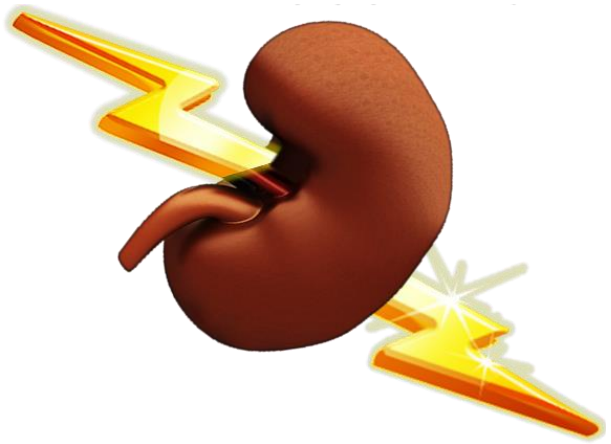


Acute kidney injury

Which is the incidence of AKI in ICU???

20% - 50%

What you should know…

- Acute renal failure or Acute kidney injury?
- What means AKI?
- Most frequent causes involved?
- How to identify an AKI?
- Where from should start our therapy?
- Renal replacement therapy – when to start?

Acute renal failure or Acute kidney injury?

RIFLE

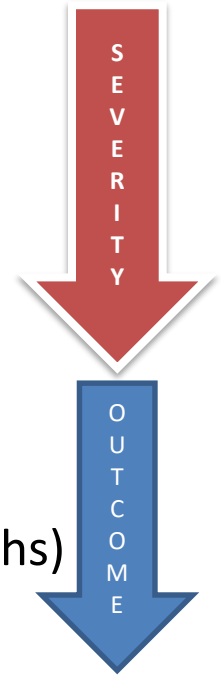
Risk

Injury

Failure

Loss (RRT>4 weeks)

End stage(RRT>3months)



AKI - Acute Kidney Injury

Stage I

Stage II

Stage III

What means AKI?

AKI - an abrupt (within 48 hours) reduction in kidney function based on:

- Elevation in serum creatinine level
- Reduction in urine output
- Need for renal replacement therapy

What means AKI?

- Increase in SCr by ≥0.3 mg/dl (≥ 26.5 μmol/l) within 48 hours, OR
- Increase in SCr to ≥1.5 times baseline, which is known or presumed to have occurred within the prior 7 days, OR
- Urine volume <0.5 ml/kg/h for 6 hours

AKI stages

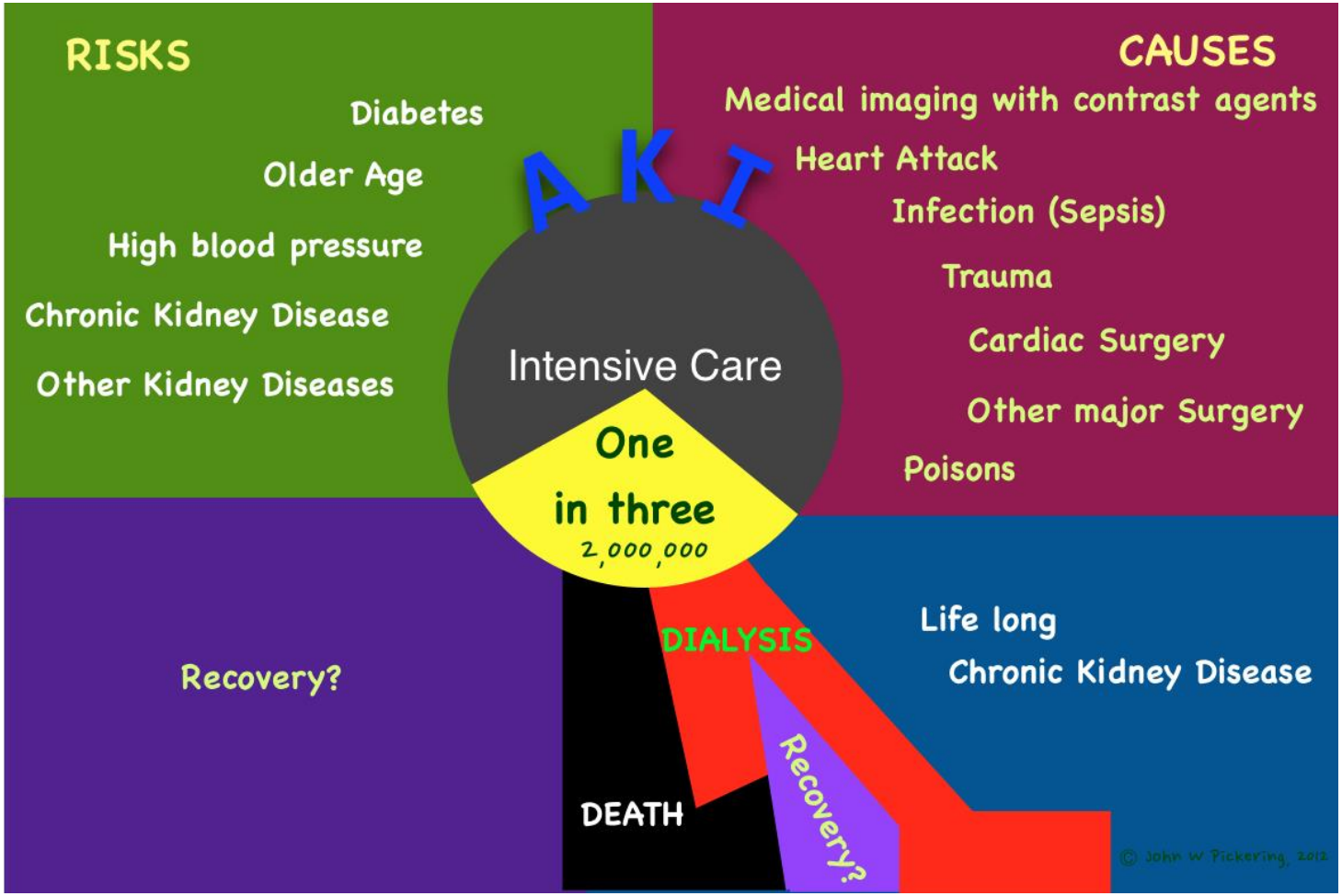
Table 1. Stages of Acute Kidney Injury

Stage	*Change in serum creatinine level*	*Urine output*	*Other*
1	Increase ≥ 0.3 mg per dL (26.52 µmol per L) or ≥ 1.5- to twofold from baseline	< 0.5 mL per kg per hour for more than six hours	—
2	Increase > two- to threefold from baseline	< 0.5 mL per kg per hour for more than 12 hours	—
3	Increase > threefold from baseline or ≥ 4.0 mg per dL (353.60 µmol per L) with an acute rise of at least 0.5 mg per dL (44.20 µmol per L)	< 0.3 mL per kg per hour for 24 hours or anuria for 12 hours	Renal replacement therapy required

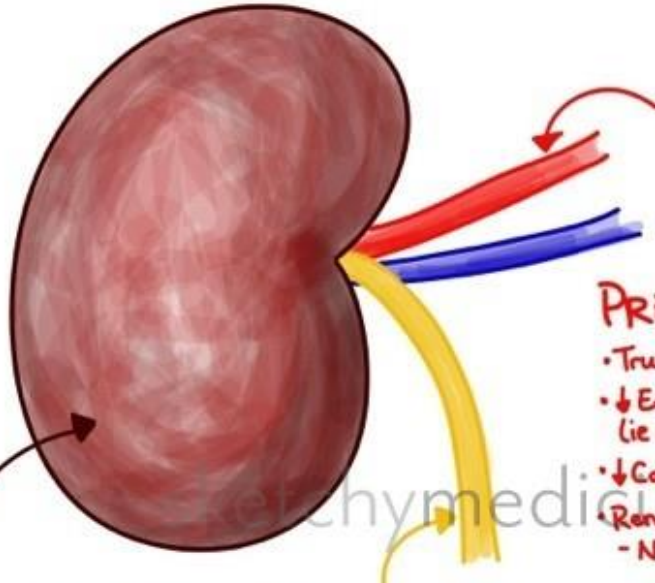
NOTE: *Each stage is defined by the change in serum creatinine level, the change in urine output, or the need for renal replacement therapy.*

Adapted with permission from Mehta RL, Kellum JA, Shah SV, et al. Acute Kidney Injury Network: report of an initiative to improve outcomes in acute kidney injury. Crit Care. *2007;11(2):R31.*

Risk factors and causes of AKI



ACUTE KIDNEY INJURY



PRERENAL (30-60%)

- True volume depletion (ie diarrhea)
- ↓ Effective circulating volume (ie edema)
- ↓ Cardiac output
- Renal vascular disease (stenosis, embolus)
  - NSAIDs

RENAL (20-40%)

① Glomerular
- 1° Glomerulonephritis
  - Anti-GBM
  - ANCA
- 2° to infection or vasculitis
- Neprotic syndrome with ATN

② Vascular
- Embolic
- HUS (hemolytic uremic syndrome)
- Cyclosporine
- NSAIDs

③ Tubulointerstitial
- Acute interstitial nephritis (AIN)
- Acute tubular necrosis (ATN)

POST RENAL (1-10%)

- Obstruction
  - Ureters
  - Bladder
  - Urethra

"RIFLE" AKI criteria

- Risk (50% ↑ sCr)
- Injury (100% ↑ sCr)
- Failure (150% ↑ sCr)
  - Or anuria for >24h
- Loss (>4 wks)
- End-stage (permanent loss)

PRE-renal or Intrinsic Renal origin

$$FE_{Na} = 100 \times \frac{(\text{urinary sodium} \times \text{serum creatinine})}{(\text{serum sodium} \times \text{urinary creatinine})}$$

- FE_{Na}<1% - PRE Renal
- FE_{Na}>2% - Renal

BUT

not specific

FE Na <1%:

Diuretic therapy
Rabdomyolisys
Contrast induced nephropathy
Acute glomerulonephritis
Urinary tract obstruction

Management of AKI

Avoid hypovolemia

Hemodynamic stability

= **Adequate renal perfusion**

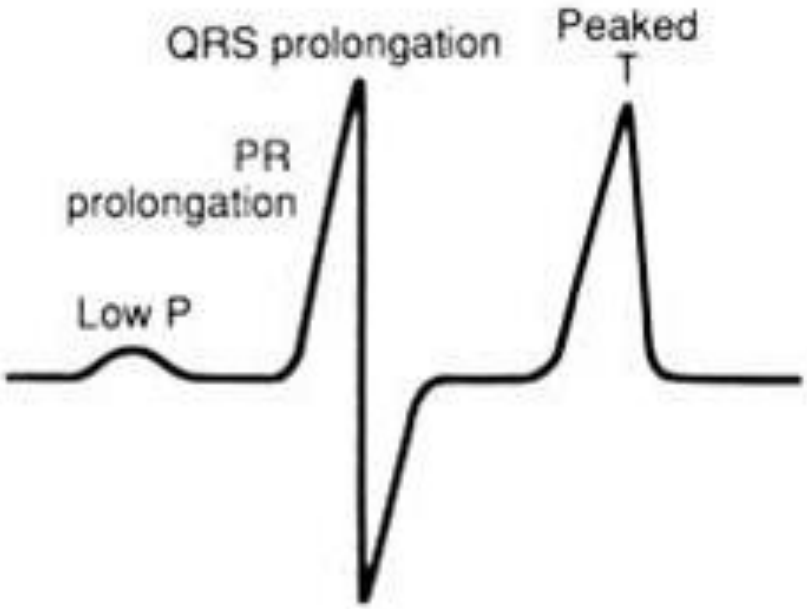
Adequate renal perfusion

- Isotonic solutions are preferred
- Goal of therapy / MAP > 65 mm Hg
- Vasopressors , If persistent hypotension
- Renal-dose dopamine – NOT recommended
- Optimize cardiac function (inotrop drugs, preload and afterload reduction)

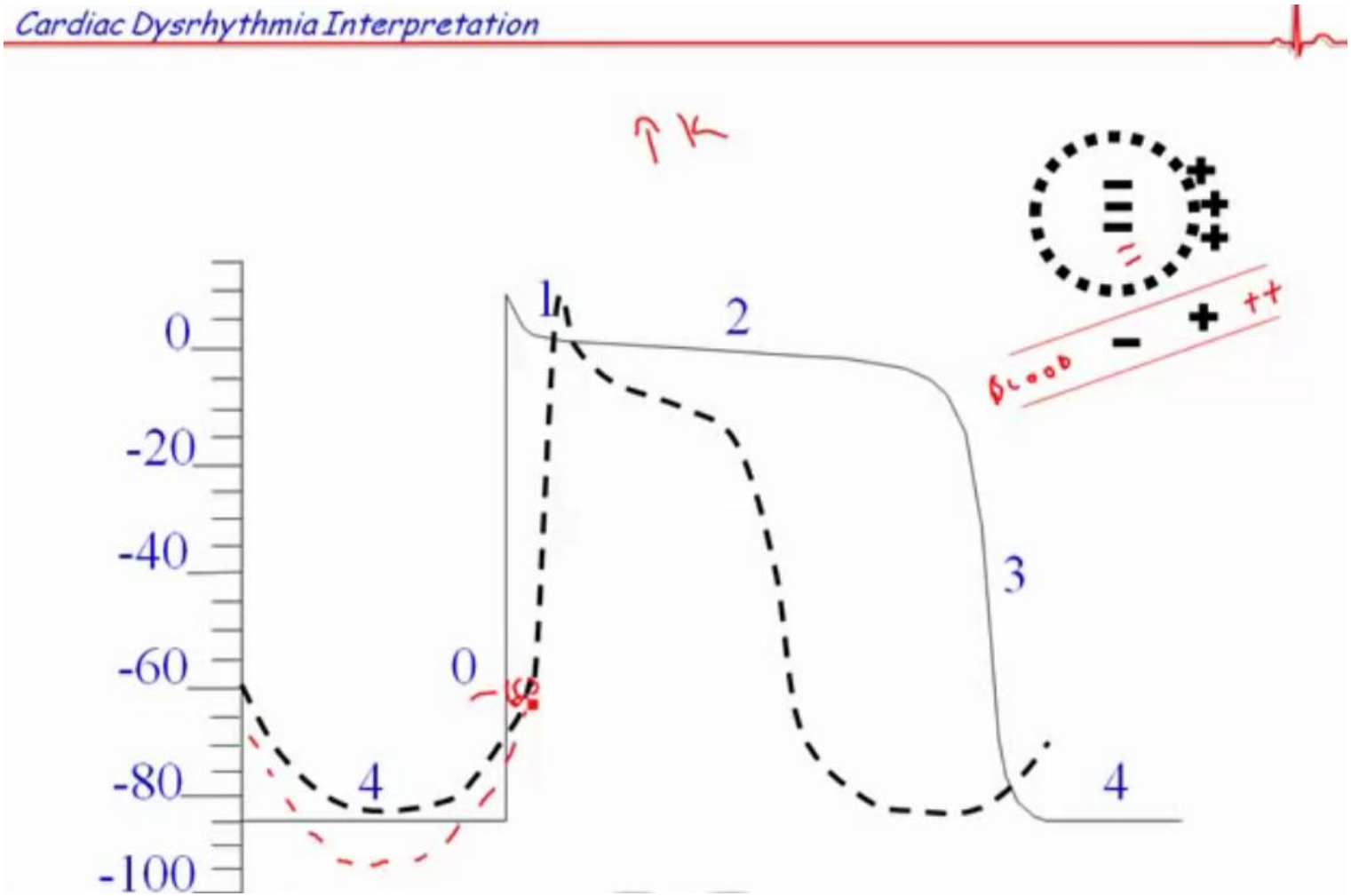
Electrolyte imbalances

- **Hyperkaliemia**
- Hyperphosphatemia
- Hypermagnesemia
- Hypo-, hypernatremia
- Metabolic acidosis

Hyperkalemia induced ECG changes



Hyperkalemia and cardiac action potential



Hyperkalemia management

Agent	Dose	Onset	Duration	Complications
Membrane stabilization				
Calcium gluconate (10%)	10 mL IV over 10 min	Immediate	30–60 min	Hypercalcemia
Hypertonic (3%) sodium chloride	50 mL IV push	Immediate	Unknown	Volume overload hypertonicity
Redistribution				
Insulin (short acting)	10 units IV push, with 25–40 g dextrose (50% solution)	20 min	4–6 hrs	hypoglycemia
Albuterol	20 mg in 4 mL normal saline solution, nebulized over 10 min	30 min	2 hrs	Tachycardia inconsistent response
Elimination				
Loop diuretics				
Furosemide	40–80 mg IV	15 min	2–3 hrs	Volume depletion
Bumetanide	2–4 mg IV			
Sodium bicarbonate	150 mmol/L IV at variable rate	Hours	Duration of infusion	Metabolic alkalosis volume overload
Sodium polystyrene sulfonate (Kayexalate, Kionex)	15–30 g in 15–30 mL (70% sorbitol orally)	>2 hrs	4–6 hrs	Variable efficacy intestinal necrosis
Hemodialysis		Immediate	3 hrs	Arrhythmias (?)

Renal replacement therapy

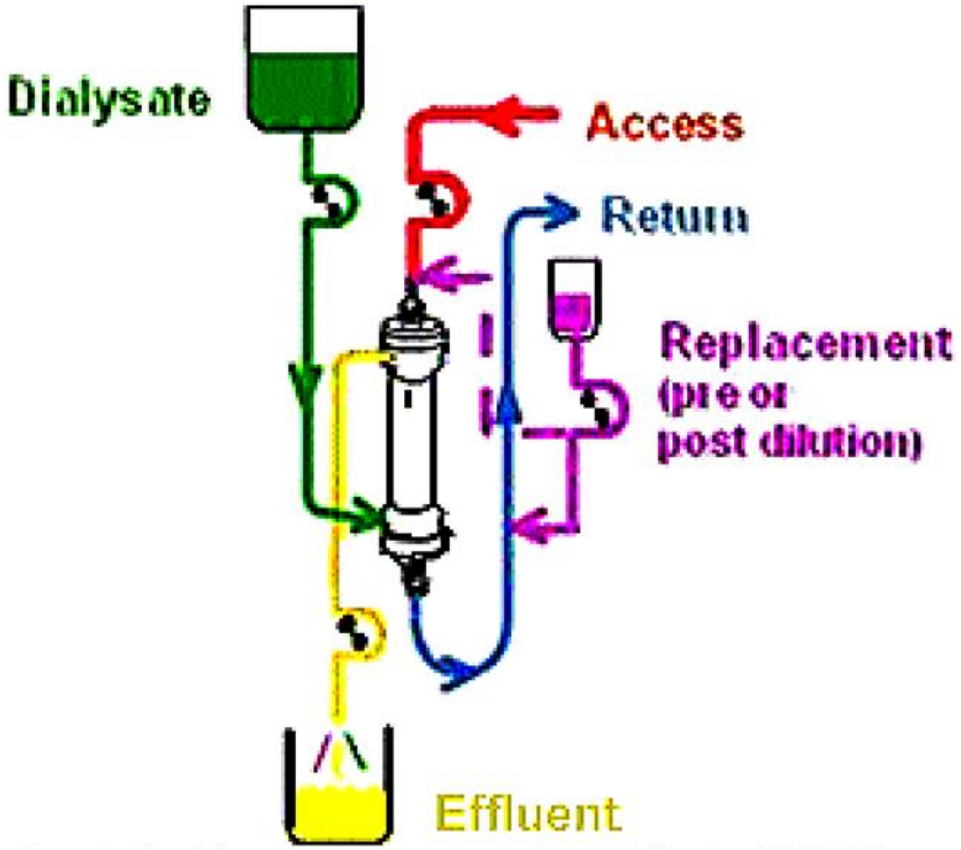


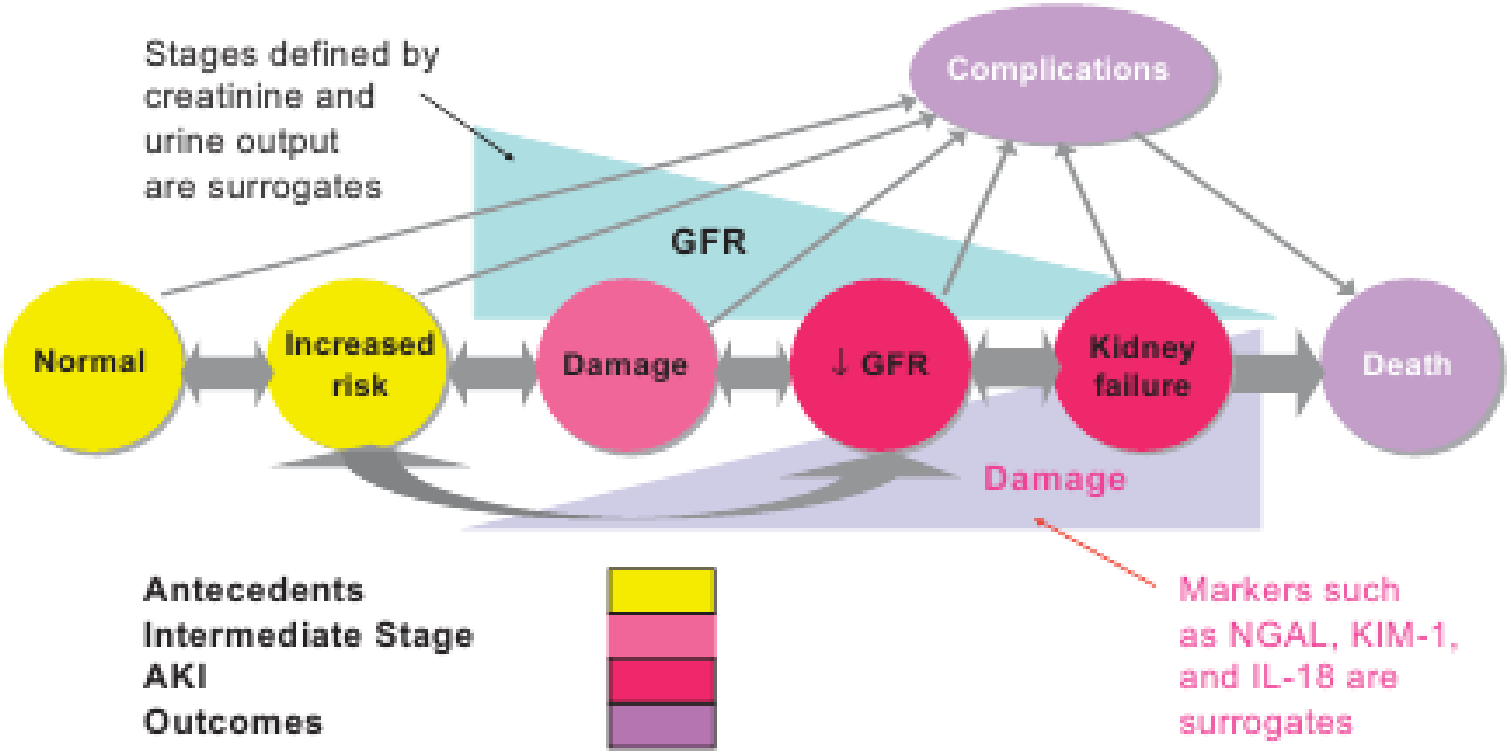
Figure-4: Circuit for continuous veno venous Haemodiafiltration (CVVHDF).

Indication for starting RRT

Indication	comments
Anuria or oliguria	Urine volume<200ml/12 h
Hyperkalemia	Serum porassium persistently>6,5 mmol/l
Severe acidaemia	pH<7,1
Serum ureea>30μmol/l , **OR** Creatinine>300 μmol/l	Value are not absolute, only a guide
Refractory fluid overload	Especially in compromised lung function
Uraemic complication	Encephalopathy, pericarditis , neuropathy or myopathy
Temperature control	Hyper- and hypothermia
Drug overdose	
Sepsis	

Summary

- Renal failure – frequent phenomena in ICU
- FIRST place - pre-renal origin
- Promptly treatment determines success
- Early RRT save kidney


Stages defined by creatinine and urine output are surrogates
Complications
GFR
Normal
Increased risk
Damage
↓ GFR
Kidney failure
Death
Damage
Antecedents
Intermediate Stage AKI
Outcomes
Markers such as NGAL, KIM-1, and IL-18 are surrogates