Infinity Journal of Medicine and Innovation
Volume 2, Issue 1, June 2026
website: https://journalscientific-journal.com/index.php/JIM
ISSN: 3080-7514 (Online)

Research article

Effect of Dialysis in chronic renal failure on some biochemical variants

Abdulhussein Mahdi Aljebory[1], Elaf Hammadi Jassim [1], Fatima Mohammed Talib [1], Widad Jawad Damad, Sajjad Ali Sharif [1]*
1. *Department of Medical Laboratory Technology, College of Medical Technology, Islamic University, Babylon, Iraq.*

ABSTRACT:
Background: Hemodialysis is a critical therapeutic intervention for patients with chronic renal failure (CRF), aimed at removing metabolic waste products and maintaining fluid and electrolyte balance. Regular monitoring of biochemical parameters is essential to assess dialysis efficacy and patient outcomes. **Objective:** This study aimed to evaluate the longitudinal changes and correlations among selected serum biochemical markers in CRF patients undergoing maintenance hemodialysis over a four-week period. **Methods:** A longitudinal observational study was conducted on 110 patients (54 males, 56 females) with CRF undergoing hemodialysis at a hospital in Babylon, Iraq, between October 2025 and February 2026. Serum samples were collected weekly for four weeks post-dialysis. Biochemical parameters including urea, creatinine, sodium, potassium, calcium, hemoglobin, iron, total iron binding capacity (TIBC), albumin, and phosphorus were measured. Data were analyzed using SPSS version 24.0, with one-way ANOVA and independent t-tests applied to compare mean differences across weeks. **Results:** Significant reductions were observed in serum urea (from 46.18 mmol/L in week 1 to 4.74 mmol/L in week 4) and creatinine (from 761.53 µmol/L to 158.6 µmol/L) over the four weeks ($p < 0.0001$ for both). Calcium levels decreased progressively ($p = 0.010$), while iron, TIBC, and albumin showed fluctuating trends with significant overall changes ($p < 0.0001$). Sodium, potassium, hemoglobin, and phosphorus did not show statistically significant changes. A strong positive correlation was noted between urea and creatinine, while TIBC showed a significant negative correlation with urea. **Conclusion:** Hemodialysis effectively reduces serum urea and creatinine levels in patients with chronic renal failure, confirming its role in waste product clearance. However, fluctuations in other biochemical markers highlight the need for comprehensive monitoring and individualized dietary and therapeutic adjustments. Further large-scale, controlled studies are warranted to optimize dialysis protocols and improve patient outcomes.

Keywords:
hemodialysis;
renal failure;
serum creatinine;
urea.

Article history:
Received: 1 May 2026.
Revised: 10 June 2026.
Accepted: 27 June 2026.
Published: 15 Sep. 2026.

*** Corresponding author:**
Abdulhussein Mahdi Aljebory
E-mail address:
abdulhussiena@gmail.com

INTRODUCTION

Chronic Renal Disease (CRD) is defined as the progressive loss of renal function [1]. It is a condition in which the kidneys fail to function normally, in excretory and regulatory capacities especially, due to infections (infections), immune diseases (autoimmunity), diabetes, hypertension, cancer and or toxicants [2]. CRD is emerging as an important public health threat [3] and has begun to reach epidemic levels worldwide [4].

Chronic renal failure (CRF) is an illness that needs specific replacement therapy of renal function as dialysis, to manage a gradual loss of function [5]. The estimated incidence of chronic renal failure has been estimated incidence rate of one in every 5000 individuals, primarily affecting middle aged and older adults. The accurate rate of this disease is challenging to establish due to the asymptomatic nature of its early stage. CRF is typically progressive and irreversible, potentially leading to complete renal failure [6, 7].

The kidneys play a vital role in filtering waste materials and fluids from the bloodstream and excreting them through the urinary system [8]. One treatment option for individuals who have experienced an unexpected loss of renal function or who are in end stage renal disease is dialysis, which removes excess toxic fluids and metabolic by products from the body [9]. This study aimed to evaluate the effects of dialysis on patients with chronic renal failure by analyzing the post dialysis mean values of serum biochemical indicators. The investigation was conducted to gain a deeper understanding of the physiological effects of dialysis on individuals with chronic renal failure after medical diagnosis by specialist doctors at the hospital.

MATERIALS AND METHODS:

The actual size of the study included (n=110) patients, aged groups from 18 years to 70 years, this age group was selected based on the number of patients visiting the hospital during the study period, both sex male and female, suffered from with chronic renal failure and undergoing hemodialysis. This study was conducted in the city of Babylon in Iraq due to the significant increase in the number of cases in this decade. It was therefore very important to conduct studies on this subject in order to find appropriate solutions in health institutions, the laboratory and clinical data for all patient were collected through four weeks interval. The biochemical variables that were estimated are serum urea, creatinine, sodium, potassium, calcium, hemoglobin, Iron, total iron binding capacity (TIBC), albumin, and phosphorus. Some pathological conditions such as (Acute renal failure, malignancy, active infection), were excluded to avoid their interfering effects on the values of certain biochemical variables, which would cause inaccurate results.

Patient's sample: blood samples (5 ml) were withdrawn from each patient before and after the administration of hemodialysis. The samples were centrifuged at 3500 rpm for 10 minutes to isolate the serum, which was then subjected to biochemical evaluation. The collected serum samples were stored in deep freeze at a temperature of -20°C to maintain their stability and integrity.

The study relies on all patients for a four-week period only, based on the standard medical treatment provided at the hospital for this condition. The group of officers was not included as they were not subject to dialysis and therefore did not participate in the research findings.

Statistical analysis: Statistical Package for (SPSS; IBM, version 24.0) was used for Data analyzed. Mean (Standard deviation [SD]) was calculated for all variables; age, urea, creatinine, potassium, calcium, sodium, hemoglobin, iron, total iron binding capacity, albumin, and phosphorus as data was normally distributed. For sex and the comorbidities like diabetes mellitus, hypertension, heart disease, family history and obesity, Pearson Chi-square was applied to find the association between the categorical variables like sex and co-morbid. While Independent t-test was applied to find the mean difference in age between males and females. Also, one-way ANOVA test was applied to show the significant mean differences between the first, second, third, and fourth weeks of biochemical parameters.

RESULTS:

The present study has total of 110 patients, their mean age at the time of estimation was 50.2±18.5 years. The median ages of males and females were 47.5±13.3 and 53.4±17.0 respectively as shown in [Table 1]. There were 42 patients over 60 years old, with the majority being female at 27and male at 19 persons. All patients underwent dialysis three times per week. Diabetes mellitus was the most prevalent comorbidity, following by hypertension, heart diseases, smoking and obesity. Additionally, a family history of chronic kidney disease was noted in 68 patients. A significant difference in smoking habits was observed between males and females ($p<0.0001$).

Over the four-week hemodialysis period, serum urea and creatinine demonstrated the most pronounced and statistically significant reductions, confirming the efficacy of dialysis in clearing nitrogenous metabolic waste products. Urea levels declined progressively from 46.18 mmol/L in the first week to 20.89 mmol/L in the second week, further dropping to 13.05 mmol/L in the third week, and reaching 4.74 mmol/L by the fourth week ($p < 0.0001$). Similarly, serum creatinine decreased substantially from 761.53 µmol/L in week 1 to 532.05 µmol/L in week 2, 385.56 µmol/L in week 3, and finally 158.6 µmol/L in week 4 ($p < 0.0001$). This steady and marked decline reflects the effectiveness of repeated hemodialysis sessions in removing these uremic toxins.

Serum calcium also exhibited a significant decreasing trend over the four weeks, falling from 9.37 mmol/L in the first week to 8.28 mmol/L in week 2, 5.76 mmol/L in week 3, and 4.25 mmol/L in week 4 ($p = 0.010$). This progressive reduction may be attributed to dialysis-induced calcium loss or altered calcium metabolism commonly observed in patients with chronic kidney disease.

In contrast, serum sodium (ranging from 133.92 to 148.37 mmol/L), potassium (3.99 to 5.02 mmol/L), hemoglobin (11.4 to 12.28 g/dL), and phosphorus (4.53 to 6.2 mmol/L) showed no statistically significant changes over the four-week period ($p > 0.05$ for all). These findings suggest that these parameters remained relatively stable despite ongoing dialysis, which may reflect adequate dietary control, effective electrolyte management, or the influence of concurrent medications.

Iron metabolism markers and albumin revealed more complex and fluctuating patterns. Serum iron decreased significantly from 21.55 µmol/L in week 1 to 14.35 µmol/L in week 2, then rose slightly to 16.88 µmol/L in week 3, before declining again to 13.75 µmol/L in week 4 ($p < 0.0001$). Total iron binding capacity (TIBC) showed a similar fluctuating trend, starting at 36.17 mmol/L in week 1, increasing to 39.58 mmol/L in week 2 and 42.75 mmol/L in week 3, then dropping to 36.39 mmol/L in week 4 ($p < 0.0001$). Serum albumin levels also varied significantly, beginning at 37.62 g/L in week 1, decreasing to 36.38 g/L in week 2, rising to 38.22 g/L in week 3, and then falling to 33.15 g/L in week 4 ($p < 0.0001$). These fluctuations may be influenced by multiple factors, including the type of dialyzer membrane used, the patient's nutritional status, dietary protein intake, fluid balance, and the cumulative physiological stress of repeated dialysis sessions.

These results confirm that hemodialysis is highly effective in significantly reducing serum urea and creatinine levels. However, the variable responses observed in calcium, iron, TIBC, and albumin highlight the importance of comprehensive biochemical monitoring and individualized patient management to optimize dialysis outcomes and prevent nutritional or metabolic complications [Table 2].

Table (1). Demographic and clinical information of the study participants

N=110	Male (54)	Female (56)	p-value
Age (years) Mean± SD	47.5±13.3	53.4±17	0.142
Smoking	32 (47.7)	0	0.0001
Diabetes mellitus	58	52	------
Hypertension	55	45	----
Heart disease	26	29	0.902
Obesity	19	14	0.182

Family History CRD	38	34	0.753

CRD= Chronic renal disease, SD= Standard deviation,

Table (2): biochemical results (after dialysis) through four weeks

	1st Week	2nd Week	3rd Week	4th Week	p-value
Urea (mmol/l)	46.18	20.89	13.05	4.74	<0.0001*
Creatinine (umol/l)	761.53	532.05	385.56	158.6	<0.0001*
Sodium (mmol/l)	148.37	133.92	138.16	135.7	0.996
Potassium (mmol/l)	4.42	3.99	5.02	4.48	0.999
Calcium (mmol/l)	9.37	8.28	5.76	4.25	0.010*
HGB (g/dl)	11.88	11.68	12.28	11.4	0.577
Iron (umol/l)	21.55	14.35	16.88	13.75	<0.0001*
TIBC (mmol/l)	36.17	39.58	42.75	36.39	<0.0001*
Albumin (g/l)	37.62	36.38	38.22	33.15	<0.0001*
Phosphorus(mmol/l)	4.75	6.2	5.38	4.53	0.224

HGB= Hemoglobin, TIBC=Total iron binding capacity, SD= Standard deviation * = Significant value

DISCUSSIONS:

The Renal failure is defined by the gradual and irreversible loss of normal kidney Function, which results in impaired excretion of urea and creatinine into the bloodstream. Patients with renal failure exhibit elevated levels of these metabolic waste products. Potentially leading to significant complications prior to the initiation of hemodialysis [10]. The study involved the random selection of 110 patients diagnosed with renal failure at Alsadiq hospital in Babylon city (IRAQ), taking into account their clinical histories, examinations and renal function testes.

After a hemodialysis various biomarkers were assessed, including serum urea and blood creatinine levels. The primary causes of chronic kidney failure are often to health conditions such as hypertension, diabetes mellitus, autoimmune diseases, and other related disorder [11], which align with the results of this study. Evaluating renal excretory function can be achieved by analyzing serum concentrations of various endogenous compounds cleared by the kidneys.

In this context, the measurement of serum electrolytes level, such as sodium and potassium in body fluids, can serve as a diagnostic tool for assessing renal disorders [12-14]. Other studies indicated that creatinine clearance is the most effective method for evaluating kidney function in hemodialysis patients who are undergoing hemodialysis [14,15].

This reflects the notable reduction in serum creatinine levels that occurs during the procedure, which can also indicate dialysis insufficiency. Moreover, individuals aged 41 to 60 years old are more likely to experience kidney failure, potentially due to underlying health issues like hypertension, diabetes or age-related changes [15]. In this study appear clearly that serum sodium levels did not significantly decrease post dialysis, which is in line with the previously mentioned studies results (p=0.999).

Additionally, a significantly decrease in as shown in Table 2 shows that there is a decrease in, Sodium, Potassium, HGB, Iron, TIBC, and Albumin levels during the first and second weeks after dialysis, but usually a relative increase in the third week followed by a decrease in the fourth week. This may be due to the type of treatment used or the patient's diet. Hemodialysis does eliminate some excess urea from the patient's blood to prevent accumulation [14]. Maintaining a balanced protein intake is crucial in avoiding the overproduction of urea the hemodialytic cycles observed in the patients were effective, as overall decrease in urea levels were recorded. Some studies showed a substantial reduction in serum urea, indicating that hemodialysis is an effective treatment. The successful removal of waste during dialysis depends on various factors, such as proper dialysis scheduling, patient education, selection of an appropriate dialyzer, and adherence to suitable diet [16-17].

Urea and creatinine level are essential biomarkers for diagnosing and monitoring renal failure progression. As a byproduct of protein metabolism, urea levels tend to rise in the blood of patients with renal failure, eventually leading to the development of uremia [18-20]. However, as this study assessed a small number of patients, further research on a large scale is necessary to evaluate these findings more effectively.

CONCLUSION

This study confirms that hemodialysis is highly effective in significantly reducing serum urea and creatinine levels in patients with chronic renal failure, demonstrating its essential role in clearing metabolic waste products. Urea and creatinine proved to be the most reliable biochemical markers for monitoring dialysis efficacy and renal function. However, the study also observed significant fluctuations in calcium, iron, TIBC, and albumin levels over the four-week period, indicating that dialysis may affect mineral metabolism and nutritional status. In contrast, sodium, potassium, hemoglobin, and phosphorus remained relatively stable. while hemodialysis effectively removes uremic toxins, comprehensive and regular monitoring of biochemical parameters is crucial for optimizing patient management, preventing complications, and improving treatment outcomes. Further long-term studies are recommended to enhance dialysis protocols and patient care strategies.

REFERENCES

1- Al-Rubayee WT. Role of Clinical Chemistry in Hemodialysis: Assessment of Biochemical Markers and Electrolyte Imbalances. Indonesian Journal of Health Science and Medicine. 2025 ;2(1):45.

2- Venktapathy R, Govindarajan V, Oza N, Parameswaran S, Dhanasekaran BP, Prashad KV. Salivary creatinine estimation as an alternative to serum creatinine in chronic kidney disease IJN; 2014; 9:833

3- Kovesdy CP. Epidemiology of chronic kidney disease: An update. Kidney Int Suppl. 2022;12(1):7–11.

4- Abdulsamad RAI. Hematological and Biochemical Variables in Hemodialysis Patients with Chronic Renal Failure in Bani Walid City. Afro-Asian J Sci Res. 2024 ;2(1):162-176.

5- Abdulla HI, Al-Kotany MY, Mahdi KA. Assessment of oral manifestations of patients with renal failure undergoing hemodialysis by serum and salivary biomarkers.MDJ.2012;9(1):118–29.

6- Narula AS. Chronic kidney disease. The looming threat. MJAFI. 2008; 64(1): 2–3.

7- Avila, M., Mora Sánchez, M. G., Bernal Amador, A. S., and Paniagua, R. (2025). The metabolism of creatinine and its usefulness in evaluating kidney function and body composition in clinical practice. Biomolecules, 15(1), 41:38.

8- Anupama YJ, Uma G. Prevalence of chronic kidney disease among adults in a rural community in South India: Results from the kidney diseases careening (KIDS) project. IJN. 2014; 24(4): 214–21.

9- Motamayel F. Ahmadi, Davoodi P., Dalband M., et al. Saliva as a Mirror of the Body Health. DJH. 2010; 1(2):89.

10- Nandan Ratheesh K, B Sivapartha Sundaram, G Sivakumar. Oral manifestation and analysis of salivary and blood urea levels of patients undergoing haemodialysis and kidney transplant. Indian J dent Res. 2005; 16: 77–82.

11- USRDS (United States Renal Data System) Annual Data Report (2022/2023). Epidemiology of Kidney Disease in the United States. National Institutes of Health / NIDDK Z. Bai, G. Lu, H. Yang, D. Zhang, Y. Zhang, and Z. Sun, "Seasonal variation of Serum potassium in hemodialysis patients: myth or reality? A narrative review of literature," 2024.

12- Abdellatif Abeer M., Hegazy Salwa A., Youssef Jilan M., et al. The oral health status and salivary parameters of Egyptian children on haemodialysis. Journal of Advanced Research. 2011; 2:313–318.

13- Mahmood R, Batool M, Majeed N, Shoukat Z, Qureshi AM, Shoaib M. Blood urea nitrogen (BUN) levels in renal failure: unraveling the complex interplay of protein metabolism and kidney health. Prof Med J. 2024; 31(3): 364–370.

14- Kaushik A, Reddy SS, Umesh L, Devi BK, Santana N, Rakesh N. Oral and salivary changes among renal patients undergoing hemodialysis: A cross-sectional study. Indian J Nephrol. 2013;23(2):125-9.

15- Visgint A, Dwigint S, Trigint DV. The Analysis Study of Prevalence of Chronic Kidney Disease in Patients with Chronic Obstructive Pulmonary Disease: A Comprehensive Systematic Review. The International Journal of Medical Science and Health Research. 2024;3(2):47-65.

16- Vaidya SR, Aeddula NR. Chronic Renal Failure. [Updated 2021 Oct 29]. In: 15 StatPearls [Internet]. Treasure Island (FL) StatPearls Publishing; 2022 Jan Available: https:// www. ncbi. nlm. nih. gov / boks/ NBK535404.

17- Ronco, C., & Clark, W. R. Haemodialysis Membranes: Evolution and Present Technology. Nature Reviews Nephrology. 2018; 14(6): 394–411.

18- Molla MD, Degef M, Bekele A, Geto Z, Challa F, Lejisa T, Getahun T, Sileshi M, Tolcha Y, Ashebir G, Seifu D. Assessment of serum electrolytes and kidney function test for screening of chronic kidney disease among Ethiopian Public Health Institute staff members, Addis Ababa, Ethiopia. BMC Nephrol. 2020; 21(1): 494. DOI: 10.1186/s12882-020-02166-0.13.Fishbane S, Kalantar-Zadeh K, Nissenson AR. Serum ferritin in chronic kidney disease, Semin Dial. 2004;17: 336-41.

19- Radeef ZK, Al-Saadi ASM, Al-Dulimi AG. Usefulness of biochemical markers in monitoring renal function in chronic kidney disease. International Journal of Advances in Nephrology Research. 2024;7(1):131-137.

20- Radeef ZK, Al-Saadi ASM, Al-Dulimi AG. Usefulness of biochemical markers in monitoring renal function in chronic kidney disease. International Journal of Advances in Nephrology Research. 2024;7(1):131- 137.

To site this article: *Aljebory A. M. et al.* Effect of Dialysis in chronic renal failure on some biochemical variants. Infinity J. Med. Innov. 2026; 1(2): 102-108.