INTOXICATIONS IN CHILDREN: A NEPHROLOGICAL APPROACH
Gaston Zilleruelo, M.D., Michael Freundlich, M.D. and José Strauss, M.D.

INTRODUCTION

Intoxications are serious world-wide problems affecting all social levels and posing questions as to prevention and treatment. These intoxications may involve drugs or poisons, and only in the United States affect two million children each year (mostly under five years of age) of which 400 die (1).

Despite several preventive and educative efforts, the prevalence of poisoning remains exceedingly high. Industry developments have increased the availability and risk of exposure to different chemicals and poisons. In addition, there has been an increased incidence of narcotic and sedative intoxications as suicidal attempts with the use of drug mixtures. In children, 75% of all poisonings occur from ingestion of "in-sight" compounds and only 25% from those hidden or "out-of-sight" (2). Accidental poisoning has a cumulative frequency of near 80% under 5 years of age and the suicidal attempts have a peak incidence in the age group of 13-30 years (3). The mortality rate remains high, ranging from 5 to 38% in hospitalized patients in stage 4 coma (4). In addition, important morbidity and sequelae are observed in a number of these patients.

In this review we will concentrate on some aspects of the management of intoxications in children from the nephrological point of view. The readers interested in more complete details should consult published thorough reviews on several clinical and diagnostic aspects of different types of intoxications (1,5).

GOALS OF TREATMENT

Intoxication always constitutes a medical emergency; thus, prompt diagnosis is essential for a good outcome. For instance, with salicylate poisoning, a mortality rate of 2% was reported in patients in whom the diagnosis was made upon admission to the hospital, while mortality was 25% when the diagnosis was delayed, regardless of the coma stage (6). Frequently, the diagnosis of accidental poisoning in a child arises from a good clinical history. In suicidal attempts, many times it is only the toxicology screen which will give the necessary information on the drugs involved. Treatment must be efficient in order to prevent additional morbidity and sequelae. Management should include three main aspects: 1) supportive therapy; 2) poison inactivation; 3) poison removal.
1) Supportive therapy: This represents the keystone of the management of intoxicated children. First of all, we must assure a permeable airway and adequate oxygenation of the patient, even if mechanical ventilation is required, and a close hemodynamic monitoring with vital signs assessment, correction of fluid and electrolyte imbalance, adequate caloric intake, and treatment of complications such as shock, convulsions, cerebral edema, respiratory depression, renal or liver failure.

2) Inactivation: There are certain substances called "antidotes" which will combine with the poison impeding its absorption to the body, making it harmless. The best example of an antidote is activated charcoal, a porous substance which adsorbs the drug or toxin, thus impeding its gastrointestinal absorption (7).

There are other substances with a protective action against specific toxins. These substances are useful when the intoxicant is known; an example is acetylcysteine, used in intoxications with acetaminophen in order to protect the liver (8), penicillamine for certain heavy metal intoxications (5), or deferoxamine for iron poisoning (9).

Other substances, which are called "antagonists" have the opposite pharmacologic action to the intoxicant. For instance, atropine is used to counteract the effect of organic phosphate compounds present in insecticides (5). Specific antibodies directed against the whole molecule or part of the intoxicant have become the most efficient way of treating certain intoxications. An example is the use of Fab-fragments of digoxin-specific antibodies to decrease active digoxin when present in toxic levels (10).

3) Removal: The most simple and rapid approach is the induction of vomiting by pharyngeal stimulation or by ingestion of ipecac syrup. The use of ipecac syrup has been controversial but there are many situations in which it is helpful if used early. Induction of vomiting and gastric lavage are contraindicated in intoxications with petroleum derivatives, caustics, or if the patient is in coma. The use of large amounts of oral activated charcoal is helpful in the management of intoxications not only by affecting absorption of the drug, but by producing an increased gastrointestinal clearance or removal; this seems to apply to phenobarbital, acetaminophen and aspirin (11).

Enhanced excretion by the use of forced diuresis is commonly recommended for drugs normally handled by the kidneys. A sustained diuresis of 2-3 times normal should be achieved in order to decrease tubular reabsorption and increase glomerular excretion rate of these drugs. In addition to intravenous fluids, the use of osmotic substances (mannitol) or loop diuretics (furosemide) may be considered. Ionized diuresis is based on the principle that renal excretion is favored when a drug is maintained in its ionized state. Forced alkaline diuresis may be helpful in enhancing removal of drugs with a low pK; in this category are salicylates, phenobarbital and uric acid (12,13). Best clearances of salicylates are obtained with urine pH > 7.5 (12). Forced alkaline diuresis can be attained with a large volume of any type of fluids (an essential component of any treatment of intoxication provided there is no cardio-pulmonary failure), plus bicarbonate or THAM, and diuretics like acetazolamide (Diamox®) (14,15). However, forced alkaline diuresis is frequently misused and abused; it has been reported to produce severe alkalemia, hypokalemia and even pulmonary edema (16). With sodium bicarbonate or THAM, one of the problems is depression of the respiratory center, while Diamox induces a metabolic acidosis.