

# Stimulants: Reviewing Commonly Encountered Street Drugs



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The street drugs encountered most commonly by physicians working in the ED are stimulants. Stimulants in Canada include but are not limited to:

- cocaine,<sup>1,2</sup>
- 3,4-methylenedioxymethamphetamine (MDMA or ecstasy),
- crystal methamphetamine and
- methylphenidate.

Although relatively uncommon, the potential side-effects of these toxins are life-threatening and require specific management.

Cocaine is the most common cause of stimulant death and street drug-related ED visits in the US. Cocaine is a stimulant and topical anesthetic. The "traditional" method of ingestion for cocaine is to chew or suck the leaves or to make coca tea. This has been done for thousands of years and produces a mild stimulant effect. The more refined forms of cocaine used today include powder that is snorted or freebase (crack) that is smoked; both have a very intense, but short-lived euphoric effect.

In Canada, like elsewhere, the number of prescriptions for methylphenidate has been on the rise for two decades.<sup>3,4</sup> There has been a concomitant increase in stimulant toxicity, particularly in the pediatric age group. Children and teenagers crush and snort this drug to achieve a significant stimulant high. According

## Gina's case

Gina, a 23-year-old regular user of cocaine, presents to the ED with a 1 hour history of chest pain (CP) which is now resolved. She uses cocaine intranasally once a week, but never had CP before. Other than shortness of breath, Gina has no associated symptoms. She characterizes her pain as sharp with residual ache.

Vital signs at triage are the following:

- Temperature: 37.2° C
- Pulse: 92 bpm
- BP: 120/84 mmHg
- Respiratory rate: 16/ breaths per minute
- O<sub>2</sub> saturation: 97%
- Her ECG is normal

### Questions

1. She would like to be discharged home. Is this safe at this time?
2. What, if any, ancillary evaluation and treatment should be initiated at this time?

Turn to page 61 for the answers...

to one student, "cocaine is the best but [methylphenidate] is second."<sup>5</sup>

It is always important to include a history of other recreational co-ingestants, usual medications and comorbidities. Stimulants sold on the street can be cut with caffeine, lidocaine, other stimulants or any other substance. All of these factors will affect both the differential diagnosis and treatment.

Table 1

## Stimulants

Drug	Addictive potential	Availability	Hallucinogenic
Cocaine powder:	+++	++	+/-
Ecstasy (MDMA):	+/-	+++	++++
Crystal methamphetamine:	++++	+++	++
Crack cocaine:	+++	+++	+/-
Ephedra:	++	+	-
Methylphenidate:	++	++++	++

MDMA: Methylene-dioxy-methamphetamine

+/-: Little or no evidence

++++: Extremely evident

+: Some evidence

-: No evidence

++: Positive evidence

+++ : Very evident

A broad differential diagnosis is important for these patients to avoid the possible pitfall of “assuming” that symptoms are all a result of the street drugs. Conversely, street drugs should be considered in the differential diagnosis for all patients presenting to the ED with undifferentiated symptoms. Serious complications of stimulant toxicity include:

- rhabdomyolysis,
- seizures,
- cardiac arrhythmias and
- hyperthermia.

### Pharmacology and clinical features

Stimulants block uptake of dopamine, serotonin and norepinephrine. These actions account for

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the cardiac and neurologic effects seen in stimulant toxicity. Cocaine also blocks sodium channels, a property not shared by other stimulants. Sodium channel blockade results in depression of conduction and cardiac contractility. This action can cause potentially fatal wide complex cardiac arrhythmias, such as those encountered in tricyclic antidepressant toxicity.<sup>1</sup>

Assessment of a complete set of vital signs, including temperature and O<sub>2</sub> saturation, is a must for all cases in toxicology. Initial assessment of the airway, breathing, circulatory status and resuscitation if required, are also important prior to gathering detailed information, or ordering ancillary evaluations.

Patients presenting with stimulant toxicity typically exhibit agitation, abnormal vital signs and sometimes chest pain. Stimulant toxicity causes hypertension, tachycardia and hyperthermia. Other clinical effects frequently experienced with stimulants include:

- euphoria,
- diaphoresis,
- anxiety,
- delirium,
- tremor,

## Gina's case cont'd...

Our differential diagnosis for Gina includes:

- Cardiac CP (possibly with arrhythmia)
- Pulmonary embolus
- Pneumothorax/pneumomediastinum (barotrauma from crack inhalation)
- Aortic dissection
- Chest wall pain
- Rhabdomyolysis

This broad differential diagnosis must be considered in the assessment phase for Gina to ascertain the nature of her presenting illness and offer her treatment. Ancillary evaluations for each of these would create unnecessary expense and radiation but they should be considered in the differential diagnosis.

- mydriasis and
- muscle hyperactivity.

With higher doses, patients can present with severe agitation, hallucinations, seizures, hyperthermia and cerebrovascular incident including stroke, aortic dissection and myocardial ischemia.

This clinical presentation can be confused with that of the anticholinergic toxidrome. However, in contrast to stimulants, anticholinergic drugs cause anhidrosis rather than diaphoresis and tend to produce milder hypertension and tachycardia.

Awareness of the complications of stimulant toxicity is crucial. Rhabdomyolysis, defined as a creatinine kinase (CK) of > 1000 IU/L, is surprisingly common and must be ruled out. Patients may not present with the expected symptoms of muscle pain or weakness, since they may have altered mental status. Thus, obtaining a baseline urinalysis specifically for myoglobin, CK, blood urea nitrogen and creatinine should be considered.<sup>2</sup> Seizures and

hyperthermia are also potentially troubling consequences in stimulant ingestions and must be anticipated.

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## Substances involved

### Amphetamines

- Cocaine or crack cocaine
- Ecstasy (MDMA)
- Crystal methamphetamine (d-N-methylamphetamine)
- Ephedra

### Pharmaceuticals

- Methylphenidate
- Amphetamine/Dextroamphetamine

### Cocaine

In addition to the above, a common ED presentation of cocaine toxicity is chest pain and tachycardia. Patients presenting with chest pain should be placed on a cardiac monitor, have an ECG and have cardiac troponins drawn eight to 10 hours after onset of symptoms, as cardiac ischemia in stimulant toxicity is well documented.<sup>6</sup> A chest

film can be useful for some cases, particularly if pneumothorax or pulmonary edema is suspected.

### *Ecstasy or MDMA*

This drug is a hallucinogenic amphetamine with empathogenic, euphoric and stimulant effects. It is very popular and widely available in tablet form. The effects typically start quickly and last about one hour. Common adulterants include:

- caffeine,
- ephedra, or
- anticholinergic substances.

On occasion, crystal methamphetamine is substituted for MDMA in an effort to get a user “hooked.” The main problems with ecstasy are hyperthermia and hyponatremia. The mechanisms by which ecstasy induces hyponatremia include:

- syndrome of inappropriate antidiuretic hormone (SIADH),
- overhydration,
- overexertion and
- intense diaphoresis due to the stimulant effect of the drug.

If large quantities of beer are consumed concomitantly, this can increase the severity of the hyponatremia.

More than half of users report having difficulty concentrating, bruxism (jaw clenching), anorexia and xerostomia. We should suspect ecstasy when patients present with a sympathomimetic toxidrome and are very open and talkative.

Some users will experience a “crash” after ecstasy use. This is typically short-lived, but can last as long as a few weeks. Although ecstasy is not physically addictive, some patients

<b>Sign</b>	<b>Anticholinergic</b>	<b>Sympathomimetic</b>
Tachycardia:	++	+++
Hypertension:	+	++++
Pupils:	Mydriasis	Mydriasis
Skin:	Dry	Diaphoretic
Mental State:	Confused	Variable
Temperature:	Elevated	Elevated

will crave more during the crash phase. With recurrent use many will find that ecstasy will “lose its magic.”

### *Crystal methamphetamine*

A synthetic stimulant, this drug has grown in popularity over the past decade. It can be made quite easily in home laboratories.

Oral ingestion produces a gradual high whereas smoking and IV use produce a “rush” or intense and rapid high.

Signs include those of the stimulant toxidrome with increased libido. “Meth mouth” is the result of habitual use secondary to the residual caustic chemicals in the finished product. Chronic users can suffer from paranoia and psychosis in addition to picking at the skin, a pattern of behaviour known as “tweaking.” Anorexia and insomnia are also significant in crystal methamphetamine users.

Crystal methamphetamine produces tolerance and significant psychological addiction. Failure of rehabilitation is more frequent with crystal methamphetamine than with cocaine, making early detection and prevention doubly important.

## Take-home message

- Avoid  $\beta$ -blockers in treatment of stimulant toxicity
- Maintain a broad differential diagnosis as stimulant ingestion can mimic infection or psychiatric illness
- Treat toxic seizures with benzodiazepines
- Look for rhabdomyolysis in stimulant overdose and regular users
- Consider methylphenidate, dextroamphetamine and amphetamine as potential drugs of abuse
- Differentiate the stimulant and anticholinergic toxidromes by the diaphoresis and more severe hypertension in stimulants in contrast to the anhidrosis and moderate hypertension seen with anticholinergics

### *Ephedra*

Ephedra or “natural E” is a combination of the stimulant ephedrine and the decongestant pseudoephedrine. It is often consumed in the form of tea. Ephedrine as an herbal supplement or a diet aid has been banned in several countries

*IV lorazepam or diazepam boluses are essential to control agitation to prevent worsening hyperthermia and rhabdomyolysis and to avoid patient or staff injury.*

due to its association with cerebrovascular accidents and other complications.

### *Methylphenidate and dextroamphetamine*

Methylphenidate and dextroamphetamine are central nervous system stimulants. Medical indications include attention deficit hyperactivity disorder, narcolepsy and sometimes chronic pain. These medications can become substances of abuse.

When these drugs are abused, the effects sought are euphoria, alertness, or weight loss. For purposes of abuse, tablets can be ingested orally, crushed to powder and snorted, or dissolved in water and injected intravenously. The fillers in tablets are not water soluble and may cause complications at the site of injection or remotely in the eyes or lungs. Chronic ingestion of excessive methylphenidate produces tolerance and addiction.

### *Treatment*

Benzodiazepines are the mainstay of treatment for all signs of stimulant toxicity. IV lorazepam or diazepam boluses are essential to control agitation, to prevent worsening hyperthermia and rhabdomyolysis and to avoid patient or staff injury. Hypertension and tachycardia also respond well to benzodiazepines.  $\beta$ -blockers must be avoided as they can exacerbate hypertension and tachycardia; this class of medications leaves the  $\alpha$ -receptors unopposed. There is some controversy in the literature about the appropriateness of treating hypertension with labetalol, as it is a mixed  $\alpha$ - and  $\beta$ -blocking medication. Despite this, use of labetalol is not

advisable since the  $\beta$ -blocking effects are much more prominent.

As previously described, cocaine also has a sodium channel blocking effect that can cause wide complex tachyarrhythmias. Treatment is IV sodium bicarbonate boluses until the QRS complex narrows and clinical improvement is seen. For chest pain, treatment can include:

- benzodiazepines,
- nitroglycerine, or
- both.

The use of thrombolysis for STEMI in this context is extremely rare. The vast majority of patients need only appropriately timed cardiac enzymes (a negative troponin at eight hours is sufficient), cardiac monitoring and observation for several hours prior to discharge.

If rhabdomyolysis is diagnosed, the treatment includes administering sodium bicarbonate to alkalinize the urine and IV fluid rehydration. Hemodialysis for acute renal failure is seldom required.


Hyponatremia is another potentially harmful complication of ecstasy ingestion. If the hyponatremia is severe ( $< 120$  mEq/L) or associated with seizures, confusion or altered mental status, rapid correction with hypertonic saline is initially indicated. In hemodynamically stable patients, a sodium between 120 mEq/L to 130 mEq/L requires only fluid restriction.<sup>7</sup>

Rarely, patients present with neurological signs or severe headache. On these occasions, a CT scan of the head without contrast is a necessity. Resuscitation and airway management may also be required for this group of patients.

*Management of symptoms is important in addition to the provision of appropriate supportive care.*

### Conclusions

Stimulants are readily available street and prescription drugs. Recognition of this sympathomimetic toxidrome is important for emergency physicians. Management of symptoms is important in addition to the provision of appropriate supportive care. Pitfalls in the diagnosis of stimulant toxicity include:

- sodium channel blockade,
- hyponatremia and
- rhabdomyolysis. 

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