The Toxic Effect of Cadmium Chloride on Lung Function and Tissue and the Protective Role of Pomegranate Seed Oil in Female Rabbits

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Abstract

The experiment was designed to determine the protective role of pomegranate seed oil on lung function and tissue against cadmium chloride toxicity.

In this experiment, 20 animals (rabbit females) were used. Lung efficiency was measured by measuring the size of red blood cells and hemoglobin, as well as studying the histological effects of cadmium chloride against lung tissue and the protective role of pomegranate seed oil . The results showed that the treatment of animals with cadmium chloride at a dose of 5 mg / kg bw for 30 days led to a significant increase in packed cell volume (PCV) and hemoglobin (Hb) compared to control group .

The treatment of animals with cadmium chloride has also shown that there is no possibility of distinguishing the alveolar of lung (AV) with the presence of focal infiltration of the inflammatory cells with a marked thickening of the wall of the blood vessel (TW) with blood congestion (CON) Pomegranate seed oil improves most of the negative effects caused by cadmium chloride .

Key word : *Cadmium chloride , Pomegranate seed oil , Packed cell volume (PCV), Hemoglobin (Hb) .*

Introduction

Cadmium (Cd) and lead (Pb) are ubiquitous and non-biodegradable pollutants representing a great concern to human health. Both metals are naturally distributed, but industrial development has dramatically increased their concentrations in the environment [(1).] The World Health Organization (WHO) has published a list of 10 chemicals or groups of chemicals of concern for human health, which includes Cd [(2).] The toxicity of cadmium has attracted the attention of researchers in different countries of the world due to its toxic effect on the cells and tissues of the body. The focus of the researchers has been on reducing the effect of effective oxygen species and free radicals causing their formation, as well as increasing interest in reducing the impact of industrial pollutants in the environment in which we live [(3)]. So researchers have sought to use a large number of plant-derived pharmaceutical products in traditional medicine or to use their extracts because of their useful properties. The plants are rich in a wide range of secondary compounds such as flavonoids, tannins, alkaloids and others [(4)] . Mentioned that the damaged central nervous system and DNA or cancer progression appeared as consequences of Cd exposure. Cadmium also causes severe soft tissues and bone damages [(5).] After absorption, Cd and Pb are distributed in the organisms via red blood cells or proteins . Amajor amount of Cd in red blood cells is bound to high-molecular-weight proteins, while a minor amount is bound to hemoglobin [(6)] . The hematopoietic system is one of the most sensitive systems and blood represents not only the mode of transportation, but also the critical toxicity target of Cd and Pb [(7).] Cadmium causes lung damage, pulmonary fibrosis, emphysema, and inflammation in human and experimental animals. Cadmium may also adversely affect the lungs by decreasing the viability or modifying the function of individual lung cells [(8).] The toxic mechanisms responsible for cadmium-induced lung cell damage are not well understood. One study [(9)] .

The use of extracts from medicinal plants and their effective non-food chemical compounds has a preventive and therapeutic effect for many disease cases and has little or no side effect compared to chemically manufactured laboratory drugs [(10)]. Pomegranate, Punica granatum L.,

is an ancient medicinal food plant which natively grows from the Himalayas in northern India to Middle East but has also been cultivated and naturalized in many other regions including Mediterranean, Southeast Asia, tropical Africa, and American Southwest [11]. In addition to extensive uses of pomegranate in folk medicine of many cultures, pharmacological studies have shown that pomegranate fruit preparations have antioxidant and anti-inflammatory,[12] antimicrobial,[13] anticancer, and chemopreventive [14] . Pomegranate seeds are rich in sugar, unsaturated- polyunsaturated fatty acids, vitamins, polysaccharides, polyphenols and minerals [15]. In particular, pomegranate seed oil contains high levels of phenolic compounds which is punicic acid, punicalagins (PNG), as well as important fatty acids such as linoleic acid, gallic acid and elagic acid [16] . Ellagic acid is a polyphenol compound with antioxidant and anti-proliferative properties that also exists in many other fruits and plants such as raspberries, pecan nuts and strawberries. ese components demonstrate anti-inammatory and antioxidant eects by inhibiting the expression of pro-inammatory enzymes and cytokines [17]. anticarcinogenic , antioxidant [18] anti-inammatory , antimicrobial [19, 20]. which are free radical scavenging compounds [21] Pomegranate is also rich in vitamins and minerals [22].

Material and Method

2-1-Experimental Design: After acclimatization, animals were randomly divided into four groups: Group 1 –Animals were given distilled water and kept as control.

Group 2 – Animals were given Pomegranate seeds oil (0.8 ml)/ kg b.w. for 30 days [23] .

Group 3- Female rabbits were treated at a dose of cadmium chloride 6 mg/kg b.w for 30 days, which promised an infected control. [24] .

Group 4 – Animals were given Pomegranate seeds oil (0.8 ml)/ kg b.w. with cadmium chloride 5 mg/kg b.w for 30 days .

2.2. Hematological Examination:

Blood samples were taken from the retroorbital venous plexus of rats. The two blood samples were collected one with EDTA for hematological analysis and other for separate serum for biochemical analysis. Erythrocyte count (RBCs) was performed using improved Neubauer Hemocytometer and Gower,s fluid as a diluting fluid according to (25). PCV% was determined by using microhematocrite centrifuge and microhematocrite capillary tubes method according to [26].

2.3. Histological study

Lung tissue samples were fixed in 10% formalin since 24 hours, dehydration by ethyl alcohol in increasing concentrations (70%, 80%, 95%, 100% and100%), clearing with xylene and then embedded with paraffin. When analyzed, all paraffinembedded tissue was sectioned at 5 µm ,and stained with Hematoxilin and eosin. These specimens were examined under a light microscope at 40X magnification power. Corresponding digital images were captured for later analysis [27] .

Results

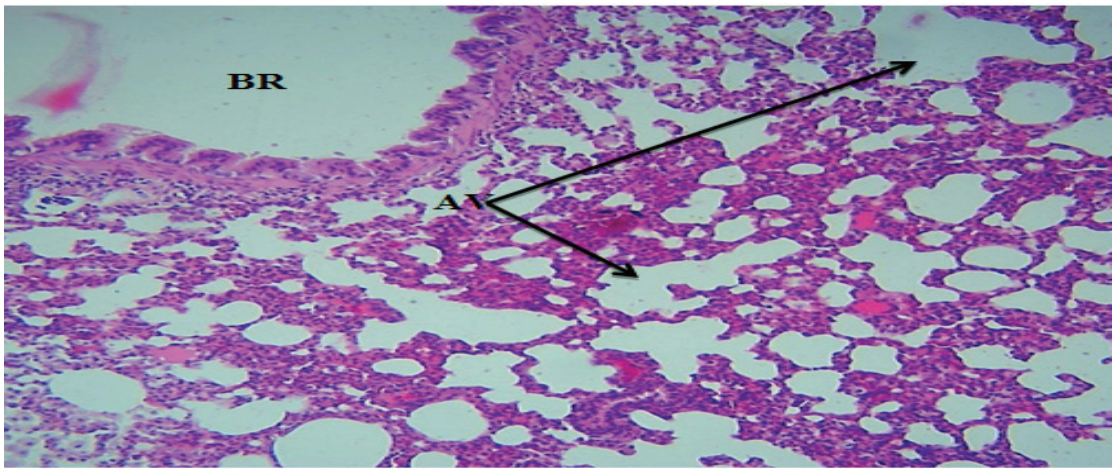

Figure (1) The lung segment control group shows pulmonary bronchioles (BR) and the alveoli (AV) within the lung tissue in its natural form H & E 400X

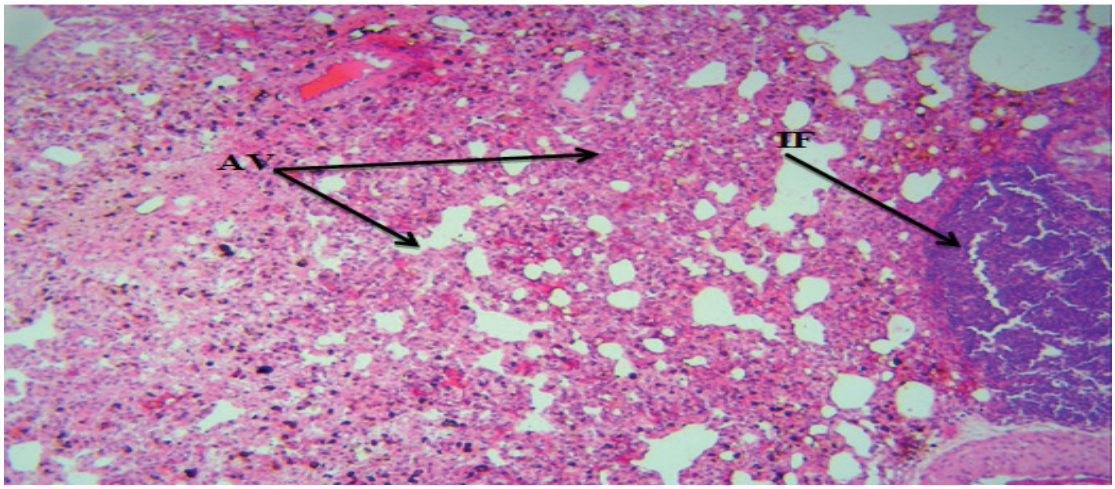

Figure (2) The lung segment The treatment of cadmium chloride shows that it is not possible to distinguish alveoli (AV) with focal infiltration of inflammatory cells (IF) H & E 100X

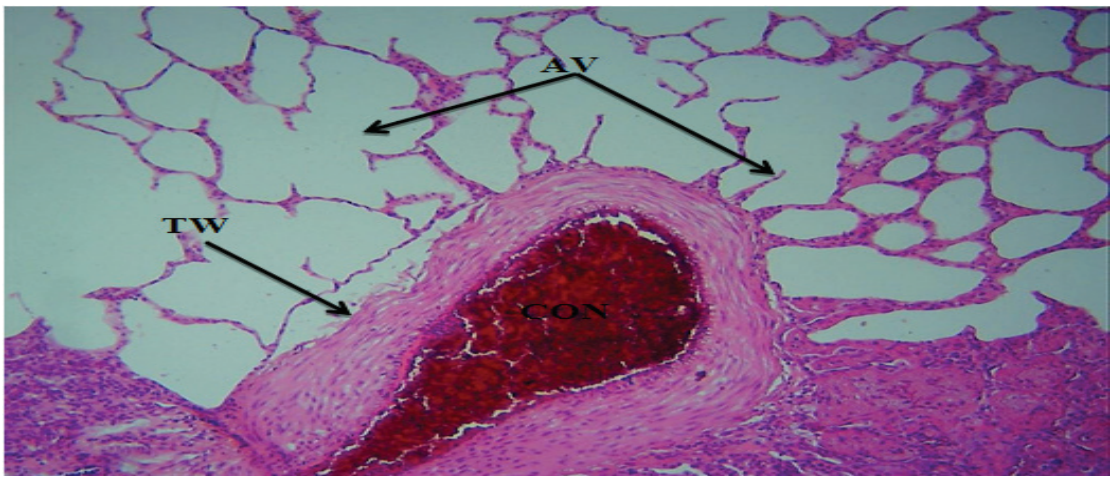

Figure (3) The lung section The cadmium chloride treatment shows the renal variability (AV) with a marked thickening of the wall of the blood vessel (TW) with blood congestion (CON) H & E 100X

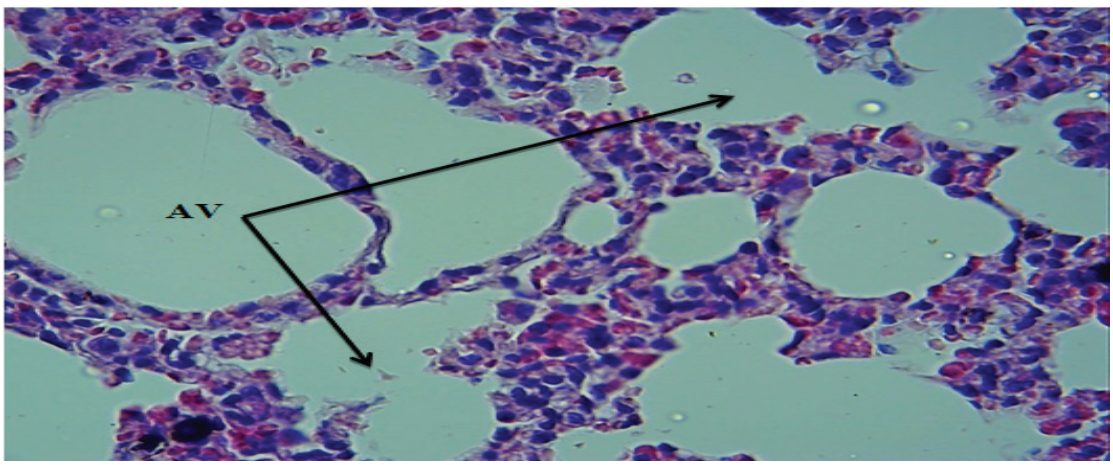

Figure (4) Lung section group treated with pomegranate seed extract showing normal the alveoli (AV) H & E 400X

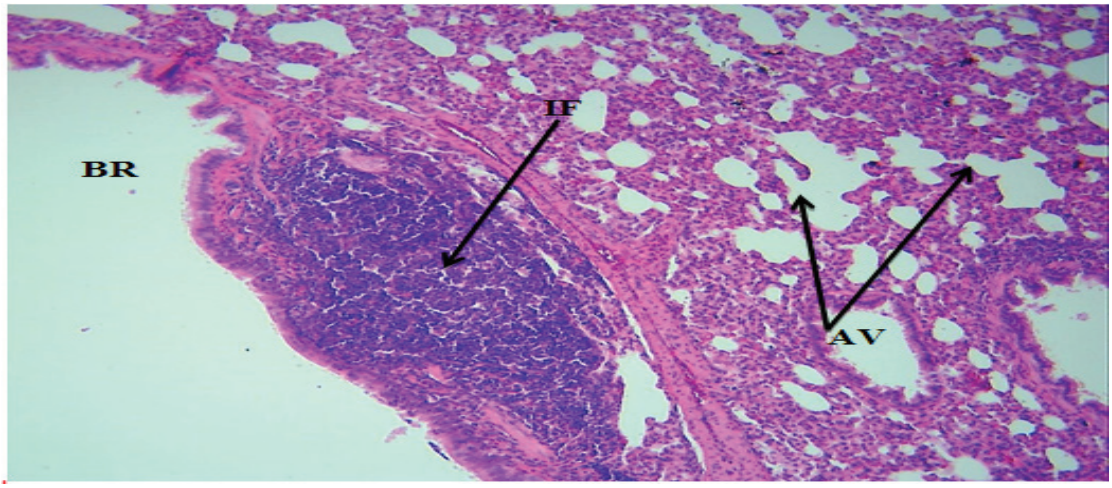

Figure (5) The lung of the cadmium chloride and pomegranate seed oil shows the the alveoli (AV) with a central infiltration of inflammatory cells (IF) adjacent to the bronchioles (BR) H & E 100X

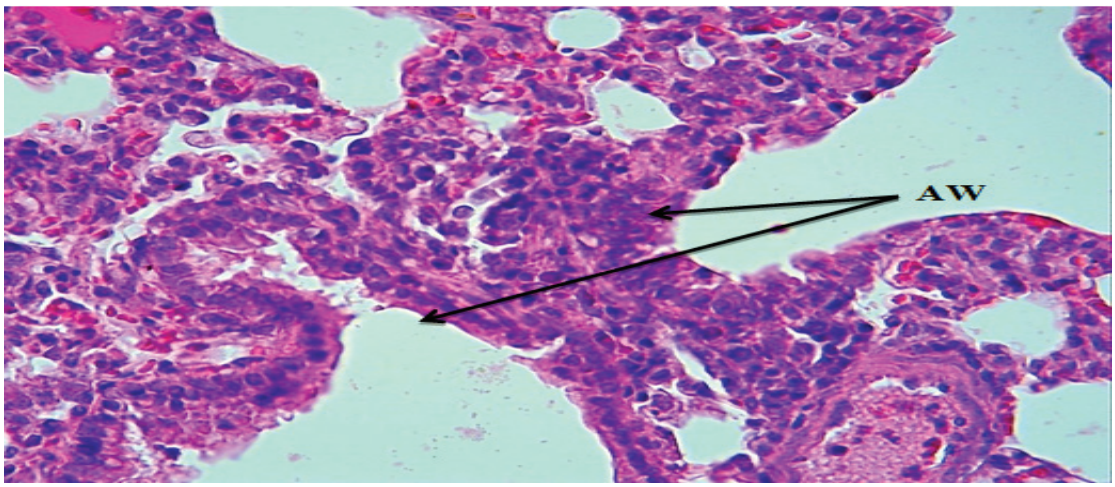

Figure (6) Lung section of the treated group Cadmium chloride and pomegranate seed oil shows the thickening of the (AW) wall clearly H & E 400X

Discussion

It is noted from the results above that treatment of animals with cadmium chloride at a dose of 6 mg / kg body weight for 30 days led to significant increase ($P \leq 0.05$), in blood volume and hemoglobin compared to control group, in consonance with found . [28] . While did not agree with [29], Who used a single dose with cadmium chloride (0.1mg / kg) . It was found that the treatment of mice With cadmium for 21 days led to a significant decrease in the value of Hb . while the protective role of pomegranate seed oil against chloride Showed a significant decrease in blood volume and hemoglobin compared with the cadmium chloride-treated animals group . The hematopoietic system is one of the most sensitive systems and blood represents not only the mode of transportation, but also the critical toxicity target of Cd and Pb. [7]. Both metals may lead to anemia by various mechanisms [30]. Cadmium and Pb are transported to the liver, in which they can cause damage and disturbed function. Liver damage can be confirmed by histopathological findings and is often accompanied by increased blood enzyme levels and reduced protein synthesis [31].

Changes in the size of red blood cells The cause is believed to be a physiological condition to compensate for the lack of oxygen in the body because of the thickening of the gas exchange membrane between the alveolar of lung and the blood and these changes lead to increase the formation of red blood cells from the reservoir of body [32] . This problem is also very important and interesting because there are many reports in literature that cadmium can result hypoxia [33]. That's why it is topical to research metabolical effect of cadmium ions and hypoxia and find out the biochemical and morphological changes of

blood indices of rats under cadmium loading as blood is a substance of organism that reacts on irritation from environment very quickly.

The decrease in RBCs count during the chronic treatment might be resulted from severe anemic state or haemolysing power of heavy metals (cadmium chloride) particularly on the red cell membrane. this agreed with [34] . The reduction in erythrocytes count might be due to the destruction of mature erythrocytes and the inhibition of erythrocytes production . It is also noticed from the tissue sections of the lung tissue that the treatment of animals with cadmium chloride led to the possibility of distinguishing the pneumonia (AV) with the presence of central infiltration of inflammatory cells with a clear thickening in the wall of the vessel (TW) with congestive blood (CON), in consonance with[35,36].

Lung tissue is one of the main targets of cadmium toxicity [37], and the respiratory system is affected severely by the inhalation of cadmium-contaminated air. Shortness of breath, lung edema, and destruction of mucous membranes as part of cadmium-induced pneumonitis have been described. Cadmium causes lung damage, pulmonary fibrosis, emphysema, and inflammation in human and experimental animals. Cadmium may also adversely affect the lungs by decreasing the viability or modifying the function of individual lung cells [8] .

Ethical Clearance: The Research Ethical Committee at scientific research by ethical approval of both environmental and health and higher education and scientific research ministries in Iraq

Conflict of Interest: The authors declare that they have no conflict of interest.

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