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Original Research Article

# Biochemical Evaluation of Creatinine and Urea in Patients with Renal Failure Undergoing Hemodialysis in Tertiary Care Hospital at Bhagalpur District, Bihar

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## Abstract

One of the slowest developing kidney disorders, renal failure is typically marked by decreased glomerular filtration rate (GRF). Hemodialysis is used as a replacement therapy for renal failure and entails the elimination of the body's excess toxic fluids and toxic metabolic waste products. In light of this context, the current effort concentrated on evaluating and correlating the importance of several biochemical indicators in blood serum from renal failure patients before and after dialysis. Serum creatinine and urea are two of the many biochemical factors found in blood that are emerging as more accurate indicators of renal failure. Thus, samples from 50 patients with renal failure before and after hemodialysis were included in the analytical part of this investigation to determine the prevalence of creatinine and urea levels. For the detection of creatinine and urea concentrations in human serum, a colorimetrical method utilising a fully automated analyzer was chosen. The concentration of urea was found to be lower than that of creatinine, and the mean values of these two components in the post-dialysis group were lower than those in the pre-dialysis group. Before hemodialysis, the incidence of serum creatinine and urea was noticeably high, and it considerably decreased following hemodialysis. The study found a statistically significant correlation between the levels of urea and creatinine in pre- and post-dialysis blood serum samples from patients with renal failure.

**Keywords:** Renal failure, Hemodialysis, Blood serum, Creatinine and urea profiles



## Introduction

In many nations around the world, kidney diseases rank among the leading causes of death and disability [1,2]. A number of kidney and urinary tract disorders frequently have renal failure as a primary cause, which is a systemic disease. Infections, auto immune illnesses, diabetes and other endocrine disorders, cancer, and toxic chemicals are just a few of the reasons that can cause renal failure, which results in a gradual and cumulative decline in kidney function [3]. It frequently happens as a result of complications from other severe medical disorders. Chronic renal failure, in contrast

to acute renal failure, develops gradually over weeks, months, or years as the kidneys gradually stop functioning, ultimately leading to end-stage renal disease (ESRD) [4,5]. One of the main factors contributing to renal failure is high blood pressure. Additionally, it might harm the kidney's blood arteries, which would impact how waste products are secreted. Waste may leak extracellular fluids and increase blood pressure, which could ultimately result in ESRD [6]. The severity of renal impairment is correlated with anaemia, and the failure of renal erythropoietin secretion is one of its major causes. One form of renal replacement therapy is hemodialysis [7]. When the kidneys are damaged, the procedure is essential for the extracorporeal elimination of wastes like creatinine, urea, and free water from the blood. Hemodialysis works on the premise of solute diffusion across a semi-permeable membrane. Hemodialysis is often administered to uremic patients two to three times per week, lasting anywhere between two and four hours [8]. The amount of waste in the body, the level of salts, and body weight are some of the variables that affect how long dialysis takes. Many kidney failure symptoms are reduced by dialysis, but some issues, such as hypertension, anaemia, and itch, frequently need for extra pharmacological therapies as well [9].

Increases in two vital blood chemicals, urea and creatinine, which are measured in serum to determine Glomerular Filtration Rate (GFR) and then renal function, indicate the progression of kidney impairment. Although they are just indicators of kidney function, neither urea nor creatinine are directly harmful [10]. Muscles create creatinine, which is then eliminated by the kidneys along with other waste materials. The equilibrium between creatinine synthesis and renal excretion regulates the level of creatinine in serum. Creatinine is produced daily at a relatively steady rate (male: 20 to 25 mg/kg/day; female: 15 to 20 mg/kg/day), with an estimated daily conversion rate of 2% of the body's creatine into the compound [11]. Because men have more muscle mass than women, their serum creatinine levels are higher. The production, glomerular filtration, and tubular secretion of serum creatinine determine the amount of creatinine in serum. Calculations based on serum creatinine and the age groups of the patient are used to estimate more precisely the degree of kidney function [12,13]. These calculated values are called the estimated glomerular filtration rate or eGFR. To assess how well the kidneys remove (or clear) creatinine from the body, a 24-hour urine collection and blood test may be combined. The amount of creatinine cleared as a result is known [14]. Age, sex, race, body habits, and diet are additional variables that affect creatinine concentrations. However, neither urea nor creatinine are poisonous in themselves; they are only used to assess renal function [15] Organic substance urea is essential for the metabolism of substances containing nitrogen. It is a byproduct of dietary protein that the kidneys also filter into urine [16,17]. The typical nitrogen waste product known as urea nitrogen is found in blood and results from the digestion of dietary protein. Urea nitrogen is removed from the blood by healthy kidneys, but when renal failure occurs, the level of urea in the blood increases [4]. The increase of urea and creatinine in patients' serum across a range of age groups with renal failure has been examined both before and after hemodialysis.

## Materials and Methods

This study was conducted at Department of Biochemistry, JLNMCH, Bhagalpur, Bihar, random samples from patients with renal failure were collected from Medicine Department of Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar

from June 2021 to 2022. The analytical study involved 50 patients who met the criteria for renal failure as determined by experienced nephrologists and epidemiologists, who used a structured approach to critically assess and validate the permanence of kidney disease in all individuals. 30% of them were between the ages of 20 and 80, and 70% of them were either males or females. These patients' blood samples (5 ml) were taken before and after hemodialysis and centrifuged separately for 10 minutes at 3000 rpm to separate the serum. The serum was then kept at -20°C for biochemical analysis. The samples' creatinine levels were measured using the Jaffe Kinetic test (22, 2002). An orange-colored complex was created when creatinine in the serum sample reacted with picric acid in the reagent's alkaline solution (i.e., alkaline picrate). The amount of creatinine in the test samples was calculated in relation to the degree to which the colour developed throughout the predetermined period of time. Using a completely automated instrument for the detection of serum creatinine, the color's intensity was assessed. Urease hydrolyzed the samples' urea levels to produce ammonium and carbonate [18]. The reactions between ammonium and 2-oxoglutarate were then used to create L-glutamate in the presence of glutamate dehydrogenase and the cofactor NADH. For every mole of urea hydrolyzed during this reaction, 2 moles of NADH were transformed into NAD+. The urea content in the serum sample, which was measured photometrically using a fully automated analyzer, was directly proportional to the rate of decline in the NADH concentration.

**Statistical analysis**

Using SPSS version 22.0 statistical software, the findings were statistically analysed to see if there was any association between the levels of urea and creatinine in the samples taken before and after hemodialysis.

**Result**

**Table 1: Age and Sex wise distribution of patients**

| | **Sex wise** | | **Age groups in years (%)** | | |
|---|---|---|---|---|---|
| Total No. of cases | Male n(%) | Female n(%) | 21-40 n(%) | 41-60 n(%) | 61-80 n(%) |
| 50 (100%) | 35 (70%) | 15 (30%) | 8 (16%) | 30 (60%) | 12 (24%) |

Renal failure is the loss of normal kidney function over time in a gradual, progressive, and irreversible manner. Patients with renal failure prior to hemodialysis experienced severe complications due to increased blood levels of urea and creatinine excreted by damaged kidneys.

On the basis of their clinical histories, clinical examinations, and renal function tests, a total of 50 patients were determined to have renal failure. Before and after the hemodialysis session, biomarker levels including serum urea and creatinine were checked. In three different age groups of participants (21–40 years old, 41–60 years old, and 61–80 years old), the mean SD values of serum creatinine before and after hemodialysis were compared and are presented in Table 2. The byproduct of muscle metabolism, creatinine, has an increased blood level that denotes kidney illness. The age group between 61 and 80 years old was found to have lower mean values of serine creatinine levels. When the mean values of creatinine were compared to the reference range, a statistically significant difference was found. The discrepancy between age groups may be explained by the fact that shorter people require less renal

function and smaller body sizes have lower metabolic demands. Patients receiving dialysis for renal failure had serum creatinine levels that were considerably above the normal range (up to 1.4 mg/dl) (p <0.005). Before starting dialysis, the mean serum creatinine levels of all the patients were 10.48 3.06 mg/dl for those between the ages of 21 and 40, 10.35±3.23 mg/dl for those between the ages of 41 and 60, and 8.27±2.60 mg/dl for those between the ages of 61 and 80. Increased serum creatinine levels have been linked to itching and damage to nerve endings. The serum creatinine level was significantly impacted by hemodialysis and decreased to close to normal levels. According to the analysis, all 50 hemodialyzed patients had post-dialysis serum creatinine levels under 5.03±1.76. In all three age groups, the paired t-test showed a significant relationship to the mean SD values of serum creatinine (t-test = 6.67, 15.61, and 9.75 in the age ranges of 21 to 40 years, 41 to 60 years, and 61 to 80 years, respectively), with p-values of 0.0001. (Table 2). The best method for assessing kidney function is creatinine clearance.

**Table 2: Incidence of serum creatinine in renal failure patient's during pre and post hemodialysis**

| Serum Creatinine Levels (mg/dl) | | | | | | |
|---|---|---|---|---|---|---|
| Age group (yrs.) | No. of cases | Pre hemodialysis | | P-value | Post hemodialysis | |
| | | Mean±SD | T-test | | Mean±SD | T-test |
| 21-40 | 8 | 10.48±3.06 | 9.681 | 0 | 4.67±1.97 | 6.67 |
| 41-60 | 30 | 10.35±3.23 | 17.54 | 0 | 5.03±1.76 | 15.61 |
| 61-80 | 12 | 8.27±2.60 | 10.99 | 0 | 4.36±1.54 | 9.75 |

**Table 3: Incidence of serum urea in renal failure patient's during pre and post hemodialysis**

| Serum Creatinine Levels (mg/dl) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Age group (yrs.) | No. of cases | Pre hemodialysis | | P-value | Post hemodialysis | | |
| | | Mean±SD | T test | | Mean±SD | T-test | P-value |
| 21-40 | 8 | 138.44±49.31 | 8.42 | 0.000 | 54.87±28.82 | 5.38 | 0.001 |
| 41-60 | 30 | 133.98±36.41 | 20.15 | 0.000 | 58.26±19.95 | 15.99 | 0.000 |
| 61-80 | 12 | 130.58±23.11 | 10.57 | 0.000 | 59.66±16.05 | 12.87 | 0.000 |

## Discussion

As mentioned by Noor ul *et al* [5] the findings of the present study strongly imply that several factors, including age, sex, and physical condition of the person, affect blood creatinine level. The findings of the current investigation were consistent with those of Attika and Lubna [19] who found that hemodialysis had a favourable impact on a considerable decrease in blood creatinine levels in patients with renal failure who were receiving dialysis. Another surrogate indicator of the insufficiency of dialysis is the decrease in creatinine level during hemodialysis. Additionally, it was found that kidney failure was more common in adults between the ages of 41 and 60, which may be associated to diseases like hypertension, diabetes, or other aging-related alterations. Regarding various age groups, there was a considerable difference in the amounts of serum urea seen before and after hemodialysis (Table 3). Urea typically builds up in the serum of kidney failure patients as a result of the breakdown

of food and tissues like muscle. The high level of urea in blood leads the body very sick unless remove it from the blood streams by kidneys [20] mass differences [21] (Table 3) represented the increased mean values of serum urea in all 3 age groups before hemodialysis (138.44 ± 49.31 mg/dl in 21 to 40 years; 133.98 ± 36.41 mg/dl in 41 to 60 years; 130.58 ±23.11mg/dl in 61-80 years) when compared to the mean values of after hemolysis (54.87 ± 28.82 mg/dl in the age between 21 and 40 years; 58.26 ± 19.95 mg/dl in the age between 41 and 60 years; 58.26 ± 19.95 mg/dl in the age between 41 and 60 years.In order to prevent accumulation, extra urea from the patient's blood is gently eliminated during hemodialysis.

Another crucial step in preventing excessive urea synthesis is the consumption of proteins in a balanced proportion [22]. The hemodialysis technique used in the study participants was thought to be effective because the resultantly documented significantly lower levels of urea and creatinine indicated that it was working. The analysed pre- and posthemodialysis urea levels, as obtained, showed a considerable decrease in serum levels, indicating hemodialysis as an effective procedure, according to Draczevski and Teixeira [1]. The removal of waste during dialysis is also influenced by the timing of the procedure, patient awareness, and the choice of dialyzer and diet [23]. The levels of urea and creatinine are significant indicators because they are essential for the diagnosis and monitoring of renal failure. Patients with renal failure experience uremia, which is caused by an accumulation of urea, one of the by-products of protein breakdown, in their blood [24-26].

## Conclusion

Patients with renal failure who provided data on renal function across various age groups showed a strong correlation between serum creatinine and serum urea levels. Serum urea and serum creatinine are both extensively used indicators to evaluate renal functioning. For the filtration of undesirable metabolites like creatinine and urea in patients at a significant range, hemodialysis forms an effective procedure as an efficient and necessary process, extending the patients' life expectancy. However, modern health research calls for newer methods for an earlier detection and quicker prevention of renal issues.

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