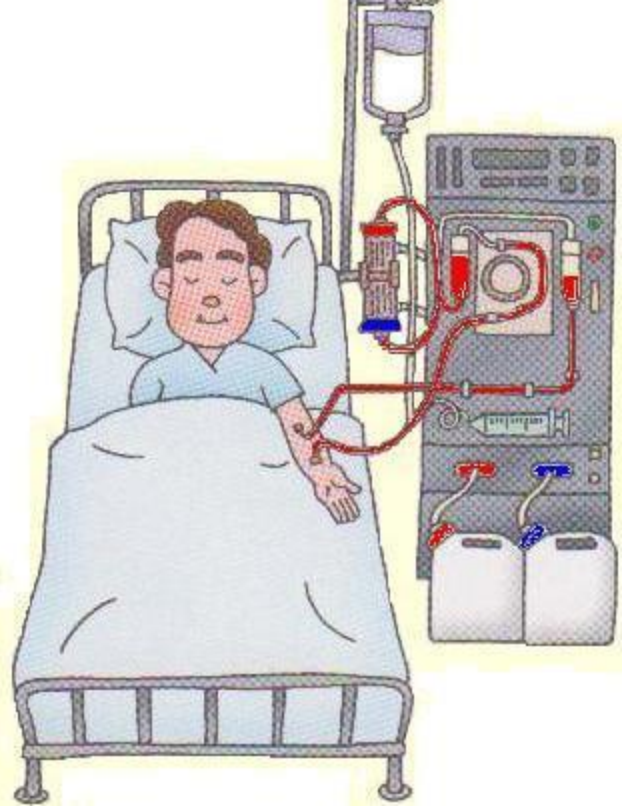
Dialysis in Acute Medicine



Dr. Mahmudul Hasan Rahat

Junior Consultant

Department of Medicine

Dhaka Medical College Hospital

AKI in Hospital Setting

- AKI is common during and after admissions.
- AKI is associated with increased mortality.
- "Minor" rises in serum creatinine associated with worse outcome.
- AKI developing after ICU/Hospital admission (late) is associated with worse outcome than AKI at admission.
- AKI requiring Renal Replacement Therapy (RRT) is associated with worst mortality risk.
- Treatment of acute kidney injury (AKI) is principally supportive -- RRT indicated in patients with severe kidney injury.
- Goal: optimization of fluid & electrolyte balance.

Modalities of RRT

- Intermittent haemodialysis (IHD) or Intermittent renal replacement therapy (IRRT)
- Continuous renal replacement therapy (CRRT)
- Peritoneal dialysis
- Hybrid therapies, like Sustained low-efficiency daily dialysis (SLEDD)

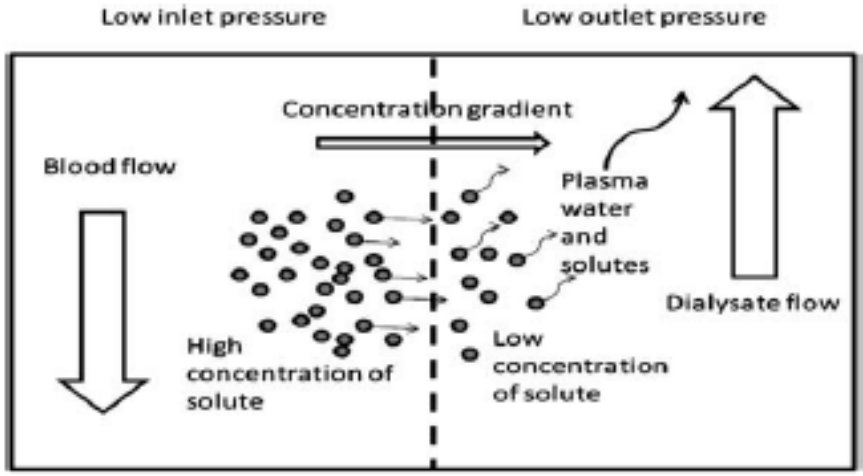
Indication for RRT in Acute Medicine

Acute management of life-threatening complications of AKI:

- **A**: Metabolic **A**cidosis (P^H <7.1)
- **E**: **E**lectrolytes imbalance—Hyperkalemia (K >6.5 meq/L) or rapidly rising K
- **I**: **I**ngestion -- Certain alcohol and drug intoxications
- **O**: Refractory fluid **O**verload
- **U**: **U**raemia, ie. pericarditis, neuropathy, decline in mental status

Principles of dialysis

- **Dialysis** = diffusion = passive movement of solutes across a semi-permeable membrane down concentration gradient
  - Good for small molecules



- **(Ultra)filtration** = convection = solute + fluid removal across semi-permeable membrane down a pressure gradient (solvent drag)
  - Better for removal of fluid and medium-size molecules

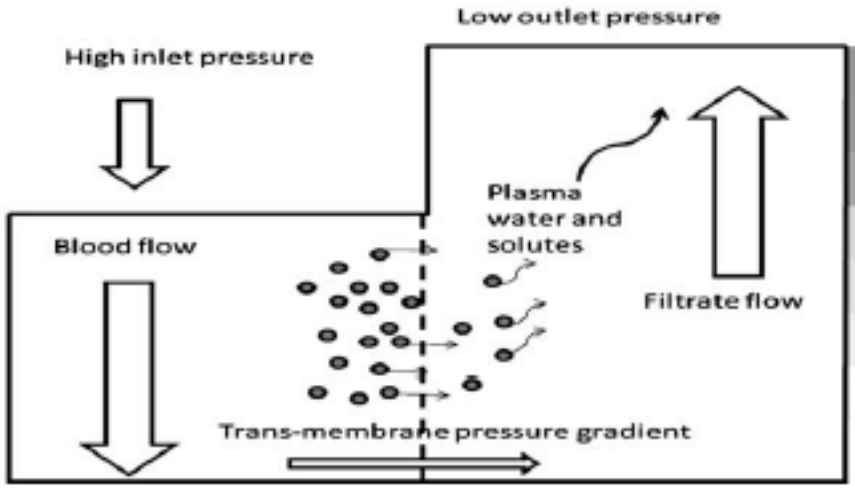


Figure 1 Principles of dialysis (top panel) and filtration (lower panel).

Principles of dialysis (contd.)

- **Haemodialysis** = solute passively diffuses down concentration gradient
  - Dialysate flows countercurrent to blood flow.
  - Urea, creatinine, K move from blood to dialysate
  - Ca and bicarbonate move from dialysate to blood.

- **Haemofiltration**: uses hydrostatic pressure gradient to induce filtration/convection of plasma water + solutes across membrane.

- **Haemodiafiltration**: combination of dialysis and filtration.

Intermittent haemodialysis (IHD)

- Oldest and most common technique
- Primarily diffusive treatment: blood and dialysate are circulated in countercurrent manner Also some fluid removal by ultrafiltration due to pressure driving through circuit
- Best for removal of small molecules
- Typically performed 4 hours 3x/wk or daily

Continuous RRT

- Involve either dialysis (diffusion-based solute removal) or filtration (convection-based solute and water removal) treatments in a continuous mode with slower rate of solute or fluid removal

- CRRT includes continuous haemofiltration, haemodialysis and haemodiafiltration, all of which can be performed using arteriovenous or venovenous extracorporeal circuits.

Peritoneal dialysis

- Least useful form of CRRT in the ICU
- Diffusive treatment: blood in capillaries of peritoneal membrane exposed to dialysate in abdomen
- Continuous or intermittent
- Inefficient solute/volume clearance if unstable or poor intestinal blood flow
- Cannot use if intra-abdominal pathology- risk of peritonitis
- Respiratory burden
- Only two RCTs comparing to hemodialysis in AKI: found inferior or no difference

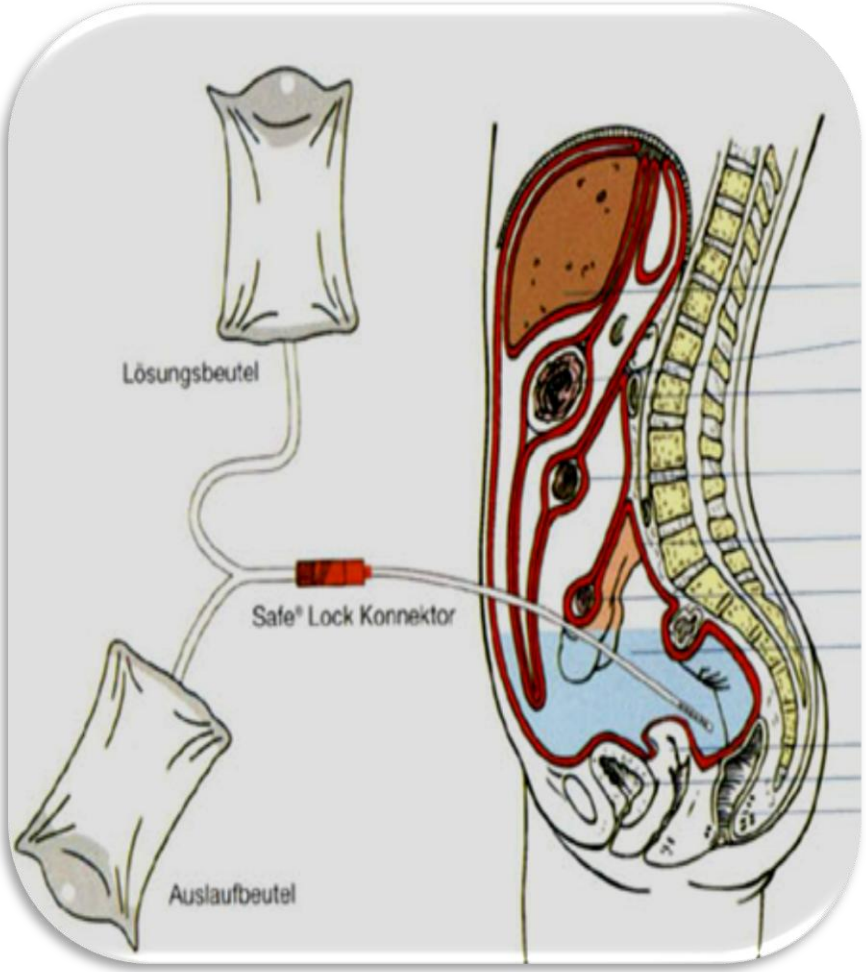
Peritoneal Dialysis (PD) in AKI

Advantages

- Hemodynamic stability
- Slow correction
- Easy access placement
- No Anticoagulation
- Tolerated in children

Disadvantages

- Risk of infections
- Difficulty to use with abdominals surgery
- Logistics

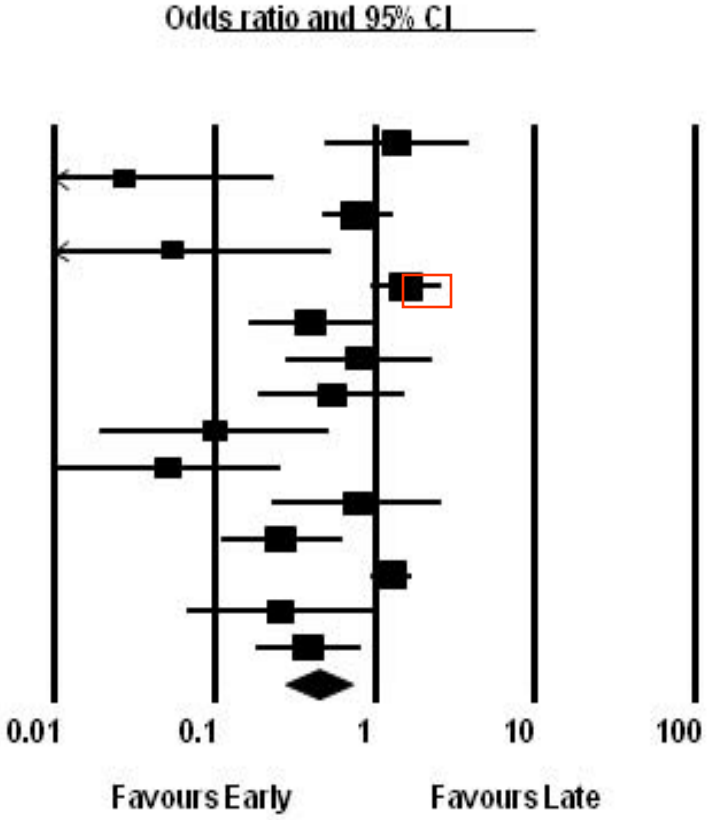


Sustained low-efficiency daily dialysis (SLEDD)

- Also known as Extended daily dialysis (EDD) or slow continuous dialysis (SCD)
- Hybrid therapy: IRRT at lower blood and dialysate flows for prolonged times (Usually ≥ 5 hrs)
- Uses conventional dialysis machines
- Flexibility of duration and intensity
- **Major advantages:** flexibility, reduced costs, low or absent anticoagulation

Timing of initiation of RRT

- Karvellas. A comparison of early versus late initiation of renal replacement therapy in critically ill patients with acute kidney injury. Critical Care 2011, 15:R72
- Meta-analysis of 15 studies
- Early RRT initiation associated with ↓mortality (pooled OR 0.45)
- However, significant heterogeneity and bias
- Some studies showed greater renal recovery, ↓ duration of RRT and ICU length of stay



Timing of initiation of RRT

- Earlier initiation of RRT in critically ill patients with AKI may have a beneficial impact on survival and outcomes but data is insufficient.
- Many recommend initiation of RRT prior to the development of advanced uraemic symptoms, or when the BUN reaches 80-100 mg/dL
- No known threshold of fluid overload for initiating RRT

Discontinuation of RRT

- Until "evidence of recovery of kidney function"
  - Improved Urine Output in oliguria
  - Decreasing creatinine
  - Creatinine clearance minimum 12 ml/min, some say 20 ml/min

Continuous vs intermittent dialysis

- Ongoing debate
- Theoretical benefits to both
- At least 7 RCTs and 3 meta-analyses have not demonstrated difference in outcome
  - Eg Bagshaw *Crit Care Med* 2008, 36:610-617: meta-analysis of 9 randomized trials: No effect on mortality (OR 0.99) or recovery to RRT independence (OR 0.76).
  - suggestion that continuous RRT had fewer episodes of hemodynamic instability and better control of fluid balance
- May be preferable in specific subpopulations

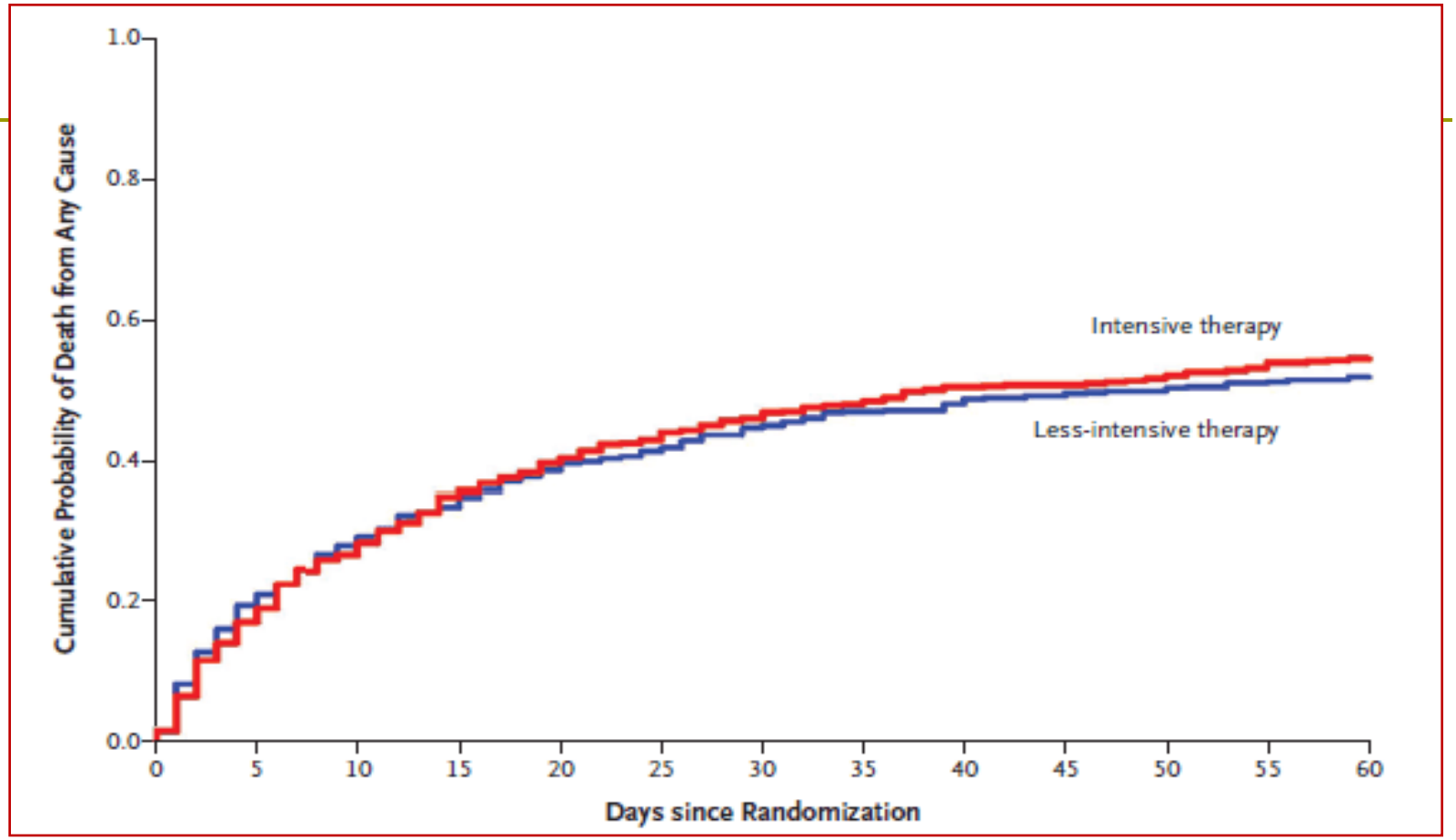
Intensity of RRT

Optimal intensity of RRT is controversial

- ✓ **Intensive RRT :** IRRT or SLEDD 6x/wk or CRRT at 35 ml/kg/hr

- ✓ **Less intensive RRT :** IRRT or SLED 3x/wk or CRRT at 20 ml/kg/hr

Intensive RRT vs Less intensive RRT



No difference in mortality

VA/NIH Acute Renal Failure Trial Network. (NEJM 2008;359:7):

Take Home Messages

- Kidney failure is a worldwide public health problem, with increasing incidence and prevalence, high costs and poor outcomes.
- When 90% or more of usual kidney function is lost, either dialysis or kidney transplantation is required to sustain life.
- Dialysis (both peritoneal and haemodialysis) is a life-saving option in acute setting in certain groups of patients.
- Earlier initiation of RRT in critically ill patients with AKI may have a beneficial impact on survival and outcomes but data is insufficient.
- Debate is ongoing about the superiority of intermittent vs continuous RRT.
- More intense RRT dosing does not improve outcome

Thank You !!