

Effect Of Haemodialysis On Plasma Lipid Peroxidation And Erythrocyte Antioxidant Enzymes In Gorgan (South East Of Caspian Sea)

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Citation

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Abstract

Free radicals are formed in all living organisms during normal cell metabolism. Patients with chronic renal failure which are regularly dialyzed are candidates for free radical damage. The aim of this study was to evaluate the effect of hemodialysis on lipid peroxidation (the level of lipid peroxidation expressed as malondialdehyde) and erythrocyte antioxidant enzymes (glutathione peroxidase, superoxide dismutase) before and after the dialysis and compared with control group.

The sampling procedure was purposive sampling. 22 patients with chronic renal failure (CRF) disease who were haemodialysed at 5th azar hospital of Gorgan dialysis center and 22 age and sex matched healthy control were recruited for this study.

Plasma malondialdehyde showed significant difference between the predialysis and control group ($P < 0.001$). It was increased in the postdialysis group when compared with predialysis and control group ($P < 0.001$, $P < 0.001$). Erythrocyte antioxidant enzymes were decreased in postdialysis group when compared with predialysis and control group ($P < 0.001$, $P < 0.001$). There was also a significant difference between the control and predialysis group ($P < 0.001$). Erythrocyte antioxidant enzymes were lower in the control group in dialysis group ($P < 0.001$, $P < 0.001$).

The significant difference of erythrocyte antioxidant enzymes between pre and postdialysis group maybe related to the loss of these antioxidants through membranes during the dialysis process and the decreased antioxidant enzymes maybe related to increasing of lipid peroxidation in haemodialysed patients. This situation may play a role in the development of atherosclerosis in these group.

INTRODUCTION

Free radicals are highly reactive molecules generated by biochemical redox reactions that occur as a part of normal cell metabolism and in the course of free radical mediated diseases such as cancer, diabetes mellitus, cardiovascular and renal diseases (1). Free radicals are eliminated from the body by their interaction with antioxidant enzymes such as glutathione peroxidase, superoxide dismutase and catalase, etc. Patients with chronic renal failure, including those receiving regular long-term hemodialysis have a high incidence of premature cardiovascular disease. Oxidative stress which occurs when there is excessive free radical production or low antioxidant level, has recently been implicated as a causative factor in atherogenesis (2). Free radicals may cause lipid peroxidation and damage macromolecules and cellular structure of the organism, endothelium and erythrocytes. Some studies have shown that

hemodialysis is connected with increased free radical production (3). Cardiovascular disease is one of the major causes of mortality in hemodialysis patients with chronic renal failure. Increased lipid peroxidation and depletion of antioxidant may contribute to increased risk of atherosclerosis (4).

This study was designed to determine the effect of hemodialysis on plasma lipid peroxidation and erythrocyte antioxidant enzymes (glutathione peroxidase, superoxide dismutase) before and after the dialysis process and compared with control group.

MATERIAL AND METHODS

The sampling procedure was purposive sampling which carried out on 22 hemodialysis patients with average age of 43.54 ± 9.21 years (range 21-55). The mean length of dialysis

for each patient was 3.95 ± 0.14 hrs with average 2.27 ± 0.45 times a week. Neither of them received antioxidant medicines and foods. Patients were chosen (14 male, 8 female) from the patients referred to the department of haemodialysis in 5th azar hospital in Gorgan University of Medical Sciences, and also 22 healthy people (14 male, 8 female) for comparing were chosen (mean age 43.77 ± 9.33).

Blood samples were obtained from the patients just before and after the dialysis process of dialysis and control group, in a heparinized tubes. Plasma is separated as soon as the blood taken. The plasma urea, creatinine, lipid peroxidation (the level of lipid peroxidation expressed as malondialdehyde (MDA)) and erythrocyte glutathione peroxidase (GPx), superoxide dismutase (SOD) were determined for hemodialysis patients before and after the dialysis process and control group, using laboratory kit specterophotometry technique in the laboratory of Biochemistry (faculty of medicine). Plasma malondialdehyde was determined with Kei Satoh method (5). Erythrocyte GPx and SOD were determined with Paglia (6) and Woolliams (7) method respectively. The finding were given to software spss-10 and analyzed by student's T test analytical method. P-value less than 0.05 was considered statistically significant..

RESULTS

As shown in table 1, the average and standard deviation of plasma urea and creatinine after the dialysis process were 55.68 ± 7.96 mg/dl and 1.96 ± 0.45 mg/dl respectively which shown meaningful reduction in their concentration after the haemodialysis were done ($P < 0.001$).

Figure 1

Table 1: The mean and standard deviation of plasma urea, creatinine, malondialdehyde, erythrocyte glutathione peroxidase and superoxide dismutase

Test control	P-value	predialysis	postdialysis
Urea 26.37 ± 4.83 (mg/dl)	<0.001	123.54 ± 8.51	55.68 ± 7.96
Creatinine 1.08 ± 0.29 (mg/dl)	<0.001	15.88 ± 3.07	1.96 ± 0.45
Malondialdehyde 0.98 ± 0.17 (nmol/ml)	<0.001	1.27 ± 0.23	2.32 ± 0.38
Glutathione peroxidase 37.52 ± 6.26 (U/g Hb)	<0.001	29.66 ± 5.95	22.26 ± 4.76
Superoxide dismutase $1402.68 \pm$ (U/g Hb)	<0.001	1019 ± 20.06	951.4 ± 17.71

The average and standard deviation of plasma malondialdehyde showed significant difference between predialysis and control group ($P < 0.001$). It was significantly increased in the postdialysis group when compared with predialysis and control group ($P < 0.001$, $P < 0.001$).

The average and standard deviation of erythrocyte glutathione peroxidase (GPx) was significantly reduced in the postdialysis group when compared with predialysis and control group ($P < 0.001$, $P < 0.001$). There was also significant difference between control and predialysis group ($P < 0.001$).

The average and standard deviation of erythrocyte activity of superoxide dismutase (SOD) was significantly decreased in postdialysis group when compared with predialysis and control group ($P < 0.001$, $P < 0.001$). It was also significant difference between predialysis and control group ($P < 0.001$).

DISCUSSION

There are varying reports on changes in plasma lipid peroxidation and erythrocyte antioxidant enzymes due to hemodialysis. Some of the studies showed an increase while some other showed a decrease. There are a few reports describing difference in plasma lipid peroxidation and erythrocyte antioxidant enzymes between healthy control and patients on dialysis therapy.

Canestrari et al (8) reported that the level of plasma malondialdehyde in hemodialysis patients was higher than healthy controls. A study by Samouilidou et al (9) on 31 hemodialysis patients and 17 control group showed that plasma malondialdehyde of haemodialysis patients increased in the predialysis group when compared with postdialysis group. But the level of plasma malondialdehyde was higher in control groups when compared with the postdialysis group. Ozden (10), Taylor (11), Toborek (12), Loughrey (2), and Balashova (13) et al reported that the level of plasma malondialdehyde in hemodialysis patients increased when compared with control groups.

In our study we determined the level of plasma malondialdehyde of hemodialysis patients before and after the dialysis process. Our results show a significant increase of plasma malondialdehyde in the postdialysis group when compared with the predialysis group ($P < 0.001$). There was a significant difference between the dialysis group (pre-, post-) and control group ($P < 0.001$, $P < 0.001$). Our results are in agreement with the groups mentioned in that the plasma level of malondialdehyde of haemodialysis patients is

significantly different from that of controls.

Oxidative damage can cause by the imbalance between the production of free radicals and the countering effect of the various antioxidant enzymes. Some studies show that activities of antioxidant enzymes change in hemodialysis patients due to the dialysis process. There are varying reports on the erythrocyte activities of enzymes glutathione peroxidase and superoxide dismutase.

Durak⁽¹⁴⁾, Baanefont-Rouselut⁽¹⁵⁾, Mimic-oka⁽¹⁶⁾ and Weinstein et al ⁽¹⁷⁾ reported an increased erythrocyte glutathione peroxidase activities and no change in level of erythrocyte superoxide dismutase enzymes due to haemodialysis.

Study of Balashova et al ⁽¹³⁾ showed no change of activities of erythrocyte glutathione peroxidase and a decreased activities of erythrocyte superoxide dismutase of haemodialysis patients.

Salamunic et al ⁽¹⁸⁾ reported that the mean catalytic concentrations of glutathione peroxidase were decreased and the mean catalytic concentrations of superoxide dismutase increased in patients before hemodialysis when compared with control values. The mean catalytic concentrations of superoxide dismutase returned to control range, while those of glutathione peroxidase still decreased compared to control values.

Kose et al ⁽¹⁹⁾ reported an increased erythrocyte glutathione peroxidase and superoxide dismutase activities in postdialysis group when compared with predialysis group. But there was a decreasing of these enzymes in postdialysis group when compared with control group.

In our study we showed significant reducing of erythrocyte glutathione peroxidase and superoxide dismutase in postdialysis group when compared with predialysis group ($P < 0.001$). It was also significantly reduced in the predialysis group when compared with control group ($P < 0.001$). The results of our study show the significant difference of antioxidant enzymes between pre and postdialysis group is thought to be related with the loss of antioxidant enzymes through the membranes and the decreased antioxidant enzymes maybe related to increasing of lipid peroxidation in hemodialysed patients. This situation may play a role in the development of atherosclerosis in haemodialysed groups. This study provides evidence that increased lipid peroxidation in hemodialysed patients is

related to the dialysis process treatment rather than the disease itself.

For this reason new approaches in dialysis membranes, hemodialysis techniques and using of different exogenous supplementation of antioxidant, removing of reactive oxygen species are important in improvement of haemodialysis patients' life qualities.

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