



## Chronic Kidney Disease, Pre and Post Hemodialysis

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**ABSTRACT**

Chronic renal failure is the progressive loss of function of kidney and patient requires a long treatment in the form of renal replacement therapy. Hemodialysis is one of the widely used renal replacement therapy, during which body's waste products, including creatinine, urea and excess water, are removed. The current study was designed to investigate the impact of hemodialysis on the removal of Non Proteinous Nitrogenous waste from the body. Sixty Chronic Kidney Disease patients were enrolled and their serum was analysed for various renal parameters. Results showed that there was significant decrease ( $p < 0.001$ ) in serum urea, creatinine levels post Hemodialysis as compared to pre Hemodialysis, while there was significant increase ( $p < 0.001$ ) in serum calcium levels.

**KEYWORDS**

Hemodialysis, Chronic Kidney Disease, creatinine.

**Introduction**

Chronic kidney disease (CKD) is becoming a major and alarming public health burden worldwide. It is a progressive condition that results in significant morbidity and mortality [1]. It is rapidly increasing in India as an epidemic. There is significant burden of CKD, though exact figures vary worldwide [2]. Chronic kidney disease is defined as "kidney damage or GFR less than 60ml/min/1.73m<sup>2</sup> for atleast three months".

End Stage Renal Disease is the final stage of Chronic kidney disease where there is progressive, irreversible loss of endogenous renal function of a degree sufficient to render the patient permanently dependent upon renal replacement therapy like Hemodialysis, peritoneal dialysis or transplantation to avoid life threatening uremia [3].

Dialysis remains the most common form of renal replacement therapy worldwide, due to the high cost associated with renal transplantation and difficulty in getting a compatible organ donor [5]. Hemodialysis is the process of separating macromolecules from ions and low molecular weight compounds in the solutions by the difference in their rate of diffusion through a semi permeable membrane, by the process of diffusion and ultra filtration [4]. Process of dialysis is performed 2-3 times per week and time required for dialysis is 2-4 hours.

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 nitrogenous substances such as urea, creatinine, uric acid and other compounds in the blood [6].

Creatinine is produced in the muscles by the non-enzymatic changes of creatine and phosphocreatine. Plasma levels of creatinine reflect endogenous production and GFR. Therefore it is an excellent indicator of assessment of renal function. Urea is an organic compound, playing a vital role in the metabolism of nitrogen-containing compounds (NPN). Urea is major excretory product of protein metabolism. 90% of it is excreted through the kidneys and kidney disease is associated with accumulation of urea in the blood. The concentration of urea in plasma is determined by renal function and perfusion, the

protein content of diet and the amount of protein catabolism [6].

Calcium is one of the key elements to be considered in patients on dialysis due to its relationship with cardiovascular risk [7]. Accurate assessment of calcium balance in patients on Hemodialysis (HD) is crucial. A negative calcium balance can cause hemodynamic instability, muscle cramps, secondary hyperparathyroidism and loss of BMD. A positive calcium balance may lead to hypercalcemia, vascular calcification and increased cardiovascular morbidity and mortality. [8]

Therefore in this study, we aim to evaluate the immediate effect of Haemodialysis on various renal parameters in patients diagnosed with Chronic kidney disease (CKD).

**Aim:**

To assess the effect of Hemodialysis on Urea, Creatinine and Calcium levels in patients diagnosed with Chronic Kidney Disease.

**Material & Methods**

Patients between age group 30-60 yrs of both genders attending Nephrology OPD of MGM Hospital, diagnosed with Chronic Kidney Disease, undergoing Haemodialysis and willing to participate in study were enrolled in this study. Written informed consent was obtained from each patient. Ethical Clearance was obtained from Institutional Ethics committee. Present and past histories of the patients were collected with the help of pre-test proforma. The study group was categorized into pre-HD and post-HD groups.

**Sample collection:**

5ml of venous blood was collected in 60 CKD patients before and after haemodialysis, under strict aseptic conditions in plain vacutainer. Serum was obtained after centrifugation at 2500 rpm for 15 minutes and stored at -70 c till further analysis.

**Methodology**

Serum Urea was estimated by enzymatic method, serum creatinine by Jaffe's method and serum calcium by phosphotung-

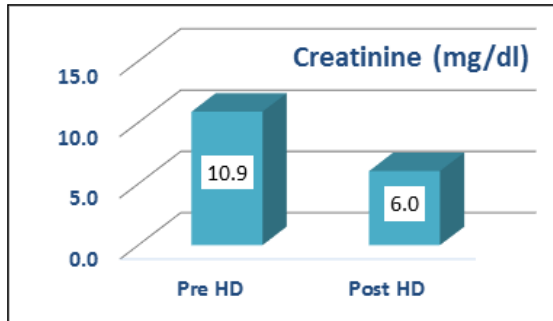
stic method on Biochemistry semi-autoanalyzer.

**RESULTS**

**Table 1: Mean and SD of serum creatinine levels in pre and post Hemodialysis group**

Groups	Sr. creatinine (mg/dl)	P value
Pre-HD group	10.9 ± 2.5	<0.001
Post-HD group	6.0 ± 1.8	

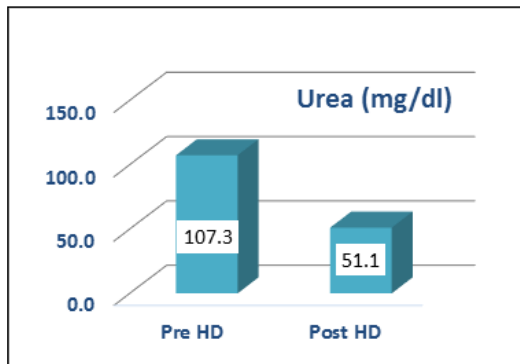
**Figure 1: Mean and SD of serum creatinine levels in pre and post Hemodialysis group**



**Table 2: Mean and SD of serum urea levels in pre and post Hemodialysis group**

Groups	Serum urea (mg/dl)	P value
Pre-HD group	107.3 ± 33.2	<0.001
Post-HD group	51.1 ± 21.0	

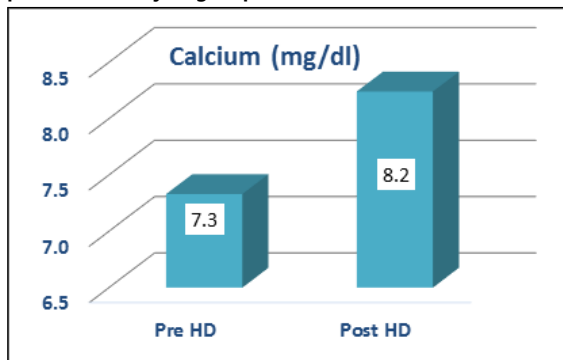
**Figure 2: Mean and SD of serum urea levels in pre and post Hemodialysis group**



**Table 3: Mean and SD of serum Calcium levels in pre and post Hemodialysis group**

Groups	Serum Calcium (mg/dl)	P value
Pre-HD group	7.3 ± 1.4	<0.001
Post-HD group	8.2 ± 1.6	

**Figure 3: Mean and SD of serum Calcium levels in pre and post Hemodialysis group**



**DISCUSSION**

Chronic kidney disease (CKD) is a modern day global epidemic and it is now recognized as a public health issue [9]. CRF that leads to severe illness and requires some form of renal replacement therapy such as dialysis is called end-stage renal disease [10]. CRF occurs in 1.0 of every 5000 people, usually in middle-aged and older people, although children and pregnant women are also susceptible. Dialysis may be used for very sick patients who have suddenly lost their kidney function (acute renal failure) or for quite stable patients who have permanently lost their kidney function (CKD)[11].

During this study, we found that both genders were equally affected by chronic renal failure but a higher total number of males with ESRD were undergoing hemodialysis. Most patients undergoing dialysis were between the ages of 50-60 years, which could be due to advancing age and progressive physiological glomerulosclerosis that leads to a decrease in renal weight. Serum creatinine and urea were estimated in CKD patient pre and post dialysis as these are important renal markers in the diagnosis, follow-up and recovery of CKD patients undergoing Hemodialysis.

Table 1 shows serum creatinine levels in pre-HD and post-HD groups. Pre-HD had mean values of creatinine levels 10.9 ± 2.5, which is higher than the normal range (upto 1.4 mg/dl) and Post-HD had mean values of 6.0 ± 1.8. The results showed that the process of dialysis leads to a significant fall in mean serum creatinine levels (p < 0.001) but the values of creatinine are still higher than the normal range. (Figure 1)

Creatinine is a breakdown product of creatine phosphate in muscle, and is usually produced at a fairly constant rate by the body depending on muscle mass [12]. Creatinine is a commonly used as measure of kidney function. A rise in serum creatinine level in CRF patients is attributed to the decrease in the number of functioning nephrons, which would reduce the GFR, which causes major decrease in renal excretion of water and solutes and gathering of toxic products [13]. It is neither secreted nor reabsorbed so its values are relatively more accurate. Thus, rise in serum creatinine is used in clinical practice as a marker of reduced GFR. Hemodialysis decreases the creatinine levels by its removal from the blood by dialyzing the patient's blood against fluid containing minerals similar to natural concentration of blood [14].

Our findings of Creatinine in study group were consistent with the clinical studies done by Dushyant et al [2013][15], Noor Ul Amin et al [2014] [6] Khaled et al[17] and Eduardo et al [2015]. These results confirm that hemodialysis is an efficient method to remove undesired substances from CKD patients, even when values are above the desired reference levels.

Table 5 shows level of urea in serum of patients undergoing dialysis i.e. in pre-HD and post-HD groups. Pre-HD had mean urea values 107.3 ± 33.2, which is higher than the normal range and Post-HD mean values were 51.1 ± 21.0. The results showed that dialysis lead to a significant fall in mean serum urea levels (p < 0.001) (Figure 5). Urea is major nitrogenous end product of protein and amino acid catabolism, produced by liver and distributed throughout intracellular and extracellular fluid. In kidneys, urea is filtered out of blood by glomeruli and is partially being reabsorbed with water [18]. 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 and other toxic chemicals in the blood. Increase of serum urea is proportional to the progression of the disease, but it is highly influenced by a catabolic state or an excessive protein ingestion [19].

Our findings of urea was supported by Israa [2013], Noor Ul Amin et al and Mahomoodally et al [2014]. Noor Ul Amin et al studied 70 patient and found clear reduction in urea levels. Mahomoodally et al showed that there was a significant decrease in the serum urea. He explained that during hemodialysis, urea, being small molecule flow through membranes into

the sterile solution and is removed due to the counter-current flow of the blood and dialysate. [20].

Eduardo et al with findings supporting our study explained that during hemodialysis, excess urea is just partially removed. In order to prevent accumulation, it is very important to balance the amount of consumed proteins, avoiding excessive production of urea [21]. The decrease in the level of urea, creatinine in post dialysis patients compared with pre-dialysis patients with CRF is due to hemodialysis process which removes toxins from the blood by a closed – loop process where the blood of the patient and is continuously being withdrawn, dialyzed, and returned to the patient. These findings also supported by other studies [22].

Urea being small molecule undergoes substantial clearance, whereas, creatinine being large molecule is cleared less efficiently. The removal of these toxic substances may occur as a result of ultrafiltration process and convective clearance causing solutes swept along with water across the semi-permeable membrane. Maintenance dialysis methods have now successfully prolonged the life of patients with terminal uremia, mortality remains high.[23]. These renal parameters i.e. urea, creatinine are very important markers for the assessment of effect of dialysis in ESRD patients.

Table 3 shows the levels of total calcium pre-HD and post-HD. The mean and SD of serum calcium levels pre-HD is  $7.3 \pm 1.4$  and post-HD is  $8.2 \pm 1.6$  (Figure 3). The values are highly significant with p value < 0.001. Calcium levels in the blood of both male and female of CKD of post HD patients are increased slightly than the pre-HD patients. It is clear from the data that both calcium levels are less than the normal values. Calcium is one of the key elements to consider in patients on dialysis due to its relationship with cardiovascular risk.

Calcium is the most common structural element of bones and teeth and has numerous functions within the body. It is also involved in normal neuromuscular function and the clotting of blood. Anneke et al [2013] [8] found decrease in serum calcium levels post dialysis, which was not in accordance with our study. Our study was in accordance with Khaled et al [2015] [17] and Roman Safraneka et al [2015] who found significant increase in serum calcium levels post dialysis. Their studies explained net positive transfer of Ca from dialysate to blood with 1.5 mmol/L and approximately neutral or slightly negative Ca flux with 1.25 mmol/L dialysate Ca in most patients . However, the main driving force responsible for calcium mass balance is diffusion gradient between Calcium in the blood and dialysate and ultrafiltration. Thus, Ca mass balance may differ widely depending on patient's factors.[24] It is observed that Serum calcium is decreased in CKD patients and the values are not much altered in pre and post dialysis conditions [16].

## Conclusion

The effectiveness of dialysis in reversing any complication of uremia depends on the nature of that complication. Those disturbances which are due to the accumulation of a uremic toxin may be reversible if that toxin is dialyzable and if the removal rate by dialysis outstrips its generation rate.

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