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Role of Electrolytes in Cardiovascular Disease (CVD) among Dhule Population

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ABSTRACT

Cardiovascular Disease (CVD) is one of the leading causes of morbidity and mortality across the world. World Health Organization (WHO) has declared cardiovascular disease as a modern epidemic. The common electrolyte abnormalities are hyponatremia, hypokalemia and in calcium ion. Several mechanisms interact to produce these alterations. The decrease in cardiac output leads directly to a reduction in renal blood flow, with impairment of renal excretion of water and electrolytes, and it causes the activation of several neurohormonal responses which affect both cardiovascular homeostasis and electrolyte balance. Electrolytes were measured with a benchtop AA (Modular ISE 900-Modul, Roche Diagnostics, Mannheim, Germany. Electrolytes instrument works on the principle of ion-selective electrodes (ISEs).

The main aim of the study was to find the electrolytes level alternations in the cardiovascular disease. We observed that cardiovascular diseases patients having at high risk for electrolytes depletion. Patients with heart failure may exhibit hyponatremia due to a decrease in water excretion, which may be related to the enhanced release of both angiotensin and vasopressin and can be exaggerated by diuretic therapy. Along with potassium and calcium that influences cardiovascular function. The two most important electrolytes are potassium and calcium. They are both vitally concerned with proper function of the cardiac muscle. Both electrolytes are needed in the proper amounts for contraction of the muscle and for the proper conduction of heart impulses through the special conduction pathway in the heart. Therefore, these findings should warrant the clinician to address for the recovery from CVD.

Keywords: Cardiovascular disease (CVD), Hyponatremia, Hypokalemia, Ionized Calcium, Diuretics.

INTRODUCTION

The cardiovascular system consists of the heart and blood vessels.[1] There is a wide array of problems that may arise within the cardiovascular system, for example, endocarditis, rheumatic heart disease, abnormalities in the conduction system, among others, cardiovascular disease (CVD) or heart disease.[2] And also subjects with congestive heart failure (CHF) usually show electrolyte disorders, due to the activation of several neurohumoral mechanisms and to drugs used in this condition, such as diuretics.[3] These abnormalities reflect the severity of CHF and contribute to the functional impairment and to the poor long-term prognosis.[4] The common electrolyte abnormalities are hyponatremia, hypokalemia and calcium ion.[5] Several mechanisms interact to produce these alterations. The decrease in cardiac output leads directly to a reduction in renal blood flow, with impairment of renal excretion of water and electrolytes, and it causes the activation of several neurohormonal responses which affect both cardiovascular homeostasis and electrolyte balance. [6]

Hyponatremia is the most common electrolyte abnormality observed in hospitalized subjects; it is defined as a serum sodium concentration lower than 136 mmol/L.[7] Mild to moderate hyponatremia is generally present in 10 % of Heart failure subjects. Hyponatremia may be a marker of neurohormonal activation that reflects the severity of heart failure, but it may also result from the HF therapy. [8]

It is well known that hypokalemia can induce cardiac arrhythmias (especially in patients with ischemic heart disease and left ventricular hypertrophy), and that it is associated with other adverse effects such as muscle weakness, rhabdomyolysis, renal failure and hyperglycemia. Thus, the importance of regulating potassium levels is well recognized in most intensive care units (ICUs) and potassium levels are measured frequently, especially in patients with cardiovascular disease. [9]

Low serum calcium levels can also induce arrhythmias (specifically shortening of the electrocardiographic QT interval). Hypocalcaemia can lead to severe cardiovascular depression [10,11] and congestive heart failure that is unresponsive to isotropic agents, especially in patients with underlying cardiomyopathies. [12] These cardiovascular effects may occur in the absence of specific electrocardiographic changes. Thus, low electrolyte levels can have severe adverse effects on the clinical course of patients with cardiovascular disease. We therefore, conducted the present study to assess the incidence of electrolyte in patients who have cardiovascular disease.

MATERIALS AND METHOD

The present study was conducted in the Department of General Medicine, Who are all attended OPD & IPD in JMF's ACPM Medical College and Hospital, Dhule. Totally, 100 subjects (50 healthy controls and 50 known CVD patients), aged between 25-75 years of both the sexes were included in this study.

Blood samples of all the participants of study were collected from antecubital vein with all aseptic precautions. Blood samples were allowed to clot at room temperature. The serum separated was used for the estimation of Serum electrolytes (Na^+, K^+, Cl^- and Ca^{++}) by using biochemical kits.

Electrolytes were measured with a benchtop AA (Modular ISE 900-Modul, Roche Diagnostics, Mannheim, Germany. Electrolytes instrument works on the principle of ion-selective electrodes (ISEs). [13] However, the measurement is performed on diluted plasma (indirect) for the former and on whole-blood samples (direct) for the latter. The data was analyzed with the help of SPSS software, version 22. The descriptive analysis results were interpreted as mean and standard error. The independent t -test was applied to compare the difference between controls and cases, *p* value <0.05 was considered significant.

RESULT

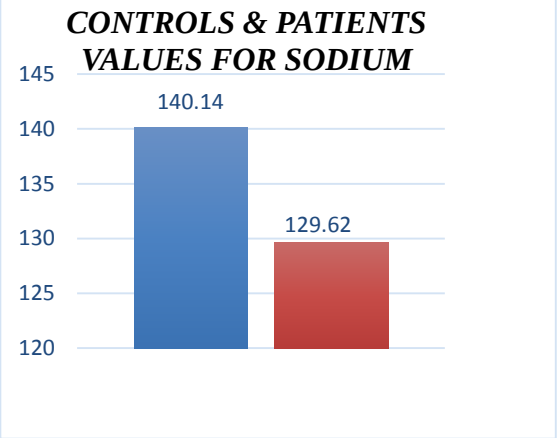

Fig 1 : Showing the Controls and Patients values for sodium

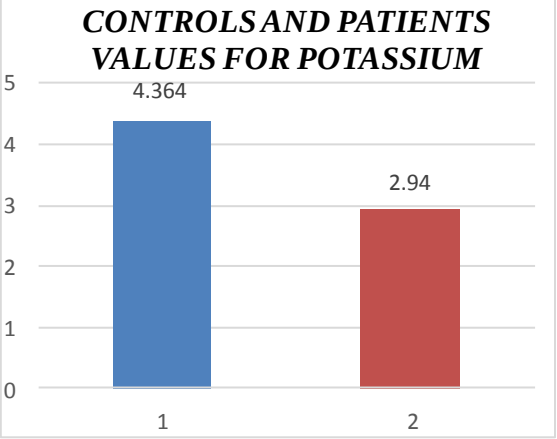

Fig 2: Showing the Controls and Patients values for Potassium

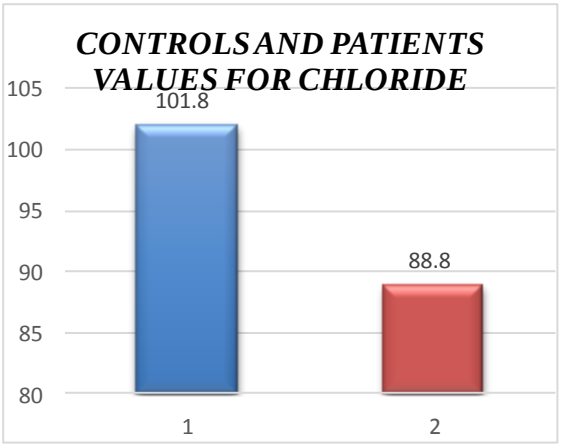

Fig 3: Showing the Controls and Patients values for Chloride

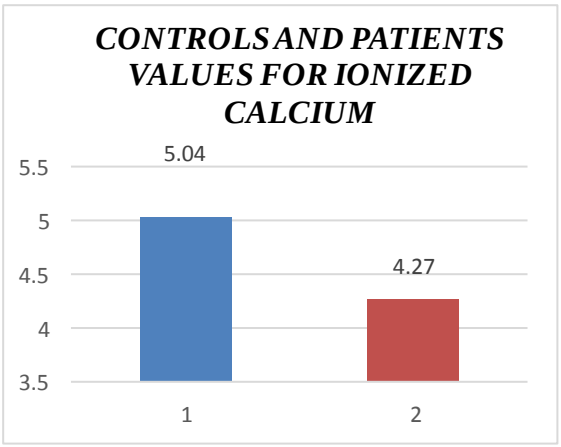

Fig 4: Showing the Controls and Patients values for Ionized Calcium

Table 1: showing Mean and Standard deviation of Na^+, K^+, cl^- and Ionized calcium.

Parameters	Mean ± SD for Patients	Mean ± SD for Controls	P* value
Sodium	129.62±3.27	140.14±2.83	< 0.03
Potassium	2.94±0.33	4.364±0.43	< 0.04
Chloride	88.80±3.5	101.8±3.4	< 0.04
Ionized Calcium	4.27±0.36	5.04±0.32	< 0.03

DISCUSSION

Electrolyte abnormalities in cardiovascular emergencies mostly found to be associated with cardiovascular morbidity and mortality. These cardiovascular effects may occur in the absence of specific c electrocardiographic changes. Moreover, when more than one electrolyte is deficient the effects may be cumulative. [14] Hyponatremia is an indicator of Acute Myocardial Infarction. Serum sodium level is prognostic indicators, i.e., rise in sodium levels after initial fall was indicative of clinical improvement. Therefore, estimation of sodium and potassium levels in AMI patients can help assess their prognosis. [15]

Electrolyte abnormalities are common in HF. They can be the result of diuretics, renal impairment neurohormonal activation, and the combination of these factors. Sodium (Na) and potassium (K) are the most commonly perturbed electrolytes. But chloride is also affected. [16] Hyponatraemia is common in acutely decompensated HF. This is thought to be the result of impaired excretion of free water via dilution hyponatraemia, a true depletion of sodium or both. Potassium abnormalities are particularly due to the treatments given for HF with hypokalaemia complicating diuretic use and hyperkalaemia particularly associated with increasing RAAS-blockade, along with potassium sparing diuretics and the sometime use of potassium supplements. Magnesium, deficiency frequently co-exists with hypokalaemia.[17] Guidelines do not specially indicate when or how frequently electrolytes should be monitored as it depends on clinical circumstances, but we believe they should be estimated daily during acute decongestive therapy, during routine post-discharge follow-up and following any dose changes in HF medication.[18]

The urinary electrolyte excretion was high whereas serum electrolyte levels were low indicates a degree of tubular dysfunction in our patients, despite the fact that serum creatinine levels were normal; if tubular dysfunction were not present then the kidney would have reabsorbed most of the excreted electrolytes. The cause of the tubular dysfunction in our patients are unknown. It seems likely that some of the medications used in their treatment played a role. All were treated with low doses of dopamine, which can enhance renal excretion of sodium and other electrolytes. [19] Low levels of serum K? may be a marker of increased neurohormonal activity and disease progression furthermore, serum K? is negatively correlated with plasma renin activity and plasma noradrenaline. [20]

CONCULSION

The main aim of the study was to find the electrolytes level alternations in the cardiovascular disease. We observed that cardiovascular diseases patients having at high risk for electrolytes depletion. Patients with heart failure may exhibit hyponatremia due to a decrease in water excretion, which may be related to the enhanced release of both angiotensin and vasopressin and can be exaggerated by diuretic therapy. Along with potassium and calcium that influences cardiovascular function. The two most important electrolytes are potassium and calcium. They are both vitally concerned with proper function of the cardiac muscle. Both electrolytes are needed in the proper amounts for contraction of the muscle and for the proper conduction of heart impulses through the special conduction pathway in the heart. Therefore, these findings should warrant the clinician to address for the recovery from CVD.

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Conflict of Interest: None

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Ethical Approval: Approved

REFERENCES

1. Farley A, McLafferty E, Hendry C. The cardiovascular system. 2012; Oct 31-Nov 6 Nurs Stand. 27(9):35-9. [PubMed]
2. Benjamin EJ, Virani SS, Callaway CW, et al., American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee. Heart Disease and Stroke Statistics -2018 Update: A Report from the American Heart Association. Circulation. 2018; Mar 20;137(12):e67-e492. [PubMed].
3. Oster JR, Preston RA, Materson BJ Fluid and electrolyte disorders in congestive heart failure. SeminNephrol.1994; 14:485–505.
4. Gheorghiade M, Hellkamp AS, Pina IL et al. Hemodynamic characterization and prognostic value of persistent hyponatremia in patients with severe heart failure in the ESCAPE trial. J Am CollCardiol 2005;45: 145A.
5. Elisaf MS, Siamopoulos KC. Acid–base and electrolyte abnormalities in patients with congestive heart failure. ExpClinCardiol. 1997; 2:140–144.
6. Dargie HJ. Interrelation of electrolytes and renin–angiotensin system in congestive heart failure. Am J Cardiol.1990; 65:28E–32E.
7. Adrogue´ HJ, Madias NE (2000) Hyponatremia. N Engl J Med 342:1581–1589.
8. Oren RM (2005) Hyponatremia in congestive heart failure. Am JCardiol 95:2–7. doi:10.1016/j.amjcard.2005;03.002
9. Zaloga GP, Chernow B: Hypocalcaemia in critical illness. *JAMA.* 1986; 256:1924-1929.
10. Drop LJ: Ionized calcium, the heart, and hemodynamic function. *AnesthAnalg.*1985; 64:432-451.
11. Connor TB, Rosen BL, Blaustein MP, Applefeld MM, Doyle LA: Hypocalcaemia precipitating congestive heart failure. *N Engl JMed* 1982; 307:869-872.
12. Ginsburg R, Esserman LJ, Bristow MR: Myocardial performance and extracellular ionized calcium in a severely failing heart. *Ann Intern Med* 1983; 98:603-606.
13. NCCLS. *Standardization of Sodium and Potassium Ion Selective Electrode Systems to the Flame Photometric Reference Method; Approved Standard: NCCLS Document C29-A.* Vol. 15. Villanova, PA, USA: NCCLS; 1995. [Google Scholar].
14. Cole NI, Suckling RJ, Swift PA, He FJ, MacGregor GA, Hinton W, et al. The association between serum sodium concentration, hypertension and primary cardiovascular events: a retrospective cohort study J Hum Hypertens. 2019; 33: 69-77. https://bit.ly/2XXnqZ1.
15. Xianghua F, Peng Q, Yanbo W, Shigiang L, Weize F, Yunfa J. The relationship between hypokalemia at the early stage of acute myocardial infarction and malignant ventricular arrhythmia. Heart. 2010;96:196.
16. Konishi M, Haraguchi G, Ohigashi H, Sasaoka T, Yoshikawa S, Inagaki H, Ashikaga T, Isobe M. Progression of hyponatremia is associated with increased cardiac mortality in patients hospitalized for

acute decompensated heart failure. J Card Fail 2012;18:620–625.
17. Gheorghiade M, Abraham WT, Albert NM, Gattis Stough W, Greenberg BH, O'Connor CM, She L, Yancy CW, Young J, Fonarow GC. Relationship between admission serum sodium concentration and clinical outcomes in patients hospitalized for heart failure: an analysis from the OPTIMIZE-HF registry. Eur Heart J 2007;28:980–988.
18. Arrigo M, Nijst P, Rudiger A. Optimising heart failure therapies in the acute setting. Card Fail Rev 2018;4:38-42.
19. Smit AJ, Lieverse AG, van Veldhuisen D, Girbes AR: Dopaminergic modulation of physiological and pathological neurohumoral activation in man. *Hypertens Res* 1995; 18 (Suppl 1):S107-S111.
20. Podrid PJ. Potassium and ventricular arrhythmias. Am J Cardiol 1990; 65:33–44.

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