Original Research Article

A study of Brain Natriuretic Peptide levels in acute cardiac failure

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Abstract

Background: The clinical diagnosis of heart failure may be difficult and may pose a particular challenge in patients presenting with acute shortness of breath (SOB) in the emergency department (ED). The present study was done to identify easily the heart failure patients and their prognostication by doing BNP level.
Materials and methods: The study group consisted of patients 50 patients presenting to the hospital with acute cardiac failure diagnosed on the basis of Framingham Criteria and excluded the patients with creatinine level >2mg/dl.
Results: We found high BNP levels in patients with high NYHA class of failure, high CPKMB value, more LVEDD, low ejection fraction, diastolic dysfunction and mortality is also high in those patients.
Conclusion: This study showed higher value of BNP level in patients with low ejaction fraction, with diastolic dysfunction, with higher NYHA class and with higher mortality. We can recognize the importance of BNP level as a marker of both diagnostic and prognostic significance. The value of such an investigation in the overall treatment of acute Dyspnea on Exertion in the emergency department cannot be understated. BNP levels can help doctors in the ED to both effectively and conclusively diagnose and prognosticate heart failure.

Key words

Brain Natriuretic Peptide, Heart failure, Dyspnea, Echocardiography, Diastolic dysfunction, Ejection fraction.

Introduction

The clinical diagnosis of heart failure may be difficult and may pose a particular challenge in patients presenting with acute shortness of breath (SOB) in the emergency department (ED). Elements of clinical history and physical examination as well as information obtained from the electrocardiogram and chest radiograph may provide valuable clues as to whether HF is the cause of symptoms in the acutely dyspneic patients. Additional diagnostic tests, including echocardiography, may be required to obtain a more definite diagnosis. The ED, however, is not an optimal setting for echocardiography. Many patients are very ill and may have difficulties in lying still. A considerable proportion of dyspnoeic patients may be obese or have chronic obstructive pulmonary disease; these factors tend to reduce image quality. Moreover, echocardiography may not be generally available on a 24-h basis in all hospitals [1]. The American heart association and European society of cardiology have recognized the importance of simple and reproducible criteria and have developed guidelines for the diagnosis of heart failure. According to these recommendations, the diagnosis is based on clinical parameters and auxiliary laboratory tests in order to determine the etiology and degree of functional impairment. As an example, the task force of the European Society of Cardiology for the Diagnosis and Treatment of acute CHF recommended that a Cardiac Natriuretic Hormone assay should be included in the first step of algorithm for the diagnosis of HF along with electrocardiography and chest X-rays [2]. B-type natriuretic peptide (BNP) was first identified in the porcine brain in 1988 [3], but was subsequently found to be present in ventricular myocardium, the main source of circulatory BNP. The main secretory stimulus for BNP appears to be a stretch of cardiomyocytes rather than transmural pressure load, and circulating levels of BNP are increased in conditions characterized by volume overload and correlate with indices of hemodynamic status and ventricular failure. The present study is a humble attempt to evaluate the diagnostic accuracy and prognostic relevance of BNP measured at point of care in patients presenting with acute CHF, and correlation of its values with left ventricle function and in-hospital mortality [4].

Materials and methods

This study of BNP levels in Acute Cardiac Failure was conducted at SMS Multispecialty Hospital, Dr. MK Shah Medical College, Chandkheda, Ahmedabad between December 2016 to February 2018. The study group consisted of patients 50 patients presenting to the hospital with acute cardiac failure diagnosed on the basis of Framingham Criteria and selected according to inclusion and exclusion criteria.

Inclusion criteria: (Framingham Criteria)

All patients presenting with acute cardiac failure based on the fulfilment of two major criteria or one major and two minor criteria of the Framingham Criteria for Congestive Heart Failure as enlisted below:

Major criteria:

1. Paroxysmal nocturnal dyspnea
2. Neck vein distention
3. Rales
4. Radiographic cardiomegaly (increasing heart size on chest radiography)
5. Acute pulmonary edema
6. S3 gallop
7. Increased central venous pressure (>16 cm H2O at right atrium)
8. Hepatojugular reflux
9. Weight loss > 4.5 kg in 5 days in response to treatment

Minor criteria:

1. Bilateral ankle edema
2. Nocturnal cough
3. Dyspnea on ordinary exertion
4. Hepatomegaly
5. Pleural effusion
6. Decrease in vital capacity by on third from maximum recorded
7. Tachycardia (heart rate > 120 beats/min)

Minor criteria are acceptable only if they cannot be attributed to another medical condition (such as pulmonary hypertension, chronic lung disease, cirrhosis, ascites, or the nephritic syndrome.)
The following patients were excluded from the study

A. Patients with preexisting renal disease as defined by a serum creatinine level of more than 2 mg/dl.
B. Patients not giving an informed consent to undergo the required investigations.
C. Morbidly obese patients

All patients included in the study underwent a clinical assessment and a general and systemic examination. We took history of age, sex and addiction with measurement of height, weight and BMI. We did following investigations in patients: CBC, ESR, Peripheral smear, random blood sugar, serum creatinine, urine analysis, CPK MB, chest x-ray PA view, ECG, 2D-Echo by cardiologist at SMS Hospital and BNP level. Reference range of BNP level**:** Interpretation of BNP levels in patients presenting with acute dyspnoeic [5, 6]

- <100 pg/ml – no heart failure.
- 100 – 400 pg/ml → clinical evaluation → Heart failure/ no heart failure.
- > 400 pg/ml → Heart failure.

Results

Results obtained from 50 patients of heart failure in our study were depicted as per **Table – 1** to **Table - 15**. We found high BNP levels in patients with high NYHA class of failure, high CPKMB value, more LVEDD, low ejection fraction, diastolic dysfunction and mortality is also high in those patients.

Discussion

Our study consisted of patients of from 30 to 80 years with 54% of them being in the age group of 51 to 70 years. Of them, 78% were males and 22% were females. Of the total 50 patients, 5 patients (10%) were underweight, 22 patients (44%) were of normal weight, 18 (36%) were overweight and 4 (8%) had grade I obesity. One patient had grade II obesity. The BNP levels in the study of our patients had a negative correlation with BMI. Patients with a higher BMI had more incidence of ischemic heart disease.

Table - 1: Age-wise Distribution of Patients with Heart Failure.

Age wise distribution of patients (Years)	No. of patients	%
30-40	4	8
41-50	11	22
51-60	15	30
61-70	12	24
71-80	6	12
Above 80	2	4

Table - 2: Sex-wise Distribution of Patients with Heart Failure.

Sex	No. of patients	%
Male	39	78
Female	11	22

Table - 3: Summary of Symptoms.

Symptoms	No. of patients	%
Dyspnea on exertion	40	80
Edema feet	27	54
Orthopnea	34	68
PND	36	72

Table - 4: Summary of Major Clinical Signs.

Clinical findings	No. of patients	%
Pedal edema	27	54
NVE/HJR	35	70
Rales	36	72
S3 Gallop Rhythm	39	78

A majority of the patients (80%) had breathlessness as the chief compliant, others being PND (72%), Orthopnea (68%) and edema feet (54%). On clinical examination, 78% of the patients had a S3 gallop rhythm, 72% had rales, 70% had neck vein engorgement and/or Hepatojugular reflux and 54% of the patients had pedal edema. Of the 25 patients having a history of habits in the study group, 9 were Tobacco chewers, 13 were smokers and 3 of them consumed alcohol.

In our study, a majority of the patients had class IV NYHA heart failure (27 pts.) while 16, 7 and

1 patients had class III, II and I failure respectively. We found a positive correlation between BNP levels and the class of heart failure indicating that as patients with a higher BNP level had a higher NYHA class of failure [7]. This correlation was found to be of a significant level by the t-test (p value of 0.002).

Table - 5: Correlation of BMI with Heart failure and BNP level.

Category	BMI	No. of patients	Percentage (%)	Mean BNP
Underweight	<18.5	4	8	2806.36
Healthy weight	18.5-24.9	18	36	1057.08
Overweight	25-29.9	18	36	983.80
Obesity G-I	30-34.9	5	10	1055.04
Obesity G-II	35-39.9	1	2	857.30
Obesity G-III	>40	0	0	

Table - 6: Patients of Heart Failure with Diastolic Dysfunction.

Diastolic Dysfunction	No. of patients	Percentage (%)
Stage I	8	16
Stage II	18	36
Stage III	14	28
Stage IV	7	14

Table - 7: Etiology of Heart Failure.

Etiology of heart failure	No. of patients	Percentage (%)
Valvular Heart disease	3	6
Dilated Cardiomyopathy	6	12
Accelerated Hypertension	2	4
Atrial fibrillation	1	2
Acute Coronary Syndromes	37	74
Pulmonary Hypertension	1	2

Table - 8: Outcome of Patients.

Outcome of patients	No. of patients	Percentage (%)
Improved	32	64
Died	18	36

Table - 9: Correlation between NYHA class and BNP levels of Patients [7].

NYHA class	No. of patients	Min BNP	Max BNP	Mean BNP
I	1	1957.59	1957.59	1957.59
II	7	54.20	958.30	547.87
III	16	220.20	7616.21	1309.02
IV	26	23.38	7616.57	1285.96

Table - 10: Correlation between CKMB Levels and BNP Levels.

CKMB	No. of patients	Mean CKMB	Min BNP	Max BNP	Mean BNP
<21 U/L	4	16.25	254.30	652.40	387.10
22-100 U/L	16	64.49	54.20	3546.30	905.87
101-200 U/L	10	134.70	23.38	3790.00	1403.41
>200 U/L	0	0	0	0	0

Table - 11: Correlation between LVEF% and BNP.

LVEF	No. of patients	Percentage	Min BNP	Max BNP	Mean BNP
Up to 30	12	24	254.60	2973.00	1231.27
31 – 40	14	28	80.00	2564.40	692.97
41 – 50	13	26	54.20	7616.57	1452.05
51 – 60	9	18	23.38	7616.21	1773.12
>60	2	4	351.00	1748.92	1049.96

Table - 12: Correlation between LVEDD and BNP Levels.

LVEDD	Mean	No. of patients	percentage	Min BNP	Max BNP	Mean BNP
<30	28.00	1	2	652.00	652.00	652.00
30-40	34.62	13	26	23.38	2624.40	989.52
41-50	44.00	9	18	54.20	2973.00	819.15
51-60	55.76	8	16	402.00	3790.00	1618.46
61-70	135.07	9	18	80.00	7616.21	1262.10
71-80	151.71	7	14	212.50	7616.57	1544.05
81-90	177.40	3	6	254.30	1957.59	1389.63

Table - 13: Correlation between Fractional Shortening (FS) and BNP Levels.

FS (%)	No. of patients	Percentage	Min BNP	Max BNP	Mean BNP
up to 10	7	14	54.20	3790.00	1274.67
10-20	12	24	564.89	7616.21	1633.53
20-30	14	28	23.38	1235.00	477.46
30-40	9	18	224.60	2973.00	1328.82
40-50	7	14	212.50	7616.57	1735.56
>50	1	2	854.30	854.30	854.30

Table - 14: Correlation of BNP Level Quartiles with Mortality.

Sr No.	BNP Quartile	Survived	Deaths
1	289.05	11	3
2	767.3	6	6
3	1227.993	6	5
4	7616.57	8	5

Table - 15: Overall Summary of Correlations of BNP levels with Various Parameters.

Sr. No.	BNP Quartile	BMI	CKMB (IU/L)	LVEF (%)	LVEDD (mm)	FS (%)
1	289.05	23.95	68.75	42.62	57.69	28.94
2	767.3	24.64	86.25	35.83	52.10	22.90
3	1227.993	24.46	75.80	40.17	52.50	28.82
4	7616.57	23.62	93.63	39.66	55.38	25.78

Of the 30 patients who had acute coronary syndromes, a positive correlation was found between the BNP levels and CPK-MB levels [10]. However, a t-test proved the relation to be insignificant (p value 0.038) and hence the correlation was deemed to be invalid.

On monitoring of the echocardiographic findings, it was found that patients with a higher BNP level had a lower ejection fraction (correlation coefficient of -0.61) [8]. Also, patients who had a higher BNP level had a larger LVEDD (correlation coefficient 0.73) [9]. Further, those patients also had a decreased shortening of the myocardium during systole (correlation coefficient -0.05).

Most of the patients in our study had Diastolic dysfunction (94%). A majority had grade II

dysfunction (36%). 28% had grade III dysfunction, 16% had grade I dysfunction and 7% had grade IV dysfunction.

We found an increase in mortality in the higher BNP quartiles. The correlation showed a coefficient of 0.206. There was also a negative coefficient of correlation between survival and BNP levels (-0.002) showing patients had a greater chance of survival with a lower BNP level.

Conclusions

We were able to draw the following conclusions from our study:

- The level of BNP rises with rising grade/class of heart failure.
- Patients with higher BMI tend to have a lower BNP value.
- An elevated level of the marker concurred with an increase in mortality, thereby also depicting the prognostic usefulness of this marker.
- The level of BNP showed a negative correlation with LVEF values and Fractional shortening. A positive correlation was found with LVEDD. These findings exhibit the usefulness of the marker in the prognosis of the patient presenting to the emergency department with acute heart failure.
- The results of our study showed trends similar to other large scale studies like Fonarow, Peacock et al. [11].

Keeping in mind the above conclusions, we can recognize the importance of BNP level as a marker of both diagnostic and prognostic significance. The value of such an investigation in the overall treatment of acute Dyspnea on Exertion in the emergency department cannot be understated. BNP levels can help doctors in the ED to both effectively and conclusively diagnose and prognosticate heart failure.

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