

Biochemical Study in Iraqi Patients with Chronic Renal Failure Therapy by Regular Hemodialysis**Ekhlas Abdallah Hassan****Biochemical Study in Iraqi Patients with Chronic Renal Failure Therapy by Regular Hemodialysis****Ekhlas Abdallah Hassan**

Department of Chemistry - University of Diyala - College of Science Baquba – Diyala - Iraq

ekhlaschem@yahoo.com**Received: 8 June 2017****Accepted: 20 February 2018****Abstract**

In this study, we evaluated the mineral disorder and some biochemical parameters of kidney functions in Patients with end-stage renal failure. The aim of study is to assess the serum concentration of each (total calcium, phosphor, urea, creatinine, albumin and glomerular filtration rate (GFR) in patients suffering from chronic renal failure therapy by regular hemodialysis. This study has been carried out at the consultative clinic in Baquba / Ibn Seena center for renal failure, for the period January 2016 to march, 2016. 75 specimens of each of patients and control groups were collected. Patients were divided into two study groups dependent on treatment period: (first) regulated hemodialysis less than year group and (second) regulated hemodialysis more than year group. The following biochemical investigations have been studied for their total calcium, phosphorus, urea, creatinine, and albumin which calculated by utilizing a ready-made laboratory kit for this purpose. A height in m and weight in kg were measured for all participant and BMI = weight / (height)² by same investigator and tools GFR can be calculated mathematically from the Modification of Diet in Renal Disease (MDRD) formula. The study showed an increase in creatinine (120.2±7 µmol/L) renal disease, urea (29.75±1.3mmol/L), phosphor (6.012±0.5mg/dl) concentration in the serum of patients group when compared with control group were creatinine (60±05µmol/L), urea (4.5±0.13mmol/L), and phosphor (2.98±1.3). The results also showed a decrease in the concentration of total calcium (3.55±1.01 mg/dl), and GFR (25.15±13 ml/min) compared with control group total

Biochemical Study in Iraqi Patients with Chronic Renal Failure Therapy by Regular Hemodialysis**Ekhlas Abdallah Hassan**

calcium was (9.02 ± 1 mg/dl) and GFR (123 ± 5 ml/min). There was a negative correlation between GFR and each of (age, creatinine, urea and phosphor) in both patient's groups. Also, there were a positive correlation between GFR and total calcium in both patient's groups. 43.4% of patients were in range of BMI less than 18 in second groups. This Study, which showed that decrease in total calcium levels and increased in phosphor levels in patients with chronic renal failure and hemodialysis process, may play an important role in improving kidney function for some biochemical variables for patients with chronic renal deficit less than year and patients' therapy by regular hemodialysis more than year may be increased weight loss

Keywords: Total Calcium, Phosphor, Chronic Renal Failure, Hemodialysis

دراسة كيموحيوية على المرضى العراقيين المصابين بالفشل الكلوي المزمن يتعالجون عن طريق الغسيل الدموي المنتظم

اخلاص عبد الله حسن

قسم الكيمياء - كلية العلوم - جامعة ديالى - العراق

الخلاصة

في هذه الدراسة تم تقييم مستوى المعادن وبعض الدالات البيوكيميائية لوظائف الكلى في مرضى عراقيين مصابين بالفشل الكلوي بمراحله الاخيرة. الهدف من الدراسة هو تقييم كل من (الكالسيوم الكلي، الفوسفور، اليوريا، كرياتينين، الالبومين ومعدل الترشيح الكبيبي) في المرضى الذين يعانون من الفشل الكلوي يتعالجون بواسطة الغسيل الدموي. هذه الدراسة قد أجريت في العيادة الاستشارية في بعقوبة/مركز ابن سينا للفشل الكلوي للفترة من كانون الثاني 2016 الى مارس 2016. 75 عينة من كل من المرضى الفشل الكلوي المزمن والسيطرة التي تم جمعها. المرضى قسموا اعتمادا على فترة المعالجة الى: مجموعة اولى غسيل دموي منتظم اقل من عام و مجموعة ثانية غسيل دموي منتظم اكثر من عام. هذه التحقيقات نفذت على مصل النماذج لقياس تركيز الكالسيوم الكلي، الفوسفور، اليوريا، كرياتينين، الالبومين بواسطة العدة المتوفرة تجاريا لهذا الغرض. دالة كتلة الجسم تم حسابها رياضيا من الوزن مقدراً بالكيلو غرام مقسوماً على الارتفاع بالمتري المربع اما معدل الترشيح الكبيبي فحسب رياضيا حسب صيغة المحدد من قبل النظام الغذائي المعدل في امراض الكلى. اوضحت الدراسة زيادة في تركيز كل من الكرياتينين واليوريا والفوسفور في مصل المرضى عند مقارنتهم مع مجموعة السيطرة. والدراسة بينت ايضا انخفاض في تركيز الكالسيوم الكلي ومعدل الترشيح الكبيبي عند مقارنتها مع مجموعة السيطرة. كانت هناك علاقة سلبية بين معدل الترشيح الكبيبي وكل من (العمر، الكرياتينين، اليوريا و الفوسفور) في كلا مجموعتين المرضى وكذلك وجود علاقة موجبة بين معدل الترشيح الكبيبي ومستويات الكالسيوم في كلا المجموعتين للمرضى. في المجموعة الثانية للمرضى

Biochemical Study in Iraqi Patients with Chronic Renal Failure Therapy by Regular Hemodialysis**Ekhlas Abdallah Hassan**

43.4% كانت دالة كتلة الجسم لهم اقل من 18. تم الاستنتاج الى ان هناك: نقصان في تركيز الكالسيوم الكلي وزيادة في مستويات الفسفور في مرضى الفشل الكلوي المزمن و عمليات الغسيل الدموي يمكن ان تلعب دور في تحسين بعض وظائف الكلى للمرضى الفشل الكلوي الاقل من سنة. و مرضى الذين يتعالجون بالغسيل الكلوي لكثر من سنة يمكن يزداد فقدان الوزن

الكلمات المفتاحية: الكالسيوم الكلي، الفسفور، الفشل الكلوي المزمن، الغسيل الدموي.

Introduction

The kidneys candidate which passes through the blood and clears it of toxin, materials in excess of the needs of the body, such as sugar, salts, proteins [1]. Divided kidney disease: renal failure acute and chronic renal failure [2]. Chronic kidney failure occurs when the kidneys slowly lose their function. It is a lifelong disease that does not get better. Causes may include diseases such as diabetes, high blood pressure and heart disease, and Kidney stones Blockage or problems in the urinary tract [3]. Dialysis means to purify the blood of toxins and waste products as a result of the inability of the kidney to do this there are two methods of dialysis are hemodialysis, where the dialysis blood pumps small amounts from the blood to outside the body through a device called the kidney industrial. This device the nomination of extra fluid and waste from the blood and then the blood is returned to the body and it takes this of treatment about four hours and is done three times. The second method is peritoneal dialysis where is placed the liquid called dialysate into the abdomen through a tube it seems that the liquid in the abdomen for several hours, where move the toxins and products from the blood into this fluid then repeat the process four or five times a day [4, 5]. Proteins are an important factor because it is a measure of the levels of calcium in the plasma. The calcium metal element is affected by absorbed on many factor, including the degree of acid, the concentration of phosphate and vitamin D. Abnormalities of phosphate, vitamin D, and calcium occur early in the course of CRF. They involve the renal regulation of levels of phosphate and serum calcium, activation of vitamin D, and regulation of levels of parathyroid hormone (PTH). The regulation level of serum phosphate requires a daily excretion of urinary of an amount equal to that absorbed from the diet. Measured total calcium in serum consists of 40% bound to albumin, about 15% bound to organic and inorganic anions, and the remaining as biologically active ionized calcium [6,7]. GFR is one of the most important functions of the kidney, where the outputs of crap of the

Biochemical Study in Iraqi Patients with Chronic Renal Failure Therapy by Regular Hemodialysis

Ekhlas Abdallah Hassan

processes of metabolism through the blood, to the glomeruli of the renal tubules happens filtration there and going through the pipes small renal and out of without being re-absorbed. But what happens to urea it's re-absorbed, in part, through pipe renal.

Leading to not rely entirely on the examination of the urea in the evaluation of the filtration function resort to the examination of the work, creatinine, which totally filtered without is absorbed again by the tubes of the renal tubules [7, 8]. Urea is a product of the removal of ammonia from amino acids which represents the final product to undermine the protein manufacture of urea from ammonia in the liver and excreted through the kidney [8]. Creatinine different form urea in to the quantity in the urine dependent on representation of proteins of the internal. While urea is dependent on external protein [9].

Materials and Methods

1. Patients and control:

This study has been carried out at the consultative clinic in Baquba / Ibn Seena center for renal failure, for the period January 2016 to march, 2016. The study included (55) patients (females and males) with age range (35-70) year. 20 control subjects comparable to patients in respect to age (35-70 year) and gender, were included in the study. Patients were divided into two study groups dependent on treatment period: (first) regulated hemodialysis less than years group and (second) regulated hemodialysis more than year group.

First group / included 32 subjects aged 40- 69 years (mean age 54.31) second group / included 23 subjects aged 40- 69 years (mean age 54.31 years) from each subject, 5 ml of blood were obtained by venipuncture, using a 10 ml disposable syringe between 9.00 and 11.00 A.M. The blood sample was dispensed in a plain tube and left for around an hour to clot at room temperature (22°C). Then, it was centrifuged at 3000 rpm for 10 minutes to separate serum. The serum was divided into aliquots (50µl) in tubes until use

2. Methods and Biochemical Determinations:

The following biochemical investigations have been studied for their total calcium, phosphorus, urea, creatinine, and albumin which calculated by utilizing a ready-made laboratory kit for this

Biochemical Study in Iraqi Patients with Chronic Renal Failure Therapy by Regular Hemodialysis**Ekhlas Abdallah Hassan**

purpose. BMI uses a mathematical formula based on a person's height and weight. BMI equals weight in Kg / height m²) [10, 11, 12]. GFR can be calculated mathematically from the Modification of Diet in Renal Disease (MDRD) formula

$$\text{GFR (ml/min/1.73 m}^2\text{)} = 186 \times (\text{creatinine concentration})^{-1.154} \times (\text{Age})^{-0.203} \times (0.742 \text{ if female}) \times (1.210 \text{ if black}) [13].$$

Statistical Analysis

All the statistical analysis was done by using computer through the SPSS program (statistical packages for social sciences version-16) and Excel 2003. The statistical significance of difference in mean of a normally distributed quantitative variable between 2 groups was assessed by independent samples t-test. In a first analysis we compared between patients and control groups with different biochemical parameters (creatinine, urea, albumin, phosphor and total calcium), with additional covariates [age, body mass index (BMI), and GFR] and in a second analysis we study distribution of patients according to treatment period using ANOVA test. Then we distribution of patients according BMI (Kg/m²) in first and second group comparison of significant by Kruskal-Wallis Test. Also, we correlation between GFR and variable (age, Albumin, creatinine, urea, phosphor and Ca) in two group of patients with CRF. A level of 0.05, 0.01 and 0.001 is used to determine the statistical significance.

Result and Discussion

The biochemical parameters and clinical characteristics of kidney function from the whole CRF groups and from the control group are showed in Table 1. BMI, Age, Total calcium, Albumin, Urea, creatinine and GFR were comparable between the CRF group and control group. The mean age for patients group was (51.05±16.344) years which were comparable to that of healthy control mean (49±14.1) year's. The patients and the control were age matched. It is clear that no significant differences in this means that the research sample homogeneous among themselves. There are no significant differences in BMI when comparing patients with non-patient's counterparts as shown in table (1). The same table revealed that mean total calcium and phosphor for patients group were (3.55±1.019027) (6.021±0.5), while the total calcium and phosphor for control group were found to be (9.02±) (2.98±1.3). The difference was highly

Biochemical Study in Iraqi Patients with Chronic Renal Failure Therapy by Regular Hemodialysis**Ekhlas Abdallah Hassan**

statistically significant ($P < 0.001$). This result agrees with Van Hooft (1993) who stated that low levels of calcium are found in people with chronic renal failure [14].

The reason for the low calcium to low absorbed in the intestines, where metabolic of calcium has a strong relationship with metabolic of phosphor, the absorption of calcium and phosphorus is in the intestines and must not exceed the ratio of calcium to phosphorus is about 1:2, with deteriorating renal function, excretion of phosphate is impaired, and as a result, levels of serum phosphate increased. At the same time, levels of calcium fall because serum calcium is inversely regulated in relation to levels of serum phosphate. Decreased in serum calcium, in turn, stimulates release of PTH, with a resultant rise in resorption of calcium from bone. The kidneys regulate vitamin D activity by converting the inactive form of vitamin D to its active form. Decreased levels of active vitamin D lead to a decrease in intestinal absorption of calcium with a resultant increase in levels of PTH.

Vitamin D also regulates osteoblast differentiation, thereby affecting bone matrix formation and mineralization [15, 16]. Albumin was found to be lower in patients compared with the healthy subjects but this difference no statically significantly as shown in table (1). Fall albumin as a result of low calcium where 50% of the calcium in the blood plasma is connected with the albumin [14]. The mean GFR in patients group was found to be significantly elevated when compared with healthy subjects. The results of the present study are similar to observation of other investigators, Guyton et al. (2000) who explained that renal failure develops when the GFR is less than 20% of normal. So, the kidneys can't regulate solute composition and volume, and metabolic acidosis. These alterations affect other systems of body to cause gastrointestinal, cardiovascular manifestations, and neurologic [17]. These lower in GFR which in turn lead to increasing in serum creatinine and urea. Serum creatinine and urea were found to be higher in patients with CRF compared with the control group ($P < 0.001$) as shown in table (1). The mean creatinine for patients group was (120.2 ± 7) which was comparable to that of healthy control mean (60 ± 05) and the mean urea for patients group was (29.75 ± 1.3) which was comparable to that of healthy control mean (4.5 ± 0.13). The results of the present study regarding serum creatinine and urea are similar to observations of other investigators, Kolagal et al. (2009) who stated that serum urea elevated in CRF [18]. The accumulation of nitrogenous wastes is an early

Biochemical Study in Iraqi Patients with Chronic Renal Failure Therapy by Regular Hemodialysis

Ekhlas Abdallah Hassan

sign of CRF, usually occurring before other symptoms become evident. Urea is one of the first nitrogenous wastes to accumulate in the blood, and level becomes of urea increasingly elevated as renal failure progresses. The increase in concentration of creatinine in serum blood of patient to the fact that creatinine of waste metabolic posed naturally with urine. In the case of renal failure gets a defect in the kidney to prevent her from doing filtration and curiosity to the outside leading to high creatinine in blood serum [19, 20].

Table 1: Characteristics of study subjects

variable	mean $\pm$ SE Patients group	mean $\pm$ SEControl group	P value
Age (years)	51.05769 $\pm$ 16.34	49 $\pm$ 14	NS
BMI(kg/m ²)	21.405 $\pm$ 5.01	24.32 $\pm$ 1.2	NS
Total calcium(mg/dl)	3. 55 $\pm$ 1.01	9.02 $\pm$ 1	P<0.00`1
Phosphor (mg/dl)	6.021 $\pm$ 0.783	2.98 $\pm$ 1.3	P<0.01
Albumin(g/dl)	3.44 $\pm$ 2.77	4.1 $\pm$ 02	NS
Urea(mmol/L)	29.75 $\pm$ 1.3	4.5 $\pm$ 0.13	P<0.001
Creatinine(μ mol/L)	120.2 $\pm$ 7	60 $\pm$ 05	P<0.001
GFR(ml/min)	25.15 $\pm$ 13	123 $\pm$ 5	P<0.001

*Significant using t test at 0.001 level of significance

The clinical characteristics of kidney function from the first group (regulated hemodialysis less than years), second group (regulated hemodialysis more than years) and from the control group are showed in table (2). Age, BMI, Total calcium, Albumin, Urea, creatinine and GFR were comparable between the three group. As shown in table 2, no significant variations were observed between the means of age in the two groups of patients and controls. Also, no significant variations were observed between the means of albumin in the two groups of patients and controls. The serum calcium showed a gradual decreased level in two groups of CRF patients (4.4 $\pm$ 0.12 and 3.63 $\pm$ 0.48, respectively) compared with controls (9.02 $\pm$ 1). Significant difference (P<0.05) was recorded (Table 2). On the other hand, in patients with first and second group, increased phosphor level, significant differences were noticed (5.62 $\pm$ 0.4 and 6.72 $\pm$ 0.35, respectively) when compared to control group. Result were in agreement with Van Hooft (1993) [14]. BMI was found to be normal in CRF patients compared with the healthy subjects and significantly lower in second group patients than first group patients and control group (P<0.05) as shown in table 3.

Biochemical Study in Iraqi Patients with Chronic Renal Failure Therapy by Regular Hemodialysis

Ekhlas Abdallah Hassan

This lower may be to inflammation which is one of important causes to hypoalbuminemia and loss of appetite in patients with washing blood more than years [21]. Serum creatinine, urea, and GFR were found to be higher in patients compared with the control group and significantly elevated in second group patients than first group patients and healthy subjects ($P < 0.05$) as shown in table 2. As shown in table 2, these results may be to when the kidneys lose most of their function, called end-stage renal failure, dialysis is needed several days a week. A transplant of kidney may also be a treatment option [22].

Table 2: Clinical characteristics of patients with CRF in the two group and control group

Variable	First group mean $\pm$ SE	Second group mean $\pm$ SE	Control group mean $\pm$ SE	P value
Age(years)	51.4 $\pm$ 16	53 $\pm$ 8	49 $\pm$ 14	NS
BMI(kg/m ²)	24 $\pm$ 3	19 $\pm$ 2	24.32 $\pm$ 1.2	P<0.05
T.C(mg/dl)	4.4 $\pm$ 0.12	3.63 $\pm$ 0.48	9.02 $\pm$ 1	P<0.05
Phosphor(mg/dl)	5.62 $\pm$ 0.4	6.72 $\pm$ 0.35	2.98 $\pm$ 1.3	P<0.04
Albumin (g/dl)	5.764 $\pm$ 1.8	4.949 $\pm$ 0.9	4.1 $\pm$ 1.3	NS
Urea(mmol/L)	31 $\pm$ 37	31.4 $\pm$ 39	4.5 $\pm$ 0.13	P<0.05
Creatinine (μ mol/L)	110 $\pm$ 2	120 $\pm$ 5	60 $\pm$ 05	P<0.05
GFR(ml/min)	33 $\pm$ 4	13 $\pm$ 5	123 $\pm$ 5	P<0.05

*Significant using ANOVA test at 0.05 level of significance

In figure (1) we notice that there was a highly significant difference ($P < 0.05$) between patients in BMI ranges, most of patients in first group were in normal range (50%) and 37% of them were in over weight. Few of patients were in range less than 18. Our results are agreed with the Kaur [23].

In figure (2) we notice that there was a highly significant difference ($P < 0.05$) between patients in BMI ranges, most of patients in second group were in normal range (47%) and 6.8% of them were in over weight. 43.4% of patients were in range less than 18. Our results are agreed with the Lesley (2012) [23]. Most of patients were in normal range or lower of normal range this may be to the larger proportions of the patients were older.

Biochemical Study in Iraqi Patients with Chronic Renal Failure Therapy by Regular Hemodialysis

Ekhlas Abdallah Hassan

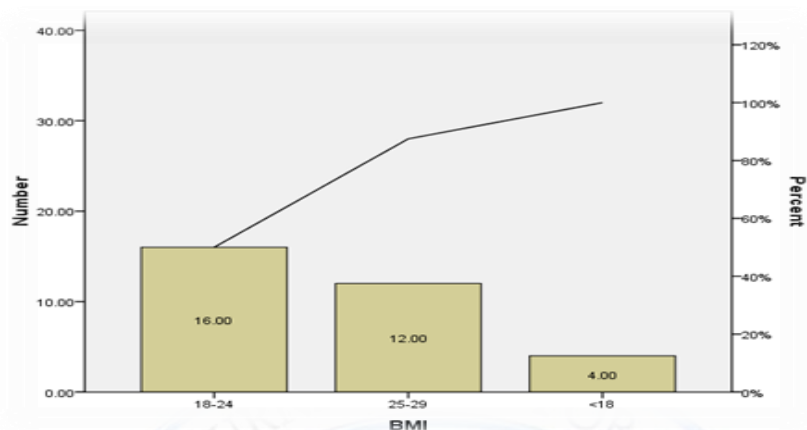


Figure 1: Distribution of patients according BMI (Kg/m²) in first group (Comparison of significant by Kruskal -Wallis Test)

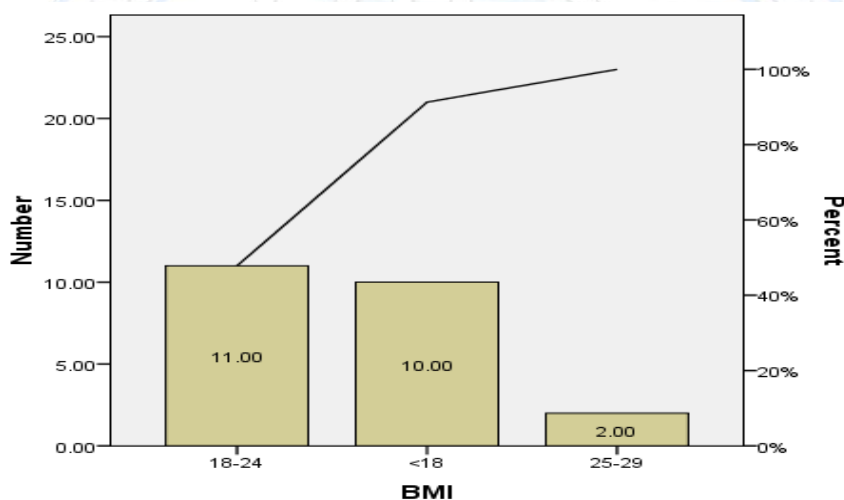


Figure 2: Distribution of patients according BMI (Kg/m²) in second group (Comparison of significant by Kruskal-Wallis Test)

The statistical analysis showed significant correlation between GFR and age in first group and second group ($r = 0.656$, $p = 0.00$ and $r = 0.425$, $p = 0.022$ respectively), as shown in table 3. Among older persons, the presentation and course of renal failure may be altered because of age-related changes in the kidneys and concurrent medical conditions. Normal aging is associated with a decline in the GFR and subsequently with reduced homeostatic regulation under stressful conditions. This reduction in GFR makes elderly persons more susceptible to

Biochemical Study in Iraqi Patients with Chronic Renal Failure Therapy by Regular Hemodialysis**Ekhlas Abdallah Hassan**

the detrimental effects of nephrotoxic drugs, such as radiographic contrast compounds. The reduction in GFR related to aging is not accompanied by a parallel increase in the serum creatinine level because the level of serum creatinine, which results from metabolism of muscle, is significantly decreased in older persons because of reduced muscle mass and other changes related with age. Determination of renal function in older persons should include estimation of creatinine clearance along with the serum creatinine levels [24]. Also, there was significant negative correlation ($r = -0.881$, $p = 0.002$, $r = -0.801$, $p = 0.00$ respectively) between GFR and each (serum creatinine and phosphor), while there was a significant positive correlation between GFR and Total calcium in first group ($r = 0.781$, $p = 0.000$) as shown in table 4. On the other hand, table 4 showed no significant correlation between serum albumin and GFR ($r=0.132$, $P = 0.530$ and $r = 0.190$, $p = 0.386$, respectively) in first and second group. A significant positive correlation in second group has been shown between total calcium and GFR ($r = 0.821$, $p = 0.00$). On the other hand, there was significant negative correlation between GFR and each of the creatinine, urea, and phosphor parameters ($r = -0.704$, $p = 0.002$, $r = -0.523$, $p = 0.04$, and $r=0.860$, $p = 0.000$ respectively) as shown in table 3. Our results are agreed with the Stevens et al (2005) [25]. CRF represents the end result of conditions that greatly decreased function of renal by destroying renal nephrons and producing a marked decrease in the reduce (GFR). The level of urea becomes increasingly elevated as renal failure progresses. Creatinine, a by-product of muscle metabolism, is filtered in the glomerulus and is not reabsorbed in the renal tubules. Several studies suggest creatinine clearance similarity to GFR and its reciprocal correlation with the level of serum creatinine. Creatinine is secreted by proximal tubular cells and then filtered by the glomerulus; thus, the clearance of creatinine exceeds the GFR. Tubular secretion of creatinine varies among and within individual persons, especially in those with a mild-to-moderate reduction in the GFR [26]. Abnormalities of calcium occur early in the course of CRF. When GFR decreased levels of serum phosphate increased. At the same time, levels of serum calcium decreased because a level of serum calcium is inversely regulated in relation to levels of serum phosphate [20].

Biochemical Study in Iraqi Patients with Chronic Renal Failure Therapy by Regular Hemodialysis

Ekhlas Abdallah Hassan

Table 3: correlation between GFR and variable (age, Albumin, creatinine, urea T.C, and P) in two patients' group with CRF

Variable	First group GFR		Second group GFR	
	Pearson Correlation		Pearson Correlation	
Serum Albumin	r	0.132	r	0.190
	p	0.530	p	.386
Serum urea	r	-.105	r	-.55*
	p	0.624	p	.04
Age	r	0.656**	r	.425*
	p	0.000	p	.022
Serum creatinine	r	-.881**	r	-.704**
	p	0.002	p	.002
Ca	r	.0781**	r	0.821**
	p	0.000	p	0.000
P	r	-0.801**	r	-0.860**
	p	0.000	p	0.000

** . Correlation is significant at the 0.01 level (2-tailed). * . Correlation is significant at the 0.05 level (2-tai

Conclusion

Notes from the above results showed that decrease in total calcium levels and increased in phosphor levels in patients with chronic renal failure and hemodialysis process may play an important role in improving kidney function for some biochemical variables for patients with chronic renal deficit less than year and patients therapy by regular hemodialysis more than year may be increased weight loss.

References

1. L. Loughridge, and M.G. Lewis. 2008, "Nephrotic syndrome in malignant disease", Lancet: William J. Marshall clinical chemistry, 6 edition; p 70-82.
2. J. William Marshall and B. Stephen, 2008 : "clinical chemistry " sixth Edition P.343.
3. FACT SHEET. 2010: "Chronic Kidney Disease and Kidney Failure". National Institutes of Health Updated October, p 1-2
4. R. A. Daelemans, P. C. D. Haese, M.E. BeBroe. 2001: " Dialysis". Seminars in Nephrology21, 204–212.
5. V. Ramanathan, S. Goral, J. H. Helderma. 2001:" Renal transplantation". Seminars in Nephrology21, 213–219.

**Biochemical Study in Iraqi Patients with Chronic Renal Failure Therapy by
Regular Hemodialysis**

Ekhlas Abdallah Hassan

6. C. M. Clase, G. L. Norman, M. L. Beecroft, D. N. Churchill.2000: "Albumin-corrected calcium and ionized calcium in stable hemodialysis patients". Nephrol Dial Transplant. 15: 1841–1846 8.
7. J. H. Ladenson, J. W. Lewis, J. C. Boyd.1978: " Failure of total calcium corrected for protein, albumin, and pH to correctly assess free calcium status". J Clin Endocrinol Metab; 46: 986–993
8. A. W. Skillen, and A. M. Pierides.1977: " Serum alkaline phosphatase isoenzyme in patient's chronic renal failure ". Clin. Chim. Acta. Oct 15;80(2):33946 .
9. R. J. Johnson. 2005: "The kidney in gout. 1960: 1: 33. and Breacnding A. Hyperuricaemia., 34:89.
10. Z. Mei, L. M Grummer-Strawn, A. Pietrobelli, A. Goulding, M. I. Goran; and W. H. Dietz .2002." Validity of Body Mass Index Compared with Other Body-Composition Screening Indexes for The Assessment of Body Fatness in Children and Adolescents". Am J Clin Nutr, 75(6) ,978–985.
11. World Health Organization WHO. 2003: Implementing National Diabetes Programs. Geneva, Switzerland: WHO Technical Report Series .
12. L. Fost, L. J. Hane, and P. Vestergaard .1991." Overweight and Obesity as Risk Factors for Atrial Fibrillation or Flutter: The Danish diet, Cancer, and Health Study". Am. J. of Med.; 118: 489-95 .
13. E. J. Kingdon, C. J. Knight, K. Dustan, A. G Irwin, M. Thomas.2003. "Calculated glomerular filtration rate is a useful screening tool to identify scleroderma patients with renal impairment". Rheumatology, 42:26–33.
14. I. M. Van Hooft. 1993: "Allegation in calcium metabolism in young people at risk for primary hypertension". the Dutch hypertension and offspring study.12: 268-276
15. T. Wheatley P. M. Clark, J. D. Dark. 1989: " Abnormalities of thyrotropin (TSH) evening rise and pulsatile release in hemodialysis patients: Evidence of hypothalamic-pituitary changes in chronic renal failure". Clin Endocrinol (Oxf); 654 .
16. J. T. Olesberg, M. A. Arndt and M. J. F. Lanigan, M. 2008: general renal function. P;237.

Biochemical Study in Iraqi Patients with Chronic Renal Failure Therapy by Regular Hemodialysis

Ekhlas Abdallah Hassan

17. A. Guyton and J. E. Hall. 2000: "Textbook of medical physiology" (10th ed., pp. 369–371, 373–378). Philadelphia: W. B. Saunders.
18. V. Kolagal, S. A. Karanam, R. D. Souza, S. Upadhya, V. Kumar. 2009: "Determination of Oxidative Stress Markers and their Importance in Early Diagnosis of Uremia-related Complication". Indian Journal of Clinical Nephrology,19: 8-12.
19. F. Llach, and J. Bover.2000: "Renal osteodystrophies. In Brenner B.M. (Ed.), Brenner and Rector's the kidney "(6th ed., pp. 2103–2135). Philadelphia: W.B. Saunders .
20. K.A. Hrusks, and S.L. Teitelbaum. 1995:" Renal osteodystrophy". New England Journal of Medicine333, 166–174.
21. S. Kaur, N. P. Singh, A. K. Jain, and A. Thakur. 2012:" Serum C-reactive protein and leptin for assessment of nutritional status in patients on maintenance hemodialysis". Indian Journal of Nephrology; 22:419-423.
22. A. Lesley, M. D. Inker, H. Christopher Ph. D. Schmid, M. S. Hocine Tighiouart , H. John M.D.,Eckfeldt . 2012: "Estimating Glomerular Filtration Rate from Serum Creatinine and Cystatin C". n engl j med 367;1.
23. R. D. Miller. 2009: "Miller's Anesthesia". 7th edition, Churchill Livingstone, p 2112 .
24. D. Choudhury, D. S. D. Raj, and B. Palmer. 2000: "Effect of aging on renal function and disease. In Brenner B. M. (Ed.), Brenner and Rector's the kidney (6th ed., pp. 2187–2210). Philadelphia: W. B. Saunders.
25. L A. Stevens, and A. S. Levey. 2005: "Measurement of kidney function "Med Clin North Am; 89:457-73.
26. A. S. Levey. 1990: "Measurement of renal function in chronic renal disease". Kidney Int; 38: 167-84.