

Frequency of Hyperkalemia and It's Correlation with eGFR in Patients with Chronic Kidney Disease

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Abstract

Original Research Article

Background: Hyperkalemia is a potential threat to patient safety in chronic kidney disease¹. It is a common feature of chronic renal insufficiency. The most serious effect of hyperkalemia is cardiotoxicity which may lead to death. Patients with CKD may predispose to hyperkalemia for a variety of reasons. This study was done to see the frequency of hyperkalemia and its correlation with eGFR in CKD patients. **Methods:** This cross sectional study was conducted in Dhaka Medical College & Hospital, Dhaka over a period of six months. The patients of chronic kidney disease who were admitted in Medicine, Nephrology and Cardiology departments of this hospital were included in this study. A semi-structured proforma was prepared for this study purpose containing patient's profile, list of all the relevant symptoms, signs with the results of laboratory tests. **Result:** Among study population of 100, 64% were male and 36% were female giving a male to female ratio of 1:0.56. Among study population 25% had hyperkalemia; 17% had mild to moderate hyperkalemia with S.K 5.5-6.9 mmol/l; 8% had severe hyperkalemia with S.K ≥ 7 mmol/l. Among 25 hyperkalemic patients 68% had S.K+ level between 5.5-6.9 mmol/l; 16% belonged CKD Stage -IV and 52% belonged CKD Stage-V. 10% of study population had typical ECG changes of hyperkalemia; 20% had Stage-IV CKD and 80% had Stage-V CKD. In Stage-V CKD one patient had ventricular tachycardia and another one had second degree AV block in ECG. **Conclusion:** The prevalence of CKD is increasing rapidly in our country. Late stages (stage 4 or 5) of CKD may be associated with a variety of metabolic disturbances. One such disturbance hyperkalemia is of great concern because of its possible life threatening complications. Frequency of hyperkalemia is increased with progressive decline of eGFR.

Keywords: Chronic kidney disease (CKD), Estimated Glomerular Filtration Rate (eGFR), Hyperkalemia.

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INTRODUCTION

Hyperkalemia is a potential threat to patient safety in chronic kidney disease [1]. Normal serum potassium levels are between 3.5 and 5.5 mmol/L [2]. At least 95% of the body's potassium is found inside cells, with the remainder in the blood. Potassium helps nerve and muscle cells, including the heart function properly. Kidneys usually maintain the level of potassium in the blood, but if there is kidney disease, the most common cause of hyperkalemia, potassium level can build up. Chronic Kidney Disease (CKD) is a common disease affecting a growing number of people [3] and refers to an irreversible deterioration in renal function which classically develops over a period of years [4]. CKD is associated with morbidity and

mortality risks far broader and higher than those of simple progression to kidney failure. Early detection of CKD and its metabolic complications is now a priority for delaying disease progression and for primary prevention of many CKD-associated chronic diseases, including cardiovascular, mineral and bone diseases [5-7]. CKD may be associated with a variety of electrolyte disturbances especially in late stages (stage 4 or 5). One such disturbance, hyperkalemia, is of great concern because of its possible implications for patient safety related to the potential for associated adverse cardiac outcomes [8-10]. Principal causes include an impaired glomerular filtration rate (GFR) combined with a frequently high dietary potassium intake relative to residual renal function, a commonly observed extracellular shift of potassium caused by metabolic

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acidosis of renal failure and most importantly, recommended treatment with renin-angiotensin-aldosterone (RAAS) blockers that inhibit renal potassium excretion. Patients with hyperkalemia may present with weakness, flaccid paralysis, hypoventilation (if respiratory muscles are involved) and the most serious one is cardiac arrest. Hyperkalemia is a common medical emergency [11]. The most serious effect of hyperkalemia is cardiotoxicity which may lead to death. This is why it is extremely important to evaluate hyperkalemia in CKD patients. In Bangladesh a good number of patients with CKD admitted into different hospitals with hyperkalemia. This study was conducted to see the frequency of hyperkalemia and its correlation with e GFR in CKD patients.

METHODS

This cross-sectional study was conducted in the department of Medicine, Nephrology and Cardiology of Dhaka Medical College, Dhaka, during the period of January 2013 to June 2013. We studied 100 CKD patients more than 18 years of age irrespective of sex and known case of CKD (evident by past medical records). Patients below 18 years of age and unwilling to give informed consent were excluded from the study. A semi structured questionnaire was used for collection of data by interviewing patients. Detailed history was taken and all patients were examined thoroughly. After collection of all informations, data were checked, verified for consistency and edited for final result. After editing and coding, the coded data were directly entered into the computer by using PC software. Data cleaning validation and analysis was performed using the PC software and graph and chart by MS excel. The result was presented in tables, figures and percentages.

RESULTS

Among study population of 100, 64% were male and 36% were female giving a male to female ratio of 1:0.56. Majority, 42% were in the age group of 49-58 year (Table-1). 45% of patients had GN, 35% had DM, 12% had HTN and 8% of patients had other causes of CKD (Fig 01). eGFR of the study population calculated by Modification of Diet in Renal Disease (MDRD) study equation. 55% patients had e GFR <15

ml/min/1.73m² (CKD stage V), 35% had e GFR between 15-29ml/min/1.73m² (CKD Stage-IV) and 10% had e GFR between 30-59 ml/min/1.73m² (CKD Stage-III) (Table-2). Among study population 100, 25% had hyperkalemia; 17% had mild to moderate hyperkalemia with S.K 5.5-6.9 mmol/l; 8% had severe hyperkalemia with S.K >=7 mmol/l (Table-3). Among 25 hyperkalemic patients, 68% had S.K+ level between 5.5-6.9 mmol/l; 16% belonged CKD Stage -IV and 52% belonged CKD Stage-V (Table-4). 10% of study population had typical ECG changes of hyperkalemia; 20% had Stage-IV CKD and 80% had Stage-V CKD (Table 05). In Stage-V CKD, one patient had ventricular tachycardia and another one had second degree AV block in EC

Table-1: Age distribution among study population (n=100)

Age in year	No. of pt	Percentage
18-28	5	5%
29-38	11	11%
39-48	25	25%
49-58	42	42%
59-68	17	17%

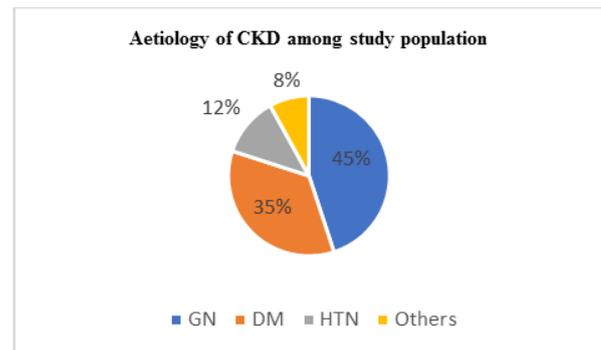


Fig-1: Aetiology of CKD among study population

Table-2: e GFR findings in study population (n=100)

e GFR(ml/min/1.73 m ²)	No. of pt	Percentage (%)
≥90	0	0
60-89	0	0
30-59	10	10
15-29	35	35
<15	55	55

Table-3: Frequency of Hyperkalemia among study population

S. K ⁺ level (mmol/l)	No. of patient	Percentage (%)
5.5-6.9(mild to moderate hyperkalemia)	17	17
≥7 mmol/l (severe hyperkalemia)	8	8

Table-4: Correlation of Hyperkalemia with e GFR

e GFR (ml/min/1.73m ²)	S.K ⁺ (mmol/l)	No. of pt (n=25)	Percentage (%)
≥90 (CKD S-I)	5.5-6.90	0	0
	≥7	0	0
60-89 (CKD S-II)	5.5-6.90	0	0
	≥7	0	0
30-59 (CKD-S-III)	5.5-6.90	0	0
	≥7	0	0
15-29 (CKD-S-IV)	5.5-6.90	4	16
	≥7	0	0
<15 (CKD-S-V)	5.5-6.90	13	52
	≥7	8	32

Table-5: ECG changes of Hyperkalemia

Stage of CKD	ECG changes of Hyperkalemia	No. of pt (n=10)	Percentage
S-IV(e GFR 15-29ml/min)	Present	2	20%
S-V (e GFR <15ml/min)	Present (including one VT and one second degree AV block)	8	80%

DISCUSSION

This was a hospital based study done to see the frequency of hyperkalemia in CKD patients and its correlation with e GFR. 100 patients of CKD were included in this study. 60% were male and 40% were female with male to female ratio 1:0.56 which was nearly equal to sex distribution in CKD patients in a study done by Saha *et al.*, [11]. Majority of the patients were in the age group of 49-58yr. Glomerulonephritis was the most common (45%) cause of CKD. 35% had Diabetes mellitus, 12% had Hypertension and 8% had other causes of CKD. A study done by Sheikh Salauddin *et al.*, [12] published in KYMC journal in Jan, 2013 also showed Glomerulonephritis as the most common cause of CKD in our country which is consistent with my study. Most of the study population had S. creatinine level between 1.5-10 mg/dl (57%), all (100%) patients had proteinuria, S.K⁺ level was >5.5 mmol/l in 25% patients, kidney size was reduced in 75% patients on USG of W/A. 55% of our study population had eGFR <15ml/min/1.73m² (Stage-V CKD), 35% had eGFR between 15-29 ml/min/1.73m² (Stage-IV CKD), 10% had eGFR between 30-59ml/min/1.73m² (Stage -III CKD). Hyperkalemia i.e. S.K⁺>5.5mmol/l was observed in 25 patients in our study. 21 patients belonged to Stage-V CKD and 4 patients belonged to Stage-IV CKD. Several studies also showed frequency of hyperkalemia was increased with progressive decline in eGFR in patients with CKD [1, 13]. Among 25 hyperkalemic patients in this study 17 had mild to moderate hyperkalemia (S.K⁺ level between 5.5-6.9 mmol/l); 4 patients had Stage-IV CKD and 13 patients had Stage-V CKD. Remaining 8 patients had severe hyperkalemia (S.K⁺ level >7 mmol/l) and belonged to Stage-V CKD. ECG changes of hyperkalemia were observed in 10 patients; 2 patients had Stage-IV CKD and 8 patients had Stage-V CKD. In CKD Stage-V, 1 patient developed ventricular tachycardia and another one developed second degree AV block. A cohort study

was done by Olivier Moranne *et al.*, [14] where 1038 patients having Stage-II to Stage-V CKD were observed to see the occurrence of metabolic complications. In their study 176(17%) patients had hyperkalemia. In my study hyperkalemia was observed in 25% patients which is nearly consistent with this study. Hyperkalemia is a potential threat to patient safety in chronic kidney disease. A study was done by Lisa M. Einhorn *et al.*, [15] to determine the incidence of hyperkalemia in CKD. This retrospective analysis of a national cohort comprised of 2,103,422 records from 245,808 veterans with at least one hospitalization and at least one inpatient or outpatient serum potassium record during fiscal year 2005. Hyperkalemic events were documented in 3.2% of the records (n=66259) which is not consistent with my study. A cross sectional study was done by Ming-Fang Hseih *et al.*, [16] to observe the serum K⁺ level in patients of the late stages of CKD (Stages III to V). A total 531 patients with late stage of CKD were included and followed up for at least 1 year. The serum creatinine, eGFR and serum electrolytes levels were recorded at least twice during the study. The average K⁺ level increased along with renal function deterioration in the late stages of CKD (stage 3: 4.36±0.49; stage 4: 4.50±0.55; stage 5: 4.69±0.73 mEq/L, p<0.05). They noticed that there was a linear increase in the standard deviation of the serum K⁺ level as renal function deteriorated. In our study higher K⁺ level was also observed in late stages of CKD which is consistent with this study.

LIMITATIONS OF THE STUDY

Study has several limitations. The sample size was small. Study period was short so proper evaluation of the patients was not possible. Pseudohyperkalemia could not be ruled out. This present study highlighted frequency of hyperkalemia in CKD patients. As no such study was done earlier in our country, it should be done in future again. Research should also be done to

determine risk factors that increase the risk of hyperkalemia in association with decline of e GFR in CKD patients.

CONCLUSION AND RECOMMENDATIONS

The prevalence of CKD is increasing rapidly in our country. Most of the patients of CKD present in advanced stage. Late stages CKD may be associated with a variety of metabolic disturbances. One such hyperkalemia is of great concern because of its possible life threatening complications. Frequency of hyperkalemia is increased with progressive decline of eGFR. As several factors may contribute to hyperkalemia like diet, medications, uncontrolled diabetes, these should be evaluated well in CKD patients.

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