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Serum renal function test in end stage renal disease patients before and after dialysis

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Abstract:

End stage renal disease is a decisive stage of kidney failure, will progressively enhance morbidity and mortality. Hence, renal function tests are desperately needed to improve quality of life before and after dialysis in ESRD patients. Therefore, it is of interest to determine and compare the serum levels of urea, creatinine and uric acid in ESRD patients in before and after dialysis. This cross-sectional study was conducted with 70 ESRD patients age between 30 to 75 years of either gender whoever on dialysis. Patient's serum urea, creatinine and uric acid were determined. There was a significant increased levels of serum urea creatinine and uric acid before dialysis and drastically reduced after dialysis in ESRD patients. There is a significant effect of HD on serum urea, creatinine, uric acid, calcium and phosphorus. Thus, monitoring and correcting them has prognostic significance in ESRD patients on hemodialysis is noted.

Keywords: Dialysis, end stage renal disease (ESRD), chronic kidney disease (CKD), urea creatinine and uric acid

Background:

The kidney excretes non-nitrogenous compounds like urea, creatinine and uric acid, unfortunately end stage renal disease (ESRD) interrupts these mechanisms. In 2019, globally around 0.6 to 1.4 million patients were died due to CKD and In 2025, 697.5 million patients were suffering with CKD and one third of the disease contributed by India around 115 million people and 132 million in china [1]. Another review study reports 12 to 21% of Indian people were suffering with CKD in 2021 [2]. The patients with CKD develops series of complications such as hypertension abnormality in electrolytes and anemia which results multi organ failure [3]. Dialysis and replacement of the kidney are ultimate treatment modalities to prevent complications, the CKD patients should get it done serum urea, creatinine and uric acid to asses kidney function before and after dialysis [4]. Since CKD patients have renal impairment should undergo dialysis which required continues measurements of urea, creatinine and uric acid [5]. Therefore, it is of interest to evaluate the serum urea and creatinine in patients with ESRD before and after dialysis.

Materials and Methods:

This cross sectional analytical study was conducted in department of biochemistry at ESIC model hospital Bangalore, India. In this study total 70 cases were included during the period of January 2019 to 2020. The age between 30 to 75 years of either gender was diagnosed with ESRD and undergoing hemodialysis was included. Patients with acute kidney injury, liver diseases heart diseases, inter current illness required hospitalization, gout, hyper and hypoparathyroidism were excluded from the study. The study was evaluated and approved by institutional ethics committee of ESIC model hospital and informed consent form obtained from all the study participants. 5ml of venous blood sample were drawn from all the recruited participants before and after dialysis and the blood sample transferred into plain red colored vacutainer. The vacutainers allowed to clot for 10 minutes then separated serum by centrifugation at 3000 RPM for 10 minutes. The serum was

send to central diagnostic laboratory for analysis of serum urea, creatinine and uric acid. Serum urea was estimated by urease method, creatinine determined by modified jaffe's method and uric acid was measured by uricase method.

Statistical analysis:

The data was represented mean and standard deviation, the minimum value, maximum value, mean and standard deviation statistics are calculated for the study variables. For comparison of study variables between the groups done by using paired t-test and P-value is considered <0.05 statistical significant. The graphical representation of study variables done by bar diagrams.

Results:

In the above table and figure the maximum, minimum and mean concentration of urea before hemodialysis is 232 mg/dl, 42 mg/dl and 94.3 mg/dl respectively, the maximum, minimum and mean concentration of urea after hemodialysis is 71 mg/dl, 6 mg/dl and 32.26 mg/dl respectively. The maximum, minimum and mean concentration of creatinine before hemodialysis is 16.9 mg/dl, 4.3 mg/dl and 8.47 mg/dl respectively, the maximum, minimum and mean concentration of creatinine after hemodialysis is 7.9 mg/dl, 0.9 mg/dl and 3.38 mg/dl respectively. The maximum, minimum and mean concentration of uric acid before hemodialysis is 11.7 mg/dl, 3 mg/dl and 6.7 mg/dl respectively, the maximum, minimum and mean concentration of uric acid after hemodialysis is 3.8 mg/dl, 1 mg/dl and 2.19 mg/dl respectively (Table 1 and Figure 1). In the above table and graph, the mean concentration of blood urea before and after hemodialysis is 94.3 mg/dl, 32.3 mg/dl respectively with mean difference of 62.04, which is highly significant (p value <0.001**). The mean concentration of Serum Creatinine before and after hemodialysis is 8.54 mg/dl, 3.4 mg/dl respectively with mean difference of 5.09, which is highly significant (p value <0.001**). The mean concentration of serum uric acid before and after hemodialysis is 6.7 mg/dl, 2.2 mg/dl respectively with mean difference of 4.51, which is highly

significant (p value <0.001**) (Table 2 and Figure 2). In the above table and graph, the mean concentration of blood urea before and after hemodialysis is 93.6 mg/dl, 32.7 mg/dl respectively with mean difference of 60.87, which is highly significant (p value 0.001**). The mean concentration of Serum creatinine before and after hemodialysis is 8.4 mg/dl, 3.5 mg/dl respectively with mean difference of 4.83, which is highly significant (p value 0.001**). The mean concentration of serum uric acid before and after hemodialysis is 6.7 mg/dl, 2.3 mg/dl respectively with mean difference of 4.45, which is highly significant (p value 0.001**) (Table 3 and Figure 3). In the above

table and graph, the mean concentration of blood urea before and after hemodialysis is 96.8, 30.5 respectively with mean difference of 66.33, which is highly significant (p value < 0.001**). The mean concentration of serum creatinine before and after hemodialysis is 8.9, 2.8 respectively with mean difference of 6.06, which is highly significant (p value <0.001). The mean concentration of serum uric acid before and after hemodialysis is 6.5, 1.8 respectively with mean difference of 4.72, which is highly significant (p value <0.001**) in female patients of the study group (Table 4 and Figure 4).

Table 1: Comparison of serum urea, creatinine and uric acid before and after Hemodialysis sessions in study population

Parameters	Hemodialysis	Mean	Std.Deviation	Minimum	Maximum
Serum Urea (mg/dL)	Before	94.3	30.69	42	232
	After	32.26	14.87	6	71
Serum Creatinine (mg/dL)	Before	8.47	2.27	4.3	16.9
	After	3.38	1.35	0.9	7.9
Serum Uric acid (mg/dL)	Before	6.7	1.5	3	11.7
	After	2.19	0.69	1	3.8

Table 2: Comparison of concentrations of serum urea, creatinine and uric acid before and after hemodialysis sessions in study population

Parameters	Hemodialysis		Mean difference	Paired t Test		
	Before	After		t-Value	P-Value	Significance
Serum Urea (mg/dL)	94.3 ± 30.9	32.3 ± 14.9	62.04	18.5	0	
Serum Creatinine (mg/dL)	8.5 ± 2.3	3.4 ± 1.4	5.09	23.9	0	HS
Serum Uric acid (mg/dL)	6.7 ± 1.5	2.2 ± 0.7	4.51	26.3	0	HS

HS=Highly Significant

Table 3: Comparison of concentrations of blood urea, creatinine and uric acid before and after hemodialysis sessions in male patients

Male Patients						
Parameters	Hemodialysis		Mean difference	Paired t Test		
	Before	After		t Value	P Value	Significance
Blood Urea	93.6 ± 32.2	32.7 ± 14.6	60.87	16.25	0	HS
Serum Creatinine	8.4 ± 2.3	3.5 ± 1.4	4.83	21.99	0	HS
Serum Uric acid	6.7 ± 1.5	2.3 ± 0.7	4.45	22.79	0	HS

HS=Highly Significant

Table 4: Comparison of concentrations of blood urea, creatinine and uric acid before and after hemodialysis sessions in female patients

Female Patients						
Parameters	Hemodialysis		Mean difference	Paired t Test		
	Before	After		t Value	P Value	Significance
Blood Urea	96.8 ± 25.4	30.5 ± 15.4	66.33	8.64	0	HS
Serum Creatinine	8.9 ± 2.4	2.8 ± 1.1	6.06	11.44	0	HS
Serum Uric acid	6.5 ± 1.3	1.8 ± 0.5	4.72	12.9	0	HS

HS=Highly Significant

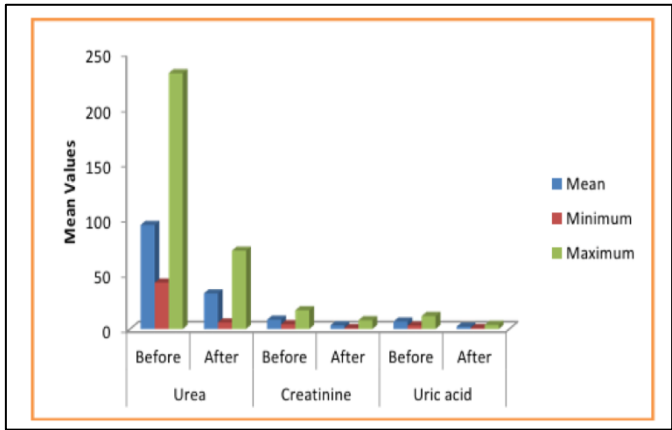


Figure 1: Comparison of serum urea, creatinine and uric acid before and after hemodialysis sessions in study population

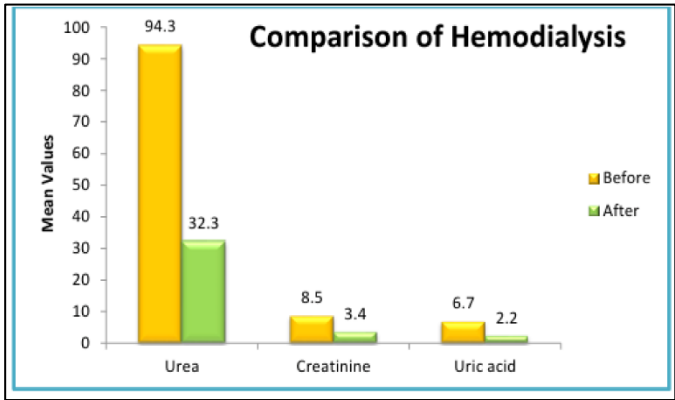


Figure 2: Comparison of concentrations of serum urea, creatinine and uric acid before and after hemodialysis sessions in the study population

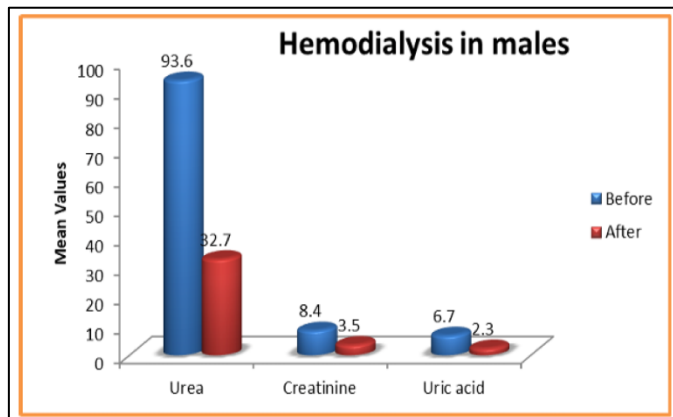


Figure 3: Comparison of concentrations of blood urea, creatinine and uric acid before and after hemodialysis sessions in male patients.

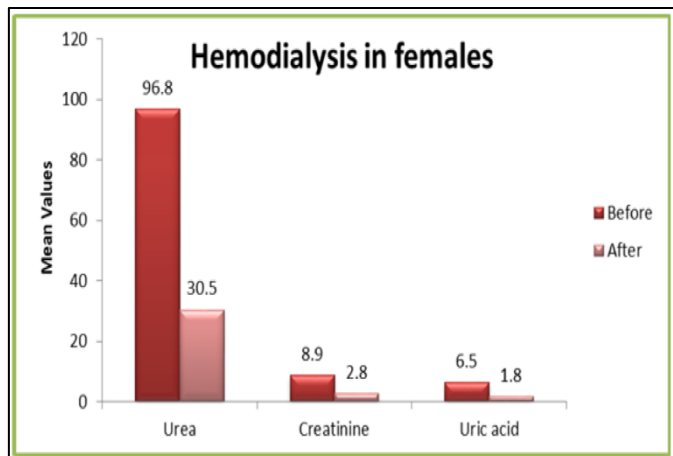


Figure 4: Comparison of concentrations of blood urea, creatinine and uric acid before and after hemodialysis sessions in female patients

Discussion:

End stage renal disease is globally alarming health issue leading risk of morbidity and mortality in CKD patients. According to the previous studies the patients with CKD are at significant risk factor for cardiovascular disease. Hemodialysis was considered the primary treatment modality in all ESRD patients to improve quality of life and delay the transplantation of kidney [6, 7]. In our study assessed pre and post dialysis changes in serum urea creatinine and uric acid in ESRD patients Hemodialysis proved an effective impact on serum urea and creatinine level which is reduced post dialytically. Analytical results showed that all the patients had reduction in urea from 94.3 ± 30.9 to 32.3 ± 14.9 and serum creatinine from 8.5 ± 2.3 to 3.4 ± 1.4 with a statistically significant paired t-test which is consistent with the study of [8] Owen *et al.* study where the pre and post dialysis urea level was

117.61 ± 24.54 and 97.76 ± 24.07 and creatinine levels were 9.21 ± 2.64 and 7.48 ± 2.43 respectively, which is also consistent with the study of Soumya *et al.*, Owen *et al.* study where the pre and post dialysis urea level was 132.34 ± 32.81 and 51.20 ± 16.19 and creatinine levels were 8.68 ± 2.77 and 4.12 ± 1.48 respectively. The urea and creatinine, being small molecules, is removed mainly due to the counter-current flow of the blood and dialysate which maximize the concentration gradient of solutes between the blood and dialysate and helps to remove more urea and creatinine from the blood after dialysis. Another cross sectional study reported increased urea levels before dialysis and progressively decreased after dialysis in patients with ESRD. The recent study observations the women with ESRD had increased urea reduction ratio when compared to males during the dialysis [8, 9]. Similarly, another study also revealed elevated serum creatinine levels in pre dialysis stage and decreased in post dialysis stage significantly. Additionally, another cross sectional study reported suggested serum urea and creatinine cleared from blood during hemodialysis were significant [10, 11]. In the current study we observed statistically significant reduction in serum levels of uric acid from 6.7 ± 1.5 to 2.2 ± 0.7 ($p < 0.001$) post dialytically which is consistent with the study conducted by Park *et al.*, Beberashvili *et al.* and Shekhar *et al.* on 55 patients with chronic renal failure undergoing hemodialysis, investigated for serum uric acid before and after hemodialysis sessions and concluded that the serum uric acid showed significant decrease in post-hemodialysis compared to pre-hemodialysis. According to epidemiological and experimental study reported uric acid is consider independent marker for progression of kidney diseases [12, 13 and 14].

Conclusion:

We show the effects of hemodialysis on serum urea, creatinine, uric acid, calcium and phosphorus. Thus, continuous monitoring and correcting have prognostic significance in end stage renal disease patients on hemodialysis.

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