Serum Electrolyte Levels among Hospitalized Cases of Acute Coronary Syndrome in A Tertiary Care Hospital

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Original Research Article

ABSTRACT

Hypomagnesemia is common in hospitalized patients, especially in the elderly with acute coronary syndrome and/or those with chronic heart failure. The present study was carried out in the department of Medicine, Peoples Medical College and research centre, Bhopal from November 2017 to October 2018. Sixty patients of acute coronary syndrome diagnosed by clinical examination and ECG criteria were included in the study. Arrhythmias and conduction blocks were noted on continues ECG monitoring in ICU. These patients were analyzed for serum magnesium, calcium, sodium and potassium concentration on admission. It was found that serum magnesium and serum sodium are significantly changed between cases and controls($p < 0.05$) but serum calcium and potassium are not significantly changed ($p > 0.05$).

KEY WORDS: acute coronary syndrome (ACS); non ST elevation myocardial infarction (NSTEMI); ST elevation myocardial infarction (STEMI); unstable angina (UA)

INTRODUCTION:

The word acute coronary syndrome (ACS) means any group of clinical symptoms compatible with acute myocardial ischemia (AMI) and covers variety of clinical conditions including unstable angina (UA), non ST-segment elevation myocardial infarction (NSTEMI) and ST-segment elevation myocardial infarction (STEMI). Unstable angina and NSTEMI are intricately related conditions having similar clinical presentations are same although differing in severity only[1,2,3]. A diagnosis of NSTEMI is made when the ischemia is severe enough to cause myocardial damage that results in the release of a biomarker of myocardial necrosis into the circulation like troponins T or I, or muscle and creatine kinase [CK-MB]. Whereas the patient is assumed to have experienced UA, if no such biomarker is detected in the blood hours after initial complaints of ischemic chest pain. Unstable angina shows 3 principal presentations: (1) resting angina (usually lasting >20 minutes), (2) new-onset (<2 months previously) severe angina, and (3) a pain character which is increasing in intensity, duration, frequency, or any combination of these factors[4,5,6].

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MATERIALS AND METHODS:

The study was conducted in ICU ward in department of Medicine, Peoples hospital, Bhanpur Bhopal. Ethical approval for the present study was obtained from the institutional review board. This study included clinically diagnosed 60 case of acute coronary syndrome and 60 age and gender matched healthy controls selected from general population for estimating serum magnesium, serum calcium, serum sodium and serum potassium concentrations. Matching was done after completion of study. Electrocar-diographic recordings of all these patients were taken.

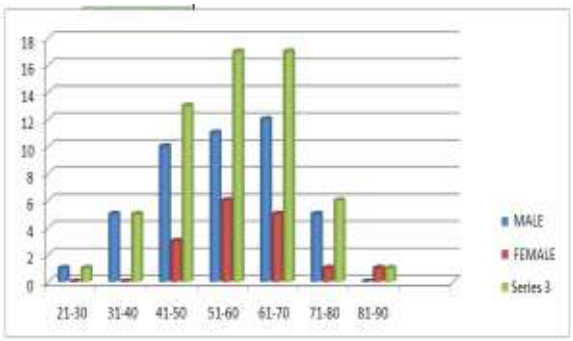
RESULTS:

Age of patients in study group ranged from 21 - 90 years of 60 patients. Forty four patients (73.33 %) were Male, whereas sixteen (26.66%) were Female. Male Female ratio was 3:1. The incidence of ACS was more in males as compared to females. Both in males & females, increased incidence of ACS was found between 51 - 70 years (50.96%) (Table 1, Graph 1) The age of controls ranged from 21-90 years. Forty four patients (73%) were males & 16 patients (27%) were females with male: female ratio of 3:1. 46 patients (77%) out of 60 cases belonged to age group of 41-70 years. (Table 2, Graph 2).

Out of 60 patients STEMI had developed in 21 patients (35%). 20 patients (33%) developed

Table 1: Age and Gender distribution of Study Group.

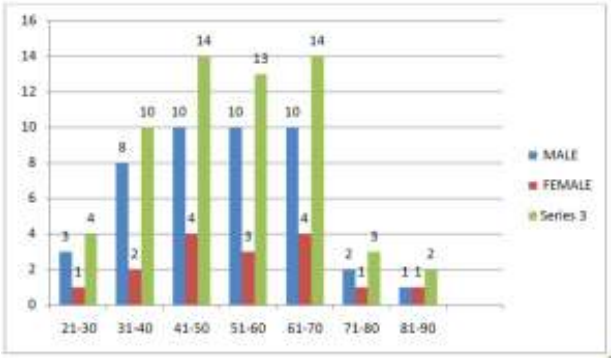
Age Group	Male	Female	Total
21 - 30	1	0	1
31 - 40	05	0	5
41 - 50	10	3	13
51 - 60	11	06	17
61 - 70	12	05	17
71 - 80	05	1	06
81 - 90	00	1	01
Total	44	16	60



Graph 1: Age and Gender distribution of Study Group.

Table 2: Age and Gender distribution of Control Group.

Age Group	Male	Female	Total
21 - 30	03	01	04
31 - 40	08	02	10
41 - 50	10	04	14
51 - 60	10	03	13
61 - 70	10	04	14114
71 - 80	02	01	03
81 - 90	01	01	02
Total	44	16	60



Graph 2: Age and Gender distribution in Control Group

unstable angina. 19 patients (32%) developed NSTEMI. (Table 3, Graph 3) Out of 60 patients of ACS, 29 patients (48.33%) had hypocalcemia, 19 patients (31.66%) developed Normocalcemia, 12 patients (20%) developed hypercalcemia. Out of 29 patients of hypocalcemia, 10 patients are of STEMI (16.67%), 19 (31.66%) patients are of unstable Angina and NSTEMI. Out of 12 patients of hypercalcemia, 6 patients are of STEMI (50%), 6 patients are of unstable Angina and NSTEMI (50%).(Table 4, Graph 4)

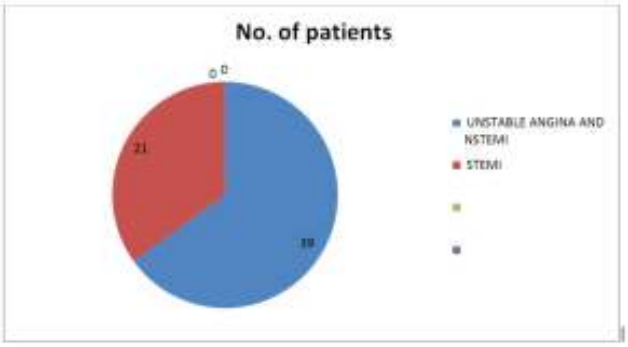
Out of 60 patients of ACS, 56 patients (93.33%) had normal potassium level. Only 3 (5%) patients had Hypokalemia. Out of 21 patients of STEMI, 2 patients (9.52%) had hypokalemia and 18 patients (85.71%) had normokalemia. Only one patient developed hyperkalemia. Out of 39 patients of unstable angina and NSTEMI, 38 patients (97.43%) had normokalemia and 1 patient (2.56%) had hypokalemia. Out of 60 patients of ACS, 29 patients (48.33%) had hypocalcemia. 19 patients (31.66%) developed normocalcemia, 12 patients (20%) developed hypercalcemia. Out of 29 patients of hypocalcemia, 10 patients were of STEMI (16.67%) and 19 (31.66%) patients had unstable Angina and NSTEMI. Out of 12 patients of hypercalcemia, 6 patients had STEMI (50%) and remaining 6 patients had unstable Angina and NSTEMI (50%). (Table 5, Graph 5) Out of 60 patients of ACS, 36 patients (60%) developed hypomagnesemia and 9 patients (15%) had hypermagnesemia. Out of 36 patients of hypomagnesemia, 15 patients (41.66%) had STEMI, 21 patients had unstable angina and NSTEMI (58.33%). Out of 9 patients of hypermagnesemia, 1 patient (11.11%) had STEMI and 8 patient (20.51%) had unstable angina and NSTEMI. (Table 6, Graph 6)

Out of 60 patients of ACS, 15 patients (25%) developed hyponatremia and 45 patients (75%) had normal sodium level. No patient developed hypernatremia. Out of 21 patients of STEMI, 5 patients (23.81%) had hyponatremia and 16 patients (76.19%) had normonatremia. Out of 39 patients of unstable angina and NSTEMI, 29 patients (74.36%) had normonatremia and 10 patients (25.64%) had hyponatremia. (Table 7, Graph 7)

Out of 21 patients of STEMI, 5 patients (23.80%) developed conduction block, 2 patients (9.52%) developed arrhythmias and rest 14 patients (66.66%) did not develop arrhythmias.

Table 3: Distribution of patients of Acute Coronary Syndrome.

Types of ACS	No. of Patients	Percentage %
Unstable Angina and NSTEMI	39	65
STEMI	21	35
Total	60	100



Graph 3: The Distribution of ACS Cases Serum Sodium, Potassium, Magnesium and Calcium Levels in Controls and Cases.

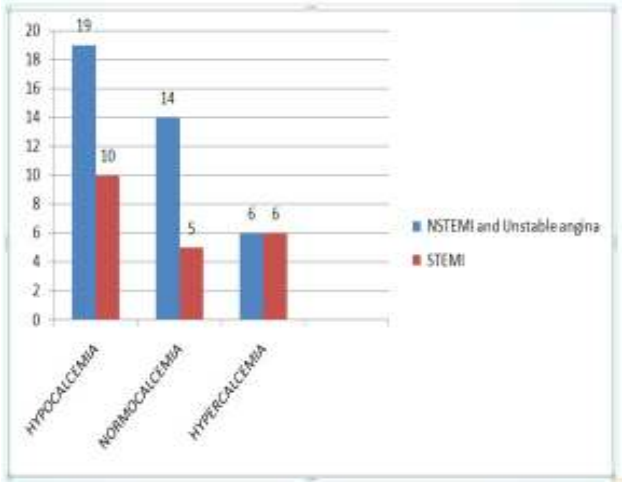
Table 4: Serum Calcium Level in ACS Cases.

S. Calcium Conc. in meq/L	NSTEMI And Unstable Angina	STEMI	Total
Hypocalcemia (< 9 meq/L)	19	10	29
Narmocalcemia level (>9-11 meq/L)	14	5	19
Hypercalcemia (>11 meq/L)	6	6	12
	39	21	60

(Table 8, Graph 8). Out of 21 patients of STEMI, 12 patients (57.14%) had hypomagnesemia and 4 patients (19.05%) had hypermagnesemia. Remaining 5 patients (23.80%) had normomagnesemia. Out of 12 patients (57.14%) of hypomagnesemia, 5 patients (23.80%) had arrhythmia. Serum Magnesium Level in Cases of STEMI with Arrhythmias and Without Arrhythmias were also assessed (Table 9, Graph 9) Out of 12 patients of hypomagnesemia, 3 patients expired (25%). An assessment was done for relationship of hypomagnesemia and mortality (Table 10).

DISCUSSION:

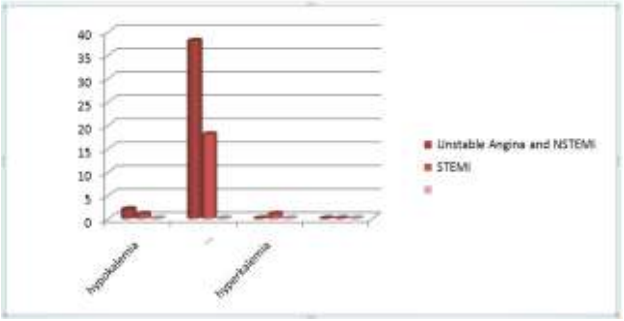
Out of 21 patients of STEMI, 12 patients



Graph 4: Incidence of Serum Calcium in ACS Cases.

Table 5: Serum Potassium Level in ACS Cases.

S. Potassium in Conc. meq/L	Unstable Angina and NSTEMI	STEMI	Total
Hypokalemia (< 3.5meq/L)	1	2	3
Normokalemia (3.5 - 4.5 meq/L)	38	18	56
Hyperkalemia (>4.5 meq/L)	0	1	1
TOTAL	39	21	60

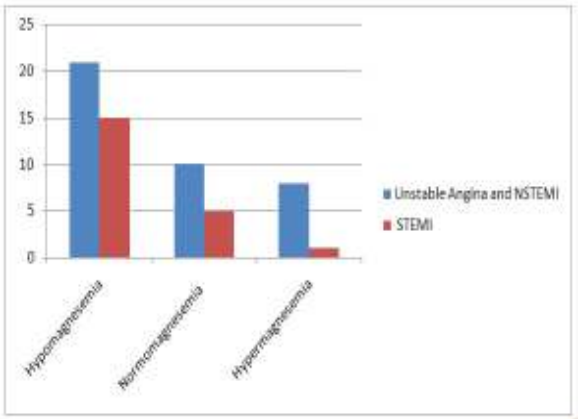


Graph 5: Serum Potassium in ACS Cases.

(57.14%) had hypomagnesemia and 4 patients (19.05%) had hypermagnesemia, remaining 5 patients (23.80%) were normomagnesemia. Out of 12 patients (57.14%) of hypomagnesemia, 5 patients (23.80%) had arrhythmia. Z- test was applied [Z>2 (i.e.,2.346] suggestive of significant relationship between hypomagnesemia and arrhythmias. Out of 21 patients of STEMI 12 patients (57.14%) had hypocalcemia and 3 patients (14.28%) had hypercalcemia, rest 6 patients (28.57%) are having normal calcium

Table 6: Serum Magnesium Level in ACS Cases.

S. Magnesium Conc. in (meq/L)	Unstable Angina and NSTEMI	STEMI	Total
Hypomagnesemia (< 1.7 meq/L)	21	15	36
Normomagnesemia (>1.7 - 2.4meq/L)	10	5	15
Hypermagnesemia (>2.4 meq/L)	8	1	9
TOTAL	39	21	60



Graph 6: Serum Magnesium in ACS Cases.

Table 7: Serum Sodium Level in ACS Cases.

S.Sodium Conc. in meq/L	Unstable Angina and NSTEMI	STEMI	Total
Hyponatremia (< 135 meq/L)	10	5	15
Normonatremia (135 -145 meq/L)	29	16	45
Hypernatremia (>145 meq/L)	-	-	-
TOTAL	39	21	60

level. Out of 12 patients of hypocalcemia, 5 patients (23.80%) had arrhythmia. Statistical Z test was applied and z > 2 [z = 2.67] suggestive of significant correlation between hypocalcemia and arrhythmias.

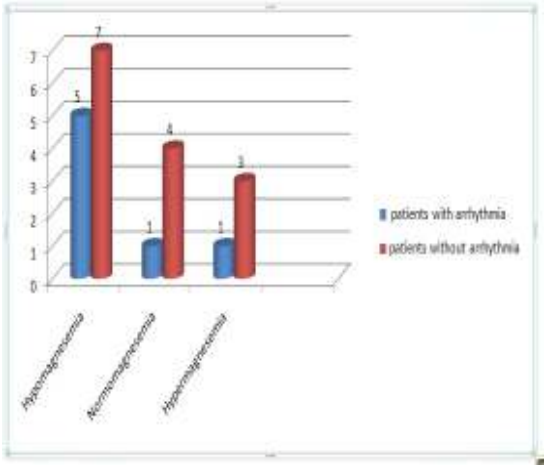
Dyckner T (1978)[7,8] found supraventricular tachycardia in 50% of hypokalemic patients, 40 percent of the normokalemic patients and 45 percent of the hyperkalemia. He also observed atrial fibrillation in 42% of hypokalemic group. Thirty percent of hyperkalemic group had AF. The incidence of atrial

Table 8: Arrhythmias in STEMI.

In AMI Patients	No. of Patients	Percentage
With Arrhythmias	2	9.52
With conduction block	5	23.80
Without Arrhythmia	14	66.66
Total	21	100

Table 9: Serum Magnesium Level in Cases of STEMI with Arrhythmias and Without Arrhythmias.

Serum levels of Magnesium	Patients with Arrhythmias	Patients Without Arrhythmias	Total
Hypomagnesemia (< 1.7 meq/L)	5	7	12
Normomagnesemia (1.7-2.4 meq/L)	1	4	5
Hypermagnesemia (> 2.4 meq/L)	1	3	4
Total	7	14	21



Graph 7: Serum Magnesium Level in Cases of AMI with Arrhythmias and without Arrhythmias.

fibrillation was more in hypokalemic group as compared to normokalemic and hyperkalemic groups.Similarly NodrehaugEJ (1981)[9] noticed that atrial fibrillation was present in 34% of patients. Dyckner T, Nodrehaug EJ and Salmon observed higher incidence of ventricular premature beats and ventricular tachycardia in hypokalemic groups as compared to normokalemic and hyperkalemic groups.

Table 10: Mortality Vs Serum Magnesium Concentration after STEMI.

FATE	Hypomagnesemia	Normomagnesemia	Hypermagnesemia	Total
Death	3	1	1	5
Recovery	9	3	4	16
Total	12	4	5	21

In the present study, maximum patients are in normokalemia group about 19 patients (92.47%). Only 2 patients (9.52%) had hypokalemia and none hypokalemic patients had arrhythmias, suggestive of no significant relationship between hypokalemia and arrhythmias. Dyckner T (1978)[7,8] observed increase number of patients with CHB, 2nd degree heart block in hypokalemic patients 40% and 16% respectively. Left bundle branch block was equal in hypo and hyperkalemia[8] cases. Right bundle branch block and ventricular premature beats were common in hyperkalemic group. In the present study, none of the hypokalemic patient out of 2 patients developed any type of conduction block. The incidence of conduction block was highest, 5 patients (22.22%) developed conduction block out of which left bundle branch block (LBBB) was commonest, Others with conduction block had either right bundle branch block (RBBB) or Right bundle branch block with Left Anterior fascicular block (LAFB). None had Left post fascicular block.

Nodrehaug J (1981)[9]demonstrated increased incidence of mortality in females as compared to males after ACS. In the present study, mortality in patients of STEMI with arrhythmia was 44.82%, while mortality in patients without arrhythmia was 13.56%. Mortality in females (33.33%) was more as compared to males 23.80%. Out of 6 female patients with arrhythmias three expired (50%), while out of seven female patients without arrhythmias two patients (28.57%) expired. Overall mortality was 5 patients (23.80%) in 21 patients of STEMI. Mortality in patients of STEMI with arrhythmia was 44.82%, while mortality in patients without arrhythmia was 14.28%, mortality in female (33.33%) was more as compared to males 23.80%. Out of two female patients with arrhythmias one had expired (50%), while out of three female patients without arrhythmias one patients (33.33%) expired. Out of five male patients with arrhythmias two patients (40%) expired, while out of 11 male patients without arrhythmias one patients [9%] expired. When STEMI was associated with arrhythmias, the incidence of mortality was more in both males & female. There is strong association between patients of arrhythmias and mortality. Out of five expired patients, three patients (60%) had hypomagnesemia, whereas one patient (20%) had hypermagnesemia. Out of 12 patients of hypomagnesemia 3 patients expired (25%). Statistical z test [(z = 6.98) > 2] IS suggestive of significant relation between hypomagnesemia and mortality.

Michael Shechter (2003)[10] observed that magnesium therapy in patient of suspected case of AMI reduced incidence of arrhythmias, congestive heart failure, and conduction disturbances compared with placebo (27% vs 40%, p = 0.04; 18% vs 23%, p = 0.27; 10% vs 15%, p = 0.21, respectively). It was concluded that magnesium sulfate should be considered as an alternative therapy to thrombolysis in patients with AMI.

LIMIT-2 (Second Leicester Intravenous magnesium Intervention Trial)[12,13] in a 2316 patient based study inferred statistically significant decreases in mortality, heart failure and dysrhythmia rates when intravenous magnesium was administered to patients with suspected AMI. Moreover, magnesium was associated with a 16% relative reduction (1.9% absolute risk reduction) in all cause mortality over a 2.8-yr follow-up period (p = 0.03). Researchers concluded that the benefits seen in experimental is chemia-reperfusion models translated into real cardioprotective benefit in the clinical setting. As a result, many physicians incorporated magnesium sulfate into their AMI treatment protocols.

These encouraging results were later challenged, when the Fourth International Study of Infarct Survival (ISIS-4)[10,11], a randomized trial of 59050 patients, reported no 5-week mortality benefit in patients treated with magnesium. Because of its large sample size, this study was compelling, and the use of magnesium for AMI was largely abandoned.

CONCLUSION:

It can be concluded from this present study that serum magnesium and calcium are significantly deranged in patients of ACS but are minor factors in development of arrhythmia solely since serum potassium and sodium are mostly in normal range. However, further research is needed to evaluate and confirm these observations.

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