NUTRITIONAL STATUS INFLUENCE ON CLINICAL OUTCOME IN A GROUP OF PATIENTS WITH MYOCARDIAL INFARCTION

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Abstract: *Malnutrition has been recognized as an independent risk factor for morbidity and mortality in patients with chronic heart failure. The objective of this study was to identify and evaluate the impact of a modified nutritional status determined by the PNI index on clinical evolution and general hospitalization period in a group of patients with acute myocardial infarction. In this retrospective observational study we included 99 patients who were diagnosed with acute myocardial infarction, admitted to SCJU Cardiology Clinic in Târgu-Mureş. This study has shown that there is an association between high levels of inflammatory status and depressed nutritional status. The results also highlighted the fact that malnutrition has a supportive role for complications onset following an acute myocardial infarction, resulting in a lower recovery and a much higher hospitalization period.*

INTRODUCTION

Worldwide in contemporary times, coronary artery disease represents the most common cause, which affects millions of people. Ischemic cardiovascular mortality rates reaching over 7 million people each year. In Europe, mortality due to acute myocardial infarction is observed in every 7th woman and 6th male.

Third Global Myocardial Infarction Task Force defines acute myocardial infarction as being the interruption of blood flow at the level of a portion of the heart that causes death of myocardial cells. The most common is the obstruction of a coronary artery following rupture of an atheroma plate, which is a deposit of lipids and white cells (especially macrophages) in the arterial wall. Ischemia (loss of blood flow) and hypoxia results, untreated in time, lead to the death (necrosis) of the heart muscle. Currently, for evidence of lesion and myocardial necrosis, in clinical practice, there are used the following serum markers: troponin levels, serum myoglobin and creatinekinase along with the electrocardiogram investigation. Specialty studies have highlighted besides vulnerable atherosclerotic plaque, a new concept, namely the "vulnerable patient", which can be defined as that patient who presents a thrombogenic vulnerable blood, increased inflammation, thrombocytosis, and hyperlipidemia.

While many researches have been conducted to identify and understand the relationship between factors that determine the increased number of deaths from cardiovascular nature, the role of nutritional status in cardiovascular disease is still poorly understood. Recent studies have shown that low body mass index (BMI) and hypoalbuminemia are important risk factors for mortality in elderly patients after acute coronary syndrome.(1,2)

Furthermore, the assessment of nutritional status by body weight and albumin level has been shown to influence clinical outcomes during hospitalization in patients with myocardial infarction.(3) However, there is a lack of knowledge about the impact of nutritional status on long-term outcomes, especially in elderly patients affected by acute cardiovascular events such as acute myocardial infarction.

Malnutrition has been recognized as an independent risk factor for morbidity and mortality in patients with chronic heart failure. Malnutrition has been associated with impaired cardio-respiratory performance, with increased risk of falling, prolonged hospitalization and increased mortality. Some nutritional indicators, such as albumin, have been shown to be closely associated with poor outcomes in investigated patients.(7,8) In addition, to assess the nutritional status, more complex indices such as the prognostic nutritional index (PNI) have been developed and widely used.(4,5) PNI is a combined nutritional-inflammatory score based on serum albumin levels and the number of lymphocytes that reflect immunological nutritional status and which measures the risk of several types of cancer in patients.(6) This index is convenient to achieve because only simple blood biomarkers are needed. It appears that low levels of serum albumin are elevated risk factors for coronary artery disease, which along with traditional risk factors can help confirm patients at risk for myocardial infarction.(2,4)

PURPOSE

The objective of this study was to identify and evaluate the impact of a modified nutritional status determined by the PNI index on clinical evolution and general hospitalization period in a group of patients with acute myocardial infarction.

MATERIALS AND METHODS

In this retrospective observational study we included 99 patients which were diagnosed with acute myocardial infarction, admitted to SCJU Cardiology Clinic in Târgu-Mureş between September 2018 and January 2019. Patients who were diagnosed with stable angina, end-stage renal disease, liver failure, a history of systemic inflammatory disease, or had insufficient data (albumin value, lymphocyte count etc.) in the observation charts were excluded.

The assessment of the nutritional status of hospitalized patients was made by computing two indices, namely Prognostic Nutritional Index (PNI) and Geriatric Nutritional Risk Index (GNRI). The PNI score was calculated according to the

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following formula: 10 × serum albumin (g / dl) + 0.005 × total lymphocyte count (mm / mm3). After studying the literature, we decided to choose a score of 50 for the PNI score as the threshold value that differentiates normal nutritional status from the modified one.

The study population (n = 99) was divided into two groups according to the nutritional status determined by the PNI score. The final evaluation groups are:

- Group 1, n = 50, patients with PNI score <50, reflecting a modified nutritional status.
- Group 2, n = 49, patients with PNI score ≥50, expressing a normal nutritional status.

Calculation of the GNRI score was performed according to a formula that included: GNI = 14.98 x serum albumin (g / dl) + 41.7 x actual body weight (GA) / GI and the ideal weight (GI) by another formula that makes the difference between men and women. For men: Body Height (H) / 4) and for women: Q (cm) - 100 - ((I-150) / 2,5). The chosen threshold value of the GNRI score that differentiates patients with adequate nutritional status from undernourished patients was 98.

Data collected from the observation charts were: socio-demographic indicators, anthropometric indicators, cardiovascular risk factors, personal medical history, laboratory biochemical data, blood count, serum albumin value, inflammatory status indicators, total hospitalization, complications that occurred after acute myocardial infarction.

Since the study was retrospective, it was not necessary to complete an informed consent form, but the study was conducted with the positive opinion of the Ethics Commission of the University of Medicine, Pharmacy, Sciences and Technology Târgu-Mureş, and in accordance with the principles of the Helsinki Declaration.

Statistical processing was done with the GraphPad Instat Demo Version software. The quantitative variables were expressed as mean ± SD. The Kolmogorov-Smirnov test was used for normality testing. The T-Student test for the normal-distribution continuous variables was applied, and the Mann-Whitney U test for the non-parametric continuous variables. The categorical variables were expressed as number and percent, and the exact tests of Pearson chi-square or Fisher were used to evaluate the differences. Correlation and logistic regression analysis was performed to investigate the association between the nutritional status expressed by the PNI score and the hsCRP levels in the period following myocardial infarction. The chosen threshold of significance was alpha = 0.05, p <0.05.

RESULTS

The general characteristics of the patients, and according to the PNI score, are highlighted in table no. 1. A total of 99 patients with STEMI and NSTEMI myocardial infarction were evaluated, the male sex being more frequent with 58.41% in the total group, 60% in group 1, and 59.18% in group 2, (p = 0.93). The mean age of the total population was 62.61 ± 13.63 years.

There were no statistically significant differences between the two PNI groups related to gender (p = 0.93), BMI (p = 0.54), smoking status (p = 0.77), diabetes mellitus (p = 0.71), and previous myocardial infarction (p = 0.72).

The body mass index of the total population had an average value of 28.09 ± 5.61 kg / m2, without a statistical difference between the two PNI groups (group 1 having BMI = 28.05 ± 4.50 kg / m2 vs group 2, BMI= 28.13 ± 6.61 kg / m2).

Determination of nutritional status through the GNRI score shows that patients with PNI <50 (malnutrition) score had a significantly lower GNRI score than patients with adequate nutritional status (PNI ≥ 50), 97.84 ± 4.60 versus 103.6 ± 4.85, p <0.0001, confirming that patients with an altered nutritional status expressed with a PNI score <50 also have a GNRI score indicating malnutrition (97.84 ± 4.60).

Comparison between the two PNI groups revealed that patients with altered nutritional status (group 2) required a significantly longer period of general hospitalization compared to patients who had a normal nutritional status (9.51 ± 3.54 days vs. 7.76 ± 1.68, p = 0.0014).

Regarding the presence of cardiovascular risk factors, our results show that undernourished patients (PNI score <50) have higher blood pressure than patients with adequate nutritional status (89.79% vs 72%, p = 0.02) and patients with normal nutritional status presents more frequently dyslipidemia than malnourished patients, the difference being significant (50% vs 20.40%, p = 0.002) (table no. 1).

Regarding complications that occurred after acute myocardial infarction, a proportion of 28.57% of patients with altered nutritional status required inotropic support compared to 8% of patients with unaltered nutritional status (p = 0.004). Regarding inflammatory status, the results from table no. 2 show the presence of systemic inflammation in patients with malnutrition both on first day post myocardial infarction (26.28 ± 38.15 mg / dl vs 7.02 ± 17.9 mg / dl, p <0.0001) and after a 5-day period. Also, the hsCRP value from day 1 to day 5 recorded an increase in both group 1 and group 2, the increasing value being significantly exacerbated in group 2 (45.25 ± 48.14 mg / dl vs 19.33 ± 26.80 mg / dl, p = 0.0004). In addition, PNI index values showed a poor but significant negative correlation with hs-CRP on day 1 (r = -0.51, p <0.0001, figure no. 1) and on day 5 (r = -0 , 49, p <0.0001, figure no. 2).

Figure no. 1. Nutritional status expressed by PNI index and serum levels of hsCRP at day 1

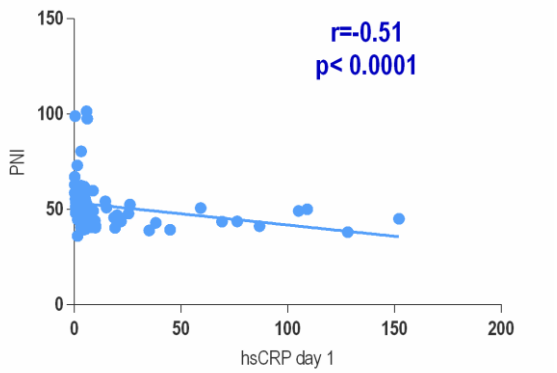

Figure no. 2. Nutritional status expressed by PNI index and serum levels of hsCRP at day 5

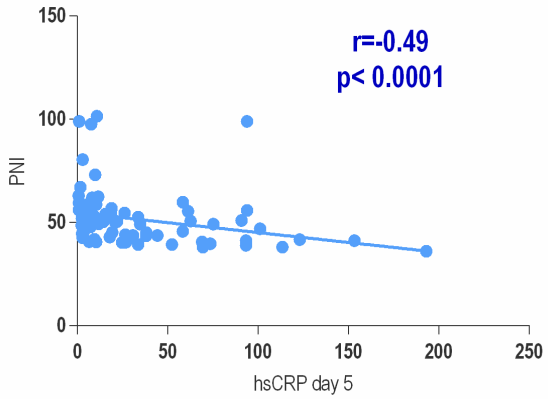

Table no. 1. General characteristics of the study population and according to the nutritional status expressed by the PNI score

Parameters	Total, n=99	Group 1 – PNI ≥ 50, n = 50	Group 2 – PNI<50, n = 49	p value
Gender, M, n (%)	59 (58.41%)	30 (60%)	29 (59.18%)	0.9340
Age (years, mean ± SD)	62.61±13.63	58.51±13.53	66.88±11.50	**0.0018**
BMI (kg/m^2 , mean ± SD)	28.09±5.61	28.05±4.50	28.13 ± 6.61	0.5421
Smoking status, n (%)	58 (57.42%)	30 (60%)	28 (57.14%)	0.7729
HBP, n (%)	79 (78.21%)	36 (72%)	44 (89.79%)	0.0246
Diabetes mellitus, n (%)	30 (29.7%)	16 (32%)	14 (28.57%)	0.7105
Dyslipidemia, n (%)	35 (34.65%)	25 (50%)	10 (20.40%)	0.0021
Obesity, n (%)	11 (10.89%)	5 (10%)	6 (12.24%)	0.722
Inotropic support, n (%)	19 (18.81%)	4 (8%)	15 (28.57%)	0.004
Days hospitalization (days, mean ± SD)	8.62±2.88	7.76±1.68	9.51±3.54	0.0014

Table no. 2. Laboratory characteristics for the total lot and the two PNI groups

Parameters	Total, n=99	Group 1 – PNI ≥ 50, n = 50	Group 2 – PNI<50, n = 49	p value
	Mean ± SD (95%CI)			
Biochemical laboratory tests				
Uric acid (mg/dL)	5.15±1.49 (4.74-5.55)	5.10±1.65 (4.48-5.71)	5.20±1.38 (4.64-5.76)	0.8077
Urea (g/dL)	43.49±42.05 (35.15-51.84)	42.32±52.66 (27.50-57.13)	44.72±27.48 (63.82-52.61)	0.0188
Creatinine (g/dL)	1.10±1.18 (0.86-1.34)	1.03±1.04 (0.73-1.32)	1.18±1.32 (0.79-1.56)	0.3953
Sodium (mmol/L)	155.3±160.3 (123.5-187.1)	138.6±3.34 (137.6-139.5)	172.5±228.9 (106.5-238.4)	0.1524
Potassium (mmol/L)	4.18±0.49 (4.09-4.18)	4.14±0.48 (4.01-4.25)	4.22±0.45 (4.09-4.35)	0.3992
hsCRP - day 1	16.46±30.77 (10.36-22.57)	7.02±17.9 (2.21-11.83)	26.28±38.15 (15.33-37.24)	**<0.0001**
hsCRP - day 5	32.03±40.69 (23.96-40.11)	19.33±26.80 (11.80-26.87)	45.25±48.14 (31.42-59.07)	0.0004
Albumin (g/dL)	3.93±0.39 (3.85-4.01)	4.16±0.32 (4.07-4.25)	3.69±0.30 (3.61-3.78)	**<0.0001**
Total cholesterol (mg/dL)	198.5±50.34 (188.5-208.5)	202±47.74(188.6-215.4)	194.9±53.16 (179.6-210.1)	0.4829
Triglycerides (mg/dL)	139.5±106.7 (111.4-167.5)	142.7±107.2 (103.3-185.1)	136.6±108 (97.04-176.3)	0.8255
Glucose (mg/dL)	140.6±56.34 (128.5-152.6)	147±57.41 (130.9-163.2)	132.2±53.7 (116.6-147.7)	0.1049
Troponin (ng/mL)	1.27±2.11 (0.79-1.75)	1.42±2.40 (0.72-2.13)	0.98±1.1.44 (0.53-1.14)	0.2924
CK (U/L)	1444±1802 (1084-1803)	1784±2024 (1215-2354)	1081±1467 (655.5-1507)	0.0108
GOT (U/L)	175.5±189.5 (137.7-213.3)	205±200.6(148.5-261.4)	144.3±173.6 (93.86-194.7)	0.0135
GPT (U/L)	61.60±72.09 (47.15-76.06)	60.77±49.70 (46.79-74.75)	62.50±90.94 (35.80-89.21)	0.2647
GNRI index	100.3±5.81 (99.14-101.6)	103.6±4.85 (102.3-105)	97.84±4.60 (95.52-98.16)	**<0.0001**
Blood count				
Hematocrit (%)	41.80±6.34 (40.53-43.07)	42.32±6.52 (40.90-44.16)	41.23±6.16 (39.42-43.04)	0.0645
Hemoglobin (mg/dL)	13.26±3.55 (12.54-13.97)	14.32±3.48 (12.35-14.30)	13.18±3.67 (12.10-14.26)	0.7192
Neutrophil count (%)	7377±10230 (5347-9407)	8167±13815 (4281-12052)	6555±3959 (5418-7692)	0.7376
Leucocytes count (/µL)	14922±22981 (10265-19575)	19799±32099(10375-29224)	10243±3494 (9240-11247)	0.0704
Thrombocyte count (/µL)	272281±162168(240653-304999)	254651±65881 (262122-273180)	291733±221368 (228148-355317)	0.8597
Lymphocyte count (/µL)	2481±2356 (2013-2948)	3640±2826 (2845-4435)	1274±459 (1142-1406)	**<0.0001**
Neutrophil/Lymphocyte ratio	4.39±4.53(3.49-5.29)	2.96±4.04 (1.83-4.10)	5.89±4.58 (4.57-7.20)	**<0.0001**
Platelet/Lymphocyte ratio	190.8±227.8 (145.6-236)	94.04±47.51 (80.68-107.4)	291.4±290.5 (208-374.9)	**<0.0001**

Laboratory parameters analysis revealed an increased value of urea in the group of undernourished patients (44.72 ± 27.48 mg / dl vs. 42.32 ± 52.66 mg / dl, p = 0.01), and a mean value of serum albumin significantly lower than of patients with PNI score ≥50 (3.69 ± 0.30 g / dL vs. 4.16 ± 0.32 g / dL, p <0.0001) (table no. 2).

The analysis of the blood count shows that patients with nutritional deficiency have significantly lower values of total lymphocytes (p <0.0001), as well as significantly lower values of platelets / lymphocytes ratio (p <0.0001) and neutrophils / lymphocytes ratio (p < 0.0001), indicating the presence of high blood thrombogenicity and inflammation.

DISCUSSIONS

Nutritional status reflects the general condition of a patient, including physical condition, protein turnover, and immunity. Malnutrition is a complex condition that consists of reducing protein reserves, caloric collapse, and weakening the immune defense system. PNI is calculated by the level of serum albumin and lymphocyte count, reflecting more comprehensive the nutritional and inflammatory status than other predictive models. PNI, calculated by serum albumin and lymphocyte count, reflects the immunological nutritional status and measures the risk of a surgical patient developing a complication.(9)

Some studies have reported an association between elevated levels of inflammation biomarkers such as TNF-α, malnutrition status and poor outcome in patients with acute heart failure.(10-12) From a mechanical point of view, activating the neurohormonal and inflammatory pathways that characterize cardiovascular disease can increase catabolic demand, and patients with already poor nutritional status may be more vulnerable to cardiac events. The results of our study suggest that, in addition to general cardiovascular intervention strategies, patients can benefit from geriatric assessments, including the investigation of nutritional status.

Our study has shown that there is an association between high levels of inflammatory status and depressed nutritional status. The results also highlighted the fact that malnutrition has a supportive role for complications onset following an acute myocardial infarction, resulting in a lower recovery and a much higher hospitalization period.

CONCLUSIONS

The comparison between the two groups, PNI, showed that patients with altered nutritional status required a significantly longer period of hospitalization than patients who had a normal nutritional status. Regarding complications that occurred after acute myocardial infarction, patients with altered nutritional status required inotropic support for patients with unaltered nutritional status. Another aspect would be the analysis of the characteristics of the haemoleucogram showing that patients with nutritional deficiency have significantly lower values of the total number of lymphocytes.

REFERENCES

1. Bucholz EM, Krumholz HA, Krumholz HM. Underweight, Markers of Cachexia, and Mortality in Acute Myocardial Infarction: A Prospective Cohort Study of Elderly Medicare Beneficiaries. PLoS Med. 2016;13:e1001998.
2. Sujino Y, Tanno J, Nakano S, Funada S, Hosoi Y, Senbonmatsu T, et al. Impact of hypoalbuminemia, frailty, and body mass index on early prognosis in older patients (>= 85 years) with ST-elevation myocardial infarction. J. Cardiol. 2015;66:263-268.
3. Yoo SH, Kook HY, Hong YJ, Kim JH, Ahn Y, Jeong MH. Influence of undernutrition at admission on clinical outcomes in patients with acute myocardial infarction. J. Cardiol. 2017;69:555-560.
4. Oduncu V, et al. The prognostic value of serum albumin levels on admission in patients with acute ST-segment elevation myocardial infarction undergoing a primary percutaneous coronary intervention. Coronary artery disease. 2013;24:88–94.
5. IsekiY, et al. Impact of the Preoperative Controlling Nutritional Status (CONUT) Score on the Survival after Curative Surgery for Colorectal Cancer. PloS one. 2015;10:e0132488.
6. Kos FT, et al. Assessment of Prognostic Value of “Neutrophil to Lymphocyte Ratio” and “Prognostic Nutritional Index” as a Sytemic Inflammatory Marker in Non-small Cell Lung Cancer. Asian Pacific journal of cancer prevention: APJCP. 2015;16:3997-4002.
7. Ueno T, et al. Albumin concentration determined by the modified bromocresol purple method is superior to that by the bromocresol green method for assessing nutritional status in malnourished patients with inflammation. Annals of clinical biochemistry. 2013;50:576-584.
8. Sujino Y, et al. Impact of hypoalbuminemia, frailty, and body mass index on early prognosis in older patients (>/= 85 years) with ST-elevation myocardial infarction. Journal of cardiology. 2015;66:263-268.
9. Sagawa M, Yoshimatsu K, Yokomizo H, Osawa G, Matsumoto A, Yano Y, et al. Assessment of host status in patients treated with mFOLFOX6 adjuvant chemotherapy after colorectal cancer surgery. Gan To Kagaku Ryoho. 2013;40:1587-1589.
10. Nakagomi A, Kohashi K, Morisawa T, Kosugi M, Endoh I, Kusama Y, et al. Nutritional status is associated with inflammation and predicts a poor outcome in patients with chronic heart Failure. J. Atheroscler. Thromb. 2016;23:713-717.
11. Baldacci S, Maio S, Simoni M, Cerrai S, Sarno G, Silvi P, et al. ARGA study group. The ARGA study with general practitioners: Impact of medical education on asthma/rhinitis management. Respir. Med. 2012;106:777-785.
12. Izawa KP, Watanabe S, Hirano Y, Yamamoto S, Oka K, Suzuki N, et al. The relation between Geriatric Nutritional Risk Index and muscle mass, muscle strength, and exercise capacity in chronic heart failure patients. Int J Cardiol. 2014;177:1140-1141.