Original Article

Major Electrolytes Imbalance in Chronic Heart Failure Patients

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ABSTRACT

Objective: To assess the major electrolytes (Magnesium, Calcium, Sodium, Potassium, Chloride) in chronic heart failure patients.

Study Design: Case Control Study.

Place and Duration of Study: This study was conducted at Basic Medical Sciences Institute, Jinnah Postgraduate Medical Centre, National Institute of Cardiovascular Diseases from April to December 2003.

Materials and Methods: A sample size of 90 was drawn through non- probability purposive sampling, 45 were diagnosed cases of chronic heart failure, 45 healthy people. Age, sex were matched. Serum electrolytes (Mg^{++}, Ca^{++}, Na^{+}, K^{+}, Cl^{-}) were determined. Renal function parameters urea, creatinine was determined. Age group was b/w 35-65 years. Data was analyzed on the SPSS 16.

Results: Mean values of serum electrolytes (Magnesium, Calcium, Potassium, Chloride) were significantly low (1.72+- 0.48, 7.46+-1.23, 3.78+_ 0.54, 99.80+-8.89) respectively in chronic heart failure patients when compared with control people.

Conclusion: The study concluded patients with chronic heart failure manifest a variety of electrolyte abnormalities hypomagnesaemia, hypocalcaemia, hypokalemia, hypochloremia, as a result of diuretics, digoxin therapy.

Key Words: Electrolytes, Abnormalities, Chronic heart failure, Imblance

INTRODUCTION

Heart failure is a chronic, progressive illness. Electrolyte instability is common in patients with congestive heart failure (CHF) during extensive time management. Digitalis was the first pharmacologic agent with positive ionotropic actions gained common use in the cure of chronic heart failure ,augment diminish cardiac contractility by inhibiting the activity of sodium potassium adenosine triphosphatase the resulting increase in the concentration of intracellular sodium enhances the entry of calcium into cells by increasing calcium-sodium exchange.[3] Diuretic agents (especially the non-potassium sparing groups) are potent kaliuretic agents,[4] promote cation excretion almost exclusively in association with chloride.[5] As with potassium there may be a magnesium dependent serum calcium deficiency.[6] Increased rate of electrolyte abnormality, cardiac arrhythmias among patients showing to digoxin–diuretic interactions has been documented in many studies. The joint therapy of digoxin, diuretic triple increases the risk of digoxin intoxication 7. The major electrolytes abnormalities are hyponatremia, hypokalemia, hypomagnesaemia. These derangements are of immense clinical importance; their development not only represents an immediate threat to the CHF patient (e.g., dysrhythmias secondary to hypokalemia), indicative of necessary pathophysiologic events, an unfavorable clinical course, an adverse therapeutic response 8.The study was designed to determine the serum electrolytes level in chronic heart failure patients as electrolyte abnormalities are common among them due to drugs .Determination have made the rapid, accurate measurement as a useful clinical tool in a prevention of variety of disease states.

MATERIALS AND METHODS

The study was carried out in the Department of Biochemistry, BMSI, JPMC, NICVD, Karachi from April to December 2003.A total of 90 people, 45 cases of chronic heart failure from NICVD, Karachi, 45 healthy normal age, gender matched people were selected as control group. Patients diagnosed, treated with diuretic, digoxin for heart failure were included. Patients with risk factors of heart diseases hypertension, diabetes mellitus, cigarette smoking, positive family history of cardiac diseases were included in study. Blood samples were collected under aseptic measures. To minimize the variability of the analytical method, all samples were processed at one time. Serum magnesium, calcium were determined by colorimetric kit method (Kit Cat No. 0137, No.0151-3) supplied by STANBIO Laboratory by (microlab-200) analyzer. Serum Sodium, Potassium, Chloride were determined by ion-selective electrode (Easy-lyte analyzer) method.

Statistical Analysis: Data analysis was done on SPSS 16. The results were given as numbers, percentage for qualitative data (gender) mean standard deviation for quantitative data (age, electrolytes). Student t-test was

used for quantitative data for comparison between cases and controls. P-value < 0.05, < 0.001 were considered significant.

RESULTS

The results were expressed as mean value (SD). Demographic distribution 0f study subjects were given in figure-1a, and 1b.

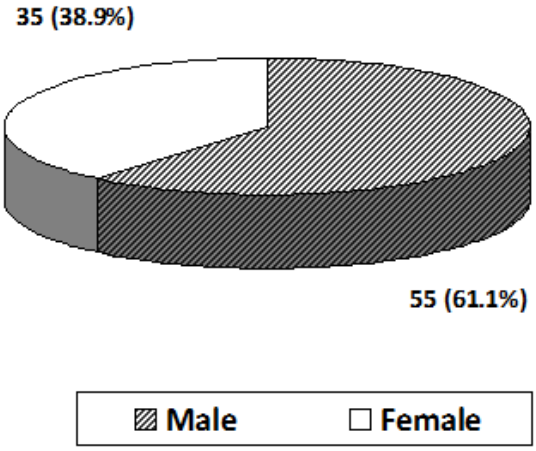

Figure No.1: Male/ Female Distribution of Chronic Heart Failure patients and Control subjects

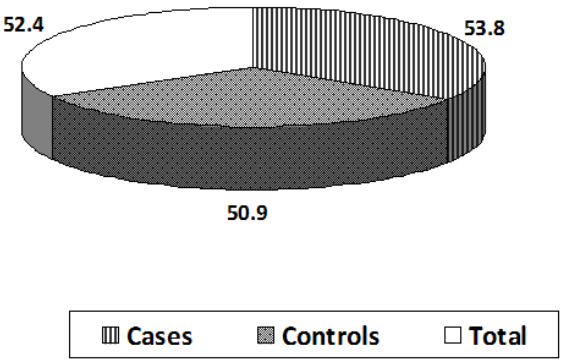

Figure No.2: Age Distribution of Chronic Heart Failure patients and Control subjects.

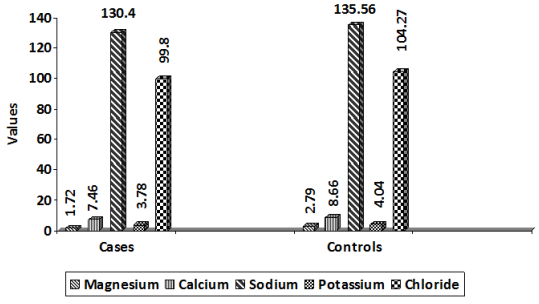

Figure No.3: Biochemical Parameter of Cases of Chronic Heart Failure & Controls groups

A total of 90 subjects, 45 were patients of chronic heart failure, 45 were control subjects. Out of 90 cases 55 (61.1%) were male, 35 (38.9%) were female. Age of 45 cases was 53.8+-9.63 and age of 45 control subjects was 50.9+-5.67. Age range was 52.4±7.98. Mean values of serum electrolytes, Magnesium, Calcium, Potassium, chloride were observed as significantly low (1.72+-0.48, 7.46+-1.23, 3.78+-0.54, 99.80+-8.89) respectively.

DISCUSSION

The study compared an important serum electrolytes magnesium, calcium, sodium, potassium, chloride in chronic heart failure patients receiving diuretics, digoxin. Chronic heart failure is metabolically demanding condition. Resting energy consumption is increased, shift from anabolic to catabolic processe[9.] Most physicians are comfortable with diagnostic, therapeutic strategies for the recognition, treatment of patients with hypokalemia. Age range was 35 to 65 years, the mean was 52.4± 7.98. Males comprised 61.1%, females38.9%.Lavie et al[10] confirmed prognostic ability with exercise cardiopulmonary variables for predicting prognosis in patients with chronic symptomatic systolic heart failure, while Tang et al[11.] Define the fluid retention after thiazolidine initiation in patients with established heart failure. In contrast to this study Pulligano[12] showed mean age of patients with heart failure was higher than 70 years, due to magnesium intake of the elderly tends to be low, their susceptibility to magnesium deficiency was diminished intestinal absorption, increased urinary output of magnesium.

Magnesium is an essential element as a cofactor in various enzymes important in metabolic homeostasis. After calcium, it is the second most abundant divalent cation present in serum13,14.Patients receiving digoxin are predisposed to the magnesium deficiency ,toxic effects of digoxin. The magnesium deficiency impairs the sodium-potassium pump, allows potassium to escape from the cell, to be lost in urine[15,16.]Magnesium reduces coronary artery tone, increases coronary blood flow by 22% in normal human subjects. At the cellular level magnesium was found to protect against ischemia, hypoxic injury by preventing intra-mitochondrial calcium accumulation, improving mitochondrial ATP synthesis essential for the functioning of enzymes in the aerobic cellular metabolism 17.Magnesium deficiency in 55% of Purvis and Morahed[18] study was observed because of diuretic agents. Pronounced diuresis by diuretics, increased renal excretion of magnesium was the cause of magnesium deficiency. Patients who received loop diuretics (furosemide) the magnesium deficiency was prominent. Ceremuzynski et al[19] assessed the role of electrolyte imbalance in cardiac arrhythmias related to increased magnesium excretion

was a feature of heart failure associated with complex ventricular arrhythmias. Clinically important electrolyte disturbances such as hypokalemia, hypocalcaemia had been described in patients with hypomagnesaemia of various causes 20. These heart failure patients are prone to magnesium deficiency as a result of diuretic, digoxin administration, neuro-hormonal activation.[21] the diuretics, digoxin causing major electrolyte disturbances were also observed by Nicholls[22] loop, thiazide diuretics induces deficits of sodium, potassium, magnesium in patients with heart failure. Eichhorn et al[23] showed diuretic, digoxin, rennin angiotensin aldosterone activation, inadequate nutrition in patients predispose congestive heart failure to hypomagnesaemia. Cohen et al[24] showed magnesium depletion, hypomagnesaemia are common among furosemide treated patients with chronic congestive heart failure. Milionis et al[25] stated patients with severe decompensate CHF exhibit acid-base, electrolyte disturbances due to the activation of neurohormonal mechanisms, drugs regularly used in patients. Leier et al observed hyponatremia, hypokalemia, hypo-magnesium were the most common electrolyte abnormalities in heart failure patients

CONCLUSION

The study concluded patients of chronic heart failure manifest a variety of electrolyte abnormalities. Diuretic (furosemide),digoxin are magnesium losing drugs with other electrolytes Calcium , Potassium ,Chloride .Recent advances in the analytic methods for serum electrolytes determination have made the rapid, accurate measurement as a useful clinical tool in a prevention of variety of electrolyte abnormalities and also apply treatment immediately to prevent disease states.

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