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Assessment of Metabolic Complications of Chronic Kidney Disease

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Abstract

Background: The aim is to assess metabolic complications of chronic kidney disease. **Subjects and Methods:** One hundred five patients with CKD of either gender was included. Glomerular filteration rate (GFR) between 15 and 60 mL/ min per 1.73 m2 was indicative of CKD. The estimation of calcium, phosphate, bicarbonate, potassium, urea etc. was performed. **Results:** Out of 105 patients, males constitute 60 (57.1%) and females 45 (42.9%). Age group 45-55 years had 18, 55-65 years had 37 and 65-75 years had 50 patients. The difference was significant (P< 0.05). The mean±SD value of hemoglobin in age group 45-55 years was 13.0±4.1 gm/dl, in age group 55-65 years was 12.5±3.8 gm/dl and in age group 65-75 years was 11.5±7.6 gm/dl. The mean potassium level was 4.5±1.2 mEq/L, 4.2±1.1 mEq/L and 4.1±1.0 mEq/L. The mean phosphorus level was 3.7±2.3 mg/dL, 3.6±2.2 mg/dL and 3.5±1.7 mg/dL and the mean bicarbonate level was 28.6±5.7 mEq/L, 27.5±4.3 mEq/L and 26.4±6.9 mEq/L in age group 45-55 years, 55-65 years and 65-75 years respectively. **Conclusion:** Metabolic complications are common in patients with chronic kidney disease.

Keywords: Chronic kidney disease, hemoglobin, potassium.

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Introduction

Chronic kidney disease (CKD) is a precursor to end-stage kidney disease and is linked with an increased risk of mortality.[1] In last decades, the prevalence of chronic kidney disease (CKD) has increased considerably and is estimated to range from about 10-15% of the elderly population.[1] Chronic kidney disease is characterized by progressive deterioration of kidney function, which develops eventually into a terminal stage of chronic kidney failure. Chronic kidney failure has traditionally been categorized as mild, moderate, or severe. Other poorly defined terms like uremia and end-stage renal disease have commonly been applied.[2]

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. CKD metabolic complications include anemia, metabolic acidosis, and mineral and electrolyte disorders.[3]

Metabolic acidosis is a further important factor that markedly contributes to negative nitrogen and total body protein balance in patients with chronic kidney failure. It has been demonstrated that the presence of uremic malnutrition increases mortality and morbidity in chronic dialysis patients.[4] Renal anemia, which is often associated with fatigue and cognitive and sexual dysfunction, has a significant impact on the quality of life of patients with chronic kidney failure. Anemia has been identified as an important etiologic factor in the development of left ventricular hypertrophy, an independent risk factor for heart failure and a predictor of mortality in hemodialysis patients.[5] Considering this, we selected present study to assess metabolic complications of chronic kidney disease.

Subjects and Methods

After considering the utility of the study and obtaining approval from ethical review committee of the institute, we selected one hundred five patients with CKD of either gender. The age range was 45-75 years.

Demographic data of each patient was recorded. General physical examination was carried out. Glomerular filteration rate (GFR) between 15 and 60 mL/ min per 1.73 m2 was indicative of CKD. Anemia was defined as a hemoglobin level less than 10 g/dL. Hyperkalemia was defined as a potassium level greater than 5.5 mEq/L. Acidosis was defined as a serum bicarbonate level less than 21 mEq/L and hyperphosphatemia as a phosphorus level greater than 4.6 mg/dL, according to the KDOQI clinical practice guidelines for nutrition and bone metabolism and disease. 5 ml venous blood was obtained and was centrifuged at 3000 rpm for 10 minutes for the separation of serum and plasma respectively. The estimation of calcium, phosphate, bicarbonate, potassium, urea etc. was performed. The results were compiled and subjected for statistical analysis using Mann Whitney U test. P value less than 0.05 was set significant.

Results

Out of 105 patients, males constitute 60 (57.1%) and females 45 (42.9%) [Table 1].

Age group 45-55 years had 18, 55-65 years had 37 and 65-75 years had 50 patients. The difference was significant (P< 0.05) [Table 2, Figure 1].

The mean±SD value of hemoglobin in age group 45-55 years was 13.0±4.1 gm/dl, in age group 55-65 years was 12.5±3.8 gm/dl and in age group 65-75 years was 11.5±7.6 gm/dl. The mean potassium level was 4.5±1.2 mEq/L, 4.2±1.1 mEq/L and 4.1±1.0 mEq/L. The mean phosphorus level was 3.7±2.3 mg/dL, 3.6±2.2 mg/dL and 3.5±1.7 mg/dL and the mean bicarbonate level was 28.6±5.7 mEq/L, 27.5±4.3 mEq/L and 26.4±6.9 mEq/L in age group 45-55 years, 55-65 years and 65-75 years respectively [Table 3].

Table 1: Gender wise patient distribution

Total- 105		
Gender	**Male**	**Female**
Number (%)	60 (57.1%)	45 (42.9%)

Table 2: Age wise patient distribution

Age group (years)	Number	P value
45-55	18	0.051
55-65	37	
65-75	50	

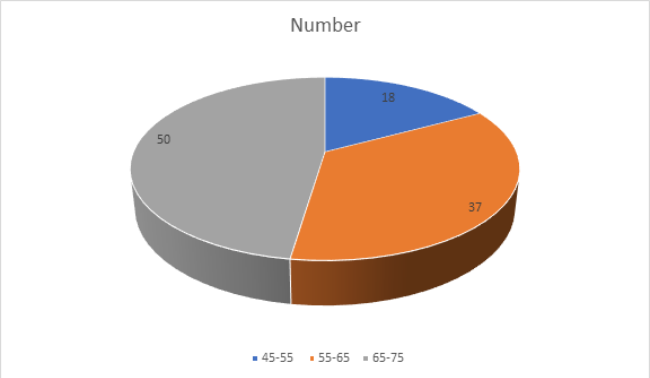

Figure 1: Age wise patient distribution

Table 3: Laboratories values based on age group

Parameters	45-55	55-65	65-75	P value
Hemoglobin (gm/dl)	13.0±4.1	12.5±3.8	11.5±7.6	0.04
Potassium, mEq/L	4.5±1.2	4.2±1.1	4.1±1.0	0.91
Phosphorus, mg/dL	3.7±2.3	3.6±2.2	3.5±1.7	0.82
Bicarbonate, mEq/L	28.6±5.7	27.5±4.3	26.4±6.9	0.76

Discussion

The major cause of renal anemia in patients with chronic kidney disease is an inadequate production of the glycoprotein hormone erythropoietin because of a reduction in functional kidney parenchyma.[6] Furthermore, free radicals elicited from leucocytes by their contact with the dialysis membrane cause hemolysis with consecutive anemia in patients on extracorporeal renal replacement therapy.[7] There are a number of other metabolic derangements associated with uremia that can affect the production and survival of red blood cells (e.g., uremic toxins, parathormone, protein malnutrition).[8] The most important factor which is responsible for the development of secondary hyperparathyroidism is a deficit of active vitamin D (calcitriol).[9] Diseased kidneys cannot sufficiently hydroxylate 25-hydroxycholecalciferol, which is a precursor of calcitriol (1,25- dihydroxycholecalciferol). The deficit of calcitriol causes an inadequate absorption of calcium in the small intestine, with resulting hypocalcemia.[10] The present study assessed metabolic complications of chronic kidney disease.

Our results showed that out of 105 patients, males constitute 60 (57.1%) and females 45 (42.9%). Drawz et al,[11] evaluated whether elderly adults with a low glomerular filtration rate (GFR) are at risk for anemia, hyperkalemia, acidosis, and hyperphosphatemia. The average GFR of participants was 46.5 mL/min per 1.73m^2, 3.1% had anemia, 2.5% hyperkalemia, 2.3% acidosis, and 4.4% had hyperphosphatemia. Lower GFR was associated with higher rates of metabolic complications across all age groups (odds ratio per 5-mL/min per 1.73 m2 decrease in GFR in multivariable models was 1.21 for anemia, 1.26 for hyperkalemia, 1.45 for acidosis, and 1.72 for hyperphosphatemia). There was no significant interaction between age and GFR in models including only age and GFR or in multivariable models (P-values for age by GFR interaction term: 0.66 for anemia, 0.19 for hyperkalemia, 0.54 for acidosis, and 0.22 for hyperphosphatemia).

Our results showed that age group 45-55 years had 18, 55-65 years had 37 and 65-75 years had 50 patients. Moranne et al,[12] studied the occurrence of metabolic complications. As mGFR decreased from 60 to 90 to <20 ml/min per 1.73 m^2, the prevalence of hyperparathyroidism increased from 17 to 85%, anemia from 8 to 41%, hyperphosphatemia from 1 to 30%, metabolic acidosis from 2 to 39%, and hyperkalemia from 2 to 42%. Factors most strongly associated with metabolic complications, independent of mGFR, were younger age for acidosis and hyperphosphatemia, presence of diabetes for acidosis, diabetic kidney disease for anemia, and both male gender and the use of inhibitors of the renin-angiotensin system for hyperkalemia. mGFR thresholds for detecting complications with 90% sensitivity were 50, 44, 40, 39, and 37 ml/min per 1.73 m^2 for hyperparathyroidism, anemia, acidosis, hyperkalemia, and hyperphosphatemia, respectively. Analysis using estimated GFR produced similar results. In summary, this study describes the onset of CKD-related complications at different levels of GFR; anemia and hyperparathyroidism occur earlier than acidosis, hyperkalemia, and hyperphosphatemia.

We found that mean±SD value of hemoglobin in age group 45-55 years was 13.0±4.1 gm/dl, in age group 55-65 years was 12.5±3.8 gm/dl and in age group 65-75 years was 11.5±7.6 gm/dl. The mean potassium level was 4.5±1.2 mEq/L, 4.2±1.1 mEq/L and 4.1±1.0 mEq/L. The mean

phosphorus level was 3.7±2.3 mg/dL, 3.6±2.2 mg/dL and 3.5±1.7 mg/dL and the mean bicarbonate level was 28.6±5.7 mEq/L, 27.5±4.3 mEq/L and 26.4±6.9 mEq/L in age group 45-55 years, 55-65 years and 65-75 years respectively. Gjorup et al,[13] found that of the total 229 study participants, 50.2% were females and the mean age was 47±15.7 years. Among study participants, the prevalence of chronic kidney disease (CKD) was found to be 21.8%. Of all study participants, 9 (3.9%) had renal impairment (eGFR < 60 ml/min/ 1.73 m^2) and 46 (20.1%) had albuminuria. Older age, systolic blood pressure ≥140mmHg, type 2 diabetes mellitus and longer duration of diabetes were independent risk factors of CKD.

Conclusion

Metabolic complications are common in patients with chronic kidney disease.

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