

## **Massive Dextromethorphan Ingestion and Abuse**

**TIMOTHY R. WOLFE MD**  
**E. MARTIN CARAVATI MD, MPH**

Division of Emergency Medicine, University of Utah School of Medicine

Utah Poison Control Center,  
Salt Lake City, UT.

**The case of a 23-year-old man who was acutely intoxicated on dextromethorphan and who was chronically addicted to the drug is described. He consumed the highest daily dose for the longest duration yet reported in the world's English-language medical literature. Toxicity, abuse potential, and therapy of dextromethorphan intoxication are discussed. (Am J Emerg Med 1995;13:174-176. Copyright © 1995 by W.B. Saunders Company)**

### **Key Words:**

Dextromethorphan

toxicity

abuse.

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Address reprint requests to Dr Wolfe, Emergency Department, University of Utah Hospital, 50 North Medical Drive, Salt Lake City, UT 84132.

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Dextromethorphan (d-3-methoxy-N-methylmorphine) is a cough suppressant available in many over-the-counter medications. It is an analog of the opiate family, but is thought to have no analgesic or addictive properties and its toxicity is presumed to be quite low.<sup>[1]</sup> There have been sporadic reports of acute dextromethorphan ingestions in the world's medical literature, but not enough to warrant its international control as a narcotic.<sup>[2]</sup> We describe a case of acute intoxication with dextromethorphan in a regular abuser who was strongly psychologically addicted to the drug.

### **CASE REPORT**

A 23-year-old man was transported via ambulance to the hospital after being found in a snowbank "agitated and hallucinating." The patient had been on his way to group therapy, which he attended for an addiction to dextromethorphan, when he became exhausted and lay down.

Before leaving for the meeting he had consumed three 12-ounce bottles of cough syrup (Robitussin DM [AH Robins, Richmond, VA]) (2160 mg or 31 mg/kg) and "several" beers.

Examination showed a somnolent and easily distracted patient who required frequent stimulations to provide a history. He was mildly confused; he was oriented to name and year but not to month or location. His speech was thick and slurred. Vital signs were: blood pressure 164/104 mm Hg, pulse 86 beats/min, respirations 18 breaths/min, and temperature 37.3C. His skin was hot and markedly diaphoretic. The pupils were 5 mm and reactive bilaterally. Horizontal and vertical nystagmus was present. There was no ophthalmoplegia. Mucous membranes were moist. Respiratory, cardiac, and abdominal examination results were normal. Extremities revealed marked tremulousness with fasciculations of the quadriceps muscles and hypertonicity. The patient's neurological examination showed marked ataxia; his gait was wide based, pigeon-toed and flat footed. He leaned forward, stumbled, and required assistance to prevent falling forward or sideways. He was unable to perform rapid alternating movements or finger-to-nose testing. The remainder of his neurological examination was normal.

The patient received 50 g activated charcoal orally, 100 mg intravenous thiamine and two 1-mg doses of intravenous naloxone. There were no acute changes in his symptoms or physical findings after this therapy. Over the next three hours, he gradually developed an increased ability to concentrate and provided a more reliable history. A blood and urine toxicology screen showed no evidence of alcohol, stimulant amines, opiates, cocaine, barbiturates, benzodiazepines, tricyclic antidepressants, or salicylates. Serum phencyclidine (PCP) and bromide were not evaluated. Liver transaminase, alkaline phosphatase, and lactic dehydrogenase were normal; creatinine phosphokinase was mildly elevated at 244 IU/L. Chemistry panel showed sodium 138 mmol/L, potassium 4.1 mmol/L, chloride 104 mmol/L, bicarbonate 22 mmol/L, BUN 8 mg/dL, creatinine 1.6 mg/dL, glucose 98 mg/dL, serum osmolality 280 mOsm/kg, calcium 9.2 mg/dL. Hemoglobin was 14.7 g/dL, white blood count was 15,700 muL. His electrocardiogram revealed notched T waves and prominent U waves in leads I, II and V<sub>2</sub>-V<sub>6</sub>, consistent with drug, electrolyte, or central nervous system (CNS) abnormality.

In further discussion, the patient divulged a prolonged history of cough syrup abuse. He consumed three to four 12-ounce bottles of Robitussin DM daily during the last two years and frequently during the previous five years. In addition, he drank a 6-pack of beer a day. He denied any other drug use or abuse. Despite this addiction, he had performed well in college, graduating with honors. At times, he had held responsible jobs, but he was now reduced to shoveling sidewalks and shoplifting his abused substances. His dextromethorphan and alcohol abuse history was confirmed by his brother. A review of systems showed numerous symptoms that occurred daily: unstable gait, restlessness, increased intensity of perceptions, blurred vision, nausea, vomiting, shivering, severe insomnia, slurred speech, tremors, "comfortably numb" sensation, floating and flying sensations, forgetfulness, visual and auditory hallucinations, and dysphoria and severe craving after drug withdrawal.

The patient was admitted for observation and his symptoms resolved overnight. No overt evidence of drug withdrawal occurred. The psychiatrist considered the patient clinically depressed with underlying substance addiction and abuse. The patient was discharged to follow up with substance abuse counseling.

## DISCUSSION

This case describes the highest daily dextromethorphan consumption for the longest time yet reported (36 to 48 ounces of Robitussin DM a day, or 2160 to 2880 mg dextromethorphan hydrobromide for up to 5 years). The case shows the potential toxic and addictive properties of this drug.

Including this case, there are 16 patients with acute dextromethorphan intoxication described in the world's English-language medical literature.<sup>[3] [4] [5] [6] [7] [8] [9] [10] [11] [12]</sup> Most cases were unintentional ingestions by children. CNS manifestations are the primary presenting symptoms of patients acutely intoxicated on dextromethorphan and consist of altered mental status (ranging from somnolence to hyperexcitability), ataxia, and nystagmus. [Table 1](#) summarizes the physical symptoms reported in these 16 patients.

Originally thought to have little or no significant toxic effects and to be "devoid of addiction liability," dextromethorphan was developed and marketed in the 1960s as an over-the-counter antitussive medication.<sup>[13] [14]</sup> Since that time, widespread abuse has been reported in a number of areas in the world. In the 1960s, a tablet form of pure dextromethorphan, Romilar, was withdrawn from the market because of increasing abuse within the drug counterculture. In 1986, the Swedish National Board of Health and Welfare forced dextromethorphan into prescription drug status because of teenage abuse of the product.<sup>[15]</sup> An epidemic of adolescent and teenage abuse of dextromethorphan in Utah in the 1980s resulted in voluntary removal of the drug from store shelves to behind pharmacy counters.<sup>[16]</sup> Most recently, physicians in Charleston, South Carolina, have noted increasing abuse of dextromethorphan in the teenage population.<sup>[17]</sup> All the case reports of intentional abusers,<sup>[6] [10] [11] [12] [17] [18] [19] [20] [21]</sup> including ours, showed signs of prolonged addiction (3 months to years). Most patients describe acute euphoria after consumption, with intense craving and dysphoria on withdrawal. No physical withdrawal symptoms are reported. The primary psychological symptoms noted by the abusers are listed in [Table 2](#). Many of these symptoms were related to us by our patient.

The marked dysphoria and depression as intoxication abated seemed to be the driving force for our patient's continued abuse of the drug.

Experimental evidence in animal models suggest that the physical effects of DM and its abuse potential are caused by the active metabolite dextropropranolol.<sup>[22] [23]</sup> This metabolite binds the same CNS receptor as PCP, and animals exhibit similar activity if given either drug. The level of the dextropropranolol metabolite is highly variable; 5 to 10% of Caucasians lack the enzyme to make it, whereas in others there is extensive metabolism.<sup>[14] [24] [25] [26]</sup> The authors of this research<sup>[22] [23]</sup> suggest that individual genetic differences in demethylation may explain the vulnerability of some patients to the addictive effects of dextromethorphan.

### *Therapy*

Acute dextromethorphan intoxication is short-lived and amenable to supportive care. However, three adult deaths have been reported in which dextromethorphan had been ingested and may

have contributed to demise, <sup>[15]</sup> <sup>[27]</sup> and an additional 120 fatalities have been reported in which dextromethorphan was an exposure. <sup>[28]</sup> Toxicity may be markedly increased if a long-acting form is ingested. <sup>[29]</sup>

There is no experimental evidence for or against charcoal use in dextromethorphan ingestion; however, charcoal is known to adsorb opiates, <sup>[30]</sup> and dextromethorphan is an opiate analog. Gastric lavage in a liquid ingestion is likely to be of little benefit unless performed immediately, and potential risks such as aspiration and gastric or esophageal rupture exist. <sup>[31]</sup>

The value of naloxone use in dextromethorphan toxicity is debatable. Its use in dextromethorphan intoxication was first reported in 1977 when it was given to an alert 22-month-old girl who was suffering excitability and ataxia. <sup>[8]</sup> She had "distinct and rapid resolution of her ataxia" after administration of 0.005 mg/kg of naloxone. However, "the remainder of her neurological symptoms resolved within eight hours." Since that publication, four other authors have reported naloxone use with mixed results. <sup>[3]</sup> <sup>[9]</sup> <sup>[5]</sup> <sup>[12]</sup> One somnolent 3-year-old patient "awoke" after its use. <sup>[3]</sup> A second patient suffering coma and near respiratory arrest during a severe asthma exacerbation had pinpoint pupils and was given naloxone. <sup>[4]</sup> Her mental status improved over three minutes and markedly improved over a longer time period. Subsequently, she was found to have no detectable narcotics on toxicology screening, and a history of 720-mg dextromethorphan use over the preceding 36 hours. An 11-week-old baby with hyperexcitability and hypertonicity after overmedication with dextromethorphan was "noted to be calmer" within 30 minutes of naloxone administration, and markedly improved over two hours. <sup>[3]</sup> Finally, a 14-year-old boy who had ingested 4 ounces of Robitussin and was combative in the emergency room was given 2 mg naloxone but "remained disoriented and slow to respond for approximately 5 hours." <sup>[12]</sup> A total of 2 mg intravenous naloxone had no noticeable effect on our patient's somnolence or symptomatology. His mental status did improve slowly during his several-hour emergency department evaluation.

Dextromethorphan hydrobromide can also cause bromide poisoning. <sup>[32]</sup> Typical symptoms of bromide toxicity include impaired CNS function including behavioral changes, headache, apathy, irritation, slurred speech, psychosis, tremulousness, ataxia, hallucinations and, eventually, coma. Weight loss and acneiform rash may also occur. <sup>[33]</sup> Patients with these symptoms and coma require immediate dialysis for bromide removal. Bromide toxicity can be confirmed by a serum bromide level.

Other potentially serious toxidromes must be considered in the differential diagnosis. The differential for patients presenting with altered mental status, ataxia and nystagmus includes PCP, lithium and anticonvulsant toxicity (phenytoin, carbamazepine), thiamine depletion (Wernicke Korsakoff syndrome), sedative-hypnotic withdrawal, and toxic alcohol ingestion (isopropyl alcohol, methanol and ethylene glycol).

## SUMMARY

In summary, this case represents the longest duration and highest daily dose of dextromethorphan abuse reported in the world's English-language medical literature. From the experience of this patient and the other reported cases, it is clear that dextromethorphan can

cause significant psychological dependence but does not seem to cause any physical dependence. Many of the effects of dextromethorphan intoxication are likely caused by its active metabolite, dextrorphan. This metabolite causes physical symptoms similar to acute PCP ingestion. In addition, genetic variability in dextromethorphan metabolism may predispose some patients to addiction because of higher levels of dextrorphan metabolite. CNS manifestations, which are the primary presenting symptoms of patients acutely intoxicated on dextromethorphan, most frequently consist of altered mental status (ranging from somnolence to hyperexcitability), ataxia, and nystagmus. Supportive care seems to be all that is necessary, although care must be taken in the severely intoxicated. The role of naloxone is unclear, but its use has not been reported to cause any adverse effects. Bromide poisoning should be considered and investigated in the chronic abuser if symptoms and laboratory abnormalities suggest its presence.

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**TABLE 1 -- Symptoms of Acute Dextromethorphan Toxicity in Reported Cases (Including This Report)**

<b>Symptoms</b>	<b>No. of Patients</b>
CNS Effects	
Hyperexcitability and restlessness	6
Lethargy or somnolence	7
Ataxia	7
Slurred speech	2
Tremors/fasciculations	1
Hyperreflexia/Hypertonic	2
Ophthalmologic Effects	
Nystagmus	7
Pupillary changes	
Pin point	1
Normal	3
Dilated	3
Other	
Diaphoresis	2
Hypertension	3

Note: Many case reports did not describe the physical findings completely; the symptoms listed here were reported out of a total of 16 patients with acute intoxication.

**TABLE 2 -- Psychological Symptoms of Dextromethorphan Intoxication and Withdrawal**

<b>Acute Intoxication</b>	<b>Withdrawal</b>
<b>Euphoria</b>	<b>Difficulty Sleeping</b>
<b>Increased Perceptual Awareness</b>	<b>Dysphoria and Depression</b>
<b>Altered Time Perception</b>	
<b>Feelings of floating</b>	
<b>Tactile Hallucinations</b>	
<b>Visual Hallucinations</b>	
<b>Auditory Hallucinations</b>	
<b>Visual Disturbances</b>	
<b>Paranoia</b>	
<b>Disorientation</b>	