CHAPTER 3

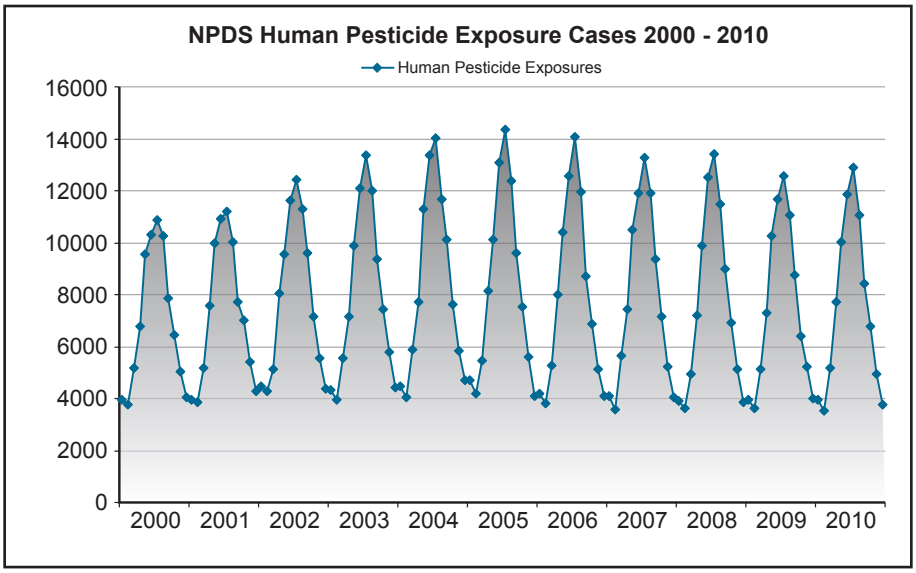
General Principles in the Management of Acute Pesticide Poisonings

Introduction

This chapter describes basic management techniques applicable to most acute pesticide exposures. Where special considerations and treatments are required for a particular pesticide, they are addressed separately in the appropriate chapter.

Remember: Treat the patient, not the poison. Symptomatic and supportive care is the mainstay of therapy. Severe poisoning should be treated in an intensive care unit setting, preferably with toxicological consultation, if available. Consultation with the regional poison control center is highly advisable. Its staff can assist with treatment recommendations or advise when no treatment is needed, helping to avoid unnecessary and possibly harmful interventions.

The American Association of Poison Control Centers (AAPCC) maintains the National Poison Data System (NPDS). NPDS records data from the 57 U.S. poison centers in near real-time. In 2010, 2.4 million human exposures were reported to NPDS. Of these, 90,037 (3.8%) were exposed to some type of pesticide. The chart below demonstrates the seasonal variation for 2000–2010, with peak exposures in July of each year.



Skin Decontamination

Decontamination must proceed concurrently with whatever resuscitative and antidotal measures are necessary to preserve life. Be careful not to expose yourself or other care providers to potentially contaminating substances. Wear protective gear (gloves, gown and goggles) and wash exposed areas promptly. Persons attending the victim should avoid direct contact with heavily contaminated clothing and bodily fluids.

Place all contaminated clothing and personal effects in an appropriate container. While no glove will provide complete protection to all possible chemical contamination, butyl rubber gloves generally provide the best protection compared to latex and other surgical or precautionary gloves. If butyl rubber gloves are not available, nitrile gloves may be an option. A double layer of gloves will increase protection, but will decrease manual dexterity.[1]

Flush exposed areas with copious amounts of water. Wash carefully behind ears, under nails and in skin folds. Use soap and shampoo for oily substances. If the patient exhibits any signs of weakness, ataxia or other neurologic impairment, clothing should be removed and a complete bath and shampoo given while the victim is recumbent.

Eye Decontamination

Ocular exposures should be treated by irrigating the exposed eyes with copious amounts of clean water for at least 15 minutes. Remove contact lenses if present prior to irrigation. If irritation persists after irrigation, patients should be referred to a healthcare facility for an ophthalmic exam.

Airway Protection

Support airway, breathing and circulation. Suction any oral secretions using a large bore suction device if necessary. Intubate and ventilate as needed, especially if the patient has respiratory depression or if the patient appears obtunded or otherwise neurologically impaired. Administer oxygen as necessary to maintain adequate tissue perfusion. In severe poisonings, it may be necessary to mechanically support pulmonary ventilation for several days.

There are a couple of special considerations with regard to certain pesticides. In **organophosphate** and **carbamate** poisoning, adequate tissue oxygenation is essential prior to administering atropine. In **paraquat** and **diquat** poisoning, oxygen is **contraindicated** early in the poisoning because of progressive oxygen toxicity to the lung tissue. See specific chapters for more details.

Gastrointestinal Decontamination

Control seizures before attempting any method of GI decontamination.[2]

Gastric lavage should NOT be routinely used in pesticide exposure management and is contraindicated in poisonings due to hydrocarbon ingestion. Lavage is indicated only when a patient has ingested a potentially life-threatening amount of poison and the procedure can be done within 60 minutes of ingestion. Even then, clinical benefit has not been confirmed in controlled studies.[2,3] Studies of poison recovery have been performed mainly with solid material such as pills. Reported recovery of material at 60 minutes in several studies was 8%-32%.[4,5] There is further evidence that lavage may propel the material into the small bowel, thus increasing absorption.[6] There are no controlled studies of pesticide recovery by these methods.

For gastric lavage, a large bore (36-40 French for adult, 24-28 French for children) orogastric tube is passed through the mouth into the stomach followed by administration of small volumes (200-300 mL adults, 10mL/kg child) warmed saline or water (avoid water in children, use saline instead), which is then allowed to drain back out with the hope of removing poisons in the stomach. Patient must be able to maintain airway or be intubated prior to lavage. Do not attempt to lavage a patient with ingestion of poisons that may cause seizures or rapid CNS depression, unless intubated. Measure the patient for the correct placement of tube; place in left-lateral decubitus position. Place on cardiac monitor and pulse oximetry. Have suction equipment

nearby. Continue lavage process until returns are clear. Volume of fluid returned should be the same as the amount instilled to avoid fluid and electrolyte imbalance. Negative or poor lavage does not rule out significant ingestion.

Complications of gastric lavage may include aspiration, fluid and electrolyte imbalance, mechanical injury to the throat-esophagus-stomach and hypoxia. Lavage is contraindicated in hydrocarbon ingestion, a common solvent used in many pesticide formulations. Therefore, for most pesticide exposures, gastric lavage should not be performed. Contraindications to gastric lavage are listed in the adjacent table.

GASTRIC LAVAGE CONTRAINDICATIONS[2]	
1	Patients with unprotected airway
2	Patients with decreased level of consciousness without intubation
3	Patients who have ingested drugs that may cause abrupt CNS depression or seizures and who have not been intubated
4	Patients who have Ingested corrosive substances: acid or alkali
5	Patients who have ingested hydrocarbon and have high risk of aspiration
6	Patients at risk of bleeding or GI perforation because of recent surgery or medical conditions such as coagulopathy

Cathartics have NO role in management of poisoned patients and are NOT recommended as a way to decontaminate the GI tract. Repeat doses of cathartics may result in fluid and electrolyte imbalances, particularly in children. [7]

Saline cathartics include magnesium citrate, magnesium sulfate, sodium sulfate and magnesium hydroxide. Osmotic cathartics increase the water content and weight of the stool. Sorbitol is a sugar alcohol that functions as an osmotic cathartic and is slowly metabolized in humans. Sorbitol is often combined with charcoal to improve the taste and mask the grittiness of charcoal. Previously given along with charcoal, cathartics were intended to decrease the absorption of poisons by speeding movement of the charcoal-poison complex through the gut resulting in bowel evacuation. The use of sorbitol is not recommended in poisonings with organophosphates, carbamates or arsenicals, which generally result in profuse diarrhea, or in poisonings with diquat or paraquat, which may result in an ileus.

Contraindications to cathartic use include absent bowel sounds, abdominal trauma or surgery, or intestinal perforation or obstruction. Cathartics are also contraindicated in volume depletion, hypotension, electrolyte imbalance or the ingestion of a corrosive substance.[7] A 2004 revision of a 1997 position paper on cathartics determined that there was no new evidence that required a change in the 1997 conclusions.[8]

Activated charcoal is an effective adsorbent for many poisonings. Volunteer studies suggest that it reduces the amount of poison absorbed if given within 60 minutes of ingestion.[9] There are insufficient data to support or exclude its use if time from ingestion is prolonged, although some poisons that are less soluble may be adsorbed beyond 60 minutes.

Nearly all clinical trials with charcoal have been conducted with poisons other than pesticides. There is evidence that paraquat is well adsorbed by activated charcoal.[10,11,12,13] *In vitro* data demonstrated that boric acid is well adsorbed by charcoal.[14] Charcoal has been anecdotally successful in cases of poisoning from other pesticides. There are *in vitro* data that evaluated the effect of the herbicide 2,4-D, although the purpose of the study was to evaluate charcoal for environmental adsorption. It was not simulated in a gastric environment, so the data do not strictly reflect an effect in human poisoning.[15]

Dosage of Activated Charcoal

It is difficult to determine the precise dosage, as clinical studies are either conducted in animals or in humans with a known quantity of ingestant. The following dosages are recommended.[16]

- ***Infants up to 1 year of age: 10–25 g or 0.5–1.0 g/kg***
- ***Children 1 to 12 years of age: 25–50 g or 0.5–1.0 g/kg***
- ***Adolescents and adults: 25–100 g***

Administer charcoal as an aqueous slurry. Encourage the victim to swallow the adsorbent. Antiemetic therapy may help control vomiting in adults or older children. As an alternative, activated charcoal may be administered through an orogastric tube or diluted with water and administered slowly through a nasogastric tube. Repeated administration of charcoal or other absorbent every 2-4 hours may be beneficial in both children and adults. Repeated doses of activated charcoal should not be administered if the gut is atonic. The use of charcoal without airway protection is contraindicated in the neurologically impaired patient.

Charcoal should be used with caution in cases of poisoning from organophosphates, carbamates and organochlorines if they are prepared in a hydrocarbon solution as this will increase the risk for aspiration.

Single-dose activated charcoal should not be used routinely in the management of poisoned patients. Charcoal appears to be most effective within 60 minutes of ingestion and may be considered for use for this time period. Although it may be considered 60 minutes after ingestion, there is insufficient evidence to support or exclude its use for this time period. Despite improved binding of poisons within 60 minutes, only one study exists to suggest that there is improved clinical outcome.[17]

Activated charcoal is contraindicated in an unprotected airway, a GI tract not anatomically intact, and when charcoal therapy may increase the risk of aspiration, such as when a hydrocarbon-based pesticide has been ingested.[9] A 2004 position paper by the American Academy of Clinical Toxicology (AACT) reviewed data since its 1997 statement was published and essentially reiterated the position of those guidelines.[8] A randomized controlled trial of multiple dose charcoal conducted in Sri Lanka was published after the 2004 AACT position paper. This study did not find a difference in mortality between the two groups, and the researchers concluded that routine use of multiple-dose activated charcoal could not be recommended in rural Asia Pacific.[18]

Syrup of ipecac was historically given to patients to induce emesis, both prior to emergency department referral and on emergency department arrival. Ipecac syrup was used as an intervention in order to prevent healthcare facility referral in minor ingestions. Ipecac has been used as an emetic since the 1950s. In a pediatric study, administration of syrup of ipecac resulted in emesis within 30 minutes in 88% of children.[19] Most clinical trials involve the use of pill form ingestants, such as aspirin,[5,20] acetaminophen,[21] ampicillin[22] and multiple types of tablets.[23] No clinical trials have been done with pesticides. In 2010, the National Poison Data System of the American Association of Poison Control Centers (AAPCC) reported more than 2.4 million human exposures, and syrup of ipecac was administered in only 359 (0.02%).[24] This was a significant decrease from 2009, when syrup of ipecac was administered for decontamination in only 658 (0.03%) of all human exposures.[25]

In 1993, the American Academy of Clinical Toxicology (AACT) advised that ipecac syrup should not be routinely administered to poison patients in a healthcare setting. In the 1997 AACT guidelines, syrup of ipecac was not considered first-line

therapy. The guidelines acknowledged that clinical studies have demonstrated no benefit from its use.[26] A subsequent revised position statement in 2004 acknowledged that no changes to the 1997 statement recommendations were required.[27]

In 2003, the American Academy of Pediatrics recommended that ipecac syrup not be used as home treatment in a child who ingested any toxic substance. The policy statement also recommended that existing ipecac in homes should be disposed of safely.[28] This recommendation was reinforced in 2005 when the AAPCC issued guidelines on syrup of ipecac use. The AAPCC concluded that there were only rare circumstances in which use of ipecac syrup should be considered. All of the following would have to be true:

1. syrup of ipecac is not contraindicated,
2. the poisoning in question will give substantial risk of toxicity to the patient,
3. there is no available alternative gastrointestinal decontamination therapy,
4. there will be a delay of greater than 1 hour to get to an emergency medical facility, and
5. ipecac syrup would not adversely affect definitive treatment available at the hospital or other medical facility.[29]

It is unlikely that syrup of ipecac would ever be indicated for home or prehospital gastric decontamination.

Seizure Management

Lorazepam is increasingly being recognized as the benzodiazepine of choice for toxicological induced single or multiple seizures, although there are few reports of its use with certain pesticides. With any benzodiazepine or other seizure control medication, one must be prepared to assist ventilation.

Dosage of Lorazepam for Seizure Control

- ***Adults: 2-4 mg/dose given IV over 2-5 minutes. Repeat if necessary to a maximum of 8 mg in a 12-hour period.***
- ***Adolescents: Same as adult dose, except maximum dose is 4 mg.***
- ***Children under 12 years: 0.05-0.10 mg/kg IV over 2-5 minutes. Repeat if necessary 0.05 mg/kg 10-15 minutes after first dose, with a maximum dose of 4 mg.***

***CAUTION:** Be prepared to assist pulmonary ventilation mechanically and endotracheally intubate the patient if laryngospasm or respiratory depression occurs and hypoxia is possible. Monitor for hypotension and cardiac dysrhythmias. Also remember to evaluate for hypoglycemia, electrolyte disturbances and hypoxia.*

For organochlorine compounds, use of lorazepam has not been reported in the literature. Diazepam is often used for this and other pesticide poisonings.

Dosage of Diazepam

- ***Adults: 5-10 mg IV and repeat every 5-10 minutes to maximum of 30 mg.***
- ***Children: 0.2 to 0.5 mg/kg IV every 5 minutes to maximum of 10 mg in children over 5 years and 5 mg in children under 5 years.***

Phenobarbital is an additional treatment option for seizure control.

Dosage of Phenobarbital

- ***Infants, children and adults: 15-20 mg/kg as an IV loading dose. Give an additional 5 mg/kg IV every 15-30 minutes to a maximum of 30 mg/kg. The drug should be pushed no faster than 1 mg/kg/minute.***

For seizure management, most patients respond well to usual management consisting of benzodiazepines and phenobarbital.

Management of Refractory Seizures

These patients require intensive care management and should be referred to a tertiary center.

Consider an infusion of propofol in patients who continue to experience seizures despite adequate benzodiazepine and/or phenobarbital dosing. Monitor closely for propofol infusion syndrome, cardiac failure, rhabdomyolysis, metabolic acidosis and renal failure, which may be fatal.[30]

Dosage of Propofol

- ***Infants, children, and adults: Start with a bolus dose of 1 to 2 mg/kg IV. Follow with an infusion of 2 mg/kg/hour IV and titrate up as needed for sedation and control of seizures.***

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