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Comparative Study of Serum Cystatin C and Serum Creatinine Level in Before and After Hemodialysis

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Chronic kidney disease (CKD) is a pathophysiologic process characterised by a decrease in nephron number and function, which often leads to end-stage renal disease (ESRD). Serum plasma cystatin C is a new test for determining kidney function. Its accuracy in determining the efficacy of haemodialysis in patients with end-stage renal disease has yet to be determined.
Serum cystatin C, which is formed at a constant rate by all nucleated cells and filtered freely by the glomerulus, is neither secreted nor reabsorbed, and is unaffected by non-renal influences.
Materials and Methods: This study was a comparative study, conducted in the nephrology Department at DMMC & SMHRC, Nagpur in collaboration with ABVRH and JNMC Wardha, Sawangi (Meghe) during September 2020 to March 2021. Total 25 patient (End stage renal disease) included for the present study, the age group 30-60 years with 17 male patients and 08 female patients.

Result: Serum creatinine concentration in the before hemodialysis with 8.72±3.00 and for the after hemodialysis 3.20±1.18(P < 0.0001). The serum cystatin C concentration in the before hemodialysis 5.50±2.09 and for the after hemodialysis 8.7±1.75(P < 0.0001). the process of hemodialysis leads to a significantly low in a serum creatinine concentration as compared to before hemodialysis. The serum cystatin C concentration significantly increase in the after hemodialysis patient as compared to before hemodialysis.
Conclusion: Hemodialysis adequacy cannot be determined using serum cystatin C. It does, however, serve as a surrogate marker of dialysis inadequacy, particularly when low flux membranes are used. Routine examination of serum cystatin C in hemodialysis patients will help in the monitoring of the patient's overall clinical condition.

Keywords: Creatinine; cystatin C; Hemodialysis; ESRD.

1. INTRODUCTION

CKD is a growing health concern around the world. There has been a rise in the number of people affected by CKD as the incidence of conditions such as diabetes mellitus and hypertension among the global population has increased. The morbidity and mortality associated with CKD are a major concern. The majority of patients are diagnosed during end-stage renal disease (ESRD) and, as a result of delayed intervention, frequently succumb to complications even after starting dialysis [1].

The effectiveness of dialysis has a significant impact on the health, outcome, and survival of patients with end-stage renal disease. As a result, careful monitoring and follow-up are needed to produce the best results. The effectiveness of dialysis is currently measured by measuring serum creatinine levels before and after each dialysis session. However, inter-individual variability in serum creatinine levels is affected by age and gender [2].

Serum creatinine is primarily a metabolite of creatine, almost all of which is located in skeletal muscle. serum creatinine normal range in male 0.8-1.4 mg/dl and female 0.6-1.2 mg /dl .females creatinine have a lower as compared to males, because female muscle mass less as compared to males [3].

The sum of creatine per unit of skeletal muscle mass and the rate of creatine breakdown are also consistent. As a result, plasma creatinine concentration is very consistent and serves as a clear indicator of skeletal muscle mass [4]. In addition, body structure and dietary influences have an effect on plasma creatinine levels. e.g Consumption of meat, can increase plasma creatinine levels because it contains creatine, which can be converted to creatinine during cooking [5].

Cystatin C is a single non-glycosylated polypeptide chain with a molecular mass of 13 kDa and 120 amino acid residues [6].

Cystatin C is a small protein that is found in all nucleated cells, is generated at a constant rate, and is freely filtered by the glomerulus. It is not secreted, but rather reabsorbed and catabolized by tubular epithelial cells, preventing it from returning to the bloodstream. These characteristics make it a useful endogenous renal function marker [7].

The present study was therefore undertaken in order to evaluate the potential clinical utility of serum cystatin C determination in patients before and after hemodialysis.

2. MATERIALS AND METHODS

This study was a comparative study, conducted in the Biochemistry Department at DMMC & SMHRC, Nagpur in collaboration with ABVRH and JNMC Wardha, Sawangi (Meghe) during September 2020 to March 2021. Total 25 patient (End stage renal disease) included for the present study, the age group 30-60 years with 17 male patients and 08 female patients.

2.1 Inclusion Criteria

- End stage renal disease (ESRD)

2.2 Exclusion Criteria

- Heart disorders
- Thyroid disorders
- Illnesses
- Malignancies
- Chronic liver diseases
- Serology positive
- Patient on glucocorticoid therapy and pregnant women were excluded from this study.

2.3 Sample Collection

5 ml Blood sample was collected before and after hemodialysis from each patient by venipuncture with standard blood collection technique in a plain vial for serum separation for the estimation of serum cystatin C and serum creatinine.

2.4 Biochemical Analysis

- Serum creatinine concentration was estimated by Jaff's method.
- Serum Cystatin C concentration was estimated by turbidimetric immunoassay.

2.5 Statistical Analysis

The data were analyzed using SPSS software program, version 20.0. The mean and standard deviation were measured. Analyzed and interpreted using descriptive and inferential statistics. The probability value is less than 0.05 ($p < 0.05$) and it was considered as statistically significant.

3. RESULT

Table 1 show the serum creatinine concentration in the before hemodialysis with 8.72±3.00 and for the after hemodialysis 3.20±1.18 ($P < 0.0001$). The serum cystatin C concentration in the before hemodialysis 5.50±2.09 and for the after hemodialysis 8.7±1.75. ($P < 0.0001$). The result show Table 1 Hemodialysis causes a substantial decrease in serum creatinine levels as compared to before hemodialysis ($P< 0.0001$). The serum cystatin C levels in the post-hemodialysis patient were significantly higher than in the pre-hemodialysis patient ($P <0.0001$).

4. DISCUSSION

CKD is a multi-etiological pathophysiologic process that results in a decrease in nephron number which function, and often leads to end-stage renal disease (ESRD). The glomerular filter normally clears molecules with molecular weights up to 58,000 Dalton (Da), but these solutes are stored in renal failure (ESRD). These retention products are usually divided according to their molecular weight and physiological properties [8-9].

Human cystatin C is primarily catabolized by free filtration in the glomeruli, induced by tubular reabsorption. The plasma renal clearance of cystatin C is 94 percent that of the commonly used glomerular filtration rate (GFR) marker, according to direct studies [10]. Present study Serum creatinine concentration was significantly increased in the before hemodialysis patient and after hemodialysis serum creatinine levels was significantly decreased in compared to the before hemodialysis patient ($P < 0.0001$). N Krishnamurthy, et al. [11] Pre-dialysis serum creatinine concentration ranged from 4.49 to 12.24 mg/dL, with a mean and SD of 7.72 ±2.22 mg/dL, and post-dialysis serum creatinine levels levels ranged from 1.64 to 5.73 mg/dL, with a mean and SD of 2.90 ±1.11 mg/dL. The finding showed post- hemodialysis a significant decrease in mean serum creatinine concentration. Tridip Kutum et al. [12] also show the pre-dialysis group had significantly higher serum creatinine concentration than the control group ($p<0.0001$). With $p<0.0001$, the post-dialysis serum creatinine concentration was significantly lower than the pre-dialysis group. Creatinine is almost entirely formed in the muscle, creatinine excretion is affected by muscle mass; thus, urinary excretion is the most accurate index to identify muscle mass [12-13]. Our Present study the serum cystatin C concentration were significantly increase in the after hemodialysis patient as compared to before hemodialysis ($P < 0.0001$). Lindstrom et al. [14] also observed that low flux hemodialysis did not reduce cystatin C. Their study also showed decrease in cystatin C levels with Hemodiafiltration and hemofiltration (to 28% and 44% respectively) ($p<0.001$) They found that

Table 1. Serum creatinine concentration and serum cystatin C concentration in before and after hemodialysis

	Before Hemodialysis	After Hemodialysis	P value
Serum creatinine concentration (mg/dl)	8.72±3.00	3.20±1.18	P < 0.0001
Serum cystatin C concentration (mg/dl)	5.50±2.09	8.7±1.75	P < 0.0001

cystatin C rebound post hemodialysis leading to a rise in cystatin C level by 12% in hemodiafiltration group. The nature of the dialyzing membrane and the composition of the dialyzing fluid could both contribute to the increase in serum cystatin C concentration after dialysis [15].

When dialysis is done with a low flux membrane, the pore size is less than 1.5 nm, making it impossible to remove low molecular weight proteins like cystatin C. The electrostatic interaction between micro-proteins and other plasma proteins adsorbed onto the dialyzer membranes is another factor to consider. Cystatin C is a strongly cationic molecule, and its charged nature can make it difficult to filter [16]. The effect of hemoconcentration, which occurs during dialysis, may also be to increase in serum cystatin C concentration. Despite these shifts, serum creatinine decreases due to the extent of this metabolite's reduction during dialysis [17-22].

5. CONCLUSION

Hemodialysis adequacy cannot be determined using serum cystatin C. It does, however, serve as a surrogate marker of dialysis inadequacy, particularly when low flux membranes are used. Routine examination of serum cystatin C in hemodialysis patients will help in the monitoring of the patient's over all clinical condition.

ETHICAL APPROVAL

Ethical clearance taken from institutional ethics committee

CONSENT

As per international standard or university standard, patient’s written consent has been collected and preserved by the author(s).

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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