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Correlations between hemorheological parameters and clinical outcome in acute myocardial infarction

PhD thesis
Summary

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Introduction

In this doctoral research we studied the correlations between hemorheological parameters and especially the alteration of hemorheologic indices and the clinical outcome of patients with acute myocardial infarction, in different clinical contexts associated with increased cardiovascular risk, introducing the concept of systemic thromboinflammation and studying its role in the determinism of acute coronary syndromes.

To demonstrate the correlation between alterations in blood hemorheology and clinical evolution in acute myocardial infarction, the doctoral thesis aimed to study the correlations between altered hemorheologic parameters and the severity of left ventricular dysfunction in hypertensive patients admitted to a cardiac intensive care unit, as well as the study of correlations between systemic markers of inflammation, correlated with nutritional status, altered hemorheologic parameters and severity of impaired cardiac function in patients with acute myocardial infarction.

Aim of the study

The aim of this research was to elucidate the role of multifactorial processes in the process of thromboinflammation placed in the vascular wall affected by the inflammatory process. For this, the doctoral research was focused on two main directions. The first direction was to study the correlation between thromboinflammatory processes and hypertension, a risk factor with a direct action on the vascular wall, in patients with recurrent cardiovascular events. The second direction of research was to study the complex correlation between thromboinflammatory processes and left ventricular function after myocardial infarction, through several studies that looked at the link between inflammation and altered hemorheologic parameters, the link between nutritional status, and the impact of these complex thromboinflammatory mechanisms on left ventricular functions post-myocardial infarction.

Materials and methods:

These studies were longitudinal, single-center prospective studies designed to examine the correlation between hypertension and inflammation in patients with acute coronary syndrome (ST-elevation myocardial infarction, ST-segment elevation myocardial infarction, or unstable angina pectoris) who suffer from recurrent acute cardiovascular events and the correlation between altered blood rheology and the incidence of complications after acute myocardial infarction, respectively the correlation between hemorheologic changes, nutritional status and the evolution of acute myocardial infarction. The patients included in the study suffered from acute coronary syndromes and were admitted to the Intensive Coronary Care Unit of the Cardiology Clinic of the Clinical County Emergency Hospital in Targu Mures, Romania between January 1, 2017 - December 31, 2020.

Results

Study 1

Patients with hypertension had significantly higher levels of NTproBNP (2340 ± 2111 pg / ml vs 1617 ± 1838 pg / ml, p = 0.001) and CK (823.7 ± 1108 U / L vs 1598 ± 1537). U / L, p = 0.0005), indicating a more extensive myocardial lesion and a ventricular dysfunction associated with the hypertensive status.

Patients with hypertension had an increased inflammatory state at baseline and on day 5, expressed by significantly higher values of several parameters associated with increased inflammatory activity: IL-6 (18.58 ± 18.23 pg / ml vs 12.43 ± 10.07 pg / ml, p = 0.04) and baseline CRPus (15.85 ± 21.61 mg / L versus 9.19 ± 7.22 mg / l, p = 0, 03).

Patients with hypertension had significantly higher values of several hemorheologic parameters associated with pro-coagulant activity. Even if the platelet count did not show significant differences between the study groups (235.5 ± 75.47 103 / µL compared to 209.7 ± 69.33 103 / µL, p = 0.08), patients with hypertension (+) showed a significant change in the platelet / lymphocyte ratio (155.8 ± 100.2 vs 124.6 ± 76.12, p = 0.01).

Regression analysis identified a significant positive correlation between baseline levels of CRP and NTproBNP in the HTA (-) patient group (r = 0.36, p = 0.01). This correlation was found to be more expressed in the hypertension group (+) (r = 0.44, p <0.0001) and on day 5 in both study groups: r = 0.36, p = 0.01 for hypertension (+) and r = 0.507, p <0.0001 for HTA (-).

Study 2

Patients in the malnourished group, with a CONUT score above 3, had an increased inflammatory condition both initially and on day 5, expressed in significantly higher values of CRP levels on day 1 (17.16 ± 32.32 (9, 08-25.23) vs. 32.43 ± 35.16 (12.96-51.90), p = 0.0023), as well as by measuring the CRPus level on day 5 (16.02 ± 21.67 (9.79-22.24) vs.52.39 ± 49.26 (25.11-79.67), p <0.0001)

Analyzing the hemorheological parameters in the groups based on the CONUT index (group 1 - CONUT <3, n = 49, group 2 - CONUT≥3, n = 15) a statistically significant difference was found in terms of the percentage of higher neutrophils in the malnourished group 59.45 ± 18.37 (54.18-2.62) vs 71.50 ± 21.21 (59.76-83.25), p = 0.0036, the number of platelets (x1000 / µl) increased in malnourished group: 244.3 ± 77.26 (222.1-266.5) vs 402.6 ± 363.0 (201.6-603.6), p = 0.0211, in the low number of lymphocytes (x1000 / µl) in the malnourished group: 2,904 ± 1,899 (2,359-3,450) vs 0.948 ± 0.3440 (0.7584-1.139), p <0.0001.

Analyzing the hematological ratios, we found a statistically significant difference regarding the platelet / lymphocyte ratio (107.5 ± 69.15 (87.64-127.4) vs 513 ± 432.96 (273.3-752.7), p <0 , 0001, with the increase in values in the group of malnutrition patients, a statistically significant difference was found and analyzing the neutrophil / lymphocyte ratio, with its marked increase in patients with nutritional deficiency: 3.82 ± 4,305 (2,583-5,056) vs 7,740 ± 5,013 (4,964-10.52), p = 0.0001.

The group of patients with subjects with nutritional deficiency presented more severe complications after acute myocardial infarction, requiring inotropic support in a higher percentage than the group of patients with normal nutritional status: 6 (35.29%) vs 7 (12.96%), p = 0, 03.

Analyzing the hematological ratios, we found a statistically significant difference regarding the platelet / lymphocyte ratio (p = 0.04), with the increase of values in the group of patients with present inotropic need (171.0 ± 228.2 vs 326.2 ± 396.7), this report is known as an independent predictor of long-term mortality in patients who have suffered an acute myocardial infarction.

Regarding the correlation between inflammatory status and post-infarction evolution, patients who required inotropic support showed an increase in ultrasensitive C-reactive protein, compared to those who did not require inotropic treatment. This difference was statistically significant on day 5: NI absent: 20.06 ± 25.92 (12.77-27.35) vs NI present: 42.11 ± 52.50 (10.39-73.84), p = 0.04

Conclusions

Systemic hypertension is associated with an accentuated thromboinflammatory status, manifested by a persistence of systemic inflammation and hypertensive patients with recurrent events have a stronger correlation between systemic inflammation and ventricular dysfunction. Hypertensive patients have significantly higher values of several hemorheologic parameters associated with pro-coagulant activity and especially the ratio of platelets to lymphocytes, which seems to be the most accurate indicator of pro-coagulation risk prediction.

Alteration of hemorheologic parameters is directly correlated with the systemic inflammation, nutritional status, and the evolution of left ventricular function after myocardial infarction. At the same time, patients with a higher inflammatory status have a higher degree of postinfarction ventricular dysfunction, in parallel with a stronger alteration of hemorheologic indicators, which reveals the presence of a thromboinflammatory status with direct determinism in the genesis of acute coronary syndromes.

Hemorheologic indices that express a more pronounced inflammatory status may serve as relevant markers for predicting the risk of acute coronary syndrome.

In conclusion, the alteration of blood rheology in a thromboinflammatory process can play an extremely important role both in the pathophysiology of acute coronary syndromes and in the short or long term evolution of left ventricular function.