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SERUM PHOSPHATE IN ACUTE MYOCARDIAL INFARCTION

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Abstract : The aim of this study is to measure phosphate levels in AMI, compare and analyse its relation with left ventricular (LV) dysfunction and mortality. Serum phosphate was measured by kinetic assay method in 40 patients with acute myocardial infarction (AMI). Echocardiographic LV function was assessed in all and the patients were followed up for 30 days. Hypophosphatemia (< 2.5 mg/dl) was observed in 27% of AMI patients (11/40). These patients formed group 1 of our study. The rest 73% patients (29/40) with normal phosphate levels formed group 2. Mean Phosphate level in group 1 was 1.96 mg/dl (range 1.2–2.37) and mean ejection fraction (EF) was .35 (range .25–.50, p value < .001). Mean phosphate in group 2 was 3.693 (range 2.6–6.00) and mean EF was .53 (range .38–.65, p value <.001). In hospital mortality of the group 1 was 28% (3/11) while in group 2 was 6.8% (2/29). We conclude hypophosphatemia in AMI is associated with LV dysfunction which results in increased 30 day mortality.

Key words : acute myocardial infarction serum phosphate LV dysfunction

INTRODUCTION

Phosphate is the major intracellular anion and is a vital constituent of myocardial energy stores. Depletion of these high energy intra myocytic phosphates is one of the earliest biochemical change observed following occlusion of coronary artery in experimental models (1). Depletion of this ion has a role in the genesis of myocardial stunning. Reversible depression of myocardial function has been reported to occur in association with hyophosphatemia (2). While there have been few studies implicating low phosphate levels with ventricular arrhythmias (3), there is very little data regarding phosphate levels in acute myocardial infarction. In this context we undertook this study of measuring serum phosphate in acute myocardial infarction (AMI).

METHODS

The study was undertaken prospectively in 40 patients admitted with AMI between January 1998 to July 1998. AMI

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was diagnosed by GUSTO protocol (4). Patients were studied with intention to treat and AHA treatment guidelines (5) of AMI were followed. All patients in the cohort received thrombolysis. The mean symptom to needle time was 8 hours. Patients with preexisting cardic failure and evidence for old MI were the exclusion criteria as assessment of LV function was one of the aim of the study. The Primary end point was in hospital death. All patients were observed for clinical left ventricular failure, ventricular tachycardia and fibrillation and left ventricular systolic function was assessed by echocardiography. Serum phosphate was estimated by kinetic assay method using ERBA 5 plus semiautoanalyser on days 0, 1, 3 and 5. The first sample was taken immediately on arrival. Hypophosphatemia was diagnosed when the 3 of the 4 samples were < 2.5 mg/dl. (Normal 2.6–4.5 mg/dl). All patients were subjected to M mode and 2D Echocardiographic study with Vingmed CFM 725 machine between day 3 and 5 after admission. Measurements were obtained according to American Society of Echocardiography Guidelines (6). Ejection fraction (EF) was calculated by modified simpson method. All patients were followed for 30 days.

RESULTS

Hypophasphatemia was observed in 27% of AMI patients (11/40). These patients formed group 1 of the study. The rest 73% patients (29/40) with normal phosphate levels

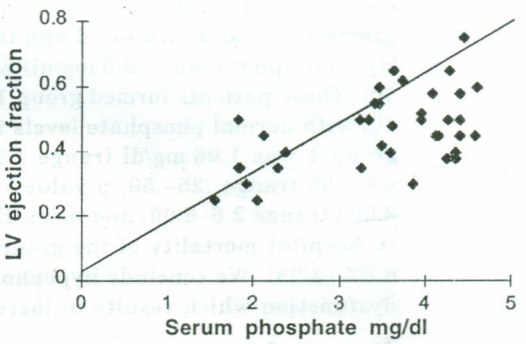

Fig.1: Relationship between serum phosphate and ejection fraction.

TABLE I: Summary of results.

	Group I	*Group II*	*P value*
Total no of patients (40)	11/40	29/40	–
Location of MI			
AWMI	8	20	NS
IWMI	3	9	
Clinical LVF	6/11 (54%)	5/29 (18%)	< .05
VT/VF	4/11 (36%)	3/29 (11%)	< .05
Mean Phosphate	1.95	3.96	<.001
Mg/DI	(Range 1.56–2.82)	(Range 3.23–5.92)	
Ejection Fraction	.35 (Range .20–.50)	.53 (Range.30–.65)	<.001
In hospital Mortality	28% (3/11)	6.8% (2/29)	<.001

AWMI: Anterior wall myocardial infarction. IWMI: Inferior wall myocardial infarction.
LVF: Left ventricular failure, VT, VF:Ventricular tachycardia, Ventricular fibrillation.

formed group 2. Results are summarised in the Table. In hospital mortality of the group 1 was 28% (3/11) while in group 2 was 6.8% (2/29). Clinical left ventricular failure was observed in 54% (6/11) of patients in group 1 and it was 18% (5/29) in group 2 (P value <.05). Incidence of ventricular arrhythmias in group 1 was 36% (4/11) and in group 2 was 11% (3/29). The two groups were analysed by paired T test for the P value. The mean EF and the in-hospital mortality showed the strongest statistical significance between the two groups (P<.001). The incidence of clinical LVF and ventricular arrhythmias were significantly higher in group 1 (P >05). There was a non significant association between anterior myocardial infarctions and hypophosphatemia (P value .15)

DISCUSSION

Mechanism of early pump failure in ischemia is speculative because of complex relationship between ATP depletion and reduced myocardial contractility. Besides magnetic response spectroscopy has revealed heterogeneous distribution of high energy phosphates (7). One of the hypothesis advanced is the accumulation of inorganic phosphates in ischemic myocardium at the expense of high energy phosphates (8). The phosphates then trap calcium resulting in sequestration of calciumphosphate in regions of myocardium making this cation unavailable for excitation contraction coupling. Studies correlating low phosphate with early pump failure in animal models are available in the literature (9). Similar studies are lacking in humans.

Our aim is to establish correlation if any between serum phosphate levels, LV function and mortality. There was a linear correlation between hypophosphatemia and LV dysfunction (Fig. 1) and the 30 day mortality was significantly higher in hypophophatemic patients. It's well known that LV dysfunction and mortality are influenced by the location of myocardial infarction. However, in our study we found low phosphate level to be an independent predictor in LV function and mortality since the study cohort in terms of location of infarction were comparable.

Limitation of this study is that extracellular inorganic phosphate depletion has been taken as surrogate marker of intracellular high energy phosphate depletion. Biochemical basis of this relationship is still not clear and is no linear correlation between them.

Clinical implication

Metabolic modification and supporting of ischemic myocardium is a new development in the management of acute coronary syndrome in recent times. This has been especially important in diabetic subjects. Knowledge of intracellular high energy phosphate stores helps in selecting the particular subset of patients who will benefit by appropriate interventions. One exciting new development is availability of intravenous ATP infusion (10). Further studies will be required to address this issue.

Conclusion

We conclude that hypophosphatemia in AMI is associated with LV dysfunction which results in increased 30 day mortality.

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