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The Effect of Lead on Lung Histology of Albino Mice *Mus musculus*

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ABSTRACT

The aim of the study was to investigate the histological changes caused by lead in the lung of albino mice . Twenty five mice were divided into 5 equal groups, . The first group was given distilled water and used as a control group. The second and third groups were orally administered (2 and 4 mg/kg of body weight) lead acetate respectively for two weeks. The fourth and fifth groups were orally administered (2 and 4 mg/kg of body weight) lead acetate for four weeks. Animals were anesthetized and the lungs were extracted for histological studies. The histological changes were observed in the lungs are emphysema, infiltration of mononuclear cells in the interalveolar septa, sloughing of epithelial cells of bronchiole, congestion of blood vessels and blood cells in some bronchi and bronchioles. The lesions were more severe in animals exposed to the high dose. In conclusion the severity of the lesions of lead toxicity depends on the dose of lead and period of exposure.
Key words: lung , lead , histological effect

تأثير الرصاص على انسجة الرئة في الفئران البيض *Mus musculus*

الملخص

تضمنت الدراسة تقييم تأثير الرصاص على البنيان النسيجي للرصاص في رئة الفئـران البـيض. قسمت الفئران إلى خمسة مجاميع 5 فأرة/مجموعة جرعت المجموعة الأولى ماء مقطر واعتبرت مجموعة سيطرة في حين جرعت المجموعتان الثانية والثالثة 2 ملغم و 4 ملغم اسيتات الرصاص/كغم على التعاقب لمدة أسبوعين. كما جرعت المجموعتان الرابعة والخامسة2 ملغم و 4 ملغم اسيتات الرصاص/كغم علـى التعاقب لمدة أربعة أسابيع. تم تجريع الحيوانات يوميا عن طريق الانبوب المعدي ثم تم تخدير الحيوانات وأخذت مقاطع من الرئة لدراسة التغييرات النسيجية. أوضحت التغيرات النسيجية حصول نفـاخ وارتـشاح التهابي للخلايا وحيدة النواة في الحواجز بين الاسناخ وانسلاخ للخلايا الظهارية للقصيبات الهوائية واحتقان للأوعية الدموية. كانت الافات اكثر شدة في الحيوانات المعرضة للجرعات العالية. تبين ان شـدة الافـات تعتمد على الجرعات فترة التعرض.

INTRODUCTION

Lead is one of the most encountered toxic elements to human health (Zhao *et al*., 2004). It has several industrial usage as in soldering, smelting, pipes, fuel additives, paints, battery manufacture etc. (Hurst and Martin, 2004 ; Mudipalli, 2007).

Lead is commonly used by people who are unaware of its adverse effects on human health (Steenland and Boffetta, 2000; Al-Nori, 2002 and Gidlow, 2004), health risks are usually associated with a degree of environmental exposure to lead emission (Mudipalli, 2007).

Toxic effect of lead involve kidney, liver, lung, brain, blood, bone marrow, bone and gonads (Goyer and Clarkson, 2001; Gidlow, 2004) . Lungs and skin are the first organs of contact for most environmental exposure . Many studies showed increased risk of lung cancer in certain lead workers (Anttila *et al*., 1995 : Singh *et al*., 1999 : Wong and Harris, 2000 ; Agius, 2001 ;Lundstrom *et al*., 2007; and Jones *et al*., 2007).

Another route of exposure for people in general population is polluted food and drinking water from lead – soldered joints or leaded pipes (Goyer and Clarkson 2001 ; ATSDR, 2005).

Exposure to lead has been shown to affect cell types, tissues and organ system in animals (Goyer, 1996). Lead acetate administered orally, cutaneously or intraperitoneally causes lung cancer in rodents and act synergestically with other carcinogen (Steenland and Boffetta, 2000). Therefore the present study was designed to determine the effects of lead ingestion on lung histology.

MATERIALS AND METHODS

Healthy male albino Swiss mice *Mus musculus*, 25-30gm weight, three months age, were obtained from the animal house of Medical College \ Mosul University . The animals were housed in plastic cages under controlled conditions of natural light (14) hrs and (10) hrs dark and temperature (25 ± 2°C). The animals received standard diet ad-libitum and water.

Twenty five mice were divided into five equal groups. The first group was given distilled water and used as a control group. The second and third groups were orally administered lead acetate (2 and 4 mg/kg of body weight respectively) for two weeks. The fourth and fifth groups were orally administered lead acetate (2 and 4 mg/kg of body weight respectively) for four weeks. All groups were treated once daily by gavage needle. At the end of the experiment the animals were anesthetized with chloroform, the lungs were excised then fixed in buffered neutral formalin for 48 hours. Following the fixation procedure the lungs were dehydrated in ascending series of ethanol, cleared in xylene and embedded in paraffin wax, (5-6) µm thick sections were obtained by a rotary microtome. These sections were stained with Harris hematoxylin and eosin (Luna,1968).

RESULTS AND DISCUSSION

Fig (1) section from normal mice lung showing normal structure such as normal alveoli and normal bronchiole, while Fig (2) showing histological changes in the lung of mice exposed to lead (first dose) for two weeks. The lesions are in the form of thickening in

the alveolar wall of some alveoli due to infiltration of inflammatory cells (mononuclear cells), congestion of pulmonary blood vessels, hemorrhages, hypertrophy in the epithelial cells of bronchiole and emphysema. Fig (3) shows more histological changes in the lung for the same concentration after four weeks, hepatization was seen due to proliferation of more alveolar cells in the interalveolar septa and destruction in the epithelial cells of some bronchioles.

In case of the (second dose) at two weeks of treatment Fig (4) shows also emphysema, infiltration of inflammatory cells in the interalveolar septa, congestion in the capillaries, sloughing in the epithelium of some bronchioles , blood in other bronchiole. Fig (5) after four weeks of treatment with the same dose the same lesions were seen but more severe, also some bronchi contain blood in their lumen Fig (6).

Lead poisoning is one of the oldest occupational and environmental disease in the world. Lead exerts multisystemic toxic effects through several mechanisms : by inhibiting enzyme activity, sometimes a consequence of binding to sulfhydryl group, also by altering the structure of cell membranes and receptors and by binding with proteins necessary for cellular functions (Kosnett, 2004 ; Hurst and Martin, 2004).

As the inhalation is a primary route for occupational exposure so the lung is the target organ of lead toxicity (ATSDR, 2005), about 90% of lead particles in ambient air that are deposited in the lungs are small enough to be retained, and absorption of retained lead through alveoli is relatively efficient and complete (Goyer and Clarkson, 2001). Lead fumes or fine particles of less than 0.5 µm are readily absorbed in the lungs, where as larger particles > 2.5 µm that are deposited in ciliated airways may be coughed up and swallowed resulting in oral exposure (Plumlee, 2004). Once absorbed from respiratory system or gastrointestinal tract lead bounds to erythrocytes and widely distributed initially to soft tissues such as the bone marrow, brain, kidney, liver and gonads
(Kosnett, 2004).

Therefore the present study was designed to investigate the effect of different levels and periods of lead ingestion on lung histology. We noticed thickening in the interalveolar septa with accumulation of inflammatory cells, these observations are similar to the results noticed by (Onarlioglu *et al*., 1999). These accumulations of inflammatory cells could be due to the harmful effect of lead to alveoli which lead to acute inflammation reaction (Adamis *et al.,* 1999 ; Agius, 2001).

This study showed that not only the period of exposure is necessary for the severity of lesions but the concentration of lead is more important, these results are agree with (Victery *et al*., 1987), in addition to the immune effect of lead which cause reduction of animal resistance and increase the mortality of experimental animals (Zhao, 2004; Gidlow, 2004)

In conclusion it could be suggested that lead causes severe lesions in lung tissue and this severity depends on the concentration and the prolonged period of exposure.

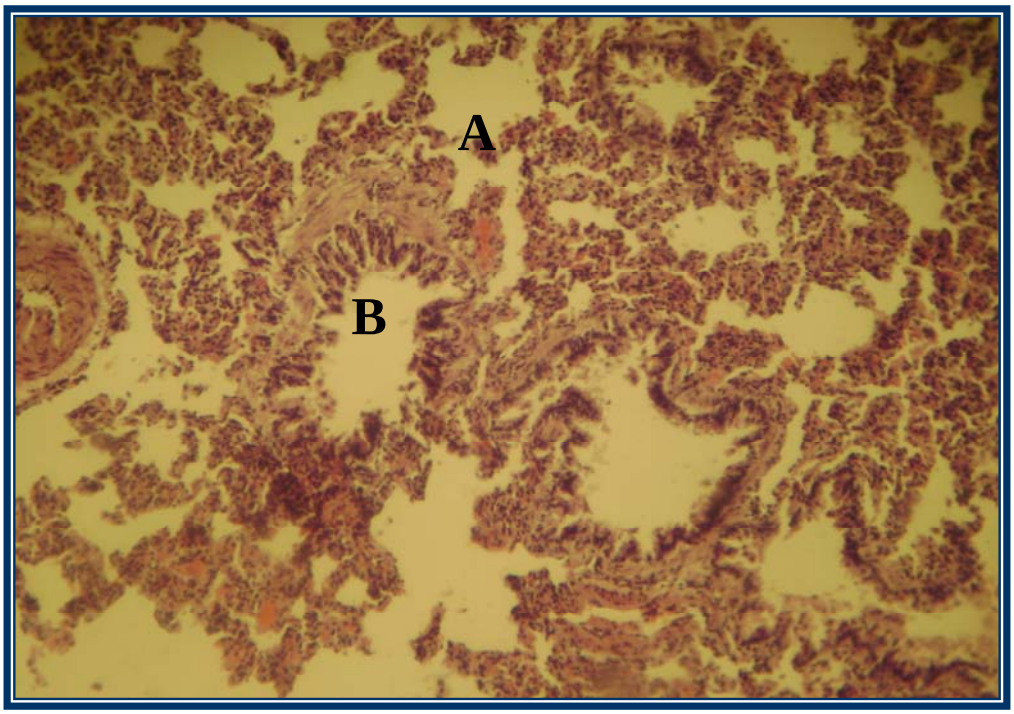

Fig. 1: section from control mice lung showing alveoli (A) and bronchiole (B). X450. H&E.

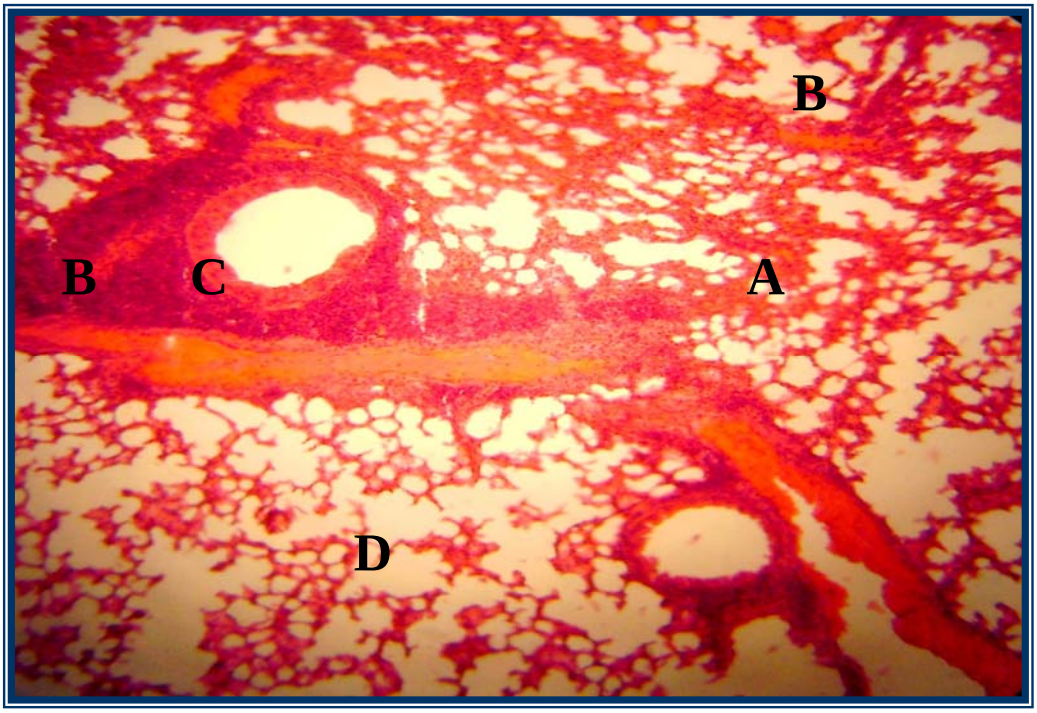

Fig. 2: section from mice lung treated with 2 mg/ 2weeks showing thickening of alveolar wall (A) infiltration of inflammatory cells (B),hypertrophy of the epithelial cells of bronchiole (C), and emphysema (D). X450. H&E.

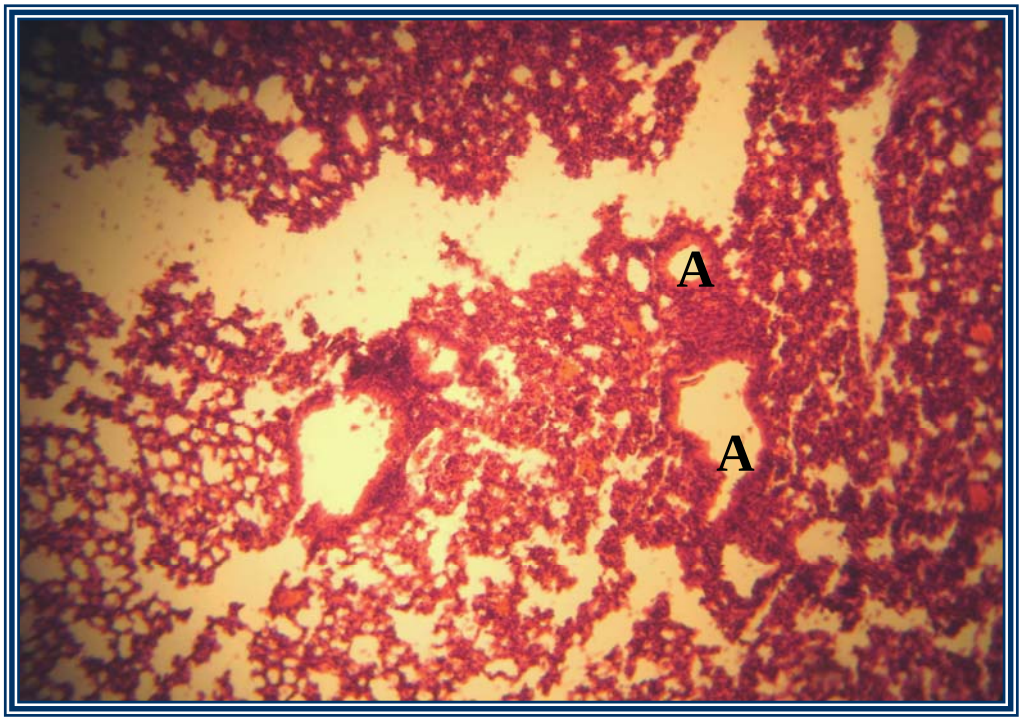

Fig. 3: section from mice lung treated with 2 mg/ 4 weeks showing hepatization (A). X450. H&E.

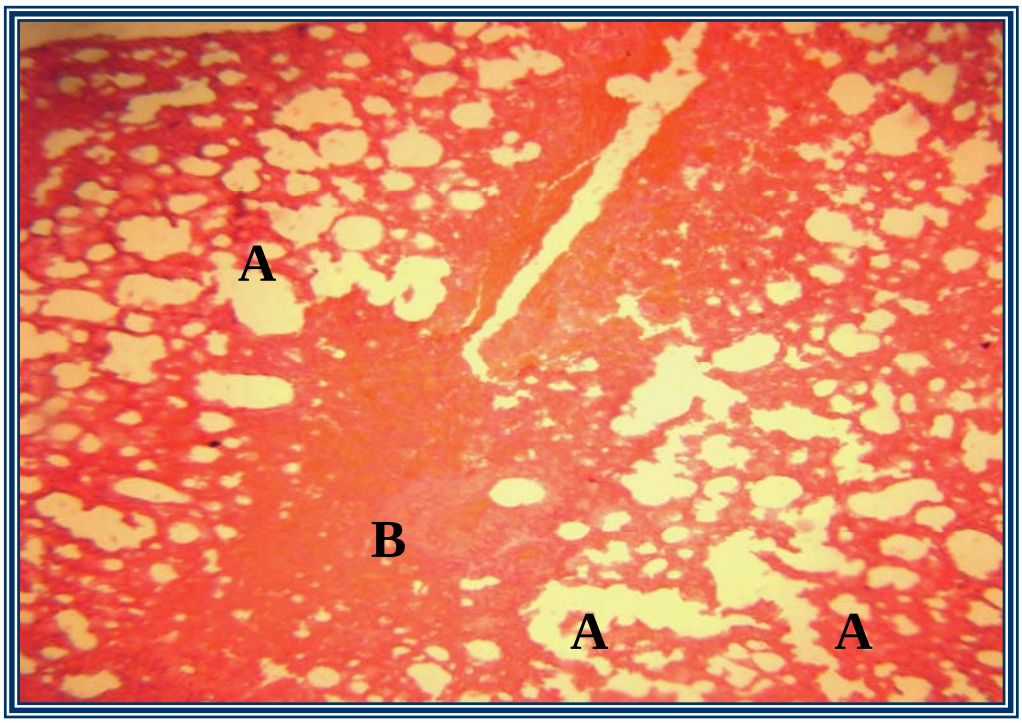

Fig. 4: section from mice lung treated with 4 mg/ 2weeks showing emphysema (A), infiltration of inflammatory cells (B). X400. H&E.

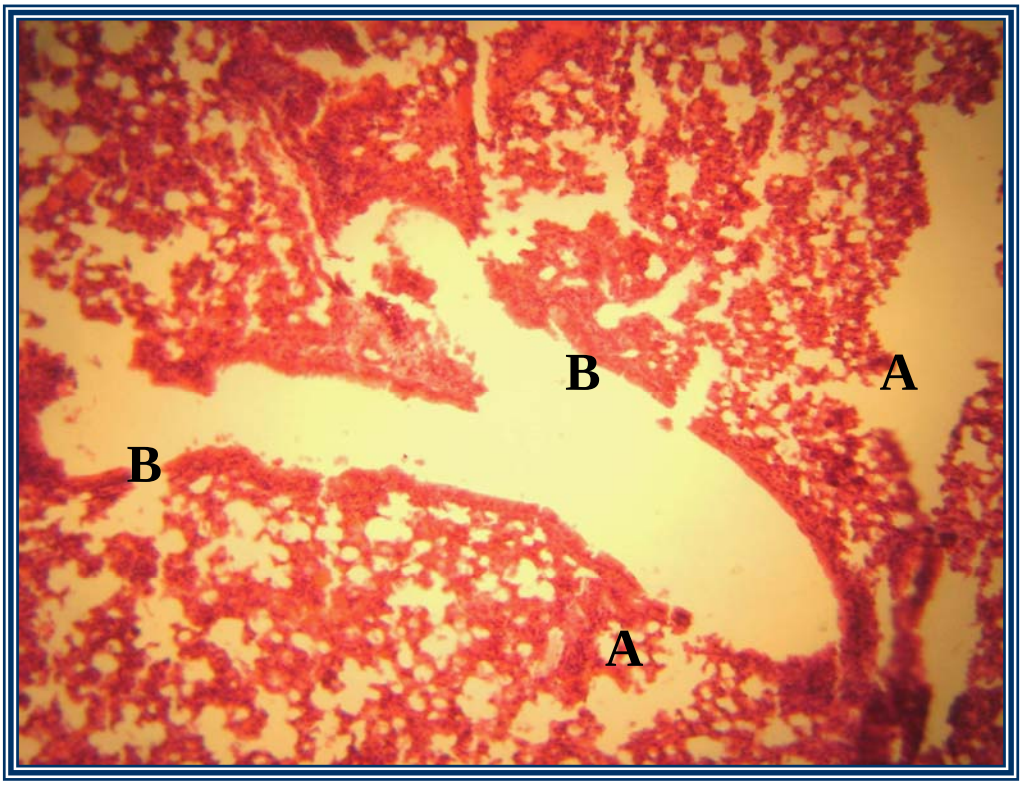

Fig.5: section from mice lung treated with 4 mg/ 4weeks showing emphysema (A) sloughing of epithelial cells of bronchiole (B). X450. H&E.

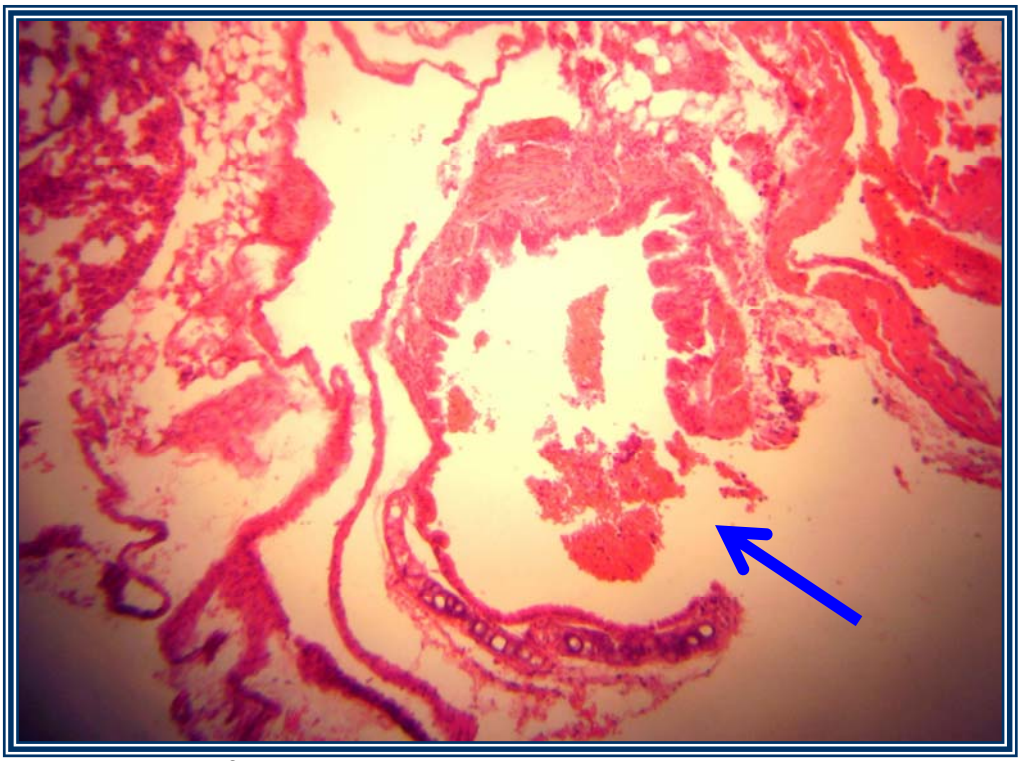

Fig. 6: section from mice lung treated with 4 mg/ 4weeks showing blood in the bronchus. X325. H&E

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