Use of dialytic therapies for poisoning

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Introduction

The nephrologist is often consulted in poisoning cases. Although management may involve attention to incident renal failure or electrolyte and acid-base disorders, blood purification may also be necessary [1]. The application of dialysis therapies or hemoperfusion to enhance clearance of intoxicants is an essential task for the nephrologist.

Since the first peritoneal dialysis for chlorate poisoning and the earliest hemodialysis for barbiturate intoxication in the early 1950’s [2, 3], the indications for dialysis in intoxication have expanded. With the development of high-flux [4] and high-efficiency membranes [5], the introduction of convective modalities (hemofiltration and hemodiafiltration [6]), and the use of continuous treatments (CRRT) [7], dialysis technology has improved. Furthermore, improvements in sorbent technology have advanced hemoperfusion in the treatment of poisoning.

This chapter will outline the principles and use of dialysis and related procedures for the treatment of the poisoned patient. Consideration will be given to criteria for use of dialysis and related modalities, decision among available options, and recent advances. Finally, detailed discussion will follow for specific poisonings for which dialysis therapies are especially effective.
Initial approach

A standard approach is recommended for all poisoned patients and should include triage and general supportive care. Initial assessment should include evaluation and stabilization of the airway, breathing, and circulatory function. Core temperature should be assessed and hypothermia or hyperthermia appropriately corrected. Hypoglycemia should also be addressed if present. A complete physical and neurological examination should follow. Poison-specific antidotes should be administered if available [8].

Further evaluation should include a complete medical history and thorough investigation of the offending drug or chemical. Multiple drugs should be considered, especially with intentional or suicidal ingestions. Appropriate toxicology panels and laboratory studies may help with the diagnosis and identify metabolic or organ-specific dysfunction. The presence of electrolyte or acid-base disorders, elevated serum anion or osmolal gap, and crystalluria may aid diagnosis and treatment.

Previously popular, primary decontamination with gastric lavage, emetics, whole bowel irrigation and cathartics may not be effective in preventing or delaying enteric absorption of poisons [9-12]. In contrast, multiple-dose oral activated charcoal is an effective method of enteric decontamination for a wide variety of ingestions [13]. However, all enteric decontamination procedures are contraindicated in petroleum distillate and caustic ingestions.

Enhanced elimination of some drugs may also be possible through modulation of urinary pH. Among patients with preserved renal function, altering the pH of the tubular fluid can increase drug ionization, trapping the ionized species in the tubule lumen and increasing clearance. Excretion of weakly acidic drugs such as methotrexate, phenobarbital, or salicylate is increased with alkalization to a urine pH > 7.5 [14]. Alkalization is recommended for salicylate levels > 50 mg/dl (even when alkalemia is present) and is first-line therapy when hemodialysis is not appropriate or available. As alkalization may cause hypokalemia, alkalosis, or hypocalcemia, electrolytes and both urine and serum pH should be measured frequently. Urinary acidification is not recommended for poisoning with weakly basic drugs such as amphetamines, fenfluramine, phencyclidine (PCP), and quinine, as most patients recover with supportive care [15].

Criteria for extracorporeal removal of poisons

The decision to use an extracorporeal therapy to remove a drug or poison is dependent upon the clinical condition of the patient. Indications include abnormal vital signs suggesting airway, breathing, or circulatory instability; deterioration despite supportive treatment; mental status alteration such as confusion, lethargy, stupor, or coma; and evidence of midbrain dysfunction. Blood purification is indicated when endogenous clearance is impaired (e.g. cardiac, renal or hepatic failure) or is much slower than with extracorporeal clearance. The risk of delayed intervention among poisoned patients with severe co-morbid illness should also be considered. In addition, hemodialysis may be prescribed to rapidly correct any concomitant electrolyte or acid-base disorders. There are discrete indications to use extracorporeal techniques for poisons with delayed toxicity; including methanol and ethylene glycol. These toxins will be discussed in the final section. It should be noted that many investigators report combining different modalities in the treatment of poisoning (discussed below).

With double-lumen intravenous catheters for acute hemodialysis, hemofiltration, and plasma exchange, the most common complications are bleeding, hematomas, catheter failure, risk of infection, central vein thrombosis and stenoses, and rarely, air embolism. Femoral placement is the site associated with the fewest non-infectious complications [16]. Complications of treatment will be discussed below.

Hemodialysis, hemofiltration, and hemodiafiltration

Apparatus and principles

Hemodialysis (HD) is the method of extracorporeal drug removal most commonly used in the treatment of poisoning [1]. The apparatus consists of a blood circuit, an electronic and mechanical device (with pumps and pressure monitors), a dialyzer cartridge (containing hollow permeable fibers), and a dialysate circuit (of purified water with added electrolytes). In practice, a double-lumen catheter is first placed in a central vein.