Original Research Article

Effect of Dialysis on Biochemical Parameters in Chronic Renal Failure Patients

ABSTRACT:

Aims: Here clearly write the aims of this study. Sample: To correlate platelet count, splenic index (SI), platelet count/spleen diameter ratio and portal-systemic venous collaterals with the presence of esophageal varices in advanced liver disease to validate other screening parameters.
Study design: Cross section study
Place and Duration of Study: The study enrolled 130 patients with chronic renal failure undergoing hemodialysis in King Khalid Hospital Tabuk, Saudi Arabia between January 2023 and February 2023.
Methodology: The study applied correlation analysis to determine the nature of the relationships between the biochemical parameters during hemodialysis. Descriptive statistics were also used to determine the mean concentrations for the parameters during hemodialysis.

Results: The concentrations of urea dropped from 45.12mmol/l from week one to 5.74mmol/l in week four. while the concentration of creatinine dropped from 761.53umol/l from week one to 160.60umol/l in week four. The study used correlation analysis to establish that there was a statistically significant strong positive correlation between urea and creatinine, calcium, iron, total iron binding capacity (TIBC), and albumin had their concentrations vary during dialysis weeks, with their concentrations increasing during some weeks and decreasing during others. It was also determined that there was a significant negative correlation between urea and TIBC.

Conclusion: The study established that there was a significant reduction in the concentration of urea and creatinine during the fourth week of dialysis compared to the first week of dialysis. Therefore, dialysis helps to remove toxic waste products from the bloodstream.

Keywords: Renal failure, Hemodialysis, Blood serum, Creatinine, Urea.

1. INTRODUCTION

Chronic Renal Disease (CRD) is characterized by a gradual decline in renal function [1]. It is a disorder in which the kidneys lose normal function, particularly excretory and regulatory functions, as a result of infections, autoimmune illnesses, diabetes, hypertension, cancer, or exposure to toxic substances [2]. CRD is on its way to becoming a significant public health issue, [3] with epidemic proportions spreading around the globe [4].
Chronic renal failure (CRF) is a severe disease that requires specific replacement therapy for the renal function, such as dialysis, to control progressive functional loss [5]. CRF has an estimated incidence rate of 1 in every 5000 persons and primarily affects middle aged and older people. The true rate of this disease is difficult to determine due to asymptomatic nature of early disease. It is mostly progressive, irreversible and may eventually result in complete renal failure [6,7]. The kidney's physiologic role entails removing waste materials and fluids from the bloodstream and disposing of them through the urinary pathway [8]. One line of treatment for individuals who have unexpectedly lost their renal function or who have reached end stage renal disease is dialysis, which includes the elimination of excess toxic fluids and metabolic end products from the body [9]. The present study aimed to evaluate the impact of dialysis on chronic renal failure (CRF) patients by assessing the post-dialysis mean values of serum renal biochemical indicators. This investigation was conducted in order to gain a comprehensive understanding of the physiological effects of dialysis on CRF patients.

2. MATERIAL AND METHODS

The analytical study enrolled 130 patients with chronic renal failure undergoing hemodialysis in King Khalid Hospital Tabuk, Saudi Arabia. Patient's clinical and laboratory data were collected from the first week to the fourth week for this

study. The patients on hemodialysis were in the age group of 18 to 81 years consisting of males and females. The patients undergoing renal dialysis were tested for serum urea, serum creatinine, sodium, potassium, calcium, hemoglobin, Iron, total iron binding capacity (TIBC), albumin, and phosphorus.

2.1 Patients Sample:

In this study, blood samples (5 ml) were obtained from the participants both prior to and after the administration of hemodialysis. These samples were centrifuged at 3000 rpm for a duration of 10 minutes to isolate the serum, which was then subjected to biochemical evaluation. The resulting serum samples were stored at a temperature of -20°C to maintain their stability and integrity.

2.2 Statistical Analysis

Data were analyzed using the Statistical Package for Social Studies (SPSS; IBM, version 24.0 Corporate headquarters 1 New Orchard Road Armonk, New York 10504-1722 United States). Mean (Standard deviation [SD]) was computed for age, urea, creatinine, sodium, potassium, calcium, HGB, iron, TIBC, albumin, and phosphorus as data was normally distributed. Frequencies with percentages were computed for sex and the comorbidities like diabetes mellitus, hypertension, heart disease, obesity, and family history. Pearson Chi-square was applied to find the association between the categorical variables like sex and co-morbid. An Independent t-test was applied to find the mean difference in age between males and females. A one-way ANOVA test was run to find the significant mean differences between the first, second, third, and fourth weeks of biochemical parameters. A p-value of <0.05 was considered significant.

3. RESULTS

The present study has total 130 patients, their mean age at the time of diagnosis was 51.3±15.7 years. The median ages of males and females were 49.3±15.3 and 53.4±16.9 respectively (Table 1). The male: female ratio was 1:1. There were 46 patients who were >60 years in which majority were females 27 (59%) and males were 19 (41%). All patients had dialysis three-time per-week. Over all diabetes mellitus was the commonest comorbidity followed by hypertension, heart diseases, smoking and obesity; however, family history of CKD was present in 72 patients. Significant difference was seen in smoking between males and female (p<0.0001) (Table 1).

Table 1. Demographic and clinical details of the study patients.

N=130	Male (67)	Female (63)	p-value
Age (years) Mean±SD	49.3±15.3	53.4±16.9	0.142a
<60 n (%)	48 (71.6)	36 (57.1)	0.084b
>60 n (%)	19 (28.4)	27 (42.9)	
Smoking n (%)	32 (47.7)	0	<0.0001b*
Diabetes mellitus n (%)	67 (100)	63 (100)	-
Hypertension n (%)	67 (100)	63 (100)	-
Heart disease n (%)	28 (14.8)	27 (42.9)	0.902b
Obesity n (%)	17 (25.4)	10 (15.9)	0.182b
Family History CRD n (%)	38 (56.7)	34 (54)	0.753b

*CRD= Chronic renal disease, a= Independent t test, b = Pearson Chi square, SD= Standard deviation, * = Significant value*

We have observed the significant mean differences in some biochemical parameters like urea, creatinine, calcium, iron, TIBC and albumin over the course of four weeks post dialysis (Table 2).

Table 2: Biochemical report post-four-week dialysis

	First Week (Mean±SD)	Second Week (Mean±SD)	Third Week (Mean±SD)	Fourth Week (Mean±SD)	p-value
Urea (mmol/l)	45.12±22.23	20.99±8.68	12.05±5.19	5.74±2.45	<0.0001*
Creatinine (umol/l)	761.53±323.20	532.05±134.93	395.56±95.82	160.6±102.56	<0.0001*
Sodium (mmol/l)	138.37±3.39	135.92±183.17	138.17±3.89	137.86±4.4	0.996
Potassium (mmol/l)	4.32±0.74	4.02±66.8	4.46±0.88	4.38±0.99	0.999
Calcium (mmol/l)	8.57±1.12	8.28±1.06	5.76±1.35	4.25±1.07	0.010*
HGB (g/dl)	11.54±1.73	11.68±9.12	12.28±2.02	11.4±1.88	0.577
Iron (umol/l)	20.54±9.00	14.35±4.83	16.88±8.78	13.75±5.83	<0.0001*
TIBC (mmol/l)	34.17±8.48	39.58±8.6	42.75±9.62	36.39±10.33	<0.0001*
Albumin (g/l)	35.62±5.20	37.38±3.93	38.18±5.09	34.05±4.433	<0.0001*
Phosphorus (mmol/l)	4.65±0.81	5±4.05	5.38±3.59	4.73±0.79	0.224

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

The significant decreasing trends in the values of urea ($p<0.0001^*$) and creatinine ($p<0.0001^*$) were seen in the course of 04 weeks post-dialysis (figure 1).

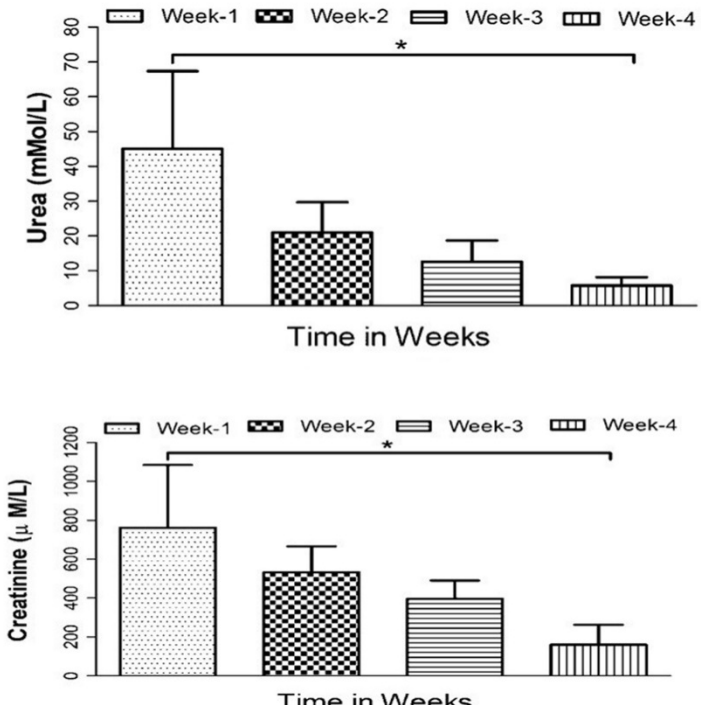

Fig. 1. Four-week trend of urea and creatinine.
*Significant value= * P < 0.05*

4. DISCUSSION

Renal failure is characterized by the gradual and irreversible loss of normal renal function, which leads to compromised excretion of urea and creatinine into the bloodstream. Individuals with renal failure experience elevated levels of these metabolic waste products, which can result in significant complications prior to the administration of hemodialysis [10] . The investigation involved the random selection of 130 patients who had been diagnosed with renal failure at King Khalid Hospital Tabuk, taking into account their clinical history, clinical examination, and renal function tests. Post-hemodialysis, a range of biomarkers was evaluated, including serum urea and blood creatinine. The leading causes of chronic kidney failure are often attributed to health issues such as hypertension, diabetes mellitus, autoimmune diseases, and other related conditions, [11] which was in concordance with our study.

The assessment of renal excretory function can be accomplished by analyzing the serum concentrations of various endogenous compounds that are cleared by the kidneys. In this regard, the measurement of serum electrolyte levels, such as sodium and potassium, in body fluids can be used as a diagnostic tool to evaluate renal disorders [12,13, 14].

The Meenakshi GG et al study has demonstrated that creatinine clearance is the most effective method of evaluating kidney function in renal failure patients who are undergoing hemodialysis [14] [15] .This is due to the significant reduction in serum creatinine levels that occurs during the process, which can also serve as an indicator of dialysis insufficiency. Additionally, individuals between the ages of 41 and 60 are more susceptible to kidney failure, potentially due to underlying conditions like hypertension, diabetes, or age-related changes [15] . Our study found that serum sodium levels did not significantly decrease post-dialysis, which is consistent with the aforementioned study's findings (p=0.999) [15] . Furthermore, we observed a significant decrease in calcium, iron, TIBC, and albumin levels.

Excess urea from the patient's blood is eliminated somewhat during hemodialysis to prevent accumulation [14]. Maintaining a proper balance of protein intake is a critical measure in preventing the overproduction of urea. [15] .The hemodialytic cycle completed in the concentrated on patients was seen to be proficient in light of the fact that altogether decreased degrees of urea were recorded ensuingly. Draczevski and Teixeira [16] showed a substantial decrease in serum urea levels, showing that hemodialysis is an effective treatment. Achieving effective waste removal during dialysis is contingent upon several factors, including appropriate dialysis scheduling, patient education, selection of a suitable dialyzer, and adherence to proper dietary habits. [17] . Urea and creatinine levels serve as crucial biomarkers in both diagnosing and tracking the progression of renal failure. As a byproduct of protein metabolism, urea levels tend to rise in the blood of patients with renal failure, ultimately leading to the development of uremia [18, 19, 20] .

In the present study, however, as the small number of patients was assessed, we need a study on a larger scale to assess these findings more efficiently.

5. CONCLUSION

According to the study's findings, the authors hypothesized that calcium absorption is diminished in patients with uremia. The concentration of sodium and calcium in post-dialysis serum is influenced by the dialysate composition of these elements and the amount of serum available for ultrafiltration. Serum creatinine and serum urea levels are strongly correlated among renal failure patients, providing information on renal function. Both markers are commonly used in assessing renal function. Hemodialysis is an effective and crucial procedure for removing unwanted metabolites, such as creatinine and urea, in patients with significant renal impairment, thereby prolonging their life expectancy. However, current research suggests that improved strategies for the early detection and prevention of renal problems are necessary.

CONSENT

All authors declare that 'written informed consent was obtained from the patient

ETHICAL APPROVAL

The research ethics committee At King Khalid University (HAPO-06-b-001) has given the approval (approval no.: ECM#2023-404)

REFERENCES

1. 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 patnties. *IJN.* 2014;(2014) Article ID 742724, 6 pages
2. 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.
3. Narula AS. Chronic kidney disease. The looming threat. *MJAFI.* 2008;64(1):2–3.
4. Anupama YJ, Uma G. Prevalence of chronic kidney disease among adults in a rural community in South India: Results from the kidney disease screening (KIDS) project. *IJN.* 2014;24(4):214–21.
5. Motamayel F.Ahmadi, Davoodi P., Dalband M., et al. Saliva as a Mirror of the Body Health. DJH.2010;1(2)
6. 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.
7. Goll Robert D., Mookerjee Basab K. Correlation of biochemical parameters in serum and saliva in chronic azotemic patients and patients on chronic hemodialysis. Journal of Dialysis. 1978; 2:399–414.
8. 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.
9. 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 Mar;23(2):125-9. doi: 10.4103/0971-4065.109421
10. Vaidya SR, Aeddula NR. Chronic Renal Failure. [Updated 2021 Oct 29]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK535404/.
11. CF Streckfus, LR Bigler. Saliva as a diagnostic fluid. Oral Diseases. 2002; 8:69–76.
12. 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 Nov 18;21(1):494. doi: 10.1186/s12882-020-02166-0. PMID: 33208123; PMCID: PMC7672884.
13. Fishbane, S., Kalantar-Zadeh, K., Nissenson, A.R. Serum ferritin in chronic kidney disease, Semin Dial. 2004; 17:336- 41
14. Nisha R, Srinivasa Kannan SR, Thanga Mariappan K, et al. Biochemical evaluation of creatinine and urea in patients with renal failure undergoing hemodialysis. J Clin Path Lab Med. 2017;1(2):1-5.
15. Meenakshi GG. Effect of Dialysis on Certain Biochemical Parameters in Chronic Renal Failure Patients. IJCMR. 2016;3(10):2869-2871.
16. Draczevski L, Teixeira ML. Avaliação do perfil bioquímicoe parâmetros hematológicos em pacientes submetidos à hemodiálise. Rev Saud Pesq. 2011; 4:15-22.
17. Merzah KS, Hasson SF. The biochemical changes in patients with chronic renal failure. : Int J Pharma Med Bio Sci. 2015;4:75-79.

18. Entedhar RS, Nawal AM. Biochemical changes in chronic renal failure pre and post hemodilysis. J Environ Sci Eng Technol. 2016; 5:190-195.
19. Suresh M, Mallikarjuna RN, Sharan BSM, et al. Hematological changes in chronic renal failure. IJSRP. 2012; 2:2250-3153.
20. Shivananda Nayak B. Manipal manual of clinical biochemistry. Jay Pee Brothers' Medical Publishers (p) Ltd, New Delhi. 2002;98-99.