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Original Research Article

A Study on the Impact of Blood Pressure and Serum Electrolytes Level on Ejection Fraction in Acute Myocardial Infarction Patients

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Abstract

Aim: 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.

Methods: A total of 50 patients of AMI were included in this study. We included those patients who visited to NMCH, Patna, Bihar, India for 12 months, for treatment. All patients were male. This study was a longitudinal, interventional study.

Results: 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 (P = 0.93). Pulse rate of 80% of patients was in normal range while some of them have tachycardia (12%) and some have bradycardia (8%). The result showed that 58% of cases have normal serum calcium level, while 42% of cases showed hypocalcemia and only 1 case (2%) had hypercalcemia. We found that 75.9% of patients who have normal serum calcium level showed improvement in EF and 85% of hypocalcemia patients showed improved EF after PCI. There was only one patient with hypercalcemia and he showed improvement in EF.

Conclusion: Increased serum sodium and potassium level are associated with poor prognosis, while lesser age and normal BMI are associated with improved prognosis in AMI patients after PCI.

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

Introduction

Patients with acute myocardial infarction typically have systemic hypotension. It has been suggested in certain research that hypotension at arrival to the hospital is a predictor of mortality in AMI patients. Despite the use of thrombolytic therapy,

the mortality rate remains high. The efficacy of thrombolytic treatment may be altered by systemic blood pressure. According to certain study, pulse pressure may have an impact on the mortality of AMI patients. A recent study found that higher systolic, diastolic, and pulse pressures were associated with worse outcomes in individuals with acute myocardial infarction. As a result, effective BP control is crucial in this population. [1]

Hydro-electrolyte disturbances are frequent in post–myocardial infarction (MI) with or without associated heart failure (HF). Water and electrolyte disorders are often associated with dismal prognosis despite prompt correction. [2,3] In particular, the occurrence of hyponatremia in MI and HF settings is a well-established, strong, and independent predictor of short- and long-term morbidity and mortality. [4-8] On the contrary, despite being broadly available in routine blood chemistry panels and its involvement in contraction alkalosis during excessive decongestion therapy, the anion chloride has not received the same attention as its sodium counterpart. [9]

When blood flow decreases to a part of the heart, it causes damage to the heart muscle and leads to acute myocardial infarction (AMI). [10] High blood pressure (BP), paucity of exercise, obesity, smoking, and diabetes Mellitus are various risk factors for AMI. [11,12] Percutaneous coronary intervention (PCI) is used to treat narrowing of coronary arteries of the heart in AMI patients. PCI is an alternative to coronary artery bypass grafting. The blood flow in the coronary artery improves after angioplasty. Many patients get relieved of their symptoms and their work efficiency gets increased. The cardiac contractility depends on various factors. Serum calcium level is one of the important factors which can alter myocardial contractility. The force of contraction of cardiac muscle depends on binding of myosin with actin. The degree of binding depends on calcium ion concentration in the cardiac myocytes. Furthermore, the sympathetic nervous system stimulation indirectly increases calcium ion concentration by releasing catecholamine. The myocardial contractility can also be altered by altering preload, afterload, and heart rate. [13] Systemic hypotension occurs very commonly in patients of AMI. Some studies found that mortality in AMI patients can be predicted on the basis of hypotension at the time of admission in the hospital. [14] In such patients, mortality rate is high despite thrombolytic therapy. Some studies postulated that success of thrombolytic therapy depends on systemic BP. [15]

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 50 patients of AMI were included in this study. We included those patients who visited to NMCH, Patna, Bihar, India for 12 months, for treatment. 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. Written, informed consent from the patients were taken.

Serum calcium, sodium, and potassium level were measured after admission. 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 and coronary angioplasty (PCI) were advised accordingly. 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	χ2	P-value
	Yes	No			
BMI (kg/m2)					
<18.5 (underweight)	5	0	5 (10)	1.27	0.50
18.5–22.9 (normal weight)	12	3	15 (30)		
≥23 (overweight and obese)	24	6	30 (60)		
Age groups					
21-50	13	2	15 (30)	0.77	0.38
51-80	27	8	35 (70)		
SBP (mmHg)					
≤108 (low SBP)	4	1	5 (10)	0.15	0.93
110–130 (normal range)	20	5	25 (50)		
132–160 (high SBP)	15	5	20 (40)		
PR (/min)					
<60 (bradycardia)	1	3	4 (8)	4.15	0.12
60–90 (normal range)	32	8	40 (80)		
>90 (tachycardia)	5	1	6 (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 (P = 0.93). Pulse rate of 80% of patients was in normal range while some of them have tachycardia (12%) and some have bradycardia (8%). About 80% of patients who have normal pulse rate showed improvement while 25% of patients having bradycardia and 87.33% of patients having tachycardia showed improvement. Hence, it can be said that as the pulse rate (PR) increases, improvement in EF increases (P = 0.12)

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

Blood parameters	Improved status		Total no. of cases	χ2	P-value
	Yes	No			
S. Na+ (mEq/lt)					
<135 (hyponatremia)	7	0	7 (14)	5.67	0.07
135–145 (normal range)	33	9	42 (84)		
>145 (hypernatremia)	0	1	1 (2)		
S. K+ (mEq/lt)					
<3.5 (hypokalemia)	5	0	5 (10)	5.67	0.07

3.5–5 (normal range)	29	5	34 (68)		
>5 (hyperkalemia)	6	5	11 (22)		
S. Ca++ (mEq/lt)					
<4.3 (hypocalcemia)	17	3	20 (40)	0.52	0.70
4.3–5.3 (Normal range)	22	7	29 (58)		
>5.3 (hypercalcemia)	1	0	1 (2)		

Table 2 shows that 58% of cases have normal serum calcium level, while 42% of cases showed hypocalcemia and only 1 case (2%) had hypercalcemia. We found that 75.9% of patients who have normal serum calcium level showed improvement in EF and 85% of hypocalcemia patients showed improved EF after PCI. There was only one patient with hypercalcemia and he showed improvement in EF. Hence, it is found that those patients who had normal serum calcium level showed less improvement in EF (P = 0.70).

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 (P = 0.07). Lip et al. (2007) found in a study that hypertensive patients have poor prognosis. [10] 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 (P = 0.93). 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 (P = 0.12). Hence, tachycardia has a positive effect on improvement in EF, though it is not statistically significant.

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 (P = 0.07). 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 (P = 0.07).

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. [16] Few studies also suggested that elderly population with AMI, who received a conservative treatment, have a higher mortality in comparison to the younger population. [17-19] In a study, Singh et al. (2018) found that AMI patients who had age more than 40 years showed less improvement after PCI. [20]

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 (P = 0.50). Interestingly, all the four underweight patients showed improvement in EF. However, there is a controversial finding termed as "obesity paradox," which tells that obese AMI patients have improved outcomes after PCI, in comparison to normal BMI patients. [21-25]

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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