Acute Kidney Injury

Clinical Case Scenario

- 69-year old woman with chronic compensated hypertension and type 2 diabetes mellitus.
- She was febrile, with cough, diarrhea and vomitting for 4 days. These symptoms worsened despite treatment with cefuroxime. Vomiting with low oral intake progressed. Peroral antidiabetics (metformin and glimepiride) were discontinued.
- After another 2 days somnolence and anuria appeared. She was admitted to the ER of the University Hospital.

Her vital signs at admission were:

- respiratory rate 25/min, SpO2 86% on room air
- BP 60/40 mm Hg, HR 50/min
- prolonged capillary refill time.
- somnolence

- Oxygen via face mask with reservoir bag was administered
- peripheral line and urinary catheter were inserted
- 1 liter of crystalloid was rapidly infused
- blood cultures and labs were taken.

Laboratory results

- B(a)pH < 6,8
- B(a)pCO2 3.2 kPa
- B(a)pO2 19.2 kPa
- B(a)HCO3 2.6 mmol/l
- B(a)BD- -35 mmol/l
- B(a)sO2c 0.888
- Glykémie 30.5 mmol/l
- Leukocyty 37.6 10^9/l
- Erytrocyty 4.31 10^12
- Hemoglobin 130 g/l
- Trombocyty 164 10^9/l
- Urea 30.3 mmol/l
- Kreat. 974 umol/l
- Na 133 mmol/l
- K 6.4 mmol/l
- Cl 86 mmol/l
- Ca 2.35 mmol/l
- Bi-celk. 6.2 umol/l
- AMS 11.07 ukat/l
- CRP 16.7 mg/l
- Prokalc. 47.66 ng/ml
- Laktát 18.2 mmol/l

- During the subsequent hour, patient remained anuric.
- Mental alteration and bradycardia with hypotension progressed
- bradypoea with severe hyposaturation developed rapidly.

- Rapid sequence intubation was performed, central venous catheter, arterial line, dialysis catheter and nasogastric tube were inserted.
- Sodium bicarbonate was administered repetitively, infusion of norepinephrine was started, crystalloids and colloids (4% albumin) were given.
- Cultures (urine, sputum) were taken, broad-spectrum antibiotic (piperacillin/tazobactam) was commenced.

Diagnosis

- Septic shock with multiple organ failure MOF/MODS (respiratory, circulatory, CNS, **renal**)
- Probable origin – urosepsis
- Severe lactic acidosis – shock induced plus metformin associated
- Decompensated diabetes mellitus
- Other chronic illnesses…

AKI - epidemiology

- 5-7% patients in hospital
- 50% AKI on ICU due to sepsis

Mechanism:

- Prerenal 40-70%
- Renal 10-50%
- Postrenal 10%

AKI - patophysiology

Prerenal:

- decreased renal blood flow - hypovolemia, hypotension
- drugs (*NSAIDs, aminoglycosides, ACEi, etc*)

Renal:

- Pathophysiology is very complex and is closely related to MODS/MOF (tissue damage by inflammation..)

Postrenal:

- obstruction that affects the flow of urine out of **both** kidneys (acute) – BPH, stones, tumor

AKI – laboratory and clinical signs

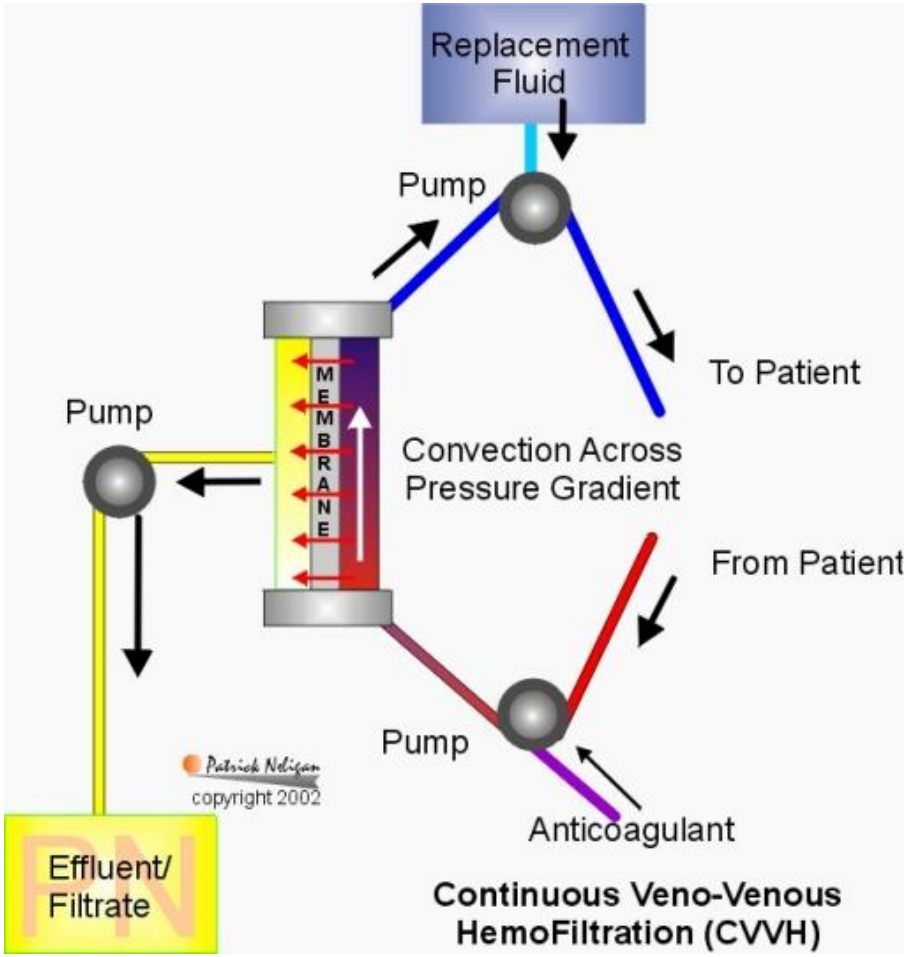
- retention of fluids
- low (oliguria) or no urine output (anuria)
- small molecules disturbance (hyperkalemia, hyperphosphatemia)
- retention of BUN (blood urea nitrogen), creatinine
- metabolic acidosis

Renal Replacement Therapy

Elimination techniques

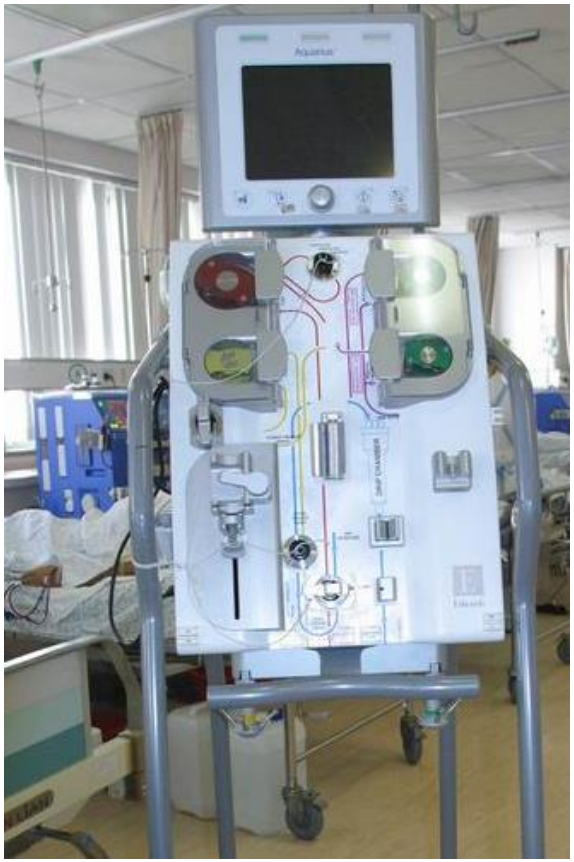
- Intermittent methods – Intermittent hemodialysis (IHD)
- Continuous methods – Continuous Renal Replacement Therapy (CRRT)
- Slow (Sustained) low-efficiency dialysis (SLED)

CVVH – Continuous Veno-Venous Hemofiltration



Technical Aspects

- Catheter for HD
- Blood pump
- Exctracorporeal circuit
- Filter
- Anticoagulation
- Substitution



Anticoagulation

Systemic anticoagulation:

- UFH
- LMWH

Regional anticoagulation:

- Na citrate
- UHF/protamin
- Extracorporeal cooling system

Without anticoagulation

CRRT - pro

- more hemodynamic stability
- advantages with nutrition
- slow fluid removal
- precise control of homeostasis

CRRT - con

- higher risk of bleeding (if systemic anticoagulation used)
- more expensive
- longer contact of blood with arteficial surfaces
- technical difficulties

- Renal replacement therapy was instituted : intermittent hemodialysis with subsequent continuous veno-venous hemofiltration.
- Regional anticoagulation with citrate was maintained during CRRT.
- Initially on high doses of norepinephrine, stress-dose of hydrocortisone was added, volumotherapy with invasive hemodynamic monitoring was performed
- After 2 days, hemodynamic stability was achieved
- After 3 days, the the therapy was switched to IHD with ultrafiltration.
- Diuresis was resumed, ongoing IHD therapy every 2 days.

- Sedation was stopped, consciousness was resumed with transient delirium.
- Weaning with daily spontaneous breathing trials was started.
- After 14 days of mechanical ventilation, patient was successfully extubated.
- After another 3 days, she was transferred to HDU with intermittent hemodialysis facility.