Effect of Kidney Dialysis on Some Biochemical Variance

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Abstract:

Background: Renal failure is one among the slowly progressive diseases of kidney function characterized generally by low glomerular filtration (GRF). The replacement therapy of renal failure by hemodialysis involves the removal of excessive toxic fluids and toxic metabolic end products from the body. In this background, the present attempt was focused to evaluate and correlate the value of various biochemical markers in blood serum from the pre and post dialysis renal failure patients. Among many biochemical parameters in blood, serum creatinine and urea are emerging as a source of more sensitive markers for the detection of the renal failure.

Aim of the study: To investigate the effect of kidney dialysis on some biochemical variables such as blood urea, creatinine and some minerals, Sodium, Potassium, and phosphorus.

Experimental: This study was conducted in Merrjan hospital in Babylon city during the period from September 2017 to March 2018. The patients were diagnosed as having renal failure for both sex based on the history, clinical examination and taking renal function test and need to under gowning haemodialysis. The control groups were volunteers; they were collected from medical staff and relatives, who were free from signs and symptoms of renal disease, Fasting blood samples were taken from the patients (8-12) hours after night meal, the study shows the following results, a significant change in most biochemical variables and duration of dialysis.

Results: The results indicate there is a good positive correlation between urea and phosphate (P) (r = 0.674) and good negative correlation between urea and Ca^{++} (r= 0.895), while there is fair correlation between urea and other markers. serum urea and creatinine showed a significant increase in their levels in patients with chronic kidney failure (CRF) before haemodialysis when compared with that found in normal volunteers for both males and females. While that of serum calcium level was significantly decreased in patient with CRF before haemodialysis (HD) when compared with the apparently healthy controls, and its level increased after HD, but it remained lower than the controls. Before HD, the serum P was significantly higher than the apparently healthy controls. After HD, a significantly decreased in its level was appeared.

Keywords: Renal failure, hemodialysis dialysis, serum urea, creatinine, phosphate, calcium, sodium, Potassium, CRF,

Introduction:

[1]The kidney is very important system in human body, so any disorder or disease in the renal system such as chronic kidney disease (CKD) give health problem. Now a day nearly 2.6 million patients with CKD (Miura et al., 2018), the big problems in patients with CKD are the risk of various complications like heart disease, high blood pressure, renal anemia, inflammation and sarcopenia (Nisha et al., 2017). While exercise is reported to improve chronic inflammation (Meenakshi, 2016), recent reports have noted that electrical stimulation (ES) is effective not only in patients with moderate to severe heart failure(Miura et al., 2018), but also in haemodialysis (HD) patients (Miura et al., 2018). ES and voluntary muscular contractions during cycle ergometer training are different ways of activating muscle fibers that influence a number of acute changes in the neuromuscular system (Miura et al., 2018). Muscle fibers type I activates by ES, while muscle fibers type II was activated with anaerobic exercise. In addition, conventional training using cycle ergometers is a whole-body exercise, whereas ES is a static and localized body exercise. Therefore, ES might be effective for elderly patients undergoing HD who have disease complication Based on this perspective, achieving a higher training benefit in HD patients would be of great importance. How- ever, effects of ES on physical function and indicators of biochemical changes in maintenance HD patients are unknown. Therefore, this study aimed to evaluate and com- pare the effects of ES on muscle strength, dialysis efficiency, and serum inflammatory markers, including cytokine factors in elderly patients undergoing maintenance HD.)

Haemodialysis is one of the renal replacement therapy (Sarhat and Murtadha, 2013). The Technique plays a vital role in the process for the extracorporeal removal of waste

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products such as creatinine, urea and free water from the blood, when the kidneys are impaired. The principle behind haemodialysis is the diffusion of solutes through a semi permeable membrane. Haemodialysis is usually performed with Uremic patients for two to three times a week and the required Times for dialysis vary from two to four hours (Furqan et al., 2014). The time interval of dialysis depends on many factors such as, salt concentration renal function, and body weight of the patient. Dialysis improves many symptoms of kidney failure, but additional drug treatments required in presence of other complication like hypertension, anaemia(Stern et al., 2014).

Urea and creatinine level in the blood is very important biochemical marker for the diagnosis of the progression of kidney damage, the evaluation of these markers in serum helps to diagnose Glomerular Filtration Rate (GFR) followed by renal function. However, both creatinine and urea is a toxic material and they are a good marker for assessment of kidney function(Ul Amin et al., 2014). Creatinine is the metabolic product of muscles it is excreted through the kidneys along with other waste products. The balance between creatinine production and kidney excretion is maintained the creatinine level in serum. Many paper claimed that nearly 2% of creatine is converted into creatinine every day, this fact is cause of constant normal values for creatinine in the range of (male: 20 to 25 mg/kg/day; female 15 to 20 mg/kg/day)(Nisha et al., 2017). Because males have greater muscle mass than female normally males have higher serum creatinine levels than females. The concentration of serum creatinine depends on many factors like their generation, glomerular filtration and tubular secretion of serum creatinine. Kidney function affected by age groups of the patient, weight and other chronic disease (Rysz et al., 2017). The calculated values of creatinine called the estimated glomerular filtration rate (GFR).

To estimate the efficiency of kidney excretion (clearance) of creatinine from the body urine collection for 24 hour and blood test together are used to measure the creatinine concentration the results are known as creatinine clearance(Sandilands et al., 2013). Both creatinine and urea are directly toxic and are just substances used to measure kidney function. There are many factors affecting creatinine concentrations include, sex, age, rice, body weight and type of diet(Yassibas, Sahin and Şanlıer, 2016). Urea nitrogen is an organic compound; it is a normal waste nitrogen product from dietary protein, filtered into urine through the kidneys(Akbulut et al., 2013). The urea nitrogen normally removed from blood by healthy kidneys, but in case of kidney failure the level of urea in blood is rises.

Many papers study the effect of anaemia on degree of kidney impairment, and it is the main causes of renal erythropoietin secretion failure, in addition to other factors such as chronic blood lose haemolysis and uremic factors (Furqan et al., 2014). An attempt was made to evaluate the increase of creatinine and urea in serum patient of different age groups with renal failure during dialysis before and after.

Experimental part:

This study was performed in university of Babylon college of pharmacy during the period from September 2017 to March 2018, the study include a total of 100 patients (60) males, (40) females and 100 healthy individuals (57) males, (43) females from 45-70 years in age. All patients were receiving haemodialysis therapy in the dialysis unit in Margan hospital in Babylon city – IRAQ. Patients with other diseases were excluded as illustrated in table-1.

Table-1: demographic characteristic of the study population

Parameter	Patients	Control
Age (years)	57.5± 12.5	52 ± 10
Sex males %	60	57
Sex females %	40	43
total	100	100
BMI (Kg/ m2)	24.3 ± 1.6	23.4 ± 2.8
Duration of hemodialysis (y)	2.2 ± 0.8	

Fasting blood samples were collected from patients and volunteers at morning (8- 9 o'clock a.m.). The blood samples were centrifuged at 4000 rpm for 15 minutes using Hitachi centrifuge, and then the serum samples were stored at freeze until assayed. Serum Ca^{+2}, P, K^+, Na^+, urea and creatinine (Cr) levels were determined by spectrophotometric, using ready for use kit according to the procedure mentioned in the leaflet of the kit.

All results are presented as mean ± SD. The biochemical parameters were estimated for each patient for six interval dialysis. Statistical analysis using ANOVA and T- test methods to show the significant value and correlation between each variance and duration of dialysis in each group.

Results and discussion:

In this study all patient groups undergoing six hemodialysis duration and the biochemical variables were estimated in each duration to show the effect of dialysis duration on each variable the results were shown in table – 2, referred to the average value for each biochemical variance as mean ± standard deviation.

Table-2: Average values of biochemical variables vs duration of dialysis in male

Duration Variance	1	2	3	4	5	6
Urea before HD	27.3 ± 2.3	27.7 ± 3.1	24 ±1.86	20.2 ±1.89	17.8 ±0.09	14.5 ±2.9

Urea after HD	12.6 ± 3.1	9.8 ± 1.4	11.3 ± 2	8.1 ± 1.2	7.9 ±1.1	5.2 ±2.4
Creatinine before HD	735 ±16.5	666 ±23.7	617 ±21	485 ±13.6	499 ±18.6	480 ±20.2
Creatinine after HD	233 ± 18.2	210.5 ±19.8	198.4 ±12.1	122.6 ±9.4	140.5 ±11.3	130.2 ±9.5
Calcium before HD	1.4 ±0.06	1.6 ±0.32	1.7 ±0.01	1.9 ±0.08	2.3 ±0.04	1.6 ±0.03
Calcium after HD	1.9 ± 0.02	2.4 ±0.08	1.9 ± 0.04	2.1 ±0.03	2.4 ±0.9	2.1 ± 0.4
Phosphate before HD	2.4 ±0.02	2.2 ±0.03	2.5 ±0.05	2.5 ±0.03	2.1 ±0.004	2.6 ±0.01
Phosphate after HD	1.8 ± 0.03	1.4 ± 0.8	1.8 ± 0.9	1.8 ± 0.7	1.1 ± 0.6	1.9 ±0.04
Potassium before HD	5.3 ±0.06	6.1 ±0.09	5.4 ±0.04	5.4 ±0.08	4.4 ±0.03	4.9 ±0.05
Potassium after HD	4.2 ± 0.04	4.6 ± 0.02	4.1 ± 0.08	4 ± 0.02	3.9 ±0.03	3.9 ± 0.02
Sodium before HD	131 ±13.6	132 ±14.2	133 ±15.7	133 ±12.3	132 ±14.1	132 ±13.2
Sodium before HD	136.2 ± 6.3	136.9 ±5.8	138.3 ± 6.9	135 ±7.2	138.4 ±7.1	137.2 ±6.8

To study the relationships between each variable with other spss program version 20 was used to calculate the correlation between these variable the results shown in table – 3. Results from this table indicate there is a good positive correlation between urea and phosphate (P) (r = 0.674) and good negative correlation between urea and Ca++(r= 0.895), while there is fair correlation between urea and other markers.

Table –3: correlation between biochemical variance in patient group

	Urea	Cr	Ca+2	PO4-2	K+	Na+
urea	1	0.173	- 0.895	0.674	0.224	- 0.113
Cr		1	- 0.344	0.340	0.349	- 0.080
Ca+2			1	- 0.508	- 0.316	0.380
PO4-2				1	- 0.223	0.297
K+					1	0.140
Na+						1

In the same time there is rare a negative correlation between, creatinine – calcium, phosphate – calcium, potassium with calcium and phosphate, sodium and each of urea and creatinine.

Table - 4: concentration of biochemical markers in normal healthy volunteers

Biomedical marker	Value
Urea	5.3 ± 2.1 mmol/L
Creatinine	96.8 ± 18.3 μmol/L
Calcium	2.4 ± 0.4 mmol/L
Potassium	4.5 ± 1.8 mmol/L)
Sodium	142.7 ±4.8 mmol/L)
Phosphate	1.31 ± 0.92 mmol/L

In the present study, serum urea and creatinine showed a significant increase in their levels in patients with chronic kidney failure (CRF) before haemodialysis when compared with that found in normal volunteers for both males and females. While that of serum calcium level was significantly decreased in patient with CRF before haemodialysis (HD)

when compared with the apparently healthy controls, and its level increased after HD, but it remained lower than the controls. Before HD, the serum P was significantly higher than the apparently healthy controls. After HD, a significantly decreased in its level was appeared.

Tables -2 and 5 represents that the levels of urea and Cr significantly reduced after the HD compared to before HD, but it remained higher than that of healthy controls level in all HD durations. At the same time there were significant differences between the levels of serum Ca++, P in patients group with respect to that in control after and before HD process at all duration. The level of phosphorus also showed a significantly decreased after HD when compared with its concentration in pre HD.

Table-5: Average values of biochemical variables vs duration of dialysis in female patients

Duration Variance	1	2	3	4	5	6
Urea before HD	19.7 ±2.8	33.8 ±4.2	38.2 ±4.9	27.6 ±5.6	35.7 ±6.8	24.8 ±3.9
Urea after HD	12.4 ±5.8	14.2 ±5.1	10.7 ±4.3	9.5 ±2.9	10.3 ±4.1	9.6 ±2.4
Creatinine before HD	546 ±12.6	907 ±22.5	912 ±24.3	589 ±18.9	802 ±20.7	781 ±23.5
Creatinine after HD	312.5 ±12.9	322.6 ±18.9	298.9 ±15.8	310.8±13.7	286.9 ±18.3	230.7 ±12.8
Calcium before HD	1.7 ±0.001	1.7 ±0.004	1.7 ±0.001	1.6±0.006	1.5 ±0.003	1.5 ±0.006
Calcium after HD	2.1 ±0.04	1.9 ±0.03	2.3 ±0.05	2.1 ±0.03	2.4 ±0.03	2.1 ±0.01
Phosphate before HD	2.6 ±0.003	2.3 ±0.007	2.8 ±0.004	2.2 ±0.006	2.8 ±0.002	2.3 ±0.007
Phosphate after HD	0.002	1.4 ±0.001	1.2 ±0.001	1.5 ±0.003	1.4 0.002	1.4 ±0.005
Potassium before HD	3.6 ±0.009	4.9 ±0.001	5 ±0.008	5.4 ±0.006	5 ±0.002	4.1 ±0.005
Potassium after HD	3.9 ±0.004	4.5 ±0.003	4.5 ±0.006	4.8 ±0.004	4.2 ±0.003	4.1 ±0.004
Sodium before HD	136 ±12.4	129 ±11.8	138 ±13.6	136 ±13.8	138 ±12.9	137 ±13.5
Sodium after HD	140.2 ±9.2	143 ±6.4	138±5.3	142.3±6.1	141±5.2	143.2±8.7

Discussion

Chronic renal failure is a gradual, progressive and irreversible loss of normal functioning of kidneys. As the excretory function of kidney is impaired, urea and Cr excretion is hampered leading to increased its levels in blood, so significant elevation in blood urea and serum creatinine levels are observed in CRF patients before HD. In the present study, the serum urea and creatinine levels were significantly higher in both male and female and in all HD duration in pre and post HD when compared with control groups and was significantly reduced after HD. These results are compatibles with the previous studies (Singh et al., 2016) which explained that the continued decreased in renal clearance or glomerular filtration rate,

leads to the gathering of urea, creatinine and other chemicals in the blood and CRF which applies to the process of containing significant irreversible reduction in the nephron. In CRF, the increase of serum urea is proportional to the progression of the disease, but it is highly influenced by catabolic state or excessive protein ingestion, leading to a higher production of other waste substances of protein catabolism (Nisha et al., 2017). These results are in agreed with the study done by (MohammedJumaah, 2013). These reductions in mean levels of urea and creatinine are observed in the post haemodialysis treatment. The observation is suggestive of clearance of Cr and urea from blood during HD.

The levels of P significantly increased in CRF in pre HD compared with controls, and they were decreased after HD. Inversely, the serum Ca++ was significantly decreased in pre HD compared with the controls but its concentration was increased in post HD compared with the pre HD.

These results in the present study are in accordance with the study of (Shahbazi et al., 2012) (Kim et al., 2015). The body needs precise regulation of minerals such as phosphorus. The kidneys were excretes the minerals that absorbed by intestines. Phosphorus was controlled by parathyroid hormone which released by parathyroid glands. The hormone is increased by decreased calcium or increased phosphate (Fouque et al., 2014).

Hyperphosphatemia plays a critical role in the development of secondary hyperparathyroidism and renal osteodystrophy in patients with advanced chronic kidney disease as well as patients on dialysis. The usual cause of hyperphosphatemia is a decrease in renal excretion of phosphate. Advanced renal insufficiency reduces excretion sufficiently to increase serum phosphate (PO_4) (Wojcicki, 2013). Kidney failure is the medical conditions that cause low blood calcium levels or increased phosphate levels can lead to secondary hyperparathyroidism (Hassen, Al-lami and Al-saedi, 2018)

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