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The Effect of Oxidative Stress and Some Biochemical Parameter in a Sample of Iraqi Chronic Renal Failure Patients in Baghdad Governorate

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Abstract: The decrease ability of a biological system to resist the excessive generation of free radicals and reactive species is an indicator of oxidative stress. The kidney is a high metabolic organ more susceptible to oxidative damage stress because of its high level of oxidation processes inside the mitochondria. The study's aim the role of oxidative stress in Chronic kidney disease patients by evaluating malondialdehyde and glutathione in the serum and some biochemical parameters the study included blood samples from 120 patients were collected from chronic kidney disease in the end stage and arranged into the following two groups: Group 1 consists of 60 samples from chronic kidney disease patients, Group 2 of 60 samples controls who appear to be in healthy control people. Malondialdehyde and Glutathione determined by using ELISA Kit assay. The routine test includes serum urea, serum creatinine, sodium, potassium, calcium and phosphor were detected using an automatic biochemical analyzer. Malondialdehyde levels were noticeably higher significant increase with ($p>0.01$) between patients group and control, while Glutathione serum noticeably reduced significantly. The levels of urea, creatinine, phosphor and potassium in serum were showed high significant increase with ($p>0.01$) patients group compared to other control groups while the levels of calcium and sodium show low significant when compered patients group to other control groups It was concluded Glutathione was reduced signification in chronic kidney disease patients and associated with the negatively level of Malondialdehyde. This suggests that oxidative stress in chronic kidney disease patients is strongly influenced by antioxidants, mostly Glutathione.

Keywords: Chronic kidney disease patients, Malondialdehyde, Glutathione.

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Introduction

The reduced ability of a biological system as a defense against excessive production of reactive species (RS) and free radicals (FR) is an indicator of oxidative stress (1). Patients with chronic kidney disease (CKD) typically have reduced anti oxidative systems, which worsen gradually with the degree of renal failure. Renal failure sometimes referred to as end-stage kidney disease, where capacity for kidney become 15% less than the normal levels (2). Linked to a higher risk of mortality as well as consequences in other organ systems(3). Under normal conditions, ROS are present inside cells in very small percentages for redox signaling; nevertheless, when their levels are high, they can cause severe oxidative damage to cellular compartments (4). Oxidative stress (OS) is a critical defense

mechanism against infections but if not properly regulated they may start a number of harmful effects such as cytokine overproduction and an increase in oxidative stress mediators (5). Malondieldehyde is the end product of polyunsaturated fatty acids peroxidation in the cells, thus, an excess of MDA is generated due to an increase in free radicals (6). Glutathione is tripeptide; it is first line of defense against oxidative damage and is necessary for maintaining redox balance and protecting cells from oxidative damage(7).

Serum creatinine and blood urea are accurate indications of renal function, and elevated serum creatinine suggests a dysfunctional kidney (8). Urea is a uraemic retention indicator in. On the other hand, at concentrations common of chronic kidney disease, urea is toxic. First, urea itself causes molecular alterations linked to apoptosis, insulin resistance, the generation of free radicals, and the breakdown of the intestinal barrier. Second, the compounds cyanate, ammonia, and carbamylated, which have all been linked to biological changes are derived from urea (9). Creatinine, a kind of creatine is found in muscle and is a sign of a healthy kidney(10). It is a metabolic waste product derived from creatine phosphate, and its levels depend on by the total muscle mass in the body. This factor remains unaffected by diet, age. A renal function impairment is indicated by creatinine level during exercise greater than 1.5 mg/dl (11). potassium is The most common cation in intracellular fluid is Hyperkalaemia is therefore more likely to occur in individuals with chronic renal failure, who have compromised regulatory systems. sodium is one of mineral that aids in maintaining the proper balance of bodily fluids is sodium. It also supports healthy neuron and function of muscles. The kidneys assist the body in keeping its salt levels in balance (12). minerals like calcium and phosphate are essential for good health. Together, they support healthy cell and neuron function as well as the growth of strong bones and teeth. Hyperphosphatemia levels are the main causes of arterial wall calcification in people with renal disease (13).

This study aimed to evaluate the level malondialdehyde (MDA) and Glutathione (GSH) as well as a number of biochemical markers in Iraqi renal failure patients in Baghdad governorate.

Materials and methods

The five ml of blood sample from patients with CKD stage 5 and control heath group were collected form Iraqi Dialysis Center and the Medical City Center. The study included a total 120 blood samples into the following two groups: Group 1 consists of 60 samples from Chronic kidney disease patients, Group 2 of 60 samples from controls who appear to be in healthy control people. Plain vacutainer tubes were used to collect blood samples. Serum was used to estimate urea, creatinine, sodium, phosphorus potassium and serum calcium after that the blood samples were centrifuged at 3000 rpm for 10 min to biochemical analysis by Automatic SIMENS Atellica CH Analyzer, USA. All the study experiments were performed at the Institute of Genetic Engineering and Biotechnology for Postgraduate Studies/University of Baghdad. The study excluded cases suffering from other chronic diseases having defective kidney function and acute kidney disease. Serum malondialdehyde and serum glutathione determined by using

competitive ELISA Kit Ela science®, USA.

Statistical analysis

To compere mean of sample using t-test to clarification the relationship between the MDA and GSH. The program that has been used the Statistical Packages of Social Sciences-SPSS 2019 **(**14**)**. It is used to statistical analysis the biochemical difference between the chronic kidney disease patients and control group.

Results and discussion

Kidney function parameter (creatinine, urea)

The CKD patients were showed the high significant (P≤0.01) of serum creatinine than the heath control patients. The mean of the serum creatinine of CKD 6.35 ±0.22mg/dl when compared to the control heath group 0.711 ±0.02 mg/dl the illustrated in the (Table 1). The result showed the high significant (P≤0.01) elevated serum urea in the CKD the mean of the patients 106.15 ±3.23 when compere to the control and The present study supports a similar study (15) who found that the high level of creatinine because in CKD patients, renal excretion, tubular secretion and creatinine degradation diminish, leading to elevated creatinine levels. Additionally, meat consumption and protein supplementation may further increase serum creatinine. Another cause could be the use of drugs that prevent tubular creatinine secretion and decrease creatinine digestion in the intestines (15).

Table (1): Comparison between difference group in urea and creatinine

Group	Mean ±SE	
	Urea (mg/dl)	Creatinine (mg/dl)
Patients	106.15 ±3.23	6.35 ±0.22
Control	31.09 ±0.58	0.711 ±0.02
T-test	6.501 **	0.449 **
P-value	0.0001	0.0001
** (P≤0.01).		

Urea is excreted by kidneys therefore the level of urea nitrogen in blood has a direct association with excretory function of kidney, in chronic renal disease, the kidney is unable to excrete urea. The inability of urea excretion is according to damage in the kidney itself, resulting in tubular necrosis and loss the ability of filtering so its concentration in blood increase(16). In CKD processes of a vicious circle by inducing the retention of urea, which is directly toxic and a source of carbamylated compounds, which catalyses carbamylation, that enhance inflammation. Although the metabolic generation of Urea can be considered as quite straight forward, as it is the final product of amino acid metabolism. The gastrointestinal system plays a vital role in the digestion of proteins, which leads to the formation of urea and the production of ammonia(17).

Patients with chronic kidney disease (CKD) suffer elevated levels of urea and creatinine due to the kidney's reduced ability to remove nitrogenous waste from the blood. As a result, this substance accumulates inside of the blood. Other causes of elevated blood levels of these substances include excessive protein intake, shock, and gastrointestinal hemorrhage (18).

Kidney function parameter (Ca, PO_4, Na and K)

The level of the calcium in this study showed highly significant decrease in CKD patient when compare with control group, showed in (Table 3) the mean of the Ca in the CKD 7.08 ±0.14 while the mean of the control group 9.62 ±0.22 and the result of this study is agreed with the study in Iraq (19).

Table (2): Comparison between difference groups in Ca, Po_4, Na and K.

Group	Mean ±SE			
	Ca (ppm)	PO_4 (ppm)	Na (ppm)	K (ppm)
Patients	7.08 ±0.14	4.89 ±0.14	130.42 ±0.62	5.41 ±0.12
Control	9.62 ±0.22	2.96 ±0.07	140.78 ±0.67	3.93 ±0.10
T-test	0.523 **	0.325 **	1.817 **	0.316 **
P-value	0.0001	0.0001	0.0001	0.0001
** (P≤0.01).				

As shown in the (Table 2) highly significant increase of phosphorus ($p \leq 0.0001$) the mean of the CKD patients (4.89 ±0.14) while control group was (2.96 ±0.07). This result agreed with a study **(**20**)**. The level of the Na in (Table 3) study showed highly significant decrease in CKD patients when compare with control group, the mean of the Na in the CKD (130.42 ±0.62) while the mean of the control group (140.78 ±0.67) and the result of this study is agreed with **(**21**)**. There was a highly significant increase in the mean serum K (P≤0.01) As shown in the (Table 3). The mean of serum K in the CKD patient patients (5.41 ±0.12) is high significant when compere to control group (3.93 ±0.10) and the result of this study is agreed with (22).

The blood calcium and phosphorous concentrations are inversely correlated, a rise in one would produce a reduction in the other, therefore a decrease in serum calcium could be the result of an increase in serum phosphorous (23).

Increased serum phosphorus levels have been associated with vascular and coronary artery calcification, leading to cardiovascular morbidity (24). The kidneys release angiotensin when blood sodium levels are low, which prompts the adrenal cortex to release aldosterone, which in return causes the renal tubules to reabsorb sodium from the glomerular filtrate. The amount of water in the blood rises when renal dysfunction happens, which lowers blood volume and, as salt controls blood pressure, decrease sodium levels, which helps to lower high blood pressure (25). Potassium excretion decreases with the progression of chronic kidney disease (CKD), and eating foods high in potassium makes it more difficult to keep the ion within the normal range. Metabolic acidosis, which is common in this population, causes the ion to move from the intracellular space to the extracellular space, which raises serum potassium levels (26).

Oxidative stress parameter
Malondieldehyde MDA

In the analytic statistic in the table (2) illustrates the high significant (P≤0.01) between the CKD and the control group the level of the MDA increase 255.39 ±8.67 when compere to control group 125.04 ±1.94 (Figure1) and this results were agreed with the results (27).

Table (3): comparison between difference group in MDA and GSH

Group	Mean ±SE	
	GSH (mg/dl)	MDA (mg/dl)
Patients	11.76 ±0.14	255.39 ±8.67
Control	22.32 ±2.72	125.04 ±1.94
T-test	5.394 **	17.598 **
P-value	0.0002	0.0001
** (P≤0.01).		

The MDA level was significantly elevated in CKD patients, the increased level of serum MDA which clearly shows that they were exposed to an increased level oxidative stress via lipid peroxidation which complained with the generation of secondary products such low molecular weight reactive substances and water soluble three carbons, aldehydemalondehyde (28). The generation of free radicals and the removal of them by the cellular antioxidant systems are in a constant balance under normal conditions. However, oxidative stress can result from either a decrease in free radical inactivation (caused by a reduced antioxidant capacity), an increase in free radical formation, or a combination of the two. The increased oxidative stress status in the hemodialysis patients specifically because of reduced dietary intake of the exogenous antioxidants, accumulation the oxidative products, and also loss of antioxidant (29). However, MDA is a hydro soluble, low molecular weight compound. even though it is a great indicator of oxidative stress, the elevated MDA levels observed in these patients because the low rate of glomerular filtration. For this reason, it seems more suitable for measuring MDA molecules bound to macromolecules that prevent this process of clearance. All of these results indicate the hypothesis that lipid peroxidation takes place during early phases of chronic kidney disease patients and will remain at high levels while the disease progresses (30).

Glutathione (GSH)

The analytic statistics of the GSH in the Table 2 was showed a signification (P≤0.01) decrease in CKD 11.76 ±0.14 compared with the control group 22.32 ±2.72 and this result was agreed with study (31). who found GSH was significantly decreased and inversely correlated with MDA levels in CKD patients (Figure 2). GSH especially increases when oxidative stress develops. The depletion of glutathione as a key antioxidant molecule may show oxidative stress. This condition may increase the risk of developing cardiovascular disease in patients with End Stage Renal Disease (ESRD) (32). Glutathione is essential for the endogenous antioxidant system and for maintaining redox homeostasis

during mitochondrial ATP production. More precisely, glutathione plays a critical role in the health the cells, especially the mitochondria. It protects essential proteins and the coenzymes by reducing harmful reactive oxygen species generated during electron transport. Additionally, glutathione protects mitochondrial membranes from oxidative damage by maintaining vitamin E in an active form. It supports detoxification enzymes, aiding in the metabolism of toxins (33).

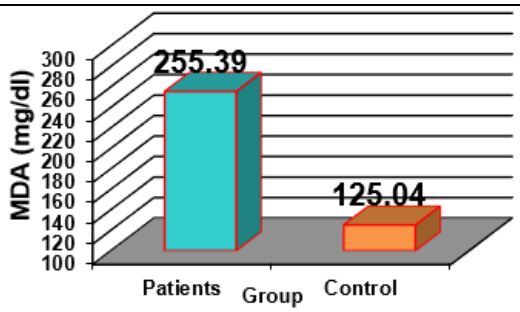

Figure 1: Comparison between difference groups in MDA

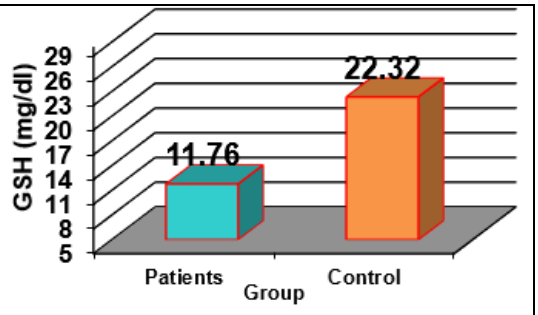

Figure 2: Comparison between difference groups in GSH

Conclusions

According to the results of this of the research. CKD patients show high oxidative stress levels than the health control group. There are significant negative association between MDA and GSH. The high level of the MDA in the end stage kidney failure is shown when compared to the heath healthy control group and elevated levels of serum urea and creatinine play a major role in diagnosing the advanced stages of kidney failure.

References

1. Khelfi, A.; Mahmoud, A.; Perrone, S.; Marín, R.; Hussain, F.; Fulop, T., *et al* Henkel, R. (2024). Oxidative Stress Monitoring: Needs and Opportunities. In Biomarkers of Oxidative Stress: Basics and Measurement of Oxidative Stress (pp. 553-595). Cham: Springer Nature Switzerland.
2. Mohsen, I. H.; Maaroof, R. J. and Harjan Mohsen, A. (2023). Renal Failure, Types, Causes and Etiology: A Review Article. International Journal of Medical Science and Clinical Research Studies, 3(8), 1663-1666.
3. Al-jumaili, R. A., Al-Jumaili, E. F., and Ramadhan, O. M. (2024). Role of Calcium Sensing Receptor Gene Polymorphism r1801725 in the Evaluation of kidney Disease. Iraqi Journal of Biotechnology, 23(1), 235–240.
4. Kadhim, S. M.; Abbood, S. M.; Taay, Y. M. and Mohammed, M. T. (2021). Oxidative stress in multiple sclerosis disease. Diyala Journal of Medicine, 21(2), 33-40.
5. De Vecchi, A. F.; Bamonti, F.; Novembrino, C.; Ippolito, S.; Guerra, L.; Lonati, S., *et al*. (2009). Free and total plasma malondialdehyde in chronic renal insufficiency and in dialysis patients. Nephrology Dialysis Transplantation, 24(8), 2524-2529.
6. Ilori, T. O.; Sun Ro, Y.; Kong, S. Y.; Gutierrez, O. M.; Ojo, A. O.; Judd, S. E., *et al*. (2015). Oxidative balance score and chronic kidney disease. American Journal of Nephrology, 42(4), 320-327.
7. Chakraborty, S.; Malvi, A.; Chaturvedi, A.; Sonkusare, K. and Dave, N. (2020). Glutathione–the master antioxidant. International Journal of Medical Research and Pharmaceutical Sciences, 7(2), 1-11.
8. Pandya, D.; Nagrajappa, A. K. and Ravi, K. S. (2016). Assessment and correlation of urea and creatinine levels in saliva and serum of patients with chronic kidney

disease, diabetes and hypertension–a research study. Journal of clinical and diagnostic research: JCDR, 10(10), ZC58.
9. Vanholder, R.; Gryp, T. and Glorieux, G. (2018). Urea and chronic kidney disease: Nephrology Dialysis Transplantation, 33(1), 4–12.
10. Balestrino, M. (2021). Role of creatine in the heart: Health and disease', Nutrients, 13(4): 1215.
11. Vasudeva, D.; Sreekumari, S. and Vaidya Nathan, K. (2016). Kidney function tests. In: Text book of biochemistry for medical students, 370–383.
12. Cusumano, A. M.; Tzanno-Martins, C. and Rosa-Diez, G. J. (2021). The glomerular filtration rate: from the diagnosis of kidney function to a public health tool. Frontiers in medicine, 8, 769335.
13. Clermont, G.; Lecour, S.; Lahet, J. J.; Siohan, P.; Vergely, C.; Chevet, D., *et al*. (2000). Alteration in plasma antioxidant capacities in chronic renal failure and hemodialysis patients: a possible explanation for the increased cardiovascular risk in these patients. Cardiovascular research, 47(3), 618-623.
14. SPSS (2019). Statistical Packages of Social Sciences-SPSS/ IBM Statistics 26 step by step. 16th Edition.
15. Safa S. Mahdi Al-Shattawi, Al-Jumaili, E. F. and Ula M. Ridha AL-Kawaz. (2024). Pin1 Gene Expression and Some Biochemical Parameters in Iraqi Population with Chronic Kidney Disease. Iraqi Journal of Biotechnology, 23(2), 105-111.
16. MarwaJ.Abd AL-Razak, Basima Q.Hasan AlSaadi, A. H. S. (2025). View of Investigate some Biochemical Parameters and Impact of NOS3 Gene Polymorphism among Iraqi Patients with Chronic Kidney Disease., Iraqi Journal of Biotechnology, 24(1): 243-252.
17. Vanholder, R.; Gryp, T. and Glorieux, G. (2018). Urea and chronic kidney disease: the comeback of the century (in uraemia research). Nephrology Dialysis Transplantation, 33(1): 4-12.
18. AL-Sallami, A. S. and Kadhim, R. A. (2016). Assessment of Some Biochemical Markers in Chronic Kidney Disease Patients in Al-Najaf Al-Ashraf Governorate. International Journal of Pharm.Tech. Research, 9(6), 473-482.
19. Ahmed Meri, M.; Hamid Al-Hakeem, A.; Saad Al-Abeadi, R. and Mahdi, D. M. (2022). Study of the changes of some biochemical parameters of patients with renal failure. 140(03), 1343–4292
20. Alsaedi, A. N. N.; Al-Asady, H. M. K.; Najm, T. A. and AL-Nasrawi, W. S. H. (2023). Study of Some Physiological and Biochemical Parameters in Patients with Chronic Renal Failure in Holy Karbala. AIP Conference Proceedings, 2414(1).
21. Al-Jumaili, R.A. and Al-Jumaili, E.F. (2024) Study of the causes of parathyroid hormone imbalance and some biochemical parameter in patients with chronic kidney disease. Romanian Journal of Diabetes, Nutrition and Metabolic Diseases, 31(1): 49-57.
22. Musleh, A. M. (2023). Estimation of some Serum Electrolytes in Chronic Renal Failure Patients. The Medical Journal of Tikrit University, 29(1).
23. Valdivielso, J. M.; Carriazo, S.; Martin, M.; Fernandez-Fernandez, B.; Bermudez-López, M. and Ortiz, A. (2024). Gender-specific risk factors and outcomes of hyperkalemia in CKD patients: smoking as a driver of hyperkalemia in men. Clinical Kidney Journal, 17(1).
24. Naser, O. A.; Al-Temimi, S. Q.; Kadhum, H. S.; Thuwaini, M. M.; Nasser, N. G.; Abd, T. N. and Hassan, N. N. (2024). Evaluation of some biomarkers (phosphorus, Parathyroid hormone, Calcium, vitamin D) in patient's serum with chronic kidney disease (CKD). Journal Port Science Research, 7(issue), 421–425.
25. Freethi, R.; Raj, A. V.; Ponniraivan, K.; Khan, M. R. and Sundhararajan, A. (2016). Study of serum levels of calcium, phosphorus and alkaline phosphatase in chronic kidney disease. International Journal of Medical Research and Health Sciences, 5(3), 49-56.
26. Watanabe, R. (2020). Hyperkalemia in chronic kidney disease. Revista da Associação Médica Brasileira, 66, s31-s36.
27. Marjani, A. (2005). Clinical Effect of hemodialysis on plasma lipid peroxidation and erythrocyte antioxidant enzyme activities in Gorgan (south east of Caspian Sea). Indian Journal of Nephrology, 15(4): 214-217.
28. Purwati, D. D.; Mustika, A.; Hakim, L. and Thaha, M. (2022). Correlation of Serum Nitric Oxide and Urine

Malondialdehyde Levels in Non-Hemodialysis Chronic Kidney Disease Patients. Molecular and Cellular Biomedical Sciences, 6(1), 43-9.

29. Raju, D, S. S. K.; Lalitha, D. L. and Kiranmayi, P. (2013). A study of lipid profile and lipid peroxidation in chronic kidney disease with special reference to hemodialysis. Journal of Biotechnology Research Center. 4(1), 28
30. Puchades Montesa, M. J.; Rico, G.; Salguero, S.; Torregrosa Maicas, I.; Juan García, I.; Miguel Carrasco, A. and Sáez Tormo, G. (2009). Study of oxidative stress in advanced kidney disease. Nefrología (English Edition), 29(5), 464-473.
31. Al-Badry, S. H.; Ibrahim, N. G.; Al-Mashhadani, H. A. and Kadhim, M. M.(2023). The role of oxidative stress in patients with chronic kidney disease. Indexed in PubMed/Medline, Scopus, Embase, Index copericus, Polish Ministry of Education and Science, Polish Ministry of Education and Science, Polish Medical Bibliography, 951.
32. Ahmadpour, P.; Eftekhar, E.; Nourouzzadeh, J.; Servat, H.; Makhdoumi, K. and Ghafari, A. (2009). Glutathione, glutathione-related enzymes, and total antioxidant capacity in patients on maintenance dialysis. Iranian Journal of Kidney Diseases, 3(1), 22-27.
33. Lana, J. V.; Rios, A.; Takeyama, R.; Santos, N.; Pires, L.; Santos, G. S., *et al*. (2024). Nebulized glutathione as a key antioxidant for the treatment of oxidative stress in neurodegenerative conditions. Nutrients, 16(15), 2476.