THE EFFECT OF SUBCUTANEOUS ADMINISTRATION OF LEAD ACETATE ON BRAIN TISSUE: A HISTOPATHOLOGIC STUDY[+]

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Abstract

Lead is one of the heavy metals that are known to damage the central and peripheral nervous systems causing irreversible changes manifested as a collection of neurological symptoms. The aim of this work is to study the effect of subcutaneous administration of lead acetate on the brain tissue of rabbits by histopathological examination.

Material and Methods: Five males rabbits 4-5 weeks in age underwent subcutaneous injection of lead acetate in a dose of 1 mg / animal for 2 days, followed by 2 mg / animal for 6 days. Animals were sacrificed on the 9th day and their brain tissues were subjected to histopathlogic study compared to those of 5 animals used as a control group.

Results: Histopathologic changes included endothelial proliferation of small blood vessels, oedema and focal demyelination of the brain tissue leading to a rarified appearance.

Conclusion: These findings represent the direct effect of small doses and short exposure to lead on the brain tissue leading to irreversible damage.

المستخلص

الرصاص هو احد المعادن الثقيلة التي لها تاثير ضار على الجهاز العصبي المركزي والمحيطي والتعرض له يؤدي الى حدوث تغيرات غير رجعية تتمثل في ظهور اعراض مرضية خاصة بالجهاز العصبي .

هدف البحث هو دراسة تأثير اعطاء خلات الرصاص تحت الجلد على نسيج الدماغ للارانب من خلال الفحص النسيجي . زرقت خمسة ارانب يتراوح اعمارها بين ٤ - ٥ اسابيع بمادة خلات الرصاص تحت الجلد وبجرعة (١ملغم / حيوان) لمدة يومين اتبعت بجرعة (٢ملغم/حيوان) لمدة ٦ ايام . قتلت الحيوانات في اليوم التاسع واجري الفحص النسيجي على ادمغتها مقارنة بخمسة حيوانات اخرى استعملت كمجموعة سيطرة .

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اظهرت نتائج الفحص النسيجي وجود تثخن في بطانة الاوعية الدموية الصغيرة ، وذمة الـــدماغ مع بؤر ازالة النخاعين مما اعطا مظهرا مخرما . تبين هذه التغيرات ان الجرع القليلة مـــن الرصـــاص ولفترة تعرض قصيرة تؤثر تاثيرا مباشرا على نسيج الدماغ مؤدية الى تلف غير رجعي .

Introduction

One of the major systems affected by lead toxicity in man is the nervous system including the central and peripheral nervous system. Lead damages the blood - brain barrier and subsequently brain tissues[1].

Patients with occupational lead exposure resulting in an increase in blood lead levels to 40-50 mg/ dl may experience fatigue, irritability, insomnia, headache and subtle evidence of mental and intellectual decline [2, 3]. Blood lead levels as low as 30-40 mg/dl decrease motor nerve conduction velocity in workers , although lead exposure levels are not associated with clinical symptoms .These sub clinical symptoms represent early stages of neurological damage. to the central and peripheral nervous systems [4]. The aim of the present work is to study the effect of subclinical lead exposure on brain tissue in experimental animals by light microscopy following subcutaneous injection of lead acetate.

Materials and Methods

Materials

Ten male rabbits of local breed were included in this study. Their age ranged from (4-5) weeks. They were divided in to 2 groups 5 as a test group and 5 as a control group.

Fifty mg lead acetate was dissolved in ten ml of distalled water and used as stock solution.

Methods

The test groups were given subcutaneous injection of lead acetate in a dose of I mg / animal (0.1 ml / animal) daily for 2 days. This was followed by 2 mg / animal (0.2 mg/animal) daily for 6 days.

On the 9th day all animals (test and control groups) were sacrificed and paraffm blocks were made from their brain tissue.

Sections were stained with haematoxyline and eosine and subjected to histopathologic study by ordinary light microscopy.

Results

Subcutaneous tissues at the site of injection area appeared swollen and firm in consistency. Histological examination revealed oedema and a mixed inflammatory cells infiltration.

Examination of brain sections revealed focal changes involving endothelial thickening of small blood vessels Fig (1) .

Odema fluid manifested as widening of the space in between cells was noted clearly giving rarified appearance Fig (2) . The white matter was affected more than the gray matter. Focal demylination was also noted as increase in eosinphilia of the cells giving them dark stain Fig(2).

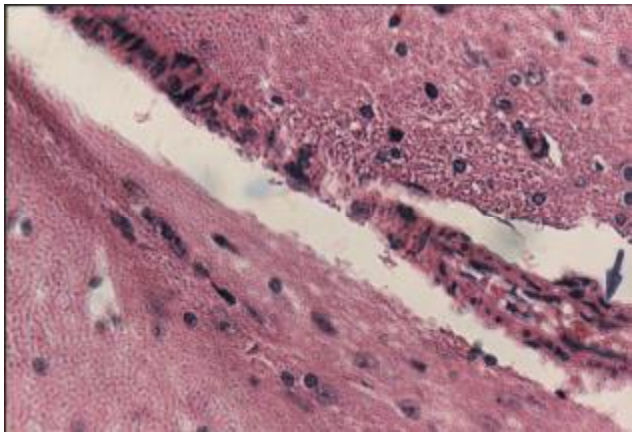
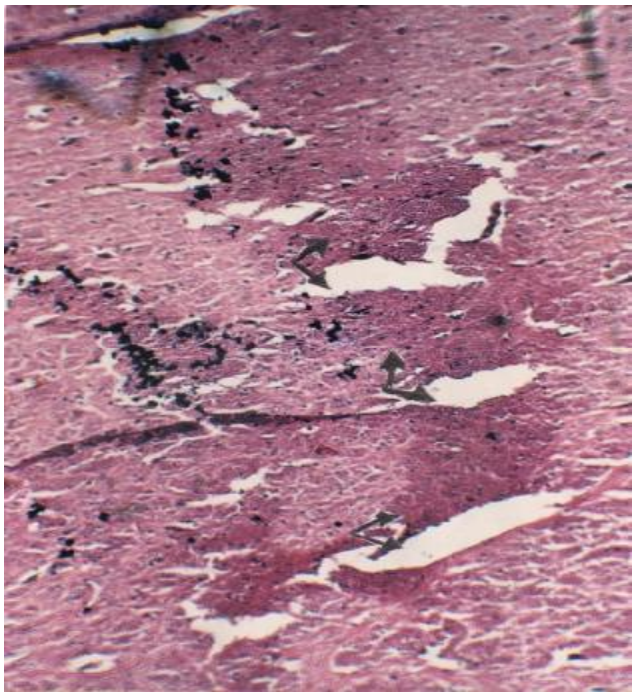


Fig (1) Blood vessel in brain tissue . There is endothelial thickening (arrow) in addition to the odema (X400).



Fig(2) Odema fluid manifested as widening space in between cells which gives a rarified appearance (x100)

Discussion

Lead arrived to the brain via the blood – brain barrier. This will lead to its deposition in the brain tissue as free granules [5].

However Minckler (1971) had described brain lesions in lead poisoning as due to direct and indirect effect. The deposition of lead in the brain tissue is associated with endothelial proliferation of the small blood vessels as a direct response to lead injury [1]. In its turn, damage to blood vessels leads to leakage of fluids into the brain tissue as odema fluid [1].

In addition to direct effect on myelin fibers [6], odema fluid produces pressure on the supported cells of the myeline sheeth of axons resulting in damage to these fibers.This explains the demyelination seen in the sections as in increase eosinophilia of the involved portion [6].

Demyelination together with odema produces a specific appearances of brain tissues described by Minckler 1971 as rarefaction [1].

The indirect effect on the brain tissue is due to the effect of lead on other vital organs such as liver haemopoitic system , with the damage produced on liver it becomes unable to detoxify nitrogenous products in the intestine leading to their accumulation in the blood stream and later affecting brain tissue . Lead affects the haemopoitic system leading to an increase in aminolevulic acid and accumulation of protoporphorin; these two substances have harmful effects on brain tissue [7, 8].

However the indirect effect couldn't be differentiated from the direct one on H and E stained section this will need further studiesand special stains to identify porphorin in the brain tissue.

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