

The Role of Vitamin E in Reducing of Cadmium Blood Toxicity in Mice

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SUMMARY

The present study was designed to investigate the role of vitamin E to eliminate the toxic effect of cadmium on blood parameters . A total of 24 healthy mice. were randomly located into one of the following groups: - First group was injected with 0.1 ml. olive oil intraperontal and left as a control group. The second group was exposed to 4 mg/kg body weight cadmium in the form of $CdCl_2$ via intraperitoneal injection (ip) daily for ten days The third group was injected (ip) with 4 mg/kg cadmium daily for ten days, and then the animals were injected (ip) with 0.6 IU (24 IU/kg body weight) vitamin (E) daily for two weeks. Blood samples for hematological analysis were taken by cardiac puncture at the ten days and twenty four days from the beginning of the experimental work. The result revealed to significant reduction in red blood cells, packed cell volume and hemoglobin values of second group compared with the control group. In addition to a significant elevation in total white blood cells, acidophil, monocytes, and lymphocytes. Neutrophils declined significantly due to the exposure of cadmium .No basophiles were seen in the three studied groups. The results also indicated that vitamin.(E) was capable to get all the abnormal values of blood parameters to its normal values as with control group .

Key word : vitamin E, Cadmium, Blood toxicity

Introduction

Cadmium is widely used in special alloys, pigments, stabilizers, coatings and in rechargeable nickel- cadmium batteries (18). Exposure to cadmium has been reported to cause an accumulation in the body tissues particularly that of the kidneys and liver tissues (12). The LD50 for single intraperitoneal dose of cadmium (in the form of CdCl_2) in mice is 6.75 mg/kg body weight (3). Most studies on cadmium toxicity reported that exposure to cadmium could causes diarrhea, stomach pain, severe vomiting, bone fraction, Reproductive failure and infertility, damage to immunity system, psychological disorders, cancer development and possibly DNA damage (4, 13 , 15 and 8).

In Iraq, some recent studies on antioxidants were issued by (2) who used phytase to cure cadmium treated mice or DL-actopherol as form of vitamin E to treat selenium poisoned anima.(1). It has been known that antioxidants substances could act to protect cell membrane against the effects of free radicals, which are damaging cells and may contribute to the development of cardiovascular diseases and cancer. Vitamin E has also been shown to play a role in immune function, in DNA repair and other metabolic processes (14 and 5). The aim of this study is to investigate the effect of cadmium on the hematological parameters of mice and the role of vitamin E to reduce blood toxicity .

Materials and methods

Twenty four sexually mature twenty one weeks old male mice (*mus musculus*, Swiss) were acquired from animal house of Veterinary College, Basrah University. Mice were divided into three groups of eight animals each. In two of the groups (second and third) each mouse was dosed via intraperitoneal injection (ip) daily with 0.01 mg (0.4mg/kg body weight) cadmium in the form of CdCl_2 (Sigma Chemical Company) dissolved in saline. The solution was prepared by calculation the LD50 for each mouse, (25 gram body weight) The dose was 0.16 mg, therefore the dose in which has been used in present study was 0.1 mg for each mouse which equivalent to 4 mg / kg. 1 mg cadmium dose dissolved in 10 ml saline (0.09% NaCl). One ml of the solution was taken and then 0.1ml (0.4 mg/kg) was injected in each mouse for ten days. The dose of 0.4 mg/kg body weight cadmium daily was derived so that over ten days exposure, the sum of the individual exposures would not exceed above single LD50 dose (0.16). Such dose (0.4 mg/kg) found in blood serum from human males who smoke approximately 20 cigarettes per day (3). One of the two groups (second group) of mice was sacrificed at the end of the tenth day. Each mouse in other group (third one) was injected with 0.6 IU vitamin E (24 IU /Kg) for 14 days. The method relied on assumption by (6), that the upper tolerable intake level for vitamin E for adults aged 19-70 years old almost (60 kg body weight) at 1500 IU (1000 mg) for any form of supplementary alpha- tocopherol per day, which equivalent to 0.6 IU for each 25 gram mouse weight. Therefore, capsule of 400 IU vitamin E dissolved in 70 ml olive oil. 1 ml of the solution was taken which contains almost 6.0 IU vitamin E and then 0.1 ml (0.6) injected daily in each mouse for 14 days and all animals were sacrificed. An equivalent volume of olive oil was injected to the first group of mice which was set as control one. Exposure and control animals were sacrificed by anesthesia in ether. Blood samples for hematological measurements were taken by cardiac puncture for each mouse in each treated group at the end of ten and twenty four days from the beginning of the experimental work for the second and third groups respectively. Calculation of hematological parameters as RBCs count, Hb, PCV, WRCs count and differential leukocytes count were determined. The data were analyzed by using SPSS programme.

Results and Discussion

It seems from table (1) that significant reduction occurs ($P \leq 0.05$) in RBCs, Hb and PCV, when mice were treated with cadmium after 10 days of injection period, compared with the control group. Severe elevation in WBCs was observed which were significantly ($P \leq 0.05$) differed with the control group. Once the cadmium treated animals were exposure to the vitamin E, the RBCs, Hb and PCV rose significantly ($P \leq 0.05$) compared with values of treated animals. However, apart of RBCS counts which were almost close to the control value, Hb and PCV were still less significantly ($P \leq 0.05$) than those values of the control group,. Vitamin E was capable of leading the WBCs down. Although WBCs in the third group were far from the control value, they differed significantly with the cadmium treated animals .Table (2) shows the effect of cadmium on the differential number of WBCs. Cadmium caused an increase ($P \leq 0.05$) the lymphocytes, acidophil and monocytes and reduction ($P \leq 0.05$) in the neutrophils compared with the control values, I. When the cadmium poisoned animals were treated with vitamin E for 14 days, apparent significant decline ($P \leq 0.05$) in acidophil and monocytes were observed compared with the value of cadmium treated animals, but they were still significantly ($P \leq 0.05$) less than those of the control value .It has seen that the vitamin E was able to rise neutrophils significantly ($P \leq 0.05$) compared with the cadmium treated animals value, but it was far a way from getting the control value. The lymphocytes were out of vitamin E effectiveness and they continued to rise significantly compared with cadmium treated animals and controls values. No basophiles were seen either in the control or in the cadmium treated groups .The present study results indicated severe anemia occurred in mice due to various inhibitory effect of cadmium on haem biosynthesis (13) .Since the red blood cells synthesis by bone marrow in the present of erythropoietin hormone in which biosynthesized in kidney and liver tissues(10). It has been known that the cadmium has the ability to damage the liver and kidney cells, therefore, little of erythropoietin would synthesize in these organs which led to decrease red blood cells count .In addition, cadmium induced reactive free radicals initiate red blood cells damage through mechanism of covalent binding to the membrane protein and cause lipid peroxidation(8)which act on red blood cell membrane and destroy them, causing a sever anemia .The increase in white blood cells, acidophils , monocytes and lymphocytes in addition to the reduction of neutrophils, is due to the defense mechanism that the white red blood cells have, particularly

lymphocytes and acidophils, against the infection process on liver and kidney .The infection process are caused bone marrow to produce immature cells, therefore, the white blood cells increase in number (17) Several experimental showed an important role of vitamin E in the prevention and therapy of liver and kidney cells damage(9 ,7 and 16) According to present study results, vitamin E has the capability of protecting the cell membrane against lipid peroxidation which is the basis of many pathological processes such as liver fibrosis, and tumour growth (4). It concluded that vitamin E decrease the lipid peroxidation and repair damaged red blood cells by increasing the antioxidant defense system activity in the cadmium treated mice .

Table (1) Effect of vitamin E on cadmium blood poisoning

Mean \pm S.D

n = 6

Treatments	RBC $\times 10^6$	Hb gm / 100 ml	PCV%	WBC $\times 10^3$
Control	7.1667 ± 0.9832 a	13.0000 ± 0.8944 a	26.3333 ± 1.0328 a	3.6667c ± 0.5164
Cd	5.5000 ± 0.5477 b	5.0000 ± 0.8944 c	9.6667 ± 2.0656 c	17.8333a ± 4.082
Vit e	6.5000 ± 0.5477 a	9.0000 ± 0.8944 b	19.6667 ± 2.0656 b	15.8333b ± 4.082

Different letters in the same column significant on ($p < 0.05$).

Table (2) Effect of vitamin E on differential number of leukocytesMean \pm S.D

n = 6

Treatments	Nut.%	Lymph.%	Acido.%	Mono%	Baso.%
Control	50.5000a ± 1.6432	40.8333c $\pm .4082$	1.0000c $\pm .00000$	5.0833b $\pm .4916$	0.0
Cd	31.5000c \pm 1.5166	47.3333b. ± 1.0328	5.0000a $\pm .0000$	14.0000a $\pm .6325$	0.0
Vit. E	38.0000b ± 24.366	53.8333a ± 2.4014	1.8333b $\pm .4082$	2.5833c $\pm .3764$	0.0

Different letters in the same column significant on ($p < 0.05$)

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دور فيتامين E في التخلص من تسمم الدم بعنصر الكاديوم في الفئران

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الخلاصة

صممت الدراسة الحالية لتقييم تأثير فيتامين E في التخلص من التسمم الناتج من التعرض إلى عنصر الكاديوم على المعايير الدموية (كريات الدم الحمر وحجم الخلايا المرصوصة والهيموغلوبين) والعدد الكلي لكريات الدم البيض والعدد التفريقي لها (الخلايا اللمفاوية والخلايا العدلة والخلايا الحمضة وخلايا وحيدة النواة وخلايا القعدة). استخدم 24 فارا ذكرا ووزعت على ثلاث مجاميع عشوائية. المجموعة الأولى حقنت تحت الجلد ب 0.1 مللتر من زيت الزيتون وعوملت كمجموعة سيطرة، المجموعة الثانية حقنت تحت الجلد ب 4 ملغم / كغم من وزن الجسم من مادة كلوريد الكاديوم يوميا ولمدة عشرة أيام ثم قُتلت، المجموعة الثالثة حقنت تحت الجلد ب 4 ملغم / كغم من وزن الجسم. مادة كلوريد الكاديوم ولمدة عشرة أيام وبعدها حقنت ب 0.6 وحدة دولية (24 وحدة دولية/ كغم من وزن الجسم) من فيتامين E ولمدة أسبوعين آخرين ومن ثم قُتلت. سحب الدم مباشرة من القلب لغرض حساب المعايير الدموية وكريات الدم البيض والعدد التفريقي بعد عشرة أيام وأربعة وعشرين يوما من بداية التجربة. أظهرت النتائج انخفاض معنوي شديد في إعداد كريات الدم الحمر وحجم الخلايا المرصوص والهيموغلوبين في المجموعة المعاملة بالكاديوم، إلا أن هذا الانخفاض في قيم المعايير الدموية ارتفع في المجموعة التي تعرضت إلى فيتامين (E) ليقترب قيم المعايير الدموية في مجموعة السيطرة. بينت النتائج ارتفاع معنوي في قيم إعداد كريات الدم البيض وخلايا وحيدة النواة والخلايا اللمفاوية والخلايا الحمضة، فيما انخفضت خلايا العدلة معنويا مقارنة مع السيطرة. لم تلاحظ خلايا القعدة سواء في مجموعة السيطرة أو في مجموعة الكاديوم. الارتفاع المعنوي في العدد الكلي لخلايا الدم البيض والعدد التفريقي (ماعد العدلة) ما لبثت أن انخفض في المجموعة الثالثة والتي حقنت فيها الفئران بفيتامين E إضافة إلى عنصر الكاديوم ولكن بفارق معنوي عن قيم مجموعة السيطرة ما عدا الخلايا اللمفاوية إذ لم يتمكن فيتامين (E) من تقليل نسبتها مقارنة مع السيطرة.