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Nutritional status is related to heart failure severity and hospital readmissions in acute heart failure

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ABSTRACT

Background: Malnutrition is common in hospitalized heart failure (HF) patients and predicts adverse outcomes. The relationship between nutritional status and outcomes in HF has been partially studied. Our aim was to determine the relationship between the nutritional status and the long-term prognosis in patients hospitalized for acute HF.
Methods: We analyzed 145 patients admitted consecutively to a cardiology department for acute HF. Nutritional status was measured with the CONUT method, a validated scale based on laboratory testing (albumin; cholesterol; lymphocytes) during hospitalization. Patients were classified as normal, mildly, moderately or severely malnourished, and followed in a HF clinic.
Results: The mean aged of the population was 69.6 years and 61% of patients were men, 54 had previous HF hospitalization (37%), 112 had hypertension (77%), 67 were diabetic (46%) and 135 had class III or IV NYHA (93%). Forty eight patients (33%) had normal nutritional status, 75 were mildly malnourished (52%), and 22 were moderately or severely malnourished (15%). Age, sex, hypertension, diabetes mellitus, or NYHA class among the three groups were not statistically different. ProBNP was directly correlated with the nutritional status. After a mean follow-up of 326 days, 27 had a HF hospitalization (19%) and 61 (42,1%) had a hospitalization not related to HF. The analysis by Kaplan-Meier curves and log rank test showed that these differences were statistically significant.
Conclusion: Malnutrition is common in patients hospitalized for HF. It seems to be a mediator of disease progression and determines a poor prognosis especially in advanced stages.

1. Introduction

Despite medical advances the outcome of heart failure (HF) patients remains particularly poor [1–3]. Hospital readmissions are still very common and ocurr due to worsening HF or non-cardiovascular events. This represents the main contributor to a considerable financial burden associated with this pathology [4–5].

Malnutrition, and particularly cachexia, are very frequent in hospitalized and chronic HF patients with a prevalence estimated between 25 and 40% [6–7]. This is in turn is associated with an increase in complications, length of stay, mortality and readmissions [8–11]. Furthermore, nutritional intervention may prevent complications and increase the quality of life in these patients [12].

The most severe form of malnutrition is cardiac cachexia, a catabolic wasting state associated with inflammation and neurohormonal activation that, is generally believed to mediate poor outcomes [13–15]. Conversely, an obesity paradox has been described in patients with chronic diseases including HF patients [1–3].

Therefore, an accurate evaluation of the nutritional status of HF patients is of utmost importance. To date however, there is no universal agreement regarding the proper method to evalute it. In fact, it is believed that malnutrition is at present underdiagnosed and consequently undertreated [12].

The *controlling nutritional status* or Ulibarri's method (CONUT) [16], is a screening tool to identify undernourished patients in hospital populations. This score is based on three parameters, serum albumin (g/dl), total cholesterol levels (mg/l) and lymphocyte number (count/ml). It allows early detection and automatic assessment of nutritional status of inpatients [16].

The aim of our study was to evaluate the value of the nutritional status (CONUT method) in patients hospitalized for acute HF in terms of assesing the disease's severity and its long-term prognosis (hospital admission and mortality).

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2. Material and methods

This is an observational retrospective study that included patients admitted to the Cardiology Department of our hospital between May 2014 and August 2015 with a diagnosis of de novo HF or decompensated chronic HF.

Exclusion criteria included pregnancy, severe chronic liver or renal disease, autoimmune or chronic inflammatory diseases, a recent (last 3 weeks) infectious process, a recent (last 3 weeks) treatment with corticosteroids or antiinflammatory drugs, a known tumour at the time of inclusion in the study, a blood disorder, or an unknown nutritional status.

The study complies with the Declaration of Helsinki and was approved by the Clinical Research Ethics Committee of Galicia. All patients signed an informed consent.

The diagnosis of HF was made according to the recomendations of the European Society of Cardiology [17].

For all included patients, detailed information was gathered from medical history and appropriate physical examination before being recorded in a database. In addition, blood samples were obtained for local laboratory analysis (haemogram, basic biochemistry and coagulation rate, lipid and thyroid hormone profiles, as well as specialized parameters such as levels of glycosylated haemoglobin, and pro-Brain Natriuretic Peptide (proBNP)). Creatinine clearance was calculated by the equation 7 of The Modification of Diet in Renal Disease Study [18]. An electrocardiogram and echocardiogram were also performed within 24 h of admission. Left ventricular ejection fraction was estimated according to the current international recomendations [19].

HF was defined as being ischaemic in aetiology if any of the following criteria were satisfied: prior admission due to an acute coronary event (acute myocardial infarction or unstable angina), prior surgical or percutaneous myocardial revascularization, presence of myocardial infarction on electrocardiogram or echocardiogram, or significant coronary disease detected by angiography. Coronary artery disease was considered clinically relevant if there was a stenosis of at least 70% in any vessel or at least 50% in the left main coronary artery. Severity of functional class was based on the New York Heart Association (NYHA) scale.

2.1. Evaluation of antropometric and nutritional status

The CONUT score was used to evaluate the nutritional status in patients with HF. This system was developed for hospitalized patients [16] and uses the following three parameters: serum albumin level (g/dl), total cholesterol level (mg/dl), and lymphocyte count (count/ml))[5]. It thus enables evaluation of the protein reserves, calorie depletion, and immune defenses, respectively (Table 1).

We classified the patients according to the CONUT score as: normal nutritional status (CONUT 0–1 points), mild malnutrition (CONUT score 2–4 points) and moderate to severe malnutrition (CONUT score ≥ 4 points).

Body Mass Index (BMI) was calculated as the weight in kilograms divided by the square of the height in metres, based on data from the medical records on admission. In the present analysis, patients were categorized in three groups, according to the BMI cut-off points proposed by the World Health Organization (WHO): 18.5–24.9 kg/m^2, normal-weight; 25–29.9 kg/m^2, and overweight; ≥30 kg/m^2, obese [20].

2.2. Follow up and outcomes

All patients were followed for a median of 326 days (range: 9–549 days). The end points were the incidence of death, readmission due to HF or readmission due to non HF causes. Follow-up methods involved one of the following: use of hospital records, hospital visits or general physician visits.

2.3. Statistical anaylisis

The results are presented as mean ± SD for continuous variables and the percentage of the total number of patients for categorical variables.

ANOVA analyses and the chi-square test were used for comparisons of numerical and categorical variables, respectively.

The association between the CONUT score and other variables was explored using multiple linear regression analyses with forward stepwise selection of covariates.

The event-free survival curves were calculated using the Kaplan–Meier method, and differences between the curves were evaluated using the log-rank test.

Univariate and multivariate Cox regression analyses were employed to calculate the estimated hazard ratio (HR) with 95% confidence interval (CI) where appropriate. The variables were entered into a multivariate model for factors with a p value of ≤0.05 in the univariate analysis. The examined variables included patient age, sex, BMI; left ventricular ejection fraction (LVEF), heart rate and systolic blood pressure, CONUT score, sodium, proBNP, leucocytes, lymphocytes, neutrophiles, albumin, total colesterol, low density lipoprotein cholesterol (LDL-c), high density lipoprotein cholesterol (HDL-c) and haemoglobin levels, as well as the use of β-blockers, angiotensin-coverting-enzyme inhibitors (ACEIs) or spironolactone.

The Statistical Package for Social Science (SPSS) for Windows, version 15.0 (software SPSS Inc.; Chicago, Illinois, United States) package, was used for all statistical analysis.

A p value of <0.05 was considered to be statistically significant.

Table 1
CONUT score.

Parameters	Score			
Serum albumin (gr/dL)	≥3,5	3,0–3,49	2,50–2,99	<2,5
Albumin score	0	2	4	6
Total Cholestesterol (mg/dL)	≥180	140–179	100–139	<100
Cholesterol score	0	1	2	3
Lymphocites (count/mL)	≥1.600	1.200–1599	800–1.199	<800
Lymphocites score	0	1	2	3

3. Results

3.1. Baseline characteristics

We analyzed 145 patients (69,6 ± 11 years, 61% men) admitted to our cardiology service for acute HF, 54 with previous HF hospitalization (37%), 112 with hypertension (77%); 68 with diabetes mellitus (46%); 135 with class III or IV NYHA at admission (93%), and 39 with ischemic aetiology (26,9%). The mean left ventricular ejection fraction (LVEF) was 42,7%; 41,4% of the patients were overweight and 45,5% were obese. (Table 2).

3.2. CONUT score

The mean value of CONUT score was 2,6 ± 1.9. The patients were categorized as follows: normal nutritional status; CONUT 0–1 (n = 48), mildly malnourished; CONUT 2–4 (n = 75), and moderately or severely malnourished; CONUT ≥4 (n = 22).

Table 2
Baseline characteristics of the population.

	All (n = 145)
Age (years), mean ± SD	69,8 ± 11,0
Men (%)	90 (61,6)
Previous HF hospitalization, n (%)	52 (35,6))
Hypertension, n (%)	112 (77,2)
Diabetes Mellitus (%), n (%)	68(46,6)
NYHA III/IV(%) n (%)	135 (93,1)
BMI (kg/m^2), mean ± SD	30,5 ± 6,4
LVEF %, mean ± SD	42,7 ± 15,5
LVEF <50, n (%)	101 (69.7)
Ischemic aetiology	40 (27,4)
proBNP (pg/ml), mean ± SD	5382,3 ± 6585.2
ACEI-ARBs, n (%)	130 (89,7)
Betablockers, n (%)	116 (80,0)
MRAs, n (%)	126 (86,3)
Statins, n (%)	95 (65,6)
Hb (g/dl) mean ± SD	13,1 ± 1,8
Lymphocytes (cell/mm^3), mean ± SD	1578 ± 961
Leucocytes (cell/mm^3), mean ± SD	7476 ± 2251
Neutrophils(cell/mm^3), mean ± SD	4964 ± 1735
Platelets(cell/mm^3), mean ± SD	213,295 ± 82,778
Uric acid (mg/dl), mean ± SD	8,5 ± 2,2
Urea (mg/dl), mean ± SD	63,3 ± 28,2
Cr (mg/dl), mean ± SD	1,08 ± 0,41
MDRD(ml/min/m^2), mean ± SD	69,45 ± 28,48
Na (meq/l), mean ± SD	140,6 ± 4,5
K (meq/l)mean ± SD	4,4 ± 0,5
Ca (meq/l), mean ± SD	8,4 ± 2,2
Albumin (g/dl), mean ± SD	3,9 ± 0,4
CT (mg/dl)mean ± SD	151 ± 41
LDL-c (mg/dl), mean ± SD	86 ± 31
HDL-c (mg/dl), mean ± SD	42 ± 16
TG(mg/dl), mean ± SD	102 ± 45
ALT(U/l), mean ± SD	35 ± 82
AST(U/l), mean ± SD	37 ± 31
GGT(U/l), mean ± SD	84 ± 68
Total Bilirrubin (mg/dl), mean ± SD	1,1 ± 0,7

HF: heart failure, BMI: body mass index, LVEF: left ventricular ejection fraction, ACEI: angiotensin converting enzyme inhibitor, ARB: angiotensin receptor blocker, MRAs: mineralocorticoid receptor antagonists, NYHA: New York Heart Association, BMI:body mass index, Cr: creatinine, MDRD: Modification of Diet in Renal Disease, Na: sodium, K: potasium, Hb: haemoglobine, CT: total cholesterol, LDL: low density lipoprotein-cholesterol, HDL-c: high density lipoprotein-cholesterol, TG; triglycerides, Ca: calcium, ALT: alanin aminotransfersasa, AST:aspartat aminotransfersasa, GGT: gammaglutariltransferasa, SD: standart desviation.

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