Marjanović et al. Scr Med 2022 Jun;53(2)125-9. DOI:10.5937/scriptamed53-37268
ORIGINAL ARTICLE

Assessment of Prognostic Markers of Heart Failure Following Acute Myocardial Infarction in Patients Treated With Primary Percutaneous Coronary Intervention

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Abstract

Background / Aim: The concentration of N-terminal brain natrium peptides (NT-proBNP) is an important marker within the diagnostic and prognostic analysis of patients with chronic heart failure. In patients with ST-segment elevation myocardial infarction, natriuretic peptides are dominant predictors of death, heart failure and additional myocardial infarctions. The aim of this study was to correlate prognostic markers of heart failure following acute myocardial infarction.

Methods: 193 patients with myocardial infarction were divided into two groups: 69 patients with NT-proBNP ≤ 1000 pg/mL and 124 patients with NT-proBNP > 1000 pg/mL. During the hospitalisation, laboratory data, clinical data and information on previous medications were collected. Echocardiography was used to identify left ventricular ejection fraction (LVEF). All statistical analysis were done in SPSS, version 23.

Results: The group with elevated NT-proBNP (> 1000 pg/mL) was older ($p < 0.001$) and suffered more often of arterial hypertension ($p = 0.04$) and atrial fibrillation ($p = 0.003$). Heart rate was higher and LVEF was lower in patients with elevated NT-proBNP values ($p < 0.001$). Mean LVEF in the 193 patients was 46.86 %. In both linear and binary logistic regression analysis multiple predictors of elevated NT-proBNP have been identified.

Conclusion: Increased ranges of NT-proBNP in patients following acute myocardial infarction are in correlation with decreased LVEF, elevated high-sensitive troponin I, lactate dehydrogenase, urea, creatinine, C-reactive peptides. This may guide clinicians to assess and treat early stages of heart failure.

Key words: NT-proBNP; Acute myocardial infarction; Heart failure.

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ARTICLE INFO

Received: 3 April 2022
Accepted: 13 June 2022

Introduction

Defining the concentration of circulating natriuretic peptides is a crucial in the diagnostic and prognostic assessment of patients with persistent coronary heart disease.[1, 2] In patients who suffered from ST-segment elevation myocardial infarction, natriuretic peptides can be dominant predictors of left ventricular dysfunction and death.[1, 3]

The aim of this study was to correlate N-terminal brain natrium peptides (NT-proBNP) ranges with indicators of myocardial necrosis, left ventricular ejection fraction (LVEF), heart rhythm and other measures such as creatinine, cholesterol, sodium, potassium, C-reactive peptides (CRP) as well as with smoking habits and on-going medications ie, antiplatelet therapy, beta-blockers, ACE-inhibitors.

This article should be cited as follows: Marjanović D, Miljković J, Stanetić B. Assessment of prognostic markers of heart failure following acute myocardial infarction in patients treated with primary percutaneous coronary intervention. Scr Med 2022 Jun;53(2):125-9.

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Methods

Study population and data collection

In this study, 193 adult consecutive patients who were treated with primary percutaneous coronary intervention (PCI) between January 2021 and October 2021 at the University Clinical Centre of Republic of Srpska were included. All patients with measured NT-proBNP levels were included.

Clinical data

During the hospitalisation, clinical documentations on previous medications were collected. Study included data on hypertension, diabetes mellitus, family history of coronary artery disease, smoking status and previous interventions (PCI, coronary artery bypass grafting). Heart rhythm was analysed by electrocardiography for detecting normal sinus rhythm and abnormalities (atrial fibrillation, atrial flutter and patients with implanted pacemaker).

Laboratory data

Blood samples were collected in first 24 hours after admission. Parameters were NT-pro BNP levels, markers of myocardial necrosis (creatine kinase (CK), CK-MB, lactate dehydrogenase (LDH), troponin), total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), triglycerides, urea, creatinine, sodium, potassium, magnesium, calcium, CRP, D-dimer, prothrombotic time, activated partial thromboplastin time (aPTT), prothrombin time - international normalised ratio (INR).

Echocardiography

Echocardiography was used to determine LVEF.

Statistical analysis

Continuous variables were presented as mean with standard deviation or median and interquartile range, based on data distribution. For normal distribution was used a T-test and in cases with abnormal distribution Mann Whitney test was used. Categorical variables were presented as number with percentage and compared using a Chi-square test. In order to assess correlation between different parameters, linear regression analysis and Person´s coefficient were used. All variables were implemented into a univariate ie, multivariate binary logistic regression model. Independent predictors of elevated NT-proBNP were identified. All analysis was done in SPSS, version 23.

Results

Clinical data

Patients were divided into two groups according to the NT-proBNP levels. First group, 69 patients (NT-proBNP ≤ 1000 pg/mL) and second group 124 patients (NT-proBNP > 1000 pg/mL). The mean age of the 193 patients was 74.6 years. There was a predominance of male patients, 120 patients ie, 62.18 %. The vast majority had hypertension (65.8 %). There were 27.46 % smokers (53 patients) and 57 out of 193 had positive family history for cardiovascular diseases. Patients had mainly sinus rhythm (83.42 %), whereas in 29 patients (15.06 %) there was atrial fibrillation. Atrial flatter was found at 1 patient (0.52 %) and there were 2 patients with pacemaker (1.04 %). Mean LVEF in the 193 patients was 46.86 % (Table 1).

Table 1: Baseline characteristics in patients with heart failure following acute myocardial infarction related to NT-proBNP values

	Total n = 193	NT-proBNP (pg/mL) ≤ 1000 (n = 69)	NT-proBNP (pg/mL) > 1000 (n = 124)	p
Age		61 (IQR 19)	72 (IQR 19)	
Male	120	43 (62.3 %)	77 (62.1 %)	< 0.001
Hypertension	127	40 (57.9 %)	87 (70.2 %)	0.97
Diabetes mellitus	47	12 (17.4 %)	35 (29.0 %)	0.04
Smoking	53	23 (33.3 %)	30 (24.2 %)	0.28
Family history	54	27 (39.1 %)	27 (21.8 %)	0.37
Previous PCI	39	13 (18.8 %)	26 (20.9 %)	0.07
Previous CABG	7	2 (2.9 %)	5 (4.0 %)	0.72
ACE inhibitor	101	36 (52.2 %)	65 (52.4 %)	0.69
Beta blocker	138	43 (62.3 %)	95 (76.6 %)	0.97
Acetylsalicylic acid	104	34 (49.3 %)	70 (56.5 %)	0.04
Clopidogrel	73	23 (33.3 %)	50 (40.3 %)	0.34
Rhythm				0.34
Sinus rhythm	161	65 (94.1 %)	96 (77.4 %)	0.003
Atrial fibrilation	29	2 (2.9 %)	27 (21.8 %)	
Atrial flutter	1	1 (1.5 %)	0 (0 %)	
Pacemaker	2	1 (1.5 %)	1 (0.8 %)	
Heart rate		81.22 ± 19.127	94.69 ± 23.266	< 0.001
LVEF (%)		55 (IQR 15)	38 (IQR 15)	< 0.001

PCI: percutaneous coronary intervention; CABG: coronary artery bypass graft; ACE: angiotensin-converting enzyme; LVEF: left ventricular ejection fraction; NT-pro-BNP: N-terminal proBrain natriuretic peptide;

The group with elevated NT-proBNP (> 1000 pg/mL) were older (p < 0.001) and suffered more often of arterial hypertension (p = 0.04) and atrial fibrillation (p = 0.003). As expected (Table 1), heart rate was higher and LVEF was lower in patients with elevated NT-proBNP values (p < 0.001).

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Table 2: Laboratory findings in patients with heart failure following acute myocardial infarction related to NT-proBNP values

	NT-proBNP (pg/mL)		p
	≤ 1000 (n = 69)	> 1000 (n = 124)	
Hs troponin I (µg/L)	62.6 ± 4355.2	1345 ± 14057.2	0.001
LDH (U/L)	229 ± 237	298 ± 352.8	0.005
CK (U/L)	164 ± 400	121 ± 358.5	0.378
CK-MB (U/L)	24 ± 30	23.5 ± 59.8	0.334
Total cholesterol (mmol/L)	5.04 (IQR 1.46)	4.79 (IQR 1.46)	0.441
HDL (mmol/L)	1.1 (IQR 0.4)	1 (IQR 0.4)	0.318
LDL (mmol/L)	3.44 (IQR 1.29)	3.29 (IQR 1.17)	0.563
Triglycerides (mmol/L)	1.74 ± 0.98	1.656 ± 0.87	0.675
Urea (mmol/L)	5.9 ± 2.3	7.25 ± 6.7	0.002
Creatinin (µmol/L)	78 (IQR 31.8)	94 (IQR 47)	0.002
Sodium (mmol/L)	140 (IQR 3)	139 (IQR 6)	0.195
Potassium (mmol/L)	4.26 ± 0.42	4.34 ± 0.64	0.406
Magnesium (mmol/L)	0.83 ± 0.09	0.78 ± 0.09	0.018
Calcium (mmol/L)	2.27 ± 0.3	2.2 ± 0.2	0.034
CRP (mg/L)	2.8 ± 16.2	13.5 ± 59.3	< 0.001
D dimer (µg/L)	5.97 ± 11.4	2.42 ± 10.3	0.788
Prothrombotic time	1.62 ± 2.1	2.29 ± 3.4	0.765
aPTT	58.29 ± 32.5	57.18 ± 29.48	0.909

PCI: percutaneous coronary intervention; ACE: angiotensin-converting enzyme; LVEF: left ventricular ejection fraction; NT-pro-BNP: N-terminal proBrain natriuretic peptide; CK: creatine kinase; LDH: lactate dehydrogenase; CRP: C-reactive protein;

Regression analysis

Regression analysis data are given in Table 2. Patients in whom NT-proBNP was higher of 1000 pg/mL had values of high-sensitive troponin I, LDH, urea, creatinine and CRP. In the linear regression analysis, serum NT-proBNP levels correlated well with LVEF, serum creatinine (µmol/L) and CRP (Figure 1). When univariate binary logistic regression analysis were applied, multiple predictors of elevated NT-proBNP (> 1000 pg/mL) were identified (Table 3).

Discussion

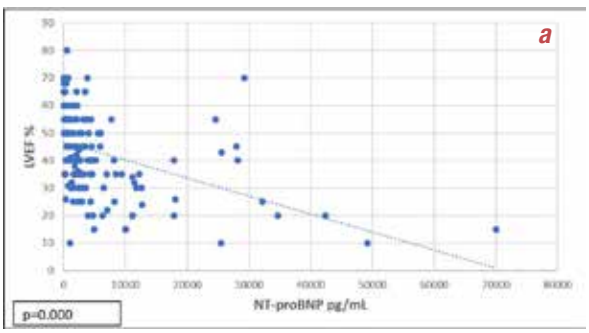
This study was focused on patients with acute myocardial infarction treated with primary PCI.

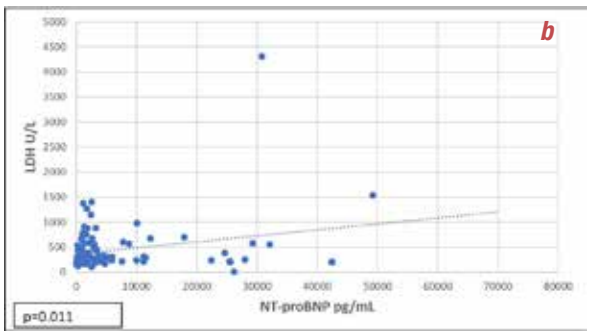
Table 3: Univariate binary logistic regression analysis in patients with heart failure following acute myocardial infarction related to NT-proBNP values

Variable	Univariate logistic regression		
	OR	95 % CI	p
Age	0.984	0.97-1.01	0.100
Male	1.009	0.55-1.85	0.976
Hypertension	1.705	0.92-3.15	**0.088**
Diabetes	1.868	0.90-3.90	**0.096**
Smoking	0.638	0.33-1.22	0.174
Prior PCI	1.143	0.54-2.40	0.724
Atrial fibrillation	2.747	1.12-6.73	0.027
LVEF (%)	0.914	0.89-0.94	**< 0.001**
ACEi	1.010	0.56-1.82	0.974
Beta-blockers	1.981	1.04-3.76	**0.036**
Acetylsalicylic acid	1.334	0.74-2.41	0.338
CK (U/L)	1.000	0.99-1.01	0.285
LDH (U/L)	1.003	1.00-1.05	**0.028**
CK-MB (U/L)	1.001	0.98-1.04	0.484
hsTroponin (µg/L)	1.005	1.00-1.10	**0.078**
Cholesterol (mmol/L)	1.002	0.99-1.01	0.715
LDL (mmol/L)	0.997	0.97-1.03	0.840
Triglycerides (mmol/L)	1.010	0.96-1.06	0.672
Urea (mmol/L)	1.013	1.01-1.02	**0.003**
Creatinine (µmol/L)	1.019	1.01-1.03	**0.002**
Sodium (mmol/L)	0.927	0.84-1.02	0.133
Potassium (mmol/L)	0.983	0.96-1.01	0.203
Magnesium (mmol/L)	0.994	0.98-1.01	0.563
CRP (mg/L)	1.001	1.00-1.01	**0.077**
D-Dimer (µg/L)	1.00	0.99-1.01	0.614

PCI: percutaneous coronary intervention; CABG: coronary artery bypass graft; ACE: angiotensin-converting enzyme; LVEF: left ventricular ejection fraction; NT-pro-BNP: N-terminal proBrain natriuretic peptide; OR: odds ratio; CI: confidence interval;

The major result of this study was the positive correlation between NT-proBNP levels with LVEF and other indicators (troponin I, LDH, urea, creatinine and CRP). LVEF was lower in patients with elevated NT-proBNP values ($p < 0.001$). Troponin I ($p = 0.078$) and LDH ($p = 0.028$) levels were considerably related with NT-proBNP levels. Previous study showed that kidney failure and aging are significant factors for elevated plasma NT-proBNP levels.[4] When serum creatinine levels are higher than 2.0 mg/dL, NT-proBNP levels elevate remarkably.[5-7] This study showed posi-





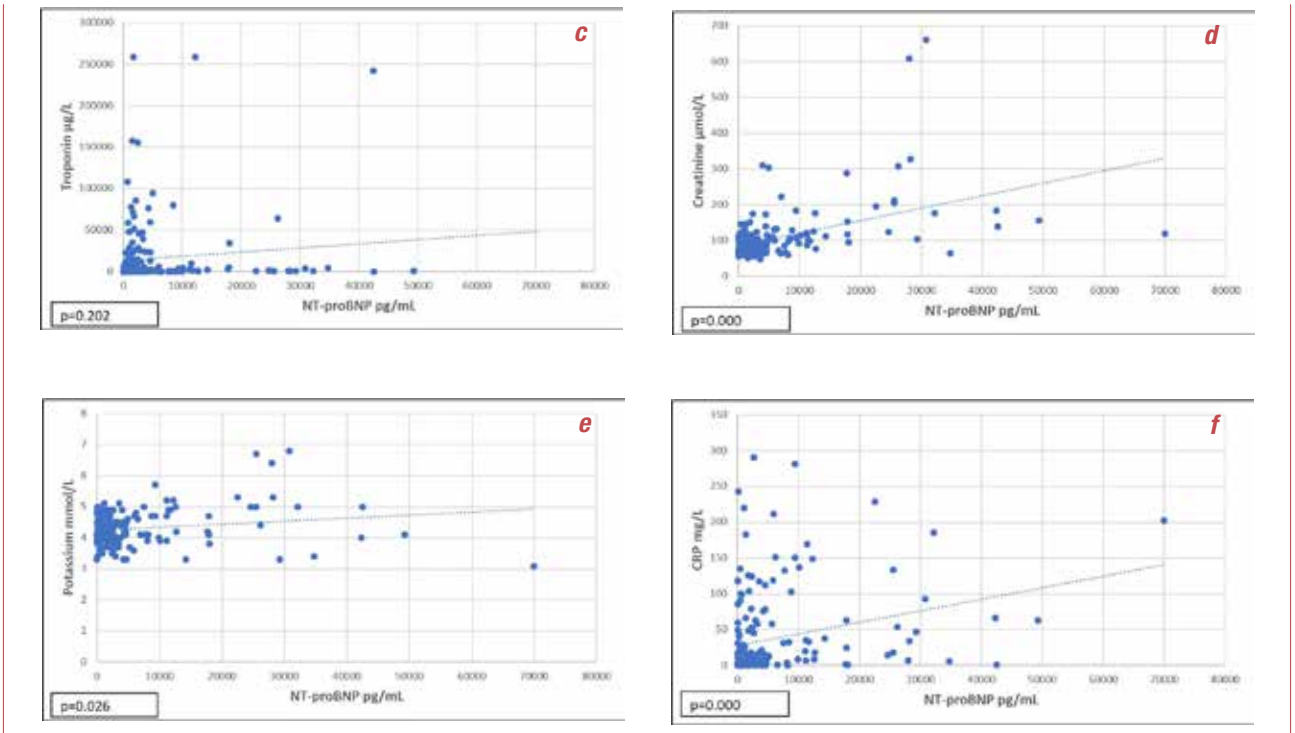


Figure 1 a-f: Linear regression analysis of parameters in patients with heart failure following acute myocardial infarction

tive correlation with urea (p = 0.003) and creatinine (p = 0.002) levels. The group with elevated NT-proBNP (> 1000 pg/mL) had higher CRP levels (p = 0.077) and suffered more often of arterial hypertension (p = 0.04) and atrial fibrillation (p = 0.003).

Study showed negative correlation with CK-MB (p = 0.484) and atherosclerosis markers (cholesterol and triglycerides). Cholesterol (p = 0.715) and triglycerides (p = 0.672) were not associated with higher NT-proBNP levels.

High NT-proBNP levels are in some measure related to the degree of ischaemic myocardial infarction, which may have prognostic value.[8] In previous study, older patients formed an enlarged amount of individuals with acute myocardial infarction and age was a powerful predictor of significant complications and death after acute myocardial infarction.[8] However, this study did not find significantly association with age and high NT-proBNP levels (p = 0.100).

Findings from this study indicate that high NT-proBNP levels can bring relevant information because of their possibility to outline the quantity of injured myocardium.

Limitations

The study has some limitations, which needs to be acknowledged. Retrospective nature of the study cannot exclude potential selection bias as well as confounding variables. Relatively small number of patients. Data on total ischaemic time were not available.

Conclusion

There are many important predictors for worse patient condition and poor outcomes. NT-proBNP levels correlated with LVEF, but also with troponin I, LDH, urea, creatinine and CRP levels. There was a relation of high NT-proBNP levels with hypertension and atrial fibrillation. This may guide clinicians to assess and treat early stages of heart failure.

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Acknowledgements

None.

Conflict of interest

None.

References

1. Jernberg T, James S, Lindahl B, Johnston N, Stridsberg M, Venge P, et al. Natriuretic peptides in unstable coronary artery disease. Eur Heart J 2004 Sep;25(17):1486-93.
2. Wiviott SD, de Lemos JA, Morrow DA. Pathophysiology, prognostic significance and clinical utility of B-type natriuretic peptide in acute coronary syndromes. Clin Chim Acta 2004 Aug 16;346(2):119-28.
3. Richards AM, Nicholls MG, Espiner EA, Lainchbury JG, Troughton RW, Elliott J, et al. B-type natriuretic peptides and ejection fraction for prognosis after myocardial infarction. Circulation 2003 Jun 10;107(22):2786-92.
4. Vanderheyden M, Bartunek J, Goethals M. Brain and other natriuretic peptides: molecular aspects. Eur J Heart Fail 2004 Mar 15;6(3):261-8.
5. Palazzuoli A, Deckers J, Calabrò A, Campagna MS, Nuti R, Pastorelli M, et al. Brain natriuretic peptide and other risk markers for outcome assessment in patients with non-ST-elevation coronary syndromes and preserved systolic function. Am J Cardiol 2006 Nov 15;98(10):1322-8.
6. Chenevier-Gobeaux C, Claessens YE, Voyer S, Desmoulins D, Ekindjian OG. Influence of renal function on N-terminal pro-brain natriuretic peptide (NT-proBNP) in patients admitted for dyspnoea in the Emergency Department: comparison with brain natriuretic peptide (BNP). Clin Chim Acta 2005 Nov;361(1-2):167-75.
7. Vickery S, Price CP, John RI, Abbas NA, Webb MC, Kempson ME, et al. B-type natriuretic peptide (BNP) and amino-terminal proBNP in patients with CKD: relationship to renal function and left ventricular hypertrophy. Am J Kidney Dis 2005 Oct;46(4):610-20.
8. Ribeiro AL. Natriuretic peptides in elderly people with acute myocardial infarction. BMJ 2009 May 6;338:b787. doi: 10.1136/bmj.b787.

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