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Cross-Sectional Comparative Study of Serum Sodium Level in CKD Stage II-III and Stage V.

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Abstract:
This was a prospective cross-sectional study and was distributed in the department of Nephrology of Sir Salimullah Medical College and Mitford Hospital, Dhaka. All patients were included in the period from July 2008 to December 2009. Our aim was to compare serum level in CKD stage II-III and stage V.Eighty (80) CKD stage V patients were taken in group I against 40 cases of CKD stage II and III in group II. There was significant decrease in serum albumin level in the study population. Mean serum sodium level was 137.81 mmol/l in the group I and 142 mmol/l in the group II. It showed a normal sodium level in the CKD stage II-III patients but hyponatremia in the CKD stage V patients. Mean serum potassium level was normal in both the groups. Mean serum bicarbonate level was found to be 20.51 mmol/l in group I which was 23.9 mmol/l in group II patients. It revealed a significant decrease of serum calcium level in the patients with CKD stage V. Mean serum calcium level was 8.57 mg/dl in the CKD stage V versus 10.35 mg/dl in the stage II-III patients. Mean serum phosphate level was significantly increased in the group I. It was 6.26 mg/dl in the group I compared with 3.7 mg/dl in the group II. This study revealed that metabolic abnormalities are more in non-dialytic CKD stage V patients (group I) in comparison with CKD stage II-III patients (group II). The group I patients were more anemic, had a raised diastolic blood pressure, showed greater percentage of hyponatremia, hypoalbuminemia, decreased bicarbonate level, hypocalcaemia and hyperphosphatemia.
Keywords:*Chronic Kidney Disease (CKD), Hyponatremia, Hypoalbuminemia, Serum Sodium Level.*

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I. Introduction

In a developing country with low GDP like Bangladesh there are two major outcomes of chronic kidney disease, namely: loss of kidney function leading to kidney failure or ESRD (End Stage Renal Disease) and development of cardiovascular disease. Cardiovascular disease (CVD) is common in patients with chronic kidney disease regardless of the stage of renal impairment the prevalence and incidence of CVD are much higher in this group then in a sex and age matched control population. Kidney failure or ESRD is the most visible outcome of chronic kidney disease, which is associated with complications in virtually every organ system [1]. Some of the more common secondary problems of kidney failure that significantly contribute to morbidity and mortality can include: anemia, hypertension, nutritional deficits, metabolic acidosis, fluid & electrolyte imbalances, renal bone disease. Anemia is a common complication of CKD, mainly due to the inability of the kidneys to secrete enough erythropoietin to stimulate adequate hematopoiesis. Additional factors that may cause or contribute to CKD-related anemia include iron deficiency, severe hyperparathyroidism, acute and chronic inflammatory conditions, aluminum toxicity, folate deficiency, shortened red blood cell survival, hypothyroidism, and hemoglobinopathies such as ∝-thalassemia [2]. In patients with ESRD, severe anemia is associated with increases in hospitalization, health care costs, and mortality. LVH (Left ventricular hypertrophy)is common finding in patients with CKD, resulting from alterations in left ventricular wall stress caused, at least in part, by hypertension and anemia. It has been shown to progress with the degree of CKD. LVH is a significant risk factor for cardiovascular events independent of blood pressure in hypertensive men, and for cardiac and all-cause mortality in patients who require dialysis or kidney transplant [2]. Eustace 2004 observed the age adjusted prevalence of hypoalbuminemia (serum albumin<3.8 g/dl) at a GFR (Glomerular filtration rate) of 90, 60, 30 and 15 ml/min/1.73m^2. They found prevalence of hypoalbuminemia 19%, 21%, 38% and 59% respectively. Hypoalbuminemia at the stage of ESRD is strongly predicts subsequent hospitalization rates as well as the adjusted annual morality rate. This poor survival rate has persisted despite multiple interventions aimed at the dialysis population, and has recently focused attention on strategies aimed at maintaining the health of patients during the period of progressive kidney dysfunction [3]. Patients with a GFR

less than 60 ml/min/1.73m^2 should be referred to a registered dietitian for nutritional assessment. For those with GFR less than 20 ml/min/1.73m^2 the nutritional assessment should include at least one value from each of the followings: serum albumin, edema free actual body weight, percent standard body weight (NHANES II) or subjective global assessment, and normalized protein nitrogen appearance or dietary interviews and diaries [4]. Metabolic acidosis is noted in the majority of patients with chronic kidney disease (CKD) when glomerular filtration rate (GFR) decreases to less than 20% to 25% of normal. Degree of acidosis approximately correlates with severity of renal failure and usually is more severe at a lower GFR. The metabolic acidosis can be of high-anion-gap variety, although anion gap can be normal or only moderately increased even with stage 4to 5 CKD [5]. In patients with chronic kidney diseases or end-stage renal disease (ESRD), a significant number of endocrine, musculoskeletal, and metabolic abnormalities are believed to result from academia. Metabolic acidosis may be related to PEM and MICS due to and increased protein catabolism, decreased protein synthesis, endocrine abnormalities including insulin resistance, decreased serum leptin level, and inflammation among individuals with renal failure [6]. In ESRD glomerular filtration decreases less than 15ml/min. in this stage the renal tubules also atrophy, which further impedes tubular reabsorption and secretion that keep biochemical and electrolyte constituents of blood within homeostatic levels. This process of slowed glomerular filtration rate (GFR) and tubule atrophy leads to electrolyte and fluid imbalances such as hyperkalemia, hypophosphatemia, hypervolemia; risings levels of blood urea nitrogen and creatinine and metabolic acidosis [7]. Renal bone disease or renal osteodystrophy is a common compaction of chronic kidney disease. Alterations in calcium, phosphorus and parathyroid hormone metabolism are responsible for renal osteodystrophy in CKD, which results in both skeletal and extra-skeletal consequences. Renal bone disease can be determined by non-invasive means, especially by estimating serum calcium, serum phosphate, serum intact parathormone iPTH (Intact parathyroid hormone) and radiology of bones [8].Diastolic pressure was more significantly raised in group I patients than the group II. Serum albumin level showed hypoalbuminemia in patients with CKD stage V.

II. Objectives

a) General objective:

- To assess the comparison of serum sodium level in CKD stage II-III and stage V.

b) Specific Objectives:

- To see the common clinical and biochemical profiles in the CKD stage II-III patients.
- To compare the common clinical and biochemical profiles between the two groups.

III. Methodology And Materials

This was a prospective cross-sectional study. This study was carried out on patients with chronic kidney disease (CKD) stage II, III and V who attended the out-patient department and was admitted, transferred or referred to nephrology department of Sir Salimullah Medical College and Mitford Hospital, Dhaka from July 2008 to December 2009. Data were collected by using a pre-designed questionnaire, examination and investigations. 80 cases of CKD stage V patients were taken in a group I against 40 cases of CKD stage II and III in group II.

a) inclusion criteria

- Any CKD patients having eGFR<15m1/min
- Not receiving any form of renal replacement therapy
- Age 18-65 years

b) exclusion criteria

- Patients with CKD stage II and III
- Patients who have history of any systemic illness other than CKD before diagnosed with CKD.

IV. Results

In this study a total number of ESRD patients as group I and 40 patients CKD stage II and stage III as group II were included. Blood hemoglobin (Hb) edema systolic and diastolic blood pressure, serum albumin, serum sodium, serum potassium, serum bicarbonate, serum calcium and serum phosphate were estimated in the both groups. (Table I) serum sodium (Na) was estimated in the group one patients as well as in the group II see disorders of sodium. Mean serum sodium was 137.81 mmol/l in the group I who were patients with ESRD. CKD stage II and III patients were the group II who showed mean serum level of sodium of 142.02 mmol/l. sodium level was normal in the group II but was lower in the group I. (Table II) Regarding serum potassium (K) level both groups revealed a normal level. Mean serum K level was 4.87 mmol/l in ESRD group and 5.27 mmol/l in the CKD t=stage II and III. (Table III) As a marker of metabolic acidosis serum bicarbonate (HCO_3) was estimated in mmol/l. though the level serum bicarbonate was just below the lower limit in the patients of group II, it was lesser in the group I. in the group I it was 20.51 mmol/l and in the group II it was 23.92 mmol/l.

(Table IV) Regarding serum calcium level control population of CKD stage II and III showed a normal mean serum level. But patients with ESRD showed the lower range of serum calcium. Mean serum level in group I was 8.57 mg/dl and group II was 10.35 mg/dl. (Table V) serum phosphate level was observed in the both groups in mg/dl. Statistical analysis revealed a highly significant increase serum level of phosphate in the group I this level was 6.26 mg/dl in the group I and 3.7 mg/dl in the group II. Group II had a normal level of serum phosphate but group I had hypophosphatemia.

TableI: Cross table showing the serum level of Na in group I and group II. (n=120)

	Group	N	Mean	P value
Na (mmol/l	I	80	137.8125	.0009 [S]
	II	40	142.025	

The result was highly significant and P value was 0.0009.

Table II: Cross table showing serum potassium level in the group I and group II.(n=120)

Serum potassium (mmol/l)	Group	N	Mean	P value
	II	40	4.8759	0.56 [NS]
	I	80	5.2775	

There was significant difference between the two groups P value was 0.56.

Figure I: Chart showing the mean level of serum K level in group I and group II. (n=120)

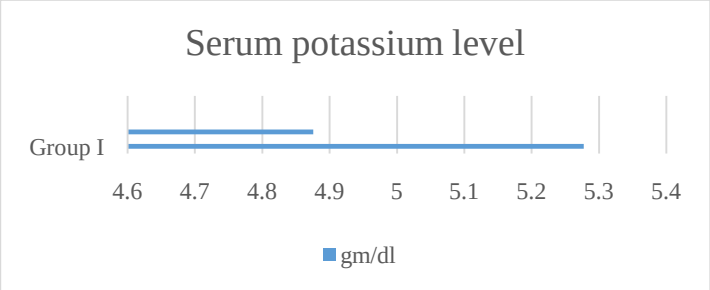

Table III: Cross table showing serum bicarbonate in the group I and group II. (n=120)

Serum bicarbonate (mmol/l)	Group	N	Mean	P value
	II	40	20.5125	.0001 [S]
	I	80	23.925	

Serum bicarbonate level was significantly decreases in the group I than the group II. P value was 0.0001

Table IV: Cross table showing the serum calcium level in the group I and group II. (n=120)

Serum calcium (mg/dl)	Group	N	Mean	P value
	II	40	8.5713	0.016 [S]
	I	80	14.355	

Statistical analysis rebuilds a significant decrease of serum calcium level in the group I than group II. P value was 0.016.

Table V: Cross table showing serum phosphate level in group I and group II. (n=120)

Serum Phosphate (mg/dl)	Group	N	Mean	P value
	I	80	6.2663	.0001 [S]
	II	40	3.705	

Regarding significant, P value was 0.0001.

V. Discussion

This study was a cross sectional study which was carried out among 80 patients of CKD stage V (ESRD) who were not on dialysis as group I. Forty patients with CKD stage II and III were taken as group II. All the patients were collected from in patient department and out-patient department of Sir Salimullah Medical College Hospital and Mitford Hospital, Dhaka. In a cross sectional study McClellan et al had shown mean hemoglobin level in deferent stages of CKD. According to that study mean Hb level in CKD stage I- II, CKD stage III and CKD stage V were 12.4±1.6, 12.0±1.6 and 10.9±1.6 g/dl, respectively [9]. In this study mean hemoglobin level of the group I, non-dialectic patients CKD stage V was 8.327 g/dl and it was 10.933 g/dl in the group II, patients of CKD stage II and III. Both the groups of this study had shown more decreased level of Hb in comparison to the cited study. Edema was observed in the group I who were non-dialytic patients with CKD stage V and in the group II who were the patient with CKD stage II and III. A study in 1999 done by Obrador et al. reveled a mean serum albumin level of 3.3 g/dl in the pre-dialysis patient where 60% were in a hypoalbuminic state. This study showed that among the patients of group I, 46.3% had edema and 53.8% were edema free. On the other hand, the group II showed edema in 15% cases. In comparison to group II, the group I reveled a higher percentage of presence of edema. Regarding systolic blood pressure there were no significant differences between the two groups. A mean systolic blood pressure of 145.625 mmHg was showed in the group I. It was only 2mmHg less in the group II, comprised with patients with CKD stage II and III. Significance test (Chi-square test) also showed a p-value of 0.6, which was meant to be non-significant. It was recommended to control the systolic blood pressure within 130 mmHg in patients with CKD [10]. But this study revealed a mean increase of systolic blood pressure about 15 mmHg in group I and 13 mmHg in the group II. On the other hand, mean diastolic blood pressure showed a significant increase in the group I patients. Group I showed a mean diastolic pressure of 87.81 mmHg and which was 82.77 mmHg in the group II. National kidney foundation recommended a diastolic pressure up to 75 mmHg. In the patients with ESRD it was about 12 mmHg higher though in the group II it was about 7 mmHg higher. The difference of this blood pressure was significant statistically, where p-value was 0.013. As a marker of malnutrition serum albumin was seen in both the group I and II. Eustace et al [3] in 2004 found that the age-adjusted prevalence of hypoalbuminemia at a GFR of 60, 30, 15 ml/min/1.73m^2 was 21%, 38%and 59%. They had found mean serum albumin in CKD stage II 4.17 g/dl, in CKD stage III 4.02 g/dl and in CKD stage V 3.83 g/dl. Patients with ESRD who comprised the group I in our study showed a mean serum level of albumin 2.816 g/dl which was less than the cited study. Mean serum albumin level in the group II was 5.2 g/dl who the patients with CKD stage II and III, statistical analysis were also revealed a highly significant result were P value was 0.001. As a consequence of hypoalbuminemia this study also revealed a more percentage of edema in the group I than the group II. Serum calcium levels were estimated in mg/dl in both the groups. Narula et al. in their review article described the high turnover disease as the pre dominant bone lesion were hypocalcaemia and hypophosphatemia are a common finding, starting early in CKD and progress with deterioration of the disease [8] the mean serum calcium level in this study was 8.57 mg/dl in the group I, patients with ESRD. It was 10.35 mg/dl u=in the group II. Though the mean calcium level was in the lower range of the normal value, it was significantly decreased in the group I in comparison with the group II. Statistical analysis with chi-square test this decreased level of serum bicarbonate in the group I reveled a highly significant result where P value was 0.0001. In a study 2007[11] Horl revealed that iron deficiency can easily be corrected by intravenous iron administration, which is more effective than oral iron supplementation, at least in adult patient's chronic kidney disease (CKD). The integration of recombinant human erythropoietin and intravenous (i.v.) iron therapy into standard anemia management protocols dramatically increases measures of hematocrit and hemoglobin and reduced the need for red blood cell transfusions. I/V iron has been proven to improve patient's response to EPO therapy replacing patients ongoing iron losses [12]. To compare serum level in CKD stage II-III and stage V.

LIMITATIONS OF THE STUDY

This was a cross sectional prospective study with small sample size, which can't reflect the scenarios of the whole country.

VI. Conclusion

This was a cross sectional study and was conducted in Sir Salimullah Medical College and Mitford Hospital, Dhaka. Eighty (80) patients diagnosed with ESRD without any renal replacement therapy as group I 40 patients diagnosed with CKD stage II and III as group II. Common clinical and biochemical profiles of renal failure namely anemia, edema, systolic and diastolic hypertension, malnutrition by serum albumin, electrolyte imbalance i.e. hypernatremia, hyperkalemia, metabolic acidosis by serum bicarbonate, hypocalcaemia and hypophosphatemia were observed in both groups. Anemia was more severe in the group I, though both the groups were anemic. Edema was present in a comparatively higher percentage in the patients of group I than group II. Mean systolic blood pressure was increased in both the groups than the KDOQI recommendations.

Mean diastolic blood pressure was about 5 mmHg higher in the group I than group II. Hypoalbuminemia was found in the group I and was about half of that in the group II. Mean serum sodium was decreased in the group I in comparison with the group II. Serum potassium level was normal in both the groups, but in a higher range in group I. Metabolic acidosis indicated by serum by carbonate level was found in group I were it was normal in the group II. Regarding mean serum calcium level, group I revealed a lower normal range where group II had about 2 mg/dl higher value. Hypophosphatemia was present in group II but was normal in the group II. From this study we could observe that the clinical and biochemical profiles related to kidney failure were present in more severe form in the patients with non-dialytic CKD stage V patients then the earlier stages (stage II and III) of CKD patients.

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