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Trabajo Original

Valoración nutricional

Exploring the link between the Naples prognostic score and the cardio-ankle vascular index

Explorando el vínculo entre la puntuación pronóstica de Nápoles y el índice vascular cardio-tobillo

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Abstract

Background: the Naples Prognostic Score is a novel scoring system designed to provide a comprehensive assessment of patients' inflammation and nutritional status.

Aim: our aim was to investigate the correlation between the Naples Prognostic Score and arterial stiffness, a factor known to be linked with heart failure and acute coronary syndrome.

Materials and methods: this prospective study included 142 consecutive patients without a history of cardiovascular disease, inflammatory disease, immunological disease, malignancy, or comorbid conditions other than hypertension. Patients were categorized into two groups based on their Naples Prognostic Scores: Group 1 (score of 0-2) and Group 2 (score of 3 or 4). Arterial stiffness was assessed using the Cardio-Ankle Vascular Index (CAVI) measured with the VaSera VS-1000 device. CAVI values were compared between the groups.

Results: the mean age of the patients was 54 ± 9 years. Group 1 comprised 114 (80.3 %) patients, while Group 2 comprised 28 (19.7 %) patients. There were no significant differences in demographic data between the groups ($p > 0.005$). Additionally, there were no statistically significant differences between Group 1 and Group 2 regarding left CAVI (7.92 ± 1.45 vs. 8.72 ± 1.85; $p = 0.295$), right CAVI (7.89 ± 1.52 vs. 8.67 ± 1.34; $p = 0.332$), or left or right ankle brachial index ($p > 0.005$).

Conclusions: despite previous studies indicating a significant association between the Naples Prognostic Score and heart failure or acute coronary syndrome, our study did not observe a significant correlation between this score and arterial stiffness assessed by CAVI.

Keywords:

Naples Prognostic Score. Arterial stiffness. Cardio-Ankle Vascular Index. Inflammation.

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Resumen

Antecedentes: la puntuación pronóstica de Nápoles es un nuevo sistema de puntuación diseñado para proporcionar una evaluación integral de la inflamación y el estado nutricional de los pacientes.

Objetivo: nuestro objetivo fue investigar la correlación entre la puntuación pronóstica de Nápoles y la rigidez arterial, un factor que se sabe que está relacionado con insuficiencia cardíaca y síndrome coronario agudo.

Materiales y métodos: este estudio prospectivo incluyó a 142 pacientes consecutivos sin antecedentes de enfermedad cardiovascular, enfermedad inflamatoria, enfermedad inmunológica, malignidad o afecciones comórbidas distintas de la hipertensión. Los pacientes se clasificaron en dos grupos según sus puntuaciones pronósticas de Nápoles: Grupo 1 (puntuación de 0-2) y Grupo 2 (puntuación de 3 o 4). La rigidez arterial se evaluó utilizando el índice vascular cardio-tobillo (CAVI) medido con el dispositivo VaSera VS-1000. Los valores de CAVI se compararon entre los grupos.

Resultados: la edad media de los pacientes fue de 54 ± 9 años. El grupo 1 comprendía 114 (80,3 %) pacientes, mientras que el Grupo 2 comprendía 28 (19,7 %) pacientes. No hubo diferencias significativas en los datos demográficos entre los grupos ($p > 0,005$). Además, no hubo diferencias estadísticamente significativas entre el Grupo 1 y el Grupo 2 con respecto al CAVI izquierdo (7,92 ± 1,45 frente a 8,72 ± 1,85; $p = 0,295$), CAVI derecho (7,89 ± 1,52 frente a 8,67 ± 1,34; $p = 0,332$) o índice braquial del tobillo izquierdo o derecho ($p > 0,005$).

Conclusiones: a pesar de que estudios previos indicaron una asociación significativa entre la puntuación pronóstica de Nápoles y la insuficiencia cardíaca o síndrome coronario agudo, nuestro estudio no observó una correlación significativa entre esta puntuación y la rigidez arterial evaluada por CAVI.

Palabras clave:

Puntuación pronóstica de Nápoles. Rigidez arterial. Índice vascular cardio-tobillo. Inflamación.

INTRODUCTION

Arterial stiffness, a hallmark of vascular aging and pathology, plays a pivotal role in the development and progression of cardiovascular disease (1). It represents one of the earliest stages of the atherosclerotic process, a pathological condition characterized by a decrease in the artery's ability to expand and contract in response to pressure changes (2). This condition typically increases with age, serving as an indicator of arteriosclerosis, and is exacerbated by various factors such as obesity, diabetes, smoking, and inflammation (3). In cases of vascular inflammation, stimulated white blood cells may adhere to the vascular endothelial intima, leading to capillary leukostasis, vascular damage, and increased arterial stiffness (4).

Several white blood cell indices, including the neutrophil-to-lymphocyte ratio (NLR) (5), the monocyte-to-lymphocyte ratio (LMR) (6), and low albumin levels (7,8), have been linked to arterial stiffness in previous studies. The Naples Prognostic Score (NPS), developed as a multifaceted assessment tool, incorporates various biomarkers to provide a comprehensive snapshot of an individual's health status. By integrating parameters such as serum albumin, total cholesterol, neutrophil-to-lymphocyte ratio, and lymphocyte-to-monocyte ratio, this scoring system aims to capture both inflammatory and nutritional components (9). Previous research has correlated the NPS with the severity of coronary artery disease (10).

The Cardio-Ankle Vascular Index serves as a non-invasive measure of arterial stiffness, evaluating vascular health from the aorta to the ankle. Elevated CAVI values have been associated with increased cardiovascular risk, including hypertension, coronary artery disease, and stroke. Thus, CAVI holds promise as a valuable prognostic tool in cardiovascular risk assessment (11). Studies have demonstrated that CAVI assessment in asymptomatic patients is a valuable method for assessing both arterial stiffness and the risk of subclinical coronary atherosclerosis (12). Our study is the first in the literature and we aimed to investigate the relationship between NPS with arterial stiffness and coronary atherosclerosis-related CAVI values, which have been shown to be associated with inflammation and coronary artery disease.

MATERIALS AND METHODS

Between January and April 2024, we consecutively enrolled non-geriatric patients into the study. Exclusion criteria comprised a history of atherosclerotic heart disease and/or myocardial infarction other than arterial hypertension, heart failure (left ventricular ejection fraction < 50 %), moderate to severe valvular disease, renal insufficiency (estimated glomerular filtration rate < 50 ml/min/1.73 m^2), a history of arrhythmia, diabetes *mellitus,* peripheral arterial disease, severe anemia (hemoglobin < 10 g/dL), active infection, immunological disease, and malignancy potentially impacting the NPS evaluation. Patients were stratified into two groups based on their NPS values and compared in terms of arterial stiffness evaluated by CAVI and ankle brachial index (ABI).

EVALUATION OF ARTERIAL STIFFNESS

Arterial stiffness was assessed by measuring CAVI using a portable VaSera VS-1000 (Fukuda-Denshi Company, Ltd., Tokyo, Japan). CAVI, a reliable index of arterial stiffness, comprises functional stiffness independent of blood pressure. Electrodes were affixed to the upper arm and ankles in the supine position, with the patient's head centrally positioned. Following a 10-minute rest period, electrography, phonocardiography, pressure, and waveforms of the brachial and ankle arteries were recorded.

EVALUATION OF THE NPS

The NPS value was determined by summing the scores obtained from the following biochemical and hematological parameters: serum albumin (mg/dl) (≥ 4 g/dL, 0 points; < 4 g/dL, 1 point), total cholesterol (> 180 mg/dl, 0 points; ≤ 180 mg/dl, 1 point), NLR (≤ 2.96, 0 points; > 2.96, 1 point), and LMR (> 4.44, 0 points; ≤ 4.44, 1 point). Referencing a previous study (13), patients were categorized into two groups: NPS 0-2 (Group 1) and NPS 3 and 4 (Group 2).

ETHICAL CONSIDERATIONS

This study adhered to the principles outlined in the Declaration of Helsinki, and approval was obtained from the local ethics committee (Ethic number: 2024/85). Verbal and written informed consent was obtained from all patients prior to study commencement.

STATISTICAL ANALYSIS

Statistical analyses were performed using SPSS 22.0 for Windows (SPSS Inc., Chicago, IL, USA). Continuous variables were presented as mean ± standard deviation, while categorical variables were expressed as numbers and percentages. Normally distributed quantitative variables were compared between groups using the independent-samples t-test, and categorical variables were compared using the chi-squared test. A probability value of $p < 0.05$ was considered statistically significant.

RESULTS

The mean age of the 142 patients enrolled in the study was 54 ± 9 years. Among them, 50 (35.2 %) were male, and 92 (64.8 %) were female. Group 1 comprised 114 (80.2 %) patients, while Group 2 consisted of 28 (19 %) patients. No significant differences were observed between the two groups in terms of demographic or laboratory data, including gender, body mass index, systolic blood pressure, diastolic blood pressure, ejection fraction, plasma glucose, creatinine, estimated glomerular filtration rate, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, and triglyceride values ($p > 0.005$). The mean NPS score was calculated to be 1.45 ± 0.38 for Group 1 and 2.28 ± 1.27 for Group 2. Detailed demographic, laboratory, and clinical characteristics are summarized in table I.

No statistically significant differences were found between Group 1 and Group 2 in terms of left CAVI (7.92 ± 1.45 vs. 8.72 ± 1.85; $p = 0.295$), right CAVI (7.89 ± 1.52 vs. 8.67 ± 1.34; $p = 0.332$), left ABI (1.08 ± 0.15 vs. 1.05 ± 0.15, $p = 0.744$), or right ABI (1.10 ± 0.15 vs. 1.14 ± 0.17; $p = 0.858$) ($p > 0.005$) (Table II).

Table I. Demographic data and laboratory results of the study groups

Parameters	NPS Group 1 (Score 0-2) (*n* = 114, 80.3 %)	NPS Group 2 (Score 3 and 4) (*n* = 28, 19.7 %)	*p*-value
Age (years)	55 ± 7	51 ± 9	0.318
Female (%) 80 (70.2 %) 12 (42.9 %) 0.055 Male (%) 34 (29.8 %) 16 (57.1 %)			
BMI (kg/m^2)	28 ± 3	26 ± 2	0.690
SBP (mmHg)	133 ± 2	129 ± 3	0.312
DBP (mmHg)	83 ± 3	80 ± 2	0.456
EF (%)	61 ± 4	60.3 ±	0.407
HT (%)	38 (28 %)	9 (32 %)	0.589
Glucose (mg/dl)	94 ± 4	98 ± 11	0.614
Creatinine, (mg/dl)	0.79 ± 0.12	0.76 ± 0.13	0.314
eGFR, mL/min/1.73 m^2	87 ± 6	92 ± 13	0.316
LDL (mg/dl)	112 ± 35	103 ± 22	0.230
HDL (mg/dl)	48 ± 11	44 ± 8	0.366
Triglyceride (mg/dl)	170 ± 15	159 ± 12	0.315
Total cholesterol (mg/dl) Albumin (g/dl)	185 ± 19 4.3 ± 0.4	169 ± 21 4.1 ± 0.5	0.001 0.017
Hemoglobin (g/dl)	14.2 ± 2.1	13.2 ± 1.1	0.412
WBC (/µL)	7.4 ± 1.7	7.2 ± 1.3	0.814
Neutrophils (/µL)	4.1 ± 1.2	3.8 ± 1.4	0.442
Lymphocytes (/µL)	2.4 ± 0.5	2.6 ± 0.2	0.814
Monocytes (/µL)	0.5 ± 0.02	0.4 ± 0.02	0.825
NPS	1.45 ± 0.38	2.28 ± 1.27	0.001

Numerical data are expressed as mean ± standard deviation and categorical data as percentages (%). BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure; HT: hypertension; EF: ejection fraction; eGFR: estimated glomerular filtration rate; LDL: low-density lipoprotein; HDL: high-density lipoprotein; WBC: white blood cell; NPS: Naples prognostic score.

Table II. Comparison of the CAVI and ABI values of the study groups

Parameters	NPS Group 1 (Score 0-2) (*n* = 116, 81.2%)	NPS Group 2 (Score 3 and 4) (*n* = 26, 18.8 %)	*p*-value
L-CAVI	7.92 ± 1.45	8.72 ± 1.85	0.295
L-ABI	1.08 ± 0.15	1.05 ± 0.15	0.744
R-CAVI	7.89 ± 1.52	8.67 ± 1.34	0.332
R-ABI	1.10 ± 0.15	1.14 ± 0.17	0.858

CAVI: cardio-ankle vascular index; ABI: ankle-brachial index; NPS: Naples prognostic score.

DISCUSSION

Our study represents the first investigation into the relationship between arterial stiffness, vascular inflammation, and NPS. We found no significant difference between patient groups with high and low NPS values in terms of CAVI, indicating that NPS did not exhibit a significant relationship with arterial stiffness.

CAVI, a parameter utilized for assessing arterial stiffness, has proven to be a valuable method for evaluating arterial stiffness in asymptomatic patients (11,13). The NPS, on the other hand, is a novel scoring system that provides a comprehensive reflection of inflammatory and nutritional status, comprising four parameters: serum albumin, total cholesterol, NLR, and LMR (14).

Previous studies have indicated associations between cholesterol (15), serum albumin, and increased albuminuria in urine (16) with increased arterial stiffness. For instance, Cheng et al. found higher arterial stiffness in albuminuric patients (17). Similarly, increased NLR has been linked to arterial stiffness in prior research (18). The association of NPS score with different diseases has been evaluated and it has been shown that high NPS is associated with the prognosis of ST segment elevation myocardial infarction, myocardial ischemia, the prognosis of transcatheter aortic valve replacement and heart failure-related mortality (HF). Oguz et al. reported significantly higher mortality in patients with a high NPS among hospitalized heart failure patients (19). Ender et al., in a study of 499 patients with acute ST-elevation myocardial infarction, observed that the SYNTAX score increased with higher NPS at admission, indicating a relationship between NPS and the severity of coronary artery disease (10). However, Eyüp et al., in an assessment of 1,138 patients undergoing coronary computed tomographic angiography, did not find a clear benefit of NPS in predicting coronary artery severity (20). According to Unkun et al., in her study, she showed that a high NPS score can be used as a predictor of ischemia in myocardial perfusion scintigraphy (21). Guven et al. mortality was found to be higher and significantly higher in patients with a high NPS score performed TAVR (22).

Arterial stiffness is a component of the chronic process of atherosclerosis (23). The lack of a significant correlation between NPS and CAVI values in our study may be attributed to the chronic nature of arterial stiffness, as seen in the study by Eyüp et al. (19). The clinical stability of our patient group and limited variability in albumin, neutrophil, lymphocyte, and monocyte counts could also contribute to this finding. Furthermore, the negative relationship between low total cholesterol levels in NPS and arterial stiffness, which develops over time, may diminish the predictive value of NPS in acute clinical conditions such as acute heart failure (19) and acute coronary syndrome (10). Nonetheless, we believe that the rapid and effective changes in the laboratory parameters comprising NPS will enhance its significance in evaluating treatment and follow-up in patient groups.

LIMITATIONS

Our study had several limitations. Firstly, it was a single-center study with a relatively small sample size, further reduced by the non-routine use of CAVI testing. Additionally, while we utilized NLR and LMR, we were unable to identify unknown comorbidities that could affect these values based on high-sensitivity C-reactive protein and procalcitonin, specific inflammation markers.

CONCLUSIONS

This study is the first to examine the relationship between NPS and arterial stiffness. We found no significant association between NPS and CAVI values in arterial stiffness.

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