DOI: https://doi.org/10.53350/pjmhs2115123868

ORIGINAL ARTICLE

Prediction of Patient Death due to Sudden Cardiac Arrest with Left Ventricular Dysfunction by Analyzing the Value of BNP: a Prospective Longitudinal Study

RIFFAT SULTANA[1], DAYARAM MAKWANA[2], FAZAL UR REHMAN[3], IRAM JEHAN BALOUCH[4], WAQAR AZIM[5], IMRAN ELLAHI SOOMRO[6]

[1]*Executive Director Cardiology, Karachi institute of heart diseases Karachi, Pakistan.*
[2]*Senior Resident Cardiology, Mohamad Bin Khalifa Bin Salman Al Khalifa Specialist Cardiac Centre (MKCC), Kingdom of Bahrain.*
[3]*Associate Professor Cardiology, Bolan Medical College Quetta, Pakistan.*
[4]*Assistant Professor Cardiology, National Institute of Cardiovascular Diseases Hyderabad, Pakistan.*
[5]*Registrar Cardiology, Sandeman Provincial Hospital Quetta, Pakistan.*
[6]*Assistant Professor Cardiology, Peoples University of Medical and Health Sciences for Women Shaheed Benazirabad Nawabshah, Pakistan.*
Corresponding author: Riffat Sultana, Email: dr_riffat2@hotmail.com

ABSTRACT

Aim: The purpose of this study was to predict the patient's death due to sudden cardiac arrest with left ventricular dysfunction by analyzing the value of BNP

Study design: Prospective longitudinal study

Place and duration: This study was conducted at Karachi institute of heart diseases Karachi, Pakistan from Feb 2020 to Feb 2021

Methodology: This cross sectional study was conducted from Feb 2020 to Feb 2021 on 70 patients who were pin pointed with acute STEMI complicated by left ventricular systolic failure and hospitalized in our hospital. A total of 70 patients who were recognized with STEMI, 48 of whom got primary PCI, and 17 of whom received thrombolytic treatment.

Results: The average age of the patients was 57.6 years and the range being from 35 to 80 years. Male patients constituted 73.3 percent of the study. It was discovered a mean of NYHA of 2.5, an average Killip classification of 2.8 and an average TIMI score of 8.1. A 90-day follow-up showed that 48 patients survived out of which 7 were reported to have a life-threatening arrhythmia and 12 had sickle cell disease. When ROC curve was shown, Pro-BNP indicated Sc.D. and unanticipated cardiac death was forecasted which also stipulated an AUC of 0.76, while the AUC was 69.6 percent of the ROC curve of the same neuropeptide in evaluating accuracy in prediction of VT, by. A Kaplan-Meier analysis reveals that an increase in pro-BNP over 3.2ng/ml has a significant predictive influence on SCD [OR 0.748 (CI 95 percent: 0.07-0.932), p-value .039]

Conclusion: BNP levels in individuals with ischemic cardiomyopathy after an acute MI are a significant, independent predictor of sudden death.

Keywords: BNP levels, ischemic cardiomyopathy, sudden death, myocardial infarction

INTRODUCTION

Death due to sudden cardiac arrest is still a big health issue despite the huge advancements in diagnostic and therapeutic treatments (1). In order to achieve maximum benefits in ICD therapy the individual risk stratification is needed to flag the patients at increased risk for SCD (2). Neurohormones are primarily metabolized as a result of ventricular stretch caused by volume and pressure overstimulation (3). One of them is the brain. The most studied are BNP (natriuretic peptide) and its precursor the BNP amino terminal fragment, prohormone (NT-proBNP) (4).

Past studies have verified that peptide are markers used to talk about the complete medical course, diagnosing the outcome of hospitalization duration and mortality in cardiac patient (5). Elevated plasma levels with is related to high risk of unanticipated cardiac arrest in patients (6). In almost all of these studies, it was said that definitive increase above average levels of NT-pro BNP surpasses that of BNP in left ventricular dysfunction, which shows the sensitivity NT pro BNP as a prognostic (7). Since it has been suggested that there must be a link between B-type natriuretic peptides and ventricular arrhythmia (8). BNP rises as a result of systolic or diastolic dysfunction and increased wall stress in the left ventricle (9).

This study was conducted to predict the patient's death due to sudden cardiac arrest with left ventricular dysfunction by analyzing the value of BNP

METHODOLOGY

This cross sectional study was conducted from Feb 2020 to Feb 2021 on 70 patients who were pin pointed with acute STEMI complicated by left ventricular systolic failure and hospitalized in our hospital. A total of 70 patients who were recognized with STEMI, 48 of whom got primary PCI, and 17 of whom received thrombolytic treatment.

Grown up patients indicated with an acute myocardial infarction (STEMI) were only included if (at least two of the following criteria) were met: Classic retrosternal chest discomfort (which is eased by nitrates). A fresh or ambiguous LBBB with a ST segment elevation larger than 0. 1 mV in limb leads or 0.2 mV in precordial leads (10). With echocardiographic indications of LV systolic failure (LVEF 50%) and an elevated cardiac biomarker indicative of myocardial damage in the first few hours. Increase in troponin is caused by high creatinine level and this is

known as renal impairment. Systemic sepsis, which results in a non-specific increase in troponin (11). Cardiac arrest is required prior to collecting samples. Patients who have had a cerebrovascular stroke. Malignancy that has progressed (12).

The patient's or a close family member's given the informed permission. The patient's or a family member's detailed medical history was taken. A clinical evaluation done. ECG leads 12 on the surface, transthoracic echocardiogram, biochemical analysis and angiography of the coronary arteries performed. A full physical examination is performed as part of the clinical assessment.

Clinical scoring systems were used to assess individuals with heart failure following a heart attack (13). A- New York Heart Association: Functional categorization based on the severity of symptoms and the amount of physical activity (14). Class I: There are no restrictions on physical activity. Ordinary physical exercise does not result in excessive shortness of breath, exhaustion, or palpitations (15). Class II: Physical activity is restricted slightly. At rest, it's comfortable, but regular physical exertion causes excessive breathlessness, weariness, or palpitations (16). Class III: Physical activity is severely restricted. At rest, it's comfortable, but less-than-normal physical exertion causes excessive breathlessness, weariness, or palpitations (17). Class IV: Unable to engage in any type of physical exercise without pain. Symptoms may be present even while the patient is at rest. When you engage in any type of physical exercise, you will feel more uncomfortable (18).

A 12-lead ECG was done every day for 5 days with consistent chest lead location. If any of the following were found on the ECG, it was considered abnormal: In limb leads, ST segment elevation is larger than 0. 1 mV, and in precordial leads, it is greater than 0.2 mV. Arrhythmias are a type of irregular heartbeat. Each patient underwent a transthoracic echocardiographic examination in the left lateral position (19). The images from each stage of the test, as well as the standard ECG, were saved for future use. On admission, cardiac biomarkers were assessed. Every patient in our study had plasma samples taken during the first 48 hours to test BNP levels. All survived patients in our group studied, as well as those who were rescued from SCD, were followed up on by a full clinical examination, a history of palpitation and syncopal attacks, and a 12-lead ECG to assess the occurrence of ventricular arrhythmia in these pts, all within 90 days of the onset of MI.

The following table shows the primary coronary parameters of interest:

Ranges	Range Definition
0 – 7 mm	The minimum diameter value of the Luminal (MLD)
1.5 – 7 mm	The reference value for the diameter of the vessel (RVD)
0 – 7 mm	The length of the Lesion
0 – 100 %	The value of the diameter of the Stenosis, calculated by (RVD – MLD)/RVD

RESULTS

We conducted this study on patients with acute MI and post-MI L.V systolic dysfunction. We studied seventy individuals with LV dysfunction, which might complicate the course of an acute MI. The average age was 56.86 years (range 35-80). Males made up 73.3 percent of the participants in our research (53 males and 17 females). Sixty-seven patients (76.7 percent) underwent primary percutaneous coronary intervention, whereas fourteen patients got medical therapy (23.3 percent). The mean NYHA score was 3.2, the Killip class was 3.2, and the TIMI risk score was 8.4, as shown in Table 1:

For survivors, a follow-up clinical examination revealed a mean NYHA of 2.1. A 95-day follow-up was conducted. From the seven individuals who experienced life-threatening arrhythmias (12.4 percent), 66 patients (80%) survived, while 14 patients in our sample died due to sudden cardiac death. All patients had an echocardiographic test, which revealed a mean EF of 42.7% and a RWMA of 14.1 percent, as shown in Table 2.

Table 1: Clinical Examination of study participants

Clinical examination	
NYHA	3.2 ± 0.7
KILLIP class	3.2 ± 0.7
TIMI risk point	8.4 ± 2.1

Table 2: Values for the echocardiographic exam taken of the patients at the time of admission

Values of the echocardiographic exam	
Left ventricular ejection fraction	42.7 ± 7.5 %
Regional wall motion abnormalities	14.1 ± 2.9

Table 3: Values for the echocardiographic exam taken of the patients after survival

Values of the echocardiographic exam	
Ejection fraction	47.9 ± 8.5 %
Regional wall motion abnormalities	8.5 ± 3.9

Table 4: Cut- Off Points for Pro-B-type natriuretic peptide

V Tach	AUC	P-Value	Cut-off	Percentage of Sensitivity	Percentage of Specificity
Pro-B-type natriuretic peptide	70.8%	0.18	2.96	74.1%	62.2%

Table 5: Cut- Off Points for Pro-B-type natriuretic peptide after sudden cardiac death

V Tach	AUC	P-Value	Cut-off	Percentage of Sensitivity	Percentage of Specificity
Pro-B-type natriuretic peptide	80.3%	<0.0001	2.96	69.8%	68.2%

Twenty-seven patients had an initial EF of greater than or equal to 46 percent, 21 patients had EFs ranging from 35 to 45 percent, and only 14 patients had EFs less than 35 percent. For survivors, a follow-up echocardiographic examination revealed a mean EF of 47.9% with RWMA: 8.5 as shown in Table 3: The following results were obtained by plotting the ROC curve to determine the optimal predictive cutoff values for pro-BNP as predictors of sudden cardiac death, as shown in table 4. By using survival analysis to investigate the prognosis accuracy of pro-BNP: Kaplan Meier analysis reveals that an increase in Pro-B-type natriuretic peptide over 3.2ng/ml has a significant predictive influence on SCD.

DISCUSSION

AMI is a leading cause of death, and despite recent diagnostic and therapeutic advances, the condition's

mortality and morbidity rates have remained high (19). Higher levels of BNP in patients with acute ST-elevation myocardial infarction (STEMI) have been linked to a poorer outcome. For individuals at high risk of potentially deadly ventricular arrhythmias, ICDs are the therapy of choice. In survivors of cardiac arrest or unstable VT, ICDs are becoming acknowledged as superior to anti-arrhythmic medicines. In certain high-risk individuals, they are more helpful than medication treatment for primary SCD prevention (20).

Our goal was to assess the impact of BNP in better predicting high-risk patients for SCD and improving risk stratification in this group of patients. In addition to all previous reports on the utility of such a marker as a prognostic marker for patients with acute heart failure, we discovered that BNP is also a useful marker in predicting SCD in post STEMI patients with LV systolic dysfunction. After AMI BNP is non dependable risk factors and accurately indicate mortality rate and hospitalization duration and this was done by using multiple regression analysis. They studied 261 AMI patients with 12-month duration and evaluated many indexes such as BNP to know about the useful prognostic factors for AMI caused mortality. Although there are few studies linking BNP levels to serious electrical issues, there are several (21).

In terms of BNP's use in predicting ventricular arrhythmia, researchers found that, in addition to functioning as a marker of left ventricular dysfunction, BNP level is also a predictor of Ventricular Tachyarrhythmia (VT), with greater blood BNP levels related with a higher incidence of VT. Several studies have linked changes in systemic or cardiac autonomic nerve function to the onset or development of heart failure, as well as the ventricular arrhythmias that cause deadly cardiac events. Autonomic nerve function affects cardiovascular illnesses and outcomes in both positive (compensatory) and negative ways.

As we know that, nervous system controls many autonomic functions of heart such as heart rate. But lethal or deadly cardiac functions are determined by many determinants such as coronary risk factors, BNP and LV ejection fraction. To put it another way, there is no one reliable predictor of arrhythmic mortality or the efficacy of preventive ICD treatment. According to Emmanuel G. et al., more precise risk classification is essential to gain the maximal benefit from ICD treatment.

CONCLUSION

BNP levels in individuals with ischemic cardiomyopathy after an acute MI are a significant, independent predictor of sudden death.

Permission: It was taken from the ethical review committee of the institute
Funding Source: None
Conflict of interest: None

REFERENCES

1 MOHAMED ABO HAMILA, M.D. AY M.Sc., AMAL RIZK, M.D. AB M.D., MOKHTAR, M.D. S. Evaluation of the Prognostic Value of BNP in Prediction of Sudden Cardiac Death in Patients with Left Ventricular Dysfunction after an Acute MI. The Medical Journal of Cairo University. 2018; 86(March):535–41.
2 Wang S, Borah B, Dunlay S, Chamberlain A, Liu J. Sudden Cardiac Death After Revascularization in Patients with Coronary Artery Disease and Left Ventricular Dysfunction. Value in Health. 2018 Sep; 21:S7.
3 Jiang W, Liu Y, He Z, Zhou Y, Wang C, Jiang Z, et al. Prognostic value of left ventricular mechanical dyssynchrony in hypertrophic cardiomyopathy patients with low risk of sudden cardiac death. Nuclear Medicine Communications. 2020; 42(2):182–9.
4 Boldueva S, Leonova IA, Bykova EG, Trostyanetskaya NA. Prognostic value of the left ventricular hypertrophy for sudden cardiac death in patients with myocardial infarction. “Arterial’naya Gipertenziya” (“Arterial Hypertension”). 2009; 15(3):325–9.
5 MALIDZE D. P.2.21 Heart-rate turbulence as risk factor of sudden cardiac death in patients with unstable angina and left ventricular dysfunction. Europace. 2003 Oct; 4:A44.
6 Billman GE. Left ventricular dysfunction and altered autonomic activity: A possible link to sudden cardiac death. Medical Hypotheses. 1986; 20(1):65–77.
7 Hasan A, Yancy CW. Treatment of Ventricular Dysrhythmias and Sudden Cardiac Death: A Guideline-Based Approach for Patients with Chronic Left Ventricular Dysfunction. Congestive Heart Failure. 2007; 13(4):228–35.
8 Angerstein RL, Thompson B, Rasmussen MJ. Preventing Sudden Cardiac Death in Post-Myocardial Infarction Patients with Left Ventricular Dysfunction. The Journal of Cardiovascular Nursing. 2005; 20(6):397–404.
9 Chattopadhyay BP, Ray R, Rath H, Singh S, Chatterjee S. Prognostic value of NT-Pro-BNP in prediction of left ventricular systolic function and outcome of patients of acute coronary syndrome. Indian Heart Journal. 2015 Dec; 67:S23.
10 Pitt B. SUDDEN CARDIAC DEATH: ROLE OF LEFT VENTRICULAR DYSFUNCTION. Annals of the New York Academy of Sciences. 1982 Mar; 382(1 Sudden Corona):218–22.
11 Watanabe J, Shiba N, Shinozaki T, Koseki Y, Karibe A, Komaru T, et al. Prognostic value of plasma brain natriuretic peptide combined with left ventricular dimensions in predicting sudden death of patients with chronic heart failure. Journal of Cardiac Failure. 2005; 11(1):50–5.
12 Waldo AL. Sudden Death in Patients with Myocardial Infarction and Left Ventricular Dysfunction, Heart Failure, or Both. Yearbook of Cardiology. 2006 Jan; 2006:442–3.
13 Bettencourt P, Ferreira A, Dias P, Pimenta J, Friões F, Martins L, et al. Predictors of prognosis in patients with stable mild to moderate heart failure. Journal of Cardiac Failure. 2000 Dec; 6(4):306–13.
14 Berger R, Huelsman M, Strecker K. B-type natriuretic peptide predicts sudden death in patients with chronic heart failure. ACC Current Journal Review. 2002; 11(6):55.
15 Moolman JA, Du Preez L, Rossouw G. Serum brain natriuretic peptide (BNP) and N-terminal brain natriuretic peptide (NT-proBNP) in heart valve disease. SA Heart. 2017 Apr; 5(1).
16 Blondé-Cynober F, Morineau G, Estrugo B, Fillie E, Aussel C, Vincent J-P . Diagnostic and prognostic value of brain natriuretic peptide (BNP) concentrations in very elderly heart disease patients: Specific geriatric cut-off and impacts of age, gender, renal dysfunction, and nutritional status. Archives of Gerontology and Geriatrics. 2011; 52(1):106–10.
17 Brueckmann M, Huhle G, Lang S, Haase KK, Bertsch T, Weiß C, et al. Prognostic Value of Plasma N-Terminal Pro-Brain Natriuretic Peptide in Patients With Severe Sepsis. Circulation. 2005; 112(4):527–34.
18 Westhoff-Bleck M, Podewski E, Tutarel O, Wenzel D, Cappello C, Bertram H, et al. Prognostic value of NT-proBNP in patients with systemic morphological right ventricles: A single-centre experience. International Journal of Cardiology. 201; 169(6):433–8.
19 Olsen MH, Wachtell K, Hall C, Ibsen H, Rokkedal J, Kjeldsen SE, et al. 888-1 N-terminal pro brain natriuretic peptide predicts cardiovascular events in patients with hypertension and left ventricular hypertrophy: A LIFE study. Journal of the American College of Cardiology. 2004; 43(5):A530.
20 Adlam D, Silcocks P, Sparrow N. Using BNP to develop a risk score for heart failure in primary care. European Heart Journal. 2005; 26(11):1086–93.
21 Wei T, Zeng C, Chen L, Chen Q, Zhao R, Lu G, et al. Systolic and diastolic heart failure are associated with different plasma levels of B-type natriuretic peptide. International Journal of Clinical Practice. 2005; 59(8):891–4.