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COMPARATIVE PROPHYLACTIC AND THERAPEUTIC EFFECTS OF ATROPINE SULPHATE INJECTION ON ACUTE TOXICITY OF ORGANOPHOSPHATE ACARICIDE IN ALBINO RATS

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ABSTRACT

Tick infestations adversely affect livestock production and wellbeing of companion animals. The acute toxic effects of organophosphate were evaluated in 25 albino rats which were grouped into 5 rats each. Group 1 served as negative control and received 48 mg/kg dose of Diazinon, ® orally. Groups 2 and 3 received same dose of Diazinon®, but they were post-treated at 10 and 20 minutes interval with Atropine®, injected subcutaneously at the dose of 10mg/kg body weight. Groups 4 and 5 were pre-treated with Atropine®, 10mg/kg, at 10 and 20 minutes intervals prior to oral Diazinon® administration, respectively. Clinical signs were monitored while the liver, heart and lungs were collected from dead rats (group 1) for histopathological studies. The results showed 100% nervous signs and mortality in groups 1 and 3. The nervous signs reduced by 60% in groups 2, 5 and by 100% in group 4, whereas 100% recovery was recorded in all rats pre-treated with atropine sulphate (Atropine®). Microscopically, there was severe hepatocellular necrosis, severe thickening of the interalveolar connective tissue with infiltration of mononuclear inflammatory cells and severe myocardial necrosis. It was concluded that pre-treatment with atropine sulphate is extremely important prior to dog wash with organophosphate acaricides.

Keywords: Atropine sulphate, Acute toxicity, Organophosphate, Acaricide poisoning, Albino rats

INTRODUCTION

Control of tick infestation through the use of acaricides is one of the methods used to reduce ectoparasitism and tick-borne diseases in livestock and companion animals (Spickett and Fivaz, 1992). A wide range of acaricides; arsenicals, chlorinated hydrocarbons, organophosphates, carbamates, and synthetic pyrethroids are being used for controlling ticks on animals. The performance of an acaricide in the control of ectoparasites depends on the activity of a product, the quality and quantity of active ingredient deposited on animal or delivered internally (George, 2000).

Poisoning by acaricides may be caused by direct application, ingestion of contaminated feed or forage treated for the control of plant parasites, or by accidental exposure. The objective of the study was to evaluate the therapeutic and prophylactic effects of atropine sulphate on acute toxicity of an ingested organophosphate in Albino rats.

MATERIALS AND METHODS

Twenty-five male albino rats were used for the study. They were fed with commercially prepared poultry feed, the Grower's mash (Vital Feed®) and clean water was given *ad libitum*. They were acclimatized for 14 days before commencement of the experiment.

Experimental Design

The rats were divided into 5 groups of 5 rats each as follows: Group 1 rats were given Diazinon® (Diazinhol) only, orally, at the dose of 48 mg/kg and allowed to exhibit the clinical signs. Group 2 rats received 48 mg/kg of Diazinon®, orally, and then treated with atropine sulphate at 10mg/kg, subcutaneously, 10 minutes post-ingestion of Diazinon® (PI). Group 3 rats were given Diazinon® orally at 48 mg/kg and then treated with atropine sulphate at 10mg/kg, subcutaneously, 20 minutes PI. In Group 4, atropine sulphate was injected at 10 mg/kg, subcutaneously, followed by Diazinon ® which

was given orally at 48 mg/kg, 10 minutes post-injection of atropine sulphate. In Group 5, atropine sulphate was injected at 10 mg/kg, subcutaneously, followed by Diazinon®, orally, at 48 mg/kg, 20 minutes post-injection of atropine sulphate.

Grading of nervous signs

The expected nervous signs (drowsiness, opisthotonos, convulsion and paralysis) were scored 0-5, based on the number of rats in a group that expressed one or all of the signs.

Histopathology

Immediately after death, tissue samples from the liver, lung and heart were collected from group A animals and prepared for histological studies. The samples were fixed in 10% neutral-buffered formalin, routinely processed and sectioned at 5µm thickness and stained with haematoxylin and eosin (H&E).

RESULTS

The results showed 100% nervous signs and mortality in groups 1 and 3 rats. These signs reduced by 60% in groups 2 and 5 and by 100% in group 4 rats, whereas 100% recovery was recorded in both groups of rats pre-treated with atropine sulphate (Table 1).

Table 1. Nervous signs and death or recovery of rats following organophosphate poisoning (48mg/kg) and pre-or post-treatment with Atropine sulphate (10mg/kg)

Groups	Nervous signs scores	Time of onset of nervous signs (minutes)	Time of death (minutes)	Time of recovery (hours)
1	5/5 (100%)	15	20-35	-
2	2/5 (40%)	15	-	4-6
3	5/5 (100%)	15	20-25	-
4	0/5 (0)	-	-	-
5	2/5 (40%)	15	-	4-6

Microscopically, the liver and myocardium showed severe necrosis, while thickening of the interalveolar connective tissue with infiltration of mononuclear inflammatory cells were observed in the lungs in group 1 rats (Figure 1).

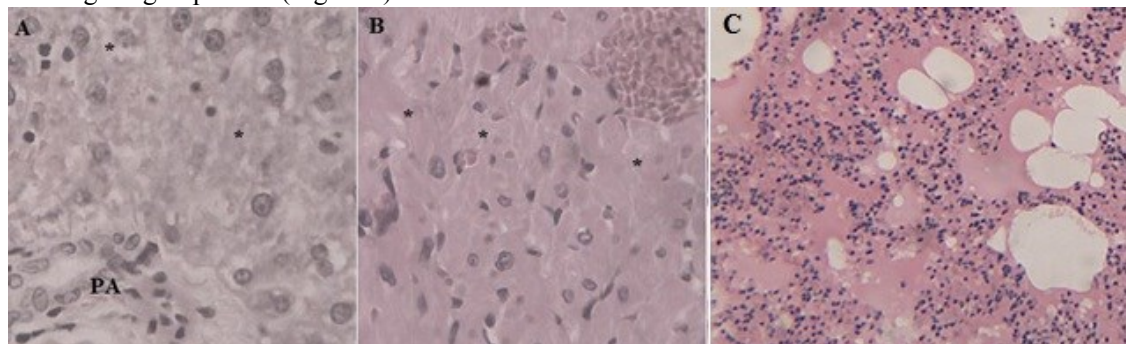


Figure 1: **A:** Hepatocellular necrosis (*asterisks*) with few mononuclear inflammatory cells in the portal area (PA). **B:** Myocardial necrosis (*asterisks*) and haemorrhage. **C.** Interstitial pneumonia and congestion. H & E stain (A, B = x400, C = x100).

DISCUSSION

Although atropine sulphate is a known potent antidote to organophosphate poisoning (Braide and Anika 2007), the results of this study show that atropine sulphate alone, given therapeutically, may not completely reverse nervous signs or prevent mortality in organophosphate poisoning. The findings of this study agree with previous reports that suggest that atropine alone does not completely reduce nervous signs in organophosphate toxicity (Gupta, 1984; Ligtenstein and Moes, 1991).

In group 4, in which neither nervous signs nor mortality occurred, injection of atropine sulphate, prophylactically successfully blocked the parasympathetic post-ganglionic nerve endings from the action of acetylcholine which is usually increased by the cholinesterase inhibition caused by organophosphates (Albuquerque et al., 1985). Atropine is known to restore adequate cardiorespiratory function by reducing bronchorrhoea, reversing bronchospasm and improving oxygenation (Eddleston and Chowdhury, 2016).

The histopathological changes in the organs evaluated were consistent with previous reports on organophosphate poisoning (WHO, 1998). Previous study in fish reported focal necrosis of hepatocytes as well as epithelial detachment and oedema of the gills (de Oliveira-Lima et al., 2021). Hepatocellular necrosis, inflammation and haemorrhages in the lungs were also reported in dogs bathed with 10-20 times the recommended dose of organophosphate (Ola-Davies et al., 2018). The liver lesions were, however, not associated with significant increase in serum enzymes, although normocytic normochromic anaemia, pan-leukopaenia and decreased low density lipoprotein (LDL) were reported in the dogs by 24 hours post-exposure (Ola-Davies et al., 2018). The present study focused more on survivability in the management of organophosphate poisoning using Atropine sulphate. Hence, the biochemical markers of liver and cardiac injuries were not evaluated. The duration of this study was also too short for such markers to be assayed.

CONCLUSION

The results of this study implies that death from accidental ingestion of a lethal dose of organophosphate acaricide following bath, dip or spray can be prevented by pre-injection of atropine sulphate prior to the bath, especially in small animal practice.

RECOMMENDATION

Pre-injection of Atropine sulphate is recommended to pet owners to reduce or eliminate the possible toxic effects of Diazinon® following acaricidal bath.

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