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The Prognostic Significance of Hyponatremia in Acute STEMI.

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ABSTRACT: This study was undertaken to assess the association of hyponatremia with different variables like hypertension, diabetes mellitus, arrhythmia across a range of population in a hospitalised setting in a Southern part of India over a year and its prognostic cignificance in acute STEMI.

KEYWORDS: hyponatremia, arrhythmia, killip classification, hypertension, diabetes mellitus, arrhythmia

I)INTRODUCTION

Disorders of serum Na+ concentration are caused by abnormalities in water homeostasis, leading to changes in the relative ratio of Na+ to body water. Water intake and circulating AVP constitute the two key effectors in the defense of serum osmolality; defects in one or both of these two defense mechanisms cause most cases of hyponatremia and hypernatremia. In contrast, abnormalities in sodium homeostasis per se lead to a deficit or surplus of whole-body Na+-Cl– content, a key determinant of the ECFV and circulatory integrity. Notably, volume status also modulates the release of AVP by the posterior pituitary, such that hypovolemia is associated with higher circulating levels of the hormone at each level of serum osmolality. Similarly, in "hypervolemic" causes of arterial underfilling, e.g., heart failure and cirrhosis, the associated neurohumoral activation is associated with an increase in circulating AVP, leading to water retention and hyponatremia. Therefore, a key concept in sodium disorders is that the absolute plasma Na+ concentration tells one nothing about the volume status of a given patient, which furthermore must be taken into account in the diagnostic and therapeutic approach.

Hyponatremia, which is defined as a plasma Na+ concentration <135

mM, is a very common disorder, occurring in up to 22% of hospitalized patients. This disorder is almost always the result of an increase in circulating AVP and/or increased renal sensitivity to AVP, combined with an intake of free water; a notable exception is hyponatremia due to low solute intake (see below). The underlying pathophysiology for the exaggerated or "inappropriate" AVP response differs in patients with hyponatremia as a function of their ECFV. Hyponatremia is thus subdivided diagnostically into three groups, depending on clinical history and volume status, i.e., "hypovolemic," "euvolemic," and "hypervolemic".

Hypovolemic Hyponatremia Hypovolemia causes a marked neurohumoral activation, increasing circulating levels of AVP. The increase in circulating AVP helps preserve blood pressure via vascular and baroreceptor V1A receptors and increases water reabsorption via renal V2 receptors; activation of V2 receptors can lead to hyponatremia in the setting of increased free water intake. Nonrenal causes of hypovolemic hyponatremia include GI loss (e.g., vomiting, diarrhea, tube drainage) and insensible loss (sweating, burns) of Na+-Cl– and water, in the absence of adequate oral replacement; urine Na+ concentration is typically <20 mM. Notably, these patients may be clinically classified as euvolemic, with only the reduced urinary Na+ concentration toindicate the cause of their hyponatremia. Indeed, a urine Na+ concentration <20 mM, in the absence of a cause of hypervolemic hyponatremia, predicts a rapid increase in plasma Na+ concentration in response to intravenous normal saline; saline therapy thus induces a water diuresis in this setting, as circulating AVP levels plummet.

The renal causes of hypovolemic hyponatremia share an inappropriate

loss of Na+-Cl– in the urine, leading to volume depletion and an increase in circulating AVP; urine Na+ concentration is typically>20 mM (Fig. 63-5). A deficiency in circulating aldosterone and/or its renal effects can lead to hyponatremia in primary adrenal insufficiency and other causes of hypoaldosteronism; hyperkalemia and

hyponatremia in a hypotensive and/or hypovolemic patient with high urine Na+ concentration (much greater than 20 mM) should strongly suggest this diagnosis.

Hypervolemic Hyponatremia Patients with hypervolemic hyponatremia develop an increase in total-body Na+-Cl– that is accompanied by a proportionately greater increase in total-body water, leading to a reduced plasma Na+ concentration. As in hypovolemic hyponatremia, the causative disorders can be separated by the effect on urine Na+ concentration, with acute or chronic renal failure uniquely associated with an increase in urine Na+ concentration (Fig. 63-5). The pathophysiology of hyponatremia in the sodium-avid edematous disorders (congestive heart failure [CHF], cirrhosis, and nephrotic syndrome) is similar to that in hypovolemic hyponatremia, except that arterial filling and circulatory integrity is decreased due to the specific etiologic factors (e.g., cardiac dysfunction in CHF, peripheral vasodilation in cirrhosis). Urine Na+ concentration is typically very low, i.e., <10 mM, even after hydration with normal saline; this Na+-avid state may be obscured by diuretic therapy. The degree of hyponatremia provides an indirect index of the associated neurohumoral activation and is an important prognostic indicator in hypervolemic hyponatremia.

Euvolemic Hyponatremia Euvolemic hyponatremia can occur in moderate to severe hypothyroidism, with correction after achieving a euthyroid state. Severe hyponatremia can also be a consequence of secondary adrenal insufficiency due to pituitary disease; whereas the deficit in circulating aldosterone in primary adrenal insufficiency causes hypovolemic hyponatremia, the predominant glucocorticoid deficiency in secondary adrenal failure is associated with euvolemic hyponatremia.

The syndrome of inappropriate antidiuresis (SIAD) is the most frequent cause of euvolemic hyponatremia . The generation of hyponatremia in SIAD requires an intake of free water, with persistent intake at serum osmolalities that are lower than the usual threshold for thirst; as one would expect, the osmotic threshold and osmotic response curves for the sensation of thirst are shifted downward in patients with SIAD. Four distinct patterns of AVP secretion have been recognized in patients with SIAD, independent for the most part of the underlying cause. Unregulated, erratic AVP secretion is seen in about a third of patients, with no obvious correlation between serum osmolality and circulating AVP levels. Other patients fail to suppress AVP secretion at lower serum osmolalities, with a normal response curve to hyperosmolar conditions; others have a "reset osmostat," with a lower threshold osmolality and a left-shifted osmotic response curve.

Finally, the fourth subset of patients have essentially no detectable circulating AVP, suggesting either a gain in function in renal water reabsorption or a circulating antidiuretic substance that is distinct from AVP. Gain-in-function mutations of a single specific residue in the V2 AVP receptor have been described in some of these patients, leading to constitutive activation of the receptor in the absence of AVP and "nephrogenic" SIAD.

Low Solute Intake and Hyponatremia Hyponatremia can occasionally

occur in patients with a very low intake of dietary solutes. Patients with hyponatremia due to low solute intake typically present with a very low urine osmolality (<100–200 mOsm/kg) with a urine Na+ concentration that is <10–20 mM. The fundamental abnormality is the inadequate dietary intake of solutes; the reduced urinary solute excretion limits water excretion such that hyponatremia ensues after relatively modest polydipsia. AVP levels have not been reported in patients with beer potomania but are expected to be suppressed or rapidly suppressible with saline hydration; this fits with the overly rapid correction in plasma Na+ concentration that can be seen with saline hydration. Resumption of a normal diet and/or saline hydration will also correct the causative deficit in urinary solute excretion, such that patients with beer potomania typically correct their plasma Na+ concentration promptly after admission to the hospital.Hyponatremia is a common electrolyte disorder amongst hospitalized patients, especially in postoperative period and in patients with heart failure, nephrotic syndrome and cirrhosis. Hyponatremia has been shown to be a predictor of cardiovascular mortality among patients with heart failure. Excessive or inappropriate AVP release, activation of the sympathetic nervous system, and the renin-angiotensin aldosterone system are the main mechanisms responsible for hyponatremia in patients with heart failure. Non-osmotic release of AVP secretion plays a greater role in hyponatremic patients with heart failure.

While the prognostic value of hyponatremia in chronic heart failure is well established, data on the prognostic importance of hyponatremia in the setting of acute myocardial infarction are lacking.

Neurohormonal activation that accompanies acute myocardial infarction is similar

to that which accompanies heart failure. However, it is not clear whether the mechanisms that contribute to the development of hyponatremia in heart failure are involved in patients with STEMI.

In acute myocardial infarction, the release of AVP is not only triggered by a low effective circulating volume, but also could occur due to the acute development of left ventricular dysfunction; a response to any combination of pain, nausea or stress. Other possible causes are renal sodium loss after diuretic use, osmotic diuresis, or extrarenal sodium loss due to excessive sweating or vomiting. In patients with myocardial infarction, hyponatremia may be aggravated further by the concomitant activation of the renin-angiotensin system and increased catecholamine production. These factors decrease the glomerular filtration rate and subsequent delivery of tubular fluid to the diluting segment of the nephron, further contributing to decreased renal water excretion. Administration of hypotonic fluid and non-steroidal analgesic may add to the problem.

The mechanism of hyponatremia at cellular level occurs due to:

1) Increased cellular permeability initiated by anoxia or ischaemia and often enhanced by stress hormones.

2) Non-osmotic release of arginine-vasopressin leads to inappropriate amount of water retention.

Data on prevalence and in hospital prognosis of hyponatremia in a setting of ST segment elevation acute myocardial infarction in a tertiary care setting is not available in this region of the country incorporating all end points of arrhythmia, heart failure and in-hospital deaths. This study is being undertaken to determine the prognostic importance of hyponatremia in the setting of acute ST elevation MI and to determine its usefulness in predicting short term survival.

Plasma sodium level may serve as a simple, easily available and cost effective to identify patients at high risk.

II)REVIEW OF LITERATURE

Qing tang et al[1], in their study of 1620 ST elevation MI patients concluded that Hyponatremia is independently associated with in-hospital adverse outcomes in Chinese patients with acute ST-elevation myocardial infarction, and the risk of in-hospital mortality was increased with the severity of hyponatremia. Patients with a sodium level of <130 mmol/L had an adverse event rate of 22.9% versus 11.0% in patients with a sodium level of 130 to 135 mmol/L (p=0.034). In multivariate logistic regression, hyponatremia was independently correlated with in-hospital mortality (OR: 1.77, 95% CI: 1.02-3.06, p=0.042) and heart failure (OR: 1.61, 95% CI: 1.06-2.43, p=0.025).

Yuko Tada et al[2], in their study observed that in hyponatremic patients the incidence of in-hospital heart failure was significantly greater (P=0.0018), long-term cardiac death was a higher trend (17.2% vs. 6.3%, P=0.19) and re-admission due to CHFwas significantly more frequent (20.7% vs. 4.5%, P=0.0024). Plasma AVP level was higher in the hyponatremia group (4.5 vs. 2.7 pg/ml, P=0.003), and it had a negative correlation with serum sodium level(r=-0.28,P=0.02).They concluded thathyponatremia was frequently found in the early phase of STEMI, andassociated with heart failure in both shortand longterm outcomes. Non-osmotic secretion of AVP could beinvolved in hyponatremia in STEMI patients.

Fahad aziz et al[3] in their study sample of 128 consecutive patients admitted with acute MI (Including both STEMI & NSTEMI) observed that hyponatremia was present on admission in 36 patients (28%). Hyponatremia (≤135 mEq/L) developed in 25 (19.9%) patients during the first 72 hours of hospitalization. Plasma sodium levels decreased to ≤130 mEq/L in 6 patients (4.3%); the lowest level was 119 mEq/L. In-patient mortality, a total of 13 deaths (10%) occurred within the hospital: 6.2% (3/55) of patients without hyponatremia, 19.8% (7/36) of patients with hyponatremia on admission, and 16.8% (4/25) of patients who developed hyponatremia after admission. Kaplan-Meier survival analysis indicated that patients who had hyponatremia at baseline or who developed hyponatremia after admission had significantly higher in-patient mortality compared with patients without hyponatremia. After adjusted logistic regression for other important covariates, both hyponatremia on admission and development of hyponatremia after admission remained independent predictors of in-patient mortality. In analyses of the association between the degree of hyponatremia and outcome, we observed that the risk of in-patient mortality increased with the severity of hyponatremia. Compared with patients without hyponatremia, the adjusted odds ratio for in-patient mortality was 2.1 in patients with sodium levels between 130 to 134 mEq/L and 3.4 in patients with levels ≤130 mEq/L. They concluded that hyponatremia and Other Risk-Assessment Models in Myocardial Infarction both hyponatremia on admission and developing hyponatremia remained independent predictors of in-patient mortality after adjusting for the other risk factors.

Suresh Harsoor et al[4], in their study of 100 patients in their prospective observational study conducted in patients presenting with acute ST-elevation myocardial infarction admitted in ICCU observed that there was no statistically significant difference between the two groups regarding the incidence of risk factors of IHD. Hyponatremics had higher rates of in-hospital mortality (24%vs 6%p<0.01) composite of death, heart failure (72% vs. 36%, p=0.05) and arrhythmias (30% vs 6% p<0.01) Anterior myocardial infarction was more frequent in patients with hyponatremia, who showed advanced Killip class. After adjustment for covariates, hyponatremia was independently correlated with in-hospital mortality. They concluded that hyponatremia on admission in patients with acute ST Elevation MI is a strong independent predictor of prognosis and sodium levels may serve as a simple marker to identify patient at high risk.

Klopotowski[5] et al, in their study of 1858 ST-elevation MI patients found that 96 patients had hyponatremia on admission. The hypo- and normonatremic groups were comparable with respect to baseline characteristics and in-hospital management. Hyponatremics had higher rates of in-hospital mortality (13.5% vs. 3.8%, p<0.001) composite of death and heart failure (27.8% vs. 18.4%, p=0.022). After adjustment for covariates, hyponatremia independently correlated with in-hospital mortality (HR: 3.89, 95%CI: 1.59–9.56, p=0.003) and the combined endpoint (HR: 1.73, 95%CI: 1.01–2.99, p=0.047). Patients in the lowest and highest sodium quintiles were 3.27 (95%CI: 1.34–8.02, p=0.009) and 2.65 (95%CI: 1.07–6.60, p=0.036) times more likely to die during hospitalization than those in the 2nd quintile (best survival). In the adjusted model, only patients in the lowest quintile had signifi cantly increased risk of in-hospital death (HR: 6.35, 95%CI: 1.83-21.72, p=0.004). They concluded that hyponatremia is a simple laboratory marker independently associated with increased risk of death in STEMI patients treated with primary angioplasty.

Ahmad Sajadieh et al[6] in their study of 671 men and women aged 55 to 75 years with no history of cardiovascular disease, stroke or cancer found that Fourteen subjects (2.1%, group A) had s-Na ≤ 134 mEq/L, and 62 subjects (9.2%, group B) had s-Na ≤ 137 mEq/L. No subject had s-Na < 129 mEq/L. An adverse outcome occurred in 43% of group A, 27% of group B, and 14% of subjects with s-Na >137mEq/L (controls) (P <.002). Adjusted hazard ratio for adverse outcome was 3.56 (95% confidence interval [CI], 1.53-8.28, P <.005) in group A compared with controls and 2.21 (95% CI, 1.29-3.80, P <.005) in group B after controlling for age, gender, smoking, diabetes, low-density lipoprotein cholesterol, and blood pressure. The hazard ratios were robust for additional adjusting for variables showing univariate association to hyponatremia (ie, beta-blocker and diuretic use, heart rate variability, creatinine, C-reactive protein, and NT-pro brain natriuretic peptide). By excluding diuretic users (18% of subjects), the adjusted hazard ratio for adverse outcome was 8.00 (95% CI, 3.04-21.0,P <.0001) in group A and 3.17 (95% CI, 1.76-5.72, P = .0001) in group B compared with controls. They concluded that hyponatremia is an independent predictor of deaths and myocardial infarction in middle-aged and elderly community subjects.

Goldberg A et al[7] in their study of 978 patients observed that Hyponatremia, was present during admission in 108 patients (11.0%). In a multivariable Cox proportional hazards model adjusting for other potential clinical predictors of mortality and for left ventricular ejection fraction, hyponatremia during admission remained an independent predictor of postdischarge death (hazard ratio [HR], 2.0; 95% confidence interval [CI], 1.3-3.2; P = .002). Hyponatremia during admission was also independently associated with postdischarge readmission for heart failure (HR, 1.6; 95% CI, 1.1-2.6; P = .04). When serum sodium level was used as a continuous variable, the adjusted HR for death or heart failure was 1.12 for every 1-mEq/L decrease (95% CI, 1.07-1.18; P<.001). They concluded that hyponatremia in the early phase of ST-elevation myocardial infarction is a predictor of long-term mortality and admission for heart failure after hospital discharge, independent of other clinical predictors of adverse outcome and left ventricular ejection fraction.

Goldberg A[8], et al in their study of 1047 have found that hyponatremia was present on admission in 131 patients (12.5%) and developed during the first 72 hours of hospitalization in 208 patients (19.9%). Plasma sodium levels decreased to ≤130 mmol/L in 45 patients (4.3%). In a multivariate logistic regression analysis, hyponatremia was independently associated with 30-day mortality. The risk of 30-day mortality associated with hyponatremia on admission (odds ratio [OR] = 2.0; 95% confidence interval [CI]: 1.0 to 3.9; P = 0.04) was similar to that of hyponatremia developing after admission (OR = 2.4; 95% CI: 1.5 to 4.2; P = 0.002). The risk of 30-day mortality increased with the severity of hyponatremia, with an odds ratio of 2.1 in patients with sodium levels between 130 and 134 mmol/L (95% CI: 1.2 to 3.5; P = 0.007) and 3.4 in those

with levels <130 mmol/L (95% CI: 1.5 to 7.8; P = 0.002). They concluded that hyponatremia on admission or early development of hyponatremia in patients with acute ST-elevation myocardial infarction is an independent predictor of 30-day mortality, and prognosis worsens with the severity of hyponatremia.

Rouleau JL et al[9] in their study of 534 patients have concluded that hyponatremia at the time of hospital discharge in post infarction patients is an independent sign of poor prognosis.

Sigurdsson A et al[10], in their study of 55 patients with acute Myocardial Infarction concluded that hyponatremia after myocardial infarction mainly occurs in patients with clinical heart failure and is related to the magnitude of myocardial damage, even in patients without heart failure.

Flear CT, Hilton P[11] in their study of 235 consecutive patients admitted to a coronary care unit, have concluded that hyponatremia, hypochloremia, and uremia were common in patients with confirmed myocardial infarctions, the degree of infarctions correlated well with all the above indices of severity. They found that plasma sodium concentration fall after infarction and that the extent and duration of the fall are severity of the infarction.

Chiara Lazzeri et al[12], in their study of 1,231 patients found that 286 patients (23.2%) had sodium values <135 mEq/L. Patients with hyponatremia were older (p = 0.018) and more frequently had diabetes (p = 0.040). Anterior myocardial infarction was more frequent in patients with hyponatremia, who showed a higher incidence of 3-vessel coronary artery disease and advanced Killip class. Higher mortality rates were observed in patients with hyponatremia during intensive cardiac care unit stay and at follow-up. On multivariate regression analysis, admission sodium concentration was not independently related to early death, nor did it show any relations with long-term mortality on Cox regression analysis. In conclusion, the main findings of the present investigation are as follows: (1) hyponatremia is a common finding, being associated mainly with older age, diabetes, and advanced Killip class; (2) patients with hyponatremia had higher rates of in-hospital and long-term mortality; and (3) hyponatremia, also when assessed by means of the propensity score model, was not independently associated with increased risk for death in the short and long terms. These data therefore strongly suggest that the presence of hyponatremia in the acute phase of ST-segment elevation myocardial infarction should be considered a marker of more ill patients.

M Aziz, M Ullah et al[13], in their study of 100 consecutive patients admitted to coronary care unit have concluded that Mortality increased with increasing severity of hyponatremia compared with patients having normal sodium level. 33 patients with hyponatremia developed Heart failure and significant arrhythmia occurred in 34 (23.5%) hyponatremic patients.

Mahmoud, Amira H et al[14] found that of 100 patients, 52 patients were admitted with STEMI and 48 with NSTEMI; 73 were hyponatremic and 27 were normonatremic. Patients who had hyponatremia were more likely to die or have recurrent myocardial infarction in the next 30 days. Hyponatremia, hypotension on admission, left ventricular ejection fraction (EF), mean level of cardiac enzymes were significantly associated with adverse outcome. On multivariate analysis, hyponatremia was a strong predictor of adverse outcome (odds ratio 2.4, 95% confidence interval). They concluded that hyponatremia is associated with 30-days adverse outcome in patients presenting with acute coronary syndrome.

Burkhardt K et al[15] in their study of 3558 patients, aged 25-74 years, with an incident acute myocardial infarction (AMI) in the years 2000-2008 who survived for at least 28 days concluded that Patients with incident Acute MI and hyponatraemia on admission showed a significantly higher risk of long-term mortality than patients without. This strong predictive value was independent of a number of prognostic factors, including diabetes, glomerular filtration rate or reduced LVEF.

Bae MH et al[16] in their study of 1290 consecutive patients (64 ± 12 years; 877 men) who survived the index hospitalization after AMI determined the 12-month mortality rates of these patients. Patients who died during the 12-month follow-up had lower sodium levels at discharge than those who had survived (137 ± 6 vs. 139 ± 4 mmol/L; P < 0.014). Hyponatremia at discharge, defined as a serum sodium level ≤135 mmol/L, was present in 210 patients (16.3 %). In the Cox-proportional hazard model, hyponatremia at discharge (hazard ratio, 2.264; 95 % confidence interval, 1.119-4.579; P = 0.023) was an independent predictor of 12-month mortality. Moreover, hyponatremia at discharge had an incremental prognostic value over conventional risk factors ($\chi^2 = 7$, P = 0.007), and conventional risk factors and log N-terminal Pro-B-type natriuretic peptide combined ($\chi^2 = 5$, P = 0.021). In the subgroup analysis, the 12-month

mortality of patients with hyponatremia at discharge was significantly higher than in those without, irrespective of age, Killip class, left ventricular ejection fraction, percutaneous coronary intervention at index hospitalization, and prescription of diuretics at discharge. They concluded that hyponatremia at discharge is an independent predictor of 12-month mortality in hospital survivors after AMI.

Bernardo Rodrigues et al[17] did a study of total of 3585 patients with stroke. Hyponatremia was observed in 565 (16%) patients. Baseline characteristics were similar between groups except heart failure (P = .015), cancer (P = .038), diabetes (P < .001), and dementia (P = .015). Hyponatremic patients had higher National Institutes of Health Stroke Scale (NIHSS) score on admission (P = .032) and at discharge (P = .02). Despite similar modified Barthel Index (mBI) preadmission, patients with hyponatremia had worse mBI on admission (P = .049). Hyponatremia was associated with higher mortality in hospital (P = .039) and at 3-month (P = .001) and 12-month follow-ups (P = .001). A poorer discharge disposition was seen in the hyponatremia group (P = .004). Complications during admission were similar between groups except for urinary infection (P = .008). Patients with hyponatremia had worse NIHSS and mBI values on admission, and their deficits worsened during their hospitalization. They concluded that hyponatremia is associated with acute mortality and poorer discharge dispositions and to confirm that higher mortality occurs in these patients, even after 12 months after a stroke.

Esha Mati et al[18] in their retrospective case control study including 50 consecutive acute MI patients admitted to the coronary care unit and 50 controls assessed Plasma sodium, potassium and chloride levels obtained in all MI patients within 48 hours of admission. Patient history, physical examination, drug history and laboratory results were recorded by chart abstraction. They concluded that Hypokalemia and hyponatremia were fairly common findings among acute MI patients.

Štěpán Havránek et al[19] in their study of 218 consecutive patients (144 males, the mean age 64 ± 13 years) with no history of heart failure admitted with acute STEMI found a total of 72 (33%) patients reached hyponatremia level; 51(23.4%) of them at admission and 21 (9.6%) later during hospitalization. The hyponatremic patients more frequently presented with reduced left ventricular systolic function, Killip class III or IV and were at increased risk of developing cardiogenic shock compared to patients with normonatremia. Compared to the rest of the population, patients who developed hyponatremia later during hospitalization had higher incidence of acute renal failure; (12 patients/6.1% vs. 5 patients/25.5%, p < 0.05). The difference in long-term survival between the hyponatremia and normonatremia groups was significant (p = 0.01, log-rank test). The multiple analysis of variance identified decrease of S-Na levels at admission independently associated with total mortality (p = 0.05). They concluded that Patients who developed hyponatremia in the early phase of STEMI were at higher risk of worse in-hospital clinical outcome. During the long-term follow-up, higher mortality rates were recorded in hyponatremic patients.

Klein L et al[20] randomized 949 patients with systolic dysfunction hospitalized for worsening heart failure to receive 48 to 72 hours of intravenous milrinone or placebo in addition to standard therapy. In a retrospective analysis, they investigated the relationship between admission serum sodium and the primary end point of days hospitalized for cardiovascular causes within 60 days of randomization, as well as the secondary end points of in-hospital mortality, 60-day mortality, and 60-day mortality/rehospitalization. The number of days hospitalized for cardiovascular causes was higher in the lowest sodium quartile: 8.0 (4.5, 18.5) versus 6 (4, 13) versus 6 (4, 11.5) versus 6 (4, 12) days (P<0.015 for comparison with the lowest quartile). Lower serum sodium was associated with higher in-hospital and 60-day mortality: 5.9% versus 1% versus 2.3% versus 2.3% (P<0.015) and 15.9% versus 6.4% versus 7.8% versus 7% (P=0.002), respectively. There was a trend toward higher mortality/rehospitalization for patients who were in the lowest sodium quartile. Multivariable-adjusted Cox proportional hazards analysis showed that serum sodium on admission, when modeled linearly, predicted increased 60-day mortality: sodium (per 3-mEq/L decrease) had a hazard ratio of 1.18 with a 95% CI of 1.03 to 1.36 (P=0.018). They concluded that in patients hospitalized for worsening heart failure, admission serum sodium is an independent predictor of increased number of days hospitalized for cardiovascular causes and increased mortality within 60 days of discharge.

Singla Iet al[21]evaluated the effect of hyponatremia on outcomes in patients with suspected acute coronary syndrome and non-STEMI. Of 1,478 patients, 341 (23.1%) were hyponatremic (sodium <135 mEq/L) on presentation. Patients who had hyponatremia on admission were significantly more likely to die or have recurrent myocardial infarction in the next 30

days (odds ratio 1.98, 95% confidence interval 1.35 to 2.89, p <0.001). This relation persisted after adjusting for factors such as age, left ventricular ejection fraction, use of diuretics before admission, hypotension on presentation, anemia, chronic renal insufficiency, pulmonary edema, and high troponin levels (odds ratio 1.7, 95% confidence interval 1.1 to 2.5, p = 0.01). It was concluded that hyponatremia on admission is associated with 30-day adverse outcome in patients presenting with suspected acute coronary syndrome/non-STEMI.

Waqas Qureshi et al[22]in a total of 11,562 patients (67.15 ± 14.6 years, males 56.3 %) found that there were a total of 1,535 (13.3 %) deaths within mean follow-up duration of 5.5 ± 3.3 years. There were 425 (27.9 %) deaths in patients with corrected hyponatremia and 155 (55.3 %) deaths in persistent hyponatremia patients. Multivariate analysis indicated that corrected hyponatremia and persistent hyponatremia were independent predictors of all cause mortality (p < 0.0001). When analyzing short-term (30 days) and long-term mortality, corrected hyponatremia group did not have associated long term mortality. Various methods to correct hyponatremia were also analyzed and use of vaptans was associated with decrease in mortality in patients with hyponatremia from 115 to 125 (HR 0.45; 95 % CI 0.26–0.78, p = 0.005). Their analysis showed that corrected and persistent hyponatremia in patients presenting with myocardial infarction is a predictor of all-cause mortality, major adverse cardiac events and heart failure related 30 day rehospitalization. In certain cases, correction of hyponatremia may actually improve survival of the patients.

Giovanni Corona et al[23] performed an extensive Medline, Embase and Cochrane search was performed to retrieve the studies published up to October 1st 2012, using the following words: "hyponatremia" and "mortality". Eighty-one studies satisfied inclusion criteria encompassing a total of 850222 patients, of whom 17.4% were hyponatremic. The identification of relevant abstracts, the selection of studies and the subsequent data extraction were performed independently by two of the authors, and conflicts resolved by a third investigator. Across all 81 studies, hyponatremia was significantly associated with an increased risk of overall mortality (RR=2.60[2.31–2.93]). Hyponatremia was also associated with an increased risk of mortality in patients with myocardial infarction (RR=2.83[2.23–3.58]), heart failure (RR=2.47[2.09–2.92]), cirrhosis (RR=3.34[1.91–5.83]), pulmonary infections (RR=2.49[1.44–4.30]), mixed diseases (RR=2.59[1.97–3.40]), and in hospitalized patients (RR=2.48[2.09–2.95]). A mean difference of serum [Na^+] of 4.8 mmol/L was found in subjects who died compared to survivors (130.1±5.6 vs 134.9±5.1 mmol/L). A meta-regression analysis showed that the hyponatremia-related risk of overall mortality was inversely correlated with serum [Na^+]. This association was confirmed in a multiple regression model after adjusting for age, gender, and diabetes mellitus as an associated morbidity. They concluded that even a moderate serum [Na^+] decrease is associated with an increased risk of mortality in commonly observed clinical conditions across large numbers of patients.

Clayton JA et al[24] Did a study on 105 patients. There was a wide range of aetiologies: diuretic therapy (loop and thiazide), congestive cardiac failure and liver disease were the most common, and 75.3% of patients had multiple causes. None of the 48% of patients whose history suggested a possible diagnosis of the syndrome of inappropriate anti-diuretic hormone (SIADH) met the generally accepted diagnostic criteria. Overall mortality was 20% during the index admission and 44.6% at follow-up, vs. 7.1% and 22%, respectively, for other patients admitted to the same directorate over the same time period (p < 0.001). Mortality was linked to aetiology, but not to reduced absolute serum sodium concentration at admission. They concluded that severe hyponatraemia in general medical patients is associated with a complex, multifactoral aetiology and a very poor prognosis.

Morten Schou et al[25] in retrospective analyses using data from the Trandolapril Cardiac Evaluation (TRACE) study – a randomized, double-blind, placebo-controlled trial of trandolapril in 1749 patients with MI and left ventricular ejection fraction (LVEF) ≤ 35%– associations between plasma sodium or hyponatremia and more than 15-year mortality risk were evaluated in multivariate Cox proportional hazard models including traditional clinical confounders before and after additional adjustment for renal function, use of diuretics or both. They found that during the extended follow-up time, 1462 patients died. Both hyponatremia [Hazard ratio: 1·30 (95% CI: 1·13–1·50), P < 0·001] and plasma sodium [Hazard Ratio pro mM increase in P-Na: 0·98 (95% CI: 0·96–0·99), P = 0·004] were associated with mortality risk, and the adjusted parameter estimates were not affected by additional adjustment for renal function, use of diuretics or both. They concluded that hyponatremia and plasma concentrations of sodium are associated

with long-term mortality risk in patients with MI complicated by left ventricular systolic dysfunction. Importantly, these associations are independent of renal function and use of diuretics.

H M McAlpin et al[26] observed the extent of neuroendocrine activation, its time course, and relation to left ventricular dysfunction and arrhythmias were investigated in 78 consecutive patients with suspected acute myocardial infarction. High concentrations of arginine vasopressin were found within six hours of symptoms, even in the absence of myocardial infarction (n = 18). Plasma catecholamine concentrations also were highest on admission, whereas renin and angiotensin II concentrations rose progressively over the first three days, not only in those with heart failure but also in patients with no clinical complications. Heart failure, ventricular tachycardia, and deaths were associated with extensive myocardial infarction, low left ventricular ejection fraction, and persistently high concentrations of catecholamines, renin, and angiotensin II up to 10 days after admission, whereas in uncomplicated cases concentrations had already returned to normal.

Vinay D. Madan et al[27] in their study of Patients (n=322) hospitalized with decompensated heart failure and serum sodium <135 mmol/L were evaluated. After hospital discharge, the first sodium value obtained within a 60- to 270-day period was recorded, and patients were classified into 3 groups, based on whether the serum sodium value increased (≥2 mmol/L), decreased (≤2 mmol/L), or remained unchanged (±1 mmol/L) relative to the baseline value. Kaplan–Meier survival curves were constructed to illustrate mortality as a function of change in sodium concentration over time, and a Cox-proportional hazards model was constructed to determine if change in serum sodium concentration predicted mortality after adjusting for relevant covariates. The mean age of the population was 66 years, 45% were women, and 55% were white. The mean baseline sodium level was 131 mmol/L and the mean ejection fraction was 32.5%. Two hundred twenty-two patients (68.9%) exhibited an increase in sodium during follow-up; in 57 patients (17.7%) the level was unchanged and in 43 patients (13.4%) there was a decrease in sodium level. During a median follow-up of 610 days, there was a strong positive association between change in sodium level and survival (P for trend <0.001); that is, increased sodium was associated with decreased mortality. In multivariable analysis, change in sodium concentration and higher blood urea nitrogen were the strongest predictors of mortality (both P<0.0001). They concluded that among patients hospitalized with heart failure and hyponatremia, change in serum sodium concentration over time is a strong predictor of long-term survival.

Dan Rusinaru,et al[28] assessed the impact of baseline natremia and changes in sodium level during hospitalization on 7-year outcome in 358 patients surviving a first hospitalization for HFPEF. On admission, hyponatremia (sodium <136 mEq/L) was diagnosed in 91 patients (25.4%). Baseline hyponatremia was associated with an increased risk of overall (hazard ratio [HR] 1.98, 95% confidence interval [CI] 1.50 to 2.61) and cardiovascular mortality (HR 1.92, 95% CI 1.36 to 2.73). After adjustment for covariates, the relations remained significant. Seven-year relative survival (observed/expected survival) of hyponatremic patients was lower than that of patients with normal baseline natremia (31% vs 63%). The association of sodium and risk of death appeared linear across quartiles of baseline natremia and slightly stronger at the lowest of sodium values. At discharge, 45 patients with low baseline sodium had normal natremia (49%) and 46 had persistent hyponatremia (51%). Patients with normalized natremia at discharge had excess 7-year overall mortality compared with the normonatremic group (HR 1.50, 95% CI 1.03 to 2.19). Patients with persistent hyponatremia had the lowest 7-year survival (HR 2.67, 95% CI 1.89 to 3.78). After adjustment for covariates, patients with persistent hyponatremia had an impressive increase in relative risk of overall mortality compared with patients with normal baseline natremia. In conclusion, hyponatremia is a powerful predictor of long-term mortality in patients with HFPEF. Patients with HFPEF and persistent hyponatremia are at high risk of adverse outcomes.

Vinod Wali M et al[29] in their study of 100 patients found that there was statistically significant decrease in sodium and potassium levels in across all age groups & in both sexes of study group compared to control group. Significant high level of sodium was observed in AMI patients who are smokers and AMI patients with Diabetes whereas the level was low in AMI patients with hypertension. They concluded that decrease in sodium level was due to hypoxia and ischaemia, which increase the permeability of sarcolemma to sodium which was influenced by the catecholamine levels which are elevated in early acute myocardial infarction.

Amita A Gandhi et al[30] in their study of 50 patients found that there was increased mortality in patients with hyponatremia.

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Mudaraddi Rakesh et al[31] in their study of 120 patients found that there was statistically significant decreased levels of serum sodium ($p<0.001$)

Masanori Konishi, et al[32] in their study, 531 patients with ADHF were normonatremic (serum sodium concentration [Na] ≥ 135 and ≤ 145 mmol/L) at admission. The 531 patients were divided into 2 groups: the non-developed group, who remained normonatremic at discharge (n = 455), and the developed group, who had progressed to hyponatremia (Na < 135 mmol/L) at discharge (n = 76). The cardiac event–free rate after 12 months was significantly lower in the developed group than in the non-developed group (22% vs. 71%; P < .0001). Although their baseline levels of brain natriuretic peptide and left ventricular ejection fraction were similar before discharge, the patients in the developed group exhibited higher fractional excretion of sodium and received higher doses of diuretics than did those in the non-developed group. They concluded that progression to hyponatremia during hospitalization is a robust predictor of poor cardiac prognosis in ADHF patients who were normonatremic at admission.

III)AIMS & OBJECTIVES

1. To study the prevalence of hyponatremia in acute ST elevation in myocardial infarction.
2. To study the prognostic importance of hyponatremia in acute ST elevation in myocardial infarction observed as

- In-hospital mortality
- Development of cardiac failure
- Development of arrhythmia

IV)MATERIALS & METHOD

1) Study area: Sri Ramakrishna hospital, Coimbatore.

2)Study population: Patients admitted in Department of Medicine.

We have 1 medical ward, 1 cardiology ward and 1 CCU. All combined approximately 800 patients are admitted each month, out of which acute myocardial infarction constitutes nearly 10% of which approximately 50% to 60% present with ST elevation MI.

3)Sample size: 212 patients.

Incidence rate of hyponatremia in acute STEMI is 32% according to Goldberg et al.

$$N=\frac{4pq}{d^2}$$

p= 32%, q=100-32= 68%.

d=20% of prevalence

$$d=\frac{20 \times 32}{100}=6.4$$

$$So,\ n=\frac{4 \times 32 \times 68}{6.4 \times 6.4}=212$$

n= 212

4)Study design: Observational, prospective cross sectional, hospital based, time bound study.

5)Study duration: May 2015 to april 2016(12 months).

6)Data collection method:

- The study was carried out on subjects presenting with acute ST-elevation myocardial infarction.
- Information was collected through prepared proforma for each subject.
- Qualifying subjects were undergoing detailed history including history of present illness, past illness, drug history andpersonal history. Relevant physical examinationwere done & recorded. All the patients were treatedwith thrombolytics or primary angioplasty.
- Treatment of complications was done as the clinical situation warrants.
- For each subject venous blood samples was drawn for plasma sodium concentration obtained on admission and at 24 hours and at discharge. Serum lipid profile weremeasured on admission.
- HbA1C by Chromatography D10 by Vitros 250.
- Fasting lipid profile was done by colorimetric enzymetric method by Vitros 250.
- Quantitative Troponin T was done by immunoassay by Vitros 250.
- Electrolytes were done by direct Ion selective electrode method by Vitros 250.
- 2D transthoracic echocardiography by Philips IE 33(2008).
- Chest X ray by digital/ computerised machine from GE healthcare.
- 12 lead electrocardiography was done.

7)Method of measurement of outcome of interest:

- Serum sodium level was measured for all subjects at admission, 24 hours and at discharge. Serum sodium levelof <135 mEq/L was considered as hyponatremia.
- Myocardial infarction was assessed by clinically, ECG, Troponin T, 2D echo.
- All the subjects werefollowed up till discharge or till mortality. Parameters ofoutcome were heart failure, arrhythmia and in-hospital mortality.

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- Occurrence of heart failure was followed upclinically by Killip class, Chest X-ray and by 2D Echocardiography.

Killip class (haemodynamic class):
Killip I- without evidence of heart failure
Killip II- bibasal rales,S3 gallop, elevated Jugular venous pressure
Killip III- pulmonary edema
Killip IV- cardiogenic shock

- Occurrence of arrhythmia will be followedup clinically and by doing 12 lead Electrocardiography.

8) Statistical methods:

- All collected data were checked and verified thoroughly to reduce inconsistency. Then data were edited, coded and entered into SPSS 19 PC program.
- Two groups of patient were compared using Chi-square test.
- For all analyses, p value of less than 0.05 was considered statistically significant.
- Results are presented in the form of tables and graphs

9) Criteria:

- Inclusion criteria:

All acute myocardial infarction patients presenting to department of medicine, Sri Ramakrishna Hospital, Coimbatore with

1. Age more than 16 years of age of both sexes
2. Chest pain more than 20 minutes
3. Characteristic ECG changes consisting of

I. ST elevation 1 mm in ≥ two contiguous limb leads.
II. ST elevation ≥ 2mm in ≥ two contiguous precordial leads

- Exclusion criteria:

1. Patients diagnosed as acute coronary syndrome without ST elevation.
2. Non Q wave MI, congestive cardiac failure, past h/o CAD.
3. Cirrhosis of liver, nephrotic syndrome, renal failure.
4. Patients with chest infection and bronchogenic carcinoma.
5. Patients on diuretics, anti-depressants and anti-epileptics will be excluded

V)OBSERVATIONS

TABLE 1 AGE DISTRIBUTION OF POPULATION

AGE GROUP	DISTRIBUTION
25-34	5.2 %
35-44	13.7%
45-54	31.1%
55-64	25.5%
65-74	16.5%
75-84	8.05%

TABLE 2 GENDER DISTRIBUTION OF STUDY POPULATION

	MALE	FEMALE
HYPONATREMIA	56%	44%
NORMONATREMIA	53.3%	46.7%

TABLE 3 SMOKING AND ITS ASSOCIATION WITH HYPONATREMIA

	SMOKING YES	SMOKING NO

HYPONATREMIA	40%	60%
NORMONATREMIA	38%	62%

TABLE 4 ALCOHOL AND ITS ASSOCIATION WITH HYPONATREMIA

	ALCOHOL YES	ALCOHOL NO
HYPONATREMIA	40%	60%
NORMONATREMIA	36.5%	63.5%

TABLE 5 DYSLIPIDEMIA AND ITS ASSOCIATION WITH HYPONATREMIA

	DYSLIPIDEMIA YES	**DYSLIPIDEMIA NO**
HYPONATREMIA	36%	64%
NORMONATREMIA	24.1%	75.9%

TABLE 6 HYPERTENSION AND ITS ASSOCIATION WITH HYPONATREMIA

	HYPERTENSION YES	**HYPERTENSION NO**
HYPONATREMIA	36%	64%
NORMONATREMIA	46.7%	53.3%

TABLE 7 DIABETES AND ITS ASSOCIATION WITH HYPONATREMIA

	DIABETES YES	**DIABETES NO**
HYPONATREMIA	42.7%	57.3%
NORMONATREMIA	27%	73%

TABLE 8 FAMILY H/O CAD AND ITS ASSOCIATION WITH HYPONATREMIA

	FAMILY H/O CAD YES	FAMILY H/O CAD NO
HYPONATREMIA	34.7%	65.3%
NORMONATREMIA	33.6%	66.4%

TABLE 9 MI AND ITS ASSOCIATION WITH HYPONATREMIA

	HYPONATREMIA	NORMONATREMIA
ANTERIOR WALL MI	44%	43.1%
INFERIOR WALL MI	40%	44.5%
OTHER MI	10.7%	9.5%
ANTERIOR AND INFERIOR WALL MI	4%	2.2%
INFERIOR AND OTHER MI	1.3%	7%

TABLE 10 CARDIAC FAILURE AND ITS ASSOCIATION WITH HYPONATREMIA

	HYPONATREMIA	NORMONATREMIA
NO CCF	68%	92%
KILLIP 1/2	14.7%	2.9%
KILLIP 3/4	17.3%	5.1%

TABLE 11 ARRHYTHMIA AND ITS ASSOCIATION WITH HYPONATREMIA

	HYPONATREMIA	NORMONATREMIA
ARRHYTHMIA YES	18.7%	2.9%
ARRHYTHMIA NO	81.3%	97.1%

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GRAPH 1ARRHYTHMIA AND ITS ASSOCIATION WITH HYPONATREMIA

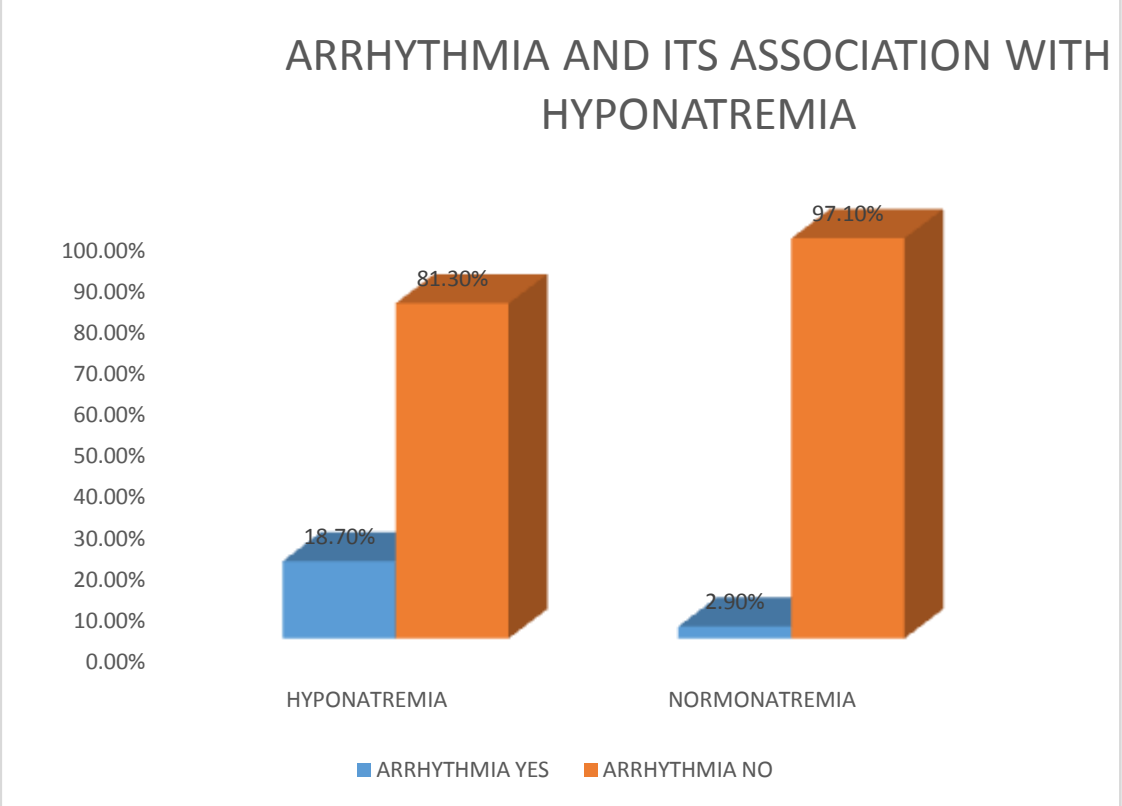

TABLE12 IN-HOSPITAL DEATHS AND ITS ASSOCIATION WITH HYPONATREMIA

	HYPONATREMIA	NORMONATREMIA
IN HOSPITAL DEATHS YES	14.7%	2.2%
IN HOSPITAL DEATHS NO	85.3%	97.8%

TABLE 13 HYPONATREMIA IN STUDY POPULATION

	HYPONATREMIA AT ADMISSION	HYPONATREMIA AT 24 HRS	HYPONATREMIA AT DISCHARGE
HYPONATREMIA GROUP	64%	92.8%	46.7%

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GRAPH 2 HYPONATREMIA IN STUDY POPULATION

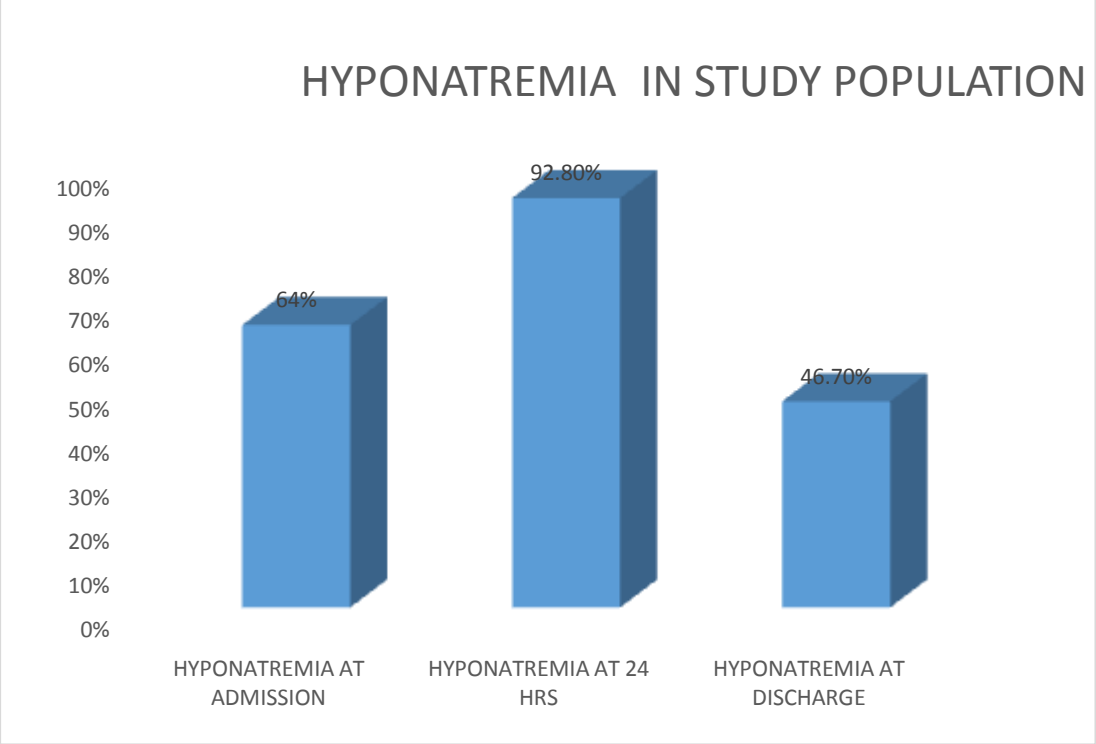

TABLE 14 TREATMENT IN STUDY POPULATION

	HYPONATREMIA	NORMONATREMIA
THROMBOLYSIS	38.7%	39.4%
ANGIOPLASTY	61.3%	60.6%

TABLE 15 AVERAGE OF PARAMETERS IN TWO POPULATION GROUP

PARAMETERS	HYPONATREMIA GROUP	NORMONATREMIA GROUP
HEART RATE	87.31±21.44	88.91±99
HbA1C	8.26±3.51	7.55±3.33
EJECTION FRACTION	46.89±6.19	45.51±7.43
PACK YEARS	5.47±7.077	5.33±7.16
UNITS OF ALCOHOL/WEEK	6.83±9.25	6.50±9.17
DAYS IN HOSPITAL	4.47±1.46	3.99±1.60

AT ADMISSION SODIUM LEVEL	130.36±7.14	139.66±2.77
AT 24 HRS SODIUM LEVEL	125.55±5.44	139.68±2.738
AT DISCHARGE SODIUM LEVEL	135.13±3.10	139.54±2.85

TABLE 16 MEAN SODIUM LEVELS IN POPULATION GROUP

	MEAN SODIUM LEVEL AT ADMISSION
SMOKER	136.57±6.43
ARRHTYHMIA	133.67±6.92
KILLIP CLASS I/II	134.20±7.72
KILLIP CLASS III/IV	131.35±9.22
IN HOSPITAL DEATHS	131.64±6.85

TABLE 17 BASELINE CHARACTERISTICS OF STUDY POPULATION

	HYPONATREMIA	**NORMONATREMIA**	**P VALUE**
SMOKING	40%	38%	<0.05
ALCOHOL	40%	36.5%	<0.05
DYSLIPIDEMIA	36%	24.1%	<0.05
HYPERTENSION	36%	24.1%	<0.05
DIABETES	42.7%	27%	<0.05
FAMILY H/O CAD	34.7%	33.6%	<0.05
ARRHYTHMIA	18.7%	2.9%	<0.05
KILLIP 1/2	14.7%	2.9%	<0.05
KILLIP 3/4	17.3%	5.1%	<0.05

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IN HOSPITAL DEATH	14.7%	2.2%	<0.05
THROMBOLYTICS	38.7%	39.4%	>0.05
ANGIOPLASTY	61.3%	60.8%	<0.05

VI)DISCUSSION

In this study out of 212 cases, maximum number of cases was seen in age group of 45-54 year which came upto 31.1%. Of this the number of males who presented with hyponatremia were56% vs 53.3% who were normonatremic. Prevalence of hyponatremia was 35.4%. Smoking was present in 40% hyponatremic patients compared to 38% normonatremic patients. Alcohol intake was present in 40% patients who presented with hyponatremia compared to 36.5% who were normonatremic. Dyslipidemia was present in 36% of patients who had hyponatremia vs 24.1% who presented with normal serum sodium levels. Hypertension was seen in 36% of hyponatremics compared to 46.7% who had normonatremia. Diabetes was seen in 42.7% in patients who had hyponatremia compared to 27% who were normonatremic. Family h/o CAD was present in 34.7% who were hyponatremic and 33.6% who were normonatremic.

Anterior wall MI was seen in 44% of hyponatremics compared to 43.1% who were normonatremic. Inferior wall MI was seen in 40% of patients who had hyponatremia compared to 44.5% whohad normonatremia. Other MI was seen in 10.7% patients who had hyponatremia compared to 9.5% who had normonatremia. Anterior and inferior wall MI together was seen in 4% patients who had hyponatremia compared to 2.2% who had normonatremia. Inferior and other MI together was seen in 1.3% who were hyponatremic compared to 7% who were normonatremic.

Killip class I/II cardiac failure was seen in 14.7% of patients who were hyponatremic compared to 2.9 % who were normonatremic. Killip class III/IV cardiac failure was seen in 17.3% who were hyponatremic compared to 5.1% who were normonatremic. Suresh Harsoor et al[4] observed heart failure heart failure of 72% vs. 36%. Klopotowski[5] et al observed that hyponatremics had heart failure 27.8% vs. 18.4%.

Arrhythmia was seen in 18.7% who were hyponatremic compared to 2.9% who were normonatremic. Suresh Harsoor et al[4] observed arrhythmias 30% vs 6% in hyponatremic vs normonatremic.

In-hospital deaths was seen in 14.7% who were hyponatremia compared to 2.2% who were normonatremic. Fahad aziz et al[3] in their study sample of 128 found that in-patient mortality was 6.2% (3/55) of patients without hyponatremia, 19.8% (7/36) of patients with hyponatremia. Suresh Harsoor et al[4] observed that hyponatremics had higher rates of in-hospital mortality (24%vs 6%p<0.01). Klopotowski[5] et al observed that . hyponatremics had higher rates of in-hospital mortality 13.5% vs. 3.8%.

On admission, Hyponatremia was seen in 64% cases at admission, 92.8% cases at 24 hours of admission, 46.7% cases at the time of discharge. Goldberg A et al[7] in their study of 978 patients observed that Hyponatremia, was present during admission in 108 patients (11.0%).

Thrombolysis was done in 38.7% patients who had hyponatremia compared to39.4% who were normonatremic. Primary angioplasty was done in 61.3% who had hyponatremia compared to 60.6% who had normonatremia.

Mean heart rate in hyponatremia group was 87 beats per minute in patients who had hyponatremia compared to 88 beats per minute in normonatremia. Mean HbA1C was 8.3% in patients who had hyponatremia compared to 7.6% who had normonatremia. Mean ejection fraction was 47% in hyponatremia cases compared to 46% who had normonatremia. Mean pack years was 6 in hyponatremic patients compared to 5 in normonatremics. Mean duration of hospital stay in patients who had hyponatremia was 4.5 compared to 4 days in normonatremics. Mean admission sodium level was 130 mEq/l in the patients who had hyponatremia compared to 140mEq/l in normonatremic patients. Mean 24 hours sodium level was 126 mEq/l compared to 140 mEq/l. Mean discharge sodium level was 135 mEq/l compared to 140mEq/l in normonatremics.

Mean sodium level at admission among smokers was 137 mEq/l. Among arrhythmics mean sodium level was 134 mEq/l. Mean sodium level was 134 mEq/l in patients who presented with cardiac failure of Killip class I/II. Killip class II/IV cardiac failure patients had mean sodium level of 131 mEq/l. In hospital death patients had mean sodium levels of 132 mEq/l

VII)SUMMARY

Prevalence of hyponatremia was 35.4%.

Arrhythmia was seen in 18.7% who were hyponatremic compared to 2.9% who were normonatremic

In-hospital deaths was seen in 14.7% who were hyponatremia compared to 2.2% who were normonatremic.

Killip class I/II cardiac failure was seen in 14.7% of patients who were hyponatremic compared to 2.9 % who were normonatremic. Killip class III/IV cardiac failure was seen in 17.3% who were hyponatremic compared to 5.1% who were normonatremic.

Hyponatremia was significantly associated with arrhythmia, cardiac failure and in- hospital mortality.

Hyponatraemia on admission in patients with acute ST-Elevation MI is a strong independent predictor of prognosis. Prognosis worsens with increasing severity of hyponatraemia. Plasma sodium levels may serve as a simple marker to identify patient at high risk..

VIII)LIMITATIONS

This was a single center study with a low number of patients, thus posing the possible risk of patient selection bias. There were differences in co-morbid conditions, such as gender and age, between the patients with and without hyponatremia which might have influenced the results. In future, studies undertaken with higher study sample could provide a detailed picture of the prognostic signifance of hyponatremia in acute STEMI.

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