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Original article

Serum Electrolyte Changes in Chronic Renal Failure Pre and Post Dialysis

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Abstract
Chronic renal failure is a progressive decline of the kidney function leading to accumulation of toxins and fluid. Hemodialysis is a method of renal replacement therapy that is used to achieve the removal of that waste product such as creatinine and urea from blood by an artificial kidney machine. The aim of the study was to compare serum urea, creatinine, sodium, and potassium and chloride levels in chronic renal failure patients before and after dialysis. This study was conducted on 35 patients. All patients had renal failure and enter the dialysis department in Gharyan teaching hospital. It was found that the mean level of serum urea, creatinine and potassium were significant difference between pre and post dialysis. The pre-hemodialysis urea was 142.2 ± 34.1 mmol/L and post-hemodialysis urea was 45.7 ± 15.8 mmol/L. The pre-hemodialysis creatinine was 11.9 ± 3.2 mmol/L and post-hemodialysis creatinine was 4.3 ± 1.5 mmol/L. The pre-hemodialysis potassium was 5.1 ± 0.8 mmol/L and post- hemodialysis potassium was 3.6 ± 0.4 mmol/L. There is decrease in serum urea, creatinine as well the level of potassium before and after hemodialysis. While the level of serum sodium and chloride not significantly changed after hemodialysis.
Keywords. Serum Electrolytes, Chronic Renal Failure, Hemodialysis.

Introduction

With an estimated prevalence of 14% in developing nations, chronic kidney disease (CKD) has spread over the world and is a major cause of end-stage renal failure in the majority of patients. The irreversible decline of renal function to the point where survival is significantly reduced in the absence of renal replacement treatment (RRT), such as dialysis or transplantation, is known as end-stage renal disease (ESRD) [1,2]. CKD often results from acute glomerulonephritis or pyelonephritis. Diabetes mellitus, renal blood vessel atherosclerosis, hypertension, polycystic kidney disease, and kidney stones are other causes of chronic renal failure [3].

It is associated with an increased risk of adverse cardiovascular outcomes and decreased survival [4]. As the kidneys play a pivotal role in the regulation of body fluids, acid–base balance and electrolytes homeostasis, which is an essential requirement for numerous metabolic processes and organ functions in the human body [5]. KCD are characterized bya gradual loss of kidneys function, with most cases subsequently leading to ESRD. ESRD is the irreversible decline of renal function to an extent that survival is greatly shortened without renal replacement therapy (RRT), either by dialysis or transplantation [6].

Around the world, hemodialysis (HD) is still one of the primary therapies for end-stage renal disease. HD aims to restore the kidney's excretory function, with a focus on avoiding or treating fluid and electrolyte disorder like metabolic disturbance and fluid overload [7].

Severe hyperkalemia occurs in 10-19% patients on maintenance hemodialysis. Many studies showed that a sudden change and decrease in serum K+ causes arrhythmia related patients undergoing dialysis [8]. Hypokalemia also arises in dialysis patients due to the exposure to low K dialysate. Post-dialysishypokalemia associated with serious cardiac arrhythmias and sudden cardiac deaths. And also stated that 67% were cardiac deaths [9].

Dysnatremia in chronic kidney disease (CKD) and end stage renal disease has high mortality rate. A few studies have shown the prevalence of hyponatremia to be higher than that of hypernatremia among maintenance hemodialysis (MHD) patients [10]. however, in CKD patients not undergoing maintenance dialysis, both hypo- and hypernatremia were associated with higher mortality risk [11]. Therefore, in this study, we aimed to evaluate the serum urea, creatinine and electrolyte before and after hemodialysis for chronic kidney failure patients.

Methods

Study design and setting

A case control study was conducted from August 10 to October 28, 2022 among patients attending hemodialysis unit at Gharyan central teaching hospital. Thirty-five patients of both sexes, ranging in age from 12 to 74, participated in this study. Every patient with renal failure entered the Gharyan Teaching Hospital's dialysis unit, where they were paired with 35 healthy individuals as a control group. Every participant gave their oral agreement after being fully informed about the purpose of the study.

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Data collection
Verbal informed consent was obtained from the eligible study participants. All samples were collected by specially trained nursing staff of the dialysis center. Each sample was analyzed within a maximum of two hours after collection; before and after hemodialysis.

Statistical analysis
The collected data were reviewed and all statistical analyses were performed using R package version 4.3.1 (R Foundation for Statistical Computing, Vienna, Austria). Categorical data were described in numbers and percentage, while continues data were presented as Mean±Standard Deviation and Range (Max and Min). Univariate analyses of serum electrolyte at pre and post dialysis patients were accomplished using the paired *t* test. Unpaired *t* test was used to compare the study factors between pre dialysis patients and healthy participants. P-value of <0.05 was considered as significant.

Results
In the present study, the total number of participants was 70. Thirty-five (63% Male, 37% Female) patients of CKD undergoing hemodialysis were cases and thirty-five (43% Male, 57%Female) participants with normal renal function were controls (Figure 1).

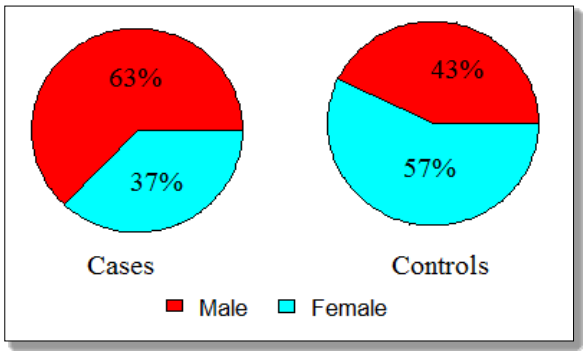

Figure 1. Comparison gender between cases and controls

The mean age of the patients was 45.94±15.56 years and age of controls was 51.51±14.85 years. As shown in table 1, the serum levels of creatinine and urea were considerably higher in pre-HD patients with chronic renal disease than in healthy controls. The result of the t-test showedthat the mean difference of creatinine and urea level pre-HD patients and healthy participants were significant (P-value =0.000). The study's results also demonstrated that pre-HD patients had higher mean serum potassium levels than controls, while their mean serum chloride levels were lower than those of healthy controls. These differences were statistically significant (P-value = 0.000). In addition, the mean serum of sodium in patients is slightly higher than in healthy participants,but this difference is not significant (P-value =0.476).

Table 1. Mean±SD of serum electrolytes (Na+, K+, Cl-), level of urea and serum creatinine in pre-hemodialysis patients and controls

Parameters	Pre hemodialysis patients	Post hemodialysis patients	P-value
Urea (mg/dl)	142.2±34.1	32.6±14.2	0.000
Creatinine (mg/dl)	11.9±3.2	0.7±0.3	0.000
Sodium (mmol/l)	136.5±5.7	137.5±5.5	0.476
Potassium (mmol/l)	5.1±0.8	4.2±0.4	0.000
Chloride (mmol/l)	105.3±3.7	107.1±6.7	0.000

The result of the paired t-test in table 2 showed that the mean difference of serum levels ofcreatinine, urea and potassium for pre- and post-dialysis patients were significant (P-value =0.000). Furthermore, there was no discernible change in the mean serum sodium and chloride levels of pre-HD patients following hemodialysis.

Table 2. Mean±SD of serum electrolytes (Na+, K+, Cl-), level of urea and serum creatinine levels in pre- HD and post – HD patients

Parameters	Pre hemodialysis patients	Post hemodialysis patients	P-value
Urea (mg/dl)	142.2±34.1	45.7±15.8	0.000
Creatinine (mg/dl)	11.9±3.2	4.3±1.5	0.000
Sodium (mmol/l)	136.5±5.7	136.4±6.1	0.929
Potassium (mmol/l)	5.1±0.8	3.6±0.4	0.000
Chloride (mmol/l)	105.3±3.7	105.2±3.1	0.936

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Discussion

Hemodialysis is the first line of treatment in almost all patients with CKD and adequate dialysis has prolonged the survival of patients with improved quality of life [12]. In our study we assessed the pre and post dialytic changes in serum electrolytes, urea and creatinine in CKD patients on maintenance hemodialysis. Compared to the mean serum potassium level of pre-HD patients, the post-HD patients' serum potassium level was noticeably lower. One of the most crucial functions of chronic HD is the elimination of potassium (K), which patients frequently collect throughout the interdialytic phase. Hyperkalemia decreases the resting membrane potential increases the rate of repolarization and slow the conduction velocity. Hyperkalemia is commonly seen in patients with end stage renal disease on hemodialysis. Atotal of 26.4%, 13.8%, and 4.9% of patients on hemodialysis were found to be hyperkalemicwith pre-dialysis serum potassium levels of more than 5.1 mEq/L, 5.5 mEq/L and 6 mEq/L, respectively [13]. Hyperkalemia in hemodialysis patients is associated with mortality, hospitalization and emergency department admissions [14]. Conversely, hypokalemia causes arrhythmia by raising the resting membrane potential and refractory time [15].

Result in table 2 represented the changes of urea and creatinine among patient before and after H.D. and there was a highly significant difference in the mean of urea (142.2±34.1mg/dl)before hemodialysis when comparison with urea (45.7±15.8mg/dl) after hemodialysis. The table also showed that there were decrease in the mean of creatinine (11.9±3.2mg/dl) before hemodialysis compared to creatinine (4.3±1.5mg/dl) after hemodialysis with a highlysignificant difference. These results were in agreement with the study in 2020 [16]. High serum urea levels in patients with chronic renal disease are correlated with the disease's progression and are strongly impacted by catabolic states or excessive protein consumption, which raises the creation of other waste products from protein catabolism. This study also showed that there were no significant differences in the concentration of sodiumand chloride before and after hemodialysis compared to control and the above observations were in agreement with the result of this study [3].

Conclusion

In this study, the main conclusion that can be drawn is that urea serum creatinine and potassiumwere significantly affected after hemodialysis. It is worth mentioning that there were no significant differences in the serum sodium andchloride levels before and after hemodialysis.

Conflict of Interest. None

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المستخلص

الفشل الكلوي المزمن هو تدهور تدريجي في وظائف الكلى مما يؤدي إلى تراكم السموم والسوائل، وبعض المخلفات الايضية، وغسيل الكلى هو طريقة من طرق العلاج التعويضي. الذي يستخدم لإزالة تلك السموم والمخلفات مثل الكرياتينين، واليوريا من الدم بواسطة جهاز الغسيل الكلوي الاصطناعي. كان الهدف من الدراسة هو مقارنة مستويات اليوريا والكرياتينين والصوديوم والبوتاسيوم والكلوريد في مصل مرضى الفشل الكلوي المزمن قبل وبعد غسيل الكلى. أجريت هذه الدراسة على 35 مريضًا يعانون من القصور الكلوي في مستشفى غريان المركزي التعليمي. وجدت الدراسة أنه كان له فرق كبير في متوسط مستوى اليوريا والكرياتينين والبوتاسيوم في المصل بين ما قبل وما بعد غسيل الكلوي. فكان مستوي متوسط اليوريا قبل غسيل الكلى 142.2 ± 34.1 مليمول / لتر، اما بعد الغسيل فكان متوسط اليوريا 45.7 ± 15.8 مليمول / لتر. وكان مستوي متوسط الكرياتينين قبل غسيل الكلى 11.9 ± 3.2 مليمول/لتر وبعد غسيل الكلى كان المتوسط 4.3 ± 1.5 مليمول/لتر. اما البوتاسيوم، فكان مستوي متوسطه قبل الغسيل 5.1 ± 0.8 مليمول/لتر، وبعد الغسيل الكلوي كان مستوي المتوسط 3.6 ± 0.4 مليمول/لتر. وبذلك كان هناك انخفاض ملحوظ في مستوي متوسط كلا من اليوريا والكرياتينين في المصل وكذلك مستوى البوتاسيوم قبل وبعد غسيل الكلوي، في حين لم يتغير مستوى الصوديوم والكلوريد في المصل بشكل ملحوظ بعد غسيل الكلى.

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