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Original Research Article

Effect of haemodialysis on renal profile in chronic renal failure patients at a tertiary care centre

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ABSTRACT

Introduction: In chronic renal failure there is a steady and continued decrease in renal clearance or glomerular filtration rate (GFR), which leads to the gathering of urea, creatinine and other waste metabolites in the blood. Haemodialysis is considered as a good therapeutic option in the context of the renal replacement therapies in which different body waste products including urea, creatinine and free water are removed from the blood. In view of that, the present study was conducted to evaluate the effect of haemodialysis on different renal biochemical parameter in CRF patients.

Materials and Methods: The present study was a hospital based study including 84 chronic renal failure patients on haemodialysis attending a tertiary care hospital in Bihar. Blood samples were collected before and four hours after haemodialysis and serum urea, creatinine, uric acid, potassium, sodium and calcium were estimated.

Results: Our results revealed that there was significant decrease in the serum level of urea, creatinine, uric acid and potassium in post dialysis samples with p-value (<0.001, 0.001 0.003 and 0.001) respectively when compared to pre dialysis samples, while showed significant increase of sodium and calcium level in post dialysis samples with p-value (<0.004 and 0.005)

Conclusion: The Study concludes that, haemodialysis increase serum sodium and calcium level and decrease serum urea, creatinine, uric acid and potassium level.

1. Introduction

Chronic kidney disease (CKD), also called Kidney or renal failure can be a temporary (often acute) condition or become a chronic condition resulting in the inability of the kidneys to filter waste from the blood. CKD is considered as a serious health problem throughout the globe.[1] The reported prevalence of CKD in different regions ranges from 1% to 13%, and recently, data from the International Society of Nephrology's Kidney Disease Data Centre Study reported a prevalence of 17% in India.[2]

Chronic renal failure induces a slow and progressive decline of kidney function. It is usually a result of complications from another serious medical condition. Unlike acute renal failure, which happens quickly and suddenly, chronic renal failure happens gradually - over a period of weeks, months, or years - as the kidneys slowly stop working, leading to end-stage renal disease (ESRD) and due to steady and continued decrease in renal clearance or glomerular filtration rate (GFR), there is gathering of urea, creatinine and other waste biomolecules in the blood.[3] 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: GFR 30 to 60 mL/minute as stage three; GFR 15 to 30 mL/minute as stage four; and GFR less than 15 mL/minute as stage five of CKD. Because of challenges in access to

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care, over 50% of patients with advanced CKD are first seen when the eGFR is, 15 ml/min per 1.73 m2.[4]

Haemodialysis is considered as a good therapeutic option in the context of the renal replacement therapies. Body waste product including urea, creatinine and free water are removed from the blood in case of impaired kidneys. From an economic point of view, dialysis is considered cheaper compared with the high cost of renal transplant. So, dialysis has superiority over renal transplant particularly, when the possibility of rejection is taken into account.[5] The procedure of haemodialysis is performed two to three times in a week and the time of dialysis is from two to four hours. The time of dialysis depends on various factors, including kidney function, amount of waste in body, level of salts and body weight.[5] The various frequent complications of haemodialysis include sleeping sickness, low blood pressure, chest pain, nausea, leg cramp, anaemia and headache.[6]

In view of above a study has been made to evaluate the pre-dialysis and post-dialysis mean values of serum renal biochemical markers in CRF patients undergoing dialysis to elucidate the effect of dialysis on CRF patients.

2. Materials and Methods

A hospital based cross-sectional study was conducted in the department of Biochemistry in collaboration with the department of Medicine and dialysis unit Narayan Medical College & Hospital, Sasaram, Bihar. The study was conducted from March 2018 to December 2019 comprising of 84 subjects. The present study was started after obtaining ethical clearance from the institutional ethical committee. Informed consents were obtained from all the participants of the study.

2.1. Subjects

The data was collected from patients of CKD who were on dialysis in the age group of 21 to 70 years. In the patients group, 62 were males and 22 were females. The selection of patients was based on previous diagnosis with chronic kidney disease, according to KDIGO guidelines (CKD is defined as abnormalities of kidney structure or function, present for >3 months, with implications for health," and requires one of two criteria documented or inferred for >3 months: either GFR <60 ml/min/1.73 m^2or markers of kidney damage, including albuminuria.)[7]

2.2. Biochemical examination

Blood samples was collected before and four hours after haemodialysis. About 10 ml of venous blood was collected into plain red top venipuncture tube without additives or anti-coagulants. Haemolysis was avoided. Blood was allowed to clot. Plain tube was centrifuged and serum was separated and stored at 2- 8^0 C until it was analyzed within next two days. Serum was used for estimating urea, creatinine, uric acid, Ca^{+2}, Na^+ and K^+. Serum urea , creatinine, uric acid and Ca^{+2} were analyzed in an automated analyzer (ERBA – EM-200). Serum Urea was estimated by diacetyl monoxime (DAM) method. Serum uric acid was estimated by uricase method. Serum calcium was estimated by Arsenazo method. Serum creatinine was estimated by using Jaffe's alkaline picrate method. Serum Na^+ and K^+ were analyzed in ion selective Electrode machine Ecolyte (Eschweiler, Germany).

2.3. Statistical analysis

Statistical analysis was performed using SPSS software version 20.0 Data were expressed as mean ± SD for continuous variables. Independent t test and chi square test were done to analyze the data. A p value <0.05 was considered statistically significant.

3. Results

The present study was conducted with 84 patients of CKD receiving haemodialysis at regular intervals in dialysis unit, NMCH, Sasaram. The study constituted a total of 84 cases, age ranged from 21 to 70 years (mean 38± 10.5 years) diagnosed with CKD. The most frequent causes of CKD among the studied group was hypertension, followed by diabetes mellitus; then glomerular nephritis, and cardiovascular diseases. Serum urea, creatinine, uric acid, Ca^{+2}, Na^+ and K^+ were estimated before and four hours after haemodialysis and the values are shown below.(Table 2)

Maximum number of cases (n=26; 31%) were in the age group of 41-50 years followed by 51-60 years age group (n=24; 28.5%) and 61-70 years age group (n=18; 21.5%). 10 cases (12%) were observed in 31-40 years of age while 6 cases were younger than 30 years. (Table 1)

Table 1: Frequency of cases in different age groups

Age Interval (in years)	Frequency	Percentage (%)
21-30	6	7
31-40	10	12
41-50	26	31
51-60	24	28.5
61-70	18	21.5

In the present study, we found serum urea level (mg/dl) before and after haemodialysis were 164.23±43.72 and 48.54±29.35 respectively. Before haemodialysis, serum creatinine levels (mg/dl) were 8.2±2.7 which deceased to 3.24±1.42 after haemodialysis with a significant p value of < 0.001. In the renal parameter serum uric acid was also estimated and its level (mg/dl) before and after haemodialysis were 5.84±0.94 and 2.83±0.74 respectively. Serum Calcium level (mg/dl) before and after haemodialysis

Table 2: Effects of Hemodialysis on the Serum urea, Serum creatinine, Serum uric acid, Serum Na^+ and Serum K^+ and Serum Ca^+ in patients with renal failure before and after Hemodialysis

Parameter	Before Haemodialysis. (Mean ± SD)	After Haemodialysis (Mean ± SD)	p-value
Serum Urea (mg/dl)	164.23±43.72	48.54±29.35	P<0.001
Serum Creatinine (mg/dl)	8.2±2.7	3.24±1.42	P<0.001
Serum Uric Acid (mg/dl)	5.84±0.94	2.83±0.74	P<0.003
Serum Sodium (mEq/L)	134.78±5.2	137.45±3.84	P<0.004
Serum Potassium (mEq/L)	5.17±1.2	3.8±1.1	P<0.001
Serum Calcium (mg/dl)	8.2±0.23	8.9±0.93	P<0.005

were 8.2±0.23and 8.9±0.93 respectively with a significant p value of < 0.005. All above mentioned biochemical parameters were evaluated by fully automated blood chemistry analyzer ERBA EM- 200.

In the present study we also estimated serum electrolyte sodium and potassium through ion selective electrode. Pre-dialysis and post-dialysis serum sodium level (mEq/L) were 134.78±5.2 and 137.45±3.84 respectively, and the results were statistically significant with p value <0.004. Before haemodialysis, serum Potassium levels (mEq/L) were 5.17±1.2 which decreased to 3.8±1.1 after haemodialysis with a significant p value of < 0.001. (Table 2)

4. Discussion

Chronic renal failure (CRF) describes the gradual loss of kidney function with decrease in glomerular filtration rate. Hypertension, diabetes mellitus, Chronic pyelonephritis, autosomal dominant polycystic kidney disease, autoimmune cause, amyloidosis etc forms the most common cause of chronic renal failure.[8] It is generally characterized by high amount of creatinine, blood urea nitrogen value and proteinuria which predict an accelerated loss of renal function that irreversibly leads to end stage renal disease.[9,10]

These biochemical changes of the blood reflect the sign and symptoms of the disease. By measuring the serum level so the compounds excreted by the kidneys, assessment of the renal excretory functions can be done and therefore serum levels of different biomolecules and electrolytes in the body fluids such as that of urea, creatinine, uric acid, sodium, potassium, and calcium etc can also be used as a diagnostic tool in assessment of renal diseases. Hence; we evaluated the pre-dialysis and postdialysis mean values of serum renal biochemical markers in CRF patients undergoing dialysis to elucidate the effect of dialysis on CRF patients.

Dialysis is a process whereby the solute composition of a solution, A, is altered by exposing solution A to a second solution, B, through a semi permeable membrane. During this process, smaller molecules and water molecule moves through semi permeable membrane but heavier molecules cannot. So the concentrations of heavier molecules (like proteins) don't change on either side of the membrane and it remains unchanged. On this principle, haemodialysis works.[11] Haemodialysis removes waste and water from circulating blood outside the body through an external filter, called dialyser, which contains a semi permeable membrane. The blood from a peripheral artery of the patient is allowed to flow on one side of the membrane and the dialysate flows by other side but in opposite direction. The counter current flow of the blood and the dialysate maintains a maximum concentration gradient of solutes between the blood and dialysate that helps to remove more urea and creatinine from blood. The solute concentration in the dialysate is so designed as to maximize diffusion of water and solute across the membrane. The net effect is the reduction of toxic molecules to the low levels in the blood while improving the levels of the essential ones.[12]

The result of our study showed that significant variation in the levels of the different renal biochemical parameters under study in the cases before dialysis and after dialysis.

4.1. Effect on serum urea levels

In the present study, we observed that group showed an increase in the levels of the urea in pre-dialysis stage and there was significant decrease in serum urea concentration after haemodialysis. Our finding is very much consistent with the findings of study of Owb WF Jr et al. on 13,473 patients. They also found that Women had higher urea reduction ratios than men during treatment.[13]

4.2. Effect on serum creatinine levels

Our study revealed that high creatinine level in pre dialyzed patients. In the post dialysis stage, serum creatinine level was reduced to a significant level. The observation of reduced creatinine level in hemodialyzed patient correlates with similar studies done by Asaad DA et al. on 60 patients in baquba teaching hospital and Rakesh et al. in Bihar.[14,15] The observation is suggestive of clearance of Creatinine and urea from blood during hemodialysis.

4.3. Effect on serum uric acid levels

Several experimental and epidemiological studies have suggested that uric acid is a causal or independent risk

factor in the progression of renal diseases. The rise in serum uric acid in chronic renal failure is substantially mitigated by marked reduction of its biosynthesis via down regulation xanthine oxidase and upregulation of its secretion by colonic epithelium.[16,17] It has been observed in our study that pre-hemodialysis stage uric acid was very much high than normal reference level and there was a significant fall after hemodialysis (P value <0.003). This is in agreement with the findings of study of Ahmed M Met al on 50 patients in Sudan.[18]

4.4. Effect on serum sodium levels

In the present study, serum sodium levels in the pre-dialyzed cases are lower than the normal reference value. The change in serum sodium is due to lowering of renin secretion from the kidney that is important in sodium control, because of failing large part of kidney.[19] Our study showed a marginal increase in serum sodium levels after dialysis and is statistically significant (p-value < 0.004). The increased level in serum sodium might be affected by a high-sodium dialysis solution. Study by Mohammad DK et al. also showed similar results in CRF patients undergoing haemodialysis.[20]

4.5. Effect on serum potassium levels

The current study showed that serum potassium level in post – dialyzed patients was significantly low (P<0.001) compared to mean serum level of pre- dialyzed patients. Hyperkalemia reduces the resting membrane potential, slow the conduction velocity and increases the rate of repolarization. Hypokalemia on the other hand increases the resting membrane potential, and refractory period, which are potentially arrhythmogenic.[21] This finding of our study is well supported by the findings of study done by Gulavani GA et al. in Pune, Maharashtra.

4.6. Effect on serum calcium levels

Our study indicates that serum calcium levels was low in pre dialyzed patients which increased in all subjects post haemodialysis and is statistically significant (p-value < 0.005). Hypocalcemia in CKD is due to hypophosphatemia associated with CKD, decrease in the number of calcium sensing receptor and vitamin D receptor in the parathyroid glands. There is also deficiency of 1, 25 dihydroxycholecalciferol which is the active form of vitamin D that helps in absorption of dietary calcium from the gut.[22] In a similar study, Swati Bhagat et al. reported a significant increase in serum calcium level after haemodialysis.[23] This finding of our study is also well-supported by findings of study by Correa S et al. in US.[24]

5. Conclusion

Our study concluded that chronic renal failure patients have higher serum urea, creatinine, uric acid and potassium level and decreased level of sodium and calcium leading to various other dangerous diseases. Haemodialysis, one form of the renal replacement therapy, led to the significant decrease in serum urea, creatinine, uric acid and potassium level with significant increase in serum calcium and sodium concentration.

6. Source of Funding

None.

7. Conflict of Interest

The authors declare that there is no conflict of interest.

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