fluid balance 12 hourly

## **DIET**

- Energy > 2000kCal/day
- Protein 20 – 40 g/day
- Sodium + potassium < 50mmol/day

# Choice of Renal Replacement Therapy

- Peritoneal dialysis
- Haemodialysis
- Haemodiafiltration

# C. Management in Recovery Phase

- Renal function improves in 1-3 weeks
- Assess regularly –
  - clinical state
  - salt & water balance
  - serum chemistry
- Major diuresis can develop –
  - recovery of glomerular function
  - tubular capacity to reabsorb sodium, potassium & water remains impaired
  - need iv fluids & supplements of NaCl & K

# Outcome of ARF

- Mortality 40%–70%
- Worse prognosis with increasing age & co-morbidity
- Some do not recover renal function  
Will require long term RRT
- Incomplete recovery of renal function  
→ chronic renal failure → ESRD

# Poor prognosis

- Age > 50 years
- Infection septisaemia
- Rising urea > 16 mmol / 24 hrs
- Oliguria >2/52
- Multi organ failure

# Preventing ARF

- **Recognize** those at higher risk - CRF
- **Temporarily withhold** nephrotoxics & diuretics when patients become unwell
- **Hydrate** well
- **Monitor renal function** after starting, or increasing the dose, of ACE-I or ARBs (check 1-2 weeks later)
- **Adjust drug doses** in renal impairment
- **Monitor drug levels** – aminoglycosides
- Hydrate & use *N*-acetyl cysteine before contrast radiology

# Thank You