Original Research Article

Prospective Study of Metabolic and Electrolyte Disturbances in Patients with Chronic Kidney Disease

Rohit Rawat[1], Sushma Trikha[2], Althesnie SS[3], Neelima Singh[4]

[1]Junior resident 3rd year Department of Medicine, Gajra Raja Medical College, Gwalior, Madhya Pradesh, India
[2]Professor, Department of Medicine, Gajra Raja Medical College, Gwalior, Madhya Pradesh, India
[3]Junior resident 3rd year Department of Medicine, Gajra Raja Medical College, Gwalior, Madhya Pradesh, India
[4]Associate Professor, Department of Medicine, Gajra Raja Medical College, Gwalior, Madhya Pradesh, India

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Abstract

Background: Kidneys play a critical role in regulating body fluids, electrolytes and acid base balance. CKD can lead to metabolic as well as electrolyte disturbances that can result in serious adverse outcomes. **Aim & Objective:** To study metabolic and electrolyte disturbances in CKD patients and its correlation with GFR. **Materials and Method:** 100 patients of CKD were studied. Detailed clinical history and physical examination were done as per pre-fixed Performa. Relevant hematological, biochemical, radiological investigations were done for assessing renal function. Staging of CKD was done with GFR. **Results:** Mean age of study participants was 43 years out of them 70% were males. All the study participants were anemic out of them 28% severely, 51% moderately and 20% mildly anemic. Majority of study participants belonged to G5 category of GFR. Among electrolytes only serum sodium was found significantly associated with GFR (p value- o.oo2). Among metabolic parameters low triglyceride levels was significantly associated with GFR (p value-0.009). **Conclusion:** CKD patients are more prone to develop metabolic as well as electrolyte disturbances. Hence, every CKD patient should be screened for any such disturbances. Although studies on this regard is still lacking and we need further study for better understanding and management, as early screening can defer early morbidity and mortality. Therefore, serum electrolyte as well as metabolic disturbances to be included as one of the first line investigations in patients with chronic kidney disease.

Keywords: Chronic kidney disease, metabolic disturbance, electrolyte disturbance

Introduction

Chronic kidney disease is a substantial public health burden associated with high morbidity and mortality.

The estimated global prevalence of CKD is 13.4% (11.7-15.1%)[1], and that of India is 17.2%[2]. KDIGO defines CKD by the presence of kidney damage or decreased kidney function for three or more months, irrespective of the cause.

Kidney damage refers to pathologic abnormalities, established either by kidney biopsy or by imaging studies or inferred from markers such as urinary sediment abnormalities or increased rate of urinary albumin excretion[3].

Decreased kidney function refers to a decreased glomerular filtration rate, which is usually estimated using serum creatinine and one of several available equations. Kidneys play a critical role in regulating body fluid, electrolytes, and acid-base balance

Electrolyte disturbances are frequently observed in patients with CKD both in treated and untreated cases.

CKD leads to electrolyte as well as acid base imbalance, resulting in serious adverse outcomes such as bone mineral disorders, vascular calcification, and even mortality[4,5].

Hyperkalaemia is more common with the progression of CKD and is one of life-threatening electrolyte disorders in CKD patients, with a nearly 10-fold risk of death in stages 4 and 5.

Materials and Methods:

Study Design: Prospective study

Source of Data: Department of General Medicine, G.R. Medical College, Gwalior (M.P.) from Jan 2021 - Jun 2022.

Sample Size: The sample size was calculated using the formula

$$n = \frac{Z^2_{\alpha/2} \times PQ}{D^2}$$

The calculated sample size was 100 patients.

Study Population: The study included 100patients with symptoms and signs of chronic kidney disease who were admitted to the medicine ward of JAH and KRH. The *INCLUSION CRITERIA* were patients over 18 years of age with chronic kidney disease. The *EXCLUSION CRITERIA* were Age <18 years, Patient in stage 1-2 of CKD, Patients who refused to give informed written consent., DM type 2 on DKA, sepsis.

Data Collection: In all cases written informed consent will be obtained from each subject. A detailed clinical history and physical examination will be done and findings will be recorded. All the patients in the study will be subjected to biochemical tests like, CBC, renal function tests, lipid profile, ABG analysis and ultrasonographic examination of abdomen to confirm the presence of end stage renal disease.

Due permission of Ethics committee was taken regarding the study participants and all ethical practices were followed.

Statistical Analysis: All data were entered into an Excel format and analyzed using SPSS Software. Numerical values were reported using mean and standard deviation or median. Categorical values were reported using number and percentages. A probability value (p) less than 0.05 was considered statistically significant.

*Correspondence
Rohit Rawat
Junior resident 3rd year Department of Medicine, Gajra Raja Medical College, Gwalior, Madhya Pradesh, India
E-mail: rohit.rawat0567@gmail.com

Results

The observations and results show the demographic profile, biochemical parameters, gfr and its correlation with chronic kidney disease.

In terms of the demographic profile, the study included 100 participants, out of which 20-29 and 30-39 year age group had equal (21%) participants and similarly 40-49 and 50-59 year age group had almost equal participants in the study. Mean age of study participants was 43 years.

The biochemical parameters of cases were also studied, 100% of study participants were anemic out of them 28% were severely anemic, 51% moderately anemic and 20% were mildly anemic. Serum urea and creatinine level was raised in all participants. 52% of study participants were having hyponatremia and hyperkalemia was found in 59% of study participants. Hypocalcemia was found in 37% of study participants. Total Cholesterol was found raised in only 15% of study participants however other lipid profile variable were found deteriorated in majority of participants like triglycerides (66%), HDL (94%), LDL (100%) and VLDL (100%).

Metabolic acidosis was found in 51% of CKD patients. Metabolic and respiratory alkalosis were found 10% and 24% respectively. Mixed metabolic respiratory acidosis and alkalosis was found 8% and 7% respectively.

No significant association or trend with age was found in the study with GFR

GFR and genders was not found associated Majority of laboratory indicators were not showing any association except serum sodium where hyponatremia was found significantly higher in G4 category

Similar to other laboratory findings lipid profile was not found associated with GFR categories except triglycerides where triglycerides level was found significantly higher in G4 category. ABG interpretation and GFR categories were not associated or showing any trend with ABG interpretation.

Table 1: Age wise distribution of study participants

Age Group	Frequency	Percent
<20 year	5	5.0
20-29 year	21	21.0
30-39 year	21	21.0
40-49 year	15	15.0
50-59 year	16	16.0
60-60 year	12	12.0
≥70 year	10	10.0
Age (Mean± SD)	43.09±17.05	
Total	100	100%

Table 2: Association between blood investigation and GFR Category

Investigation		GFR Category				P Value
		G3a	G3b	G4	G5	
		N (%)	N (%)	N (%)	N (%)	
Hemoglobin	<7 gm	0 (0%)	0 (0%)	2 (50%)	26 (28.3%)	0.699
	7-10 gm	0 (0%)	2 (66.7%)	1 (25%)	47 (51.1%)	
	10-13 gm	1 (100%)	1 (33.3%)	1 (25%)	21 (19.6%)	
	>13 gm	0 (0%)	0 (0%)	0 (0%)	1 (1.1%)	
Blood Urea	<20 mg%	0 (0%)	0 (0%)	0 (0%)	0 (0%)	NA
	20-45 mg%	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
	>45mg%	1 (100%)	3 (100%)	4 (100%)	92 (100%)	
Serum Creatinine	<0.6 mg%	0 (0%)	0 (0%)	0 (0%)	1 (1.1%)	NA
	0.6-1.4 mg%	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
	>1.4mg%	1 (100%)	3 (100%)	4 (100%)	92 (100%)	
Serum Sodium	<136 mg%	0 (0%)	1 (33.3%)	3 (75%)	48 (52.2%)	0.002
	136-142 mg%	0 (0%)	1 (33.3%)	1 (25%)	40 (43.5%)	
	>142mg%	1 (100%)	1 (33.3%)	0 (0%)	4 (4.3%)	
Serum Potassium	<3.6 mg%	0 (0%)	0 (0%)	0 (0%)	7 (7.6%)	0.818
	3.6-5.0 mg%	0 (0%)	2 (66.7%)	2 (50%)	30 (32.6%)	
	>5.0mg%	1 (100%)	1 (33.3%)	2 (50%)	55 (59.8%)	
Serum Calcium	<09mg%	1 (100%)	1 (33.3%)	1 (25%)	27 (29.3%)	0.850
	9-11 mg%	0 (0%)	2 (66.7%)	3 (75%)	62 (67.4%)	
	>11mg%	0 (0%)	0 (0%)	0 (0%)	3 (3.3%)	

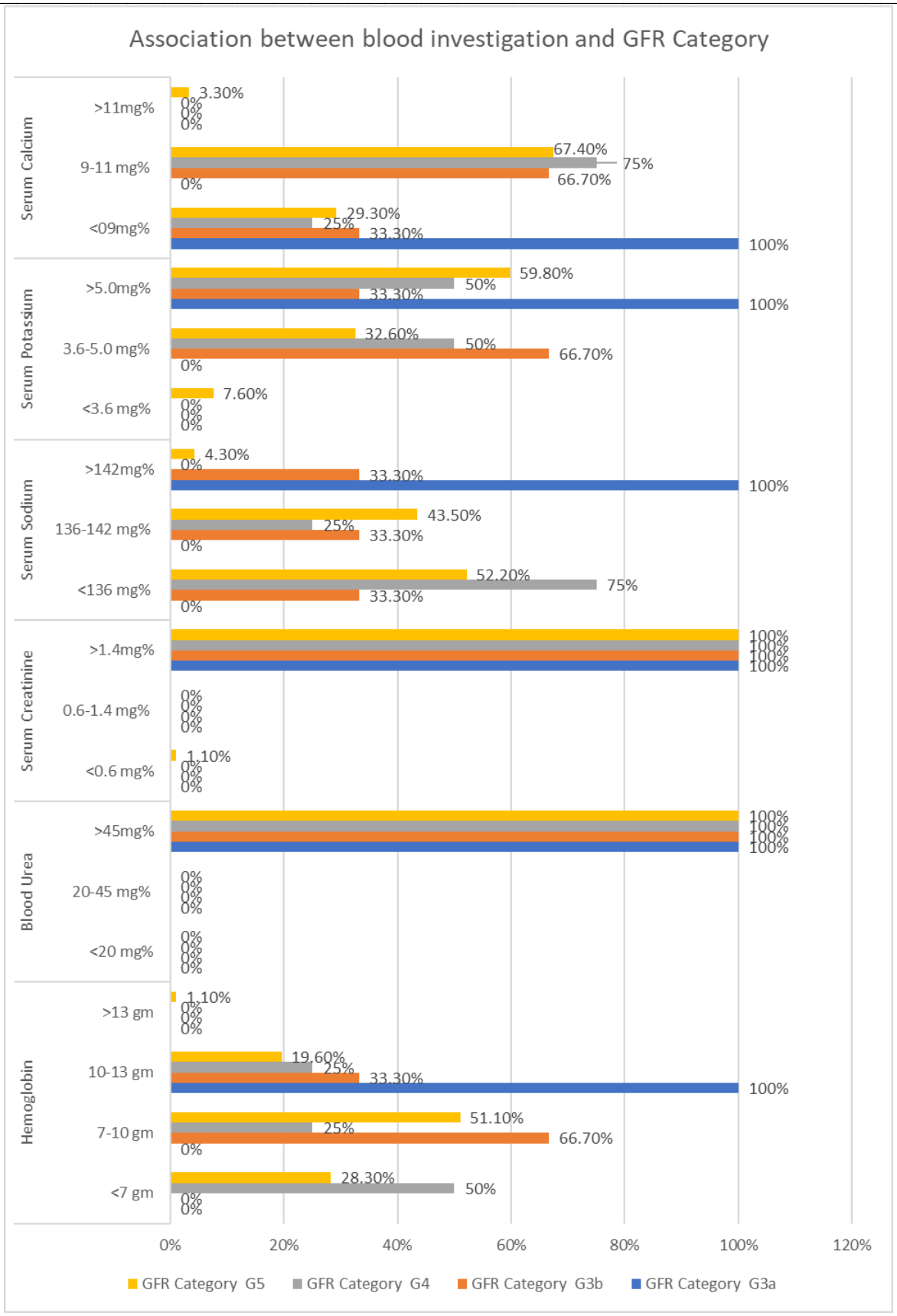
Association between blood investigation and GFR Category
Serum Calcium
>11mg%
9-11 mg%
<09mg%
Serum Potassium
>5.0mg%
3.6-5.0 mg%
<3.6 mg%
Serum Sodium
>142mg%
136-142 mg%
<136 mg%
Serum Creatinine
>1.4mg%
0.6-1.4 mg%
<0.6 mg%
Blood Urea
>45mg%
20-45 mg%
<20 mg%
Hemoglobin
>13 gm
10-13 gm
7-10 gm
<7 gm
3.30%
67.40%
75%
66.70%
29.30%
25%
33.30%
100%
59.80%
50%
32.60%
7.60%
4.30%
43.50%
52.20%
1.10%
19.60%
51.10%
28.30%
0%
20%
40%
60%
80%
100%
120%
GFR Category G5
GFR Category G4
GFR Category G3b
GFR Category G3a

Table 3: Association between Lipid Profile and GFR Category

Investigation		GFR Category				P Value
		G3a	G3b	G4	G5	
		N (%)	N (%)	N (%)	N (%)	
Total Cholesterol	<200 mg/dl	1 (100%)	3 (100%)	4 (100%)	78 (84.8%)	0.702
	≥200 mg/dl	0 (0%)	0 (0%)	0 (0%)	14 (15.2%)	
Triglyceride	<150 mg/dl	1 (100%)	3 (100%)	3 (75%)	27 (29.3%)	0.009
	≥150 mg/dl	0 (0%)	0 (0%)	1 (25%)	65 (70.7%)	
HDL	>40 mg/dl	0 (0%)	0 (0%)	1 (25%)	5 (5.4%)	0.412
	≤40 mg/dl	1 (100%)	3 (100%)	3 (75%)	87 (94.6%)	
LDL	<30 mg/dl	0 (0%)	0 (0%)	0 (0%)	0 (0%)	NA
	≥30 mg/dl	1 (100%)	3 (100%)	4 (100%)	92 (100%)	
VLDL	<130 mg/dl	0 (0%)	0 (0%)	0 (0%)	0 (0%)	NA
	≥130 mg/dl	1 (100%)	3 (100%)	4 (100%)	92 (100%)	

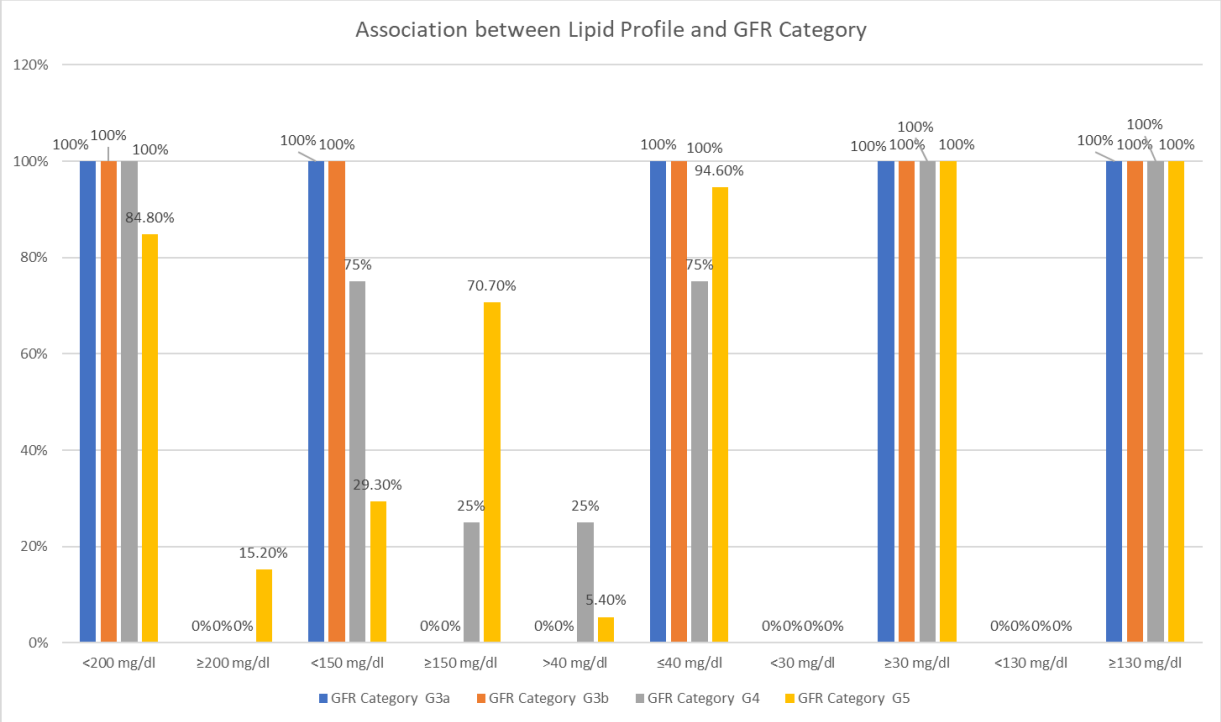

Table 4: Association between ABG interpretation and GFR Category

ABG interpretation	GFR Category				P Value
	G3a	G3b	G4	G5	
	N (%)	N (%)	N (%)	N (%)	
M. Acidosis	1 (100%)	1 (33.3%)	3 (75%)	46 (50%)	0.844
M. Alkalosis	0 (0%)	0 (0%)	1 (25%)	9 (9.8%)	
R. Alkalosis	0 (0%)	2 (66.7%)	0 (0%)	22 (23.9%)	
Mixed MR Acidosis	0 (0%)	0 (0%)	0 (0%)	8 (8.7%)	
Mixed MR Alkalosis	0 (0%)	0 (0%)	0 (0%)	7 (7.6%)	

Discussion

In our study association between serum electrolyte and GFR were analysed which showed hyponatremia was predominantly (52%) seen with decreasing GFR comparable with the results by Soraya Arzhan *et al*[6]

Hyponatremia was found statistically significant with decreasing GFR (p value-0.002).

In our study 59% participants had hyperkalemia[7] but was not found statistically significant with the decreasing GFR (p value-0.818).

Lipid profile was deranged in all the study participants showing its significance in CKD patients.

However only triglyceride levels increased with decreasing GFR and was statistically significant (p value-0.009) consistent with the study by Zdzislaw Kochan *et al*[8]

Acid base disturbances was seen in all patients.

Metabolic acidosis was more frequently (51%)[9] seen in CKD patients but does not showed any significant statistical association (p value-0.844).

Conclusion: Declining GFR can have various impact on metabolic as well as electrolyte levels in CKD patients. Hyponatremia showed a significant association with decreasing GFR. Lipid profile was not found to be associated with GFR however deranged. Metabolic acidosis was predominantly seen with decreasing GFR, however statistically significant association could not be found. CKD patients

are more prone to develop metabolic as well as electrolyte disturbances. Hence, every CKD patient should be screened for any such disturbances

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