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Original Research Article

Correlation of brain natriuretic peptide (BNP) and renal dysfucntion in patients of acute myocardial infarction

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ABSTRACT

Background: We examined the effect of renal dysfunction on B-natriuretic peptide (BNP) in patients with myocardial infarction (MI) and its correlation with renal dysfunction used as a marker for mortality in acute coronary syndromes and MI.

Methods: 123 patients fulfilling the inclusion criteria were enrolled as study population. The statistical analysis was done using the statistical package for Social Sciences (SPSS) version 21.0 statistical analysis software. The values were represented in number (%) and mean (SD).

Results: Among the study population of 123 patients of MI 26% was of ST-elevation myocardial infarction (STEMI) and 74% was non-ST-segment elevation MI (NSTEMI). The present study also showed a statistically significant inverse correlation between BNP and estimated glomerular filtration rate (eGFR) ($P<0.001$). Comparing the ejection fraction (EF) with BNP levels in our study it was found that there is an inverse correlation between these two variables with a p-value of <0.001. The mean BNP was 742.01pg/mL in patients with EF >40% as compared to patients with EF<40%, where the mean BNP level was 1724.71pg/mL. Multivariable logistic regression analysis concluded that, left ventricular ejection fraction (LVEF) of 40% or less and eGFR of 60 mL/min/1.73m^2 or less independently predicted BNP value with both variables independently having negative correlation with BNP levels ($P<0.05$).

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Conclusions: After acute MI, LVEF is of prognostic significance and plays a major role in determining the therapeutic response. Measurements of the plasma BNP together with measures of LVEF could allow useful refinement of risk stratification.

Keywords: Renal dysfunction, MI, LVEF, BNP

INTRODUCTION

B-natriuretic peptide (BNP) and N-terminal (NT)- proBNP are peptides secreted from the cardiac ventricles in response to increasing tension in the ventricular wall[1]. Both peptides are useful in the diagnosis of congestive heart failure (CHF) and as a prognostic tool in predicting mortality for patients with CHF, populations at risk of developing chronic heart failure, recent myocardial infarction (MI), and acute coronary syndromes (ACS) without myocardial necrosis[2-4]. BNP is eliminated by receptors located in the liver, lung, kidney, and vascular endothelium and through the kidneys.

Renal dysfunction affects these peptides. Increasing BNP and NT-proBNP concentrations are functions of renal and cardiac function and, in addition, receptor function for BNP. Cardiovascular disease is the leading cause of death in patients with end-stage renal failure, and the progression of renal disease can be monitored by assessing the decrease in glomerular filtration rate (GFR)[6]. Increased concentrations of BNP and NT-proBNP may result from decreasing renal function (progressive kidney disease) because of increased intravascular volume, in addition to impaired cardiac function[6].

In this study, we examined the effect of renal dysfunction on BNP concentrations in acute MI patients.

METHODS

The study was conducted in the department of medicine, MLN Medical College and SRN Hospital, Prayagraj (formerly Allahabad) from January 2019 – June 2020 (18 months). MI

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patients of more than 18 years of age, diagnosed by suggestive signs, and symptoms and confirmed by physical examination electrocardiogram (ECG) and 2D-Echo findings attending Swaroop rani Nehru hospital were enrolled in the study.

We excluded patients with right heart failure due to Chronic obstructive pulmonary disease (COPD), asthma, valvular heart disease, arrhythmia, sepsis, ARDS, cirrhosis, hyperthyroidism, and chronic kidney disease (CKD). 123 patients fulfilling the inclusion criteria were enrolled as the study population (75 males and 48 females). The eGFR was calculated from the serum creatinine concentration (traceable to the isotope dilution mass spectrometry reference method), age, and sex: GFR (mL/min/1.73 m^2) = 175 × (serum creatinine)–1.154 × (age)–0.203 × (0.742 if female). Statistical analysis was carried out using SPSS 20.0 software (SPSS, Chicago, IL). Study participants were divided into 5 groups with CKD stages according to level of eGFR as defined in the clinical practice guidelines of the National Kidney Foundation of the United States through its kidney disease outcomes quality initiative. individual group data for sex are presented as number (percentage) of men, whereas those for age, systolic and diastolic blood pressure, heart rate, left ventricular ejection fraction (LVEF), eGFR, creatinine level, BNP, NT-proBNP, molar ratio of NT-proBNP/BNP (pmol/L/pmol/L), creatine kinase MB activity, and troponin I and troponin T concentrations are reported as the geometric mean and standard error of estimate (SE). Differences among independent groups were analyzed by the analysis of variance model.

RESULTS

Among 123 patients, 75 were male and 48 were female. The minimum age of patients enrolled in the study was 24 years while the maximum age was 80 years. Mean (SD) age of patients enrolled in the study was 55.88 (13.02) years. The most common presenting

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complaint was chest pain (95.9%) which was reported by all the patients except 5 (4.1%). Other major presenting complaints were diaphoresis (57.7%) followed by dyspnea (56.1%). Out of 123 cases enrolled in the study, 63 (51.2%) were hypertensive, 53 (43.1%) were diabetic, 49 (39.8%) were obese, 54 (43.9%) smokers, 44 (35.8%) alcohol consumers and 23 (18.7%) had family history of MI (Fig. 1).

Out of 123 patients, 2 patients were referred to higher centre therefore outcome of patients is calculated among 121 patients comparing the out was observed that mean eGFR in mortality group [47.07 (24.19)] was lower than the mean eGFR in discharged group [64.06 (25.12)] and comparing both the group by using t-test the result came statistically significant with $P<0.05$ (Table 1).

Among 121 patients, outcome was compared with the LVEF and it was found that the mean (SD) LVEF value [41.31 (9.76)] in patients who had expired was lower than the mean LVEF value in patients who got discharged, while comparing these two-group using t-test it came out to be statistically significant ($P<0.05$). The mean (SD) BNP value [1766.8 (1287.1)] patients who expired was higher than patients who got discharged ($P<0.05$) (Table 1).

Only 1 case had eGFR level <15 mL/min/1.73 m². It was observed that cases of MI having eGFR levels >90 mL/min/1.73 m² had minimum BNP levels [527.26 (391.48)] pg/mL followed by those having eGFR 60-89 mL/min/1.73 m² [735.20 (405.59)] pg/mL while maximum BNP levels were observed among cases having eGFR ≤29 mL/min/1.73 m² [2349.76 (1144.81) pg/mL followed by those having eGFR 30-44 mL/min/1.73 m² [1248.56 (440.78) pg/mL and eGFR 45-59 [1104.89 (578.07) pg/mL. It was observed that mean BNP levels of cases with low eGFR levels was higher as compared to those with high eGFR levels. This association was found to be significant statistically (Fig.2).

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An inverse correlation between BNP and eGFR was observed. Level of correlation was moderate (r=0.5 to 0.7) and correlation was found to be statistically significant (P<0.001) (Fig.3).

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DISCUSSION

BNP and NT-proBNP were introduced as biomarkers for heart failure but have also found use as markers for mortality in ACS and MI. Renal dysfunction or failure represents a variable that complicates the interpretation of these markers.[1-2]

Our study shows that BNP levels at hospital admission in patients with acute MI are independently related to both cardiac and renal dysfunction. In the patients of acute MI, risk stratification is the first step for the early identification of high-risk subsets, and for planning targeted therapeutic strategies. Several parameters have been shown to be associated with STEMI and NSTEMI patients' outcomes, and incorporated in complex risk Scores.[9] Moreover, LVEF and eGFR, possibly the two most important prognostic parameters in acute MI, have not been included in most of these scores.[10] Nevertheless, several studies have clearly demonstrated that LVEF and eGFR, when considered singularly and, in particular, in association, are strong predictors of short- and long-term morbidity and mortality in both STEMI and NSTEMI patients.

In accordance with previous studies the present study also showed statistically significant inverse correlation between BNP and eGFR values with a significant p value of <0.001. Moltrasio, et al.[11] also showed the similar significant inverse relationship between BNP and eGFR (r=0.333; P<0.0001). Susan Vickery, et al.[12] showed that there was a significant trend toward increasing plasma BNP (r=0.36; P =0.0001) concentrations with declining estimated GFR. Peter A. Mc Cullough et al.[13] also concluded similar results showing raw and log-log transformed correlations between BNP and eGFR values were r=0.19 and r=0.17 with p value of <0.001 for those with CHF. In our study, multivariable logistic regression analysis concluded that, LVEF of 40% or less and eGFR of 60 ml/min/1.73m^2 or less independently predicted BNP value with both of variable independently having negative correlation with BNP levels (P<0.05 in both the cases). Marco Moltrasio, et al.[13] also showed LVEF and BNP

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levels were found to be independent predictors of the combined end point. Another study done by Yashamito, et al.[14] showed that NT-proBNP significantly correlated with LVEF ($r=0.407$, $P<0.001$) and with eGFR ($r=0.466$, $P<0.001$), and it was considered to be a marker of integrated cardio-renal burden in the situation of cardiac emergency.

Conclusion

BNP plasma levels are closely related to LVEF and eGFR at hospital admission, in both STEMI and NSTEMI patients. Future studies should investigate whether BNP levels can summarize in a single parameter the prognostic information provided separately by cardiac and renal dysfunction. After acute MI, LVEF is also of prognostic significance and plays a major role in determining the therapeutic response. Measurements of the plasma BNP together with measures of left ventricular contractile function could allow useful refinement of risk stratification beyond that provided by either marker alone. However, more prospective cohort studies with large number of participants are needed to further identify the combined role of BNP, eGFR and LVEF and independently among patients of acute MI.

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DECLARATIONS

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Table 1: Correlation with outcomes of patients

Causes	eGFR	LVEF	BNP levels
Expired (N=19)	47.07 (24.19)	41.31 (9.76)	1766.8 (1287.1)
Discharged (N=102)	64.06 (25.12)	47.36 (9.86)	1002.7 (699.91)
P value	t=2.72 P<0.05	t=2.45 P<0.05	t=3.74 P<0.05
Data presented as mean (SD) unless otherwise specified. BNP, B-natriuretic peptide; eGFR, estimated glomerular filtration rate LVEF, left ventricular ejection fraction.			

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Figure 1: Risk factors present in study population

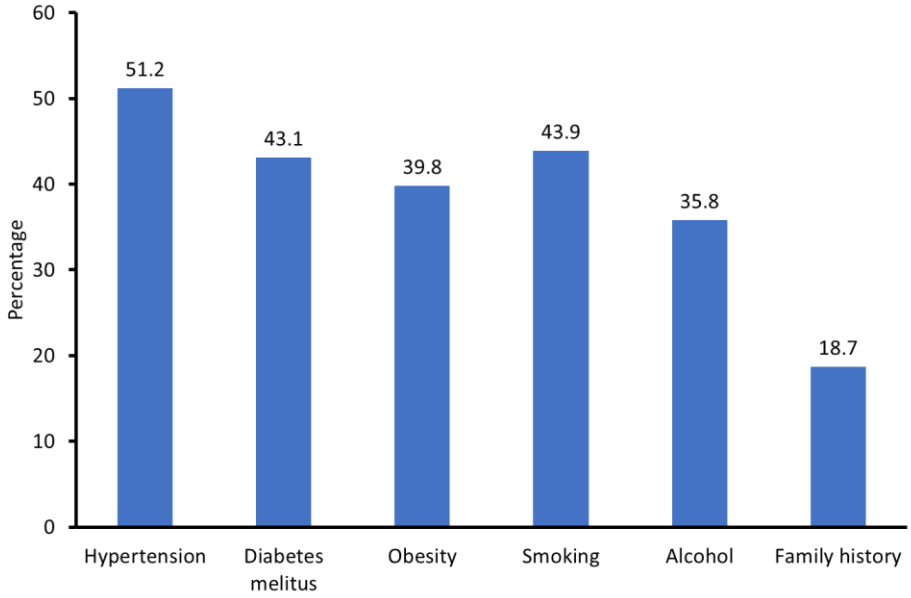

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Figure 2: Association of eGFR levels and BNP

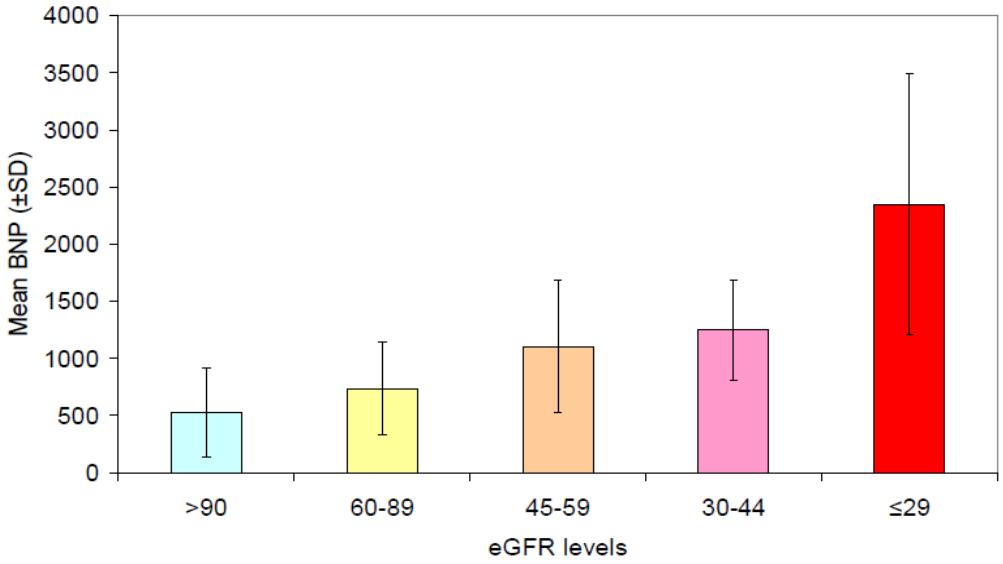

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Figure 3: Correlation of eGFR and BNP among study population