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Impact of hemodialysis on some biomarkers among patients with chronic kidney disease

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ABSTRACT

Background: Regardless of the etiology, chronic kidney disease (CKD) is characterized by decreased kidney function seen by a glomerular filtration rate (GFR) of less than 60 mL/min per 1.73 m2, kidney damage markers, or both for at least three months. Chronic kidney disease, a degenerative illness for which there is not a solution yet, is linked to high rates of morbidity and death. Compared to the general population, individuals with diabetes and hypertension are more likely to have it. This research aimed to investigate the effects of hemodialysis on some biomarkers among patients with chronic kidney disease CKD.

Patient and methods: This research is cross-sectional and conducted in a hospital setting. The study included 30 control samples and 60 patients with CKD.

Results: Asignificant increase in the biochemucal parameters for urea, creatinine and uric acid while the revers effect shown with that of albumin.

INTRODUCTION

Chronic kidney disease (CKD) is defined as reduced kidney function for at least three months, as evidenced by a glomerular filtration rate (GFR) of less than 60 mL/min per 1.73 m², kidney damage indicators, or both, regardless of the cause.[1] chronic kidney disease is a degenerative condition that has no known cure and a high rate of morbidity and mortality. It is more common in adults with diabetes and hypertension than in the general population. [2]According to reports, the prevalence of chronic kidney disease (CKD) in high-income nations is approximately 8.6% in males and 9.6% in women over 20.[3] The incidence of chronic kidney disease (CKD) is greater in females than in males and varies by race.[4] Approximately 13.4% of the global population suffers from chronic kidney disease (CKD).[5] The primary cause of the early morbidity and mortality suffered by people with chronic kidney disease is cardiovascular disease.[6] CKD is a silent killer since there are no clinical signs in the early stages, but a continuous decline of glomerular filtration rate (GFR) develops over a period of more than three months.[7] CKD classification is based on estimated glomerular filtration rate (eGFR) into six groups (G1 to G5, with G3 divided into 3a and 3b) and based on albuminuria into three levels of (A1, A2, and A3). [8]

Gasdermin D is a protein that is encoded by GSDMD on chromosome 8. [9] During the inflammation process, GSDMD generates pore structure in the plasma membrane, which results in osmotic lysis and cell death. This causes the release of inflammatory cellular components into the extracellular area.[10] Gasdermin D (GSDMD) plays a role in the pyroptosis pathway, Pyroptosis is an essential pathogenic mechanism behind kidney cell destruction in chronic kidney disease (CKD). [11]

MATERIALS AND METHODS

This study is cross-sectional and hospital-based. The Diyala Health Department has approved the attendance agreements at Baquba Teaching Hospital and Baladruz General Hospital for the purpose of collecting patient samples. The study was conducted between September 20, 2024, and the end of February 2025. The study comprised 60 CKD patients, aged 18–64, who received regular hemodialysis, as well as 30 control samples. A nephrologist made the clinical diagnosis that they were hemodialysis patients with end-stage renal disease. They were divided into three categories.

Group 1: CKD patients. (30 sample pre dialysis).

Group 2: CKD patients. (30 sample post dialysis).

Group 3: control group. (30 sample).

The blood samples were drawn from the vein. (5 ml) of the blood sample were collected and allowed to clot at room temperature (25 ˚C) for 30 minutes. After that centrifugation was done at (4000) rpm for 10 minutes to separate the serum.

Biochemical analysis. Gasdermin D and were determined using an Enzyme Immunoassay (ELISA) kit. Blood urea, serum creatinine, serum uric acid and Albumin were measured colorimetrically using commercially available kits on a fully auto analyzer of Clinical Biochemistry Laboratory.

Data analysis was performed using (SPSS) version 26.0 (IBM Corp., Armonk, NY,

USA). Data are presented as mean ± standard deviation (SD) for normally distributed variables. Paired t-tests were used to compare pre- and post-dialysis parameters within the same group of patients, and using (ANOVA) followed by Tukey's post hoc test for multiple comparisons. with P-value <0.05 considered significant. The diagnostic performance of novel biomarkers was evaluated using Receiver Operating Characteristic (ROC) curve analysis, with calculation of Area Under the Curve (AUC), sensitivity, specificity, and optimal cutoff values.

RESULTS

In this study, the pre-dialysis group had the highest levels of Gasdermin D (1.93 ± 0.40 ng/ml), followed by the post-dialysis group (1.25 ± 0.24 ng/ml), and the control group (0.75 ± 0.34 ng/ml). The post-dialysis percent reduction was 35.2%. According to Table (2), the pre-dialysis group's blood urea levels (92.96 ± 17.58 mg/dl) were substantially higher than those of the post-dialysis group (47.61 ± 7.40 mg/dl) and the control group (26.97 ± 5.21 mg/dl) ($p<0.001$). 48.8% decrease in blood urea levels after dialysis. A similar pattern was also seen in serum creatinine levels, which were significantly higher before dialysis (6.64 ± 1.76 mg/dl) than after (3.26 ± 0.85 mg/dl) and control (0.71 ± 0.11 mg/dl) ($p<0.001$). Serum creatinine decreased by 50.9% as a result of hemodialysis. However, there were notable variations in the groups' serum uric acid levels ($p<0.001$). The control group had levels of 4.11 ± 0.98 mg/dl, while the pre-dialysis group had higher levels (4.58 ± 0.93 mg/dl) than the post-dialysis group (2.83 ± 0.79 mg/dl).

This study showed Serum albumin levels were highest in the control group (4.19 ± 0.34 g/dl), followed by the pre-dialysis group (3.55 ± 0.30 g/dl) and the post-dialysis group (3.36 ± 0.30 g/dl) ($p<0.001$).

DUSCUSSION

This study investigated the effects of hemodialysis on some biomarkers in patients with chronic kidney disease. The studies showed a number of significant observations. The demographic analysis showed that the study groups were well matched, with no apparent differences in the distribution of CKD on dialysis by age or gender from the control groups. This demographic similarity reduces potential confounding factors in the interpretation of biomarker levels and enhances the accuracy of the study's comparative findings. Analyzing the gender distribution revealed that there were more women (60%) (n=18) in the CKD on hemodialysis group [12], who demonstrated that chronic renal disease is more common in women.

Before dialysis, Gasdermin D levels were significantly higher (1.93 ± 0.40 ng/ml) than in controls (0.75 ± 0.34 ng/ml), and they significantly decreased after hemodialysis (1.25 ± 0.24 ng/ml, $p<0.001$). This decrease suggests that dialysis may have an effect in reducing Gasdermin D levels, a protein associated with inflammation and apoptosis. This may be an indication of an improvement in the inflammatory status of patients after dialysis. This pattern suggests potential roles for GSDMD in reflecting disease severity and monitoring treatment response [13], that found that patients with ESKD had significantly higher blood GSDMD levels and were linked to CKD complications. GSDMD plays an important role in the initiation and progression of several inflammatory disorders.

The ROC curve analysis demonstrated outstanding diagnostic accuracy, with an AUC of 0.996 (95% CI: 0.932–1.000), indicating that Gasdermin D has excellent discriminatory power to distinguish between patients with and without specific pathological conditions related to CKD or hemodialysis. This near-perfect AUC value suggests that Gasdermin D could serve as a highly reliable biomarker in clinical settings.The optimal cutoff value of >1.261 ng/ml further strengthens the clinical utility of Gasdermin D. This cutoff provides a clear threshold for identifying patients who may be at higher risk or who may require closer monitoring or intervention. The high sensitivity and specificity associated with this cutoff value underscore the potential of Gasdermin D to improve diagnostic precision in CKD management.

The pre-dialysis group's blood urea levels were significantly higher (92.96 ± 17.58 mg/dl) than those of the post-dialysis group (47.61 ± 7.40 mg/dl) and the control group (26.97 ± 5.21 mg/dl). ($p<0.001$) [14, 15]. Which show that hemodialysis patients have higher serum urea levels than the control group [16]. Which indicated that urea levels are highest in patients with chronic kidney disease (CKD). Blood urea levels decreased significantly after dialysis. This decrease reflects the effectiveness of dialysis in removing nitrogenous waste products from the blood, indicating an improvement in the function of the artificial kidney.

Pre-dialysis serum creatinine levels (6.64 ± 1.76 mg/dl) were significantly greater than post-dialysis levels (3.26 ± 0.85 mg/dl) and control levels (0.71 ± 0.11 mg/dl) ($p<0.001$). That hemodialysis patients have elevated creatinine levels in comparison to the control group [14, 15, 17].

Serum creatinine levels decreased significantly after dialysis. Creatinine is an important indicator of kidney function, and its decrease after dialysis indicates improved removal of waste products from the blood.

Serum uric acid levels were higher in the pre-dialysis group (4.58 ± 0.93 mg/dl) than in the post-dialysis group (2.83 ± 0.79 mg/dl). Serum uric acid levels decreased after dialysis, but were higher in the control group compared to the post-dialysis group. This indicates that dialysis is effective in removing uric acid, which is important for preventing complications, and suggest hyperuricemia associated with CKD [18]. That suggested the Serum uric acid levels were significantly lowered with HD replacement therapy.

The study found that the control group had the highest serum albumin levels (4.19 ± 0.34 g/dl), followed by the pre-dialysis group (3.55 ± 0.30 g/dl) and the post-dialysis group (3.36 ± 0.30 g/dl) ($p<0.001$). Significant hypoalbuminemia is seen in CKD patients, likely as a result of protein losses, inflammation, and metabolic dysregulation. The slight reduction in albumin levels post-dialysis could be attributed to fluid shifts and dialysis-associated albumin loss.

Serum albumin levels decreased after dialysis compared to the control group. This decrease may indicate that dialysis may affect protein levels in the blood, which may require monitoring and nutritional interventions to improve the patients' condition.

CONCLUSION

Patients with CKD have higher levels of GSDMD. our study provides strong evidence for the potential utility of Gasdermin D as diagnostic and monitoring tools in CKD. the results show that dialysis has a positive effect on several biomarkers in CKD patients, indicating improved waste removal and control of some inflammatory factors. These results could be useful in improving the management of CKD patients and guiding future treatment.

CONFLICT OF INTEREST

There are no conflict of interest.

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TABLES

Table 1: Analysis of Novel Biomarkers and Traditional Parameters Among Study Groups

Biomarker	Pre-dialysis (n=30)	Post-dialysis (n=30)	Control (n=30)	F-value	p-value	Post-hoc significance
Gasdermin D (ng/ml)	1.93 ± 0.40	1.25 ± 0.24	0.75 ± 0.34	92.11	<0.001	Pre > Post > Control
Blood Urea (mg/dl) *	92.96 ± 17.58	47.61 ± 7.40	26.97 ± 5.21	253.52	<0.001	Pre > Post > Control
Serum Creatinine (mg/dl)	6.64 ± 1.76	3.26 ± 0.85	0.71 ± 0.11	200.22	<0.001	Pre > Post > Control
Serum Uric Acid (mg/dl)	4.58 ± 0.93	2.83 ± 0.79	4.11 ± 0.98	29.26	<0.001	Pre = Control > Post
Serum Albumin (g/dl)	3.55 ± 0.30	3.36 ± 0.30	4.19 ± 0.34	56.35	<0.001	Control > Pre > Post

FIGURE

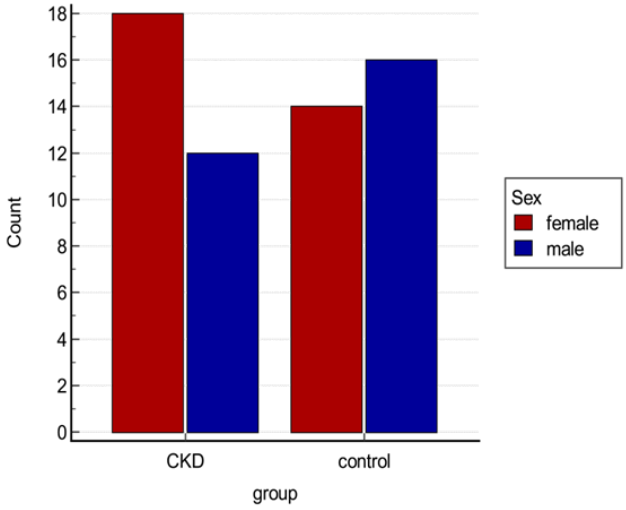

Figure 1: Gender distribution across study groups

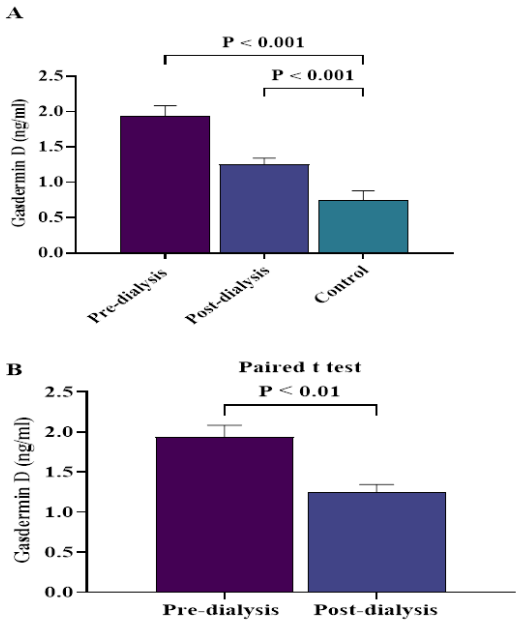

Figure 2: Serum Gasdermin D levels across study groups and pre-post dialysis comparison; (A) Comparison of Serum Gasdermin D levels among pre-dialysis, post-dialysis, and control groups.
(B) Paired comparison of Serum Gasdermin D before and after hemodialysis in CKD patients (n=30).

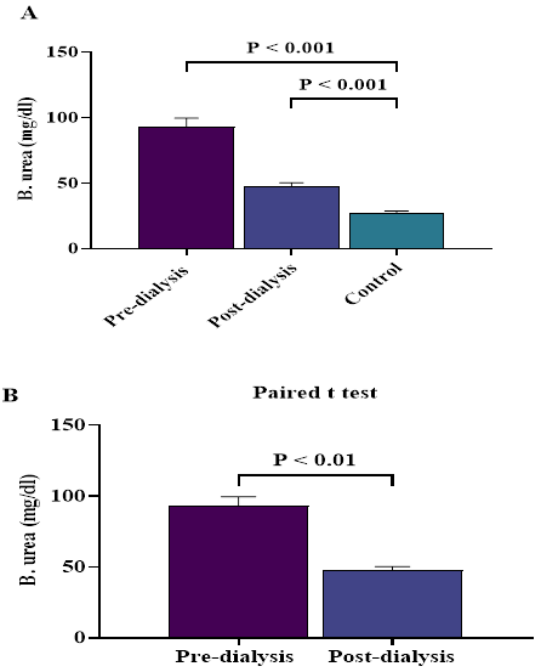

Figure 3: Blood urea levels across study groups and pre-post dialysis comparison, (A) Comparison of blood urea levels among pre-dialysis, post-dialysis, and control groups.
(B) Paired comparison of blood urea levels before and after hemodialysis in CKD patients (n=30).

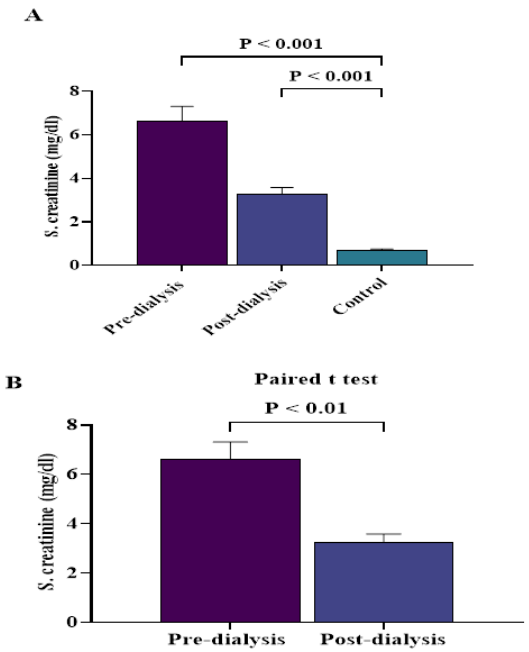

Figure 4: Serum Creatinine levels across study groups and pre-post dialysis comparison
(A) Comparison of Serum Creatinine levels among pre-dialysis, post-dialysis, and control groups.
(B) Paired comparison of Serum Creatinine levels before and after hemodialysis in CKD patients (n=30).

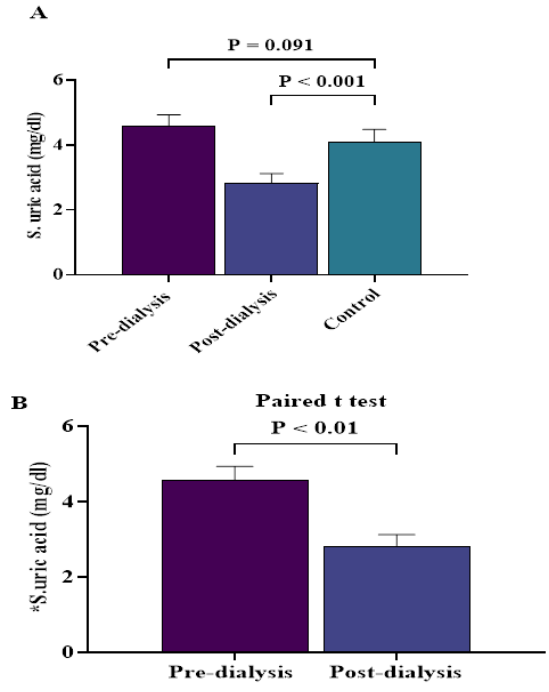

Figure 5: Serum Uric Acid urea levels across study groups and pre-post dialysis comparison
(A) Comparison of Serum Uric Acid levels among pre-dialysis, post-dialysis, and control groups.
(B) Paired comparison of Serum Uric Acid levels before and after hemodialysis in CKD patients (n=30).

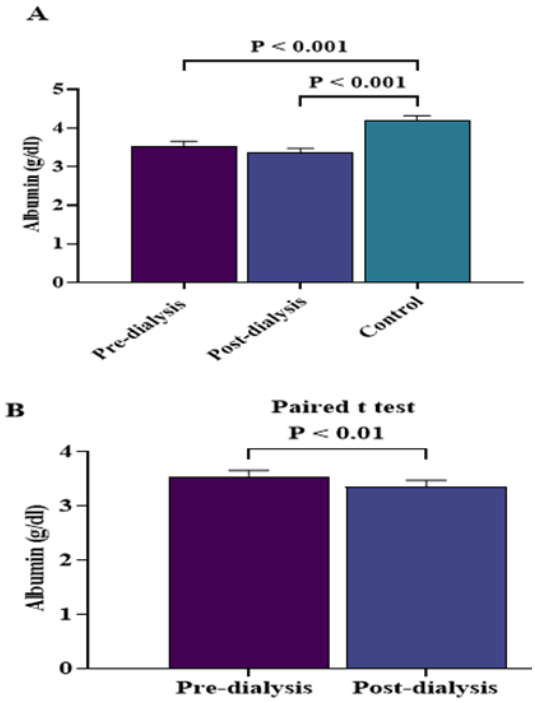

Figure 6: Serum Albumin levels across study groups and pre-post dialysis comparison
(A) Comparison of Serum Albumin levels among pre-dialysis, post-dialysis, and control groups.
(B) Paired comparison of Serum Albumin levels before and after hemodialysis in CKD patients (n=30).

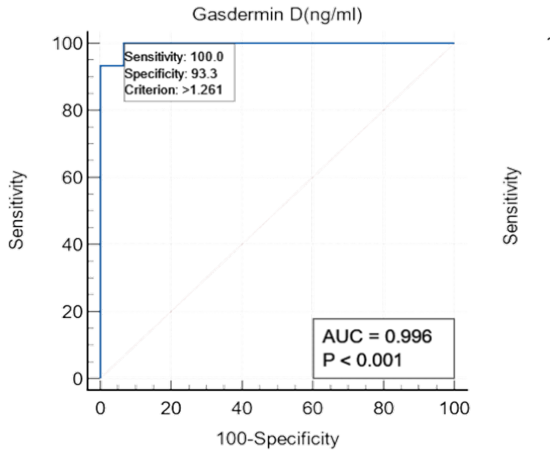

Figure 7: ROC Curve Analysis of Gasdermin D for CKD Diagnosis. The marker distinguishes between pre-dialysis patient from control.