Elimination Enhancement

Introduction to Elimination Enhancement

Definition

- Elimination enhancement refers to a group of therapeutic interventions aimed at accelerating the removal of toxins or drugs from the body after systemic absorption has already occurred.
- These techniques are primarily used when the amount of toxin in the body is significant and cannot be adequately managed by natural excretion mechanisms or antidotal therapy alone.
- **They are typically used in cases of:**
    - Severe poisoning
    - Life-threatening toxicity
    - Substances with prolonged half-lives
    - Drugs with limited endogenous elimination

Objectives of Elimination Enhancement

- Reduce the toxic burden
- Shorten the duration of toxicity
- Prevent or reduce organ damage
- Avoid complications of poisoning
- Improve clinical outcomes in serious intoxications

Pharmacokinetic Considerations

- Before deciding on elimination enhancement, understanding the pharmacokinetics of the drug is essential:

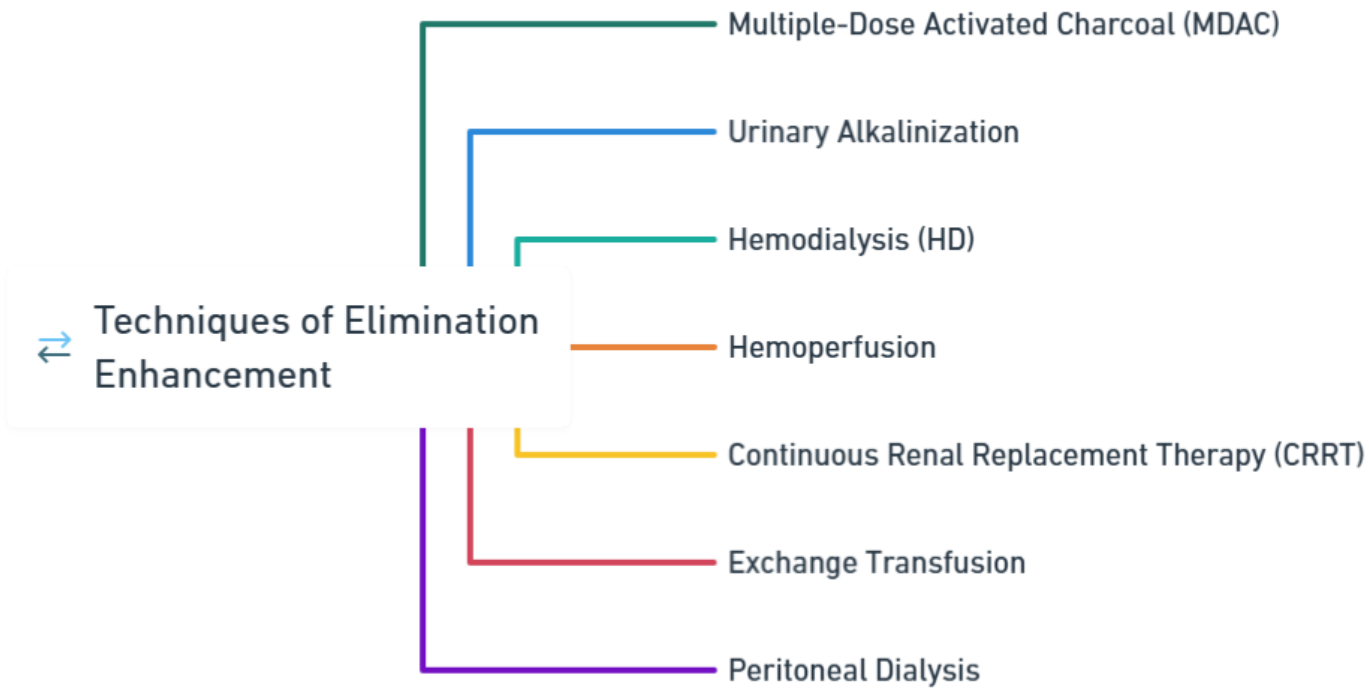
Parameter	Relevance
Volume of Distribution (Vd)	Drugs with **low Vd (<1 L/kg)** are more amenable to extracorporeal removal
Protein Binding	Drugs with **low protein binding** are more effectively removed
Molecular Weight	Drugs with **low molecular weight** are easier to dialyze
Water Solubility	Water-soluble drugs are more suitable for hemodialysis
Half-Life	Longer half-life substances benefit more from enhanced elimination

Techniques of Elimination Enhancement

- **The main methods include:**

1. Multiple-Dose Activated Charcoal (MDAC)
2. Urinary Alkalinization
3. Hemodialysis (HD)
4. Hemoperfusion
5. Continuous Renal Replacement Therapy (CRRT)
6. Exchange Transfusion
7. Peritoneal Dialysis (rarely used today)

Let's explore each in detail:



A. Multiple-Dose Activated Charcoal (MDAC)

Mechanism:

- Repeated doses of activated charcoal are given to interrupt enterohepatic and enteroenteric recirculation of certain drugs.
- Enhances elimination by maintaining a concentration gradient between the blood and GI tract.

Dosing:

- Initial dose: 50–100 g orally or via nasogastric tube
- Maintenance: 25–50 g every 4 hours

Indications:

- Drugs undergoing **enterohepatic recirculation** or **GI secretion**, such as:
  - Carbamazepine
  - Theophylline

- Phenobarbital
- Dapsone
- Quinine
- Digoxin (limited effect)

Contraindications:

- Bowel obstruction or perforation
- Unprotected airway
- Ileus

Complications:

- Aspiration
- Constipation or diarrhea
- Electrolyte disturbances

B. Urinary Alkalinization

Mechanism:

- Involves administration of sodium bicarbonate to increase urine pH to 7.5–8.0, which enhances renal excretion of weak acids by ion trapping.

Drugs enhanced by this method:

- Salicylates (aspirin)
- Phenobarbital
- Methotrexate
- Chlorpropamide

Protocol:

- IV bolus of sodium bicarbonate (1–2 mEq/kg)
- Followed by continuous infusion: 3 ampoules (150 mEq) of sodium bicarbonate in 1 L of 5% dextrose at 250 mL/hour
- Potassium supplementation is often required to maintain alkalinization

Monitoring:

- Serum potassium
- Blood pH (target: <7.55 to avoid alkalosis)
- Urine pH (target: 7.5–8.0)

Contraindications:

- Renal failure

- Hypokalemia
- Alkalemia (pH >7.55)

Complications:

- Hypokalemia
- Fluid overload
- Metabolic alkalosis

C. Hemodialysis (HD)

Mechanism:

- Blood is passed through a semipermeable membrane; solutes diffuse across based on concentration gradients.
- Useful for small, water-soluble, low Vd, low protein-binding drugs.

Indications:

- Severe poisoning with:
  - Methanol
  - Ethylene glycol
  - Lithium
  - Salicylates
  - Theophylline
  - Phenobarbital
  - Valproic acid (in severe cases)

Advantages:

- Rapid and effective clearance
- Correction of acid-base and electrolyte disturbances

Contraindications:

- Hemodynamic instability (relative; CRRT may be used instead)

Complications:

- Hypotension
- Hemorrhage
- Infection
- Electrolyte disturbances

D. Hemoperfusion

Mechanism:

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