Table 5: Comparison of specific biochemical parameters in hemodialysis group pre-and post-dialysis

Parameters	*Pre-dialysis*	*Post-dialysis*	*P*
Retinol (µmol/L) X±SD Range	3.78±0.9 (2.5-5.58)	5.5±1.0 (3.47-8.87)	<0.001
MDA (nmol/ml) X±SD Range	161.4±30.9 (85.71-224.39)	206.8±56.6 (134.84-303.91)	<0.001
SOD (U/L) X±SD Range	46.8±5.1 (37.8-58.2)	55.7±5.9 (47.4 - 64.8)	<0.001
CAT (mmol/L) X±SD Range	128.2±47.5 (47.41-198.86)	164.1±33.5 (102.27-225.9)	<0.001
ALAD (U/L) X±SD Range	14.99±0.68 (14.32-16.63)	12.1±0.8 (11.0-13.41)	<0.001

MDA: Malondialdehyde **SOD**: Superoxide dismutase **CAT:** Catalase **ALA-D**: Aminolevulinate dehydretase

Table 6: Correlation coefficient of plasma retinol (µmol/L) versus some studied parameters in group III after hemodialysis

Item	*Retinol (µmol/L)*	
	r	*P*
MDA **(nmol/ml)**	0.66	< 0.001
SOD **(U/L)**	0.48	< 0.001
CAT **(mmol/L)**	0.52	< 0.001
ALA-D (U/L)	-0.65	< 0.001

MDA: Malondialdehyde **SOD**: Superoxide dismutase **CAT:** Catalase **ALA-D**: Aminolevulinate dehydretase

4. Discussion

Chronic renal failure is a pro-oxidant state, characterized by increased levels of free radical oxidants relative to antioxidants [**13**]. Hemodialysis leads to significant changes in the antioxidant system of the blood of patients with CRF. The effect is noticeable with antioxidant enzyme activities and concentrations of nonenzymatic components of the system [**14**]**.** Retinoids have redox-related properties and they influence the oxidative status of the cell. Increased concentrations of malondialdehyde (MDA)-intermediate product of oxidation of polyunsaturated fatty acids have been reported in the plasma and erythrocytes, as well as in platelets and mononuclear cells of hemodialyzed patients [**15**].

The aim of the present work was designed to study the possible influence of plasma retinol levels on classical oxidative stress blood biomarkers as antioxidant enzymes activity include: (SOD and CAT levels), lipid peroxidation biomarkers include: malondialdehyde (MDA) and erythrocyte ALA-D activity include: δ-aminolevulinate dehydratase in HD patients before and after dialysis compared to healthy subjects and chronic renal impairment patients. Also, we evaluate the effect of dialysis on oxidative stress.

In both chronic renal impairment and hemodialysis patients the systolic and diastolic blood pressure were significantly higher than the control group that may point to a pathogenic role of hypertension, among other factors, in the development of vascular and renal diseases. In both chronic renal impairment and hemodialysis patients serum uric acid, serum creatinine and blood urea were significantly higher than control group. Also, serum creatinine and blood urea were significantly increased in hemodialysis group before the first session compared with chronic renal impairment patients. Both uremic markers were significantly decreased in patients after hemodialysis compared with the patients before dialysis. Creatinine clearance was significantly decreased in studied groups compared with control group.

Low clearance values for creatinine and urea indicate a diminished ability of the kidneys to filter these waste products from the blood and to excrete them in the urine. As clearance levels decrease, blood levels of creatinine and urea nitrogen increase. Since it can be affected by other factors, an elevated blood urea alone is certainly suggestive for kidney dysfunction. However, it is not diagnostic. An abnormally elevated blood creatinine, a more specific and sensitive indicator of kidney disease than the BUN, is diagnostic of impaired kidney function [**16**].

The levels of plasma retinol were highly increased in hemodialysis patients after three months of regular dialysis when compared to the same patients before hemodialysis. Plasma malondialdehyde (MDA) levels, the biomarker of lipid peroxidation, were also high significantly increased in patients after hemodialysis compared with the same patients before hemodialysis. This result is in agreement with **Roehrs et al** who reported in their results, plasma retinol levels have significantly increased in HD patients compared to healthy subjects [**17**]. Also, they reported that the plasma MDA levels, the biomarker of lipid peroxidation, were significantly increased in HD patients. There was a positive correlation between plasma levels of retinol and MDA, this supports this connection between CKD and oxidative stress. There is increasing evidence that oxygen radicals are involved in the progression of renal damage and of uremic symptoms [**18**].

Lipid peroxidation products (MDA and 4-Hydroxnonenal) were higher in CRF patients under hemodialysis compared with those on conservative treatment though this difference did not reach a significant value. This difference in lipid peroxidation markers in hemodialysis patients than in CRF patients on conservative treatment suggests that hemodialysis may be a cause of oxidative stress due to the activation of polymorphonuclear neutrophil leukocytes (PMNLs) through contact of blood with the dialysis membranes **[19]**.

Hemodialysis may induce repetitive bouts of oxidative stress, primarily through membrane bioincompatability and endotoxin challenge. While alterations in pro- and anti-oxidant capacity start during the early stages of CRF, they are most pronounced in patients who are on dialysis. Overall, there is some controversy as to whether the onset of regular dialysis improves or worsens oxidative stress [**20**]**.**

Taccone-Gallucci, et al. observed evidence for elevated lipid peroxidation in the erythrocyte membranes of patients with serum creatinine > 5.0 mg/dl. It is interesting that these patients were not on dialysis. This suggests that the lipid peroxidation abnormality is related to renal failure rather than the process of dialysis [**21**].

In this study, activities of erythrocyte enzymes that scavenge superoxide radicals (SOD) and catalase (CAT) were measured in HD patients and controls. These results demonstrated highly significant increase of the blood SOD and CAT activity in patients after dialysis when compared to the patients before hemodialysis. Also, superoxide dismutase (SOD) activity and catalase activity (CAT) were significantly increased in studied groups when compared to controls. **Roehrs and his workers** suggested that there was significantly increased in SOD activity in HD patients compared to healthy subjects [**17**]. There was a positive correlation between plasma levels of retinol and superoxide dismutase (SOD). Also, there was a positive correlation between plasma levels of retinol and catalase (CAT)

The aminolevulinate dehydratase (ALA-D) activity also was significantly decreased in patients before hemodialysis compared with patients after dialysis. The aminolevulinate dehydratase (ALA-D) activity also was significantly decreased in dialysis group compared to healthy group. There was a negative correlation between plasma levels of retinol and ALA-D in the patients after hemodialysis.

The present study showed that plasma retinol levels and plasma malondialdehyde (MDA) levels were significantly increased in dialysis patients compared to healthy subjects. Also, our study showed that the SOD-activity was significantly higher in dialysis patients compared to healthy subjects, and CAT activity also was significantly higher in dialysis patients compared to healthy subjects. These results are in accordance with those of older studies [**22,23**].

Several publications describing enzyme participation in free radical metabolism have yielded wrong and mixed results. **Roehrs et al** explained this by adaptative mechanisms to oxidative stress [**17**]. This mechanism can also be explained by another finding, in accordance with **Murata and Kawanishi,** who demonstrated the increase of O_2^- and H_2O_2 by retinol increase [**24**]. Our results tend to confirm these observations. The activities of these enzymes (CAT and SOD) were significantly with the retinol levels.

Failure of the kidney to metabolize retinol to retinoic acid may cause diminished excretion via bile and urine, thus leading to accumulation of retinol in chronic renal failure (CRF) [**25**].

In this study our result also, found that an increased with retinol, MDA, SOD and CAT parameters compared with ALA-D had decreased after dialysis. In contrast, the HD procedure had no significant effect on plasma retinol level. As it is a lipid soluble compound, so significant dialytic clearance of plasma retinol is not expected [**26**].

Ajala et al. in his study, found that a significant increase in MDA were observed, which is the measurement of secondary products of lipid peroxidation and a significant decrease in total antioxidant status in chronic renal failure patient after dialysis [**27**].

This finding supports most of the previously published findings that the hemodialysis procedure alters lipid peroxidation and the antioxidant status. Some researchers have reported increased status [**28**], while some have recorded reduction [**29**], and others were equivocal [**30**] on MDA levels after hemodialysis. However, **Peuchant et al.** (**1994**) reported low post-hemodialysis MDA in contrast to increased MDA reported in studies where less specific analytical techniques were used [**31**].

Our study demonstrated that before dialysis patients had low MDA levels and high antioxidant status, but after dialysis samples gave an opposite levels of the analytes. In study done by **Derici U et al.** of patients with chronic renal failure that had peritoneal dialysis, they observed high MDA levels and low antioxidant capacity [**32**]. There seems to be no significant difference in the serum level of oxidative stress indices between peritoneal dialysis and hemodialysis patients regardless of the structure of the dialysis membranes used. The use of vitamin E-coated membranes could help minimize the increased oxidative stress and the attendant risk of atherosclerosis in dialysis patients. **Mune et al.** have shown that the use of vitamin E-coated cellulose membrane dialyzers for 6 months resulted in a significant reduction in low density lipoprotein, oxidized-LDL, and eventually low peroxidation compared to the ordinary cellulose membrane dialyzer [**33**]. In order to decrease membrane bioincompatibility, and thereby minimize oxidative stress in hemodialysis patients, more compatible filters have been elaborated. Preliminary characterization of vitamin E-coated membranes has shown decreased activation of polymorphonuclear cells and monocytes, lower free radical production, and high biocompatibility [**27**]. Due to this conflict of information, more studies regarding the action of retinol are still needed since there are several therapies based on the use of retinol for several diseases [**34**].

5. Conclusion

From the present study we could conclude that there was a significant difference in antioxidant capacity before and after hemodialysis. There is loss of antioxidant during the course of hemodialysis, probably through the dialyzer membranes or generation of free radicals on the surface of dialyzer membranes or both. The decreased antioxidant capacity could be related to increasing lipid peroxidation in hemodialysed patients as there was a positive correlation between high plasma retinol levels and lipid peroxidation and also the induction of antioxidant enzyme activity and inhibition of thiol group-dependent enzyme, ALA-D, increase of plasma retinol levels in HD patients tends to act as additional effect, as a pro-oxidant agent.

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