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Effect of Cadmium Chloride on the Histological Structure of Lung in Adult Male Mice with and without Parsley Oil

Maha Alsammak*

Department of Anatomy, Histology and Embryology, College of Medicine, University of Mosul, Iraq

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***Correspondence:** Maha Abdul Jabbar Al-Sammak, Department of Anatomy, Histology and Embryology, College of Medicine, University of Mosul, Iraq. E-mail: Mai@uomosul.edu.iq
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Abstract

AIM: This study is to detect the toxic effect of cadmium chloride on the histological structure of the lung and the effect of parsley oil to ameliorate these changes.

METHODS: In this experiment, 40 adult male mice were divided into four groups. Group A (control group) in this group animals were injected with the normal saline intraperitoneally single daily dose for 30 days. Group B injected intraperitoneally with cadmium chloride single daily dose 3.5 mg/kg body weight for 30 days. Group C injected intraperitoneallywith cadmium chloride in a dose of 3.5 mg/kg body weight. Intragastric tube was put to receive parsley oil in a dose of 0.5 ml/kg body weight before cadmium injection. The two drugs were given for 30 days. Group D received 0.5 ml/kg body weight by intragastric tube of parsley oil for 30 days. At the end of this experiment, the animals were sacrificed the lungs were collected from all groups and prepared for light microscopical examination.

RESULTS: Histological changes were detected in cadmium chloride treated group in comparison with the control group including congestion, inflammatory cell infiltration, interstitial pneumonia (decreased alveolar space), thickening of interalveolar septum, and damage to the alveolar cells. All these changes were eliminated by giving parsley oil.

CONCLUSION: This study revealed that cadmium chloride effect the histological structure of the lung and that parsley oil eliminated these changes.

Introduction

Cadmium chloride is a heavy metal that causes environmental pollution it is widely present in the soil, food, air, and water in various concentration [1].

Cadmium toxicity cause many symptoms such as sore throat, tightness of the chest and abdominal pain. The lung is the main target organ for the toxic effect of cadmium [2]. Herbal remedies widely used such as parsley oil which has antioxidant, anti-inflammatory, and anticarcinogenic activities [3].

Cadmium chloride exerts its toxic effect by causing oxidative damage to cellular organelles by inducing the formation of reactive oxygen species [4].

Lead and cadmium are the two heavily toxic metals that mostly cause environmental pollution [5]. Contamination with cadmium chloride occurs also in the fish which take the heavy metal cadmium from the water and accumulated in the tissue to dangerous level. The risk in the human occurs by ingestion of fish containing cadmium [6].

Cadmium toxicity causes interference with essential metals which lead to induction of oxidative stress, inhibition of DNA repair, interference with apoptosis, and induction of active pulmonary inflammatory response [7].

Animal Studies and Drug Treatment

We obtained cadmium chloride from the biochemistry department in the college of medicine. Because of its high toxicity we used the safety measures which include mask and gloves. Parsley oil was bought from the local market. Animals were provided from the animal house in the college of veterinary medicine. They were kept under convenient circumstances. They adapted to the conditions 1 week before the experiment. They were caged in a temperature controlled environment. They were allowed to access food and water.

Experimental Design

40 adult male mice away 12–13 weeks ranging 25–30 g in weight. 10 mice were kept in each plastic cage. They were divided into four groups.

Group A (control group) injected with normal saline intraperitonially single daily dose for 30 days. Group B injected intraperitonially with cadmium chloride in a dose 3.5 mg/kg body weight single daily dose for

30 days. Group C injected intraperitonially by cadmium chloride in dose 3.5 mg/kg body weight and intragastric tube was put to receive parsley oil in a dose 0.5 ml/kg body weight prior to the cadmium injection. The two drugs were given for 30 days. Group D receives 0.5 ml/kg body weight of parsley oil using gastric tube for 30 days. In the lower lateral part of the abdomen, the intraperitoneal injection was given [8]. At the end of the experiment, the animals were sacrificed and the lungs were collected from all groups, fixed in 10% neutral formalin dehydrated by alcohol and cleared by xylol and mounted in paraffin wax. Sections were taken from the block and stained with Harris hematoxylin and Eosin stain.

Results

Light microscoical observation of the lung tissue from the control group and from Group D showed normal histological structure including normal alveoli and normal inter alveolar septum. (Figures 1-4), respectively. In contrast Group B receiving cadmium chloride showed many histological changes in the lung tissue including congestion, reduce alveolar space indicating interstitial pneumonia, massive inflammatory cell infiltration, thick interalveolar septum, and alveolar cellular damage (Figures 5 and 6). Group C treated with cadmium and parsley oil showed improvement in the histological structure of the lung so parsley oil preserved lung structure, no congestion, no infiltration, normal alveoli, and normal interalveolar septum (Figures 7 and 8).

Discussion

Cadmium is naturally distributed, but industrial development lead to dramatic increase in its concentration in the environment, the focus is to reduce its effect on the organs by herbal substances such as parsley oil used to decrease its toxicity. Lung tissue is one of the main targets of cadmium toxicity leading to lung damage, interstitial pneumonia, and inflammation of the lung [9].

Lung tissue from the control group showed normal appearance of the alveoli and normal interalveolar septum similar to those observed by other workers [10]. In this study, there is severe interstitial pneumonia with congestion and inflammatory cell infiltration; this is in agreement with the finding of Asl *et al*. [7], Farhan [11], and Jaafar [12]. Cadmium has been demonstrated to produce free radical leading to oxidative deterioration of lipid protein and DNA,

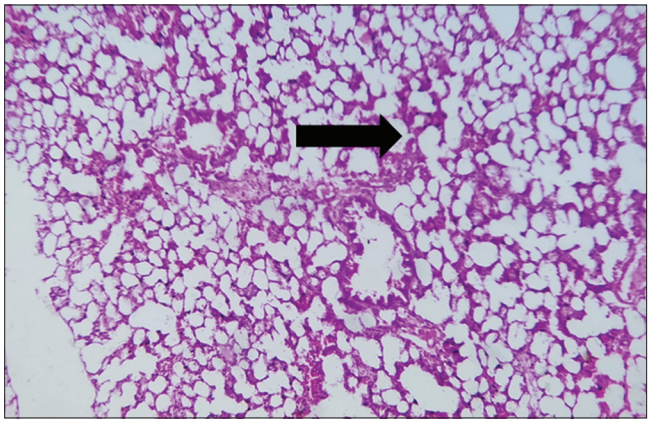

Figure 1: Tissue section from the lung of the control group (Group A) showing normal alveolus (black arrow) (H and E ×100)

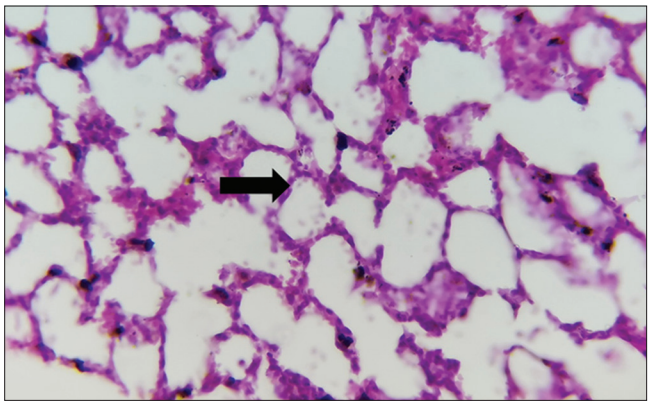

Figure 2: Tissue section from the lung of control group (Group A) showing normal interalveolar septum (black arrow) (H and E ×400)

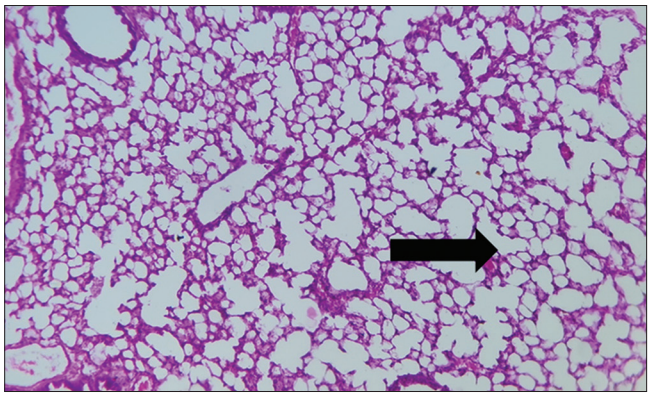

Figure 3: Tissue section from the lung of Group D showing normal alveoli (black arrow) (H and E ×100)

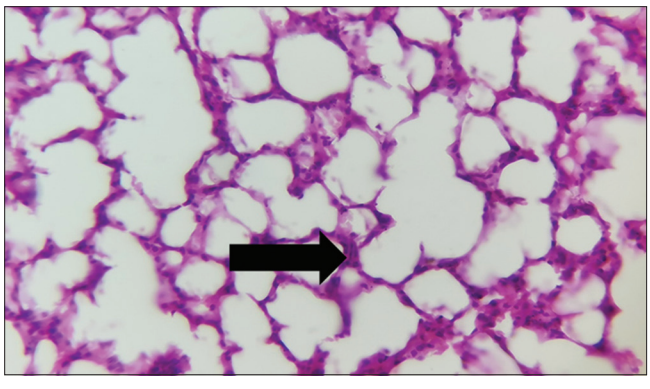

Figure 4: Tissue section from the lung of Group D showing normal interalveolar Septum (black arrow) (H and E ×400)

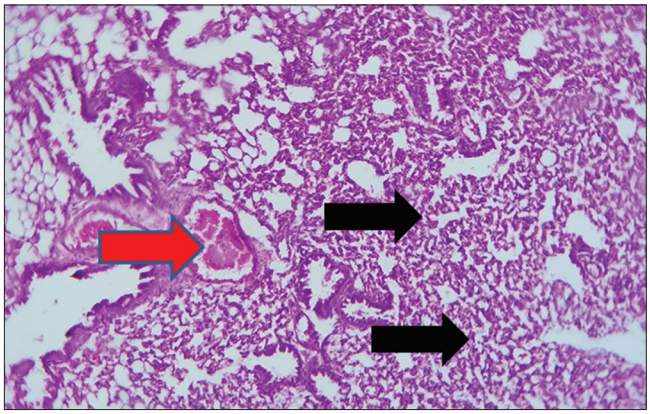

Figure 5: Tissue section from the lung of the treated group with cadmium (Group B) showing congestion (red arrow) reduce alveolar space (black arrows) (H and E ×100)

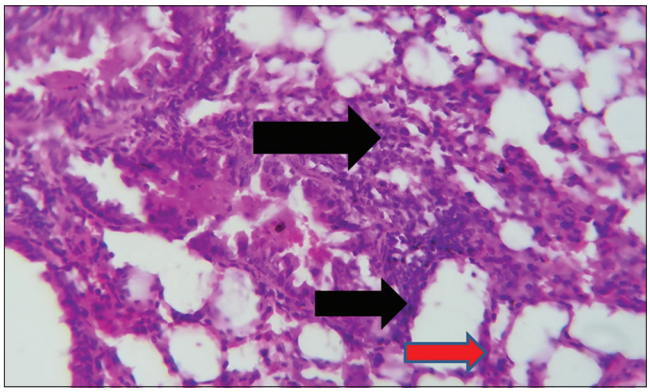

Figure 6: Tissue section from the lung of the treated group with cadmium (Group B) showed massive inflammatory cells infiltration (black arrows) thick interalveolar septum and cellular damage (red arrow) (H and E ×400)

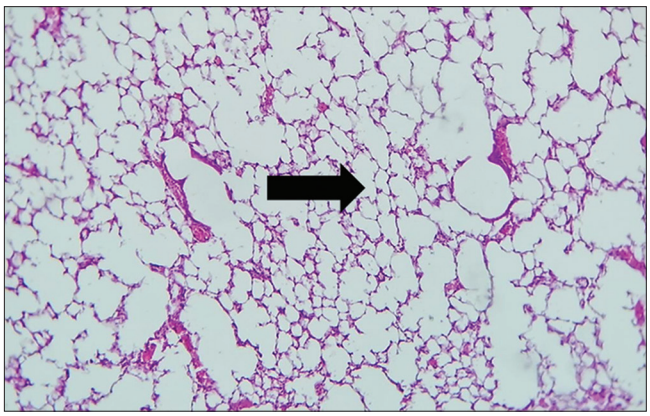

Figure 7: Tissue section from the lung of Group C revaling nearly normal alveoli (black arrow) (H and E ×100)

Cadmium induce apoptosis and/or necrosis of the cells through its formation of reactive oxygen species such as super oxide radicles, hydroxyl ion, and hydrogen peroxide [3], [4], [13].

In this study, damage to interalveolar septum involving pneumocyte type 2 which is responsible for the formation of surfactant and this substance is important

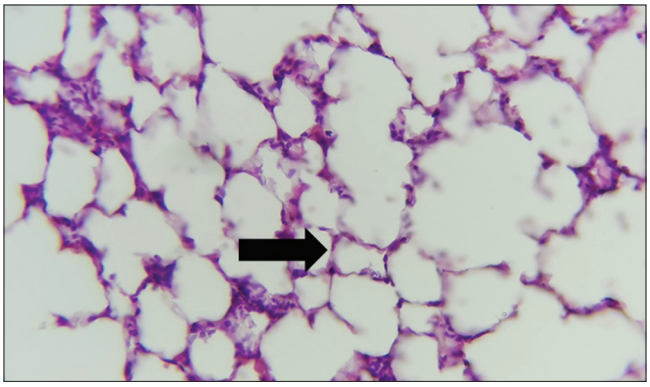

Figure 8: Tissue section from the lung of the Group C showing reduce in the thickening of the interalveolar septum (black arrow) (H and E ×400)

to prevent alveolar collapse and reduce alveolar tension so deficiency of this substance cause hypoxia and respiratory distress, this result is not mentioned by other workers. Oxidative damage is initiated by imbalance between oxidant and antioxidant resulting in mitochondrial damage and DNA damage which are the main manifestation of oxidative stress that occurs in cadmium toxicity [14], [15].

Concomtant use of antioxidants produce improvement in the histological structure of the organ, this finding is in agreement with the finding of other workers [16], [17], [18], [19], [20].

Conclusion

Cadmium chloride is a toxic heavy metal, lung is one of main organs affected by its toxicity, this study proves the toxicity of cadmium chloride in lung tissue which can be ameliorated using parsley oil.

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Ethical Approval

The research was approved by Medical Research Ethics Committee, College of Medicine, University of Mosul

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