

Vitamin E reduces blood urea concentrations level after formaldehyde exposure in rat

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ABSTRACT

In this study, effect of vitamin E on kidney after exposure to formaldehyde was evaluated. 24 adult male wistar rats divided randomly in three groups: control, formaldehyde (E1), vitamin E and formaldehyde (E2). After two weeks rats were sacrificed, and 5 ml of blood was taken from their heart. Blood urea nitrogen (BUN) and creatinine concentrations were measured. BUN concentration was significantly increased in E1 ($P=0.03$) and E2 groups ($P=0.02$) compare with control group. There were no significant differences in creatinine levels between groups ($p=0.11$). The results showed that vitamin E probably protect kidney against formaldehyde alterations in rat. It may be possible to use vitamin E when increasing blood urea concentrations to restore urea plasma balance and prevent kidney damage.

Keywords: Blood urea nitrogen, formaldehyde, rats, vitamin E

INTRODUCTION

Formaldehyde is a gas that is present in the atmosphere and is created by various

biological and biochemical processes. When formaldehyde is inhaled in experimental animals and humans, it is rapidly metabolized in the respiratory system [1]. The

formaldehyde is genotoxic *in vitro* and probably genotoxic at the place of contact *in vivo* [2]. It is classified as a carcinogen for humans and causes diseases such as nasopharyngeal cancer [3]. Formaldehyde also found in all cells of the body, and is produced in the metabolism of amino acids of methionine, glycine and serine [4]. In our previous study had shown that formaldehyde induced production of free radicals in the body [5]. In the other hand, some places such as laboratories of pathology, anatomy, wood and food processing industries are in the high exposure levels (exceeding the 0.5 mg/mg) and people need to receive something to protect them from harmful effect of formaldehyde [3,6].

Antioxidants such as vitamins A, C, E could reduce free radicals, and protect body from the harmful effects of this substance [7]. Vitamin E is a family of lipid-soluble vitamins, it acts as an antioxidant in the cells and protect plasma membrane integrity from drug and chemical Toxicology [8]. The kidneys are one of the important organs in the body, which can cause damage from the oxidant agent due to the high circulation of blood in the glomerulus. The urinary system is studied in most of the routine protocols for testing toxicity of toxic material on body. Researchers showed that urea and creatinine levels in the serum of rats can be used as an

indicator of kidney function [9]. As above description, we decided to investigate the effect of the protective potential of vitamin E on formaldehyde-induced damage in the male rat kidney.

MATERIALS AND METHODS

In this experimental study, a total of 24 adult male wistar rats (aged 8-10 weeks, weight 250-300 g) divided randomly in three groups (8 in each group): A:control group A, B: formaldehyde group E1, C:vitamin E and formaldehyde Group E2. Animals were housed for 1 week in 12- h darkness and brightness conditions, room temperature of $27^{\circ}\text{C} \pm 1^{\circ}\text{C}$ and had free access to water and food. Animals were handled according to the Guilan university of medical sciences, animal care and committee protocols. Group A received 1 ml of intraperitoneal normal saline. Group E1 received 10 mg/kg of intraperitoneal formaldehyde and Group E2, received 10 mg/kg of formaldehyde and 30 mg/kg of intraperitoneal vitamin E for two weeks. 24 h after receiving the last dose of vitamin E and formaldehyde, rats were sacrificed after induction of general anesthesia by chloroform, and 5 ml of blood was taken from the heart of the rats with sterile syringe. Then the specimens were centrifuged at 4000 rpm for 10 min and stored

at -20 °C for until test were performed. BUN and creatinine concentrations were measured with creatinine and urea UV Pars Azmoon detection kit based on their specific kits protocols. Data analyses were performed using SPSS version 18. The difference between the mean values of continuous variables was test with one-way ANOVA. All the data are presented as mean± standard deviation (SD). P values <0.05 were considered statistically significant.

RESULTS

The amount of the BUN indicated that formaldehyde could significantly increase the BUN concentration of E1 group compare with control and also E2 groups ($p=0.03$ and $p=0.02$ respectively). Our data showed that application of formaldehyde and vitamin E reduced BUN concentration to levels similar to control group ($p=0.85$) (table 1). There were no significant differences in creatinine levels between groups.

Table1. The mean of BUN and creatinine concentration of treated groups

Parameter	Control	E1	E2	P value
BUN(mg/dl)	37.50±6.30	46.21±3.93	37.17±3.93	0.03*
Creatinine(mg/dl)	0.46±0.04	0.56±0.12	0.51±0.07	0.11

* Significantly different from control by ANOVA, $P<0.05$. E1: Experimental group1, E2: Experimental group2, Blood Urea Nitrogen (BUN)

DISCUSSION

These results are consistent with previous reports which use from Radix paeoniae and Curcuma Longa respectively as antioxidant agents to reduce the BUN concentration [10,11]. On the other hand, some reports revealed that in serum urea levels was

significantly decrease following the administration of vitamin E, vitamin C, and selenium [8,12]. This data was in accordance with our study, and perhaps the disruption of the urea cycle could lead to a reduction in its production.

Renal metabolism is damaged in exposure of some oxidant agents such as formaldehyde

injection and vitamin E, and C might modulate the toxicity through the anti-oxidative mechanism [8,12,13]. Researchers showed that for investigation of nephrotoxicity caused by toxic substances, Creatinine and urea are susceptible biomarker that used for the assessment of kidney function [14]. We showed previously histopathological alteration in rat kidney treated with formaldehyde and these changes were significantly reduced in the rats receiving vitamin E and formaldehyde [13]. It seems may be vitamin E give affect the metabolism of water, the permeability of substances and finally release urea from the kidneys.

The levels of measured creatinine in this study were very low (the mean of creatinine concentration was 0.46 ± 0.04 mg/dl). At first, this may be related to low weight and also low muscular mass of rats. The creatinine concentrations had no significant difference among control and experimental groups. Plasma creatinine usually is a product of the metabolism of creatine in skeletal muscle and the normal range of human plasma creatinine is 0.5-1.2mg/dl. Creatinine is easily refined in glomeruli and is not absorbed again and excretion of creatinine by the gastrointestinal system increases in progressive renal failure [15]. Second, as a result of tubular secretion of creatinine and

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the damage of the renal tissue by formaldehyde may alter the amount of creatinine in the plasma. We did not measure creatinine in rat urine, Creatinine may be excreted excessively in the urine and this has affected the plasma level in this study.

CONCLUSION

The present study demonstrated that vitamin E protected the kidney against formaldehyde -induced alterations in rat. It may be possible to use vitamin E when increased blood urea concentrations to restore urea plasma balance and prevent kidney damage.

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