Toxicology of Explosives and Fireworks in Small Animals

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• Explosives • Nitrates • Explosive detection dogs/working dogs
• Fireworks • Barium • Chlorates

Exposure to explosives and fireworks in dogs can result in variable severity of clinical signs depending on presence of different chemicals and the amount. The risk can be lessened by proper education of dog handlers and owners about the seriousness of the intoxications.

EXPLOSIVES

An explosive is any material that can undergo rapid and self-propagating decomposition, resulting in the liberation of heat and the production of energy, most commonly through the expansion of gases. The released energy has a number of potential uses. These include commercial applications such as blasting in mines and quarries, demolition in the construction industry, military applications, and firearms applications.

There are over 300 materials classified by the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) as explosive materials.[1] It is beyond the scope of this article to deal with each of these materials from a toxicity standpoint. However, explosive materials can be grouped according to similarity of chemical structure, which makes evaluation of the toxicity potential much easier to understand.

Explosives are classified based on the rapidity of the decomposition and resultant energy wave as either low-order explosives or high explosives. Examples of low-order explosives include pipe bombs, gunpowder, and petroleum-based bombs. High explosives propagate a supersonic shockwave when the explosive material decomposes into hot, rapidly expanding gases. Examples of high explosives include trinitrotoluene (TNT), cyclonite (RDX), and pentaerythritol tetranitrate (PETN) (**Table 1** provides a glossary of abbreviations).

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Table 1
Glossary of abbreviations

Abbreviation	Definition
ANFO	Ammonium nitrate/fuel oil
Blackpowder	Potassium nitrate + carbon + sulfur
C4	RDX + plasticizer
EGDN	Ethylene glycol dinitrate
NC	Nitrocelluose
NG	Nitroglycerine
PETN	Pentaerythritol tetranitrate
RDX	Research Department Explosive; cyclotrimethylenetrinitramine, also known as cyclonite, hexogen, and T-4
Semtex	RDX + PETN
Smokeless powder	Nitrocellulose based propellant (gunpowder)
TNT	Trinitrotoluene

Explosives can also be classified as primary, secondary, or tertiary based on how easily the decomposition process can be initiated. Primary explosives are used to ignite secondary explosives. Examples of primary explosives include lead azide (LA), lead styphnate (LS), and nitroglycerin (NG). Blasting caps contain primary explosives and are used to ignite secondary explosives to initiate the decomposition process. Secondary explosives are much more stable than primary explosives and detonate only under specific circumstances. Examples of secondary explosives include TNT and RDX. Tertiary explosives are quite insensitive to shock and cannot be reliably detonated by primary explosives. Typically, a small amount of a secondary explosive (ignited by a small amount of a primary explosive) is used to detonate tertiary explosives. Ammonium nitrate and fuel oil (ANFO) is an example of a tertiary explosive.[1]

Most explosives are tightly regulated, with access limited by various agencies, most notably the ATF. Exposure of small animals to explosive materials is limited primarily to dogs and will most commonly result from improper or negligent storage of materials, stolen materials no longer being handled appropriately, and training aids used to train explosives detection dogs.

Explosives detection dogs working in actual field conditions (not in training scenarios) are unlikely to suffer from toxic ingestions as they are trained extensively not to touch or otherwise interfere with explosives. A working dog that violates this training in actual field conditions is more likely to be seriously injured or killed by an explosion than to suffer any toxicity. Therefore, it is dogs in training that are most likely to consume explosive agents. Careful training techniques that limit the novice dog's ability to come in contact with and consume training aids make oral exposures uncommon.

While the specific odors that explosives detection dogs are trained to detect may vary based on specific needs, these dogs are commonly trained to alert on 6 specific odors: black powder or smokeless powder; commercial dynamite containing ethylene glycol dinitrate (EGDN) or NG; RDX; PETN; TNT (military dynamite); and slurries/water gel explosives.[2] Therefore, these are the explosives most likely to be encountered by a training dog in a clinical setting.

Many low explosives are also tightly regulated and not likely to be ingested by dogs. However, some agents used in explosives are readily available without