

CEPCP
Self Study Package
Summer 2008

Toxidromes; what's
your poison?

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Introduction

It's early on a Sunday morning; really, really early. The humidity is already noticeable and hangs like a wet blanket in the air. The hazy night air is slowly clearing to reveal a clear blue sky and with it, a promise of another hot August day.

In a back alley in south Oshawa, an EMS crew is just arriving to deal with a patient who is unresponsive and barely breathing. A troubled upbringing has lead down a path of drug abuse. This morning it has gone too far and the patient is dangerously close to death.

Seemingly far removed from the back alley in Oshawa, cottagers in Haliburton are waking up to a beautiful morning, the kind of morning that the pages of "Cottage Living" are filled with, a morning to enjoy a cup of steaming coffee in a Muskoka chair to the backdrop of mist drifting over a glossy lake. The morning is disturbed however by the sounds of sirens, as Haliburton EMS responds to an elderly female who cannot be woken up by her concerned family members. The patient is suffering from a malignant cancer that is ripping through her frail body. Yesterday the pain got worse and in order to sleep she took a few extra pills.

These calls are different, seemingly from two different worlds, but when broken down to their nuts and bolts, they are very similar. The physiological derangements are the same and the treatment should be exactly the same.

With the list of possible substances that people overdose on growing every day, it seems a daunting task to stay on top of the game and, as a paramedic, quickly determine what someone has been exposed to, and anticipate what complications may arise and what treatment will be necessary en-route to hospital. The concept of toxidromes and a little bit of memory work can go a long way towards mastering this task consistently.

What is a Toxidrome?

Toxidromes group drugs together according to the signs and symptoms they generally produce in patients, so when you encounter a patient presenting a certain way, you will be able to recognize the toxidrome. With this knowledge you will be able to shorten the list of ‘suspect’ drugs which the patient may be under the influence of, as well as alert you to possible complications and treatment options. The bad news is that you need to memorize which drugs are in what toxidrome. In addition, you need to know what signs and symptoms are consistent with a given toxidrome group. The good news is that it is a whole lot easier than memorizing signs and symptoms for each individual drug!

What are the major toxidromes? Authors vary, but we will stick to the following four:

- ☑ Anticholinergics
- ☑ Sympathomimetics / Withdrawal
- ☑ Opiate / Sedative
- ☑ Cholinergic / Anticholinesterase

Before we get into the nitty-gritty details of each toxidrome, it is important to review the autonomic nervous system. If you feel very comfortable about this topic and wish to skip this section, I suggest completing exercises number one to three in the hand-in package. If you can complete the exercise without too much trouble, then skip straight to ‘The Toxidromes’.

The Autonomic Nervous System (ANS)

The Autonomic Nervous System (which will be referred to as the ANS in the rest of this text) is a rather complex system that controls many of our involuntary responses and actions. It is comprised of a large number of sensors that measure the internal state of your body: things like blood pressure, oxygen levels, carbon dioxide levels, pH, temperature, brain perfusion and cardiac stretch (I’ve probably missed a few but you get the idea). All the information from the sensors travel along nerves to various parts of the brain (mostly the brain stem), where it is processed and further combined with information from other areas of the brain that monitor our external environment. Once the

information is processed, the brain sends out signals along nerves and relay stations to various organs, causing them to adjust their actions accordingly.

Let's say you stand up from your chair right now. Gravity will cause less blood to return to the heart and your blood pressure will drop. Sensors in your carotid sinuses and in the ventricles will detect the drop in pre-load (blood return) and blood pressure. The signals are sent to the brainstem where a quick decision is made; blood vessels are constricted and heart rate is increased. Those signals are sent along the appropriate nerves, and in no time your SA node picks up its speed, the AV node increases its conduction rate and vascular smooth muscles constricts, causing the vessels to narrow. Soon the sensors 'read' a better number, and the response can be adjusted accordingly.

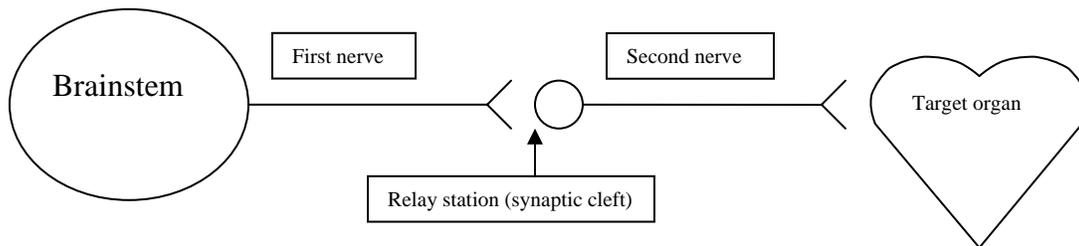
The system also monitors external factors, so even if the blood pressure and heart rate is adequate for the internal environment, the information that someone just pulled out a knife and is running at you will filter down to the brain stem and ensure that the heart rate is increased, the blood vessels to your muscles are dilated (to ensure good blood flow in the event of a fight) and that your pupils are dilated (to ensure good, clear vision as you either fight or run away...I suggest the second option).

Most of the actions of the ANS happens on a subconscious level and are outside of our control. So, why do we care about it? The reason why it is important to have at least a rudimentary understanding of the ANS is because a large number of drugs (legal and illegal) work by artificially influencing the ANS in some way. Three out of the four toxidromes are groups of drugs that alter the ANS. Hence, if a paramedic has a clear understanding of what signs and symptoms are indicative of a given part of the ANS being activated or blocked, it becomes very easy to determine which toxidrome is affecting the patient.

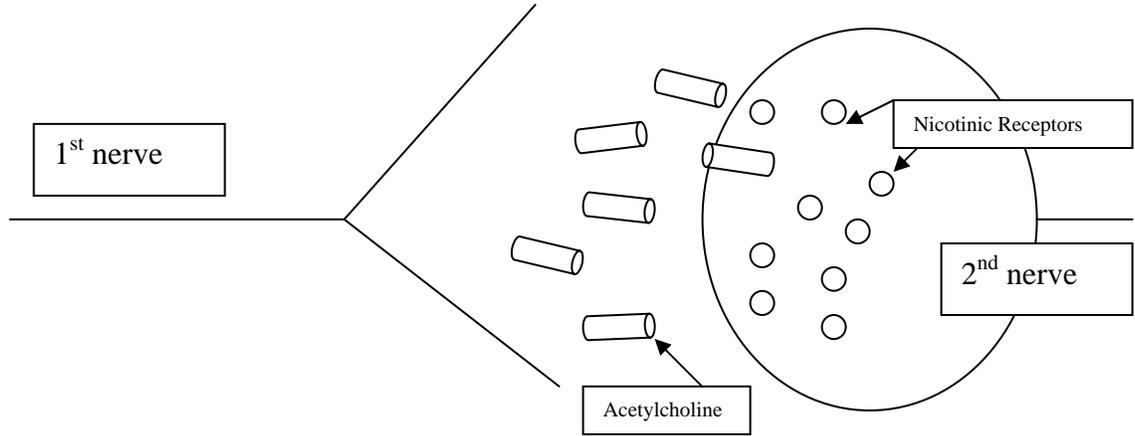
The part of the ANS that we are most interested in is the part that sends the signals *from* the brain *to* the various organs, as this part is most affected by various drugs. This part is divided into two major systems: the sympathetic and the parasympathetic system. Generally speaking, the sympathetic side will speed things up (also known as the 'fight or flight response'). The parasympathetic side will slow things down (also known as the 'rest and digest response'). Many find it useful to think of the sympathetic nervous system as a gas pedal and the parasympathetic nervous system as a break.

The ANS uses a system of relay stations to convey its messages from the brain to the organs. Starting from the brain stem, a signal is sent out along a selected nerve. At the end of that first nerve is a depot of neurotransmitter that is released into the synaptic cleft (big word for relay station), the neurotransmitter binds to the start of the next nerve and triggers a signal that travels down the second nerve. At the end of the second nerve, another squirt of neurotransmitter is released onto the target organ, triggering the desired effect. Once the neurotransmitter has been released it is either recollected into the sending nerve to be reused (yes, even the ANS recycles) or it is broken down by enzymes. If there were no mechanisms in place to get rid of the neurotransmitter it would simply keep reactivating its trigger.

So let's recap. The brain sends a signal down the first nerve, the first nerve squirts neurotransmitter onto the second nerve triggering that nerve, the second nerve squirts neurotransmitter onto the target organ triggering the desired effect.

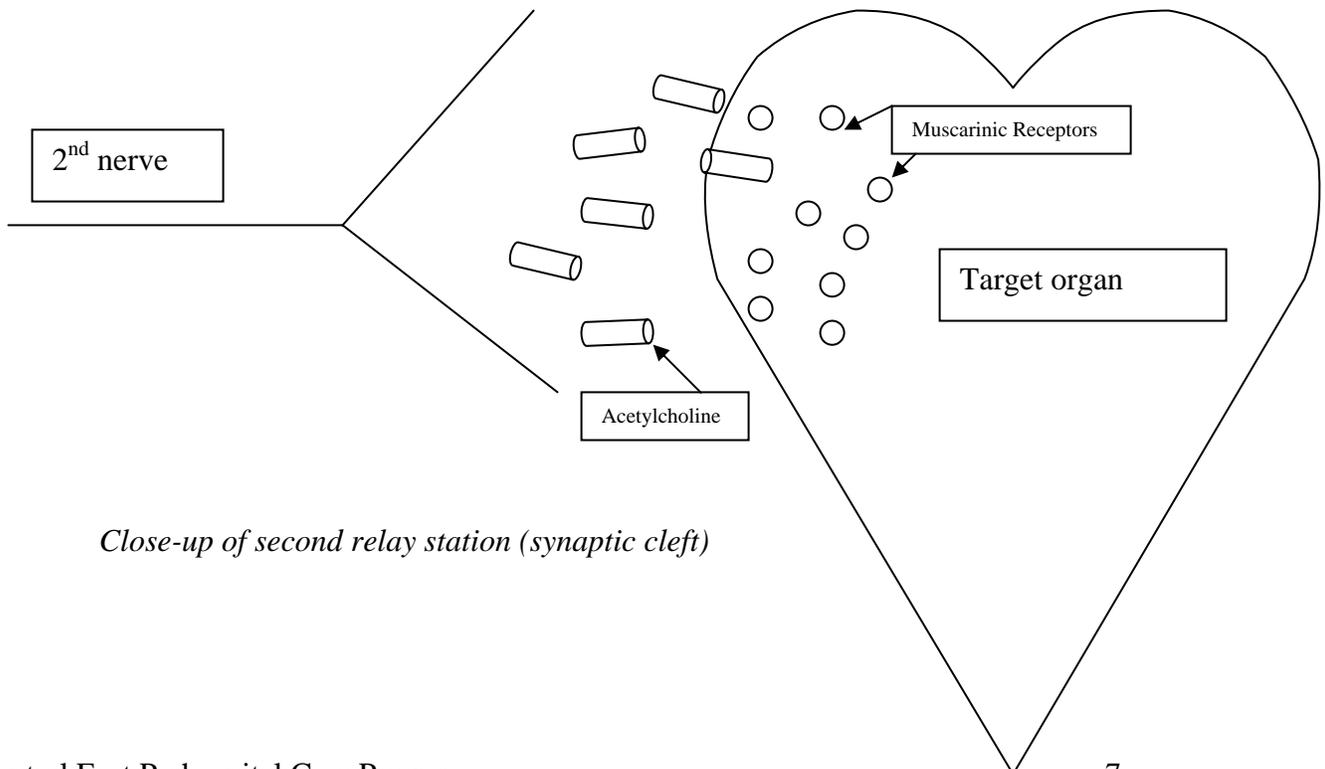


In order to understand the effects of drugs on the various parts of this relatively simple system, it is important to know what neurotransmitter is used onto what type of trigger in the various parts. Let's again start from the top. The neurotransmitter that is released from the first nerve is acetylcholine (Ach), the receptor (trigger) it activates is called the nicotinic receptor (as it can be artificially triggered by nicotine). Once the acetylcholine has done its job, it is broken down by an enzyme called cholinesterase (think of it as the acetyl**choline-eraser**).



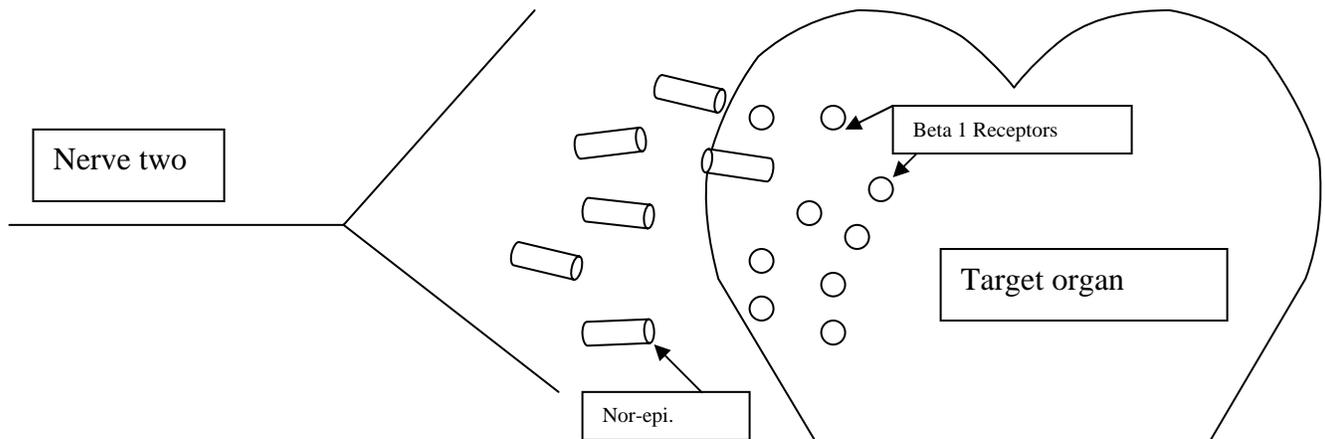
Close-up of relay station (synaptic cleft)

In response to the nicotinic receptor being triggered, a signal is sent down the second nerve, releasing its neurotransmitter. If it is the parasympathetic nervous system that is being activated, it will again be acetylcholine that is released. The receptors (triggers) on the target organs are called muscarinic receptors (named by the substance muscarine that is found in some mushrooms and that artificially triggers these receptors). Again, once the acetylcholine has done its job, it is broken down by cholinesterase.



Close-up of second relay station (synaptic cleft)

If it is the sympathetic nervous system that is being triggered, the neurotransmitter released at the end of nerve two is called nor-epinephrine. The nor-epinephrine activates the triggers (receptors) on the target organ, there are three types of receptors that are triggered by the neurotransmitter nor-epinephrine; Beta-1, Beta-2 and Alpha-1. Different organs have different receptors (more on this later). The nor-epinephrine is for the most part reabsorbed and reused.



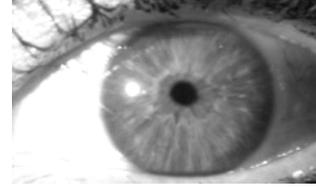
Close-up of second relay station (synaptic cleft)

In order to test your understanding of the above information complete exercises 1-3 in your hand-in package (section 2).

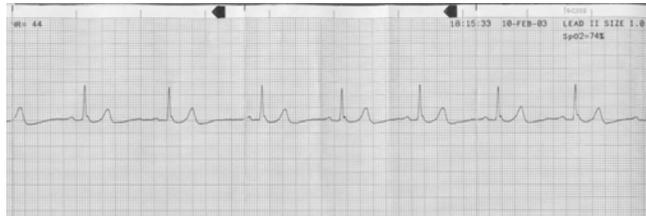
The Parasympathetic Response

The signs and symptoms that follow once acetylcholine binds to the muscarinic receptors on the various target organs are as follows:

Eyes – pupil constriction (also called miosis) and secretion of tears



Heart – slows the heart rate and conduction through the A-V node



Lungs – constricts the bronchial tree

GI – increases peristalsis, blood flow to the GI tract and salivation

One of the major nerves responsible for sending parasympathetic signals to the target organs is the vagus nerve. The vagus nerve is extensively connected to the heart, GI tract and lungs, and it works, both ways, sending messages *from* the organs *to* the brain as well as sending messages *from* the brain *to* the organs. Sometimes the wires get crossed and a strong signal from the GI tract (cramping or nausea for example) can act to slow the heart rate down. Because the vagus nerve is very involved in these various actions, a strong parasympathetic response is sometimes referred to as a ‘vagal response’. Alternatively, because acetylcholine is the end-organ neurotransmitter on the parasympathetic side, a parasympathetic response is sometimes referred to as a ‘cholinergic response’. Notice that the ‘acetyl’ is dropped from the acetyl-choline as ‘acetylcholinergic’ would just sound awkward and weird.

You may have already noticed that one of the toxidromes is named ‘cholinergic/anticholinesterase’. Substances under this toxidrome work directly on triggering the muscarinic receptors (cholinergic) or block the actions of cholinesterase

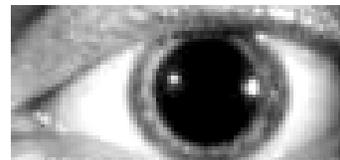
(anticholinesterase). When the action of cholinesterase is blocked, it prevents the breakdown of the secreted acetylcholine, causing it to continuously trigger the muscarinic receptors which will lead to a prolonged and/or exaggerated response of the target organs.

Another toxidrome is named ‘anticholinergic’ and refers to drugs that block the muscarinic receptors and thus block the actions of the parasympathetic nervous system.

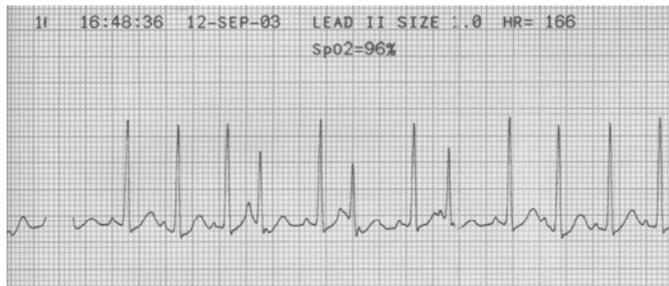
The Sympathetic Response

The signs and symptoms that follow once nor-epinephrine binds to the various receptors are as follows;

Eyes (Alpha 1)– pupil dilation (also called mydriasis)



Heart (Beta 1) – increased heart rate, speed of conduction, strength of contraction and irritability.



Lungs (Beta 2) – dilation of bronchial tree

Skin (Alpha 1) – constriction of vessels, sweating, goose bumps

Muscles (Beta 2) – increased blood flow due to vasodilation



As you can probably tell, the effects of the sympathetic nervous system is what we see when we say a person looks ‘shocky’, with the pale, cool, sweaty skin and general look of apprehension.

Another interesting effect of the sympathetic nervous system, is that it triggers the release of epinephrine from the adrenal glands that are located on top of the kidneys. The epinephrine is released into the blood stream and has similar effects as the nor-epinephrine. By releasing the epinephrine into the blood, the sympathetic response lasts longer than if we had to rely on the individual sympathetic nerves to constantly squirt nor-epinephrine onto their target organs. Epinephrine is sometimes referred to as adrenalin and the receptors (Beta-1, Beta-2 and Alpha-1) are sometimes collectively referred to as the ‘adrenergic’ receptors.

Drugs that trigger one or more of the adrenergic receptors or block the re-uptake of epinephrine/nor-epinephrine are called sympathomimetics as their effects mimic the sympathetic response.

The Toxidromes

With a good understanding of the autonomic nervous system, the signs and symptoms of the various drugs almost become second nature. The exception is the opiate / sedative toxidrome that does not trigger or block the ANS but work on separate receptors, they will be discussed later.

Anticholinergics

The anticholinergic toxidrome, as the name implies, is a group of drugs that interfere with the binding of acetylcholine to muscarinic receptors (Burns et al. 2000).

The basic effect of blocking the muscarinic receptors, is to block the parasympathetic nervous system. Those of you who like the ‘brake and gas pedal’ analogy for the sympathetic versus parasympathetic nervous systems, can think of this as losing the brakes! The effects have been described in the following classic memory aid:

- ☑ **“Hot as a Hare” – Hyperthermia**
- ☑ **“Blind as a Bat” – Dilated pupils (mydriasis)**
- ☑ **“Dry as a Bone” – Dry skin**
- ☑ **“Red as a Beet” – Vasodilation causing flushed skin**
- ☑ **“Mad as a Hatter” – Agitation / Hallucinations**

(Neety & Wong 2002, p. ER28)



The patient will also have tachycardia and possibly dysrhythmias (Kulig 1993, P. 286). All combined, this is a scary patient. Often they are very agitated, flushed and un-cooperative. The next question is, “what drugs cause this mayhem?” Here is a list of some common ones:

Tricyclic antidepressants- *Amitriptyline (Elavil), Clomipramine (Anafranil), Doxepin (Sinequan)*

Tricyclic antidepressants are falling out of favour for treating depression due to the emergence of more effective, less toxic selective serotonin re-uptake inhibitors (SSRIs) (Brent & Birmaher 2002). However, tricyclic antidepressants are still used, not just for depression, but to treat a variety of other problems such as migraines (Goadsby, Lipton & Ferrari 2002), back pain (Carragee 2005) and other ailments.

Antihistamines – *Claritin, Benadryl, Gravol, many cough syrups*

Antihistamines are usually used for treating allergies but can also be used to treat nausea and vomiting or cold and flu symptoms. They are often combined with other medications such as acetaminophen or ASA. Although Gravol and Benadryl are most known for their sedative effects, an overdose on these drugs brings about their anticholinergic effects that can range from hallucinations, excitement and convulsions to drowsiness and coma (Kadar 1998, p. 406).

Tegretol (Carbamazepine) –

Antiseizure medication commonly prescribed to epileptic patients.

Anti-parkinson medications – *benztropine (Cogentin), biperiden (Akineton), ethopropazine (Profenamine hydrochloride), orphenadrine (Norflex), procyclidine (Kemadrin) and trihexyphenidyl (Aparkan and Artane)*

These drugs have been used to treat some of the signs and symptoms associated with Parkinson's disease for years. However, as newer drugs have become available they are falling out of favor due to their potential side effects.

Anti-psychotics- *clozapine, chlorpromazine and thioridazine*

Jimson weed



Jimson weed is a plant that grows wild throughout North America. (Gahlinger 2001, p.183). These plants are commonly ingested, smoked or made into a tea (Gahlinger 2001, p. 183). Case reports of people hospitalized due to Jimson Weed intoxication are common (Defrates et al 2005; Tiongson & Salen 1998; CDC 1994; Dewitt, Swain & Gibson 1998; Guharoy & Barajas 1991; Shervette et al 1979).

2.6 percent of Ontario high school students admitted to having tried Jimson weed in 2007, with the eastern Ontario region reporting slightly higher than average use (2.7 percent) (CAMH 2007). Sometimes referred to as Angel's Trumpet, Stink Weed or Moonflower, the plant seeds contain 0.1 mg Atropine per seed (lethal dose in adults is >10mg) (Arnett 1995).

Atropine

Atropine is carried in all ALS drug bags in our region and has been a longstanding treatment for bradycardia and cardiac arrest.

Treatment for Anticholinergic Overdoses

Pre-hospital treatment should focus on safe, rapid transport with oxygen administration and cardiac monitoring, and staying alert for complications such as vomiting, seizures or violent behaviour (MOH 1996, p.68).

In-hospital treatment is focused on supportive measures in most cases. A rarely used option is the administration of physostigmine, a short-acting cholinesterase inhibitor (Burns et al. 2000). By inhibiting cholinesterase, the breakdown of acetylcholine is inhibited in the hopes that higher amounts of acetylcholine will overwhelm the blocked muscarinic receptors.

Sympathomimetics / Withdrawal

The sympathomimetic toxidrome mimics the sympathetic nervous system effects (fight or flight). Alcohol and drug withdrawal present the same way as sympathomimetics, which is why they are grouped together. The effects of drugs that mimic the sympathetic nervous system are predictable:

- ☑ **Tachycardia, Dysrhythmias**
- ☑ **Hypertension**
- ☑ **Diaphoresis**
- ☑ **Goosebumps**
- ☑ **Delusions, Paranoia,**
- ☑ **Seizures**
- ☑ **Increased temperature**
- ☑ **Dilated pupils**

(Neety & Wong 2002, p. ER38)

Looking at the above list, one can appreciate how the sympathomimetic toxidrome could be mistaken for an anticholinergic toxidrome or vice versa. The distinguishing features are the diaphoresis and pale skin in sympathomimetics, versus flushed, dry skin in the anticholinergic toxidrome.

If we were able to assess bowel sounds, they would be present in the sympathomimetic, versus diminished or absent in the anticholinergic toxidrome. This may appear to be a bit of a silly point considering we don't assess bowel sounds in the pre-hospital setting, and we certainly wouldn't be successful in an agitated, overdosed patient. The only reason I mention it at all is due to its tendency to come up on various exams.

So what drugs fall into the sympathomimetic toxidrome category? Here is a list;

Caffeine

Yes, caffeine IS a drug! Here is a list of the caffeine contents of some popular drinks

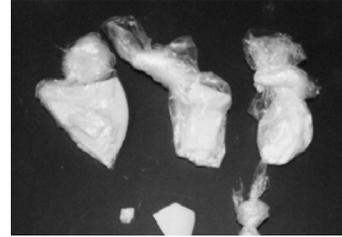


- Coffee –
 - 140 mg in a Lg. Tim Horton's
(*Tim Horton's: Caffeine Content, 2008*)
 - 260 mg in a Tall Starbucks
(*Starbucks Beverage Details*)
- Red Bull – 80 mg/can
- Jolt Cola – 72 mg/can
- Fixx energy drink – 500 mg/bottle
- Coca Cola – 46 mg/can
- 'Wakeups' – 100mg/pill
(Gahlinger 2001)

A dangerous dose causing seizure, respiratory failure or death is >10 grams (10,000mg)(Gahlinger 2001, p.181), so clearly it would be difficult to overtly overdose on caffeine but even in smaller doses caffeine can act as a cardiac irritant and cause arrhythmias and sudden death.

Cocaine

Cocaine exists in several forms; as a powder that can be snorted or rubbed on the gums, as crack that is smoked, or dissolved and injected (Gahlinger 2001, p.247). In Ontario, 3.4 percent of high school students report using cocaine in 2007 (CAMH 2007). The difference between the Toronto area versus the rest of the province is negligible, disproving the myth that ‘hard’ drugs, such as cocaine, are strictly a big city problem. In addition, 6 percent of adults in Ontario report having used cocaine in their lifetime, with the highest use reported in those earning \$80,000.00 or more (CAMH 2005).

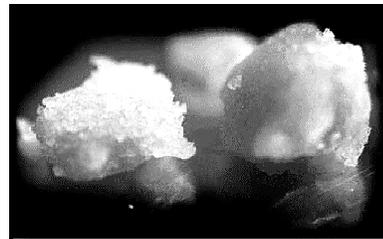


The side effects of cocaine can be severe and is not dose dependent. Both short and long term cardiac effects can occur, but the short term effects are the greatest. The risk of having a heart attack is increased 24 times during the hour after cocaine use (Lange & Hilus 2001).

Therefore, anyone who is suspected of having used cocaine must be treated as a potential cardiac patient. Oxygen administration and 12 lead ECG are mandatory. In addition, nitro and ASA may be administered, as needed, to treat those suffering an acute coronary syndrome. Continuous cardiac monitoring is imperative en-route to hospital.

Amphetamine (speed), Methamphetamine (ice, crank), Ritalin

The above drugs are all part of the amphetamine family. They are synthetic versions of ephedrine, which grows on the Ephedra bush in desert regions. The use of methamphetamine, a more potent version of amphetamine, in Ontario high schools has declined sharply to 1.4 percent of students having reported using the drug in 2007, down from an alarming 5 percent in 2005 (CAMH 2007). However, a report published by the RCMP in



2006 indicates a rise in methamphetamine production by homegrown meth labs. The report also indicates a wide use of methamphetamine as an additive to ‘softer’ drugs such as marijuana or ecstasy in order to increase the addiction potential of those drugs (RCMPa 2006). Out of 200 pills sold as ecstasy on the street, 80 percent actually contained ecstasy and 71 percent of those pills also contained methamphetamine (RCMP 2006b).

Theophylline

Traditionally used to treat asthma and COPD, rarely used these days.

LSD (acid)

LSD is the most potent and highly studied hallucinogen known. Its popularity has been on a steady decline. In 2007, 1.6 percent of Ontario high school students reported having used the drug during the past year (CAMH 2007).

Ecstasy (MDMA)

Originally used to treat depression, ecstasy has become well known as a rave drug. Ecstasy is also a synthetic version of ephedrine and shares many of its properties (Gahlinger 2001). Its use in Ontario is also on the decline from its peak in 2002. In 2007, 3.5 percent of Ontario high school students reported using the drug in the past year (CAMH 2007).



Treatment for Sympathomimetic Overdoses

Pre-hospital treatment for sympathomimetics is the same as that for an anticholinergic overdose. In-hospital treatment will most likely include administration of a benzodiazepine to calm agitated patients.

Transporting Agitated Patients

A special word of caution is in order here before we leave the topic of anticholinergics and sympathomimetics. There is a phenomenon that we as pre-hospital providers need to be aware of, it has been coined *excited delirium* and needs to be considered when dealing with violent, potentially overdosed patients.

On June 5th 2005, a 43 year old, well educated man, arrived at the Ottawa International Airport on a flight from Halifax (Office of The Chief Coroner 2007). The gentleman suffered from psychiatric disease, but what exactly triggered the behavior that would ultimately lead to his death is unknown. What is known is that he began diving head first from a bench onto the floor, injuring himself. He was restrained by passengers and airport staff until the Police department arrived (Office of The Chief Coroner 2007). The gentleman was out of control, displaying supernatural strength and struggled with police (Office of The Chief Coroner 2007). Ottawa paramedics arrived and the gentleman was placed face down on the stretcher, with his hands cuffed behind his back.

About 15 minutes after being restrained on the stretcher, he was sedated by Paramedics and immediately appeared to calm down. Minutes later it was discovered that the gentleman was in deep trouble and resuscitation was started but was ultimately unsuccessful (Office of The Chief Coroner 2007). The Coroners report does not implicate the use of sedation as the cause of the man's death; but rather 'positional asphyxia' was legally blamed (Office of The Chief Coroner 2007).

Similar incidents have happened too many times and are obviously a litigation nightmare for Police and Paramedics alike - not to mention a tragedy for the patients and their families.

So, what causes this phenomenon? There are a few different theories. One theory places the blame on what has been coined 'positional asphyxia' (as is the listed cause of death in the case above). It has been theorized that the prone 'hogtie' position can limit ventilation and possibly lead to



hypoxia (Chan et al. 1997). However, studies in controlled settings are having limited success in supporting this theory. In fact, no significant difference in oxygenation and ventilation has been found in the prone 'hogtie' position (Chan et al. 1997).

The other theory looks at 'agitated delirium' as a potential cause of death (Karch 1995). This theory places the blame on the effects of the drugs such as sympathomimetics (Karch 1995). Many sympathomimetics have potential to cause life threatening dysrhythmias, and the additional effect of a violent struggle with police could precipitate this potential. Most of these deaths have occurred during warm, humid summer days and hyperthermia seems to play a role as well (Karch 1995).

The take-home lesson is to be extremely cautious when transporting agitated, restrained patients.

ALWAYS insist that an officer with a hand-cuff key is present at all times. Agitated patients must be transported supine, so explain the risks associated with keeping the patient prone to the police if they remain reluctant. You can suggest using several handcuffs to restrain the hands and feet to the stretcher in a more normal anatomical position. Attempt to administer oxygen to the patient and monitor the SpO₂ and ECG continuously. If possible, check the patient's temperature; if it is elevated employ rapid cooling methods (Karch 1995). Be very alert to the struggling patient who suddenly becomes quiet. See the BLS-PCS pages 8-6 to 8-8 for patient restraint techniques.



Opiate (Narcotic) / Sedative

The opiates are also called *narcotics*, from the Greek word *narkotikos* which means 'to numb' (Gahlinger 2001 p.14). This is a common source of confusion since the term narcotics is often used to refer to all illegal drugs (Gahlinger 2001 p.14). For our purposes, narcotics will be used only in reference to opiates. Original opiates were derived from the poppy plant and many are still made this way, while others are synthetically designed and produced (Gahlinger 2001 p.361-367). Opiates bind to opioid receptors (these are different and

in no way related to the ‘muscarinic’ receptors of the ANS), in the central nervous system, to produce the following signs and symptoms;

- ☑ **Pin-point pupils** (Miosis)
- ☑ **Respiratory depression** – Due to decreased sensitivity of the respiratory center to CO₂ (Kalant 1998 p. 268). This can be very pronounced, even as slow as 2-4 breaths/min!
- ☑ **Sedation** – Often GCS 3
- ☑ **Nausea and vomiting** – Due to stimulation of the chemoreceptor trigger zone (Kalant 1998, p. 269)
- ☑ **Hypothermia** – Due to inhibition of the thermoregulatory area (Kalant 1998, p. 270).

These patients can range in presentation from totally unresponsive and barely breathing (a presentation that could easily be confused with cardiac arrest), to those who present drowsy but are rousable with verbal or gentle tactile stimulation. Watch the breathing carefully, many opiate overdoses will breathe adequately when roused, but will slow down dangerously if allowed to ‘sleep’.

Here is a list of common opiates (legal use mainly for pain control);

- ☑ **Heroin**
- ☑ **Morphine (MS-contin)**
- ☑ **Hydromorphone (Dilaudid)**
- ☑ **Codeine (Tylenol #3) – Cause little miosis**
- ☑ **Propoxyphene (Darvon)**
- ☑ **Hydrocodone (Hycodan)**
- ☑ **Oxycodone (OxyContin, Percocet, Percodan)**
- ☑ **Fentanyl (Sublimaze, Duragesic)**
- ☑ **Meperidine (Demerol) – Does not cause miosis**



Opiates are widely abused, not just in its traditional form as heroin but prescription drug abuse is a widespread problem as well. Always consider an opiate overdose when assessing elderly patients with altered LOC who have been prescribed an opiate for pain control. Increasing pain or confusion can cause accidental overdoses.

An alarming trend is the recreational use of opioid pain relievers by high school students in Ontario. In 2007, over 20 percent of students reported having used an opioid drug for non-medical purposes during the past year (CAMH 2007). That is 1 out of 5 students!!



Where are students getting the illegal pain relievers from? Almost three quarters of users got them from home (CAMH 2007).

There are many inventive ways of abusing opioid pain relievers. Fentanyl patches can be purchased illegally on the street and dissolved into tea, burned in a spoon and injected or even inserted in the rectum (Coon et al. 2005)! On a positive note, heroin use is continuing a downward trend and is becoming quite rare in the younger population (CAMH 2007).

Treatment of Opiate Overdoses

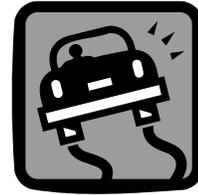
Pre-hospital treatment should focus on supporting the ABC's. Often significantly overdosed patients will require suctioning, placement of an airway adjunct and supported ventilations with a BVM. Even if the patient can be roused, monitor the respiratory effort carefully. Sometimes patients need to be told to 'take a few deep breaths' to maintain adequate ventilations. Don't get a false sense of security due to good SpO₂ readings. SpO₂ only tells you about oxygenation, not ventilation (elimination of CO₂). A patient can have normal SpO₂ values with a dangerously elevated CO₂ and resultant respiratory acidosis.

The sedation exhibited by opiate overdose patients are often due to a combined effect of the drug itself, as well as high carbon dioxide levels that result from slowed

respirations. Many of these patients will regain consciousness from positive pressure ventilation alone, as the carbon dioxide is ventilated out.



ALS, as well as in-hospital treatment may consist of the administration of Naloxone (Narcan); a drug that binds to the *Mu* receptors, essentially ‘blocking’ them without causing any opiate effects. Always use narcan with caution - you can very quickly go from having an easily managed and sedate patient, to a combative individual in full withdrawal. Some users combine heroin with amphetamine or cocaine, “*speed balling*”. Removing the heroin component of that overdose can lead to dangerous sympathomimetic ‘overdrive’. Imagine someone driving with both feet pressing as hard as they can on the brake and gas at the same time, engine screaming, brakes smoking and suddenly the foot is taken off the brakes!



Cholinergic / Anticholinesterase

The most likely place to encounter this type of poisoning is on written examinations. Although not a very common toxidrome, it is an important one to recognize if encountered. As the name implies, this toxidrome leads to elevated levels of acetylcholine, either through direct ‘cholinergic’ effects or by inhibiting the enzyme responsible for the breakdown of acetylcholine (cholinesterase).

The symptoms associated with this toxidrome are associated with both nicotinic and muscarinic effects. The effects are outlined in two well known acronyms;

DUMBELS;

Diaaphoresis, **D**iarrhea, **D**ecreased blood pressure
Urination
Miosis
Bronchorrhea, **B**ronchospasm, **B**radycardia
Emesis, **E**xcitation of skeletal muscle
Lacrimation (tearing)
Salivation, **S**eizures

(Neety & Wong 2002, p. ER38)

SLUDGE;

Salivation
Lacrimation (tearing)
Urination
Defecation
GI distress
Emesis

(Woods, Young &Just 2000)

Another easy way to remember the signs and symptoms of this toxidrome is that there are things leaking from every orifice. Yuk!

So what are the drugs that can cause this rather unpleasant toxidrome? Here are some examples;

Cholinergic:

- ☑ Nicotine
- ☑ Mushrooms

Anticholinesterases:

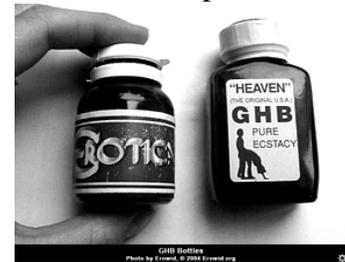
- ☑ Organophosphate insecticides
(consider in farming communities)
- ☑ Nerve gas (sarin)



The pre-hospital treatment focuses on the ABC's and vigorous monitoring. Be prepared for seizures. ALS and in-hospital treatment would include the administration of Atropine, an anticholinergic.

GHB and Ketamine

These two drugs do not fit neatly into any of the above toxidromes but are part of the 'club drug' family along with ecstasy. Prior to 2000, GHB was available for sale in health food stores as a natural supplement to aid in sleeping, or as a body building substance. In 2000, the DEA listed GHB as a controlled substance but its use, illegal now, continued (Gahlinger 2001). An overdose on GHB can



become quite serious or even life threatening as patients can become unconscious and lose airway protective reflexes. Signs and symptoms in addition to unconsciousness are bradycardia, (often with 'U' waves), slow respiratory rate and hypothermia. A unique feature often found with GHB overdoses is a brief return of consciousness during painful stimuli where a patient may sit up, and appear agitated and combative only to lose consciousness again within seconds (Gahlinger 2001).



The loss of consciousness is the life threat and the patient may require aggressive airway management. Narcan will not work to reverse the effects of GHB.

Ketamine is a dissociative anesthetic, widely used in veterinary medicine. It is well suited as an anesthetic as it does not affect the respiratory muscles. However, due to its hallucinogenic effects, its use in humans is limited. Due to those same effects the drug is popular as a rave drug. Although overdoses are rare, there are reported deaths following ketamine ingestions.

In Closing

Although the concepts of toxidromes allow us to quickly and accurately figure out the majority of our overdosed/poisoned patients, it is by no means an all encompassing concept. There are many common overdoses that do not fit neatly into one of the mentioned toxidromes. There are constantly new designer drugs hitting the streets and people find new, innovative ways of abusing old drugs. The best advice is to read current, well recognized journals to keep up on emerging trends. Never be afraid to ask the receiving hospital staff about a patient that seemed to present in a manner that doesn't seem to 'fit'. Good luck in your management of these challenging patients!

References:

- Arnett, AM 1995, 'Jimson Weed (*Datura stramonium*) Poisoning', *Clinical Toxicology Review*, Vol. 18, no. 3
- Burns, MJ, Linden, CH, Graudins, A, Brown, RM & Fletcher, KE 2000, 'A Comparison of Physostigmine and Benzodiazepines for the Treatment of Anticholinergic Poisoning', *Annals of Emergency Medicine*, Vol. 34, no. 4, pp. 374-375
- Carragee, EJ 2005, 'Persistent Low Back Pain', *New England Journal of Medicine*, Vol. 352, no. 18, pp. 1891-1898
- Centers for Disease Control and Prevention (CDC) 1994, 'Jimson weed poisoning-Texas, New York and California, 1994', *Morbidity & Mortality Weekly Report*, Vol. 44, no. 3, pp. 41-44
- Center for Addiction and Mental Health (CAMH) 2007, *Drug Use Among Ontario Students 1997-2007*
- Center for Addiction and Mental Health (CAMH) 2005, *Addiction and Mental Health Indicators Among Ontario Adults, 1997-2005*
- Chan, TC, Vilke, GM, Neuman, T & Clausen, JL 1997, 'Restraint Position and Positional Asphyxia', *Annals of Emergency Medicine*, Vol. 30, no. 5, pp. 578-586
- Coon, TP, Miller, M, Kaylor, D & Jones-Spangle, K 2005, 'Rectal Insertion of Fentanyl Patches: A New Route of Toxicity', *Annals of Emergency Medicine*, Vol. 46, No. 5, p. 473
- DeFrates, LJ, Hoehns, JD, Sakornbut, EL, Glascock, DG & Tew, AR 2005, 'Antimuscarinic intoxication resulting from the ingestion of moonflower seeds', *Annals of Pharmacotherapy*, Vol. 39, no. 1, pp. 173-176
- Dewitt, MS, Swain, R & Gibson, LB 1997, 'The dangers of Jimson Weed and its abuse by teenagers in the Kanawha Valley of West Virginia', *West Virginia Medical Journal*, Vol. 93, no. 4, pp. 182-185
- Gahlinger, PM 2001, *Illegal Drugs: A Complete Guide to Their History, Chemistry, Use and Abuse*, Sagebrush Press, USA.
- Goadsby, PJ, Lipton, RB & Ferrari MD 2002, 'Migraine – Current Understanding and Treatment', *New England Journal of Medicine*, Vol. 346, no. 4, pp. 257-261

Guharoy, SR & Barajas, M 1991, 'Atropine intoxication from the ingestion and smoking of Jimson Weed (*Datura Stramonium*)', *Veterinary & Human Toxicology*, Vol. 33, no. 6, pp.588-589

Kalant, H 1998 'Opioid Analgesics and Antagonists', in *Principles of Medical Pharmacology*, 6th edn., Oxford University Press, New York, NY.

Knaggs, RD, Cobby, TF & Hobbs, GJ 2004, 'The Pupillary Effects of Intravenous Morphine, Codeine and Tramadol in Volunteers', *Anesthesia Analgesia*, no. 99, pp. 108-112

Lange, RA & Hilus, LD 2001, 'Cardiovascular Complications of Cocaine Use, *New England Journal of Medicine*, Vol. 345, no. 5, p. 351

Karch, SB & Wetli, CV 1995, 'Agitated Delirium Versus Positional Asphyxia', *Annals of Emergency Medicine*, Vol. 26, no. 6, p. 760

Kulig, K 1993, 'General Approach to Poisonings', in *Emergency Medicine Secrets*, Hanley & Belfus Inc., Philadelphia, PA.

Ministry of Health (MOH) 1996, *Basic Life Support Patient Care Standards*, Ronen House, Toronto, Ont.

Mycek, MJ, Harvey, RA & Champe, PC 2000, *Lippincott's Illustrated Reviews: Pharmacology*, 2nd edn, Lippincott Williams & Wilkins, Philadelphia, PA

Neety, P & Wong, S 2002, *MCCQE 2002: Review Notes & Lecture Series*, 18th edn, University of Toronto Faculty of Medicine, Toronto, Ontario.

Office of The Chief Coroner 2007, *Verdict of Coroner's Jury; Stephane Michaud*, November 2007, Kingston, Ontario

Royal Canadian Mounted Police (RCMPa) 2006, *Drug Situation Report – 2006*, Criminal Intelligence Royal Canadian Mounted Police, Ottawa, Ontario

Royal Canadian Mounted Police (RCMPb) 2006, *Chemical Drug Scene*, RCMP "E" Division, Vancouver, B.C.

Shervette, RE, Schydlower, M, Lampe, RM & Fearnow, RG 1979, 'Jimson "loco" weed abuse in adolescents', *Pediatrics*, Vol. 63, no. 4, pp. 520-523

Starbucks, *Starbucks Beverage Details*, Starbucks Corporation.
<http://www.starbucks.com/retail/nutrition_beverage_detail.asp>

Tim Horton's 2008, *Tim Horton's: Caffeine Content*, April 7th, 2008, Tim Horton's Research and Development, Oakville, Ontario
<<http://www.timhortons.com/pdf/caffeine-canada-en.pdf>>

Tiongson, J & Salen, P 1998, 'Mass ingestion of Jimson Weed by eleven teenagers', *Delaware Medical Journal*, Vol. 70, no. 11, pp. 471-476

Woods, WA, Young, JS & Just JS 2000, *Emergency Medicine Recall*, Lippincott Williams & Wilkins, Baltimore, Maryland, p. 340.