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Assessment biochemical parameters and electrolyte in renal failure patients on hemodialysis and Type 2 diabetes patients in Tikrit city

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Abstract :

Background: Diabetes mellitus is the main reason for end-stage renal disease. Death rates are higher in hemodialysis patients with diabetes than in those without diabetes. Enhancing glycemic control can decrease the heightened risk of death and morbidity in individuals with HD. **Aim of the study**: The current study aimed to assess several biochemical markers and serum electrolytes in individuals with renal failure and diabetes. **Material and methods:** This study included 90 samples. This study was divided into three groups. The first group is for patients undergoing dialysis (35 patients), the second group is for patients with type 2 diabetes (35 patients), and the control group (20 individual) consists of individuals with normal renal indicators and no history of renal failure, whose ages range from 40 to 70 years. , male and female. From September 2023 to February 2024, in the Artificial Kidney Department at the Teaching Hospital in Tikrit.. The biochemical test and electrolyte panel includes Blood Glucose, Urea, Creatinine, Iron, Total Protein, Albumin, Phosphate, Calcium, Chloride, Potassium, and Sodium. **Results:** The study found higher blood glucose and phosphate levels in hemodialysis patients (191.500±0.707, 5.7370±1.482) and diabetics (245.500±0.707, 6.3200±1.283) compared to controls,(p-value <0.05). Hemodialysis patients had higher urea and creatinine levels (190.50±21.500, 7.805±2.16), in compared with diabetic patients and controls (p-value <0.05). Total Protein and Albumin levels decreased in hemodialysis patients (6.4395±0.2861, 3.638 ±0.473) and diabetics (5.4100±0.6141, 3.415±0.707) compared to controls, (p-value <0.05). Potassium levels increased in hemodialysis and diabetic patients (5.416±1.693,5.620±2.028) respectively) compared to controls (3.610±0.693) (p-value <0.05).**Conclusion:** The study concluded increase blood glucose, potassium, and phosphate in both hemodialysis patients and diabetics. While increase urea and creatinine in hemodialysis patients only . As well as decrease albumin and total protein in both hemodialysis patients and diabetics. Furthermore no differences in iron, calcium, chloride, and sodium between study groups.

Keyword: hemodialysis, diabetic, biochemical parameters, electrolyte

تقييم المعايير الكيموحيوية والكهارل لدى مرضى الفشل الكلوي الخاضعين لغسيل الكلى ومرضى السكري في مدينة تكريت

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مستخلص:

الخلفية: داء السكري هو السبب الرئيسي لمرض الكلى في المرحلة النهائية. معدلات الوفاة أعلى لدى مرضى غسيل الكلى المصابين بداء السكري مقارنة بأولئك الذين لا يعانون من مرض السكري. يمكن أن يؤدي تعزيز التحكم في نسبة السكر في الدم إلى تقليل خطر الوفاة والمراضة لدى الأفراد الذين يخضعون لغسيل الكلى. **الهدف من الدراسة:** هدفت الدراسة الحالية إلى تقييم العديد من المعايير الكيموحيوية والكهارل لدى الأفراد المصابين بالفشل الكلوي والسكري. **المواد والطرق:** شملت هذه الدراسة 90 عينة, تم تقسيم هذه الدراسة إلى ثلاث مجموعات. المجموعة الاولى لمرضى الذين يخضعون لغسيل الكلى (35مرضى)، والمجموعة الثانية لمرضى السكري من النوع الثاني (35مرضى)، ومجموعة السيطرة (20 اشخاص) تتكون من أفراد ذوي مؤشرات كلوية طبيعية وليس لديهم تاريخ من القصور الكلوي، الذين تتراوح أعمارهم بين 40 إلى 70 عاماً، من الذكور والإناث. في الفترة من سبتمبر 2023 إلى شباط 2024, في قسم الكلى الاصطناعية في المستشفى التعليمي في مدينة تكريت. يتضمن اختبار الكيموحيوية والإلكتروليت: جلوكوز الدم واليوريا والكرياتينين والحديد والبروتين الكلي والزلال والفوسفات والكالسيوم والكلوريد والبوتاسيوم والصوديوم. **النتائج:** وجدت الدراسة ارتفاع مستويات الجلوكوز والفوسفات في الدم لدى مرضى غسيل الكلى (191.500±0.707, 5.7370±1.482) على التوالي, ومرضى السكر (245.500±0.707, 6.3200±1.283) مقارنة مع مجموعة التحكم (قيمة p <0.05). كان لدى مرضى غسيل الكلى مستويات أعلى من اليوريا والكرياتينين (190.50±21.500, 7.805±2.16) مقارنة مع مرضى السكري والمجموعة الضابطة مستويات مماثلة، قيمة p <0.05. انخفض إجمالي مستويات البروتين والزلال في مرضى غسيل الكلى (6.4395 ± 0.2861، 3.638 ± 0.473) ومرضى السكر (5.4100 ± 0.6141، 3.415 ± 0.707) مقارنة مع مجموعة التحكم (قيمة p <0.05). ارتفعت مستويات البوتاسيوم لدى مرضى غسيل الكلى ومرضى السكري (5.416 ± 1.693a و 5.620 ± 2.028a على التوالي) مقارنة مع مجموعة السيطرة (3.610 ± 0.693) (قيمة p <0.05).الاستنتاج: خلصت الدراسة إلى زيادة نسبة الجلوكوز والبوتاسيوم والفوسفات في الدم في كل من مرضى غسيل الكلى ومرضى السكر. بينما ترتفع نسبة اليوريا والكرياتينين عند مرضى غسيل الكلى فقط. وكذلك انخفاض الألبومين والبروتين الكلي في كل من مرضى غسيل الكلى ومرضى السكر. وعلاوة على ذلك لا توجد فروق في الحديد والكالسيوم والكلوريد والصوديوم بين مجموعات الدراسة.

الكلمات المفتاحية: غسيل الكلى، مرض السكري، المعايير الكيموحيوية، الكهارل .

1. Introduction

Chronic kidney disease (CKD) is a significant public health issue. Approximately 26 million individuals in the United States have non-dialysis dependent kidney illness, and over 4 million persons have chronic renal disease, which accounts for over 13% of the US population [1].

Chronic renal disease causes a gradual and continuous deterioration of kidney function. It often arises due to problems caused by another severe medical disease. Chronic renal failure develops gradually over a prolonged period of time as the kidneys progressively lose function, ultimately resulting in end-stage renal disease (ESRD) [2,3]. Major risk factors for chronic kidney disease are hypertension, diabetes mellitus, and obesity. Biochemical processes are impacted in Chronic Kidney Disease (CKD) and become increasingly apparent as the condition advances[4].

The kidneys are crucial for maintaining body fluid balance, electrolyte levels, and acid-base equilibrium. Chronic kidney disease (CKD) and end-stage renal disease (ESRD) commonly lead to multiple issues including high levels of potassium (hyperkalemia), metabolic acidosis, and elevated phosphorus levels (hyperphosphatemia). These imbalances can cause serious complications like bone disorders, muscle loss, vascular calcification, and increased mortality[5]. Imbalances in biochemical parameters such as sodium, potassium, calcium, magnesium, and chloride can be life-threatening, hence it is important to maintain these values within the normal physiological range[6]. Dialysis is a common treatment for Chronic Kidney Disease (CKD) that involves using a machine to remove waste products from the blood and get rid of extra fluids from the body[7]. Peritoneal dialysis, hemodialysis, and continuous renal replacement therapy are different types of dialysis. Hemodialysis uses artificial kidney apparatus to filter the blood, while peritoneal dialysis uses the lining of the abdominal cavity as a natural filter[8]. Continuous renal replacement therapy is a form of dialysis employed in severely ill patients to continually remove waste products and excess fluids from the bloodstream. Dialysis is a powerful treatment for chronic kidney disease, but it can significantly affect the results of medical tests. Dialysis al-

ters the levels of many components in the bloodstream, such as electrolytes, creatinine, and urea. During hemodialysis, creatinine concentration in the blood decreases rapidly as the dialysis machine removes this substance. This decrease might affect the accuracy of creatinine-based estimations of kidney function, such as the estimated glomerular filtration rate (eGFR)[9].

2. Materials and methods

2.1 Sample collection

This study included 90 samples. This study was divided into three groups. The first group is for patients undergoing dialysis (35 patients), the second group is for patients with type 2 diabetes (35 patients), and the control group (20 individuals) consists of individuals with normal renal indicators and no history of renal failure, whose ages range from 40 to 70 years. , male and female. From September 2023 to February 2024, in the Artificial Kidney Department at the Teaching Hospital in Tikrit.

5 ml of venous blood was collected in sterile polypropylene tubes without anticoagulant to avoid contamination. To prevent the rupture of red blood cells, the blood was allowed to clot. The isolated serum was centrifuged and transferred to sterile, clean, and dry polypropylene tubes. The biochemical tests were performed on the same day.

2.2 Measurement of biochemical parameters

After getting the serum analysis kit (Standard Kits) from the French company (Biolabo) was used to measure sugar, serum iron, urea, creatine, albumin , tolal protein, calicum and phosphate level by spectrophotometer. While [Na], [Cl] and [K] levels were estimated using several analyzes prepared by the Japanese company (FUJIFILM, FUJI DRI-CHEM SLIDE).

2.3 Statistical analysis:

The data was analyzed with the ANOVA test using the Minitab program. The mean was determined to be statistically significant based on the Duncan multiple range test at a significance level of 0.05.

3. Results

The results showed increase blood glucose and phosphate in hemodialysis patient (191.500±0.707, 5.7370±1.482) mg\dL respectively, and Diabetics patients (245.500±0.707, 6.3200±1.283) mg\dL as compared with control that were (94.500±2.120, 3.8100±1.141)

mg\dL respectively, at (p-value <0.05). As for urea and Creatinine increase in hemodialysis patient(190.50±21.500, 7.805±2.16) mg\dL respectively as compared with control, and no differences between Diabetics patients(45.50±10.707, 0.840±1.671)mg\dL respectively and control(35.99± 3.407, 0.545±0.064)mg\dL respectively, at (p-value <0.05). While decrease Total Protein and Albumin in hemodialysis patient(6.4395±0.2861, 3.638 ±0.473) g\dL respectively and in Diabetics patients(5.4100±0.6141, 3.415±0.707) g\dL respectively in compared with control (7.3100±0.8220, 4.065±0.927) g\dL respectively, at (p-value <0.05). Furthermore no differences in Iron and calcium level between study groups that were (7.192± 1.641 µmol/L, 8.192±2.739 mg\dL) respectively in hemodialysis patient,(7.450±2.707 µmol/L, 8.100± 1.141 mg\dL) in Diabetics patients and (7.810±1.414 µmol/L, 8.905±2.281 mg\dL) in control, at (p-value >0.05). As shown in Table (1).

Table (1): Comparison between hemodialysis patient, Diabetics patients and Control regarding the mean ± SD of Blood Glucose, Urea, Creatinine, Iron, Total Protein, Albumin, phosphate, and calcium.

Parameters	hemodialysis patient(35)	Diabetics patients(35)	Control (20)	P-value
Blood Glucose (mg\dL)	191.500± 0.707 b	245.500± 0.707a	94.500± 2.120 c	0.00008
Urea (mg\dL)	190.50± 21.500 a	45.50± 10.707 b	35.99± 3.407b	0.02
Creatinine (mg\dL)	7.805± 2.166 a	0.840± 1.671 b	0.545± 0.064 b	0.04
Iron(µmol/L)	7.192± 1.641 a	7.450± 2.707 a	7.810± 1.414 a	0.855
Total Protein((g\dL))	6.4395± 0.2861 b	5.4100± 0.6141 c	7.3100± 0.8220 a	0.0008
Albumin(g\dL)	3.638 ±0.473 b	3.415± 0.707b	4.065± 0.927 a	0.034
phosphate (mg\dL)	5.7370± 1.482a	6.3200± 1.283a	3.8100± 1.141 b	
calicum (mg\dL)	8.192± 2.739a	8.100± 1.141a	8.905± 2.281a	0.392

Additionally, the results showed no differences in chloride and sodium level between study groups that were (104.950±15.480, 134.110±18.880) Mmol/l respectively in hemodialysis patient, (105.150±13.212, 136.200±14.283) Mmol/l respectively in Diabetics patients and (105.935±17.061, 138.815±19.035a) Mmol/l respectively in control, at (p-value >0.05). as for potassium, the study show increase potassium in hemodialysis patient (5.416±1.693a) Mmol/l, and Diabetics patients (5.620±2.028a) Mmol/l, as compared with control that were (3.610±0.693) Mmol/l,, at (p-value <0.05).As shown in Table (2).

Table (2): Comparison between hemodialysis patient, Diabetics patients and Control regarding the mean ± SD of chloride**,** potassium**, and** sodium**.**

Parameter	hemodialysis patient(35)	Diabetics patients(35)	Control(20)	P-value
chloride (Mmol/l)	104.950 ± 15.480a	105.150 ± 13.212a	105.935 ± 17.061a	0.968
potassium(Mmol/l)	5.416 ± 1.693a	5.620 ± 2.028a	3.610 ± 0.693b	0.006
sodium(Mmol/l)	134.110 ±18.880a	136.200 ± 14.283a	138.815 ± 19.035a	0.731

4. Discussion

This study show the highest mean of blood glucose was in diabetics patients, followed in hemodialysis patients in compared with control. The differences was significant at p-value 0.00008. The study done by [10] show increase blood glucose in hemodialysis patient as compared with control. Other study done by [11] show increase blood glucose in diabetes type 2 patients as compared with control. Another study explain the many reason that cause decrease glucose in hemodialysis patient, The patient's renal failure results in reduced excretion of insulin or hypoglycemic medicines, causing insulin accumulation in the body. During hemodialysis, insulin, being a macromolecular molecule, is not easily eliminated by dialysis, but glucose, being a tiny molecular material, may easily pass through the filter membrane of the dialyzer. Sugar-free dialysate is commonly utilized in Chinese hospitals due to challenges in storing glucose-containing dialysate and the risk of hospital-acquired infections[12].

The study revealed that hemodialysis patients had the highest mean levels of urea and creatinine, followed by diabetic patients compared to the control group.[13]. Increased blood urea and serum creatinine levels are widely recognized as reliable markers of reduced kidney function in patients with chronic kidney disease (CKD), and there is a general agreement among medical professionals on their significance in evaluating kidney health. These measures are commonly utilized to assess kidney function in diabetic and hypertensive persons at risk for chronic kidney disease (CKD)[14]. This study's urea results concurred with those of Al-Jumaili [15]. Both diabetic nephropathy and chronic renal failure can lower urine urea excretion, which is one of the causes of elevated urea levels. Low urea excretion from renal disorders leads to urea buildup and elevated blood concentrations. The absence of commitment is the second cause of elevated urea levels. Individuals who consume a lot of protein have higher blood urea concentrations [16,17]. It was also found that blood urea concentrations are almost equal to blood creatinine concentrations, suggesting that renal filtration function problems may be present. A number of other serious diseases can result from elevated serum urea and creatinine levels, which have been noted by other researchers like Noor et al. [18] in individuals with CKD. Elevations in serum chemical levels signify kidney disease. Creatinine and urea are trustworthy markers of healthy renal function. renal injury caused creatinine levels to rise considerably, Moses and Johnkennedy [19] found, and this was followed by a decrease in glomerular filtration rate because of renal inflammation.

This study show no differences in iron level, while decrease both albumin and total protein in hemodialysis patients and diabetics patients, this result may be due to either changes in the structure of basement membrane of glomeruli which lead to the leakage of albumin and some molecular weight protein or protein malnutrition. This study agree with [20], that show decrease albumin level in hemodialysis patients. while disagree with[21], that show increase albumin level in hemodialysis patients. This study show increase phosphate in both hemodialysis patients and diabetics patients while no differences in calcium level between study groups.

In our investigation, we observed a statistically significant rise in phosphate and potassium levels in the sick group compared to the healthy group ($p \leq 0.05$). The kidney's function is to maintain the balance of body fluids, electrolytes, and acid-base levels. Chronic kidney disease can cause various imbalances such as high levels of phosphorus, potassium, and metabolic acidosis. These imbalances can result in severe complications like vascular calcification, muscle loss, and bone mineral disorders[22]. Hyperkalemia is a prevalent and potentially life-threatening electrolyte problem in Chronic Kidney Disease (CKD) [23]. It becomes increasingly common as chronic kidney disease progresses. CKD patients exhibit elevated extrarenal potassium excretion due to enhanced potassium translocation into intracellular compartments and heightened intestinal potassium levels[25].

5. Conclusion:

The study concluded increase blood glucose, potassium, and phosphate in both hemodialysis patients and diabetics. While increase urea and creatinine in hemodialysis patients only . As well as decrease albumin and total protein in both hemodialysis patients and diabetics. Furthermore no differences in iron, calcium, chloride, and sodium between study groups.

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