Enhanced Elimination

Overview

Increased rate of removal of an agent to reduce mortality, complications, more invasive interventions, or LOS. In practice useful only when positive risk-benefit analysis and:

- Severe toxicity
- Poor outcome despite supportive care/antidote
- Slow endogenous rate of elimination
- Suitable pharmokinetic properties

Options

- Multiple-Dose Activated Charcoal (MDAC)
- Urinary Alkalinisation
- Extracorporeal Elimination

Multiple-Dose Activated Charcoal (MDAC)

Repeated oral activated charcoal fills GIT → interrupts enterohepatic circulation (effective if small VD) and provides gastrointestinal dialysis (effective if small lipid-soluble molecule with small VD & low protein-binding).

Indications:

- Carbamazepine – reduces duration of intubation & ICU LOS if coma
- Phenobarbitone – reduces duration of intubation & ICU LOS if coma
- Dapsone – V. rare. May reduce prolonged methaemoglobinaemia
- Quinine – Marginal benefit over aggressive supportive care.
- Theophylline – Haemodialysis is more effective.

Procedure:

- 50g (child 1g/kg) PO (OGT/NGT if intubated) initial dose, then 25g (0.5g/kg) q2h
- Check for bowel sounds, and stop if none heard
- Rarely required past 6hrs

CI: ↓LOC without airway protection, bowel obstruction.

Cx: Vomiting, aspiration, constipation, charcoal bezoar formation, bowel obstruction/perforation, corneal abrasion, distraction from Resus/supportive care priorities

Urinary Alkalinisation

Alkalinising urine will promote ionisation of (weak) acids and trap them in renal tubules/collecting ducts. Toxins need to be filtered at the glomerulus and have small VD.

Indications:

- Salicylates – Acute, symptomatic OD. Severe OD should have haemodialysis.
- Phenobarbitone – Inferior to MDAC but may ↓duration of intubation & ICU LOS if coma

Procedure:

- Correct any hypokalaemia first
- 1-2mmol/kg **sodium bicarbonate** IV bolus
- Infuse 250ml/hr (child 5ml/kg/hr) of solution of 100mmol $NaHCO_3$ in 1L **5% dextrose**
- 20mmol **KCl** may be added to each litre of solution to maintain $[K^+]$
- Monitor serum $[HCO_3^-]$ & $[K^+]$ q4h and keep urine at pH>7.5
- Continue until clinical & lab evidence of resolution of toxicity

CI: Fluid overload.

Cx: Alkalaemia (usually well-tolerated), hypoK, hypoCa (mild).

Extracorporeal Elimination

Invasive, specialised equipment/staff, resource intensive techniques with serious potential complications. Reserved for life-threatening poisonings where outcome would otherwise be poor.

Techniques:

- Haemodialysis
- Haemofiltration
- Charcoal Haemoperfusion
- Plasmaphoresis
- Exchange Transfusion

Haemodialysis

Most frequently employed. Requires large double-lumen venous vascath (or A-V fistula), dialyser, dialysate and anticoagulation. Need to be small molecule with small VD, rapid redistribution from tissues and plasma, which has slow endogenous elimination.

Clinical indications: LiCK STAMPS

- **Li**thium – severe, chronic OD
- **C**arbamazepine – massive OD
- **K** (Potassium salt) OD – with life-threatening hyperK+
- **S**alicylates – severe late acute OD or chronic OD with ↓LOC
- **T**heophylline
- Toxic **A**lcohols: Ethylene glycol & methanol
- **M**eformin-induced lactic acidosis
- **P**henobarbitone - coma
- **S**odium valproate – massive OD

Haemofiltration

Continuous A-V or V-V haemodiafiltration (CAVHD, CVVHD) – filters molecules based on filter pore size. Slower than haemodialysis but less invasive and less impact on haemodynamics.

Charcoal Haemoperfusion

Similar to haemodialysis but blood pumped through a column of activated charcoal. Thrombocytopenia can be a problem. Better clearance rates than haemodialysis and need not be small or water soluble, however need charcoal filter which is not always available.

Indications:

- Higher clearance than dialysis: salicylates, theophylline, phenobarbitone, carbamazepine, paraquat.
- Non-dialysable toxins: phenytoin.

Plasmaphoresis & Exchange Transfusion

Don't appear to be employed very often.