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Original research article

A case-control study to evaluate the various biochemical renal parameters in chronic renal failure

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Abstract

Aim: The aim of the present study to evaluate the minerals, urea, and creatinine in chronic renal failure.

Methods: A case-control study was conducted in the Department of Biochemistry, Vardhman Institute of Medical Sciences (VIMS), Pawapuri , Nalanda, Bihar, India and dr.Siingh Diagnostic ,Nawada,Bihar, for 1 year, A total of 80 patients in the age group of 25-65 years were included in this study. 40 patients were taken as a control group (Group A) and 40 clinically diagnosed cases of chronic renal failure patients based on the creatinine value > 7.0 mg/dl as cases (Group B). The parameters RBS, creatinine, urea, sodium, potassium, magnesium phosphorous, iron and calcium was analyzed by Automated Analyzer.

Results: The age of the patients was 25-65 years. Comparison between the controls and cases (CRF) of RBS, creatinine, urea, sodium, potassium, magnesium phosphorous, iron and calcium parameters have shown a statistically significant difference in all the parameters, p-value <0.05. A comparison of CRF subjects based on gender in persons undergoing dialysis has shown no statistically significant difference in all the parameters, p-value > 0.05 Comparison of groups RBS, creatinine, urea, sodium, potassium, magnesium, phosphorus, iron and calcium parameters in CRF with hypertension versus CRF with both hypertension and DM cases have shown statistically no significant difference in all the parameters, p-value > 0.05.We observed increase in the levels of serum calcium mean value 8.14±0.53 (mg/dl) and decrease in serum potassium mean value 4.71±0.77 (mEq/L), in male CRF subjects compared with female CRF subjects and has shown no statistical significance. we observed elevated serum creatinine 10.9±4.42 (mg/dl) in CRF patients with hypertension compared with CRF subjects with both hypertension and DM serum creatinine 9.88 ± 4.43 (mg/dl) and have shown no statistical significance.

Conclusion: The elevated serum phosphate, magnesium and decreased serum calcium, iron are concerning with CRF. Serum phosphorous, magnesium, serum calcium and iron play important role in renal profile.

Keywords: Minerals, CRF, RBS

Introduction

Renal failure refers to a condition where the kidneys lose their normal functionality, which may be due to various factors including infections, auto immune diseases, diabetes and other endocrine disorders, cancer, and toxic chemicals. It is characterized by the reduction in the

excretory and regulatory functions of the kidney; it is the ninth leading cause of death in United States as well as most industrialized nation throughout the world.[1,2] Chronic kidney disease (CKD) affects an estimated 27 million adults in the United States and is associated with increased mortality, morbidity, and health care costs.[3,4] CKD is also associated with significantly increased risks of cardiovascular disease[5] and stroke.[6] The incidence and prevalence of CKD among U.S. adults have increased dramatically since 1991.[7] More than 500,000 Americans were treated for end-stage renal disease in 2007.[8] The increases are partly explained by the increasing prevalence of diabetes mellitus and hypertension, the leading risk factors for CKD. Awareness of CKD among patients has modestly increased in recent years, but remains low. According to the 2003-2004 National Health and Nutrition Examination Survey, less than 5 percent of patients with stage 1 or 2 CKD and less than 10 percent with stage 3 reported having been diagnosed with CKD; only 45 percent of patients with stage 4 were aware of their condition.[9] Although clinical laboratories report estimated glomerular filtration rate (GFR) directly to physicians, CKD recognition remains low.[10] In 2002, the National Kidney Foundation's Kidney Disease Outcomes Quality Initiative published practice guidelines to help primary care physicians identify patients with early CKD and improve health outcomes.[11] CKD is defined by the presence of structural or functional abnormalities of the kidney with or without an accompanying reduction in GFR. Persons with CKD may have one or more of the following: pathologic abnormalities, markers of kidney damage (i.e., imaging abnormalities and abnormalities in serum or urine, including proteinuria and abnormal urinary sediment), or GFR less than 60 mL per minute per 1.73 m2 for at least three months. If the duration of the abnormality is unknown, the possibility of acute kidney injury should be considered and appropriate evaluation performed for reversible causes. Most persons who have received kidney transplants are considered to have CKD.
Throughout the progression of this disease, several changes occur in the organism, such as disorders of calcium and phosphorus metabolism, development of secondary renal hyperparathyroidism (SRHP), and increases in serum fibroblast growth factor 23 (FGF-23), oxidative stress and inflammation.[12] There is consensus that use of renal diets is essential for decreasing the progression rate of CKD and improving the survival of affected animals.[13]

Material and methods

A case-control study was conducted in the Department of Biochemistry, Vardhman Institute of medical sciences (VIMS), Pawapuri , Nalanda, Bihar, India, and dr.Siingh Diagnostic ,Nawada,Bihar,for 1 year

Methodology

After taking informed consent detailed history was taken from the patient or the relatives if the patient was not in good condition. The technique, risks, benefits, results and associated complications of the procedure were discussed with all patients. A total of 80 patients in the age group of 25-65 years were included in this study. 40 patients were taken as a control group (Group A) and 40 clinically diagnosed cases of chronic renal failure patients based on the creatinine value > 7.0 mg/dl as cases (Group B).[14] From the subjects, 5ml of venous blood was drawn and allowed to stand for 30 minutes, then centrifuged at 3000 RPM for ten minutes andsamples were analyzed.
The parameters RBS, creatinine, urea, sodium, potassium, magnesium phosphorous, iron and calcium was analyzed by Automated Chemistry Analyzer. RBS was analyzed by Hexokinase method**,** Creatinine was analyzed by Jaffe's method**,** Urea was analyzed by GLDH method, Sodium, Potassium was analyzed by ISE Direct method, Magnesium was analyzed by Xylidyl blue method, Phosphorous was analyzed by Molybdate UV method, Iron was analyzed by TPTZ method and Calcium was analyzed by Arsenazo method. Hypertensive

patients, diabetes mellitus patients, and chronic renal failure patients were involved in the study. Persons who came to our hospital outpatient department for health check-up are the healthy controls and were involved in the study. Patients with thyroid disorders, liver disorders, cardiac patients and patients who have undergone dialysis were excluded. Data analysis was done using the Z test. p-value < 0.05 was defined as significant.

Results

The age of the patients was 25-65 years. Comparison between the controls and cases (CRF) of RBS, creatinine, urea, sodium, potassium, magnesium phosphorous, iron and calcium parameters have shown a statistically significant difference in all the parameters, p-value < 0.05 (Table 1). A comparison of CRF subjects based on gender in persons undergoing dialysis has shown no statistically significant difference in all the parameters, p-value > 0.05 (Table 2).

Comparison of groups RBS, creatinine, urea, sodium, potassium, magnesium, phosphorus, iron and calcium parameters in CRF with hypertension versus CRF with both hypertension and DM cases have shown statistically no significant difference in all the parameters, p-value > 0.05 (Table 3). The RBS, creatinine, urea, magnesium, phosphorous and potassium levels were significantly increased ($p<0.05$) in Group B compared with Group A. The levels of calcium, iron and sodium were decreased significantly ($p < 0.05$) in Group B compared with Group A. The RBS, magnesium, calcium, phosphorous, iron, and potassium were decreased in CRF patients with hypertension compared with CRF subjects with both hypertension and DM. Creatinine, urea and sodium were increased in CRF patients with hypertension compared with CRF subjects with both hypertension and DM and have shown no statistical significance, p-value > 0.05

Table 1: Comparison of biochemical variables between the controls and cases

Parameters	**Group A**	**Group B**
	Mean ± SD	**Mean ± SD**
RBS (mg/dl)	85.5 ± 6.6	135.9 + 72.21
Creatinine (mg/dl)	0.61 ± 0.11	10.87 ±4.77
Urea (mg/dl)	31.9± 5.42	192.1 ± 71.77
Magnesium (mg/dl)	2.4± 0.18	3.12 ± 1.11
Calcium (mg/dl)	9.6 ± 0.52	7.63 ± 0.40
Phosphorous (mg/dl)	2.6 ± 0.21	6.70 ± 2.52
Iron (µ g/dL)	126.3 ± 29.09	43.53 ± 15.28
Sodium (mEq/L)	140.9 ± 2.7	133.13 ± 6.75
Potassium (mEq/L)	4.2 ± 0.31	4.79 ± 0.84

Table 2: Comparison of biochemical variables in CRF subjects based on gender

Parameters	**Females (16)**	**Males (24)**	
	Mean ± SD	**Mean ± SD**	P value >0.5
AGE	45.7± 11.3	52.9 ± 11.86	NS
RBS(mg/dl)	159.3 ± 111.13	122.87± 0.62	NS
Creatinine(mg/dl)	13.1 ± 4.77	11.1 ± 4.73	NS
Urea(mg/dl)	195.9 ± 71.12	185.2± 72.17	NS
Magnesium(mg/dl)	2.69 ± 0.22	3.21 ± 1.7	NS
Calcium(mg/dl)	7.63 ± 0.88	8.14 ± 0.53	NS
Phosphorous (mg/dl)	7.62 ± 3.12	6.45 ± 2.35	NS
Iron(µg/dL)	41.95 ± 17.69	47.57± 13.63	NS

Sodium(mEq/L)	135.7 ± 8.12	130.7 ± 5.59	NS
Potassium(mEq/L)	4.87 ± 0.66	4.71 ± 0.77	NS

Table 3: Comparison of biochemical variables in CRF patients with Hypertension and both Hypertension and DM cases

Parameters	**CRF with HTN(18)**	**CRF with HTN + DM (25)**	P value >0.5
	Mean ± SD	**Mean ± SD**	
RBS(mg/dl)	106.9 ± 15.97	161.7 ± 101.12	NS
Creatinine(mg/dl)	10.9 ± 4.42	9.88 ± 4.43	NS
Urea(mg/dl)	188.1 ± 60.52	168.7 ± 61.78	NS
Magnesium(mg/dl)	2.6 ± 0.41	3.2 ± 1.39	NS
Calcium(mg/dl)	7.69 ± 0.88	7.86± 0.49	NS
Phosphorous(mg/dl)	6.7 ± 2.11	7.63 ±3.11	NS
Iron(µg/dL)	41.8 ± 15.93	44.8 ± 15.71	NS
Sodium(mEq/L)	135.2 ± 5.7	130.4 ± 6.72	NS
Potassium(mEq/L)	4.3 ± 0.55	4.8 ± 0.77	NS

Discussion

The measurement of creatinine concentrations in plasma and urine samples illustrates the filtration capacity of the glomerulus, also known as the glomerular filtration rate (GFR.) Creatinine is produced endogenously within the body and is freely filtered by the glomerulus. These characteristics make creatinine a useful endogenous marker for creatinine clearance. If the GFR is decreased, as is in renal disease, creatinine clearance via the renal system is compromised. The reduced GFR will then lead to an increase in plasma creatinine concentration. The measurement of plasma alone should not be used to assess renal function. Plasma creatinine levels may not be affected until significant renal damage has occurred. In addition, a plasma creatinine level that is within normal reference range does not equate to a normal functioning renal system.

One of the progressive diseases causing irreversible descend in the glomerular filtration rate further resulting in elevation of blood urea and serum creatinine levels is chronic renal failure.[15] The main reason for chronic renal failure is hypertension, diabetes mellitus, autoimmune cause, etc. Reduced kidney function is associated with a variety of biochemical abnormalities which include serum electrolytes, calcium, and phosphorus levels. In our study, we observed, the significant increase in the levels of serum glucose, creatinine, urea in Group B (p-value < 0.05), when compared with Group A. The same results were found in the studies conducted by other authors.[14,16,17] In the present study, there is significant increase in the levels of serum potassium, magnesium and phosphorous in Group B (p -value < 0.05), when compared with Group A. The same results were found in the studies conducted by various authors.[18] Hyperkalemia in CRF is due to decreased renal excretion, may be because of leakage from the intracellular space and also due to an impaired thirst mechanism. Hypermagnesemia in chronic renal failure is due to decreased renal excretion of magnesium which is a precondition of impairment of renal function.[18] Increased levels of serum phosphorus in chronic renal failure compensate the loss of reservoir function of the skeleton.[19] Serum sodium, calcium and iron levels were found significantly decreased (p - < 0.05) in Group B, when compared with Group A. Reduced serum sodium levels in CRF due to impaired regulation of dilution and concentration of kidneys.[20] Decreased calcium levels is due to decreased intestinal calcium absorption because of low plasma calcitriol (1,25 dihydroxy cholecalciferol) levels which are synthesized in the kidney from 25-OH cholecalciferol by the action of enzyme 1α hydroxylase. Decreased iron levels in advanced chronic renal failure are mainly due to decreased intake and reduced absorption from the

intestine results in negative iron imbalance.[19] In chronic renal failure, anemia is commonly seen as erythropoietin (EPO) is not sufficiently produced due to kidney damage, which helps in the production of red blood cells from the bone marrow. Serum urea and creatinine levels are increased in chronic renal failure patients, leading to various other dangerous diseases 12 like heart and blood vessel disease. In chronic renal failure, elevated serum phosphate, and decreased serum calcium is due to mineral bone disorder.[21] In our study, we observed increase in the levels of serum calcium mean value 8.14±0.53 (mg/dl) and decrease in serum potassium mean value 4.71±0.77 (mEq/L), in male CRF subjects compared with female CRF subjects and has shown no statistical significance. The same results in the levels of serum calcium mean value 8.26 ± 1.18 (mg/dl) and decrease in serum potassium mean value 4.73 ± 1.04 (mEq/L) were found in the studies conducted by various authors.[22] In our study, we observed elevated serum creatinine 10.9±4.42 (mg/dl) in CRF patients with hypertension compared with CRF subjects with both hypertension and DM serum creatinine 9.88 ± 4.43 (mg/dl) and have shown no statistical significance. The same results were found in the studies conducted by various authors.[23]

Conclusion

We concluded that the elevated serum phosphate, magnesium and decreased serum calcium, iron are concerning with CRF. Serum phosphorous, magnesium, serum calcium and iron Play important role in renal profile.

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