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Original Research Article

To Evaluate the Effectiveness of Percutaneous Coronary Intervention (PCI) and to Forecast the Prognosis in Patients with Acute Myocardial Infarction (AMI) by Learning the Role of Blood Pressure (BP) and Serum Electrolytes

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Abstract

Aim: This study aims to find out the role of BP and serum electrolytes in patients of Acute Myocardial Infarction (AMI) and to assess the efficacy of percutaneous coronary intervention (PCI) as well as to predict the prognosis in AMI patients.

Methods: A total of 100 patients of AMI were included in this study. We included those patients who visited to cardiology department and medicine ward for treatment. All patients were male. This study was a longitudinal, interventional study.

Results: Half of individuals have normal systolic blood pressure, 40% have high, and 10% have low. Every patient has normal diastolic blood pressure. EF improved in 80% of normal, 80% of low, and 75% of high SBP patients after percutaneous coronary intervention (PCI). Thus, abnormal SBP patients improved less in EF. Despite 12% tachycardia and 8% bradycardia, 80% had normal pulse rates. In 58% of patients, serum calcium levels are normal, 40% have hypocalcemia, and 2% have hypercalcemia. Serum sodium was normal in 84% of patients and potassium in 68%.

Conclusion: Elevated blood sodium and potassium levels are correlated with unfavourable prognosis, but younger age and normal BMI are linked with enhanced prognosis in AMI patients after PCI.

Keywords: Acute Myocardial Infarction; Percutaneous Intervention; Ejection Fraction; Serum Electrolytes

Introduction

Cardiovascular diseases comprise bulk of the serious disorders in the industrialized countries and also are a rapidly growing problem in developing nations like India. Cardiovascular diseases form a majority of all deaths each year and many of these deaths are sudden. The growing prevalence of obesity, diabetes mellitus and metabolic syndrome are important risk factors for atherosclerosis. Patients with coronary artery disease may be grouped into, patients presenting with stable angina and those with acute coronary syndromes (ACSs). The acute coronary syndrome group, in turn, is composed of patients with acute myocardial infarction (AMI) with S-T segment elevation on presenting electrocardiogram (ECG) and those with unstable angina. According to Harrison's principles of internal medicine, stable angina pectoris is characterized by chest or arm discomfort that may not be described as pain but is reproducibly associated with physical exertion or stress and is relieved within 5-10 minutes by rest and/or sublingual nitroglycerin. [1]

Unstable angina is defined as angina pectoris or equivalent ischaemic discomfort with at least one of three features:itoccurs at rest (or with minimal exertion), usually lasting >10 minutes, it is severe and of new onset(i.e. within the prior 4-6 weeks) ; and/or it occurs with a crescendo pattern (i.e. distinctly more severe , prolonged or frequent than

previously). [1] The diagnosis of non ST elevation myocardial infarction is established if a patient with clinical features of unstable angina develops evidence of myocardial necrosis; as reflected in elevated cardiac biomarkers.1Diagnosis of ST Elevation Myocardial Infarction is established if a patient with clinical features of chest pain of more than 20 minutes in duration and ST elevation at the J-point in two contiguous leads with the cut-off points: ≥0.2 mV in men or ≥0.15 mV in women in leads V2-V3 and/or ≥0.1mV in other leads and elevated cardiac biomarkers like Trop-T and/or CPK-MB. [2,3]

Serum sodium level changes occur in patients of acute myocardial infarction. In AMI, there is activation of the renin angiotensin aldosterone system. This may lead to sodium retention and potassium loss as well as production of several growth factors that have a remodeling effect on the heart. Besides this, there is release of brain natriuretic peptide (BNP) and N terminal pro BNP from the damaged myocardium, especially the atrium. This leads to hyponatremia. [4] There is also inappropriate release of vasopressin, which leads to increased expression of aquaporin-2 water channels and leads to increased water absorption, ultimately leading to hyponatremia. [5] Hyponatremia may be defined as serum sodium levels of less than 135 meq/land hypernatremia may be defined as sodium levels of more than 145 meq/l. Some studies have shown hyponatremia to be associated with poor outcomes in both STEMI and NSTEMI. Potassium is a major intracellular ion and is hugely important for maintaining heartbeat and muscle function. The depolarization and contraction of heart recquires potassium. [6] Hypokalemia is prognostically important to patients with Acute Myocardial Infarction. Hypokalemia may be defined as serum potassium levels of less than 3.5 meq/l. Hypokalemia is associated with increased mortality and morbidity. [7] Hyperkalemia may be defined as serum potassium values of greater than 5.5 meq/l. It is also associated with increased mortality and morbidity. Hypokalemia is associated with a wide variety of arrhythmias in AMI such as ventricular tachycardia and ventricular fibrillations. Sudden cardiac deaths after MI are mainly due to alteration of environment at the level of myocyte and Purkinje fibers that are mainly caused by electrolyte imbalances. [8]

This study aims to find out the role of BP and serum electrolytes in patients of AMI and to assess the efficacy of PCI as well as to predict the prognosis in AMI patients.

Materials and Methods

A total of 100 patients of AMI were included in this study. We included those patients who visited to cardiology department of Employee State Insurance Medical College and Hospital, Bihta, Patna, and other nearby multispeciality centres in Patna, Bihar, India for treatment for one year. All patients were male. This study was a longitudinal, interventional study.

Patients with any of the conditions such as anemia, valvular heart disease, myocarditis, and cardiac tamponade, endocrinal disorders such as thyroid dysfunction, vitamin deficiency such as Vitamin B1 deficiency, pericardial effusion, and atrial fibrillation were excluded to minimize the possibility that these conditions may influence the outcome of study.

Serum calcium, sodium, and potassium level were measured after admission in the cardiology emergency. In general examination, pulse rate and BP (sphygmomanometer) were measured. Echocardiography (ECHO) method was used to measure EF within 6–8 h of diagnosis of AMI. Coronary angiography was done and then patients underwent coronary angioplasty (PCI). After angioplasty, EF was measured with the help of ECHO. The EF obtained before and after PCI was analyzed.

Improvement in these patients is defined by two criteria – (1) relieved chest pain and discomfort and (2) improvement in EF from the baseline value. Statistical software Statistical Package for the Social Sciences trial version 16 was used for analysis of data. "$P < 0.05$" was considered to be statistically significant at two-tailed test.

Results

Table 1: Baseline characteristics of patients categorized by improvement in EF after coronary angioplasty

Baseline characteristics	Improved status		Total no. of cases	$\chi 2$	P-value
	Yes	No			
BMI (kg/m2)					
<18.5 (underweight)	10	0	10 (10)	1.32	0.64
18.5–22.9 (normal weight)	24	6	30 (30)		
≥23 (overweight and obese)	48	12	60 (60)		
Age groups					
21-50	26	4	30 (30)	0.88	0.45

51-80	54	16	70 (70)		
SBP (mmHg)					
≤108 (low SBP)	8	2	10 (10)	0.18	0.85
110–130 (normal range)	40	10	50 (50)		
132–160 (high SBP)	30	10	40 (40)		
PR (/min)					
<60 (bradycardia)	2	6	8 (8)	4.36	0.11
60–90 (normal range)	64	16	80 (80)		
>90 (tachycardia)	10	2	12 (12)		

It has been noticed that 50% of patients have normal systolic BP while 40% have high SBP and few (10%) have low SBP. All patients have normal diastolic BP. About 80% of patients with normal SBP showed improved EF after PCI while 80% of patients with low SBP and 75% of patients with high SBP showed improvement in EF. Hence, it is found that those patients who had abnormal SBP showed less improvement in EF. Pulse rate of 80% of patients was in normal range while some of them have tachycardia (12%) and some have bradycardia (8%).

Table 2: Blood parameters of patients categorized by improvement in EF after coronary angioplasty

Blood parameters	Improved status		Total no. of cases	$\chi 2$	P-value
	Yes	No			
S. Na+ (mEq/lt)					
<135 (hyponatremia)	14	0	14 (14)	5.75	0.07
135–145 (normal range)	66	18	84 (84)		
>145 (hypernatremia)	0	2	2 (2)		
S. K+ (mEq/lt)					
<3.5 (hypokalemia)	10	0	10 (10)	5.85	0.07
3.5–5 (normal range)	58	10	68 (68)		
>5 (hyperkalemia)	12	11	22 (22)		
S. Ca++ (mEq/lt)					
<4.3 (hypocalcemia)	34	6	40 (40)	0.62	0.90
4.3–5.3 (Normal range)	44	14	58 (58)		
>5.3 (hypercalcemia)	2	0	2 (2)		

58% of cases have normal serum calcium level, while 40% of cases showed hypocalcemia and only 2 cases (2%) had hypercalcemia. 68% had normal serum potassium level and 84% had normal serum sodium level.

Discussion

Efficient heart pumping is necessary to meet the body demand. For instance, in physical exercise, body needs increased level of oxygen in comparison to resting state for increased muscular activity. Ejection fraction (EF) is an important parameter to measure efficiency of heart.

This was an exploratory study and after analyzing the data, we found that EF is affected by the factors under investigation though only serum sodium and serum potassium level showed some significance. Lip et al. (2007) [9] found in a study that hypertensive patients have poor prognosis. In our study, it is found that hypotensive and hypertensive patients showed slightly less improvement in EF in comparison to those patients who had normal BP. Hence, we can say that results are equivocal in reference to BP. It is also found that as the PR increases, improvement in EF increases within the group. Hence, tachycardia has a positive effect on improvement in EF, though it is not statistically significant. It has been noticed that 50% of patients have normal systolic BP while 40% have high SBP and few (10%) have low SBP. All patients have normal diastolic BP. About 80% of patients with normal SBP showed improved EF after PCI while 80% of patients with low SBP and 75% of patients with high SBP showed improvement in EF. 58% of cases have normal serum calcium level, while 40% of cases showed hypocalcemia and only 2 cases (2%) had hypercalcemia. 68% had normal serum potassium level and 84% had normal serum sodium level. Increased sodium consumption leads to increased BP. This increased BP put extra load on arterial wall and hence affecting blood flow. Hence, we can say that serum sodium level can affect outcome after PCI indirectly by affecting BP. In our study, we found that increasing serum sodium level decreases improvement. Serum potassium level plays an important role in regulation of BP. When serum potassium level increases, it reduces BP but hyperkalemia can disturb the heart rhythm. It has been found in our study that increasing serum potassium level deteriorates the improvement in EF.

It is a well-known fact that serum calcium plays an important role in cardiovascular physiology. Normal serum calcium level is important for adequate myocardial contractility. Contrary to the previous findings, in this study, we found that the patients with normal serum calcium level showed less improvement in comparison to the patients with abnormal serum calcium level. It is clear from the findings that age has adverse effect on outcome of coronary angioplasty, especially over 50 years, though it is statistically not significant (P = 0.38). Starr et al. (1934) found that the average cardiac index slowly declines after 50 years. [10] Few studies also suggested that elderly population with AMI, who received a conservative treatment, have a higher mortality in comparison to the younger population. [11-13] In a study, Singh et al. (2018) found that AMI patients who had age more than 40 years showed less improvement after PCI. [14]

It is a well-known fact that overweight and obese patients have poor prognosis after coronary intervention. In this study, we found that as the BMI increases, improvement in EF decreases. Interestingly, all the four underweight patients showed improvement in EF. However, there is acontroversial finding termed as "obesity paradox," which tells that obese AMI patients have improved outcomes after PCI, in comparison to normal BMI patients. [15-18] This study has some limitations. First of all, we did not record serum parathyroid hormone and Vitamin D level to find more accurate correlation between serum calcium level and improvement in EF.

Conclusion

Based on the findings of this study, it can be concluded that increased serum sodium and potassium levels are associated with poor prognosis, while lesser age and normal BMI are associated with improved prognosis in AMI patients after PCI.

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