Recognition and Management of Acute Medication Poisoning

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Poisoning is a common cause of morbidity and mortality in the United States, with several million episodes reported annually. Acute medication poisonings account for nearly one half of all poisonings reported in the United States and should be considered in persons with an acute change in mental status. The initial approach to a person who has been poisoned should be to assess the airway, breathing, and circulation, and to take a thorough history. Less than 1 percent of poisonings are fatal; therefore, management in most cases is supportive unless a specific antidote is available. Single-dose activated charcoal is the gastrointestinal decontamination modality of choice, but should not be used universally. Toxidromes are constellations of symptoms commonly encountered with certain drug classes, including anticholinergics, cholinergics, opioids, and sympathomimetics. Evaluation of possible medication poisonings should include basic laboratory studies, such as a complete metabolic profile, to determine electrolyte imbalances and liver and renal function. Most other laboratory studies should be performed based on clinical presentation and history. Ongoing treatment of unstable patients with toxic medication ingestions should focus on correcting hypoxia and acidosis while maintaining adequate circulation. These patients can have rapid decline in mental or hemodynamic status even when they appear to be compensating. Children can experience more profound effects from small amounts of medication. Disposition of a person who has been poisoned warrants careful consideration of multiple factors, and those exhibiting signs or symptoms of toxicity must be monitored longer. (*Am Fam Physician.* 2010;81(3):316-323.

Poisoning remains a common cause of morbidity and mortality in the United States. The most recently published data from the American Association of Poison Control Centers (AAPCC) show that in 2006 there were more than 2.4 million reported poisoning exposures in the United States. Most of these exposures were treated at home with no medical intervention, but almost one fourth were treated in a health care facility.[1] A 2001 Institute of Medicine report estimated that more than 4 million poisoning episodes, resulting in 300,000 hospitalizations and 24,173 poisoning-related deaths, occur in the United States each year.[2] Annual costs related to poisoning are estimated to be billions of dollars.[3]

Poisoning can result from exposure to a variety of substances, ranging from cosmetics to pesticides. However, prescription and over-the-counter medications account for nearly one half of the poisoning exposures reported in the United States. For adults and children (five years and younger), 14 of the 25 most common exposures are from prescription or over-the-counter medications.[1] The most common medication poisonings in adults (in order of prevalence) include analgesics; sedatives, hypnotics, and antipsychotics; antidepressants; cardiovascular drugs; anticonvulsants; antihistamines; hormones and hormone antagonists; antimicrobials; stimulants and illicit drugs; cough and cold preparations; muscle relaxants; topical preparations; gastrointestinal preparations; and miscellaneous drugs.[1] The most common medication poisonings in children (in order of prevalence) include analgesics; topical preparations; cough and cold preparations; vitamins; antihistamines; gastrointestinal preparations; antimicrobials; hormones and hormone antagonists; electrolytes and minerals; cardiovascular drugs; dietary supplements, herbal medications, and homeopathic medications; asthma therapies; antidepressants; and sedatives, hypnotics, and antipsychotics.[1]

Poisoning from medications can happen for a variety of reasons, including intentional overdose, inadvertently taking an

extra dose, dispensing or measuring errors, and exposure through breast milk.[1] According to AAPCC data, topical preparations account for 2 percent of adult exposures, and the dermal route of exposure is second only to ingestion for all exposures.[1] Family physicians should be familiar with treatment of accidental and intentional medication ingestions; therefore, this article focuses on the management of acute poisoning caused by medication ingestion.

SORT: KEY RECOMMENDATIONS FOR PRACTICE

Clinical recommendation	*Evidence rating*	*References*
Single-dose activated charcoal is the gastrointestinal decontamination modality of choice in most medication ingestions; it can generally be used up to one hour after ingestion of a potentially toxic amount of medication.	C	8, 10
Ipecac syrup has no indication for use in a health care setting.	C	13-16

A = consistent, good-quality patient-oriented evidence; B = inconsistent or limited-quality patient-oriented evidence; C = consensus, disease-oriented evidence, usual practice, expert opinion, or case series. For information about the SORT evidence rating system, go to http://www.aafp.org/afpsort.xml.

Triage

Persons who have been poisoned may come into contact with family physicians in three distinct settings: on the telephone, at the office, or in a hospital. For patients in any of these settings, early contact with the poison control center (telephone: 800-222-1222) will assist with ongoing management. Patients calling on the telephone may be treated from home with assistance from the poison control center if they are asymptomatic, have ingested a known nontoxic quantity of medication, and are known to be reliable. Symptomatic patients or those with an uncertain exposure should be transferred to the emergency department by ambulance. Patients presenting to a physician's office with altered mental status or unstable vital signs, or those who have taken an intentional overdose should be transferred to the emergency department immediately. In addition, gastrointestinal decontamination should be performed only in the hospital or emergency department setting; therefore, patients who may benefit from this procedure (see initial approach section) should also be transferred. Only stable patients who have accidentally ingested a known quantity of a medication with low potential for toxicity should be monitored in the office setting.

Initial Approach

In the initial approach to a child or adult with an acute change in mental status, physicians should consider the possibility of inadvertent or intentional improper medication ingestion. Factors that would raise the level of suspicion include acute behavioral changes; concern about possible ingestion on behalf of a relative, friend, or health care professional; and evidence of ingestion, such as pills found in the patient's possession.[4]

The initial approach is to assess the airway, breathing, and circulation, and to take a thorough history. The purpose of airway management and breathing support in a person who has been poisoned is to correct hypoxia and acidemia while preventing aspiration. Pulse oximetry should be initiated in patients with respiratory distress or cyanosis; cardiac monitoring is indicated for patients with hemodynamic instability.[5] In patients with altered mental status of unknown etiology, consider giving naloxone (formerly Narcan) if opioid toxicity is suspected based on history and examination findings. Routine administration of glucose is not indicated, because a blood glucose level can be determined rapidly.[5] Initial evaluation should include inspection to determine the presence of transdermal patches, because many potentially toxic medications are now available in this form, including analgesics, antidepressants, and stimulants.

Once the patient has been stabilized, information should be sought from the patient, friends or family members, and emergency medical services personnel when appropriate. The most important question to answer immediately is when the ingestion occurred, because gastrointestinal decontamination with activated charcoal should be performed within one hour of ingestion. Identifying the ingested medication, including the precise formulation and known or estimated amount, is also important.[6] Medication packaging can be inspected when available. Ingestion of and exposure to transdermal

patches should be considered; a child who has been playing with a medication patch may deny taking anything by mouth.[7]

Several methods have been used for gastrointestinal decontamination, but no conclusive data have proven their effectiveness in improving outcomes. All of these methods have the potential for serious adverse effects, and the risks versus benefits must be carefully considered. A single dose of activated charcoal is the gastrointestinal decontamination treatment of choice in most medication ingestions and should only be used within one hour of ingesting a potentially toxic amount of medication.[8] Gastric lavage, cathartics, or whole bowel irrigation should be considered for ingestion of medications that are poorly absorbed by activated charcoal (e.g., iron, lithium) and for sustained-release formulations or enteric-coated tablets.[9-11] *Table 1* outlines the use of gastrointestinal decontamination.[8-16]

Table 1. Methods of Gastrointestinal Decontamination with Indications, Contraindications, and Dosing

Method	*Indications*	*Contraindications*	*Dosing*
Activated charcoal[8,10]	Use within one hour of ingestion of a potentially toxic amount of medication	Decreased level of consciousness Ingestion of medication with a low affinity for binding with activated charcoal (e.g., iron, lithium) Increased risk of gastrointestinal bleeding or perforation	Children up to one year of age: 10 to 25 g or 0.5 to 1.0 g per kg Children one to 12 years of age: 25 to 50 g or 0.3 to 1.0 g per kg Adolescents and adults: 25 to 100 g
Gastric lavage[9,12]	For extraordinary situations involving a potentially toxic amount of medication	Unprotected airway Ingestion of substances with high potential for aspiration (e.g., hydrocarbons) Ingestion of strong acid or alkali Increased risk of gastrointestinal bleeding or perforation	Lavage via large-bore orogastric tube with 200 to 300 mL of warm saline or water for adults, 10 mL per kg of warm saline for children Continue until fluid is free of pills or pill fragments
Cathartics[10]	No definite indications for use Consider for ingestion of potentially toxic amounts of sustained-release, enteric-coated drugs, or medications that are poorly absorbed by activated charcoal	Bowel obstruction or perforation Absent bowel sounds Recent bowel surgery Volume depletion Electrolyte imbalance	Use only single dose (caution should be used in children younger than one year and in older persons) Adults: 1 to 2 mL per kg sorbitol 70% solution; or 250 mL magnesium citrate 10% solution Children: 4.3 mL per kg sorbitol 35% solution; or 4 mL per kg magnesium citrate 10% solution
Whole bowel irrigation[11]	Consider for ingestion of potentially toxic amounts of sustained-release, enteric-coated drugs, or medications that are poorly absorbed by activated charcoal Used in persons who ingest large quantities of illicit drugs for the purpose of smuggling (body packers)	Unprotected airway Ileus or bowel obstruction or perforation Intractable vomiting Hemodynamic instability	Infuse via nasogastric tube (or have patient drink) polyethylene glycol electrolyte solution until rectal effluent is clear Children nine months to six years of age: 500 mL per hour Children six to 12 years of age: 1,000 mL per hour Adolescents and adults: 1,500 to 2,000 mL per hour
Ipecac syrup[13-16]	No role in health care setting Routine home use is not recommended and it should be removed from all homes		

NOTE: *Methods are in order of most to least commonly used.*

Information from references 8 through 16.

Ongoing Management

Mortality from acute poisoning is less than 1 percent overall, so physicians should recognize that most medication ingestions will not be life threatening.[10] If the patient is asymptomatic, supportive therapy is likely all that is indicated unless a specific antidote is available. Some symptoms can be managed with basic modalities, such as the Trendelenburg position and fluid resuscitation for hypotension, stimulation for apnea or lethargy, and warming or cooling measures for hyper- or hypothermia. Evaluation should include basic laboratory studies, such as a complete metabolic profile, to determine electrolyte imbalances and liver and renal function. Most other laboratory studies should be performed based on clinical presentation and history. Acidosis and hypoxia can be detected with an arterial or venous blood gas analysis. Electrocardiography can be used to determine the significance of arrhythmias, and chest radiography can evaluate for pulmonary edema.[5] Signs and symptoms associated with medications commonly involved in acute poisoning are presented in *Table 2*.[4,5,17-27] Toxidromes are constellations of symptoms that are typically seen in specific types of poisonings and are described in *Table 3*.[28]

A general toxicology screen will not likely assist in the immediate treatment of a person who has been poisoned because the results may not be available in a timely manner; the results do not indicate if medications are present at toxic levels; some drugs can be detected several days after ingestion; and several potentially toxic medications, such as synthetic opioids, are not included in these screens. There may be some benefit for the admitting physician if the diagnosis remains undetermined later.

Quantitative drug levels should be obtained only if the patient's medication or medical history points to a possible ingestion, or if the signs and symptoms are compatible with toxicity from that drug.[6] One exception is a serum *N*-acetyl-para-aminophenol level, which should be checked in all intentional overdoses and unknown ingestions. This is because acetaminophen is easily available in many over-the-counter preparations, and persons in early stages of toxicity may be asymptomatic despite a history of ingestion or may exhibit nonspecific findings.[6,17] Medications with commonly available quantitative laboratory tests that can be useful in guiding treatment of persons who have been acutely poisoned include acetaminophen, carbamazepine (Tegretol), digoxin, ethanol, iron, lithium, phenobarbital, phenytoin (Dilantin), salicylates, theophylline, and valproate (Depacon).[5] Ethanol is included in this list because it is a common ingredient in over-the-counter preparations.

Ongoing treatment of unstable persons with toxic medication ingestions should focus on correcting hypoxia and acidosis while maintaining adequate circulation. For an intubated patient, standard ventilator

Table 2. Signs and Symptoms Associated with Medications Commonly Involved in Acute Poisonings

Medication	*Signs and symptoms*
Acetaminophen[17-20]	Anorexia; elevated liver enzymes; jaundice; lethargy; liver failure; nausea and vomiting; pallor
Benzodiazepines[5]	Anterograde amnesia; ataxia; coma; confusion; drowsiness; lethargy; sedation
Beta blockers[5,21,22]	Acidosis; bradycardia; bronchospasm; coma; hyper- or hypoglycemia; hyperkalemia; hypotension; respiratory depression; seizures
Calcium channel antagonists[4,21,23]	Arrhythmias; bradycardia or tachycardia; coma; dizziness; hypotension; lethargy; seizures
Clonidine (Catapres)[4,5,24]	Apnea; bradycardia; coma; hyper- or hypotension; hypothermia; mental status change; pinpoint pupils
Opioids[4,5]	Central nervous system depression, including coma, lethargy, or stupor; constipation, nausea, and vomiting; flushing and pruritus; hypotension; meiosis; pulmonary edema; respiratory depression; seizures
Salicylates[4,5]	Alkalosis or acidosis; coma; diaphoresis; disorientation; electrolyte abnormalities (e.g., hypokalemia, hyper- or hyponatremia); hyper- or hypoglycemia; hyperventilation; nausea and vomiting; renal failure; seizures; tinnitus or deafness
Sulfonylureas[4,25-27]	Coma; decreased appetite; dizziness; hypoglycemia; lethargy; seizures; weakness
Tricyclic antidepressants[4,5]	Coma; confusion; delirium; dilated pupils; dry mouth; hypotension; seizure; tachycardia; urinary incontinence

Information from references 4, 5, and 17 through 27.

Table 3. Common Toxidromes

Syndrome	*Symptoms*	*Common causes*
Anticholinergic	Delirium; hyperthermia; ileus; mydriasis; tachycardia; urinary retention; warm and dry skin Mnemonic, "blind as a bat, mad as a hatter, red as a beet, hot as a hare, and dry as a bone"*	Antihistamines; atropine; psychoactive drugs; scopolamine; tricyclic antidepressants
Cholinergic, muscarinic	Bradycardia; bronchorrhea; meiosis; wheezing SLUDGE syndrome (salivation, lacrimation, urination, defecation, gastrointestinal cramps, and emesis)	Physostigmine; pilocarpine; pyridostigmine (Mestinon)
Cholinergic, nicotinic	Abdominal pain; fasciculations; hypertension; paresis; tachycardia	Nicotine
Opioid	Hypotension; hypothermia; hypoventilation; meiosis; sedation	Opioids
Sympathomimetic	Agitation; diaphoresis; hypertension; hyperthermia; mydriasis; psychosis; seizures; tachycardia	Amphetamines; caffeine; phenylpropanolamine†; theophylline

*—*From Carroll L.* Alice's Adventures in Wonderland. *London, England: MacMillan & Co.; 1865.*

†—*No longer available in the United States.*

Adapted with permission from Porter RS, ed. The Merck Manual of Diagnosis and Therapy. *18th ed. Whitehouse Station, N.J.: Merck & Co., Inc.; 2006. http://www.merck.com/mmpe. Accessed July 14, 2009.*

settings will not be adequate to compensate for profound metabolic acidosis. Although a patient may appear to be compensating, physicians should be observant for a rapid decline in mental or hemodynamic status. For patients with cardiovascular collapse, standard life support protocols may be inadequate or inappropriate; for example, high doses of epinephrine will be necessary for patients with calcium channel antagonist overdose.[5] *Table 4* outlines specific therapies for acute medication poisoning.[4,5,17-27]

The overall approach to children and adults with acute medication poisoning is similar; however, children differ from adults in more than just size and stature. Children are at risk of profound effects, including death, from ingestion of just one or two pills, such as tricyclic antidepressants or sulfonylureas.[29,30] The importance of tailoring treatment specifically to children is exemplified with acetaminophen poisoning. For children weighing less than 88 lb (40 kg), the same intravenous dose of *N*-acetylcysteine in mg per kg should be given, but in a much smaller volume.[18] This is because hyponatremia-induced seizures caused by an excess free water load have been reported during treatment of acetaminophen toxicity.[19] A review of childhood poisonings was recently published in *American Family Physician* and provides further details on treating children.[31]

Disposition

When determining whether to observe, admit, transfer, or discharge a person who has been poisoned, there are several factors to consider. For unstable patients, admission to an intensive care unit is appropriate, and transfer to a tertiary care facility should be considered, especially with children. For stable patients, the amount of observation time is based on the half-life of a medication, the amount ingested, and the formulation. Any patient who develops signs or symptoms of toxicity that do not reverse during the observation period should be admitted for further observation.[6] When a patient is ready for discharge, his or her home situation must be taken into account, especially if the patient is a child.[4] Patients who have attempted suicide will need a psychiatric evaluation and will likely be admitted to a psychiatric unit. Patients with substance abuse issues should be referred for counseling.

Table 4. Specific Therapies for Acute Medication Poisoning

	Treatment	
Medication	*Adults*	*Children*
Acetaminophen[17-20]	Treatment based on Rumack-Matthew nomogram (see: http://www.merck.com/mmpe/sec21/ch326/ch326c.html or http://www.ars-informatica.ca/toxicity_nomogram.php?calc=acetamin) *N*-acetylcysteine: oral loading dose of 140 mg per kg, then 70 mg per kg every four hours for a total of 17 doses IV loading dose of 150 mg per kg over 15 to 60 minutes, then 12.5 mg per kg per hour for four hours, then 6.25 mg per kg per hour for 16 hours (use if ingestion occurred less than 10 hours before treatment) Treat to clinical end points	*N*-acetylcysteine: oral and IV dosing same as for adults, except when using the IV protocol in children weighing less than 88 lb (40 kg); mg per kg dosing same as for adults, with dilution to concentration of 40 mg per mL of *N*-acetylcysteine using dextrose 5% in water
Benzodiazepines[5]	Flumazenil (Romazicon): initial infusion of 0.5 to 5 mg over three to five minutes; titrate to effect Contraindications include history of seizures, chronic benzodiazepine use, coingestion that could induce seizures (e.g., tricyclic antidepressants, cocaine)	Flumazenil: initial infusion of 0.005 to 0.2 mg over three to five minutes; titrate to effect Contraindications (same as for adults)
Beta blockers[5,21,22]	Glucagon: initial bolus of 50 to 150 mcg per kg; may repeat in three to five minutes, then start infusion at effective dose per hour Calcium gluconate 10% solution: bolus of 0.6 mL per kg over five to 10 minutes, then infusion at 0.6 to 1.5 mL per kg per hour Epinephrine: 1 mcg per kg per minute (may need high doses) Insulin "euglycemia" therapy: 1 IU per kg regular insulin plus dextrose bolus of 25 g, then infusion of regular insulin at 0.5 IU per kg per hour with dextrose (0.5 g per kg per hour) and adjust to keep serum glucose level at 100 to 250 mg per dL (5.55 to 13.88 mmol per L) Sodium bicarbonate: bolus of 50 mEq of a 1 mEq per mL solution	Glucagon: initial bolus of 50 to 150 mcg per kg; may repeat in three to five minutes, then start infusion at 0.1 mg per kg per hour Calcium gluconate (same as adult dosing) Epinephrine: 10 to 30 mcg per minute (may need high doses) Insulin "euglycemia" therapy (same as adult dosing) Sodium bicarbonate: bolus of 1 to 2 mEq per kg if QRS interval greater than 120 milliseconds
Calcium channel antagonists[4,21,23]	Glucagon, calcium gluconate, epinephrine, insulin euglycemia therapy, or sodium bicarbonate (same dosing as above)	Glucagon, calcium gluconate, epinephrine, insulin euglycemia therapy, or sodium bicarbonate (same dosing as above)
Clonidine (Catapres)[4,5,24]	Naloxone (formerly Narcan): if no respiratory depression, initial IV dose of 0.1 to 0.4 mg; with respiratory depression, initial IV dose of 1 to 2 mg If no or partial response, then IV dose of 2 mg every three to five minutes for a total of 10 to 20 mg Can also be given intramuscularly Atropine: 0.5 to 1 mg Dopamine: 5 to 20 mcg per kg per minute	Naloxone: if no respiratory depression, initial IV dose of 0.1 mg per kg (in children younger than five years or weighing less than 44 lb [20 kg]); with respiratory depression, initial IV dose of 2 mg If no or partial response, then IV dose of 2 mg every three to five minutes for a total of 10 to 20 mg Can also be given intramuscularly Atropine: 0.02 mg per kg; maximal dose of 0.16 mg Dopamine: start at 5 mcg per kg per minute, increase by increments of 5 mcg per kg per minute Add norepinephrine if more than 20 mcg per kg per minute of dopamine is needed

continued

Table 4. Specific Therapies for Acute Medication Poisoning *(continued)*

	Treatment	
Medication	*Adults*	*Children*
Opioids[4,5]	Naloxone (same dosing as above)	Naloxone (same dosing as above)
Salicylates[4,5]	Urine alkalinization: three sodium bicarbonate ampules in 850 mL of dextrose 5% solution, with 40 mEq of potassium chloride infused at 2 to 3 mL per kg per hour	Urine alkalinization: sodium bicarbonate solution same as for adults, then infuse at 1.5 to 2 times the calculated maintenance rate
	Consider hemodialysis (based on symptoms; salicylate level of 100 mg per dL or more in acute toxicity or 60 mg per dL or more in chronic toxicity; or if patient requires intubation)	Consider hemodialysis (based on symptoms; salicylate level of 80 mg per dL or more; or if patient requires intubation)
Sulfonylureas[4,25-27]	Dextrose bolus or infusion with dosing based on degree of hypoglycemia	One month to two years of age: dextrose 25% solution bolus of 2 to 4 mL per kg
		Older than two years: dextrose 50% solution bolus of 1 to 2 mL per kg
	Octreotide (Sandostatin): 50 to 100 mcg per dose subcutaneously two to three times per day	Octreotide: 4 to 5 mcg per kg per day subcutaneously, divided every six hours for maximum of 50 mcg per dose (based on case reports)
	Glucagon: 1 mg per dose; may repeat every 20 minutes as needed (temporary emergent treatment only)	Glucagon: 0.5 mg for children and 0.025 mg per kg per dose for neonates and infants; may repeat every 20 minutes as needed (temporary emergent treatment only)
		Consider continuous glucose infusion
Tricyclic antidepressants[4,5]	Benzodiazepines for seizures (avoid barbiturates and phenytoin [Dilantin]): lorazepam (Ativan), 2 to 4 mg	Benzodiazepines for seizures (avoid barbiturates and phenytoin): lorazepam, 0.05 to 0.1 mg per kg
	Sodium bicarbonate for prolonged QRS interval to maintain pH less than 7.5 (same dosing as above)	Sodium bicarbonate for prolonged QRS interval to maintain pH less than 7.5 (same dosing as above)
	Dopamine (same dosing as above) or norepinephrine: 8 to 12 mcg per minute (adjust to maintain low normal blood pressure)	Dopamine (same dosing as above) or norepinephrine (safety not established in children): 0.1 mcg per kg per minute (adjust to maintain low normal blood pressure); maximum of 6 mcg per minute
	Avoid physostigmine and class IA and IC antidysrhythmics	Avoid physostigmine and class IA and IC antidysrhythmics

IV = intravenous.

Information from references 4, 5, and 17 through 27.

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