Original Research Article

Level of Serum Urea and Creatinine in Chronic Renal Failure Patients during Pre Dialysis and Post Dialysis Period

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Conflict of interest: Nil

Abstract:

Introduction: Chronic renal failure is the progressive loss of function of kidney. It requires renal replacement therapy like Hemodialysis, In this background this study was done to assess the biochemical renal parameters serum urea and creatinine during predialysis and postdialysis period.

Materials and Methods: The study was done in 35 chronic renal failure patients undergoing hemodialysis regularly. 3ml blood sample was collected during pre-dialysis and postdialysis period. Serum urea and creatinine were estimated.

Results: The study was done in 35 patients, 80% (n=28) were males and 20% (n=7) were females. They were categorised into 3 age groups. The mean urea in predialysis and postdialysis for age group 21-40,41-60,61-80 were 97 ± 15.16 and 29.8±7.85, 105.75±27.27 and 36.87±14.54, 109.33±13.37 and 37.83±15.39 respectively. The mean creatinine in predialysis and postdialysis for age group 21-40, 41-60, 61-80 were 10.92±2.4 and 3.54±1.07, 9.94±3.34 and 3.79±1.36, 9.53±1.45 and is 3.28±0.6. Paired t test of serum urea mean difference of predialysis and postdialysis is 69.08±17.4 with standard error of mean 2.944, t value = 23.477, p value of 0.0001 and is highly significant. Paired t test of serum creatinine shows mean difference in Pre and Post dialysis is 6.34±2.02 with standard error of mean 0.341, t value = 17.41, p value of 0.0001 is significant.

Conclusion: The present study concluded that a significant relationship between the predialysis and postdialysis availability of serum urea and creatinine.

Keywords: Chronic Renal Failure, Hemodialysis, Pre and Post Dialysis, Serum Urea and Creatinine.

Introduction

In the human body, the kidneys are the most important organs which play a major role in filtration, absorption, reabsorption and excretion of all metabolic products. It also plays a major role in the maintenance of Acid base balance, regulation of calcium and synthesis of active form of Vitamin D and erythropoietin synthesis. The Renal diseases are one of the most important cause of death and disability in many countries throughout the world [1, 2]. It is one of the most prevalent, worldwide health problem of the elderly population. The damage to the kidney occurs as a result of complications arising from serious medical conditions like infections, diabetes, auto immune diseases, cancer, endocrine disorders and toxic chemicals. [3]. The continuous damage to kidney causes a slow and progressive reduction in renal function leading to Renal Failure.

Renal failure is a systemic disease and can be acute or chronic onset. The chronic renal failure occurs gradually over a period of weeks, months or years. According to the Kidney Disease Improving Global Outcomes (KDIGO) declaration GFR of less than 60 mL/minute/1.73 m^2 is the indication of CKD. KDIGO additional classified the CKD in different stages which are stage III (GFR 30 to 60 mL/minute), stage IV (GFR 15 to 30 mL/minute), stage V (GFR less than 15 mL/minute) [4].

Renal failure requires renal replacement therapy like Hemodialysis, peritoneal dialysis or renal transplantation. Dialysis is defined as the process of diffusion of solutes through a semi permeable membrane.

Hemodialysis is one of the important renal replacement therapy [5]. When the renal functionsare impaired, dialysis plays an important role in the process for the extracorporeal removal of waste products such as creatinine, urea and free water from the blood. It also helps to control blood pressure and balance important minerals such as potassium, sodium and calcium, in the blood. Hemodialysis is usually performed in uremic patients for about two to four hours for two to three times a week [6]. The arteries carrying oxygenated blood from the heart are connected to a vein forming an arteriovenous shunt. The impure blood of the patient is withdrawn from the AV fistula and subjected to Hemodialysis. The required frequency and duration of each cycle for dialysis depends on various factors such as kidney function, amount of waste generated in the body, level of salts accumulated and body weight. Dialysis helps to improve many of the symptoms of kidney failure[7]. Hemodialysis effectively reduces serum urea and creatinine in this haemodialysis patient [8]

The progression of kidney damage is marked by the rise in two important biochemical substances in the blood - urea and serum creatinine. The adequacy of hemodialysis can be assessed by simple calculation called urea retention ratio (URR). The URR is the percentage fall in plasma urea attained during a dialysis session is measured as follows [9]:

[(predialysis {urea}-postdialysis {urea})/ predialysis {urea}]*100%.

The expected adequacy of ≥ 0.67 in intermittent hemodialysis in patients with acute kidney injury (AKI) [10]. Explores the prognostic value of the BUN/Cr ratio in hemodialysis patients, linking higher ratios with increased risks of infections, cardiovascular events, and mortality.[11]

This study is done to evaluate the changes in the levels of serum urea and creatinine in chronic renal failure patients during pre-dialysis and post dialysis period.

Materials and Methods

A cross-sectional study was carried out duringDecember 2019 to January 2020. Patients who are already diagnosed as having chronic renal failure (Stage III, IV & V) and are under regular hemodialysis treatment (2 cycles per week) were selected. Convenient sampling method was followed. Sample from 35 patient attending Dialysis units in Department of Nephrology, Karpaga Vinayaga Institute of Medical Sciences & Research centre were collected 30 minutes prior to

hemodialysis (Pre-Dialysis) and 30minutes after hemodialysis (Post-Dialysis). A total of 70 samples were used for estimating serum urea and creatinine.

Inclusion Criteria:

- Patients undergoing two cycles of hemodialysis per week are selected for the study.
- Patients providing consent for participation.

Exclusion Criteria:

- Chronic renal failure patients who are irregular in attending their hemodialysis treatment.
- Patients who are not willing to take part in the study.

Written informed consent for participation was obtained from patients fulfilling inclusion & exclusion criteria were subjected to complete history taking & physical examination. 3mL of blood sample was collected from patients in clot activator container (BD clot activator tube). The samples are allowed to clot for about 30 minutes. Then centrifuge was done at 3000 RPM for 15 minutes. Urea and creatinine estimation was analysed using fully automated clinical chemistry analyser (Biosystems BA200) using Biosystem reagents. Blood urea and creatinine was estimated using Urease / GLDH (Glutamate dehydogenase) & Jaffe's method respectively.

Biological Reference Interval of Blood urea: 15-39 mg/dL

Biological Reference Interval of serum creatinine: Men: 0.9 to 1.3 mg/dL

Women: 0.6 to 1.1 mg/dL.

Statistical Method: Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency for categorical variables. Data was also represented using appropriate diagrams like bar diagram and pie diagram. For normally distributed Quantitative parameters the mean values were compared between study groups using paired sample t-test (2 groups). p value < 0.05 was considered statistically significant.

Results

A total of 35 patients who were diagnosed for renal failure based on their clinical history, clinical examinations and renal function test were randomly evaluated. Biomarkers of renal function such as serum urea and creatinine during Pre and Post dialysis sessions were estimated & analysed.

Table 1:Gender wise percentage distribution of the study population

	Total number of cases	Male	Female
N	35	28	7
Percentage	100%	80%	20%

Table 1 shows that the study population comprised of 80% (n=28) are males and 20% (n=7) are females.
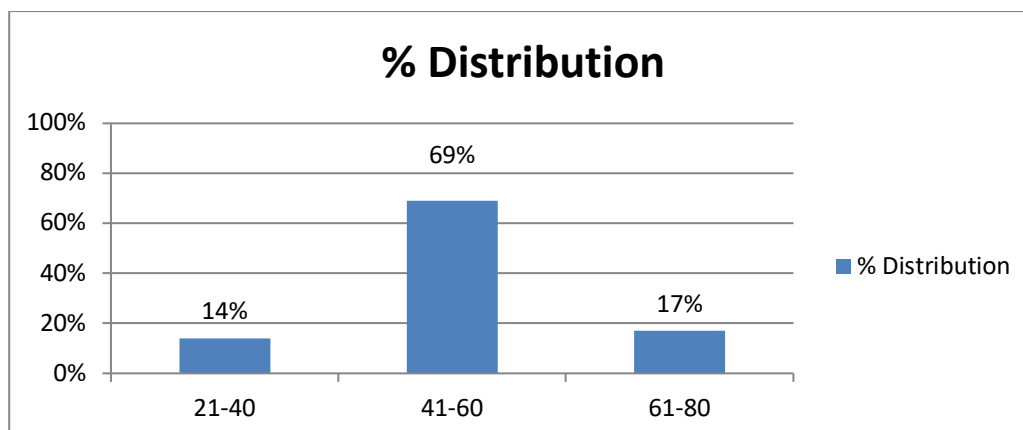

Figure 1:Bar diagram depicting Percentage distribution of patients in Age Groups

Figure 1 shows patients being categorised into 3 age groups, 21-40 (14%,n=5) 41-60 (69%, n=24), 61-80 (17%, n=6).Majority of study population belonged to 41-60 years.

Table 2: Duration Wise Distribution of Patientsunder Hemodialysis treatment

Duration	No of Patients	% Of Distribution
<12 Months	7	20%
12-24months	10	29%
24-36months	13	37%
>36months	5	14%

Table 2 patients are categorised into 4 groups depends on the duration of years of hemodialysis treatment. 20%(n=7) of patients are under hempdialysis<12 months period. 29%(n=10) of patients are under hemodialysis of 12-24months period. 37%(n=13) of patients are under hemodialysis for about 24-36 months period. 14%(n=5) of patients are under hemodialysis for > 36 months.

Table 3: Age wise Mean value of urea in Pre Dialysis and Post Dialysis period

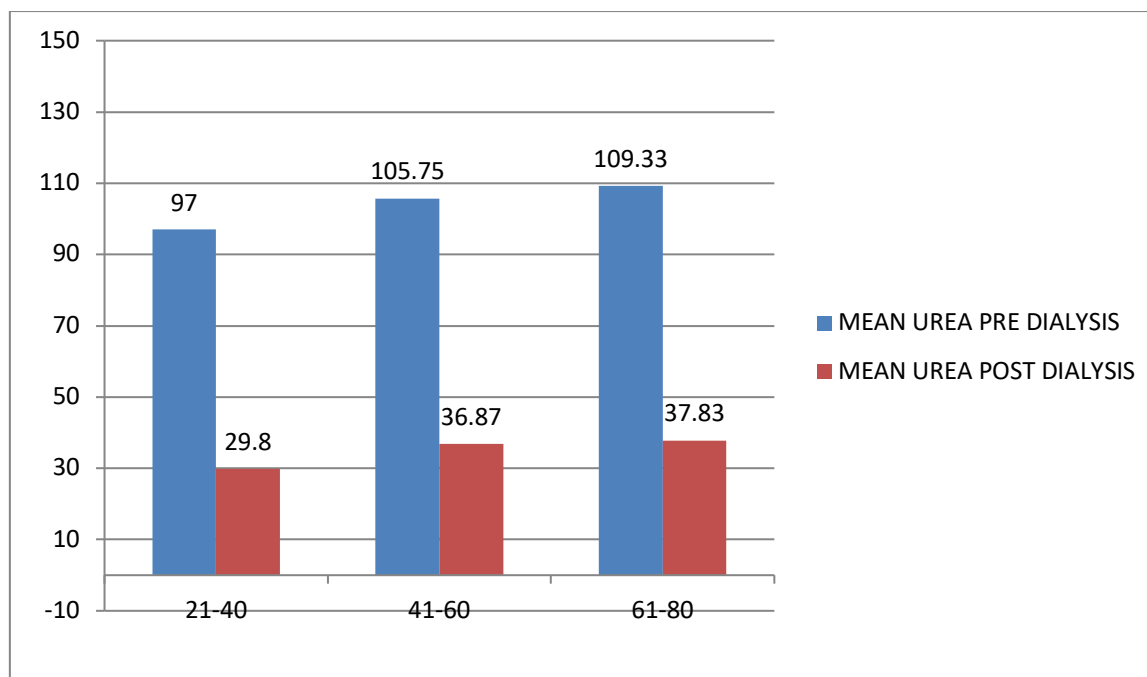| Age (Years)	Mean Urea Pre Dialysis (mg/dL)	Mean Urea Post Dialysis (mg/dL)
21-40 (n=5)	97 ± 15.16	29.8±7.85
41-60 (n=24)	105.75±27.27	36.87±14.54
61-80 (n=6)	109.33±13.37	37.83±15.39

Figure 2: Bar Diagram - Age wise Mean value of urea in Pre Dialysis and Post Dialysis period

Table 3 & Figure 2 shows Blood urea level was significantly higher than normal range (15-30 mg/dL) in the Predialysis sample in renal failure patients undergoing dialysis.

All selected patients are categorised into three age groups. Age 21-40yrs with the mean blood urea level in Pre-dialysis and Postdialysis as 97 ± 15.16 and 29.8±7.85 respectively, 41-60 yrs with the mean blood urea level in pre-dialysis and Postdialysis as 105.75±27.27 and 36.87±14.54 respectively, 61-80 yrs with the mean blood urea level in Pre-dialysis and Postdialysis as 109.33±13.37 and 37.83±15.39 respectively.

As age increases the mean urea levels during pre-dialysis and postdialysis period also increased in all three age groups.

Table 4: Age wise Mean value of Creatinine in Pre Dialysis and Post Dialysis period

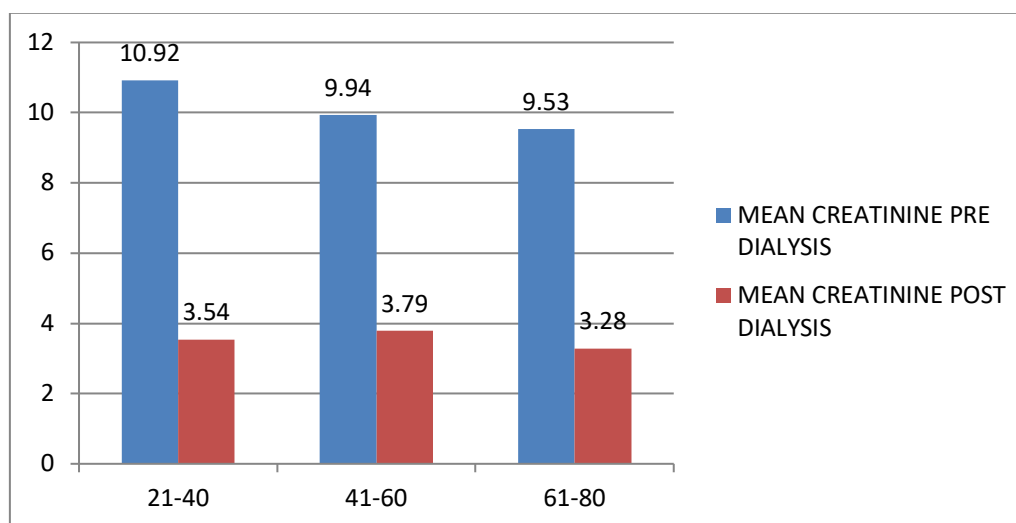| Age (Years)	Mean Creatinine Pre Dialysis (mg/dL)	Mean Creatinine Post Dialysis (mg/dL)
21-40 (n=5)	10.92±2.4	3.54±1.07
41-60(n=24)	9.94±3.34	3.79±1.36
61-80(n=6)	9.53±1.45	3.28±0.63

Figure 3: Bar-Diagram Age wise Mean value of Creatinine in Pre Dialysis and Post Dialysis period

Table 4& figure 3 the mean value of serum creatinine in predialysis of age group 21-40 is 10.92±2.4, 41-60 is 9.94±3.34 is 61-80 are 9.53±1.45. The mean value of creatinine in post

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dialysis of age group 21-40 is 3.54±1.07, 41-60 is 3.79±1.36, 61-80 is 3.28±0.6. The mean values of serum creatinine level were observed to be less in the age group between 61 and 80 years. Highest mean creatinine during predialysis and postdialysis period as observed in 21-40 years age group.

Table 5: Paired Sample Statistics for Urea

Urea		Mean (mg/dL)	SD	SEM
Urea	Pre Dialysis	105.11	23.87	4.034
	Post Dialysis	36.028	13.85	2.341

Table 5 shows Mean and SD of predialysis and postdialysis urea levels were 105.11± 23.87 and 36.028± 13.85 respectively. Standard error of mean inpredialysis and postdialysis urea levels were 4.034 and 2.341 respectively after doing paired sample test.

Table 6: Paired Sample Statistics for Creatinine

Creatinine		Mean (mg/dL)	SD	SEM
Creatinine	Pre Dialysis	10.01	2.95	0.499
	Post Dialysis	3.67	1.21	0.206

Table 6 shows Mean and SD of predialysis and postdialysis creatinine levels were 10.01± 2.95 and 3.67± 1.21 respectively. Standard error of mean in predialysis and postdialysis creatinine levels were 0.499 and 0.206respectively after doing paired sample test.

Table 7: Paired t test - Urea

	Mean	Std. dev	SEM	95% CI Upper	Lower	T	df	p-value
Urea Pre and Post dialysis	69.08	17.4	2.944	63.11	75.07	23.477	34	0.0001

Table 7 shows difference in mean of serum urea in Pre and Post dialysis sample is 69.08±17.4 with standard error of mean 2.944, t value = 23.477, p value of 0.0001 and is highly significant. This implies that there is a significant variation in urea in Pre and Post dialysis. Serum urea levels have reduced significantly followed by hemodialysis.

Table 8: Paired t test - Creatinine

	Mean	Std. dev	SEM	95% CI Upper	Lower	T	df	p-value
Creatinine Pre and Post dialysis	6.34	2.02	0.341	5.633	7.122	17.41	34	0.0001

Table 8 shows the mean difference of Serum Creatinine in Pre and Post dialysis is 6.34±2.02 with standard error of mean 0.341, t value = 17.41, p value of 0.0001 is significant. So this shows there is a significant variation in serum creatinine Pre and Post dialysis

Discussion

Urea is an organic compound and plays a vital role in the metabolism of nitrogen-containing compounds. It is a by-product of protein metabolism and is also filtered in urine by the kidneys [12,13]. The normal and healthy kidneys remove urea nitrogen from blood. The level of urea in blood rises in kidney failure.

Creatinine is formed from creatine. Serum creatinine concentration in the body is maintained by the balance between its generation and excretion by the kidneys. Everyday about 2% of the body's creatine is converted into creatinine. The daily generation of creatinine is about male: 20 to 25 mg/kg/day; female 15 to 20 mg/kg/day [14].

Males(<60 years) have higher muscle mass, so they have high serum creatinine levels than females. The amount of creatinine in serum depends on their production, glomerular filtration and tubular secretion. Calculations based on serum creatinine and the age groups of the patient are used to estimate eGFR. Hence it is more precise to evaluate the degree of kidney function [15,16].Other factors affecting creatinine concentrations include age, sex, ethnicity, body habits and diet. [17].

Noor ul Amin et.al in his study found out the most of the CKD patients (53%) had serum urea level between 200-300 mg/dl in predialysis period. 26% of CKD patients in postdialysis had urea level reduced to 1- 100 mg/dl and 40% of CKD patients in post dialysis period had urea level of 101-200 mg/dl[18]. In our study, the mean serum urea level in predialysis patients is 105.11± 23.87 mg/dL and in post dialysis patient is 36.028± 13.85 mg/dL. Noor ul Amin et.al in his study found out serum creatinine in predialysis patients between 7.6-12 mg/dl (57 %) and 12-15 mg/dl (27 %). In post

dialysis patients (58%) had serum creatinine below 7 mg/dl[16]. In our study, the mean serum creatinine in pre-dialysis is 10.01± 2.95 mg/dL and post-dialysis is 3.67± 1.21mg/dL.

Nisha R et.al in their study categorised the patients into 3 groups according to their age. Serum urea in pre dialysis in age group 21-40 years is 138.44 ± 49.31 mg/dl, 41-60 years is 133.98 ± 36.41 mg/dl, 61-80 years is 130.58 ± 23.11mg/dl. In postdialysis period 21-40 yrs is 54.87 ± 28.82 mg/dl in the age group of 41-60 yrs is 58.26 ± 19.95 mg/dl, in 61-80 yrs is 59.06 ± 16.05 mg/dl in the age between 41 and 60 years[7]. In our study serum urea level in predialysis period in age group 21-40 years is 97 ± 15.16, 41-60 yrs is 105.75±27.27 and 61-80 yrs is 109.33±13.37. In postdialysis period Age 21-40yrs is 29.8±7.85, 41-60 yrs is 36.87±14.54 and 61-80yrs is 37.83±15.39 respectively. As age increases the serum urea increases in predialysis and postdialysis all three age groups.

In our study the mean value of serum creatinine in predialysis of age group 21-40years is 10.92±2.4, 41-60 years is 9.94±3.34 is 61-80 years is 9.53±1.45. The mean value of creatinine in post dialysis of age group 21-40 is 3.54±1.07, 41-60 is 3.79±1.36, 61-80 is 3.28±0.6. Patients in 61-80 years age group have less muscle mass so have less creatinine level in both pre and post dialysis when compared to other two age groups. Nisha R et.al in their study stated that serum creatinine level in pre-dialysis patients of age group 21-40 years is 10.48 ± 3.06 mg/dl, 10.35 ± 3.23 mg/dl in the age group 41- 60 years and 8.27 ± 2.60 mg/dl in the age group 61-80.In post dialysis period of age group is 4.67±1.97 mg/dl, 41-60 yrs is 5.03±1.76mg/dl and 61-80 yrs is 4.36±1.54mg/dl[7].

The paired t test in serum urea in Pre dialysis is 105.11± 23.87, standard error of mean 4.034. Post dialysis mean is 36.028± 13.85 with standard error of mean 2.341.Similar changes in predialysis and postdialysis were observed by Nisha R et.al

In study done by Nisha R et al. the paired t test for serum creatinine shows t-test = 6.67, 15.61 and 9.75 for age group 21-40 yrs, 41-60 yrs, 61-80yrs and p value-0.0001[7]. In our study the mean difference of serum Creatinine Pre dialysis and Post dialysis is 6.34±2.02 with standard error of mean 0.341 and with t value = 17.41, p value 0.0001 which is highly significant.

Conclusion:

There is strong evidence (urea -t = 23.47, p = 0.0001, creatinine – t= 17.41, p=0.0001) that dialysis improves both urea and creatinine. The 'mean paired difference' in urea and creatinine is 69.08 & 6.34 respectively with 95% confidence interval and p value of 0.0001 in both urea and creatinine. Serum creatinine level is less in the age

group 61-80 years when compared to other two groups which is attributed to having less muscle mass. The study concluded that serum urea and creatinine continue being good markers for monitoring effectiveness of hemodialysis.

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