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Full Length Article

Acute coumaphos organophosphate exposure in the domestic dogs: Its implication on haematology and liver functions

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ABSTRACT

Indiscriminate use of organophosphate acaricides especially among livestock and dog owners in the control of ticks and other ectoparasites has taken a worrisome dimension. In the present study, we investigated, the effects of acute dermal exposure in the form of acaricides baths of coumaphos at different concentrations on the haematology, blood pressure and liver functions in local mongrel dogs.

Twenty-four, male mongrel dogs of about 8 months of age with an average weight of 9.88 ± 0.4 kg were used for the study. The dogs were divided into four groups consisting of six dogs per group. Group A (control) was bathed with ordinary water, while group B was bathed with the recommended concentration of 0.016% (160 ppm) Coumaphos in water. Groups C and D were bathed with 10 and 20 times the recommended dose (1600 ppm and 3200 ppm), respectively.

Significant leucopenia, increased plasma urea and decreased low density lipoprotein (LDL) values were observed at 8 h post exposure, which worsened with time. At 24 and 36 hrs post exposure, normochromic normocytic anaemia, pan leucopenia, bloody diarrhoea, retching, vomiting and paddling were observed in affected animals. Post mortem examination revealed severe lungs, liver and stomach congestion. Multifocal areas of necrosis in the liver and kidney, serosal and mucosal haemorrhages and haemorrhagic meningitis were also observed.

The use of excessively high concentration of organophosphate as acaricides bath is associated with severe anticholinesterase poisoning, which may result in death of affected animals.

1. Introduction

Indiscriminate and incessant use of organophosphates in the developing world in the control of ectoparasites in domestic animals has been on the rise. It has also been associated with majority of self-poisoning cases in humans with a case fatality rate of about 15% in developing countries worldwide [1]. Many of them, from this writer's personal observation, are even marketed in bits and pieces on the road, local markets and in street corners. They are then used as baits for killing of large animals without recourse to the toxic effects of these insecticides on the final user of the baited animal [2], nor consider the effects of these chemicals when they find their ways into the environment, especially when they seep into water bodies, thereby resulting in bioaccumulation in fish and other aquatic organisms with its attendant effects on final consumers of the aquatic products [3]. Although the use of organophosphate and other acaricides is a cheap and effective method of control of arthropod vectors on livestock and companion animals including dogs and cats, their use is nonetheless associated with considerable signs of toxicity and eventual death in affected animals [4].

Organophosphate insecticides act by inhibition of acetyl cholinesterase at the synaptic junction, thereby resulting in the accumulation of acetylcholine and subsequent prolongation of the muscarinic and nicotinic effects of acetylcholine in the autonomic nervous system, CNS and in neuromuscular junctions [5]. They have also been reported to cause neurotoxicity, even at concentrations below those capable of inhibiting acetyl cholinesterase ((sub) micromolar concentrations) by concentration-dependent inhibition of depolarization-evoked Ca^{2+} influx at the synaptic bulb [6].

The general clinical manifestation of organophosphate toxicity is well documented and summarized by Eddleston et al. [1] in their review of management of acute organophosphates poisoning. They

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Table 1
Clinical signs shown by dogs 24 h after organophosphate bath with varying concentrations of Coumaphos.

Parameter	Group A Control Water alone (n = 6)	Group B Control Normal Coumaphos concentration (n = 6)	Group C ×10 Coumaphos Concentration (n = 6)	Group D ×20 Coumaphos Concentration (n = 6)
Muscle twitching, /tremor, confusion	None	None	+ +	+ + + +
Shouting, Biting of metal, Anxiety, Restlessness	None	None	+ + + +	+ + + +
Salivation	None	None	+ + + +	+ + + + + +
Lacrimation	None	None	+ + +	+ + +
Urination	None	None	+ + +	+ + +
Emesis and	None	None	+ + +	+ + +
Diarrhoea	None	None	+ + +	+ + +
Death	None	None	+ + +	+ + + +

Table 2
Body temperature and blood pressure of local mongrel dogs exposed to various concentrations of Coumaphos acaricides bath.

		Group A	Group B	Group C	Group D
Temp (°C)	Before bath	37.25 ± 0.46	36.26 ± 0.92	38.45 ± 0.20	38.46 ± 0.19
	After bath (2 hrs)	n/a	37.61 ± 0.57	37.82 ± 0.66	38.33 ± 0.27
BP (mm/Hg)	SBP	120.7 ± 9.9	140.0 ± 28.8[a]	115.3 ± 10.9[a]	129.2 ± 17.9
	DBP	75.0 ± 7.8[abc]	112.9 ± 27.5[ad]	77.2 ± 7.61[bd]	95.57 ± 15.5[c]

BP = Blood pressure, SBP = Systolic blood pressure, DBP = Diastolic blood pressure. n/a = Not applicable.
Values are expressed as mean ± SD.
Values with the same superscript alphabets along the same row are significantly different.

Table 3
Erythrocytic indices of local dogs at 8 hours following exposure to different concentrations of coumaphos organophosphate as acaricides bath.

Parameters	Group A	Group B	Group C	Group D
PCV (%)	48.1 ± 2.88	47.17 ± 3.37	47.50 ± 2.59	45.33 ± 3.98
RBC ($\times 10^6$/μL)	10.82 ± 1.4	10.14 ± 1.13	9.38 ± 0.75	8.54 ± 0.97
Hb (g/dL)	16.34 ± 1.0	15.93 ± 1.26	16.70 ± 1.00	15.25 ± 1.39
MCV (fl)	44.92 ± 4.26	46.80 ± 4.10	50.77 ± 1.88	53.26 ± 2.14*
MCH (ρg)	15.27 ± 1.57	16.09 ± 1.84	17.17 ± 0.64	17.92 ± 0.80*
MCHC (g/dL)	33.98 ± 0.82	33.78 ± 0.45	33.82 ± 0.51	33.64 ± 0.40

Values are expressed as mean ± SD.
Values with superscript asterisk along the same row are significantly different from the control, at $P < 0.05$.
Abbreviations: PCV, packed cell volume; RBC, red blood cell count; Hb, haemoglobin concentration, MCV, mean corpuscular haemoglobin volume; MCH, mean corpuscular haemoglobin and MCHC, mean corpuscular haemoglobin concentration.

Table 4
Leucocyte and platelet parameters of local dogs at 8 hours following exposure to different concentrations of coumaphos organophosphate as acaricides bath.

	Group A	Group B	Group C	Group D
WBC ($\times 10^3$/μL	8.00 ± 0.84	8.08 ± 0.66	8.02 ± 0.94	8.39 ± 1.58
Neut ($\times 10^3$/μL)	5.15 ± 0.80	5.20 ± 0.38	4.98 ± 0.81	5.16 ± 1.13
Lymph ($\times 10^3$/μL)	2.76 ± 0.49	2.83 ± 0.54	2.99 ± 0.30	3.15 ± 1.05
Mono ($\times 10^3$/μL)	1.25 ± 0.26	0.041 ± 0.07*	0.025 ± 0.033*	0.053 ± 0.087*
Eos ($\times 10^3$/μL)	0.253 ± 0.059	0.013 ± 0.032*	0.020 ± 0.039*	0.015 ± 0.037*
Baso ($\times 10^3$/μL)	0.092 ± 0.029	0	0.020 ± 0.039*	0
Plat ($\times 10^6$/μL)	0.73 ± 0.16	0.72 ± 0.12	0.66 ± 0.06	0.61 ± 0.09

Values are expressed as mean ± SD.
Values with superscript asterisk along the same row are significantly different from the control, at $P < 0.001$.
Abbreviations: WBC, white blood cell counts; Neut, differential neutrophil count; Lymph, differential lymphocyte count; Eos, differential eosinophil count, Baso, differential basophil count and Plat, platelets counts.

included signs of overstimulation of the muscarinic acetylcholine receptors in the parasympathetic nervous system such as bronchospasm, bronchorrhea, miosis, lachrymation, urination, diarrhoea, hypotension, bradycardia, vomiting and salivation. Overstimulation of nicotinic acetylcholine receptors in sympathetic nervous system on the other hand results in tachycardia, mydriasis, hypertension and sweating. In the CNS overstimulation of both nicotinic and muscarinic acetylcholine receptors results in confusion, agitation, coma or respiratory failure while muscle weakness, paralysis and fasciculations are the hallmark of excessive stimulation of nicotinic acetylcholine receptors at the neuromuscular junction [7].

Toxicity of organophosphates is both dose and route dependent, but major study emphasis has been placed on oral ingestion and or inhalation in self and accidental poisoning cases [8], with less or no attention on dermal exposure. In facts, several studies have been conducted on the toxic effects of ingestion of organophosphates alone or potentiated by other insecticides [9,10], but little studies have been reported in the literature on dermal exposure through acaricides baths,