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Procedures for Administering Nerve Agent Antidotes in Dogs

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Nerve Agent Antidote Administration in Dogs

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Introduction

The first rule of administration of nerve agent antidotes in dogs is the handlers should treat themselves first if there has been an exposure.

A second consideration is how likely is the diagnosis? The signs of nerve agent exposure include salivation, excessive tearing, urination and defecation, slowing of the heart rate, small pupils, and difficulty breathing. Dogs may have increased salivation from many different compounds that would not warrant emergency administration of these antidotes.

Currently there is no official provision for supplying handlers with Mark 1 kits for their dogs. In light of some of the difficulties with using a human-designed antidote kit on canines, having these drugs available as separately for use in canines may be considered. However, should the need arise, these will guide Mark 1 kit use in dogs.

Medical Management

Managing a victim of nerve agent intoxication consists of 4 things:

1. Decontamination
2. Ventilation
3. Antidote administration – IM injection, epaxial muscle if possible
4. Supportive care based on patient condition

Decontamination of the skin is usually unnecessary after exposure to vapor alone, but remove any items from the body (collar, leash, pack) that may trap vapor and cause off-gassing. Soap and copious amounts of water are used for skin decontamination. Be cognizant of the ambient temperature as well as the wash water temperature. Special attention should be given to hard-to-clean areas, like the footpads.

Ventilation is important because air resistance increases (in humans up to 50-70 cm H_2O) due to bronchoconstriction and secretions. *Atropine* will alleviate resistance, but also thickens secretions, which may require suctioning. Most dogs will tolerate some form of open cone mask through which oxygen can be introduced if necessary. If the dog can remain in a sitting or sternal position (standing or lying down on the sternum), that will allow the most lung expansion of both sides of the thorax.

Antidote treatment is based on counteracting the organophosphorous cholinesterase inhibition of nerve agents. The Mark 1 self-injectors are designed for this purpose in humans, and can also be used for dogs. These injections are designed to be administered intramuscularly in the field. For dogs, it is recommended to give them in the epaxial musculature, the band of muscles on either side of the lumbar spinal cord. Familiarity with the anatomy is important.

A note of caution: Realize the injection may hurt enough that the dog may turn around and snap at the injection and/or the injector. Sudden movement may prevent the entire dose from being absorbed. The dogs should be muzzled and properly restrained during the injection to prevent injury to the handler and themselves. This does not require a manufactured muzzle but may be as simple as briefly wrapping the leash around the muzzle to keep the mouth closed during the injection. Because the dog may be having breathing difficulty as a result of exposure, the muzzle must be able to be removed quickly.

The Mark 1 kits involve 3 drugs:

1. **Atropine**

    - Anticholinergic, blocks excess acetylcholine at peripheral muscarinic sites
    - Common side effects: sinus tachycardia, dry mouth, thirst, mydriasis, constipation
    - Adverse Effects: initial bradycardia, 2^{o} heart block, vomiting, urinary hesitancy, CNS stimulation, drowsiness, ataxia, seizures, respiratory depression, hypotension
    - Mark 1 autoinjector contains 2 mg, and is connected alongside the 2-Pam injector
    - Canine dosing range for treatment of cholinergic toxicity: 0.2-2.0 mg/kg
    - Consider using the lower end of the dose, which can be repeated if signs persist

Weight (lb)	Weight (kg)	Dose Range (mg)	Min # Injectors
40	18	3.6 - 36 mg	2
50	23	4.6 - 46 mg	2
60	27	5.4 - 54 mg	3
70	32	6.4 - 64 mg	3
80	36	7.2 - 72 mg	3.5
90	41	8.2 - 82 mg	4

*It is very difficult to give a fraction of an autoinjector, therefore in the case of a dog weighing between 80 and 90 pounds (36-41 kg) the dog should be evaluated after the 3rd injector and a 4th considered if the heart rate is less than 140 and there are active signs of toxicity.

2. 2-Pam CL

- Pralidoxime chloride, or Protopam chloride is an oxime
- Oximes attach to the nerve agent that is inhibiting the cholinesterase enzyme and they break the agent-enzyme bond to allow cholinesterase to return to normal activity
- Used as an antidote in organophosphate poisoning (NOT in carbamate poisoning) along with atropine
- Adverse side effects: neuromuscular blockade, acetylcholinesterase inhibition, tachycardia, weakness
- Mark 1 autoinjector contains 600 mg, and is connected alongside the atropine injector
- Canine dose range for OP toxicity: 20 mg/kg 2-3 times a day as needed
- Veterinary attention should be sought for any dog exposed to nerve agent, and continued administration should be determined by a veterinarian

Weight (lb)	Weight (kg)	Dose Range (mg)	Min # Injectors
40	18	360 - 900 mg	0.5
50	23	460 - 1150 mg	0.5 - 1
60	27	540 - 1350 mg	1
70	32	640 - 1600 mg	1
80	36	720 - 1800 mg	1
90	41	820 - 2050 mg	1.5

*It is very difficult to give a fraction of an autoinjector; therefore 1 autoinjector should be used for the 40-50 pound dogs, and 2 injectors for dogs > 90 lbs. While the safety margin is pretty wide, be aware that an overdose can cause signs similar to the signs of the original nerve agent such as muscle weakness, vomiting, increased respirations, or seizures.

3. Diazepam

- A benzodiazepine anticonvulsant drug also known as valium
- Serum half-life in dogs is 2.5 – 3.2 hours
- Common side effects include sedation, ataxia, excitement, occasionally paradoxical aggression
- Overdose causes CNS depression
- Mark 1 injector contains 10 mg
- This injector is separate from the atropine and 2-PAM

Weight (lb)	Weight (kg)	Dose Range (mg)	Min # Injectors
40	18	5 - 10 mg IV	1
50	23	5 - 10 mg IV	1
60	27	5 - 10 mg IV	1
70	32	5 - 10 mg IV	1
80	36	5 - 10 mg IV	1
90	41	5 - 10 mg IV	1

*These doses are published for IV injection. Absorption of diazepam from an IM route of administration is slower than oral and incompletely absorbed. It may also be painful due to the propylene glycol used to solubilize the drug. If available, midazolam, a water soluble drug of the same class and dosing, is readily absorbed intramuscularly.

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