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Original article

Impact of Malnutrition on Long-Term Mortality in Hospitalized Patients With Heart Failure

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ABSTRACT

Introduction and objectives: The prevalence of malnutrition among patients with heart failure and the role it might play in prognosis is not currently known. The aim of this study was to analyse the prevalence and risk of malnutrition as well as its possible influence on long-term mortality in patients with heart failure.

Methods: A prospective analysis was conducted on 208 patients discharged consecutively from our centre between January 2007 and March 2008 after being hospitalised with heart failure. Before discharge, a complete nutritional assessment was performed and diagnosis of malnutrition and risk of malnutrition was done with the Mini Nutritional Assessment. Its possible independent association with mortality was assessed by a Cox multivariate analysis.

Results: The mean age of the patients was 73 ± 10 years, with 46% women; the most common aetiology of heart failure was ischaemia (41%). In addition, 13% were classified as malnourished, 59.5% at risk of malnutrition and 27.5% were well-nourished. At a median follow-up of 25 months, mortality in the three groups was 76%, 35.9% and 18.9%, respectively (log-rank, $P < .001$). In the Cox multivariate analysis, the malnutrition state was an independent predictor of mortality (hazard ratio 3.75, 95% confidence interval, 1.75-8.02, $P = .001$).

Conclusions: Malnutrition and the risk of malnutrition are highly prevalent in patients hospitalised for heart failure. Furthermore, we found that the state of malnutrition as defined by the Mini Nutritional Assessment survey is an independent predictor of mortality in these patients.

Influencia de la desnutrición en la mortalidad a largo plazo de pacientes hospitalizados por insuficiencia cardiaca

Palabras clave:
Insuficiencia cardiaca
Desnutrición
Mini Nutritional Assessment
Mortalidad

RESUMEN

Introducción y objetivos: Actualmente se desconoce la prevalencia de desnutrición entre los pacientes con insuficiencia cardiaca y el papel que este estado pudiera tener en su pronóstico. El objetivo de este estudio es analizar la prevalencia y riesgo de desnutrición y su posible influencia en la mortalidad a largo plazo de los pacientes con insuficiencia cardiaca.

Métodos: Se analizó prospectivamente a 208 pacientes dados de alta consecutivamente desde nuestro centro entre enero de 2007 y marzo de 2008 tras un ingreso por insuficiencia cardiaca. Antes del alta, se realizó una completa valoración nutricional y se realizó el diagnóstico de desnutrición y riesgo de desnutrición mediante la encuesta *Mini Nutritional Assessment*. Su posible asociación independiente con la mortalidad se valoró mediante un análisis multivariable de Cox.

Resultados: La media de edad fue 73 ± 10 años, el 46% eran mujeres y la etiología más frecuente de la insuficiencia cardiaca fue la isquémica (41%). El 13% de los pacientes fueron clasificados como desnutridos; el 59,5%, en riesgo de desnutrición y el 27,5%, bien nutridos. A los 25 meses (mediana de seguimiento), la mortalidad en los tres grupos fue del 76, el 35,9 y el 18,9% respectivamente (*log-rank test*, $p < 0{,}001$). En el análisis multivariable de Cox, el estado de desnutrición resultó ser un predictor independiente de mortalidad (*hazard ratio* = 3,75; intervalo de confianza del 95%, 1,75-8,02; p = 0,001).

Conclusiones: La desnutrición y el de riesgo de desnutrición alcanzan una prevalencia elevada en pacientes hospitalizados por insuficiencia cardiaca. Además, hemos encontrado que el estado de desnutrición definido mediante el *Mini Nutritional Assessment* es un predictor independiente de mortalidad en estos pacientes.

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Abbreviations

AMI: acute myocardial infarction
BMI: body mass index
CC: creatinine clearance
HF: heart failure
MNA: Mini Nutritional Assessment
NS: nutritional status

INTRODUCTION

Despite progress in its treatment, heart failure (HF) continues to have high morbidity and mortality.[1] In studying its development, a large number of factors influencing prognosis have been identified.[2] However, the role that malnutrition might play in this regard has not yet been sufficiently clarified.

Chronic diseases affect the nutritional status (NS) of the patient and malnutrition affects the course of a chronic disease.[3–5] As in other chronic diseases, the relationship between HF and NS can be approached from this double perspective. The most notorious nutritional effect of the deterioration caused by HF is what has traditionally been termed cardiac cachexia,[6,7] which affects prognosis.[8] Conversely, several studies have shown the relevance of some aspects of NS in the evolution of HF patients, such as body mass index (BMI)[9] and albuminaemia.[10] Because no single parameter can accurately assess NS,[11,12] various methods have been designed in recent years to give an overall assessment of malnutrition.[11] These include the Mini Nutritional Assessment (MNA), which was designed and validated to provide a simple and rapid assessment of the patient's NS.[13,14] Malnutrition is still a common problem in hospitalised patients,[15] and the MNA score has been extensively used to evaluate it. In addition, malnutrition assessed in this way has been associated with a longer hospital stay[16,17] and increased both long-term mortality[16,18] and mortality in the hospital[16] for elderly patients with different diseases. However, there is currently no data on the prevalence of malnutrition according to the MNA in hospitalised patients with HF; therefore, its prognostic value for this patient group is not known. The aim of our study was to analyse the prevalence of malnutrition and risk of malnutrition using the MNA in patients hospitalised with HF, and to assess its prognostic value in overall mortality. Additionally, the malnutrition markers in this group of patients were analysed.

METHODS

This was an observational, analytical, prospective study that included patients discharged consecutively from our department between January 2007 and March 2008, after being hospitalised for decompensated and chronic, or new onset HF. Patients that underwent surgery or cardiac catheterisation to correct the cause of acute HF during hospitalisation were excluded, as well as those that could not carry out a nutritional assessment in accordance with the established design or did not consent to do so. The study was approved by our hospital's bioethics committee. Diagnosis of HF was established according to the recommendations of the European Society of Cardiology.[1] Diagnosis of diastolic dysfunction and HF with preserved systolic function were performed by following the same document. Demographic, clinical, laboratory and echocardiographic data were collected during admission.

Creatinine clearance (CC) was calculated using Equation 7 in the Modification of Diet in Renal Disease Study.[19]

Comorbidity was assessed using the Charlson index.[20]

Nutritional Assessment

A comprehensive nutritional study was carried out using biochemical and anthropometric parameters.[11,12] The biochemical parameters (albumin, prealbumin, transferrin, total cholesterol, calcidiol, folic acid, vitamin B_{12} and lymphocytes) were determined within 72 h of admission. For each patient, the BMI was calculated, the body composition was assessed by triceps skinfold (TS) as an indicator of fatty tissue, and the arm muscle circumference (AMC) was measured as an indicator of muscle tissue.[11] These measurements were taken upon discharge: weight (in kilograms), height (in centimetres), TS (in millimetres), and arm circumference (AC, in centimetres), according to standard methodology.[21] The height and weight were measured on a clinical balance with height rod, of 100 g and 0.5 cm accuracy, respectively, with the patient barefoot and wearing light clothes. A Holtain plicometer with an accuracy of 0.2 mm and a pressure of 10 g/mm^2 was used for the TS. A tape calibrated in millimetres was used to measure the AC. Three measurements for each parameter were taken and their median value was used.

The BMI was obtained from the formula: BMI = weight/height^2 (kg/m^2).

The AMC was obtained from the Jelliffe equation[22]: AMC = AC–($\pi \times$ TS), expressed in centimetres.

Following the World Health Organization recommendations,[21] patients were distributed by percentile for the TS and AMC, according to reference tables for age and sex, using data reported by Frisancho,[23] and by Esquius et al.[24] for those over 75 years of age. Patients were classified into three percentile groups: < 5, 5-95 and >95.

Diagnosis of malnutrition and risk of malnutrition was established according to the MNA score.[13] This was completed the day the patient was discharged, and is a global nutritional test designed and validated to provide a simple and rapid evaluation of the patient's NS. It includes 18 items divided into four sections: anthropometric, general status, dietary aspects and subjective assessment. This gives a final score classifying the subject into one of three possible categories: well-nourished ($\geq$24 points), at risk of malnutrition (17-23.5 points) and malnourished ($<$17 points); these were the three groups analysed.

Main Variable

The primary variable to study prognosis was death from any cause.

Statistical Analysis

Quantitative data are presented as mean $\pm$ standard deviation. Qualitative data were expressed as percentages. For the quantitative variables, compliance with the normal distribution was assessed using the Kolmogorov-Smirnoff or Shapiro-Wilk tests, as appropriate. For comparing the groups, the chi-square test or Fisher's exact test were used for qualitative variables and the ANOVA or Kruskal-Wallis test for quantitative variables. To assess the association of each variable with the state of malnutrition, a multiple logistic regression analysis was performed. Results are presented as odds ratios with confidence intervals of 95%, and the Hosmer-Lemeshow goodness-of-fit test was used. Kaplan-Meier survival curves were obtained for the groups according to the MNA classification, which were compared

using the log-rank test. To assess whether the different MNA categories were independent predictors of mortality, a multivariate analysis using a Cox regression model was performed. The results are given in hazard ratios with confidence intervals of 95%. The multivariate analysis included variables for which significant differences between the groups were found, those showing a prognostic value in the univariate analysis ($P < .05$ for Wald statistic), as well as others of known prognostic significance (forced variables). Variables with a $P > .15$ for the Wald statistic were removed one by one from the model.

Comparison between the reduced model and the one that included the eliminated variables was performed using the likelihood ratio test. The scale of continuous variables was assessed by the Box Tidwell test. Possible interactions between the variables were studied. Variables with a significance greater than 0.05 were studied as possible confounding factors (considered as such when the percentage change of the coefficients was >15%), and eliminated from the model if not. The final model was compared with the model that included only the constant using the likelihood ratio test again. To assess the goodness-of-fit, graphic representations of martingale and Schoenfeld residuals were used.

All statistical analyses were performed using SPSS® version 15 (SPSS INC, Chicago, United States).

RESULTS

Mini Nutritional Assessment and General Features of the Patients

After 15 months, a total of 208 patients were included in the study. The demographic and clinical features of the series are shown in Table 1. The average MNA score was 21.2 ± 3.9. According to this scale, 27 patients (13%) were malnourished and 127 (59.6%) at risk of malnutrition. The remaining 57 patients (27.4%) had an appropriate NS. The three groups (see Table 2 for baseline characteristics) were homogeneous in aetiology of HF and the prevalence of diabetes, hypertension, hyperlipidaemia and prior acute myocardial infarction (AMI). The overall comorbidity assessed using the Charlson index was similar in all three groups, although the percentage of patients with cognitive impairment was higher in the malnourished group. The CC levels were also poorer, showing lower levels of haemoglobin. This group also had a higher percentage of women and a higher mean age than the other two groups. Regarding nutritional assessment parameters, the malnourished patients, according to the MNA, showed lower levels of albumin and prealbumin and a significantly lower BMI. The other nutritional parameters were similar across the three groups. The percentage of patients prescribed beta-blockers at discharge was lower in the malnourished group (Table 2). To evaluate malnutrition markers, a multiple logistic regression analysis included the following types of variables as independent variables: demographic (gender and age), clinical (aetiology of HF, type of acute HF and left ventricular ejection fraction [LVEF]), comorbidity-related (previous AMI, diabetes, malignant tumour, cognitive impairment, haemoglobin, CC and serum sodium), and variables included in the nutritional study. The following variables were independently associated with poor NS, as defined by the MNA: female sex, cognitive impairment, poorer CC, lower prealbumin levels and reduced BMI (Table 3).

Mini Nutritional Assessment and Survival

Data were obtained from the patient follow-up (mean follow up: 22.1 ± 11.6 months). At the median follow-up (25 months, interquartile range 12-32 months) the overall mortality in the series was 37.2% and mortality due to cardiovascular causes was 29%. As a result of the progression of the HF, 38 patients died (43.7%), 16 sudden deaths (18.4%), 8 due to other cardiovascular problems (9.2%) and 25 from non-cardiovascular causes (28.7%).

Overall mortality in patients who were classified as malnourished according to the MNA score was 56%, 76% and 80.8% at 12, 25 and 32 months follow-up, respectively. For patients at risk of malnutrition, the figures were 23.5%, 35.9% and 42.4%, respectively; while patients with adequate NS had values of 11.3%, 18.9% and 26.6% (long-rank, $P < .001$ for the three groups analysed together). Differences were found between malnourished patients and those at risk of malnutrition ($P < .001$) and those who had adequate NS ($P < .001$); differences were also found between the latter two groups ($P = .03$). The Kaplan-Meier survival curves are shown in Figure 1.

Table 1
Demographic and Clinical Characteristics of Patients

Age (years)	73 ± 10.1
Women	96 (46.2)
Decompensated chronic heart failure	116 (55.8)
Previous admissions for heart failure	55 (26.4)
LVEF, %	45 ± 16
Depressed systolic function (LVEF < 45%), No. (%)	115 (55.3)
Heart failure aetiology, No. (%)	
Ischaemic	87 (41.8)
Idiopathic DCM/alcohol	27 (13)
Valvular	28 (13.5)
Hypertensive	42 (20.2)
Other	24 (11.5)
HT	158 (76)
Hyperlipidaemia	72 (34.6)
Diabetes	121 (58.2)
Anaemia (Hb < 12g/dl)	100 (48.1)
CC < 60 ml/min	129 (62)
Previous AMI	63 (30.3)
Smoking	
Current	22 (10.6)
Ex-smoker	57 (27.4)
Alcoholism	
Current	18 (8.7)
Former alcoholic	4 (1.9)
Previous ischaemic heart disease	82 (39.4)
Previous valvulopathy	37 (17.8)
Need for intravenous inotropic support	25 (12)
Treatment at discharge	
Beta blockers	148 (71.2)
ACEI/ARB II	189 (90.9)
Aldosterone antagonists	123 (59.1)
Digoxin	54 (26)
MNA	
Malnourished	27 (13)
Malnutrition risk	127 (59.6)
Adequate nutritional status	57 (27.4)

ACEI/ARB II, angiotensin converting enzyme inhibitors/angiotensin II receptor blockers; AMI, acute myocardial infarction; CC, creatinine clearance; DCM, dilated cardiomyopathy; HT, hypertension; LVEF, left ventricular ejection fraction; MNA, Mini Nutritional Assessment.
Data are expressed as mean ± standard deviation or n (%).

Table 2
Cohort Study Features According to the Nutritional Status Determined by the Mini Nutritional Assessment

	Malnoutrished MNA < 17 (n=27)	Risk of malnutrition MNA 17-23.5 (n=127)	Adequate nutritional status MNA ≥ 24 (n=57)	*P*
Age (years)	78.6 ± 7.9	72.6 ± 9.7	70.8 ± 10.9	.005
Women (%)	80	47.8	22.6	<.001
Decompensated chronic heart failure (%)	64	58.3	45.3	.19
LVEF (%)	49 ± 17	46 ± 17	43 ± 15	.25
Ischaemic aetiology of heart failure (%)	40	39.1	45.3	.75
HT (%)	80	73.9	77.4	.77
Hyperlipaemia (%)	36	32.2	35.8	.87
Diabetes (%)	60	57.4	60.4	.92
Previous AMI (%)	28	31.3	39.6	.48
Need for intravenous inotropic support (%)	12	11.3	11.3	.99
CC (ml/min)	40.2 ± 20.5	55.1 ± 25.1	57.4 ± 19	.006
Haemoglobin (g/dl)	11.2 ± 2	12 ± 1.9	12.9 ± 2	.001
Serum sodium (mEq/l)	135.6 ± 5.9	137.3 ± 5.6	138.5 ± 3.5	.06
BNP (pg/ml)	1291 ± 1185	922 ± 736	770 ± 440	.08
Charlson index	5.3 ± 2.5	4.4 ± 2.4	4 ± 2	.12
Cognitive impairment (%)	20	6	2	.01
Malignant tumour (%)	16	15	15	.99
Albumin (g/dl)	3.5 ± 0.4	3.8 ± 0.5	3.8 ± 0.4	.03
Prealbumin (mg/dl)	15.7 ± 5.6	19.5 ± 6.1	19.6 ± 5.5	.01
Transferrin (mg/dl)	253.4 ± 74.5	249 ± 58	247.5 ± 46.5	.9
Total cholesterol (mg/dl)	151.5 ± 39.7	159.5 ± 36	158.9 ± 4.3	.64
Calcidiol (ng/ml)	24 ± 15.4	38.2 ± 38.6	32 ± 21	.11
Folate (ng/ml)	636.8 ± 409.4	503.8 ± 274	475.6 ± 234	.07
Vitamin B_{12} (pg/ml)	465.5 ± 386.3	413 ± 447.1	419.8 ± 344.5	.88
Lymphocytes/μl	1468 ± 841	1457 ± 742	1550 ± 663	.38
BMI, kg/m²	25.4 ± 6.1	29.5 ± 6.3	30 ± 4.8	.004
TS percentile (%)				.12
<5	16	4.4	2	
≥95	28	32.7	32.1	
AMC percentile (%)				.86
<5	28	20.4	18.9	
≥95	4	2.7	2	
MNA score	13.5 ± 2.3	21 ± 1.7	25.2 ± 1.1	<.001
Treatment at discharge				
Beta blockers (%)	48	70.4	79.2	.02
ACEI/ARB II (%)	88	92.2	86.8	.51
Aldosterone antagonists (%)	52	61.7	62.3	.64
Digoxin (%)	28	28.7	17	.26
HMG-CoA reductase inhibitors (%)	52	44.3	58.5	.22

ACEI/ARB II, angiotensin converting enzyme inhibitors/angiotensin II receptor blockers; AMC, arm muscle circumference; AMI, acute myocardial infarction; BMI, body mass index; BNP, brain natriuretic peptide; CC, creatinine clearance; HMG-CoA, hydroxymethylglutaryl-coenzyme A; HT, hypertension; LVEF, left ventricle ejection fraction; MNA, Mini Nutritional Assessment; TS, triceps skinfold.
Unless otherwise indicated, data are expressed as mean ± standard deviation.

The following variables were included in the Cox multivariate analysis: albumin (quantitative), BMI (quantitative), TS percentile (qualitative), MNA classification (qualitative), age (quantitative), aetiology of HF (qualitative), type of acute HF (decompensated chronic HF compared to new onset HF, qualitative), haemoglobin (quantitative), previous AMI (qualitative), CC (quantitative), serum sodium (quantitative), treatment with beta-blockers at discharge (qualitative), treatment with angiotensin converting enzyme inhibitors (ACEI) or angiotensin II receptor blockers (ARB II) at discharge (qualitative), diabetes (qualitative) and LVEF (quantitative).

The variables for type of acute HF, haemoglobin, previous AMI, treatment with beta blockers at discharge, treatment with ACEI/ARB II at discharge and diabetes were eliminated from the model (likelihood ratio test: G = 3.381, *P* = .76, degrees of freedom = 6). The variables albumin, BMI, CC, age, LVEF and serum sodium all had linear scales. All possible interactions were evaluated and no significant interaction was found. The variables CC (*P* = .14), BMI (*P* = .1), albumin (*P* = .07) and TS percentile (*P* = .08) were studied as confounding factors. None were considered as such, and were eliminated from the model. The only variables that were independently associated with mortality were age, LVEF, HF aetiology, MNA classification and serum sodium (Table 4). Malnutrition, according to the MNA, was the only nutritional assessment parameter considered an independent predictor of mortality (Table 4).

Table 3
Logistic Regression Analysis: Variables Independently Associated With Poor Nutritional Status Using Mini Nutritional Assessment

	Coefficient	Standard error	*P*	OR	CI 95%
Female	2.336	0.648	<.001	10.34	2.9-36.85
CC (ml/min)	−0.054	0.016	.001	0.95	0.92-0.98
Prealbumin (mg/dl)	−0.143	0.054	.009	0.87	0.78-0.97
BMI (kg/m^2)	−0.166	0.054	.002	0.85	0.76-0.94
Cognitive impairment	1.929	0.831	.02	6.88	1.35-35.05
Constant	6.089	1.907	.001		

BMI, body mass index; CC, creatinine clearance; CI, confidence interval; OR, odds ratio.
Likelihood ratio test: G = 56.138; Degrees of freedom = 5, $P < .000001$. Hosmer-Lemeshow goodness-of-fit test, $P = .95$. Specificity 97.4%, sensitivity 44%; accuracy 90%. Area under the ROC curve: 0.91 (95% CI: 0.86-0.96).

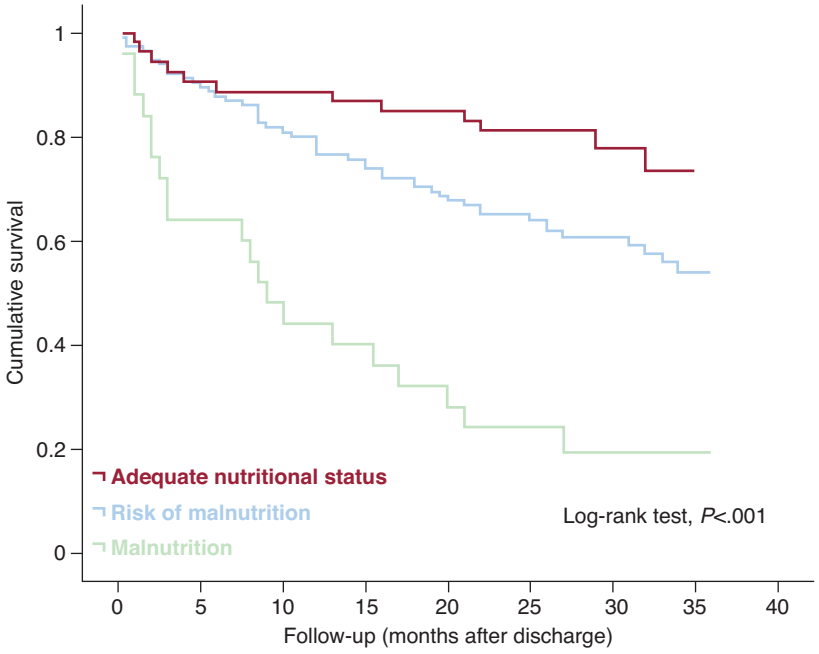

Figure 1. Kaplan-Meier survival curves for the three groups, as defined by the Mini Nutritional Assessment.

DISCUSSION

The influence of HF on NS has been widely established. The pathogenesis of this phenomenon has been associated with the catabolic state imposed by the disease, either by neurohormonal or immune-inflammatory activation.[7,25–28] To this can be added other mechanisms such as malaise, loss of appetite, immobility, venous stasis in the splanchnic and hepatic territory and malabsorption.[27] We wanted to analyse precisely the opposite, i.e., how NS affects the evolution of a chronic illness in a patient, in this case HF.

The NS evaluation can consider multiple parameters that provide integrating, complementary information.[11,12] From this perspective, malnutrition in hospitalised patients may reach a high prevalence.[15] We focused on the diagnosis of malnutrition and risk of malnutrition from the MNA scores obtained in a non-selected sample of patients hospitalised due to HF. The MNA is a validated tool to provide a quick and easy nutritional assessment, and has been widely used in hospitalised patients.[16–18,29,30] Although it was originally designed to assess malnutrition in the elderly population,[13] its use has spread to other age groups.[17] Its application in a series of patients with HF has not been previously tried, and its usefulness is evident when considering the prognostic value, which has not yet been described. According to the MNA, in our study we found a high prevalence of malnutrition and risk of malnutrition in patients hospitalised for HF, especially regarding the second group, as only a quarter of the patients in the series had an adequate NS. Orsitto et al.[30] obtained very similar results in a health and welfare centre similar to ours and with a similar average age to that of our series, but with patients admitted for a wide variety of reasons. The prevalence of malnutrition according to the MNA in patients hospitalised for medical conditions is lower in younger patients,[17] but reached almost 50% in octogenarian patients.[16] This is not a coincidence, as an inverse linear relationship between age and the MNA score has been described.[29] Moreover, in most of the series (with a wide variety of patient pathology), the average age of the malnourished patient group is higher than the other two groups,[16,17,30] as in our study. However, in our series, there was no independent relationship between age and the malnutrition state, but there was with female sex, cognitive impairment, poorer CC, low prealbumin and low BMI. Although the overall comorbidity (Charlson index) was similar in all three groups, the partial analysis shows the influence of certain concomitant diseases in the NS of patients with HF. We know that patients with cognitive impairment have a higher prevalence of malnutrition and an MNA score significantly lower than patients without cognitive impairment.[30] In addition, the number of patients with cognitive impairment was greater in the malnourished group in our series. This situation is

Table 4
Crude and Adjusted Hazard Ratio (Cox Multivariate Analysis) for Overall Mortality in the Study Population for Variables Considered in the Multivariate Analysis

	Crude HR (CI 95%)	*P*	Adjusted HR (CI 95%)	*P*
Albuminaemia	0.49 (0.32-0.76)	.002	0.6 (0.34-1.03)	.07[a]
BMI	0.94 (0.89-0.98)	.003	0.95 (0.9-1.01)	.1[a]
TS percentile (wrt percentile < 5)		.02		.16[a]
Percentile 5-95	0.34 (0.16-0.72)	.005	1.64 (0.68-4)	.27[a]
Percentile >95	0.42 (0.19-0.92)	.03	2.31 (0.92-5.79)	.08[a]
Decompensated chronic heart failure (with respect to new onset heart failure)	1.72 (1.1-2.67)	.02	1.25 (0.75-2.09)	.4[a]
Haemoglobin	0.86 (0.77-0.95)	.004	1.04 (0.91-1.18)	.59[a]
Previous AMI	1.35 (0.87-2.1)	.18	1.52 (0.66-3.52)	.33[a]
CC	0.98 (0.97-0.99)	<.001	0.99 (0.98-1.003)	.14[a]
Beta-blockers at discharge	0.66 (0.42-1.02)	.06	0.72 (0.42-1.26)	.25[a]
ACEI/ARB II at discharge	1 (0.48-2.07)	.51	1.03 (0.43-2.49)	.94[a]
Diabetes mellitus	1.05 (0.69-1.61)	.82	0.93 (0.54-1.59)	.93[a]
Age[b]	1.09 (1.06-1.12)	<.001	1.08 (1.05-1.12)	<.001
LVEF[b]	1.01 (0.99-1.02)	.17	0.98 (0.96-0.99)	.04
Aetiology (with respect to ischaemia)[b]		.06		.004
Idiopathic DCM/alcohol	0.83 (0.44-1.58)	.57	2.92 (1.32-6.49)	.008
Valvular	1.14 (0.64-2.04)	.7	1.07 (0.57-2)	.83
Hypertensive	0.5 (0.27-0.94)	.03	0.42 (0.21-0.84)	.01
Others	0.42 (0.18-0.98)	.05	0.95 (0.38-2.36)	.9
Serum sodium[b]	0.92 (0.89-0.96)	<.001	0.94 (0.9-0.98)	.007
MNA (with respect to adequate nutritional status)[b]		<.001		.002
Malnutrition	6.26 (3.05-12.86)	<.001	3.75 (1.75-8.02)	.001
Nutritional risk	2.01 (1.07-3.79)	.03	1.75 (0.92-3.33)	.09

ACEI/ARB II, angiotensin converting enzyme inhibitors/angiotensin II receptor blockers; BMI, body mass index; CC, creatinine clearance; DCM, dilated cardiomyopathy; HR, hazard ratio; LVEF, left ventricle ejection fraction; AMI, acute myocardial infarction; MNA, Mini Nutritional Assessment; TS, triceps skinfold.
[a] *P* values when the variable was eliminated from the multivariate analysis model.
[b] Variables making up the final model (likelihood ratio test: G = 72.056, *P* < .00001; Degrees of freedom = 9).

exacerbated in series of very elderly patients, where cognitive impairment is also an important risk factor for the development of malnutrition.[16] In patients with renal failure (RF), concomitant HF is associated with a worse NS.[5] Likewise, our analysis shows the influence of RF in the nutritional of patients with HF. The binomial HF and RF, therefore, has a decisive influence on the NS. A direct relationship has been established between prealbuminaemia and the MNA score.[14] Prealbumin is a carrier protein with a short half life (2 days) which makes it a highly sensitive sign to early detect protein depletion or acute nutritional changes.[12] The findings in our study, showing an association between malnutrition and prealbuminaemia, underline its usefulness as a biochemical marker of malnutrition in patients hospitalised for HF. In addition, the BMI has a direct relationship with the MNA score[14,29]: the higher the BMI, the better the patient's NS. In our series, it also played an important role as an anthropometric malnutrition marker in patients hospitalised for HF. Perhaps the most notable aspect of this analysis, for being so unexpected, is the association found between malnutrition and being female. This finding must be confirmed with further studies and any causes revealed.

In our series, treatment with beta blockers at discharge showed no prognostic benefit in the long term. However, we note that the percentage of malnourished patients prescribed with this treatment at discharge was much lower than the other groups. It is difficult to explain this finding, since neither comorbidity nor any other clinical or demographic characteristics evaluated can offer an explanation. If greater clinical deterioration is present in the patient's overall subjective assessment, it could influence the cardiologist choosing a treatment which has adverse effects.

However, if there is anything we should highlight in our study, it is the finding of the prognostic impact in mortality that malnutrition, as defined by the MNA, has shown in patients with HF. Previous studies have demonstrated that malnutrition according to the MNA leads to a longer hospital stay.[16,17] Also, in elderly patients hospitalised for different diseases, it is associated with increased both long-term[16,18] mortality and mortality in the hospital.[16] In our series, the mortality of malnourished patients is much higher than that of the other groups. This is noticeable from the first months after hospital discharge, as shown by the Kaplan-Meier survival curves (Fig. 1). Furthermore, the MNA malnutrition status is shown as a powerful independent predictor of long-term mortality in patients with HF. During the follow-up period of our study, any other parameters included in the NS showed that predictive power. If the other variables are the same, a patient hospitalised for HF who is malnourished according to the MNA, has almost a 4 times greater risk of death than another with an adequate NS. These findings highlight the relevance of the development of the NS in the patient when facing the illness. In this case, the MNA is a useful tool for identifying patients at high risk. Therefore, the assessment of NS should be foremost in the comprehensive assessment of patients with HF. To date, the nutritional parameter which has been evaluated the most, for influencing the prognosis of patients with HF, is the BMI.[9] Several studies have shown an inverse relationship between BMI and mortality in patients with HF, i.e. the higher the BMI the lower the mortality.[9] We also found this paradoxical relationship in our study. As shown in the Cox univariate analysis, there was a decreased risk of death with increasing BMI. However, for the study follow-up period, BMI was not an independent predictor of mortality. With respect to this parameter, malnutrition according to the MNA, as well as providing more comprehensive information on the NS, has a greater impact on prognosis. Its influence on survival is detected earlier, and unlike BMI, which stands as mere observational data, the detection of malnutrition in

a HF patient, according to the MNA, could justify interventional measures. It may be that a treatment designed to improve the NS or intensive clinical follow-up could help improve the prognosis of these patients; however, this will have to be assessed in future studies.

CONCLUSIONS

In our series, only a quarter of patients admitted for HF had an adequate NS according to the MNA. The malnutrition state as defined by the MNA was associated with increased mortality and was an independent predictor of mortality in the multivariate analysis, along with other normal prognostic variables. The assessment of NS should therefore be integrated as a fundamental part in the overall assessment of HF patients. Nutritional intervention may help improve the prognosis of these patients.

CONFLICTS OF INTEREST

None declared.

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