Nutritional Repercussion in Advanced Heart Failure and its Value in Prognostic Assessment

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Objective
To analyze the nutritional repercussion in heart failure and its relations with left ventricular dysfunction and mortality.

Methods
A series of nutritional parameters in a group of 95 patients with advanced chronic heart failure, arising out of dilated cardiomyopathy and age < 65 years old, without concomitant diseases was studied. The duration of symptoms, final diastolic diameter and left ventricular ejection fraction were verified. The nutritional assessment, included the ideal percentage of weight the triceps skin fold thickness, percentiles of circumference of muscular mass of the arm, the albumin serum levels and the lymphocytes global count.

Results
The nutritional situation was altered in 45.3% to 94.7% of the patients in accordance to the assessment parameter used. There was neither correlation between the nutritional parameters and the length of symptoms, nor with the ventricular dysfunction level. That group of patients had a homogenous evolution, and 75.8% of them died in an average time of 21.86 weeks. The left ventricular diastolic diameter and ejection fraction did not allow for the prediction of survival. A diminished body mass identified a group with higher risk of death. The ideal percentage of the body mass was predictive of survival (p=0.0352), the patients with less than 80% of ideal weight had a higher relative risk of death of 1.99 (1.12–3.02) (p=0.0132).

Conclusion
Malnutrition is frequent in patients with advanced heart failure and dilated cardiomyopathy. The reduced body mass was a better predictor of survival than the left ventricular ejection fraction in patients under advanced stage of myocardial compromising.

Key words
malnutrition, dilated cardiomyopathy and advanced heart failure

Since the beginning of medicine, malnutrition is acknowledged as a manifestation associated to congestive heart failure (CHF), especially in its more advanced stages. Among the list of classical manifestations of cardiac diseases we find many levels of protein-caloric depletion, even the extreme clinical features, generically called cardiac cachexia.

The clinical and experimental data available indicate a cause-effect relation between CHF and malnutrition. There are questions about which mechanisms lead to malnutrition and the importance of each mechanism in the maintenance and aggravation of the features.

Along with the questions concerning the physiopathology, there are others on the assessment way. The nutritional assessment, which is usually done in hospitalized patients is inaccurate and can use many parameters to achieve a general impression on the existence or not of protein-caloric malnutrition. The key point to determine the malnutrition level, as well as the best assessment parameters, has not been properly defined and standardized yet.

This study had as objective to assess the behavior of many indexes of malnutrition status in a group of chronic CHF carriers as a consequence of left ventricular dysfunction due to dilated cardiomyopathy, in an advanced stage of the disease. It also aimed at verifying whether the compromising level of nutritional parameters has any relation with the time of evolution of its symptoms, if the intensity of compromising of indicators of the nutritional status of the disease is related to the level of left ventricular systolic dysfunction, and if its changes have a prognostic value in advanced chronic CHF.

Methods
The nutritional status of 95 carriers of congestive heart failure due to dilated cardiomyopathy in functional class III/IV, hospitalized at Hospital Auxiliar de Cotoxó (HCFMUSP) for compensation, was assessed.

The patients were selected among those 1,176 hospitalized during the 12 months of sample selection for the study, from which 412 were carriers of congestive heart failure.

The exclusion criteria of the study were situations that could cause changes in the nutritional situation of the patients or modify the natural history of the disease: age < 15 or > 65 years old; valvar dysfunctions subjected to surgical corrections; coronary failure; symptomatic cardiac arrhythmias; diastolic blood pressure at admission > 105 mmHg, diabetes mellitus; creatinine levels
Nutritional Repercussion in Advanced Heart Failure and its Value in Prognostic Assessment

> 2.0 mg/dl; chronic pneumopathy; degenerative chronic diseases; neoplasias; AIDS diagnosis; previous alcoholic ingesta > 100 ml of distilled spirits or 600 ml/day of beer and use of illegal drugs. Based on those criteria 312 patients were excluded. Other five patients later excluded for not having returned to the ambulatory.

The data from the clinical history and the physical exam were valued in the 95 patients for the assessment of the functional situation and the duration of the disease. All of them were submitted to a cardiologic assessment through an echocardiographic study, from which the measurement of left ventricular diastolic diameter (LVDD) was valued and the left ventricular ejection fraction (LVEF) assessed through the cube method.

All patients, in the absence of contraindications, were discharged with prescription of digital, diuretic and ACE inhibitors. In patients with renal insufficiency or in those who showed side effect with ACE inhibitor, hydralazine and nitrate were prescribed.

For the assessment of the nutritional status, anthropometric and laboratorial parameters, and determination of immune competence were considered. The adopted parameters were chosen due to their better standardization, better reproducibility, feasibility and cost.

Besides those objective indicators, adopted for statistic analysis, the patients were classified in malnourished, normal or obese, based on their physical aspect, also taking into consideration the skin turgor and elasticity, the thickness and color of the hair and facies.

All patients were measured and weighed. The percentage of ideal weight was estimated as percentage in relation to the standard weight expected for the population of same sex and height, based on the tables of American Society of Actuaries, which are modified for median build and measurements without clothes. The body weight obtained was compared through percentage to the ideal body weight from the tables, by adopting the criteria proposed by Blackburn et al. for classification of results: normal (over 90% of ideal weight), mild nutritional compromising (between 80 and 90% of ideal weight), moderate nutritional compromising (between 70 and 79% of ideal weight) and important nutritional compromising (less than 70% of ideal weight).

The thickness in millimeters of the triceps skin fold (TSF) was obtained in accordance to the technique described by Jelliffe, by means of a Lange caliper. In the middle point of non-dominant arm (between the acromial process and the olecranon), in sitting position, with the arm freely stretched along the body, a fold of skin is pinched with the fingers where the caliper is applied, at a depth equal to the thickness of the skin fold, being verified the measurement 2 seconds after the total pressure is exerted by the caliper on the skin; the measurement is repeated twice, and the mean of the results is taken. The value obtained is compared with standardized tables, by estimating the level of compromising of adipose reserves in terms of the percentile in which the obtained value is situated in relation to population measurements: normal (over percentile 50), mild compromising (percentiles 25 to 50), moderate compromising (percentiles 10 to 24) and important compromising (below percentile 10).

The muscular circumference of the arm, in centimeters, was calculated from the measurements of the arm circumference and the thickness of the triceps skin fold, using the formula proposed by Jelliffe: \( c_2 = c_1 - 3.14s \), in which \( c_2 \) is the muscular circumference, \( c_1 \) the arm circumference and \( s \) is the thickness of the triceps skin fold, in centimeters. The arm circumference is measured in the middle point between the acromial process and the olecranon.

Similarly to the thickness of the triceps skin fold, the values obtained were classified in percentiles, through the standardized tables for sex and age elaborated by a Frisancho from population data of HANES I (United States Health and Nutritional Examination Survey, 1971-74) study. From the percentile obtained, the level of compromising observed was defined in relation to that parameter: normal (over percentile 50), mild compromising (percentiles 25 to 50), moderate compromising (percentiles 10 to 24) and important compromising (below percentile 10).

The serum level of albumin at admission was determined through bromocresol green method. In terms of albumin, the nutritional compromising level was classified within the following intervals: normal (over 3.5 g%), mild compromising (2.8 to 3.5 g%), moderate compromising (2.1 to 2.7 g%) and important compromising (below 2.1 g%).

At admission the lymphocytes count in peripheral blood was elaborated, used was a nutritional parameter, expressing compromising of the immuno system. That parameter was also subdivided in four intervals: normal (over 2,000 lymphocytes/mm³), mild compromising (1,200 to 2,000 lymphocytes/mm³), moderate compromising (800 to 1,199 lymphocytes/mm³) and important compromising (below 800 lymphocytes/mm³).

In table I is shown the main characteristics of the studied population.

It was tried to verify whether there was a relation between the evolution time of CHF and the level of left ventricular dysfunction with the nutritional parameters, by determining the linear correlation coefficient of Pearson among the variables analyzed.

For the analysis of survival two methods were used: estimate of Kaplan-Meier: The estimate of survival observed in the sample studied, which does not depend on any parameter. Analyzed along with the non-parametric test of Log-Rank and the Semi-Parametric model of proportional risks of Cox: suitable for the study of continuous variables, by means of presupposition that the survival curves do not cross, which means that the risk is proportional during the whole time interval studied. Besides making possible to indicate which variables are important in the survival prediction of patients, it allows for obtaining the risk rate between two levels of a given variable. The significance level of 5% was adopted in this study.

**Results**

The subjective analysis of nutritional status classified 23/95 (24.2%) patients as malnourished, 62/95 (65.3%) as normal and 10/95 (10.5%) as obese. The main results from the nutritional assessment are shown in table II.

Except the arm muscular circumference, most of variables analyzed assessed the nutritional status as normal or with mild intensity changes.

Only the percentile of the arm muscular circumference showed a correlation with the evolution time of CHF (\( r = -0.2105, p = 0.0355 \)). There was no correlation among the other variables of assessment of nutritional status and the evolution time of CHF symptoms prior to the inclusion in the study: Percentage of ideal weight (\( r = 0.0797, p = 0.4306 \)); Percentile of triceps skin fold.
The carriers of moderate or important change of ideal weight, with the weight observed below percentage 80, had higher mortality, with a risk rate of 1.99 (CI 95%; 1.12 to 3.02) (fig. 1).

The non-parametric analysis by Kaplan-Meier and by the test of Log-Rank, and the semi-parametric analysis by the model of proportional risks of Cox showed that both the fraction of ejection and the LV diastolic diameter were not significant in the prediction of survival time of the patients studied.

Discussion

In a population of patients with advanced heart failure (severe), due to dilated cardiomyopathy (idiopathic 61%, chagasic 36% and peripartum 3%) it was detected a malnutrition level in 45.3% to 94.7% of the patients, according to the assessment parameter used. The presence of malnutrition did not have any relation with the duration of clinical manifestations or with the intensity of myocardial compromising. However, the malnourished patients, when assessed through the reduction of ideal weight, had a higher mortality than those without signs of malnutrition.

The association between the clinical features of cachexia and heart failure is a classic phenomenon and quite frequently observed in clinical practice. Its prevalence varies in accordance with the composition of the studied population, being described in percentage that varied from 13.7 to 61.5%, which seemed to have a relation with the cause of heart failure and a certain relation with the duration of symptoms and the intensity of heart failure7-10,17.

Such differences in the incidences can also be related to the different ways of assessment of nutritional status and to the lack of a single definition on what malnutrition and cachexia is.

Among the most frequently used measures for the assessment of nutritional status, some are easy to obtain, such as weight and height, which allow us for assess the nutritional status, by comparing the obtained values with those from tables or assessing the body mass index. We used the tables from American Society of Actuaries12. Due to the simplicity of obtaining, we used the percentage of ideal weight, the measurement of triceps skin fold, the arm muscular circumference and laboratory exams, through the dosage of albuminemia and lymphocytes count11-14, in our studies to assess the nutritional status.

All those variables have been used in many studies that proposed to assess the nutritional status in different diseases. No single measurement is ideal, and the use of many of them to achieve a
real assessment of the nutritional status of a patient is important. The normal weight (ideal weight) table, adopted as a reference, was the one recommended by Jelliffe\textsuperscript{4}. The main concern about the use of such table is the fact that it comes from a population study carried out in the USA some decades ago. However, in the country itself where the table was elaborated by the American Society of Actuaries, authors already warned about the fact that the studied population had an income below the average and mixed ethnic composition, which does not properly reflect the majority Anglo-Saxon biotype of the nation\textsuperscript{18}. Despite the absence of a population study with a similar dimension in our milieu, comparative analyses with national more limited numerically series, validate the use of that table in Brazil. Other American tables more recently elaborated, as those by Frisancho et al., seem to have a better correlation with the biotype of small Brazilian populations studied\textsuperscript{16,19,20}.

Although our sample had a showed a wide dispersion of values in relation to the duration of CHF symptoms, a correlation between that variable and the different indicators of nutritional status analyzed was not observed. Although the percentile of arm muscular circumference had shown some significance in the analysis by the coefficient of Pearson, with $p=0.0355$, we considered the obtained correlation coefficient ($r=-0.21$) as very low, allowing for, at most, perceiving a tendency that the patients with a longer period of congestive manifestations show a greater compromising of the skeletal muscular mass. However, the low correlation coefficients observed in the analysis of other variables suggest that, at the pre-end-stage of CHF, the duration of congestive symptoms is not a determining factor of the nutritional compromising observed.

The analyzed indicators of nutritional status had low correlation coefficients with LVEF determined by the echocardiogram. Only the percentile of arm muscular circumference reached values close to significance, with $p=0.0706$. However, the low value of correlation coefficient ($0.18$) and the disagreement on that was observed in all remaining variables reinforces the impression that the ejection fraction, analyzed through this method, has no correlation with the nutritional status compromising. That result is compatible with previous observations\textsuperscript{7} in another sample with similar methodology, and also with the results from the study by Carr et al.\textsuperscript{10}, which analyzed nutritional indicators by utilizing the hemodynamics and the two-dimensional echocardiogram, estimating the ejection fraction through the Simpson’s planar formula, as methods for the study of myocardial function.

Left ventricular dimension, echocardiographically assessed by LVDD, showed a correlation coefficient of $0.2768$ with a significant percentage of ideal weight ($p=0.0058$). We also noted values of $p$ close to $0.05$, although non-significant, in the correlation of LVDD with the percentile of triceps skin fold and with albuminemia, which could indicate a tendency. However, the correlation coefficients were lower than $0.20$. Besides, such data seem to differ from a previous observation\textsuperscript{8}. The final impression provided by that set of data is that there was no clear relation between the left ventricular dimension and the nutritional compromising in the analyzed sample.

Those results suggest that the nutritional repercussion in advanced heart failure, despite resulting from left ventricular contractile dysfunction as common etiologic factor, has in each individual factor other than those that transcend the simple compro-
Despite the evidences that the total body mass is a prognostic indicator of CHF in advanced stage, the compromising of caloric reserves (estimated through the percentile of TSF) or skeletal muscular mass (assessed through the percentile of AMC), singly considered, did not show a predictive value for survival in the sample studied. As in CHF there is a prevailing nutritional compromising of marasmus type – in which the decrease of body mass essentially occurs at the expense of muscular mass and adipose tissue –, it would be expected that those indicators showed a prognostic value, similarly to the analysis of percentage of ideal weight.

The changes in plasmatic albumin or lymphocytes count were not prognostic either.

Those results must be analyzed carefully, as they refer to an extremely severe population, a fact that can have made difficult the identification of mortality predictors. We cannot either exclude the possibility that the lack of significance for the variables studied has been arising out of the small population studied.

It is always important to emphasize that those results cannot be applied to populations with less severe clinical records.

The nutritional situation of the patients is also influenced by socioeconomic factors, and that is another limitation of the study, as those data were not analyzed in that group of patients.

In conclusion, the changes of anthropometric, biochemical, and/or immunologic parameters compatible with moderate or important nutritional compromising are frequent findings in advanced CHF. The subjective assessment of nutritional status shows lower sensitivity for the detection of moderate or important changes of nutritional indicators. The changes of nutritional indicators studied were generally not related to the evolution time of CHF symptoms or to the level of left ventricular compromising. A moderate or important diminishing of body mass, determined through the percentage of ideal weight, was associated to a shorter survival and showed an independent prognostic value. Other forms of assessment did not show correlation with the prognostic.

References