Original Article

Frequency of Hyperkalaemia in Non-Dialysis Dependent Chronic Kidney Disease (CKD) Patients

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ABSTRACT

Objective: To examine the prevalence of hyperkalaemia and its relationship with various demographic and clinical variables among non-dialysis dependent chronic kidney disease (CKD) patients.

Study Design: A cross-sectional study.

Place and Duration of Study: This study was conducted at the Nephrology Unit of Khyber Teaching Hospital, Peshawar, from September 6, 2020, to March 5, 2021.

Materials and Methods: The study evaluated 150 diagnosed non-dialysis dependent CKD patients aged between 20 to 60 years. Demographic information, duration of CKD, and other relevant clinical data were recorded. Serum potassium levels were obtained, and renal function was quantified using the MDRD-4 equation. Serum K level >5 mmol/L was considered hyperkalaemia. Statistical analyses, Mean ± SD, univariate and multivariate logistic regression were produced using latest version 21 SPSS.

Results: Patients mean age was 39 ± 11.2 years, with 53.3% being male 46.7% female. The mean duration of CKD was 10.2 ± 7.2 months, and 60% of patients had been diagnosed with CKD for less than 1 year. Hyperkalaemia was observed in 45.3% of the patients. Significant associations were found between hyperkalaemia and factors such as CKD duration ($p < 0.05$), CKD staging ($p < 0.05$), and BMI >25 kg/m² ($p < 0.05$).Log odds of hyperkalemia increased by 1.9598 as patients were moving from Stage 1-2 to Stage 3-4.

Conclusion: This study features the high prevalence of hyperkalaemia in non-dialysis dependent CKD patients and its associations with CKD Stages, duration, and demographic characteristics. These findings emphasize the seriousness of surveying and managing serum potassium levels in these patient population to prevent potential life-threatening complications.

Key Words: Hyperkalaemia, Chronic kidney disease, Nephrology, Prevalence

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INTRODUCTION

Potassium is predominant ion found in body fluid, with about 98% of its levels located inside cell at a concentration of 140-150 mmol/L, and only 2% outside the cell, that is3.5-5.0 mmol/L[1,2].

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The proportion of potassium inside to outside the cellis a major factor of the resting membrane potential and plays vital role in regulation of cellular excitability, and to generates a transmembrane potential, cardiac conduction, neuromuscular function, cellular metabolism, and maintaining acid-base equilibrium. If the serum level of K is more than 5.0 mmol/Lit will be stated as hyperkalaemia[3]. Constant level of extracellular potassium is maintained by certain homeostatic mechanisms[4] among those,kidney maintains optimal level of potassium in body by secreting it through the proximal collecting duct and distal convoluted tubule[5].

Hyperkalemia stands as a significant metabolic complication due to its potential to induce electrophysiological abnormalities that can have severe clinical consequences, even leading to death[6]. Among all population hyperkalemia is infrequent that is, 4 cases per 100 person-years, although it is a quiet common complication in individuals having chronic kidney disease (CKD), with (eGFR) is <60

ml/min/1.73m^2 [3]. Patients with chronic kidney disease who are non-haemodialysis-dependent are at the risk of developing life-threatening cardiovascular complications, including arrhythmias, sudden cardiac arrest[7]. The presence of hyperkalaemia varies in CKD patients, ranging from 2% to 35%, depending on the glomerular filtration rate (eGFR)[8]. There is a relationship between decreased eGFR in CKD and risk of hyperkalaemia[9]. As eGFR gets down from 60 to20 ml/min/1.73m^2, prevalence of hyperkalaemia abruptly increased from 7% to 42% with an overall frequency of 17%[11]. In individual with eGFR less than 59 ml/min/1.73m2, for every 5 ml/min/1.73m^2 drop in eGFR, risk of hyperkalaemia raised by26%[9]. CKD stage wise prevalence of hyperkalaemia is 20.7% in Stage III, 42.1% in Stage IV and 56.6% in Stage V.[3] The occurrence of hyperkalaemia exhibits a gradual rise, starting at 13% in Stage II CKD and progressively increasing to 34% in Stage IV CKD, which is almost a three-time increase.[12].

Renal failure and certain medications usage are recognized considerable risk factors for the prevalence of hyperkalaemia in hospital setup.[6] In patients with reduced renal function, pathophysiology of hyperkalaemia is, metabolic acidosis-induced movement of intracellular potassium across the cells membrane to ECF, resulting in elevated levels of potassium in the bloodstream. Diabetes, heart failure (HF), and the utilization of renin-angiotensin-aldosterone system antagonists (RAAS i) are additional significant risk factors for hyperkalaemia[6]. While renin-angiotensin-aldosterone system antagonists (RAAS i) have demonstrated effectiveness to slowdown the progress of chronic kidney disease, but risk of hyperkalaemia is associated with its use.[13,14] At serum K level >6.0 mmol/L risk of mortality within one day, increase to 30-fold[14] mostly due to ventricular arrhythmia and sudden death.[15] Non-dialysis CKD patients who experienced an episode of hyperkalaemia had an elevated risk of complications related to cardiac arrest and arrhythmia.[16]

The need of this study was to find the frequency of hyperkalaemia in CKD patients who were not on dialysis, evaluate the factors influencing hyperkalaemia, and compare the clinical and demographic characteristics among hyperkalaemic and normokalaemic groups.

MATERIALS AND METHODS

Cross-sectional observational study on Non-Dialysis dependent CKD Patients at Nephrology Unit, Khyber Teaching Hospital, Peshawar was conducted from September 6, 2020, to March 5, 2021. By using Sample size calculation formula,150 patients were included in the study with diagnosed non-dialysis dependent CKD for > 3 months, both male and female patients aged between 20 to 60 years. Demographic information along with detailed history assessment, including the duration of CKD, were recorded using a pre-designed Proforma. Serum K levels and pertinent laboratory results were achieved from laboratory archives. All laboratory investigations were performed by a single experienced biochemist following standardized protocols. Renal function was evaluated by MDRD-4 equation.(19). CKD stages were defined as follows KDIGO guidelines(20) CKD stage I is eGFR more or equal to 90 ml/min/1.73 m² with findings of kidney injury lasting >3 months; CKD stage II is eGFR between 60 and 89 ml/min/1.73 m² with findings of kidney injury; CKD Stage (IIIa) is eGFR in between 45 and 59 ml/min/1.73 m²; CKD Stage (IIIb) is eGFR between 30 and 44 ml/min/1.73 m²; CKD stage IV is eGFR in between 15 and 29 ml/min/1.73 m²; and CKD stage V is eGFR that is less than 15 ml/min/1.73 m². Serum K more than 5 mmol/L was considered Hyperkalaemia.To ensure data accuracy confounders and biases were controlled by strictly adhering to the exclusion criteria, through which we excluded who had a history of potassium supplementation in the past three weeks, those undergoing chemotherapy and Hemodialysis in past.

Statistical analysis was done for continuous variables in the form of mean ± 1 standard deviation (SD),and Student's t-test was used for any associations. For categorical variables frequencies (n) and percentages (%) were used. Furthermore, logistic regression both univariateand multivariate analyses were carried out to evaluate the correlation of Hyperkalaemia with various clinical and demographic findings such age, CKD stages, duration of CKD, gender and BMI groups. $P<0.05$ was our statistically significant limit. For statistical analysis version 21 of the Statistical Package for Social Sciences (SPSS Inc., Chicago, Ill., USA) was used.

RESULTS

Total 150 patients were assessed. In terms of gender distribution, male were 53.3% while female were 46.7%.Mean age was 39 ± 11.2 years among the participants, 56% fell into 20-40 years age group, while 44% were between 40-60 years age group. The mean body mass index (BMI) was 23 ± 3.1. Additionally, 67.3% of the individuals had a BMI <25 kg/m², while 32.6% had a BMI greater than 25 kg/m².

The mean duration of CKD was found to be 10.2 ± 7.2 months with 60% of patients had been diagnosed with CKD for less than 1 year, whereas 40% for more than 1 year. In terms of CKD staging, 40% of the patients were classified as being in stage 1 or 2, while 60% were in stage 3 or 4.

The mean serum potassium level was 4.7 ± 5.2 mg/dl. 45.3% of the patients were hyperkalaemic.

There was a considerable association between hyperkalaemia and certain variables. Patients with CKD for more than 1 year showed a higher prevalence of

hyperkalaemia (p value < 0.05). Similarly, stage 3 and 4 CKD was more associated with hyperkalaemia(p value < 0.05). In term of binary univariate logistic model, the estimated coefficient (β1) associated with Stage 3-4 (X2) was approximately 1.9598. This indicates that moving from Stage 1-2 to Stage 3-4 increases the log odds of hyperkalaemia by 1.9598.There was also a considerable association between hyperkalaemia and body mass index greater than 25kg/m^2(p value < 0.05).

Results for these stratifications can be found in Tables No. 1.

Table No. 1: Clinical and demographic attributes of Hyperkalemic and Normokalemic CKD patients

Parameter	Hyperkalaemic group (N = 68)	Normokalaemic group (N= 82)	P value
Age group years n (%) 20-40 years 40 – 60 years	 40 (47.6%) 28 (39.3%)	 44 (52.4%) 38 (60.7%)	 0.52
Gender n (%) Male Female	 39 (48,7%) 29 (41.4%)	 41 (51.3%) 41 (58.6%)	 0.10
BMI group n (%) <25 kg/m2 >25 kg/m2	 40 (39.6%) 28 (57.1%)	 61 (60.4%) 21 (42.9%)	 < 0.043
CKD stages n (%) Stage 1-2 Stage 2-4	 23 (27%) 45 (69.2%)	 62 (73%) 20 (30.8%)	 <0.001
Duration of CKD n (%) < 12 months > 12 months	 22 (24.4%) 46 (76.6%)	 68 (75.6%) 14 (23.4%)	 < 0.001

N.B**Bold**values are considered significant.

DISCUSSION

In our study, we observed that around 45.3% of patients exhibited hyperkalaemia. This finding aligns closely with the results of a Denmark cohort study, where hyperkalaemia (K more than 5.0 mmol/L) was detected in approximately 43% of individuals with CKD.[16]

This study revealed a significant correlation between chronic kidney disease (CKD) stages and the occurrence of hyperkalaemia. Particularly, hyper-kalaemia found to be more prevalent in stages 3-4 of CKD (p < 0.001), it went up from 10% in stage 1-2 to a staggering 85% in stage 2-4. For instance, a large cohort study comprising nearly 70,000 individuals, CKD stage wise prevalence of hyperkalaemia was around 20% in stage III, 42% in stage IV and 56% in stage V, in other words, 11 time increase in CKD stage 5 as compared to normal individuals.[3] Another study demonstrated a considerable link of declining glomerular filtration rate (GFR) in CKD with risk of hyperkalaemia[9]. One study shows, if estimated GFR (eGFR) reduce by 5 ml/min/1.73 m^2, risk of hyperkalaemia went up by 26%.[9,10]. In another study there was 10 time increase in prevalence of hyperkalaemia when eGFR fell from 60-90 ml/min/1.73 m^2 to 20-30 ml/min/1.73 m^{2}range.[11]

In this study, patients with BMI >25kg/m^2 the risk of hyperkalaemia was high (p value < 0.05). A study conducted in England examine the link between body mass index (BMI) and stages of CKD, the study found that patient shaving BMIs of 25-30 kg/m^2 and 30-35 kg/m^2 had a 34% and 94% higher risk respectively of CKD stages 4-5.[19]

The development of hyperkalaemia is frequently associated with demographic factors such as age and gender. Among these, gender act as independent risk factor, as mentioned in several studies, with males being more prone to developing hyperkalaemia[20,21].

In a study involving large number patients examined the prevalence of hyperkalemia CKD, 14.0% males and 7.3% females were hyperkalaemic.[3] In our study, we found that, among all hyperkalaemic patients, the proportion of male and female were,48% and 41% respectively. However, in terms of gender our findings did not demonstrate statistical significance.

Age has been identified as another demographic factor related with the occurrence of hyperkalaemia. In a study it was noted that the prevalence of hyperkalaemia was nearly doubled in patients aged 65 and above, compared to those under of 65 years, even when controlling for similar comorbidities.[22]

However, in our study, we could not find considerable difference between age groups and hyperkalaemia. Nevertheless, we did note that the proportion of patients with hyperkalaemia in the younger age group (20-40 years) was 47.6% compared to 39.3% in the 40-60 years age group. These findings align with another study that also found an opposite association between age and hyperkalaemia. Specifically, they reported an odds ratio of 0.969 (95% CI: 0.951-0.987, p = 0.001), indicating a decrease in the likelihood of hyperkalaemia with increasing age.

CONCLUSION

This study features the high prevalence of hyperkalaemia in non-dialysis dependent CKD patients and its associations with CKD Stages, duration, and demographic characteristics. These findings emphasize the seriousness of surveying and managing serum

potassium levels in these patient population to prevent potential life-threatening complications.

Author's Contribution:

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Conflict of Interest: The study has no conflict of interest to declare by any author.

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