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Cadmium and Chlorpyrifos induced histopathological alterations in the heart of male rats

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Abstract

The study was aimed to know the cardiac toxicity by cadmium, chlorpyrifos and their combination in *albino wistar* rats. Experiment was carried out for 28 days. Group 1 - Control. Group 2 - Cadmium chloride (Cd) @ 22.5mg/ kg b.wt /per oral / day. Group 3 - Chlorpyrifos (CPF) @ 25 mg/ kg b.wt /per oral / day. Group 4 - Cadmium chloride (Cd) @22.5 mg + Chlorpyrifos (CPF) @ 25 mg/ kg b.wt /per oral / day. Heart showed mild to moderate congestion in groups 2 and 3 and moderate to severe in group 4 on 15th and 29th day of the experiment. Heart sections of control rats showed normal architecture. Group 2 rats on 15th day of the experiment revealed loss of striations with swollen nuclei, inter fibrillar haemorrhages, mild congestion and focal lymphocytic infiltration; on 29th day, lesions noticed were edema, inter fibrillar haemorrhages and degenerative changes. The sections of heart from group 3 rats revealed inter fibrillar haemorrhages on 15th day and marked degenerative changes in the muscle fibres on 29th day. Heart sections of group 4 rats on 15th day revealed severe degenerative changes in the muscle fibres; on 29th day, disruption of cardiac muscle fibres and focal areas of lymphocytic infiltration was observed. The adverse effects of combined CdCl₂ and CPF group (Group 4) were more severe than the individual groups (Group 2 & 3) due to synergistic action of the combined toxic agents.

Keywords: Cadmium, Chlorpyrifos, histopathological alterations, heart, male

Introduction

Cadmium (Cd) and Chlorpyrifos (CPF) are the most common components among all toxic compounds present in the environment [1]. The Cd common sources of In the environment, the sources of contamination of Cd are industrial, mining activities, plastic stabilizers and batteries which may result in widespread into environment and agricultural fields [2]. The organophosphorus (OP) insecticides are widely used for control of insects. Chlorpyrifos (CPF) is one of the most commonly used OP pesticides in domestic and agricultural applications throughout the world [3]. The combined intoxication may occur directly through drinking water, indirectly through feed ingredients of plant origin, through irrigation water source and also through inhalation of polluted air [4]. Environment receives combination of multiple intoxicants through environment contamination, there is need for conducting induced toxicopathological studies to assess the impact of individual and combined environmental pollutants [5, 6]. Cd induces oxidative stress and apoptosis [7], CPF causes deleterious effects through acetyl cholinesterase inhibition at synapse of central and peripheral nervous system [8], thereby causing damage to various vital organs. Along with many other organs, heart is susceptible for environmental pollutants [9, 10].

The present study was focussed on alterations in heart induced by Cd, CPF and their combination in rats.

Materials and Methods

Wistar albino male rats (48) were procured from Sanzyme Laboratories Ltd., Hyderabad, animals were divided into 4 groups, 12 animals in each group. Rats were randomly divided into 4 groups consisting of 12 in each group. Group 1 serves as control. Group 2 rats were administered Cadmium chloride (CdCl₂) @ 22.5mg/ kg b.wt /per oral / day. Group 3 rats were administered Chlorpyrifos (CPF) @ 25 mg/ kg b.wt /per oral / day. Group 4 rats were administered Cadmium chloride (Cd) @22.5 mg + Chlorpyrifos (CPF) @ 25 mg/ kg b.wt /per oral / day for 28 days of experiment. Detailed necropsy was conducted on 15th and 29th day of the experiment and gross changes were noticed, if any. Pieces of heart were collected in 10% neutral buffer formalin (NBF).

Samples were processed, sectioned (5µm), stained with Hematoxylin and Eosin (H&E) as per the standard protocol given [11].

Results and Discussion

Heart sections of group 1 rats revealed normal cardiac muscle fibres (Fig.1). Group 2 rats on 15th day of the experiment revealed loss of striations with swollen nuclei, inter fibrillar haemorrhages, mild congestion and focal lymphocytic infiltration (Fig.2). On 29th day, lesions noticed were edema, inter fibrillar haemorrhages and degenerative changes (Fig.3) in the muscle fibres. The lesions might be due Cd-induced depolarization of the mitochondrial membrane and increase permeability of the plasma membrane. These observations are similar to the earlier findings [12, 13] in Cd treated rats. The sections of heart from group 3 rats revealed inter fibrillar haemorrhages (Fig.4) on 15th day and marked degenerative changes in the muscle fibres on 29th day of the experiment (Fig.5). These changes could be the result of an increased in ROS in heart tissue. Similar observations in CPF induced toxicity in rats was reported by other authors [14, 15]. Heart sections of group 4 rats on 15th day revealed severe degenerative changes in the muscle fibres. On 29th day, disruption of cardiac muscle fibres and focal areas of lymphocytic infiltration was observed (Fig.6). The lesions were severe because of the synergistic effect of CdCl₂ and CPF [4].

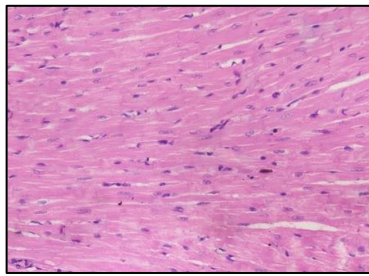


Fig 1: Photomicrograph of heart showing normal muscle fibres (Group 1, Day 29): H&E×100.

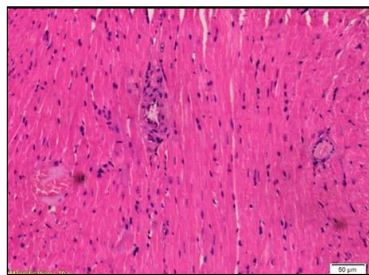


Fig 2: Photomicrograph heart showing loss of striations with swollen nuclei, inter fibrillar haemorrhages, mild congestion and focal lymphocytic infiltration (Group 2, Day 15) H&E×100.

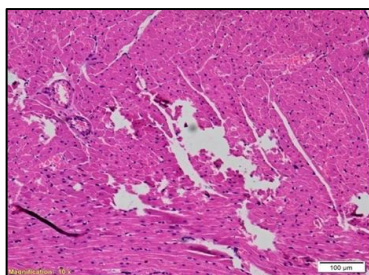


Fig 3: Photomicrograph of heart showing marked degenerative changes, congestion and inter fibrillar haemorrhages (Group 2, Day 29): H&E x 100.

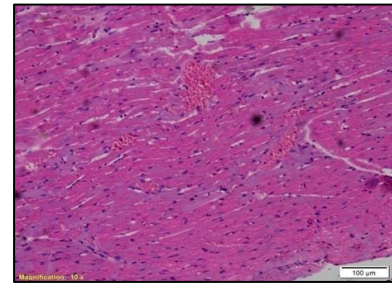


Fig 4: Photomicrograph of heart showing inter fibrillar haemorrhages (Group 3, Day 15): H&E×100.

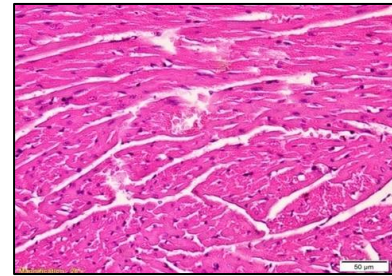


Fig 5: Photomicrograph heart showing marked degenerative changes (Group 3, Day 29): H&E×200.

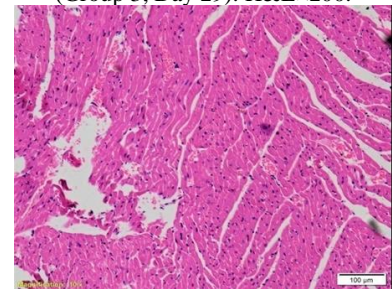


Fig 6: Photomicrograph heart showing severe degenerative changes (Group 4, Day 29): H&E×200.

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