

NO MORE Coma Cocktails

Using science to dispel myths
& improve patient care

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MANY EMS PRACTICES HAVE EVOLVED with a lack of scientific evidence to support them. The MAST/PASG device is a good example of this. When formally investigated, the purported physiological effects of the device couldn't be demonstrated. Now, with scientific knowledge, MAST/PASG serves a much more limited role in modern EMS.

It's curious that practices often adopted by the EMS community come virtually out of nowhere. *Example:* teaching the mnemonic NAVEL (referring to naloxone, atropine, Valium, epinephrine and lidocaine) to remember the five drugs that supposedly could be administered via a properly placed endotracheal tube.

There's absolutely no scientific evidence to support the recommendation that diazepam (Valium) can be administered endotracheally. First, it's not water-soluble; it can be diluted only in alcohol. Medications administered endotracheally must be diluted in a solvent to deliver an adequate volume of the drug to the respiratory tree. Because most ambulances don't carry ethyl alcohol as a solvent, it's

impossible to dilute diazepam.

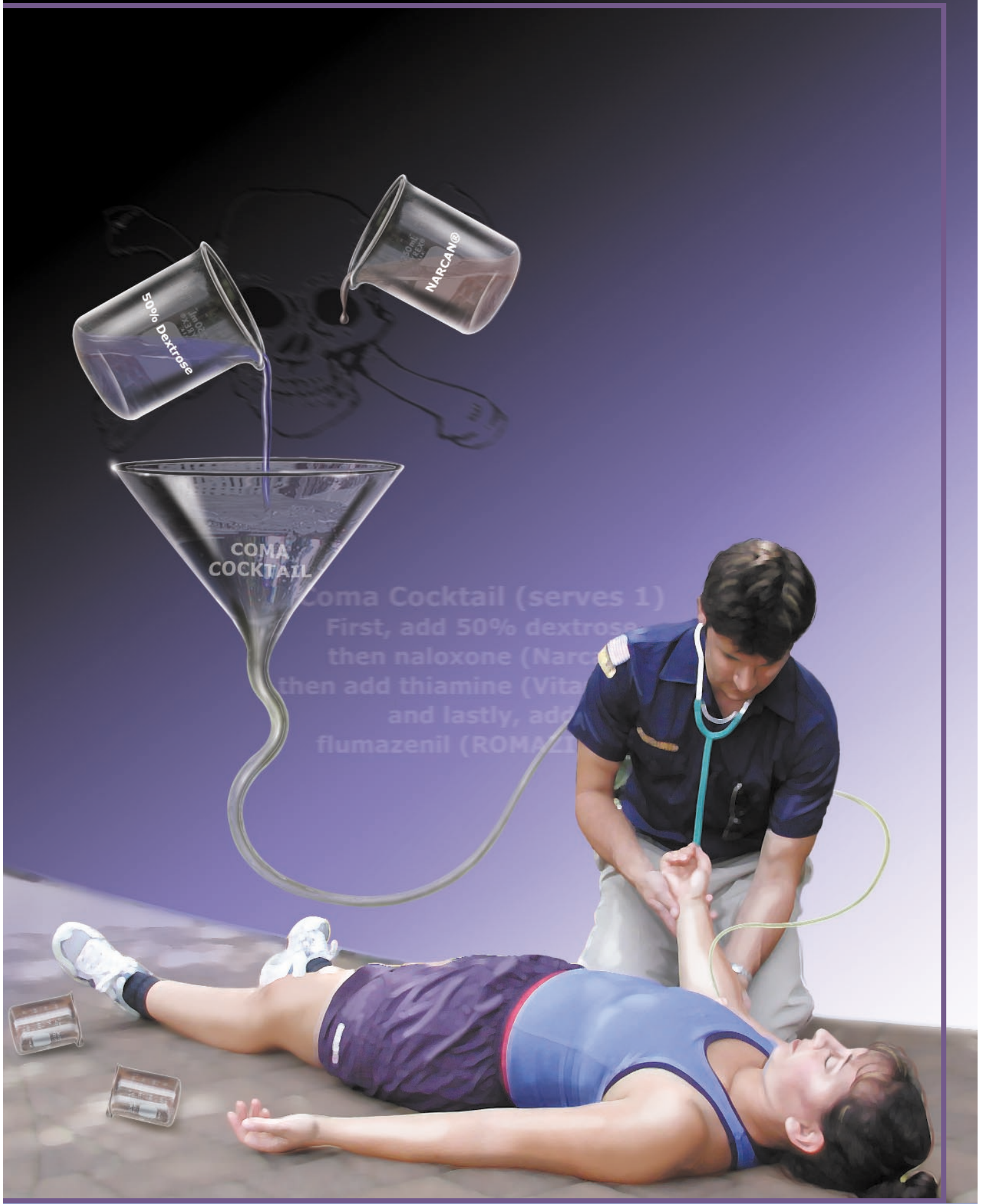
Second, the low pH of diazepam and the presence of preservatives and solvents could potentially damage sensitive pulmonary tissues. When studied in animal models, endotracheal diazepam inflamed pulmonary tissues and adversely impacted respiratory gas exchange.

Similar misconceptions have resulted in some EMS systems touting the advantage of a "coma cocktail" in treating unconscious people.

The coma cocktail

The coma cocktail consists of 50% dextrose solution, the narcotic antagonist naloxone (Narcan) and thiamine (vitamin B1). In some regions, the benzodiazepine antagonist flumazenil (Romazicon) is also administered. Some systems administer this series of medications in rapid succession in an attempt to determine possible causes for unconsciousness.

I wonder what paralysis of intellect gave birth to this idea. This is equivalent to going duck hunting and shooting three or four shotgun rounds at a flock of birds hoping you'll hit the single mallard flying in the middle. EMS is



COMA
COCKTAIL

Coma Cocktail (serves 1)

First, add 50% dextrose

then naloxone (Narc)

then add thiamine (Vita

and lastly, add

flumazenil (ROMAZI

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more sophisticated than this. Let's break this down and look at the various components of the coma cocktail and detail how each should, or should not, be used.

An unconscious patient presents a dilemma for prehospital providers. What caused the unconscious state? Is the patient diabetic? Is it a drug overdose? Have they suffered a stroke? Virtually all these questions can be answered through patient assessment and simple diagnostic tests.

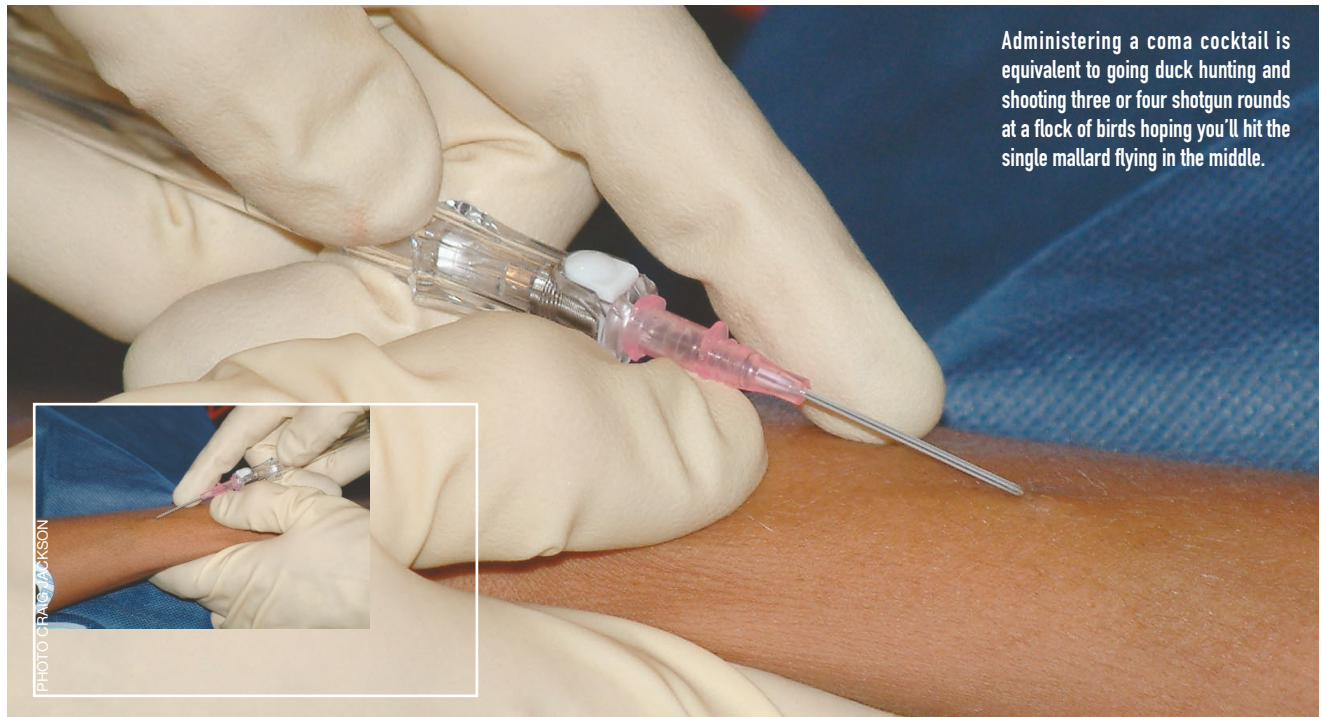
50% dextrose

Hypertonic dextrose solution (50% dextrose) is indicated for the treatment of abnormally low blood glucose levels (hypoglycemia). Hypoglycemia results most commonly from an excess dose of insulin or from inadequate caloric intake following a

based on the assumption that glucose administration is harmless to patients who have normal or even elevated blood glucose levels. However, recent studies show this may not be the case.

In animal models and in some varied human research, studies have shown that patients with brain ischemia (stroke or cardiac arrest sufferers) who received glucose solutions either before or during periods of ischemia tend to have more significant neurological damage than patients who received only saline solution.

The pathophysiology behind this is fairly straightforward. The brain uses glucose as its primary energy source. Normal glucose metabolism requires oxygen. Administering a large quantity of glucose during periods of brain ischemia floods the brain with glucose molecules, but the brain is oxygen-deprived and the glucose cannot be fully broken down. Thus, glucose converts to lactic acid, which can harm or destroy delicate brain tissue,



Administering a coma cocktail is equivalent to going duck hunting and shooting three or four shotgun rounds at a flock of birds hoping you'll hit the single mallard flying in the middle.

normal insulin dose. This phenomenon almost exclusively occurs in diabetics.

The incidence of bona fide hypoglycemia in adults who don't have diabetes mellitus is exceedingly rare. In extreme stress states and in the rare case of insulin-secreting tumors called insulinomas, hypoglycemia can develop. In addition, intoxication with certain drugs, such as beta-blockers, ethanol and oral diabetes agents (sulfonylureas), has resulted in hypoglycemia. Again, these situations are uncommon.

In a study of 926 adult trauma patients with a Glasgow Coma Scale of less than 15, only four cases of hypoglycemia (serum glucose < 60 mg/dL) were found, and only one of these was in a nondiabetic-induced state.¹ Although this study addresses multiple-trauma patients, it clearly indicates the incidence of hypoglycemia is fairly rare in the population at large and exceedingly rare in nondiabetics.

The reasoning behind empiric glucose administration is based on the concern that irreversible brain damage may result from delayed recognition and treatment of hypoglycemia. It's also

aggravating an already bad situation. Because of this, if a patient's comatose state is due to cerebral ischemia or cardiac arrest, glucose administration may worsen their neurological outcome or otherwise hamper their recovery.²

Granted, decades ago when the coma cocktail concept was implemented, little testing equipment existed to verify the presence of hypoglycemia. Now, with technology that has been available for years, EMS personnel can determine a blood glucose level in less than a minute with either an electronic glucose monitor or with glucose reagent strips. Thus, it should be quite simple to determine whether hypoglycemia factors into a patient's unconscious state.

Also, the presence of diabetic supplies (insulin, reagent strips, syringes, Medic-Alert bracelet) should alert you to or heighten your suspicion of diabetes and hypoglycemia.

Always obtain a blood glucose level. If there's no diabetes history and you obtain a borderline blood glucose level, then it may be prudent to repeat the finger stick and reading. The lack of a diabetes history in an adult makes hypoglycemia unlikely.



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However, if the blood glucose level is low, regardless of the cause, administer IV glucose. *Important note:* Bona fide hypoglycemia in nondiabetic neonates and babies is not uncommon and can result from stress and infection. Because of this, approach unconscious babies and young children with heightened suspicion for hypoglycemia.



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Naloxone (Narcan)

Naloxone (Narcan) is indicated for the reversal of respiratory depression associated with narcotic overdoses. It's an effective antagonist for all opiates and many synthetic opioid compounds (Darvon, Stadol, Nubain). But it's ineffective in reversing coma due to any other cause.

Narcan effectively reverses respiratory depression associated with narcotic ODs, but won't reverse coma due to any other cause.

EMS personnel should recognize a narcotic overdose fairly easily. It's characterized by respiratory depression that can lead to cardiac arrest. In severe overdoses, depression of the cardiovascular system can exist as well. In addition, the pupils become very constricted—almost pinpoint—in narcotic overdoses. Putting all these factors together should point to possible narcotic overdose.

You should also take into consideration on-scene observations, information presented by bystanders and other physical examination findings. If the call occurs in an area with a high incidence of heroin or other opiate use (e.g., a "shooting gallery"), suspect narcotic overdose. Likewise, if the patient exhibits the symptoms described and has needle-track marks or if a bottle of prescription narcotics (e.g., Vicodin, Lortab, OxyContin) is found nearby, consider narcotic overdose. Administering naloxone to those without these signs and symptoms, although probably not harmful, is usually a waste of time and money.

The goal of prehospital naloxone therapy is to reverse respiratory depression. Rapidly bolusing 2 mg of naloxone into a narcotic addict will cause acute narcotic withdrawal, resulting in patient agitation, tachycardia, sweating, copious watery foul-smelling diarrhea, a runny nose that drains large quantities of mucus and many other things unpleasant for you and the patient. Thus, naloxone should be used only when the patient exhibits signs or symptoms of narcotic overdose or when something found in the environment points to the possibility of narcotic overdose.

If and when naloxone is indicated, administer it only in low, titrated doses to carefully reverse the respiratory depression.

Thiamine (vitamin B1)

Thiamine, also called vitamin B1, has become commonplace on EMS vehicles. It appears that the sudden interest in thiamine as an EMS drug resulted from a case report published in 1994.³ In that paper, a single thiamine dose spontaneously resolved a chronic alcohol abuser's confusion, difficulty ambulating and visual disturbances. However, I'll bet that few, if any, para-



An acute thiamine deficiency can cause Wernicke's encephalopathy, characterized by the triad of ophthalmoplegia (paralysis of the eye muscles), ataxia (failure of muscular coordination) and altered mental status. However, WE incidence is rare.

medics have had a comatose patient wake up following thiamine administration.

A vitamin is a substance the body needs for normal functioning but can't manufacture. Thus, vitamins must be obtained from diet. Vitamin deficiencies can cause scurvy, pernicious anemia and other well-known problems.

Thiamine is essential for normal cellular metabolism and is necessary for proper glucose utilization. Glucose is first converted to a substance called pyruvate (pyruvic acid) in a process called *glycolysis*. Then the pyruvate enters a second metabolic process, called *Kreb's cycle*, in which the glucose is broken down further, producing energy. Thiamine is a cofactor in the enzyme that converts pyruvate into a form that can enter *Kreb's cycle*. Without adequate thiamine, glucose metabolism becomes impaired and pyruvate accumulates and subsequently converts to lactate (lactic acid).

Adequate thiamine is easily obtained through a balanced diet. However, alcoholics tend to get a great deal of their nutritional calories through alcohol products. In the United States, alcohol products are not fortified with vitamins like they are in such countries as Australia, France and the Netherlands. In addition to this, chronic alcohol use can impair the body's ability to absorb thiamine and other essential vitamins.

Thiamine deficiency results in a recognizable disease process. An acute thiamine deficiency can cause Wernicke's encephalopathy (WE) characterized by the triad of ophthalmoplegia (paralysis of the eye muscles), ataxia (failure of muscular coordination) and altered mental status. However, this triad occurs in only a small percentage of cases.

WE results from death of selected nerve cells in various parts of the brain. In certain cases, some patients with WE go on to develop Korsakoff's psychosis (KP), characterized by amnesia (loss of memory) and confabulation (the recitation of imaginary experiences to fill in memory gaps). WE can be reversed with thiamine, but KP, once developed, is often irreversible.⁴

So what's the problem with routine thiamine administration? Well, there are several. First, WE incidence is rare (less than 0.2% in several studies). Second, although the vast majority of WE patients exhibit altered mental status, few present with coma. Third, though rare, cases of severe anaphylactic reactions to IV

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thiamine have occurred.⁵ Fourth, to fully reverse WE symptoms, thiamine must be administered over a period of at least three days.

Several cases have been reported in which acute WE was precipitated by the administration of glucose-containing solutions prior to the administration of thiamine. For this reason it's perhaps reasonable to administer thiamine before D50 when managing hypoglycemics who are, or are suspected of being, alcoholics.

Thiamine is an essential vitamin, but has a limited role in EMS. It would be more cost-effective for the health-care system and taxpayers if manufacturers of alcohol products fortified alcohol products, especially those consumed by alcoholics, with thiamine and other essential vitamins. Thus, although the alcoholic receives the majority of their calories through alcohol products, they would at least get enough vitamins to prevent WE.

Some oppose vitamin fortification of alcohol products because the wording "vitamin-enriched" on the label may encourage some to assume that it's a healthy beverage.

Another solution is to fortify essential foods with thiamine. Many countries have fortified flour with thiamine. In Sydney, Australia, the incidence of WE and KP was reduced by 40% following the fortification of flour with thiamine.⁶

Flumazenil (Romazicon)

Flumazenil is a less common ingredient in the coma cocktail. This benzodiazepine antagonist can effectively reverse some effects of drugs in that class, such as diazepam (Valium), lorazepam (Ativan), alprazolam (Xanax) and others. Overdoses of benzodiazepines can cause altered mental status, slurred speech, dysrhythmias and coma.

Benzodiazepines are among the most prescribed medications in modern medical practice. They're used for anxiety and sleep disorders, as muscle relaxants and for similar uses. Like many substances that affect mood or cause euphoria, benzodiazepines can be highly addictive. In fact, short-acting benzodiazepines, such as alprazolam (Xanax), can result in addiction in a matter of weeks.

Withdrawal from benzodiazepines can be life-threatening. Because of this, patients dependent on benzodiazepines are often slowly withdrawn from the drug over a period of weeks to months. Flumazenil administration can induce an acute withdrawal syndrome in patients dependent on benzodiazepines. This can result in tremors, high anxiety levels, muscle jerks and eventually seizures. Thus, administration of flumazenil can be life-threatening in patients dependent on benzodiazepines.

Because of this, flumazenil should *never* be used as a part of a coma cocktail. If part of the EMS formulary, it should be used only in cases where conscious sedation has been administered (e.g., for electrical cardioversion) or in cases of acute benzodi-



Flumazenil can reverse the effects of some benzodiazepines.

azepine overdose in which drug dependence is unlikely.⁷ Even then, the patient will do well only if supportive care (oxygenation, mechanical ventilation) is provided until the patient can be evaluated in the ED.

Bottom line: Flumazenil has no role in a generic coma cocktail. It is profoundly dangerous in a benzo-dependent patient (and those are the patients who usually overdose on benzos), and it's contraindicated in polysubstance overdoses, as many overdoses are.

Summary

It should be clear from this discussion that coma cocktails are a bad idea and should be immediately abandoned. In fact, the indiscriminate use of the coma cocktail may indeed harm patients. EMS evolved to a point where any EMS provider should be able to reasonably determine the most likely cause of coma, or, in a worst-case scenario, narrow the cause to but a few possibilities.

Certainly, patients with bona fide hypoglycemia should receive IV glucose. Because the consequences of prolonged hypoglycemia are severe, if there's a doubt about whether hypoglycemia is present, then glucose should be empirically administered.

Naloxone should be used only for those cases in which a narcotic overdose appears likely. Similarly, thiamine administration should be limited to patients suspected of chronic alcohol abuse and who exhibit at least one of the three symptoms of WE described above.

Flumazenil has no role in the routine treatment of coma unless the patient is known to *not* be benzodiazepine dependent and the overdose is known to result only from benzos—two very difficult requirements to verify in the back of an ambulance at 2 a.m.

Coma cocktails are bad medicine. Let's banish them from our EMS armamentarium. **■**

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