Score for Nutritional Status Evaluation: The Role Played in the Prognostic Stratification of Dilated Cardiomyopathy and Advanced Heart Failure Patients

Luiz Guilherme Veloso, Antonio Carlos Pereira-Barretto, Mucio Tavares de Oliveira Junior, Robson Tadeu Munhoz, Paulo César Morgado, Jose Antonio Franchini Ramires
Hospital Auxiliar de Cotoxó, Instituto do Coração do Hospital das Clínicas – FMUSP - São Paulo, SP - Brazil

Objective

Develop a method for the evaluation of patient's nutritional status through a score that expresses universal nutritional status, as well as investigate if that score would be efficient for the prognostic stratification of advanced heart failure (HF) pts.

Methods

The score was reached by the selection of evaluation methods that would quantify nutritional status: ideal body weight percentage, thickness of tricipital skinfold, percentiles for arm muscular mass circumference, albumin serum level, lymphocyte total count. In order to be validated, the score was applied to a group of 95 pts. Pts were under 65 years old no evidence of consumptive diseases. The score was analyzed to confirm whether it would keep correlation with HF clinical data and whether it would stratify its prognostic.

Results

Nutritional status suggesting moderate or severe malnutrition could be observed in 31/95 (32.6%). No correlation was found between nutritional score values and the duration of symptoms, or the level of ventricular dysfunction. Pts with high nutritional score showed a trend towards higher mortality rate (p=0.0606).

Conclusions

Those data suggest malnutrition is reported by 1/3 of pts with advanced HF. A score comprising 5 parameters for nutritional status showed good correlation with the clinical, global evaluation of pts with HF. A score over 8 identified pts with higher probability of death as outcome, confirming that pts under higher malnutrition exhibit worse evolution.

Key words

Malnutrition, cardiac cachexia, dilated cardiomyopathy.

Mailing Address: **Antonio Carlos Pereira Barreto** • Av. Enéas de Aguiar, 44 – 05403-000 – São Paulo, SP - Brazil
E-mail: pereira.barretto@incor.usp.br
Received on 04/02/03 • Accepted on 06/08/05

From the times of Hippocrates the association between malnutrition and congestive heart failure (CHF) has been being described, especially in its more advanced stages. From all classic manifestations of heart diseases, we have found degrees of protein and calorie depletion to the point of extremely generic conditions called cardiac cachexia[1,2].

Clinical and experimental data that have analyzed the correlation between CHF and malnutrition show a cause-effect relationship[3,4]. Doubts are pending both about the mechanisms that lead to malnutrition, and the relevance of each mechanism in the maintenance and worsening of the condition[5-8].

Nutritional status may be assessed by interpreting changes in the anthropometric, biochemical, and immunological parameters from CHF patients as compared to the patterns considered as normal for the population.

It should be pointed out that malnutrition has not been systematically investigated; when it has, the studies are subjective and non-systematized. Also to be pointed out is that the key aspects to determine malnutrition level, as well as the best parameters have not been properly defined or organized yet, and most studies that have tried to evaluate the nutritional status have used one or two parameters; therefore, one could say malnutrition has been quantified only partially[9,10].

Additionally to those doubts as to the best way to investigate malnutrition, its real prevalence is yet to be found[10-20].

The present study tried to develop a score to evaluate a nutritional status that would include the most commonly used assessment methods, and then validate it by comparing results with those of a subjective evaluation of the nutritional status of patients with dilated cardiomyopathy and advanced heart failure. The research also tried to check whether that score kept any correlation with heart failure duration time and level of heart impairment, and whether it allowed patients' stratification.

Methods

The nutritional status of 95 patients was investigated - all dilated cardiomyopathy patients with Congestive Heart Failure (CHF), Functional Class III/IV, at Hospital de Cotoxó to be compensated.

The 95 patients were selected among the 1,176 admitted in the 12 months period for study sample screening. Out of those, 412 were CHF patients.

The exclusion criteria were situations that could sponsor changes in the nutritional status of patients or their natural history of CHF: age range below 15 and over 65; valvar dysfunction that could be corrected surgically; symptomatic heart arrhythmia; diastolic blood pressure above 15 mmHg at the time of admission; diabetes mellitus; creatinine level above 2.0 mg/dl; chronic pneumopathy; chronic, degenerative diseases; neoplasias; AIDS diagnosis; history of daily alcohol consumption above 100 ml for distilled beverages or 600 ml of beer, and the use of illegal drugs.

Based on those criteria 312 patients were excluded. Five other patients were later excluded as well, since they did not return to the outpatient unit, and could not be contacted after hospital discharge, with follow-up having been lost.

Clinical history and physical examination were considered relevant to investigate functional status and condition duration time in the 95 patients selected. All patients were submitted to cardiologic assessment through echocardiographic study, where left ventricular diastolic diameter (LVDD) and left ventricular ejection fraction (EF) assessed by the cube formula were considered relevant.

Assessment of nutritional status - All patients were measured and weighed.

Anthropometric and laboratory parameters as well as immune capacity were considered for the assessment of patients' nutritional status [14]. The parameters were based on best pattern features, best reproducibility, best cost, and easiest execution. The following nutritional status methods were selected: ideal body weight percentage, thickness of tricipital skinfold, percentiles for arm muscular mass circumference, albumin serum level, lymphocyte total count.

The technique used for each of those parameters and their results has been shown in our service publications[9,10,21-23].

In addition to those objective indicators adopted for statistical analysis, the clinical, subjective impression of primary author ranked patients as "undernourished", "normal", or "obese", based on their physical appearance and taking into consideration skin turgor and elasticity, hair color and thickness, and facies. That subjective classification had the exclusive purpose of assessing nutritional score, as described below.

Nutritional score - The intent was to group the different indicators so as to conduct a simultaneous analysis based on a score that would take into account the anthropometric, biochemical and immunological assessment of patients.

Five parameters were empirically selected to make up the score. Each of those parameters was given a number of points based on the level of impairment that was observed, and the cut-off points as follows:

a) Percentage of ideal weight[16] - normal: above 90% (zero points), mild impairment: between 80 and 90% (1 point), moderate impairment: between 70 and 79% (2 points) and severe impairment: below 70% (3 points);

b) Percentile of tricipital skinfold[14] - normal: above 50th percentile (zero points), mild impairment: 25th to 50th percentile (1 point), moderate impairment: 10th to

24th percentile (2 points) and severe impairment: below 10th percentile (3 points);

c) Percentile of arm muscular circumference[14] - normal: above 50th percentile (zero points), mild impairment: 25th and 50th percentile (1 point), moderate impairment: 10th to 24th percentile (2 points) and severe impairment: below 10th percentile (3 points);

d) Albumin serum level[14] - normal: above 3.5 g% (zero points), mild impairment: 2.8 a 3.5 g% (1 point), moderate impairment: 2.1 to 2.7 g% (2 points)and severe impairment: below 2.1g% (3 points);

e) Number of lymphocytes in peripheral blood[14] - normal: above 2,000 cells/ml (zero points), mild impairment: from 1,200 to 2,000 cells/ml (1 point), moderate impairment: from 800 to 1,199 cells/ml (2 points) and severe impairment: below 800 cells/ml (3 points).

For the purpose of sample statistical analysis, normal or mild nutritional impairment patients were those reporting a score under 8 points; moderate or severe nutritional impairment were all other patients – with total of 8 points or more (Table 1).

Characteristics of population under study - Table 2 shows major characteristics of population under study as documents of a group of patients with strong myocardial impairment, with course towards high morbi/mortality.

Statistical analysis - The study tried to detect any correlation between CHF time course and left ventricular dysfunction level and the score through Pearson's linear correlation for the variables under analysis.

Parameters for ventricular function assessment were compared through Student t and Kruskal-Wallis test for patients reporting nutritional score compatible with moderate or severe impairment (8 points or more) and the remaining patients.

For survival analysis, two methodologies were used:

- Kaplan-Meier Estimate: Survival estimate observed in sample of interest , which is not parameter dependant. Analysis conducted through Log-Rank non-parametric test.

- Cox Semiparametric Model of Proportional Hazard: appropriate for the study of continuous variables, assuming survival curves do not cross, which is to say, that hazard is kept proportional all along the time interval under study. In addition to allowing the indication of which variables are important for patients' survival prediction, it also allows hazard ratio between two levels of a given variable to be obtained.

Significance level in the study was defined at 5%.

Results

Primary author's subjective impression ranked patients as: "undernourished" 23/95 (24.2%), "normal" 62/95 (65.3%) and "obese" 10/95 (10.5%).

Moderate or intense undernourished patients were shown by the 32.63% score; while 67.36% of patients were considered eutrophic or mildly undernourished.

Correlation between nutritional parameters and time course - Correlation analysis between nutritional score and disease time course did not show to be significant (r=0.0761, p=0.4517).

Table 1 - Nutritional Score: Points given following level of impairment for different nutritional parameters

Parameter/impairment	Normal	Mild	Moderate	Severe
Percentage of ideal weight	0	1	2	3
Percentile - tricipital skinfold	0	1	2	3
Percentile – muscular circumference	0	1	2	3
Albuminemia	0	1	2	3
Lymphocytes	0	1	2	3

Table 2- Patients' major characteristics

Variable	Values
Age (years)	47.35±12.96
Gender (males)	68 (71.6%)
History (months)	37.75±41.58
Dilated Cardiomyopathy	58 (61.05%)
Chagas Disease	34 (35.78%)
Functional Class III/IV	60 (63.15%)/35 (36.84%)
LVDD (mm)	72.65±8.56
EF (%)	34.84±6.65%
Deaths	72 (75.78%)
Inotropic Support	27 (28.43%)
New hospitalizations	33 (34.73%)

For patients reporting under 8 points score – considered eutrophic or under mild nutritional impairment – time course was 24 months, the same as those with moderate to severe impairment.

Correlation between nutritional score and myocardial dysfunction level - The analysis between the score and myocardial dysfunction level did not show correlation between ventricular dilation level and nutritional score (r=-0.1353, p=0.1841), neither between ejection fraction and score (r= - 0.1238, p=0.2195).

Patients reporting moderate to severe nutritional impairment (score above 8) showed LVDD and LVEF similar to that of patients under lower malnutrition.

Nutritional score and survival - Nutritional score was analyzed as continuous variable and as discrete variable. Therefore, through Cox model of proportional hazard descriptive level of the score as continuous variable was 0.3094 – non-significant as patients' survival predictor. When lower nutritional impairment patients were considered (score under 8), a trend towards longer survival could be observed when compared to the others. Out of the 56 cases with scores indicating lower nutritional impairment, half of those was alive at week 26, whereas half of the group that had reported 8 points or more had already died at week 16 after study start. However, despite the apparent difference in Kaplan-Meier's curves – observed when higher and lower impairment groups were compared through the score – descriptive level was 0.0606 and 0.0676, respectively, for the Log-Rank test and for the Cox model: both indicating only marginal evidences of nutritional score values as predictors of patients' survival (fig. 1).

The non-parametric analysis through Kaplan-Meier and through Log-Rank test, as well as Cox semiparametric model of proportional hazard, have indicated that both ejection fraction and left ventricle diastolic diameter have not shown to be significant to predict survival time of patients under study.

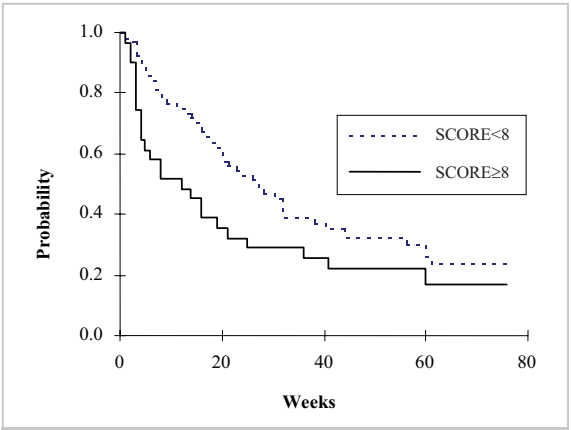

Fig. 1 *- Survival Estimate (Kaplan-Meier) following nutritional score (SCORE). p = 0.0606 (Log-Rank).*

Discussion

The association between cachexia condition and heart failure is a classical phenomenon, and is observed somewhat frequently in clinical practice. Its prevalence is variable, and it is influenced by the characteristics of population under study. It is described through percentages ranging from 13.7 and 61.5%, and seems to keep correlation with duration of symptoms and heart failure level[10-13,19-24].

Those incidence differences are probably the result of different ways of assessing nutritional status, as well as of the lack of one common, actual definition for malnutrition and cachexia.

The study tried to create a nutritional assessment score that would use different measures for malnutrition so as to reach one measure that would be more easily reproducible and that would be a global expression of patients' nutritional status. In order to do that, a series or variables already used for nutritional assessment was adopted. The intent was to create an assessment model that could be used by most clinicians, since variables selected did not use sophisticated or costly techniques.

Based on those premises, our study investigated nutritional status using parameters such as ideal body weight percentage, tricipital skinfold measure, arm muscular circumference, and laboratory exams with albuminemia level and lymphocyte count.

All variables used in studies had the purpose of assessing the nutritional status for different conditions (10-24). None of those variables was separately considered as ideal for nutritional status assessment. It is important to use several of them so as to have the actual evaluation of the nutritional status of patients.

The score was proposed to allow global assessment of malnutrition, with an indicator that would analyze – as a whole – the parameter to reflect body mass index (percentage of ideal body weight), subcutaneous calorie storage (percentile of tricipital skinfold), somatic protein of skeletal muscular mass (percentile of arm muscular circumference), visceral proteins (albuminemia), and immune status (lymphocytes count). The score was conceived empirically, by giving scores to the level of impairment observed in each of the five nutritional indicators for a continuous mathematical variable. Such approach also tried to minimize individual behavior influences of nutritional indicators for the statistical analysis, since high heterogeneity is commonly found in one given level of impairment under different parameters for the same patient. It is not unusual, for instance, to see severe depletion of muscular mass and normal thickness of subcutaneous tissue or normal levels of serum albumin. Also empirically, our purpose was to lend the score a qualitative characteristic by adopting the average value of 8 points (out of 15 possible points) to isolate a subgroup defined as of moderate or severe nutritional repercussion from the remaining patients, defined by that criterion as eutrophic or mildly undernourished.

Although few papers in the literature have proposed the joint investigation of nutritional variables in the score format[21], the method that has been created to make patients' analysis easier seems to be valid – at least for application in the sample of CHF patients in the advanced stage, with whom it was used.

Through this analysis, nutritional status was commonly shown to be altered in CHF patients, reporting a high score (≥8), and thus suggesting moderate to severe malnutrition in 31 (32.6%) of all 95 cases.

Through an analysis to check on score validity for patients' nutritional status we observed high correlation between the score and the different variables for nutritional status assessment. We have also observed that the subgroups under subjective classification by primary author as "undernourished", "obese", and "normal" reported significantly different scoring when assessed objectively through this method. No patient classified as "obese" reported a score within the range for moderate or severe malnutrition. Out of 23 cases of "undernourished" appearance, only 3 had borderline score, although low, so as to be included in the statistical analysis of the "score" variable as eutrophic or mildly undernourished. Additionally, it is our view that the fact that score points reported normal distribution, when the sample was analyzed as a whole the methodology is confirmed as valid for all purposes of the present study. However, it should be pointed out that the application of the method may not be valid for groups reporting other affections, or for monitoring response to nutritional therapeutics. Further studies should be conducted before the method is used for those purposes.

Although the sample did report wide value dispersion in relation to HF time course, no correlation was found between that variable and the nutritional score.

No correlation was found, either, between nutritional status assessed by the score and the measures of ventricular impairment assessed through echocardiogram.

Those results suggest that the nutritional repercussion on dilated cardiomyopathy – although resulting from left ventricle contractile dysfunction as a common etiologic factor – shows other factors as major determinants for each individual, and which transcend some mere impairment of the cardiac pump. Nutritional impairment might possibly be better understood on the realm of the complex peripheral adaptation and of the neurohormonal response to myocardial failure. Our results do not differ from those found in literature, where there is no report on strong correlation between malnutrition level and ventricular dysfunction level[24-27].

In the survival analysis, no correlation was found between cardiac impairment level and survival, although many studies report such correlation[28-37]. Our group has observed that under advanced CHF condition ventricular impairment analyzed through left ventricle diameter and ejection fraction is not a predictor for survival time span [36,37]. However, the high homogeneity of the group in regard to those parameters and to clinical manifestation intensity may also lie behind such observation. It is possible that – in a sample that is uniformly placed at the end point of CHF clinical spectrum - indicators of left ventricle function may have reduced prognostic value, thus unfavoring other clinical and laboratory variables.

If ventricular impairment was not a good predictor for condition course, our study has demonstrated that malnutrition has identified a group of patients with stronger potential for poor evolution.

When analyzed as a continuous variable, the nutritional score was not predictive for patients' survival. Considered as a discrete variable, Kaplan-Meier curve for survival estimate (fig. 1) of the 31 (32.6%) patients reporting moderate or severe nutritional impairment proved to be distinctive from all other remaining cases. In this group, 50% mortality occurred around week 16, as opposed to the 64 normal or under mild impairment, whose 50% mortality rate only occurred at week 26. The descriptive level of Log-Rank and Cox tests were 0.0606 and 0.0676, respectively, which was not statistically significant, although acceptable as marginal evidence of nutritional score value as predictor of patients' survival.

These results do not substantially differ from those presented by Anker et al, where patients who lost over 7.5% of their body weight in the previous 6 months showed mortality rate above 65% in a 15-month time course[19,20]. That population differed from ours in that it was made up of outpatient unit patients, whereas ours was screened among those hospitalized for compensation - therefore, more severe. Both studies did show, though, that undernourished patients showed worse evolution as compared to those better nourished.

Although the score provides a global assessment of malnutrition, it did not report better performance in stratifying time course (mortality rate) if compared to some traditional indices, such as 80% reduction of ideal body weight or 7.5% reduction of body weight within 6 months – which succeeded in identifying which patients would report higher mortality rate in the populations under study[20-24].

So, it seems appropriate to conclude that a combined analysis using the score, anthropometric, biochemical and immunological indicators under study has evidenced a tendency towards higher mortality among patients with CHF in their advanced stage of nutritional impairment.

In conclusion, moderate to severe nutritional changes are a common finding in cardiomyopathy patients with advanced stage CHF. Nutritional changes under analysis

did not report correlation with time course of CHF symptoms, or with level of left ventricular impairment. Higher mortality rate was reported for cardiopathy patients with moderate to severe nutritional status impairment when evidenced by a score that was used for combined assessment of malnutrition.

Potencial Conflict of Interest

No potential conflict of interest relevant to this article was reported.

References

1. Katz AM, Katz PB. Diseases of the heart in works of Hyppocrates. Br Heart J. 1962; 24: 256-64.
2. Pittman JG, Cohen P. The pathogenesis of cardiac cachexia. N Engl J Med. 1964; 271: 403-9.
3. Gottdiener JS, Gross HA, Henry WL, Borer JS, Ebert, MH. Effects of self-induced starvation on cardiac size and function in anorexia nervosa. Circulation. 1978; 58 (3): 425-33.
4. Alden PB, Madoff RD, Stahl TJ, Lakatua DJ, Ring WS, Cerra FB. Left ventricular function in malnutrition. Am J Physiol. 1987; 253 (suppl H): H380-H387.
5. Ansari A. Syndromes of cardiac cachexia and the cachetic heart: current perspective. Prog Cardiovasc Dis. 1987; 30: 45-60.
6. Morrison WL, Edwards RHT. Cardiac cachexia - We know about the mechanisms but not how to reverse it. Brit Med J. 1991; 302: 301-2.
7. Anker SD, Sharma R. The syndrome of cardiac cachexia. Int J Cardiol. 2002; 85: 57-66.
8. Conraads VM, Bosmans JM, Vrints CJ. Chronic heart failure: an example of a systemic inflammatory disease resulting in cachexia. Int J Cardiol. 2002; 85: 33-49.
9. Velloso LGC, Csengeri LF, Alonso RR, Ciscato CML, Barretto ACP, Bellotti G, et al. Desnutrição na miocardiopatia dilatada: correlação com índices ecocardiográficos da função ventricular esquerda. Arq Bras Cardiol. 1992; 58: 189-92.
10. McMurray J, Abdullah I, Dargie HJ, Shapiro D. Increased concentrations of tumor necrosis factor in "cachetic" patients with severe chronic heart failure. Br Heart J. 1991; 66: 356-8.
11. Bollet AJ, Owens S. Evaluation of nutritional status of selected hospitalized patients. Am J Clin Nutr. 1973; 26: 931-8.
12. Carr JG, Stevenson LW, Walden JA, Heber D. Prevalence and hemodynamic correlates of malnutrition in severe congestive heart failure secondary to ischemic or idiopathic dilated cardiomyopathy. Am J Cardiol. 1989; 63: 709-13.
13. Bernard MA, Jacobs DO, Rombeau JL. Suporte nutricional e metabólico de pacientes hospitalizados. Rio de Janeiro: Guanabara, 1988. Cap.3, 24-42: Avaliação Nutricional.
14. Jelliffe DB, Jelliffe EFP. Community nutritional assessment - With special reference to less technically developed countries. New York: Oxford University Press, 1989, 56-550.
15. Blackburn GL, Bistrian BR, Mains BS. Nutritional and metabolic assessment of the hospitalized patients. J Parent Ent Nutr. 1977; 1: 11-22.
16. Jelliffe DB. The assessment of the nutritional status of the community - With special reference to field surveys in developing regions of the world. Geneve. WHO Monograph Series, 1966; 53: 50-242.
17. Frisancho AR. New norms of upper limb fat and muscle areas for assessment of nutritional status. Am J Clin Nutr. 1981; 34: 2540-5.
18. Torosian MH, Mullen JL. Nutritional assessment. In: Kaminski MV ed. Hyperalimentation: a guide for clinicians. New York: Marcel Dekker Inc; 1985. p. 47-75.
19. Anker SD, Ponikowski P, Varney S, et al. Wasting as independent risk factor for mortality in chronic heart failure. Lancet. 1997; 349: 1050-53.
20. Anker SD, Rauchhaus M. Insights into the pathogenesis of chronic heart failure: immune activation and cachexia. Curr Opin Cardiol. 1999; 14: 211-16.
21. Buzby GP, Mullen JL, Matthews DC, Hobbs CL, Rosato EF. Prognostic nutritional index in gastrointestinal surgery. Am J Surg. 1980; 139: 160-7.
22. Horwich TB, Fonarow GC, Hamilton MA, et al. The relationship between obesity and mortality in patients with heart failure. J Am Coll Cardiol. 2001; 38: 789-95.
23. Anker SD, Coats AJS. Cardiac cachexia. A syndrome with impaired survival and immune and neuroendocrine activation. Chest. 1999; 115: 836-47.
24. Veloso LGC, Pereira-Barretto ACP, Oliveira Jr MT, Munhoz RT, Morgado PC, Ramires JAF. Repercussão nutricional na cardiomiopatia dilatada e seu valor na avaliação prognóstica de portador de insuficiência cardíaca em forma avançada. Arq Bras Cardiol. 2005; 84: 480-85.
25. Cohn JN, Levine B, Olivari MT, Garberg V, Lura D, Francis GS, et al. Plasma norepinephrine as a guide to prognosis in patients with chronic congestive heart failure. N Engl J Med. 1984; 311(13): 819-23.
26. Packer M, Lee WH, Kessler PD, Gottlieb SS, Bernstein JL, Kukin ML. Role of neurohormonal mechanisms in determining survival in patients with severe chronic heart failure. Circulation. 1987; 75 (suppl. IV): 80-92.
27. Lee WH, Packer M. Prognostic importance of serum sodium concentration and its modification by converting-enzyme inhibition in patients with severe chronic heart failure. Circulation. 1986; 73: 257-67.
28. Parameshwar J, Keegan J, Sparrow J, Sutton GC, Poole-Wilson PA. Predictors of prognosis in severe chronic heart failure. Am Heart J. 1992; 123: 421-6.
29. Saxon LA, Stevenson WG, Middlekauff HR, Fonarow G, Woo M, Moser D, et al. Predicting Death from progressive heart failure secondary to ischemic or idiopathic dilated cardiomyopathy. Am J Cardiol. 1993; 72: 62-5.
30. Franciosa JA. Why patients with heart failure die: hemodynamic and functional determinants of survival. Circulation. 1987; 75 (suppl IV): 20-7.
31. Schwartz F, Mall G, Zebe H, Schmitzer E, Manthey J, Scheurlen H, et al. Determinants of survival in patients with congestive cardiomyopathy: quantitative morphologic findings and left ventricular hemodynamics. Circulation. 1984; 70(6): 923-8.
32. Unverferth DV, Magorien RD, Moeschberger ML, Baker PB, Fetters JK, Leier CV. Factors influencing the one-year mortality of dilated cardiomyopathy. Am J Cardiol. 1984; 54: 147-52.
33. Gradman A, Deedwania P, Cody R, Massie B, Packer M, Pitt B, et al, for the Captopril-Digoxin Study Group. Predictors of total mortality and sudden death in mild to moderate heart failure. J Am Coll Cardiol. 1989; 14: 546-70.

34. Cohn JN, Johnson GR, Shabetai R, Loeb H, Tristani F, Rector T, et al, for the V-HeFT VA Cooperative Studies Group. Ejection fraction, peak exercise oxygen consumption, cardiothoracic ratio, ventricular arrhytmias and plasma norepinephrine as determinants of prognosis in heart failure. Circulation. 1993; 87 (suppl VI): 5-16.

35. Mady C, Cardoso RHA, Pereira-Barretto ACP, Luz PL, Bellotti G, Pileggi F. Survival and predictors of survival in patients with congestive heart failure due to Chagas' cardiomyopathy. Circulation. 1994; 90: 3098-102.

36. Canesin MF, Giorgi D, Oliveira Jr MT, Wajngarten M, Mansur A, Ramires JAF, et al. Ambulatory blood pressure monitoring of patients with heart failure. A new prognosis marker. Arq Bras Cardiol. 2002; 78: 83-89.

37. Del Carlo CH, Pereira-Barretto ACP, Cassaro-Strunz C, Latorre MRDO, Ramires JAF. Serial measure of cardiac troponin T levels for prediction of clinical events in decompensated heart failure. J Cardiac Fail. 2004; 10: 43-48.