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Original Research Article

Evaluating Levels of Urea, Creatinine and Electrolytes in Patients with Chronic Kidney Failure Pre and Post Dialysis: A Retrospective Analysis

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Abstract

Chronic renal failure is one of the slowest progressive and irreversible diseases of kidney function which is characterized by low glomerular filtration (GRF). Chronic kidney diseases (CKD) is the 17thcause of disability and 12th major cause of death. Dialysis is the artificial way of carrying out removal of toxic metabolic products from blood, when the kidneys are not functioning. Even though there is a dramatic improvement of dialysis technology and pharmacological treatment, mortality rates for dialysis patients are still high. In India within a year approximately 9-13% hemodialysiate patients die. Highest cause of mortality among CKD is sudden cardiac death (SCD), in which death occurs from sudden unexpected cessation of cardiac activity with hemodynamic collapse. Serum creatinine and urea are considered as the most sensitive markers for the detection of the renal failure. In CKD patients one finds both hyperkalemia and hypokalemia which can be due to a decreased kidney function or due to diuretic administration eventhough their impact on mortality and end-stage renal disease (ESRD) is not very well understood. The present study was undertaken to evaluate the pre and post dialysis samples for values of renal biochemical markers like serum urea, creatinine and electrolytes. Total 68 CKD patients were observed. Statistically significant difference was observed between pre and post dialysis blood urea, serum creatinine, sodium and potassium levels. Hemodialysis is an effective and efficient process in removing these undesirable metabolites, helps increase life expectancy.

Keywords: renal failure, cardiac death, glomerular filtration.

INTRODUCTION

In developing countries like India, Chronic kidney disease (CKD) is one of the global public health problems, with a greater burden and a very high cost of care [1]. CKD is the 17thcause of disability and the 12th major cause of death [2]. CKD is one of the slowest progressive and irreversible diseases of kidney function which is characterized by low glomerular filtration (GRF) [3]. It is defined as kidney damage or when glomerular filtration rate is below 60 mL/min per 1.73 m^2 for three months or more, irrespective of any cause. Its symptoms may not be seen until there is severe renal damage and it slowly worsens [4]. There are five stages of Chronic renal failure (CRF) based on the GFR, and dialysis is preferred in stage 5 when GFR is < 15 ml/min/1.73m^2, this stage is also called end stage renal disease (ESRD) [4]. Creatinine levels are raised in CRF indicating a lowered GFR. Kidney dialysis is the artificial way of carrying out the removal of toxic metabolic products and toxic fluids from blood when the kidneys cannot any more do the job properly [3]. The most common type of dialysis used is Hemodialysis. In Hemodialysis blood is pumped out of the patient's body and goes through a dialyzer (an artificial kidney). Hemodialysis is done three to four times a week. Each session lasts for at least 3 to 4 hours [3]. Even though there is a dramatic improvement of dialysis technology and pharmacological treatment, mortality rates for dialysis patients are still high. In India, within a year approximately 9-13% hemodialysiate patients die [5]. There are many biochemical parameters for detection of kidney failure, the most reliable and sensitive markers are serum creatinine and urea [6]. Progression of kidney damage is detected with the rise of these two chemical substances in the blood, which assess the renal function [3]. Urea and creatinine are not toxic but are helpful to measure renal function. Creatinine is produced from muscles and is excreted through the kidneys along with other waste products [3]. Urea is an organic compound and has an important role in the metabolism of nitrogen-containing compounds. Urea is the metabolized product of dietary proteins, the waste product filtered through the kidney into the urine [6].

Highest cause of mortality among CKD is sudden cardiac death (SCD), in which death occurs from a sudden unexpected cessation of cardiac activity with hemodynamic collapse [7]. Hyperkalemia has been suggested as a risk factor for mortality in patients undergoing dialysis patients, which is associated with ventricular arrhythmias and sudden cardiac arrest [8]. In CKD patients one finds both hyperkalemia and hypokalemia which can be due to a decreased kidney function or due to diuretic administration [9], even though their impact on mortality and end-stage renal disease (ESRD) is not very well understood [10]. In this background, the present attempt was focused to evaluate and correlate the values of various biochemical markers like urea, creatinine and electrolytes in blood from pre and post dialysis samples of renal failure patients and to evaluate the effects of dialysis on them.

METHODOLOGY OF STUDY

This retrospective, record based study was conducted to evaluate the effects of dialysis on CRF patients. Approval from the Institutional Ethics Committee was obtained. The study was carried out in the dialysis unit, GMERS Medical College, Dharpur, Patan from January 2014 to March 2019. Data were collected from medical records of the dialysis unit.

Inclusion criteria: CKD patients diagnosed by nephrologists who were on dialysis in the age group of 18 to 70 years consisting of male and female.

Exclusion criteria: Those case records which did not have the relevant data or incomplete data. Pregnant and lactating women.

Sample size: Total of 68 patients were included in the final analysis.

Study tools: Data were collected in case record form (CRF). The CRF comprise of details regarding diagnosis, cause of renal failure, pre and post dialysis serum biochemical marker values.

Statistical Analysis

The data were entered into Microsoft office excel and analyzed by Epiinfo software. Descriptive statistics were reported in the form of mean, standard deviation. Normal distribution of data was checked by Shapiro – Wilk test. Comparison of Pre and Post dialysis serum biochemical markers was done by paired t-test. P-value < 0.05 will be considered as statistically significant.

RESULTS AND DISCUSSIONS

A total of 68 patients who were diagnosed by nephrologists for renal failure were retrospectively studied. Biomarkers such as serum creatinine, serum urea and electrolytes like sodium and potassium levels before and after the hemodialysis session were screened. Demographic data were also analyzed like on the basis of age and gender. Out of the 68 patients on dialysis maximum were male 48 (70.5%) and females 20 (29.5%). Majority of patients 32 (47%) were in the age group 41-60 followed by 21-40 yrs 25 (36.8%) (Table-1) this finding was similar to other studies [4]. Younger patients with CKD experience progressive loss of the kidney, whereas CKD is more prevalent in the elderly population.

Table-1: Distribution of Patients According To Age and Gender

Age (years)	Male	Female	Total no.	%
<20	2	1	3	4.4
21-40	17	8	25	36.8
41-60	21	11	32	47
>60	8	0	8	11.8
Total	48	20	68	100

There was a statistically significant difference observed between pre-dialysis and post-dialysis blood urea levels (Table-2). Serum urea levels above 80 mg/dl was seen in 66 (97.06%) cases while 48cases (70.58%) had ≥ 100mg/dl. Generally, urea accumulation in blood serum of kidney failure patients arises from the degradation of dietary proteins and tissues such as muscle. The high level of urea in blood makes the body very sick unless it's removed from the blood by the kidneys [3]. Urea accumulates leading to azotemia and ultimately uremia. When there is a high concentration in the systemic circulation, it's excreted in sweat and crystallize on the skin, as the sweat evaporates forming "uremia frost" [3].

There was a statistically significant difference observed between pre-dialysis and post-dialysis serum creatinine levels (Table-2). Serum creatinine levels above ≥ 6mg/dl were noted in 51 cases (75%), out of these, 26 (38.23%) cases had ≥ 8mg/dl. CKD initially doesn't show any specific symptoms and generally can be detected by an increase in serum creatinine or protein in the urine, as the kidney function decreases. A rise in serum creatinine from a baseline value of 0.6 mg/dl to 1.2 mg/dl in a patient, which is still in adult normal range, actually represents a loss of 50% of functioning nephron mass. An Increasing level of creatinine in serum may cause itching and damage to nerve endings [3]. Similar results were also observed in different studies [2, 12] showing significantly high serum urea and creatinine levels in CKD patients, suggesting hemodialysis, which helps to decrease in these metabolites in serum and reduces the burden on the kidney. There was a statistically significant

difference observed between pre-dialysis and post-dialysis serum potassium levels (Table-2). Hyperkalemia is usually not seen until the glomerular filtration rate falls less than 20-25ml/min/1.73m^2, at this point kidney has a decreased ability to excrete potassium. Hyperkalemia in CKD can be exaggerated by acidemia which leads to an extracellular shift of potassium and from lack of insulin [13].

Table-2: Mean Values of Serum Parameters in Pre and Post Dialysis Group

Parameters	Pre dialysis (mean value ± SD)	Post dialysis (mean value ± SD)	p value
Serum Urea(mg/dl)	121.32±31.02	32.16±13.33	<0.0001
Serum Creatinine(mg/dl)	7.3±2.27	2.67±0.10	<0.0001
Serum Sodium(mEq/L)	136.57±3.03	138.37±3.08	<0.0001
Serum Potassium(mEq/L)	5.73±1.01	3.72±0.79	<0.0001

There was a statistically significant difference observed between pre-dialysis and post-dialysis serum sodium levels (Table-2). A similar observation was seen in Nisha R *et al.*, studies [3], suggesting hemodialysis as an efficient technique

Yusuf *et al*., [14] concluded in their studies that hyperkalemia was associated with all-cause mortality with serum potassium ≥5.7 mEq/l and risk of mortality increased when values were ≥6.0 mEq/l, suggesting a value which could be more dangerous. In our study, we observed above ≥5.5 mEq/l in 40 cases (58.82%) and even noted values above ≥7 mEq/l in 11 cases (16.17%) but no deaths were recorded. Einhorn *et al*., [13] also stressed the importance of this metabolic disturbance as a threat to patient safety in CKD. In our study Hypokalemia (below 3.5mEq/l) was also found, in 28 cases (41.18%) in post-dialysis. Hypokalemia is associated with higher mortality rates due to a lack of nourishment. However, even after adjusting for nutritional factors such as SGA and BMI, lower serum potassium level was still an independent risk factor for mortality [15]. During dialysis, it is assumed that the serum electrolyte levels approach the concentration of dialysate. Sarif Imran *et al*., [16] in their case study on severe post-dialysis hypokalaemia leading to quadriparesis concluded that the dialysate potassium concentration should be higher than normal; potassium estimation should be frequently done on a patient who has a history of potassium loss. In rapid correction of acidosis in uremic patients undergoing hemodialysis can cause transcompartmental shifts of potassium and life-threatening hypokalemia may occur [16].

Removal of waste during dialysis also depends upon dietary habits of patients, patient awareness, proper timings of dialysis and appropriate dialyzer [12]. According to Nisha R *et al.*, [3], hemodialysis forms an efficient and indispensable process for the removal of undesired metabolites such as creatinine and urea in patients to a quite normal range thereby increasing their life expectancy and suggested urea and creatinine levels to be important biomarkers as a role in diagnosis and follow-up of kidney failure. On the basis of their evidence, Tandukar *et al.*, [17] recommend keeping the potassium levels in CKD patients between 4.0 and 5.0 mmol/L. Elements such as Na+, K+, Ca++, Mg+, Cl-, and H+ must be kept in a rather narrow physiological range, otherwise, life threatening events may occur [4].

CONCLUSION

It can be concluded that a high percentage of urea, creatinine and potassium levels accumulates in blood in patients with kidney damage. Hemodialysis can be an effective and efficient process in removing these undesirable metabolites and increase their life expectancy. Chronic kidney failure is associated with different degrees of abnormality in biochemical parameters especially potassium that needs careful evaluation and management.

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