

## Winter Hazards

### ***Carbon Monoxide***

Nationally, the leading cause of poison deaths is exposure to carbon monoxide with faulty gas furnaces and automobiles as the most common sources. Carbon monoxide causes toxicity by displacing oxygen from hemoglobin's binding sites. Hemoglobin's affinity for carbon monoxide is about 250 times greater than that for oxygen. In addition, the presence of carbon monoxide causes a left shift in the oxyhemoglobin disassociation curve, reducing the ability of hemoglobin to release oxygen to tissue. The result is tissue hypoxia and possible organ injury, especially brain and heart.

The clinical symptoms of carbon monoxide depend on severity of the exposure. The cardiovascular and the central nervous systems are the most sensitive because they have the highest oxygen demand. There is not a good correlation between the severity of symptoms and carboxyhemoglobin levels. The severity of carbon monoxide toxicity is reflected in cardiac, neurologic, and metabolic findings.

- Minimal to mild symptoms include: headache, nausea, and dizziness
- Moderate to severe symptoms include: confusion, syncope, vomiting, shortness of breath, seizures, unconsciousness, ECG changes

Antidotal therapy for carbon monoxide toxicity is oxygen. Victims of mild to moderate toxicity should be treated by using 100% oxygen by face mask. This shortens the half-life of carbon monoxide from approximately 6 hours to 90 minutes. Severe toxicity requires the administration of oxygen under pressure in a hyperbaric chamber. Under three atmospheres of pressure, the half-life of carbon monoxide is further reduced to about 30 minutes.

### ***Ethylene Glycol***

Ethylene glycol (EG) is commonly available as automobile radiator antifreeze. Because of its sweet taste, improperly stored antifreeze is a common source of EG exposures in children. The need for therapy may be based on a history of ingestion, anion gap metabolic acidosis, increased osmolar gap or oxalate crystals in the urine. The best determinant is a serum ethylene glycol concentration greater than 20 mg/dl. Unfortunately, many health care facility laboratories are unable to perform this useful measurement. Therefore, in each hospital, a protocol for obtaining immediate ethylene glycol levels should be developed if one does not currently exist.

Ethylene glycol is rapidly absorbed from the gastrointestinal tract. Toxicity can be divided into three stages:

- Stage 1 – Neurological (0.5-12 hours post-ingestion)
- Stage 2 – Cardiopulmonary (12-24 hours post-ingestion)
- Stage 3 – Renal (24-72 hours post-ingestion)

Antizol® (fomepizole) by Orphan Medical in Minnetonka, Minnesota, is a specific antidote for the treatment of ethylene glycol toxicity. It works by inhibiting the enzyme alcohol dehydrogenase which is responsible for the conversion of ethylene glycol into its toxic metabolites that cause the renal injury and metabolic acidosis. Antizol® is recommended as first line therapy.

Ethanol, another competitive alcohol dehydrogenase inhibitor, may be used in the absence of Antizol®.

However, it has the disadvantages of producing central nervous depression and hypoglycemic effects. Ethanol requires continuous treatment and monitoring to ensure adequate serum concentrations. In patients with a serum ethylene glycol concentration greater than 50 mg/dl, hemodialysis is indicated to enhance its elimination. Other indications for hemodialysis include metabolic or electrolyte disturbances and renal failure. Adjunctive therapy with pyridoxine and thiamine encourages metabolic pathways that convert EG into non-toxic metabolites.

### ***Methanol***

Methanol is commonly available in the home as automobile windshield washer fluid and as a gas line anti-icing additive. Methanol is minorly toxic. Its major toxicity follows its metabolism to formic acid. Usually there is a long latent period of 18-24 hours before toxic symptoms develop. However, this latent period (period of metabolism) can last anywhere from 30 minutes to 48 hours. The need for therapy, as with ethylene glycol, may be based on history of ingestion, anion gap metabolic acidosis or increased osmolar gap. The best determinant is measurement of a serum methanol level. Not all health care facility laboratories can run this level. A protocol should be developed to obtain a level in a timely manner.

Antizol® (fomepizole) by Orphan Medical in Minnetonka, Minnesota, is the specific antidote for the treatment of methanol toxicity. It works by inhibiting the enzyme alcohol dehydrogenase which is responsible for the conversion of methanol into its toxic metabolites: formaldehyde and formic acid. Ethanol therapy may be used in the absence of Antizol®. The disadvantages of ethanol therapy include central nervous system depression, has hypoglycemia, and the need for continuous treatment and monitoring to ensure adequate serum concentration.

Hemodialysis enhances the elimination of methanol. Indications for the use of hemodialysis include:

- methanol level greater than 50mg/dl
- intractable metabolic acidosis
- visual disturbances
- renal failure

Antizol® and ethanol are easily dialyzable. Therefore, frequency of dosing must be increased during dialysis. Adjunctive therapy with folinic acid and folate will enhance the metabolism of formic acid to carbon dioxide and water.

### ***Long-Acting Anticoagulants***

As the weather turns colder, small rodents seek the warmth of homes, leading to an increased use of rodenticide baits. Consequently, rodenticide exposures sharply increases in children. The most common agents used in these products are long acting anticoagulants, such as brodifacoum, diphacinone or bromadiolone. They are usually in the form of blue-green colored loose pellets and less commonly in solid blocks. Because the concentration of the active ingredient is usually low (0.1%-0.005%), it takes about a "mouthful" (15-20 pellets) to produce significant anticoagulation in a child. These agents are vitamin K1 antagonists which inhibit the synthesis of vitamin K dependent clotting factors. Signs of toxicity may not occur for 24-36 hours. Initial treatment may consist of emptying the stomach, and the use of activated charcoal. If toxicity can be demonstrated by a significant increase in PT/INR values at 36-48 hours post ingestion, then vitamin K1 should be considered. In patients, with active bleeding, administer fresh frozen plasma and/or factor concentrates in addition to packed red cells and vitamin K1.

## ***Cough And Cold Preparations***

Cough and cold products are found universally within most American households. Virtually thousands of products help ameliorate coughing, nasal congestion, excessive secretions and other symptoms of the common cold and “flu”. Many of the cough and cold products combine a variety of pharmacological agents. These can challenge the health care provider more than the ingestion of a single agent. Most cough and cold preparations contain various combinations of the following pharmacological agents: analgesics and antipyretics, antihistamines, decongestants, expectorants and, finally, cough suppressants.

### ***Analgesics and antipyretics***

Most cough and cold preparations contain acetaminophen, aspirin or ibuprofen as their analgesic and antipyretic agent. Usually, the analgesic/antipyretic component as the greatest potential to cause toxicity and the dose ingested directs the treatment.

In adults, a single dose of acetaminophen or aspirin greater than 150mg/kg will warrant intervention in a health care facility. Children (less than 5 years of age), ingesting greater than 200mg/kg of acetaminophen, 150mg/kg of aspirin or 200mg/kg of ibuprofen will need to be evaluated in a health care facility.

### ***Antihistamines***

Antihistamines are heavily used in products to treat the common cold despite questionable efficacy. The toxicity of antihistamines is variable and unpredictable. Anticholinergic effects usually predominate.

Antihistamine products include:

acrivastine	doxylamine
azatadine	loratadine
bromodiphenhydramine	phenindiamine
brompheniramine	pheniramine
carbinoxamine	phenyltoloxamine
chlorpheniramine	promethazine
clemastine	pyrilamine
dexbrompheniramine	terfenadine
dexchlorpheniramine	triprolidine
diphenhydramine	

In adult overdoses, the antihistamine effects usually predominate over the sympathomimetic effects of the decongestants. In pediatric overdoses, either the anticholinergic or sympathomimetic effects may predominate. A general rule of thumb is that children can tolerate three times the maximum daily dose of the individual agent.

### ***Decongestants***

Sympathomimetic oral decongestants are used for their vasoconstrictive properties to relieve the engorgement of the vascular beds of the mucous membranes causing nasal stuffiness. Pseudoephedrine and phenylephrine are the most common ingredients. Phenylpropanolamine was widely used until the FDA restricted its use in 2000. Be aware that products containing phenylpropanolamine are still available in many homes.

Adolescents and adults may experience agitation, tachycardia, and modest hypertension with ingestion of decongestants. Paradoxically, pediatric patients may experience drowsiness as the primary symptom. As with antihistamines, gastric decontamination is indicated in patients who present promptly (<1-2 hours) after ingestion. Activated charcoal should always be used in ingestions of sustained release preparations. Usually, pediatric patients can tolerate up to 3-4 times the maximum daily dose.

### ***Expectorants***

Expectorants are used to facilitate the elimination of mucous and other respiratory debris. They have little efficacy and have very little toxicity. Guaifenesin is the major expectorant in this category. Terpin hydrate and ammonium chloride have been used historically, but are uncommon now.

### ***Cough Suppressants***

The two agents used primarily in this category are codeine and dextromethorphan. Dextromethorphan, a non-addictive opiate isomer, is not a controlled substance as is codeine. Therefore, it is found in most non-prescription cough suppressant formulations.

Ingestion of dextromethorphan in dosages greater than 10mg/kg may cause toxicity and gastric decontamination should be considered. Symptoms include excessive drowsiness, ataxia and slurred speech that normally last 4-6 hours, but may last longer if a delayed release formulation is ingested. Naloxone, an opiate antagonist, is effective in treating both dextromethorphan and codeine toxicity. Ingestion of codeine of 2mg/kg may produce toxicity especially in the pediatric population. Gastric decontamination and naloxone should be considered.

### ***Ethanol***

Liquid cough and cold preparations may contain ethanol as a solvent and a preservative. Its concentration may be as high as 20-25%. These preparations pose an ingestion risk for children. Ethanol causes central nervous system depression, as well as symptomatic hypoglycemia.

The Poison Center is available 24 hours a day to answer questions regarding toxic exposures and/or treatment at **1-800-222-1222** .