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Original Article

Effect of oxidative stress in pre and post hemodialysis in chronic renal failure patients

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ABSTRACT

This study was undertaken to evaluate the effect of oxidative stress in chronic renal failure patients before and after hemodialysis. The study comprised of 30 hemodialysis patients compared with 30 healthy controls. Blood samples were obtained from the patients before starting dialysis and one month later samples were collected from the same patients. Malondialdehyde (MDA) showed significant increase ($p<0.001$) in post dialysis compared to pre dialysis patients. Antioxidant enzymes such as superoxide dismutase, catalase, reduced glutathione, glutathione peroxidase were significantly reduced in post dialysis ($p<0.001$) compared to pre dialysis and control group. The result of our study have shown a decrease in antioxidant enzyme activity in pre & post hemodialysis patients which is thought to be related to the loss of antioxidant enzymes through the membrane leading to increased lipid peroxidation.

1.Introduction

Chronic renal failure (CRF) is a common clinical syndrome characterized by decline in glomerular filtration, perturbation of extracellular fluid volume, electrolyte and acid base homeostasis and retention of nitrogenous waste from protein catabolism. CRF is often a complication of sepsis, trauma or multiple organ dysfunctions. The primary event leading to renal failure is a free radical mediated injury to the endothelial cells in the outer medulla. In recent years Hemodialysis has been successful in extending life span of renal patients and is effective in correcting the metabolic abnormalities related to renal oxidative stress that contributes to morbidity in Hemodialysis patients [1]. Oxidative stress due to the overproduction of ROS (Reactive Oxygen Species) and impairment in antioxidant defense mechanisms have been suggested as possible factors contributing to the pathogenesis of atherosclerosis in patients with end stage renal disease. Oxidative stress causes imbalance between Reactive Oxygen Species (ROS) generation and antioxidant system that scavenge or reduce ROS concentration. Redox imbalance caused by increased ROS production and/or reduced antioxidant reserve leads to pathological consequences including damage to proteins, lipids and DNA [2].

Factors like exposure of blood to dialysis membrane, high risk of acute and chronic infections and dietary limitations in the intake of the antioxidant vitamins make dialysis patients on dialysis susceptible to more oxidative stress [3].

Free radicals are atoms or molecule that contains one or more unpaired electrons. The presence of unpaired electrons make the species highly reactive. They play an important role in human diseases. Free radicals include free oxygen related reaction compounds collectively known as "Reactive Oxygen Species" (ROS).The reactive oxygen includes superoxide, hydrogen peroxide (H_2O_2), hydroxyl ($OH^{\cdot}$) and the superoxide radicals which is formed when electrons leak from the electron transport chain. The dismutation of superoxide ($O_2^{\cdot}$) results in the formation of hydrogen peroxide. The hydroxyl ion is highly reactive and can modify purines and pyrimidines that cause strand breaks resulting in DNA damage. Some oxidase enzymes can directly generate the hydrogen peroxide radical.

Free radicals result in peroxidation of polyunsaturated fatty acids in the cell membrane and subsequent generation of further unstable radicals leading to a chain of events. This attack makes cell membrane leaky and the functions of absorption and secretion are lost that finally leads to cell death [4].

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In chronic renal failure (CRF) patients, the balance between pro oxidant and anti oxidant capacity is shifted towards an increased oxidative stress. Hemodialysis [HD] may include repetitive bouts of oxidative stress, primarily through membrane and endotoxin challenge while alterations in pro and anti oxidant capacity starts during the early stages of CRF which are more pronounced in patients on dialysis.

Therefore this study was carried out to evaluate the lipid peroxidation and antioxidant enzyme activities in patients with chronic renal failure before and after hemodialysis.

2. Materials and Methods

The study includes 30 Hemodialysis patients with average age 45 ± 15. All patients were dialyzed for 4 ± 1 hour with average 2 ± 1 times a week. Subjects chosen were (20 Males, 10 Females) from the patients attending Nephrology department SRM Medical college Hospital and Research centre. The control group comprised of 30 healthy volunteers (20 males, 10 females).

Blood samples were obtained from the concerned patients before starting Hemodialysis and samples were collected one month later from the same patients and analyzed for the following parameters. Plasma Malondialdehyde (MDA) was estimated by the method [5]. Erythrocyte glutathione peroxidase (GPX) was estimated by the method [6]. Superoxide dismutase (SOD) was determined by the method [7]. Catalase was measured by the method of [8] and reduced glutathione was determined by the method of [9].

The diagnosis was based on history, detailed clinical examination and relevant laboratory investigation. Informed consent was obtained form each patient before sample collection.

2.1.Statistical analysis

Data are expressed as mean ± SD and analyzed with SPSS program 10. Student's t-test was used to compare the groups. The level of statistical significance was set at p<0.001.

3. Results

As shown in Table 1, the average and standard deviation of plasma urea and creatinine after the dialysis process were 55.68 ± 7.96mg/dl and 1.96 ± 0.45mg/dl respectively which showed significant reduction in their concentration after Hemodialysis [p< 0.001].

The average and standard deviation of plasma malondialdehyde showed significant difference between pre-dialysis and control group [p<0 .001]. It was significantly increased in the post-dialysis group when compared with pre dialysis and control group [p<0.001]. Post Hemodialysis plasma MDA showed non significant rise when compared to pre Hemodialysis level. And a significant rise when compared to control.

Table 1 : Levels of parameter studied in CRF patients before and after hemodialysis and in healthy controls.

Test	Pre dialysis	Post dialysis	Control
Urea(mg/dl)	123.5 ± 8.51**	55.68± 7.96**	18.3 ± 2.25
Creatinine(mg/dl)	9.59±1.50**	3.8±2.75**	0.85±0.096
Plasma MDA (nmol/ml)	3.89 ± 0.35**	3.93 ± 0.31**	16.2 ± 5.54
Superoxide dismutase (u/gHb)	1055 ± 65*	1019± 38*	1254 ± 98
Catalase(u/gHb)	2.1 ± 1.10*	1.4 ± 0.85*	8.2 ± 3.32
Glutathione peroxidase (u/gHb)	33.7 ± 11.04**	22.4 ± 11.32	43.1 ± 14.82
Reduced glutathione (u/gHb)	16.7 ± 5.44**	12.4 ± 5.32**	22 ± .2 .68

**p< 0.001

The average and standard deviation of erythrocyte glutathione peroxidase activity [GPx] was significantly reduced in the post dialysis group when compared with pre dialysis and control group [p< 0.001.]. There was also a significant difference between pre dialysis and control group [p< 0.001]

As compared to pre hemodialysis patients the levels of SOD were non-significantly altered in post hemodialysis sample (p<0.01) while compared with controls the level of this parameters were significantly decreased in post hemodialysis sample. While the erythrocyte activity of catalase and reduced glutathione was significantly reduced in post dialysis when compared with pre-dialysis and control group (p< 0.001). There was also a significant difference between pre-dialysis and control group.

4. Discussion

There are varying reports on changes in plasma lipid peroxidation and erythrocyte antioxidant enzyme due to hemodialysis. Some studies showed an increase while some show a decrease in the levels. In our study we determined the level of plasma malondialdehyde of hemodialysis patients before and after dialysis. Our results show a significant increase of plasma malondialdehyde in the post dialysis group when compared with the pre-dialysis group. There was also a significant difference between the dialysis group (pre and post) compared to the control group.The plasma malondialdehyde of hemodialysis patients is increased in pre dialysis group when compared with post dialysis group. Oxidative damage can be caused by the imbalance between the production of free radicals and the countering effect of various anti oxidant enzymes [10].

In our study we observed a significant reduction in erythrocyte glutathione peroxidase in post-dialysis group when compared with pre-dialysis group and also a significant reduction in the pre-dialysis group when compared with control group. Weinstein etal [11]. reported an increased erythrocyte activity of glutathione peroxidase. In our study we have obtained decreased erythrocyte catalase activity in post dialysis when compared with pre dialysis and control group.

The time duration of one month adopted between dialysis showed a significant difference occurred between pre dialysis and post dialysis and is believed to be the real change than that observed immediately after dialysis on the same day. As the body has to adapt to the dialyzer membrane during this time interval, there is loss of antioxidant enzyme through the membrane.

Thus the results of our study shows that significant difference of antioxidant enzymes between pre and post dialysis group is thought to be related with the loss of antioxidant enzymes through the membrane and the decreased antioxidant enzymes may be related to increased of lipid peroxidation in hemodialysed patient.

5. Conclusion

Our results suggest that in CRF patients undergoing hemodialysis, oxidants and antioxidants play a vital role in the pathogenesis of disease. The result shows increased ROS accompanied by decreased antioxidant defence in CRF patients on hemodialysis. New approaches in dialysis membranes, hemodialysis techniques and usage of different exogenous supplementation of antioxidants, for removal of ROS are important in improvement of life qualities of hemodialysis patients

6. References

[1] Jackson P, Loughrey CM, lightbody JH, Mc Namee PT, Young IS . Effect of haemodialysis on total anti oxidant capacity and serum anti oxidants in patients with chronic renal failure. Clin chem.1995;41(8 pt1)1135-1138.

[2] Samouilidou E,Grapsa E. Effect of dialysis on plasma total anti oxidant capacity and lipid peroxidation products in patients with end stage renal failure. Blood purif.2003;21(3)209-212.

[3] Durak I, Akyol O, Basesme E, Canbolat O, Kavutcu M. Reduced defence mechanism against free radical toxicity in patients with chronic renal failure. Nephron. 1994;66:76 – 80.

[4] Taylor JE, Scott N, Bridges A, Henderson IS, Stewart WK, Belch JJ. Lipid peroxidation and anti oxidants in continous ambulatory dialysis patients. Perit.Dial.Int.1992;12(2):252-256.

[5] Yagi K. Lipid peroxides and human diseases. Chem phys Lipids. 1978; 45: 337-351.

[6] Rotruck JT, Pope AL, Ganther HE, Swanson AB, Hafeman DG, Hoekstra WG. Selenium: biochemical roles as a component of glutathione peroxidase. Science. 1973;179:588-590.

[7] Misra HP, Fridovich I The role of superoxide anion in the auto-oxalation of epinephrine and a simple assay for superoxide dismutase. J Biol Chem. 1972; 247:3170-3175.

[8] Sinha K.A Colorimetric assay of catalase. Anal Biochem. 1972; 47:389-394.

[9] Ellman Gl. Tissue sulfhdryl groups. Arch Biochem Biopsys. 1959; 82:70-77.

[10] Massy AZ, Nguyen-Khoa T. Oxidative stress and chronic renal failure, markers and management. J. Nephrol 2002; 15: 336-341.

[11] Weinstein T, Chagnac A, Korzets A, Boaz M, Ori Y, Herman M, Malachi T, Gafter U. Haemolysis in haemodialysis patients :Evidence for impaired defence mechanisms against oxidative stress . Nephrology Dialysis transplantation .2000;15(6),883 – 887.