ORIGINAL ARTICLE

Evaluation of Electrolyte Levels in Patients with Acute Coronary Syndrome

Amna Saleem[1*], Muhammad Farooq[2], Noor ul Hadi[1], Jehandad Khan[1]

ABSTRACT

Objective: The study aims to assess electrolyte imbalances in patients diagnosed with acute coronary syndrome (ACS) and to explore whether these imbalances are associated with poor clinical outcomes in ACS.

Study Design: Cross-sectional analytical study.

Place and Duration of Study: The study was conducted at the Department of Cardiology, Mardan Medical Complex Mardan, Pakistan from September 2023 to December 2023.

Methods: A cross-sectional study on 360 patients was conducted using the WHO sample size calculator. Patients from both genders were included in this study. Demographic information of patients was obtained. Serum electrolyte levels were done from the hospital's laboratory. Information was collected in predesigned proforma. Sampling was done via non-probability convenient sampling. Informed consent was taken from all patients, ensuring confidentiality and the fact that there will be no risk to the patients who are taking part in this study.

Results: Unstable angina was found in 60 (16.7%), in Non-ST-elevation myocardial infarction (NSTEMI) 154 (42.8%) and in ST elevation myocardial infarction (STEMI) 146 (40.6%) patients. Hyponatremia was found to be in 108 (30%) patients, and it was associated in causing heart failure in around 58 (16.11%) patients. Hypokalemia was present in 65 (18%) patients and showed VT in 28 (7.77%) cases. Hypomagnesemia (31.9%) caused heart failure in 30 (8.33%) patients followed by VT in 26 (7.22%), cardiogenic shock in 24 (6.66%). All electrolyte disturbances of the current study carried statistical significance in causing complications i.e. *P*-value <0.001.

Conclusion: We concluded that electrolyte disturbances are common in patients with acute coronary syndrome, and they carry adverse outcomes with respect to ACS related complications and mortality.

Keywords: *Acute Coronary Syndrome, Electrolytes, Troponins.*

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Introduction

Acute Coronary Syndrome (ACS), otherwise known as type 1 myocardial infarction encompasses Non-ST-elevation myocardial infarction (NSTEMI), ST-elevation myocardial infarction (STEMI), and unstable angina and is linked to rupture of plaque followed by thrombus formation and coronary occlusion resulting in a decrease in blood supply to the heart. More than 7 million individuals in the world are diagnosed with acute coronary syndrome every year.[1,2]

Electrolytes play a pivotal role in body functioning. Na-K ATPase pump has significant application In cardiovascular physiology so it's malfunctioning can result in diverse pathologic conditions.[3,4] Magnesium is an important mineral for maintaining and regulating cardiovascular health and its deficiency has been thought to involve in causing endothelial

[1]*Department of Cardiology*
Mardan Medical Complex (MTI) Mardan, Pakistan
[2]*Department of Medicine*
Combined Military Hospital (CMH) Nowshera, Pakistan

Correspondence:
Dr. Amna Saleem
Department of Cardiology
Mardan Medical Complex (MTI) Mardan, Pakistan
E-mail: aminasaleem1234@gmail.com

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dysfunction, hypertension, diabetes mellitus, and coronary artery disease.[5,6] Chloride is an important ion involved in maintaining cell volume by stabilizing cell membrane potential, pH, and fluid secretion.[7] Antithrombotic therapy including aspirin, P2Y12 inhibitors as evidenced by CURE trial and anticoagulation is the mainstay of management after acute coronary syndromes in clinical practice guidelines.[8] The purpose of this study is to evaluate dyselectrolytemia in the setting of acute coronary syndrome among patients admitted to the cardiology department of Mardan Medical Complex, KPK. In order to determine high-risk individuals, this study would ascertain the correlation between ACS and gender. Also, there is a scarcity of research in our setting regarding the association of electrolyte disturbances with poor outcomes in ACS patients with respect to complications and in-hospital mortality, so, this will be assessed in the current study.

Methods

This cross-sectional study at the Department of Cardiology, Mardan Medical Complex Mardan, Pakistan from September 2023 to December 2023. After getting approval from the Ethical Review Committee of the institute dated: 12th July 2023 vide letter no: 0347/BKMC. The sample size was calculated using the WHO sample size calculator taking a confidence interval of 95%, a margin of error of 5%, and a reported prevalence of ACS as 36.9%.[9] The approximate sample size was 358. All included participants gave written and verbal informed consent.

Inclusion Criteria: Individuals aged more than 18 years, a working diagnosis of ACS, serum electrolytes, and Troponin I done at admission were included in this study. Patients qualifying two of the following three points were diagnosed as ACS in our study. 1) Clinical presentation of the patient with chest pain in accordance with ACS 2) raised troponin I above the normal range 0-29 pg/ml 3) Coronary angiography showing lesion consistent with ACS. Patients were further categorized as STEMI, NSTEMI, and unstable angina (USA).

Exclusion Criteria: Patients with chest pain not corresponding to ACS, patients having inflammatory conditions, infections, history of bleeding diathesis, and malignancy were excluded from this study.

Detailed history including co-morbidity was taken from all individual participants. All required laboratory investigations including serum electrolytes (sodium, potassium, chloride, and magnesium) and troponin-I were carried out on admission. Blood samples were taken very carefully by the nursing staff to prevent tube shaking and minimize the error.

Data analysis was done via Statistical Package for Social Sciences version 20.00. Continuous variables were expressed as mean±SD. Frequencies (percentages) were calculated for all the categorical variables like sex, diagnosis, diabetes mellitus, hypertension, troponin I, electrolytes (Sodium, Potassium, Chloride, Magnesium) complications, and mortality. Categorical variables were compared using the Chi-square test. Also, Pearson's analysis was performed to assess possible correlation between different variables.

Results

A total of 360 participants were part of this study. General characteristics of study groups are summarized in Table-1. The age range was 31 - 89 years with a mean of 54.83 ±11.16. Our study groups were classified into three groups based on a primary diagnosis of unstable angina 60 (16.7%), STEMI 150 (40.6%), and NSTEMI 154 (42.8%), (Figure.1), and its relationship was assessed with gender, hypertension, diabetes mellitus, and electrolyte levels. as shown in Table-1. We found out that 174 (48.33%) out of 360 patients had normal troponin while raised troponin levels were seen in 77 (21.38%) STEMI patients, 104 (28.88%) of NSTEMI individuals and 5 (1.38%) patients with unstable angina. Chi-square value was statistically significant (P <0.001).

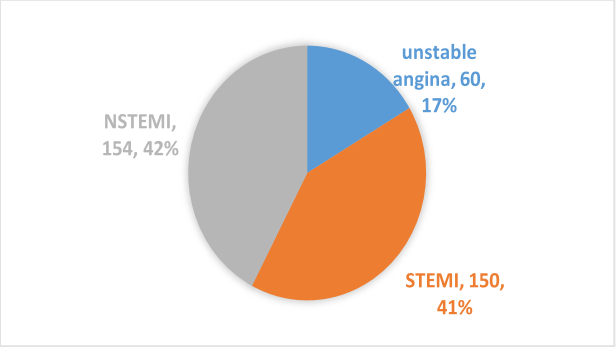

Fig. 1: Presentation of Acute Coronary Syndrome

Table-1: Baseline characteristics

Baseline Characteristics		Diagnosis			Chi-square value
		Unstable angina n (%)	NSTEMI n (%)	STEMI n (%)	
Gender	Males = 232 (64.4%)	40 (11.11%)	99 (27.5%)	93 (25.83%)	0.920
	Females=128 (35.6%)	20 (5.55%)	55 (15.27%)	53 (14.72%)	
Electrolytes					
Sodium					
Normal	246 (68.3%)	60 (16.66%)	124 (34.44%)	62 (17.22%)	<0.001
Decreased	108 (30%)	0	30 (8.33%)	78 (21.66%)	
Increased	6 (1.7%)	0	0	6 (1.66%)	
Potassium					
Normal	260 (72.2%)	57 (15.83%)	105 (29.16%)	98 (27.22%)	0.001
Decreased	65 (18%)	3 (0.83%)	31 (8.61%)	31 (8.61%)	
Increased	35 (9.7%)	0	18 (5%)	17 (4.72%)	
Chloride					
Normal	299 (83.1%)	60 (16.66%)	125 (34.72%)	114 (31.66%)	0.001
Decreased	61 (16.9%)	0	29 (8.05%)	32 (8.88%)	
Magnesium					
Normal	237 (65.8%)	57 (15.83%)	98 (27.22%)	82 (22.77%)	<0.001
Decreased	115 (31.9%)	3 (0.83%)	48 (13.33%)	64 (17.77%)	
Increased	I8 (2.2%)	0	8 (2.22%)	0	
Hypertension					
Present	177 (49.2%)	26 (7.22%)	65 (18.05%)	86 (23.88%)	0.009
Absent	183 (50.8%)	34 (9.44%)	89 (24.72%)	60 (16.66%)	
Diabetes Mellitus					
Yes	178 (49.4%)	14 (3.88%)	88 (24.44%)	76 (21.11%)	<0.001
No	182 (50.6%)	46 (12.77%)	66 (18.33%)	70 (19.44%)	
NSTEMI-Non ST Elevation Myocardial Infarction					
STEMI-ST Elevation Myocardial Infarction					

Derangement of electrolyte levels showed poor prognostic outcomes in terms of mortality (Table-2).

Hyponatremia was found to be in 108 (30%) patients and it was associated in causing Heart failure in around 58 (16.11%) patients, VT in 10 (2.77%), cardiogenic shock in 23 (6.38%) and AV block in 9 (2.5%) of patients.

Hypokalemia was present in 65(18%) patients and showed VT in 28 (7.77%) cases. Hyperkalemia was found to cause cardiogenic shock in 22 (6.11%) patients. Disturbances in magnesium levels i.e hypomagnesemia (31.9%) caused heart failure in 30 (8.33%) patients followed by VT in 26 (7.22%), cardiogenic shock in 24 (6.66%) and AV block in 17 (4.72%) individuals. Hypochloremia occurred in 61 (16.9%) patients that caused heart failure in 18 (5%) and cardiogenic shock in 22 (6.11%) cases. In a nutshell, all electrolyte disturbances of a current study carried statistical significance in causing complications i.e. *P*-value <0.001.

Discussion

The primary aim of our study was to evaluate that if electrolyte disturbances primarily sodium, magnesium, potassium and chloride occur in

Table-2: Effect of deranged electrolytes on mortality

Parameters		Mortality n (%)		Chi-square value
		Yes	No	
Sodium	Normal	14 (3.88%)	232 (64.44%)	<0.001
	Decreased	31 (8.61%)	77 (21.38%)	
	Increased	3 (0.83%)	3 (0.83%)	
Potassium	Normal	3 (0.83%	257 (71.38%)	<0.001
	Decreased	19 (5.27%)	46 (12.77%)	
	Increased	26 (7.22%)	9 (2.5%)	
Chloride	Normal	27 (7.5%)	272 (75.55%)	<0.001
	Decreased	21 (5.83%)	40 (11.11%)	
Magnesium	Normal	2 (0.55%)	235 (65.27%)	<0.001
	Decreased	46 (12.77%)	69 (19.16%)	
	Increased	0	8 (2.22%)	

patients with acute coronary syndrome. Additionally, we sought to determine whether these derangements are linked to poor outcomes in terms of in hospital complications and mortality. Also we determined the prevalence of diabetes and hypertension in patients of ACS. We observed that males were predominantly in our study population with a prevalence of 64.4% while females were 35.6%.

Hyponatremia occurred in 108 (30%) patients in our study and was associated with various complications like heart failure that happened in 58 (53.73%) and cardiogenic shock in 23 (21.2%) patients. Mortality occurred in 31 (28.7%) of hyponatremic individuals. These results are comparable to one of the studies in which hyponatremia occurred in around 16% of the study participants leading to more number of complications like heart failure and mortality. Also, this risk was increased with increasing severity of hyponatremia.[10] Another systematic meta-analysis stated that the hyponatremia had a notable value in short term and long term prognosis after acute coronary syndrome and its occurrence is associated with an overall increase in mortality than non-hyponatremic patients.[11] One of the cross-sectional study also demonstrated a 50.2 % prevalence of hyponatremia in ACS patients with an overall increase in mortality secondary to complications like heart failure.[12] Potassium disturbance was also not an uncommon condition in current study as hypokalemia occurred in 18% and hyperkalemia occurred in around 10% of ACS patient. These disturbances were associated with ventricular tachycardia that was present in 28 (43%) individuals and mortality that occurred in 45 (12.5%) individuals. One of the case-control studies demonstrated that hypokalemia was prevalent among 24% of acute MI patients in comparison to normal healthy individuals. Not only this, but hypokalemia was also more frequently associated with VT and VF. In turn, mortality was also associated with hypokalemia.[13-15]

We found out that hypochloremia occurred in 61 (16.94%) patients and was associated with complications specifically heart failure (29.50%). These results are comparable to those studied in one systematic review and meta-analyses where the incidence of decreased levels of chloride was a common finding in heart failure and causing mortality.[16] Magnesium levels were significantly decreased in 115 (31.94%) in current study. Adding on, hypomagnesemia was associated with more complications like VT, cardiogenic shock, and AV block. Likewise, another study exhibited a 30% prevalence of hypomagnesemia which propagates to adverse outcomes like VT and an overall increase in mortality.[17,18] The Current study demonstrated a 49% prevalence of diabetes in ACS patients which was statistically significant. Babes E and et al also studied 30% prevalence of diabetes mellitus and its significant association with ACS.[19] We could not find significant relationship between hypertension and ACS. This has also been shown in one of the meta-analysis of patients without standard modifiable risk factors (SMuRF less) that patients without traditional risk factors carry poorer prognosis in ACS.[20]

Conclusion

We concluded that electrolyte disturbances are common in patients with acute coronary syndrome,

and they carry adverse outcomes with respect to ACS related complications and mortality.

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Authors Contribution

AS: Idea conception, study designing, data collection, data analysis, results and interpretation, manuscript writing and proofreading

MF: Idea conception, study designing, data analysis, results and interpretation, manuscript writing and proofreading

NH: Study designing, data collection, manuscript writing and proofreading

JK: Study designing, data collection, manuscript writing and proofreading