ORIGINAL ARTICLE

Comparative study of oxidative stress in peritoneal dialysis and hemodialysis patients

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Background. Two general types of extrarenal depuration are used in patients with terminal uremia – peritoneal dialysis (CAPD) and hemodialysis (HD). All uremic patients are exposed to oxidative stress, due to uremia "per se" and some artificial materials are suspected as well, but not surely proved.

Material and methods. The study compares some plasma markers of oxidative stress in 22 patients on CAPD (1st group) (12 males and 10 females) and 22 HD patients (2nd group), (12 males and 10 females) more than 24 months on dialysis: MDA and oxidized LDL (ELISA) and, of antioxidant activity: enzymatic - glutathione peroxidase (GPx) (enzymatic assay): and non-enzymatic factors: vitamin E and vitamin C (HPLC). All patients - non-diabetic and without peritonitis – were tested for above mentioned biochemical markers (before HD for the 2nd group).

Results. The existence of oxidative stress was proved to be in both groups. CAPD patients had lower levels of markers of oxidative stress (NS) and significantly higher antioxidant activity for vitamin E and GPx ($p<0.01$ and $p<0.01$ respectively) compared to patients in HD group. The measured values for 1st /2nd group were: MDA 6.01±0.33μmol/l versus 6.21±0.23μmol/l (p: NS); oxidized LDL 350±230mU/ml versus 366±252mU/ml (p: NS); GPx 18.8±5.8 μmol/Hb versus 14.8±4.7μmol/Hb ($p<0.01$) and vitamin E 24.7±4.4 μmol/l versus 20.8±5.3μmol/l ($p<0.01$); vitamin C 52.12±26.2 μmol/l versus 50.2±25.6 μmol/l (p: NS)

Conclusion. The findings suggest that uremia is playing the main role in oxidative damages even in dialysis faze of chronic renal failure, but CAPD seems to be slightly more bio-compatible than conventional HD, probably because of the greater number of artificial materials used in the latter. In conclusion dialysis patients more or less need some kind of antioxidant treatment in both dialysis procedures – CAPD or HD despite CAPD has some advantages.

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Two general types of extrarenal depurations are used in patients with terminal uremia – CAPD and HD. All uremic patients are perhaps exposed to oxidative stress due to uremia "per se", as uremia was recently characterised as chronic inflammatory status[1-4]. Oxidative stress is a kind of "disequilibrium" syndrome where the reactive oxygen species (ROS) are enormously yielded and are not fully neutralized by a number of antioxidant agents[3-6]. The problem is emerging in uremia probably because ROS are produced in an increased quantity and there is a deficit of antioxidant agents synthesis[1,2]. Dialysis procedure has also some influence on development or augmentation of oxidative stress, especially some effects of artificial materials: hemodialysis membranes, tubs, peritoneal kateters etc. Data on similarity or difference between oxidative stress manifestation in patients on CAPD or HD are still quite controversial[7-9].

The aim of the study was to find out if there are changes in the serum levels of substances increasing ROS as well as of substances acting against ROS production - action in uremic patients on CAPD or HD and if there is any difference between the two groups.

Materials and methods

We measured in 22 patients on CAPD (1st group), 12 males and 10 females with a mean age 44±14 years and 22 patients on HD (2nd group), 12 males and 10 females with a mean age 47±15 years, some serum markers of oxidative stress (lipid peroxidation): malonedialdehyde (MDA) and oxidized LDL (o-LDL) (ELISA) and; some markers of antioxidant activity: a. glutathion peroxidase (GPx) (enzymatic assay): and b. non-enzymatuic factors: vitamin E and vitamin C (HPLC). All patients were tested before a dialysis session. All of them were for more than 24 months on dialysis, they were not diabetics and they had not recent episode of peritonitis.

Data were evaluated by Student t-test, analysis of variance and linear regression and are expressed as mean±SD.

Results

Oxidative stress was present in both groups, as it is shown by the decreased levels of GPx, vitamin E and vitamin C and increased MDA and o-LDL (Table 1). Evidently there was no difference between serum levels of oxidative stress markers MDA and o-LDL in both groups. Antioxidant markers however were lower in HD patients than in CAPD, except levels of vitamin C (Fig. 1 and 2).

Table 1. *Mean values of MDA, O-LDL, GPx, Vit E and Vit C in CAPD and HD patients*

Group No	MDA mcmol/l	o-LDL mU/ml	GPx mcmol/Hb	Vit.E mcmol/l	Vit.C mcmol/l
1st (CAPD)	6.01 ± 0.33	350±230	18.8±5.8	24.7±4.4	52.12±26.2
2nd (HD)	6.21±0.23	366±366	14.8±4.7	20.8±5.3	50.20±25.6
p	NS	NS	0.01	0.01	NS

NS: not significant

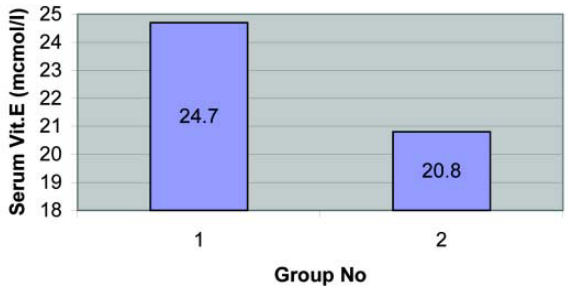

Figure 1. *Serum levels of Vit. E in CAPD (1) and HD (2) patients*

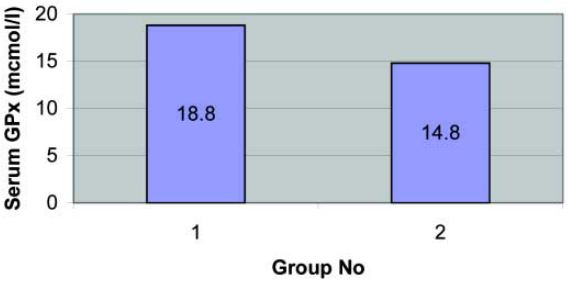

Figure 2. *Serum levels of GPx in CAPD (1) and HD (2) patients*

Discussion

In all biological membranes there are large amounts of polyunsaturated fatty acids associated with membrane proteins. Peroxidation of them can disrupt the structure and function of membranes[10-13]. Malondialdehyde (MDA) and oxidized LDL are two of the markers of peroxidation found increased in uremia and in dialysis patients.

There are endogenous and exogenous antioxidant systems which limit peroxidation activity and maintain a control system. The most important antioxidant endogenous systems are superoxide dismutase, catalase and glutathione peroxidase. The glutathione antioxidant system is formed by reduced glutathione and glutathione reductase enzyme activity which reduced systematic oxidised glutathion; Transferrin and ceruloplasmin are antioxidant proteins. Exogenous antioxidants are vitamins A, C and E, as well as copper and selenium metals. The latter is a cofactor of glutathione peroxidase enzyme[14-17]. Glutathione peroxidase (GPx), a selenoenzyme, vitamin E and vitamin C are a part of the cellular antioxidant system and their serum levels could be used to evaluate the enzymatic and non-enzymatic antioxidant activity that may be affected in dialysis patients as well[8,14,15,18,19].

Our study found decreased levels of GPx, vitamin E and vitamin C and increased MDA and o-LDL in all investigated dialysis patients. It suggests that oxidative stress is a common event in end stage renal failure no matter what kind of dialysis is used for maintaining patient's life. On the other hand, there was no difference between serum levels of increased oxidative stress markers MDA and o-LDL in the compared groups (CAPD and HD); antioxidant markers GPx and vitamin E however were lower in HD patients than in CAPD patients. The late could be due to the use of much more artificial materials in hemodialysis procedure, forcing suppression of antioxidant agents synthesis. In conclusion we can say that all patients treated by dialysis need treatment of oxidative stress with hemodialysis patients requiring more aggressive therapy than these on peritoneal dialysis due to the existence of more aggressive artificial provokers of this status.

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