Assessment of Blood Urea, Creatinine, Uric Acid, Calcium and Phosphorus levels pre- and post-dialysis in Sudanese patients diagnosed with Chronic Kidney Disease (CKD).

Graduation project submitted in partial fulfillment for requirement of bachelor degree in clinical chemistry

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اعوذ بالله من الشيطان الرجيم

بسم الله الرحمن الرحيم

(اقراء باسم ربك الذي خلق (١) خلق الانسان من علق (٢) اقراء وربك الاكرم (٣) الذي علم بالقلم (٤) علم الانسان ما لم يعلم (٥))

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Dedication

To our beloved families and friends

Acknowledge

First And Foremost, We would like to thank god for his never grace, Mercy

We would like to thanks Us Rayan Mohamed, Us Mawda Ibrahim & Us Maissa kamal for their expert advices and encouragemen. This project would have been impossible without their support. Also we thank Dr. Sulafa saif aldeen and all staff and Participants Included in Research

Abstract

Background:

Chronic Kidney Disease (CKD) is a permanent Loss of normal kidney functional or structural with or without reduction in Glomerular Filtration Rate (GFR), which may be due to various factors including infections, autoimmune diseases, diabetes, hypertension and other endocrine disorders, and toxin chemicals, may lead to death.

Materials and Methods:

A descriptive Cross-sectional study was conducted to measure the effectiveness of haemodialysis on (19) Sudanese patients with chronic kidney disease aged between (25-60). Three ml of venous blood was drawn pre and post dialysis from each patient, using disposable syringe. Serum Level of urea, creatinine, uric acid, calcium and phosphors were estimated in all samples by co-bas C311, statistical evaluation was performed using SPSS for windows.

Results:

The study showed significance statistical difference in the mean of urea, creatinine, uric acid and phosphorus p-value(0.000001),(0.0001),(0.0001),(0.002) respectively however the mean of calcium showed insignificant statistical difference p-value(0.992).

Conclusion:

The findings showed that hemodialysis have an effected on urea, creatinine, uric acid and phosphorus but has no effect on calcium.

المستخلص

خلفية:

مرض الكلى المزمن (CKD) هو فقدان دائم لوظائف الكلى الطبيعية أو الهيكلية مع أو بدون انخفاض في معدل الترشيح الكبيبي (GFR) ، والذي قد يكون بسبب عوامل مختلفة بما في ذلك الالتهابات وأمراض المناعة الذاتية والسكري وارتفاع ضغط الدم واضطرابات الغدد الصماء الأخرى ، و الكيماويات السامة ، قد تؤدي إلى الموت.

المواد والطرق:

أجريت دراسة مقطعية وصفية لقياس فعالية غسيل الكلى على (19) مريضاً سودانياً يعانون من مرض الكلى المزمن والذين تتراوح أعمارهم بين (25-60). تم سحب ثلاثة مل من الدم الوريدي قبل وبعد غسيل الكلى من كل مريض. تم تقدير مستوى البولينا والكرياتينين وحمض البوليك والكالسيوم والفوسفور في جميع العينات بواسطة CO-bas C311، وتم إجراء التقييم الإحصائي باستخدام نافذة الحزمة الاحصائية للعلوم الاجتماعية .

نتائج:

أظهرت دراسة فروق ذات دلالة إحصائية في متوسط كل من البولينا والكرياتينين وحمض البوليك والفوسفور القيمة الاحتمالية (0،000001) ، (0،0001) ، (0،0001) ، (0،002) على التوالي فرق المعنوية في متوسط الكالسيوم القيمة الاحتمالية (0،992). (القيمة الاحتمالية = 0،05).

استنتاج:

وأظهرت النتائج أن غسيل الكلى يؤثر على نسبة البولينا والكرياتينين وحمض البوليك والفوسفور في الدم ولا يؤثر علي الكالسيوم.

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1. Introduction:

1.1 Back ground :-

Chronic Kidney Disease (CKD) is a permanent loss of normal kidney functional or structural with or without reduction in glomerular filtration rate (GFR), which may be due to various factors including infections, auto immune diseases, diabetes, hypertension, other endocrine disorders, and toxin chemicals. [1,2].

1.1.1 Symptoms, risk factors and complication of Chronic Kidney Disease (CKD):-

Nausea, vomiting, loss of appetite, fatigue and weakness, Changes in how much you urinate, Muscle twitches and cramps, Swelling of feet and ankles, Persistent itching, Shortness of breath, if fluid builds up in the lungs. [3,4]

The major risk factor of CKD coronary artery disease. such as diabetes and hypertension. Uremia-related cardiovascular disease risk factor including inflammation, oxidative stress, abnormal calcium-phosphorus metabolism. The global prevalence of CKD was 9.1% (697.5 million cases in Aljazera city). Complications of CKD: hypertension diabetes, dyslipidemia, cardiovascular diseases, anemia and bone disorders [3][4]

Patient with CKD characterized by proteinuria, abnormal urine sediments, development of secondary renal hyperthyroidism and/or GFR less than 60ml/min/1.73m^2 for at least three months. [6]
It often involves a progressive loss of kidney function necessitating renal replacement therapy (dialysis or transplantation) [7].

1.1.2 Diagnosis of CKD:-

We can confirm that patient has CKD by three medical examinations blood test, urine test or take a biopsy sample.

1.1.2.1 Blood tests:

Kidney function tests look for the level of waste products, such as creatinine and urea, in blood.

We can say the patient have CKD if urea more than 24mg/dl and creatinine more than1.3mg/dl.[8]

1.1.2.2 Urine tests:

Analyzing a sample of urine can reveal abnormalities that point to chronic kidney failure and help identify the cause of chronic kidney disease. We can say the patient have CKD if we found protein in urine specially Albumin.[8]

1.1.2.3 Removing a sample of kidney tissue for testing:

Doctor might recommend a kidney biopsy, which involves removing a sample of kidney tissue[8].

1.1.3 Urea is a waste product from dietary protein and is filtered into urine by the kidneys. It is the best monitor for the efficiency of hemodialysis, its level changed immediately after dialysis. [3].

1.1.4 Creatinine is produced from muscles and is excreted through the kidneys along with other waste products. The maintenance of creatinine levels in serum by the balance between creatinine excretion by the kidneys and its generation, thus its rate of generation is constant during the day [10]

1.1.5 Uric acid is a waste product of purine metabolism. Its production and metabolism involve the hepatic production as well as renal and gut excretion of this compound. Most of the produced uric acid is filtered from glomeruli and approximately 90 % of it is reabsorbed into blood [11]. In patients with CKD, uric acid level is increased due to impaired filtration and/or secretion [17].

1.1.6 Calcium is an essential nutrient that maintain normal neuromuscular function, blood cloting. The rate of calcium absorption from the gastrointestinal tract matches the rate of losses from the body through the kidneys, skin, hair, and nails in normal adults. [12].

1.1.7 Phosphorus is phosphate compounds that present in every cell of the body, it regulates skeletal growth and maintains energy through adenosine triphosphate molecules (ATP). [14]. Hypophosphatemia , may occurs in patient with: ketoacidosis, malignancy, longterm treatment with total parenteral nutrition (TPN), while hyperphosphatemia commonly present in patients with acute or chronic kidney disease.[14].
The disturbances in phosphorus and Calcium are usually spotted patients with chronic disease (CKD) in dialysis patients, the mineral metabolism be revealed as important predictors of morbidity and mortality [13].

1.1.8 Dialysis is the process of remove the toxic substances from the blood outside the body by using machine. Dialysisor kidney transplantation consequently the final outcome. [3][4].

1.1.8.1 Classification of Dialysis:

1.1.8.1.1. Hemodialysis (outside body)

Is procedure where a dialysis machine clean your blood by using a special filter called an artificial kidney or a dialyzer in dialysis center. Usually it take 3 to 4 hours, 2 to 3 time in the week.[5]

1.1.8.1.2 Peritoneal dialysis (inside body)

By putting a soft plastic tube (catheter) in the belly by surgery, a sterile cleansing fluid put in the belly through this catheter, the act like filter and faltering the blood then the fluid leave the body by the catheter.[5]

1.2 Literature review:

A study conducted at Gezira State in units of dialysis (Gezira Hospital for Renal Disease and Surgery) and (Omer Elhag Musa Center for Kidney Diseases and Surgery Rufaa) in April 2015 revealed that CKD is more common in male than females with most of patients were aged from 40-60 years. it showed significant statistical significant decrease in urea and creatinine levels after dialysis, the drop of urea levels were more significant than creatinine levels in patients when compared with the control group.[3]

A Study conducted in 2020 in Iraq, aimed to evaluate calcium, uric acid, urea and Creatinine in Iraqi patients with renal failure pre dialysis. It Showed a strong relationship between serum urea creatinine, uric acid and calcium levels among in patients with CKD with varied age groups (20 -40) and (50 – 80) years. Patients with CKD showed increased serum urea, creatinine and uric acid levels before dialysis. while calcium level was significantly decreased . [15]

Another case-control study aimed to evaluate biochemical renal parameters in patient with CKD concluded that the elevated serum phosphate, magnesium and decreased serum calcium, iron are concerning with CKD. [16]

1.3 Objectives:

1.3.1. General objectives:

To assess the levels of blood urea, creatinine, uric acid, calcium and phosphorus in Sudanese patients with CKD who undergo dialysis.

1.3.2 Specific objectives:

1. To estimate blood urea level in patients with Chronic Kidney Disease pre and post dialysis.
2. To estimate blood Creatinine level in in patients with Chronic Kidney Disease pre and post dialysis.
3. To estimate blood uric acid level in in patients with Chronic Kidney Disease pre and post dialysis.
4. To estimate blood calcium level in in patients with Chronic Kidney Disease pre and post dialysis.
5. To estimate blood phosphorus level in in patients with Chronic Kidney Disease pre and post dialysis.
6. To compare the blood levels of urea, creatinine, uric acid, calcium and phosphorus pre and post dialysis.

Chapter Two

Materials and methods

2. Materials and Methods

2.1 Study Area

This study was carried out in Khartoum state, Omdurman city at the military hospital during the period from 20/11/2021 to 25/12/2021.

2.2 Study Design:

This study is adescriptive Cross-sectional study

2.3 Sample Size:

Nintean patients

2.4 Sampling technique:

Cota technique**.**

2.5 Study population:

Sudanese patients with chronic kidney disease who attended the military hospital for dialysis

2.6 Selection criteria:

2.6.1 Inclusion criteria:

Sudanese Patients diagnosed with CKD, who underwent dialysis

2.6.2 Exclusion criteria:

Any Patients diagnosed with CKD but didn't undergo dialysis.

2.7 Ethical Considerations and informed consent:

The ethical approval was taken from NAPATA COLLEGE RESEARCH CENTER and the administrative unit at Military hospital.

2.8 methods of data collection:

2.8.1 Clinical data collection:

The clinical data of participants were obtained using Questiannaire.

2.8.2 Laboratory data collection

Three ml of venous blood was drawn using asyring after disinfecting the collection area with 70% alcohol. The blood was placed in heparin container then centrifugation at 3000 rpm for 5 minutes to obtain plasma. Plasma was separated from the cells immediately after centrifugation.

2.9 Analytic method:

Blood urea, creatinine uric acid, and calcium were analyzed by enzymatic method and phosphorus by Gomari Reaction method using co-bas c311 auto-analyzer

2.10 Data statistical analysis

SPSS V.23computerized program was used to analyze the data by using paired T-test and Wilcoxon signed ranks test.

2.11 Quality control:

Normal and pathologic levels of control sera were used to insure the reliability of the result.

Chapter Three

Results

3. Result

The study was carried out in Omdurman city from November to December 2021. The study population was Sudanese patients with CKD who attended military hospital and underwent dialysis.

Table (3-1): Shows the distribution of gender.

Gender	Frequency	Percent
Male	**15**	**78.9%**
Female	**4**	**21.1%**
Total	**19**	**100.0%**

Table (3-2): Show the mean and SD of age duration of dialysis and blood flow.

Descriptive Statistics

	N	Minimum	Maximum	Mean ± SD
Age	**19**	**23**	**81**	**49.9 ± 19.0**
Duration of dialysis	**19**	**0.20**	**14.000**	**3.97 ± 4.9**
Blood flow(ml/min)	**19**	**200**	**250**	**236.6 ± 22.5**

Table (3-3): Show the mean and SD of Urea, Creatinine, Uric acid, Calcium and Phosphorus pre dialysis.

Parameters Pre-Dialysis				
Parameter (mg/dl)	**N**	**Minimum**	**Maximum**	**Mean ± SD**
Urea	**19**	**11**	**170**	**115.1 ± 42.4**
Creatinine	**19**	**1.4**	**16.4**	**8.9 ± 4.2**
Calcium	**19**	**6.2**	**7.8**	**7.1 ± 0.4**
Uric Acid	**19**	**1.5**	**11.1**	**6.8 ± 2.5**
Phosphorus	**19**	**2.9**	**6.5**	**4.7± 0.96**

Table (3-4): Shows the mean and SD of Urea, Creatinine, Uric acid, Calcium and Phosphorus post dialysis

Parameters Post-Dialysis				
Parameter (mg/dl)	**N**	**Minimum**	**Maximum**	**Mean ± SD**
Urea	**19**	**5**	**72**	**39.4 ±17.8**
Creatinine	**19**	**1.2**	**108.0**	**3.6 ± 2.0**
Calcium	**19**	**1.0**	**10.1**	**7.1 ± 2.2**
Uric Acid	**19**	**1.1**	**7.5**	**3.1 ±1.5**
Phosphorus	**19**	**3.0**	**4.7**	**3.8 ± 0.5**

Table (3-5): Shows the comparison of e mean of urea, creatinine, uric acid, calcium and phosphorus pre and post dialysis

Paired Samples T-Test					
Variables		Number	Mean	Std. Deviation	P value
Urea (mg/dl)	Pre-dialysis	19	115.05	42.381	0.000001**
	Post-dialysis	19	39.37	17.846	
Creatinine (mg/dl)	Pre-dialysis	19	8.926	4.2271	0.0001**
	Post-dialysis	19	3.616	2.0307	
Uric Acid (mg/dl)	Pre-dialysis	19	6.832	2.5349	0.0001**
	Post-dialysis	19	3.058	1.4908	
Calcium (mg/dl)	Pre-dialysis	19	7.111	0.3943	0.992*
	Post-dialysis	19	7.116	2.1887	
Phosphate (mg/dl)	Pre-dialysis	19	4.663	0.9622	0.002**
	Post-dialysis	19	3.826	0.4863	

- ****.P value<0.05 that's considered as statistically significant.**
- ***.P value>0.05 that's considered as statistically insignificant.**

Table (3-6): Shows the mean rank, sum and range ranks and p-value for Urea, Creatinine, Uric acid, Calcium and Phosphorus.

Wilcoxon Signed Ranks Test					
Variables		Number	Mean Rank	Sum of Ranks	P value
Post-dialysis Phosphate (mg/dl) - Pre-dialysis Phosphate (mg/dl)	Negative Ranks	15	10.5	157.5	0.002**
	Positive Ranks	3	4.5	13.5	
	Ties	1			
Post-dialysis Uric Acid (mg/dl) - Pre-dialysis Uric Acid (mg/dl)	Negative Ranks	16	11.38	182	0.001**
	Positive Ranks	3	2.67	8	
	Ties	0			
Post-dialysis Calcium (mg/dl) - Pre-dialysis Calcium (mg/dl)	Negative Ranks	4	13.75	55	0.107*
	Positive Ranks	15	9	135	
	Ties	0			
Post-dialysis Creatinine (mg/dl) - Pre-dialysis Creatinine (mg/dl)	Negative Ranks	17	10.76	183	0.0004**
	Positive Ranks	2	3.5	7	
	Ties	0			
Post-dialysis Urea (mg/dl) - Pre-dialysis Urea (mg/dl)	Negative Ranks	18	10.39	187	0.0002**
	Positive Ranks	1	3	3	
	Ties	0			
Negative rank (Post-dialysis P< Pre-dialysis)=Decrease					
Positive rank (Post-dialysis > Pre-dialysis)=Increase					
Ties (Post-dialysis = Pre-dialysis)=Maintained					

- ****.P value<0.05 that's considered as statistically significant.**
- ***.P value>0.05 that's considered as statistically insignificant.**

Chapter Four

Discussion

Conclusion

Recommendations

References

4.1. Discussion

The study aimed to evaluate blood urea, creatinine, uric acid, calcium and phosphorus levels pre and post dialysis in Sudanese patients with CKD.

The study population were 19 patients, 15 patients were males and 4 patients were females aged between 23 and 81 years old. With a mean and SD 49.9 and 19Years respectively. Table (3-1).

All patients underwent hemodialysis with duration ranged from 0.02 to 14 years, mean and SD 3.9 and 4.9 Mean. And Blood flow between 200 & 250 ml/min receptively table (3-2). In this study, the mean of urea, Creatinine, uric Acid, Calcium and phosphorus pre dialysis were (115.1) (8.9) (6.8) (7.1) (4.7) while post dialysis were (3.4) (3.6) (3.1) (7.1) (3.8) respectively. Table (3-3) and (3-4)

This study shows statistical significance difference in the mean of urea, creatinine, uric acid, phosphorus p-value (0,000001),(0,0001),(0,0001),(0,002) respectively, However there was statistical insignificant difference in the mean of calcium p-value (0,992). Table (3-5)

These result agree with a Study conducted at EIGazira University in April 2015 revealed that CRF is more common in male than females with most of patients were aged from 40-60 years. it also showed statistical significant decrease in urea and creatinine levels after dialysis, the drop of urea levels were more significant than creatinine levels in patients when compared with the control group) in urea and creatinine.[3][4]

Also agree with a study conducted in Iraq, showed the biochemical evaluation of calcium, uric acid, urea and Creatinine in Iraqi patients with renal failure pre dialysis. Renal failure patients have higher serum urea, creatinine and uric acid levels before dialysis .while calcium level was (significantly decreased). [15]

4.2. Conclusion:

The study concludes that there are statistical significant difference in the levels of urea, creatinine, uric acid, calcium and phosphorus. and the dialysis is efficient for patients attending hospital.

The study also concludes that there are statistical insignificant different in the level of Calcium.

4.3. Recommendations

It is recommended to perform the study on a wide range of population, large sample size, to investigate the long term effects of dialysis and evaluate the effect of dialysis on ionized calcium as the functional form, the reason of why calcium does not affected.

4.4 References:-

1. Meyer TW and Hostetter T. "Uremia.NEngl,"J.Med.2007; 357(13):1316.
2. Arias E, Anderson RN, Kung HC, Murphy SL, Kochanek KD. Deaths: final data for 2001. National vital statistics reports. 2003 Sep 18;52(3):1-16.
3. Almahy AM. Estimation of Urea and Creatinine Pre and Post Dialysis in Patients with Chronic Renal Failure, Gezira Hospital for Renal Disease and Surgery, Gezira State, Sudan (Doctoral dissertation, University of Gezira).
4. Elbashir EE. Serum Calcium, Phosphorus, Magnesium and Albumin levels in patients with Chronic Renal Failure in Sennar Hospital for Renal Diseases, Sennar State, Sudan (2014-2015) (Doctoral dissertation, University of Gezira).
5. www.kidney.org/atoz/centent/hemodialysis. www.kidny.org./atoz/content/pertoneal.
6. Mascha V, Rashmi K, Priyadarshi S and Bibhu R. 2006.comparing age with reference inter values for serum creatinine concentration in areality check of ther recommended cut-off.Indian.J.clin.Biochem.21(2):90–94.
7. Chertow GM, Burdick E, Honour M, Bonventre JV, Bates DW. Acute kidney injury, mortality, length of stay, and costs in hospitalized patients. Journal of the American Society of Nephrology. 2005 Nov 1;16(11):3365-70.
8. Devi TR, Gunasekaran S, Hudson JW, Joybell IS. Analysis on renal failure patients blood samples: characterization and efficacy study. Indian Journal of Science and Technology. 2009 Feb;2(2):46-50.
9. Ossman DH, Marouf BH, Ameen KH. Effect of extracorporeal fractionated heparin on heamatological and electrolyte markers in hemodialyzed patients. Journal of Practical Pathology. 2014;4:431-9.
10. Iseki K, Ikemiya Y, Fukiyama K. Risk factors of end-stage renal disease and serum creatinine in a community-based mass screening. Kidney international. 1997 Mar 1;51(3):850-4.
11. Chaudhary K, Malhotra K, Sowers J, Aroor A. Uric acid-key ingredient in the recipe for cardiorenal metabolic syndrome. Cardiorenal medicine. 2013;3(3):208-20.
12. Evenepoel P, Viaene L, Meijers B. Calcium balance in chronic kidney disease: walking the tightrope. Kidney international. 2012 Jun 1;81(11):1057-9.
13. Singh S, Upadhyay-Dhungel K, Aryal G. Value of Calcium and Phosphorous in chronic kidney disease patients under hemodialysis: A retrospective study. Journal of Pathology of Nepal. 2012 Sep 25;2(4):293-6.
14. Shiber JR, Mattu A. Serum phosphate abnormalities in the emergency department. The Journal of emergency medicine. 2002 Nov 1;23(4):395-400.
15. Abdulrazzaq IH, Murtadha JH, Dhahir SA. Study the biochemical evaluation of calcium, uric acid, urea and Creatinine in Iraqi patients with renal failure pre dialysis. Journal of the college of basic education. 2020(**وقائع المؤتمر العلمي الدولي الثاني/نقابة الاكاديميين العراقيين**).
16. Singh BS, Sweta G, Kumari S. A case-control study to evaluate the various biochemical renal parameters in chronic renal failure. European Journal of Molecular & Clinical Medicine. 2021 Apr 10;7(11):8084-9.
17. Harrison's Online. Retrieved spring 2008 from www.harrisonsonline.com/.

18. **-kidney-conditions/chronic-https://www.mayoclinic.org/diseases 20354527-treatment/drc-disease/diagnosis**

19. Hakim RM, Lazarus JM. Initiation of dialysis. Journal of the American Society of Nephrology. 1995 Nov 1;6(5):1319-28.

Questionnaire

Research Title:

Estimation Of Urea, Creatinine ,Uric Acid , Calcium and Phosphoures Pre and Post Dialysis With Chronic Renal Failure

Questionnaire

Patient NO/ID: Pre ( ) , Post ( )

Date: /

Name: _____

Time Of Dialysis: _____ Duration of dialysis: _____

Type Of Dialysis: _____ Blood flow: _____

Age: _____ (years)

Gender: _____

Occupation: _____

Clinical Data & Complain

Parameter	Pre Dialysis result:	Post Dialysis result:
1.Urea		
2.Creatinine		
3.Uric Acid		
4.Calcium		
5.Phosphoure		