Hospital Readmissions and Death from Heart Failure - Rates Still Alarming

Antonio Carlos Pereira Barretto, Carlos Henrique Del Carlo, Juliano Novaes Cardoso, Paulo Cesar Morgado, Robson Tadeu Munhoz, Marcelo Ochiai Eid, Mucio Tavares Oliveira Jr, Airton Roberto Scipioni, Jose Antonio Franchini Ramires

Instituto do Coração do Hospital das Clinicas da FMUSP, Hospital Auxiliar de Cotoxó, São Paulo, SP - Brazil

Summary

Background: **Patients who require hospitalization because of decompensated HF represent a group of the most seriously ill individuals who evolve with high mortality and hospital readmission rates.**

Objectives: **We sought to evaluate the current natural course of HF by analyzing mortality and readmission rates in this new era of neurohormonal blockage.**

Methods: **We followed the progress of 263 patients with a mean EF of 27.1%, admitted for decompensated HF between January 2005 and October 2006. Patients readmitted were only those whose health status precluded discharge after assessment and drug treatment in the Emergency Department. Patients were classified as HF-FC III/IV, mean age was 59.9±15.2 years, most were men, and 63.1% required inotropic drugs for cardiac compensation in the acute phase.**

Results: **Average hospital stay was 25.1±16.7 days. During hospitalization, 23 (8.8%) patients died. After discharge, over an average follow-up period of 370 days, of the 240 patients who were discharged 123 (51.2%) returned to the Emergency Department 1 to 12 times (total number of visits: 350); 76 of them were readmitted, and the average length of readmission stay was 23.5±18.0 days. Over the first year of follow-up, 62 (25.8%) patients died.**

Conclusions: **HF remains a condition associated with high mortality and high hospital readmission rates. At the end of the first year, 44.5% of these patients had not needed to visit the ER or had died, which indicates that we should provide HF patients with the best possible care in an attempt to change the natural course of this increasingly frequent syndrome. (Arq Bras Cardiol 2008; 91(5) : 309-314)**

Key words: **Heart failure, congestive; natural history of diseases; mortality; hospitalization**

Introduction

Heart failure (HF) is a disease known to progress with high morbidity and mortality[1]. Epidemiological studies have shown that HF patients suffer a significant deterioration in their quality of life and progress worse than do those with many types of cancer[2].

Treatment with neurohormonal blockers has changed the course of the disease by reducing the high mortality and readmission rates, and improving HF patients' quality of life[3,4]. This improvement has been well demonstrated in clinical trials and controlled studies, but it is unknown if this is also the case in real life, in patients at institutions, outpatient clinics, and medical offices[3,4].

In Brazil, however, SUS data have shown that the clinical progress of HF patients has not changed significantly, at least when it comes to hospital mortality and the number of patients admitted each year. On the contrary, mortality seems to be increasing[5]. We point out that the difficulty of patients in reaching a physician for guidance, lack of ongoing follow-up at outpatient clinics and health centers, lack of a policy for systematic medicine distribution, and even the lack of the appropriate medicines to be administered to HF patients, all contribute significantly to maintaining the disease's natural course.

With the hopes of better understanding these issues, we assessed the progress of the patients admitted to our institution in 2005 and 2006. We should point out that only the most severe cases are admitted to our institution. Those patients whose condition improves after being seen and medicated at the Emergency Department are discharged, whereas patients with symptomatic hypotension, low cardiac output, and those with very marked clinical signs of congestive heart failure (anasarca) and little possibility for discharge are admitted.

Methods

From January 2005 to October 2006, 263 consecutive admissions of patients with HF and systolic dysfunction (mean EF 27.1%) at the Hospital Auxiliar de Cotoxó were

Mailing Address: Antônio Carlos Pereira Barretto •
Rua Piave, 103, Vila Inah - 05620-010, São Paulo, SP - Brazil.
E-mail: pereira.barretto@incor.usp.br, pbarreto@cardiol.br
Manuscript received November 26, 2007; revised manuscript received January 10, 2008; accepted January 14, 2008.

prospectively analyzed. All patients were classified as NYHA HF-FC III or IV, most of them FC IV.

We evaluated clinical and laboratory characteristics of patients admitted due to HF. Patients were followed for mortality during hospitalization and over the first year of follow-up. After discharge, we also assessed the number of times each patient needed to be seen at the Emergency Department and how many were readmitted. These patients are still being followed today.

Glomerular filtration rate (GFR) was estimated using the simplified Modification of Diet in Renal Disease (MDRD) formula: GFR (mL/min/1.73 sqm) = 186 x (Serum creatinine [mg/dL])$^{-1.154}$ x (Age)$^{-0.203}$ x (0.742 for females) x (1.1210 for Afro-descendents).

Continuous variables are expressed as mean ± standard deviation values, whereas categorical variables are expressed as frequencies and percentages. Patient characteristics were compared as to mortality at the end of the follow-up period. Continuous variables were analyzed using the Mann-Whitney U test, whereas for the categorical variables we used the chi-square test or Fisher's exact test. Mortality predictors were determined by uni- and multivariate analysis using Cox's Proportional Hazards method. Based on follow-up data, a Kaplan-Meier survival curve and an event curve were built, showing the number of visits to the Emergency Department.

A significance level of <0.05 was adopted and the P values shown are bi-tailed.

Results

Patient age ranged from 17 to 94 years (mean age, 59.9), most were men (165 – 62.7%), and 166 (63.1%) patients needed inotropic support to compensate heart failure.

Table 1 shows the major characteristics of the study population. The most frequent etiology was ischemic heart disease, followed by hypertensive and Chagasic heart disease. Dobutamine was the most commonly used inotropic agent. Acute renal failure was detected in 121 (46.0%) patients during hospital stay. The B-type natriuretic peptide (BNP) level was determined in 78 patients, with a mean value of 1637.3 ± 1235.6 pg/mL. Mean systolic blood pressure was 103.6 mmHg at baseline.

Table 2 shows the comparison between baseline characteristics of the patients who died and those who survived at the end of the follow-up period.

Patients needed prolonged hospitalization for compensation (average of 25.1 days). In this advanced HF patient cohort, mortality during hospitalization was 8.8% (Table 3 and Figure 1).

The mean follow-up period was 370 days, and among those 240 patients who were discharged, 62 (25.8%) died and 123 (51.2%) returned to the Emergency Room 1 to 12 times (total number of visits to the ER: 350). Of those who returned, 102 needed to be readmitted and stayed for an average 23.5 ± 18.0 days in the hospital (Figure 2).

Table 1 – Main clinical characteristics of the study population

Variável	n = 263
Idade (anos)	59.9 ± 15.2
Sexo	
Gender	165 (62.7)
Female	98 (37.3)
Etiology of the CHF	
Alcoholic	8 (3.0)
Chagasic	57 (21.7)
Hypertensive	71 (27.0)
Idiopathic	39 (14.8)
Ischemic	76 (28.9)
Peripartum	2 (0.8)
Post-chemotherapy	3 (1.1)
Valvular heart disease	6 (2.3)
Viral	1 (0.4)
LVEF (%)	27.1±11.9
SAP (mmHg)	103.6±22.3
DAP (mmHg)	66.4±17.5
Hemoglobin (g/dL)	13.0±1.9
Hematocrit (%)	39.6±5.4
Anemia (Hb ≤12,0 g/dL)	84 (31.9)
Blood urea (mg/dL)	75.1±44.2
Creatinine (mg/dL)	1.5±0.8
Acute renal failure	121 (46.0)
GFR (mL/min/1,73 m^2)	60.1±29.1
Sodium (mEq/L)	136.7±4.7

Data are presented as mean ± standard deviation or number (percentage); SAP - systolic arterial pressure; DAP - diastolic arterial pressure; LVEF - left ventricular ejection fraction; GFR - glomerular filtration rate.

Table 3 shows data on the progress of the total number of patients, indicating how many times they visited the Emergency Department and new admissions. Most patients returned to the Emergency Department after being discharged from the hospital, and more than half were readmitted.

The multivariate analysis identified the markers of seriousness of the disease in this study population as being renal dysfunction (glomerular filtration rate <60 mL/min/1.73 m^2) and Chagas' Disease (Table 4).

Figure 1 shows the event-free Kaplan-Meier curve for mortality, whereas Figure 2 shows the curve of returning visits to the Emergency Department, where the yet high incidence of events is shown.

Over this period, 117 (44.5%) patients did not experience any event, required no emergency visit to the hospital, or died.

Table 2 – Comparison of the characteristics of the study population as to mortality during follow-up

	Death		
Characteristic	Yes (n = 62)	No (n = 201)	p
Age (years)	62.7±16.3	59.0±14.7	0.062
Male	33 (53.2)	132 (65.7)	0.076
Etiology			
Alcoholic	1 (1.6)	7 (3.5)	0.685
Chagasic	19 (30.6)	38 (18.9)	0.050
Hypertensive	12 (19.4)	59 (29.4)	0.121
Idiopathic	10 (16.1)	29 (14.4)	0.742
Ischemic	20 (32.3)	56 (27.9)	0.504
Valvular heart disease	0 (0.0)	6 (3.0)	0.341
Other	0 (0.0)	6 (3.0)	0.341
SAP (mmHg)	101.5±22.3	104.3±22.3	0.508
DAP (mmHg)	66.2±16.2	66.5±17.9	0.922
LVEF (%)	27.5±10.2	27.0±12.4	0.497
Hemoglobin (g/dL)	12.9±2.1	13.1±1.8	0.629
Hematocrit (%)	38.9±5.9	39.9±5.3	0.289
Anemia (Hb 12,0 g/dL)	22 (35.5)	62 (30.8)	0.493
Blood urea (mg/dL)	83.0±45.7	72.7±43.6	0.029
Creatinine (mg/dL)	1.6±0.5	1.5±0.8	0.069
GFR (mL/min/1.73% sqm)	52.5±23.0	62.5±30.4	0.017
GFR <60 mL/min/1.73 sqm)	44 (71.0)	99 (49.3)	0.003
Sodium (mEq/L)	135.9±4.7	137.0±4.7	0.059

Data are presented as mean ± standard deviation or number (percentage); SAP - systolic arterial pressure; DAP - diastolic arterial pressure; LVEF - left ventricular ejection fraction; GFR - glomerular filtration rate.

Table 3 – Data on clinical progress and post-discharge follow-up of patients with decompensated heart failure hospitalized at the Hospital Auxiliar de Cotoxó – HCFMUSP

Results	n = 263
In-hospital mortality	23 (8.8)
Post-discharge mortality (follow-up)	62 (25.8)
Clinical event (death or re-admission)	146 (55.5)
Visits to the Emergency Department	350 visits
1 visit	41 (15.6)
2 visits	33 (12.5)
3 or more	49 (18.6)
Re-admissions	102 re-admissions
1 re-admission	57 (21.7)
2 re-admissions	13 (4.9)
3 or more	6 (2.3)
Mean length of first stay (days)	25.1±16.7
Mean length of re-admission stay (days)	23.5±18.0

Data are presented as mean ± standard deviation or number (percentage)..

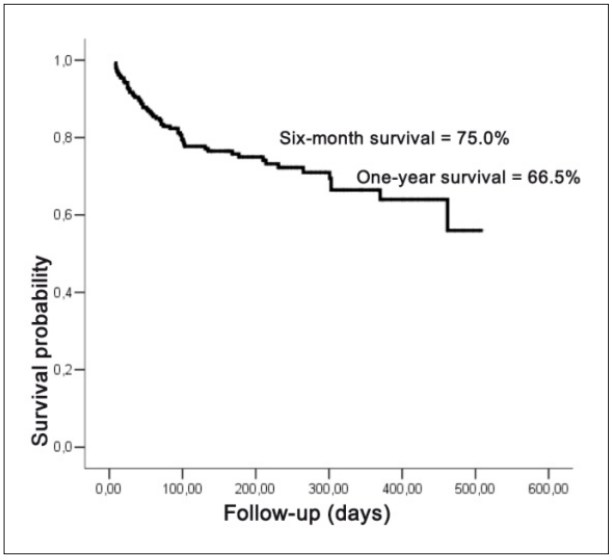

Figure 1 - Survival curve of patients admitted to Hospital Auxiliar de Cotoxó, in 2005 and 2006.

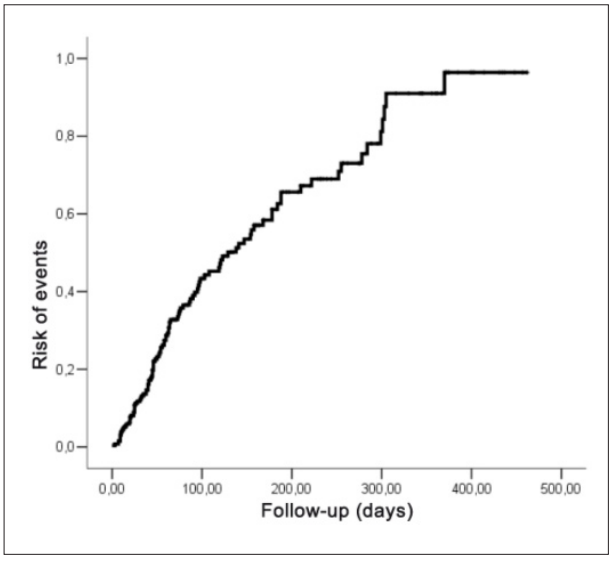

Figure 2 - Readmission curve (return to the Emergency Room) of patients who were discharged from the Hospital Auxiliar de Cotoxó in 2005 and 2006.

Comments

Data obtained at the hospital, and over the follow-up period, on these patients admitted for cardiac compensation at a tertiary hospital in São Paulo, have documented that, even with the currently available treatment of HF, which includes ACE inhibitors, angiotensin II receptor blockers, hydralazine and nitrate, beta-blockers and spironolactone, morbidity and mortality rates are still high. Over the first year of follow-up, 117 (44.5 %) patients either did not need emergency care or died.

Table 4 – Univariate and multiple regression analysis of death predictors using Cox's Proportional Hazards method

Multivariate analysis	Hazard ratio	95% CI	p
Age > 60 years	1.4	0.8–2.3	0.226
Male	0.6	0.4–1.1	0.079
Chagasic etiology	1.6	1.0–2.8	0.076
SAP <90 mmHg	0.8	0.5–1.3	0.335
LVEF> 25.0%	1.2	0.7–1.9	0.544
Anemia Hb ≤12.0 g/dL	1.1	0.7–1.9	0.717
Sodium <135 mEq/L	1.4	0.8–2.4	0.196
Acute renal failure	1.6	1.0–2.7	0.065
GFR <60 mL/min/1.73 sqm	2.4	1.4–4.1	0.002
Multivariate analysis			
Chagasic etiology	2.4	1.4–4.3	0.002
GFR <60 mL/min/1.73 sqm	3.0	1.7–5.4	<0.001

SAP - systolic arterial pressure; DAP - diastolic arterial pressure; LVEF - left ventricular ejection fraction; GFR - glomerular filtration rate.

The progress of patients with decompensated HF depends on multiple variables, including the presenting form of the disease, patient characteristics, severity of the disease, and current and future treatment during and after cardiac decompensation[6,7]. Patients with cardiogenic shock, renal failure, Chagas' disease, severe myocardial impairment, and those who do not receive proper guidance compose the group with the worst clinical progression[6-8]. In populational studies, hospital admittance for decompensated HF is an indicator of greater seriousness and worse prognosis[9,10].

Patients with greatest cardiac impairment and most marked and difficult-to-control clinical conditions are referred to our institution, a tertiary hospital in São Paulo[11]. Only those patients whose conditions do not improve after being evaluated and medicated at the ER are admitted.

The length of stay for compensation of our advanced HF patients was quite extensive, longer than any other cases found in medical literature, in general 4 to 5 days for moderately serious and approximately 9 days for highly serious cases[12-18]. In Rio de Janeiro, patients seen at the ER of a private institution remained in the hospital 9.5 days, and in Porto Alegre, at a teaching hospital such as ours, the length of stay was 11 days. In both cases, the length of stay was shorter than at our hospital[12,14]. The greater seriousness in our cases may partially explain such a prolonged stay.

The length of stay for stabilization of decompensated HF patients is crucial, since it directly affects treatment costs. More seriously ill patients and those more prone to develop co-morbidities need a longer time for compensation and their treatment will cost more.

In this study population, 8.8% of the patients died during hospitalization for compensation. This mortality rate is high and was higher than that recorded in the ADHERE Registry, in the European HF registry (Euro-Heart Failure Survey II), and in Brazil, according to data published by SUS[5,17,18].

The natural course of decompensated HF was analyzed in the ADHERE Registry, which followed more than 65,000 patients admitted to 263 hospitals in the United States[18]. Among that population, in-hospital mortality was 4.0%, much lower than that recorded at our institution. The ADHERE Registry showed that it is possible to stratify HF patients based on routine evaluation data[18]. Baseline urea, blood pressure, and creatinine values identify patients at lower and higher risk of death. Patients with urea levels over 86 mg/dl, systolic AP under 115 mmHg, and creatinine over 2.75 mg/dl were identified as those at higher risk of dying during hospitalization for HF compensation. According to this stratification, mortality among low-risk patients was 2.2%, and 20.9% among high-risk patients[18]. In comparing the profile of our patients, classified as per the ADHERE study, with that of the patients of the Registry itself, in general our population is more seriously ill than the group recorded in the ADHERE Registry. Seventy-nine per cent of the patients admitted to our hospital had systolic arterial pressure under 115 mmHg, whereas in the ADHERE Registry, only 18.5% were hypotensive[18]. Therefore, at least partially, the high mortality recorded among our patients is likely the result of more serious disease. It is noteworthy that, despite the greater mortality in our study population, when one analyzes the group of more seriously ill patients and compares it with that recorded in the ADHERE Registry, mortality did not differ significantly, and among our patients it was even numerically lower than that of the North-American study (14.0% vs 15.3%), suggesting not only that our treatment is correct, but also that it reduces mortality in such a severely ill population (Figure 3).

These findings were repeated when comparing our data with those of the European decompensated HF registry[17]. In the European registry, the overall mortality of patients with decompensated HF was 6.7%, with different rates according to the presenting form of the disease[17]. Among patients with chronic HF who suffered decompensation, mortality was 5.8%, and among those with acute (DeNovo) HF, it was 8.1%. When these data were compared, the mortality rate at our hospital was greater, but in the European Registry mortality among cardiogenic shock patients was 39.6%[17]. Therefore, during hospitalization, patients' clinical status plays a very important role in prognosis as well as in mortality. Considering that we treat very seriously ill patients, most of them requiring inotropic support, an 8.8% mortality rate is not so high.

The same applies to SUS data from 2002 which showed a mortality rate of 6.97%, lower than that observed at our Institution[5]. Although it has not been possible to evaluate the seriousness of the SUS cases due to the comprehensive data involved, it is possible to suppose that a wide range of patients is included and not only the most severely ill, as is the case in our group.

The number of publications with Brazilian data is small, but when we compare the results published with those obtained in our study, we observe that, despite the higher seriousness of the cases, mortality at our hospital was lower than that recorded at those institutions. In Rio de Janeiro, for patients seen at the ER of a private institution, mortality was 10.6%, and in Porto Alegre, at a teaching hospital such as ours, it was 11%s[12,14]. These differences in mortality rates are probably due

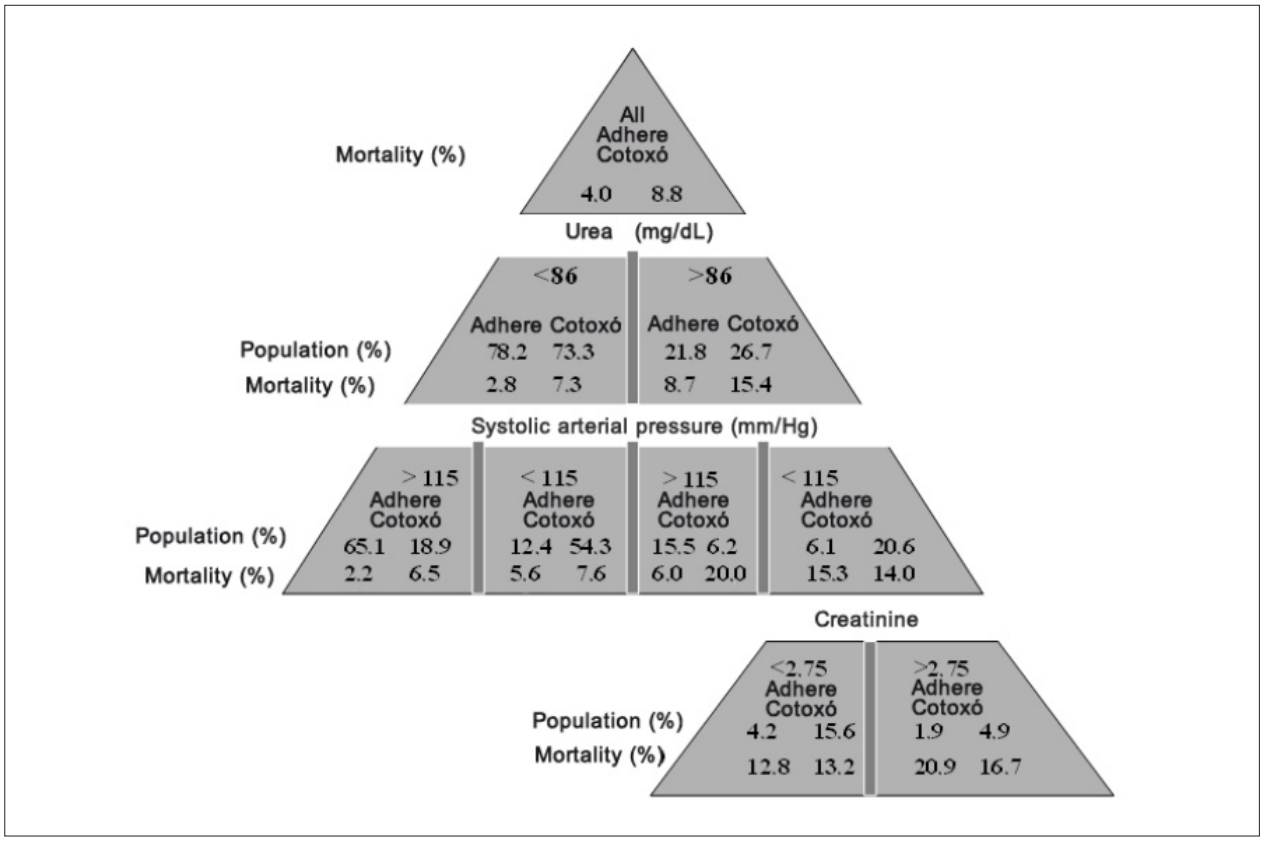

Figure 3 - Comparison of Mortality rates among patients of the ADHERE Registry and that of patients admitted to Hospital Auxiliar de Cotoxó, considering the risk stratification proposed by the ADHERE Registry..

to the admission screening criteria used and the period of data collection, but they do not differ significantly.

Although the mortality rate recorded is still high, we were able to compare it with previously published data from our own institution[19]. In the first study, patients evaluated had been hospitalized during the year of 1999. The population under study at that time was quite similar to the current one, since admission criteria have not changed since then. By comparing both studies, a significant drop in hospital mortality rate is noted, decreasing from 20% to the current rate of 8.8%[19]. This decline is probably due to a more aggressive management of cardiac decompensation and to the greater proportion of patients currently on ACE inhibitors and beta-blockers. Therefore, although hospital mortality is still high, it has significantly decreased when data from both periods are considered. We highlight that the SUS data do not show the same reduction; on the contrary, from 1992 to 2002, there was an increase in mortality rates (from 5.41% to 6.97%)[5].

Mortality over the first year of follow-up varied significantly in the studies published, ranging from 16% to 55%, probably reflecting the different levels of disease seriousness of the study populations and the year when the study was conducted, since treatment has been continuously improving[12-23]. In our population, the mortality rate during the first year of follow-up after hospital discharge was 25.8%, similar to the best results published.

Similarly, when we compared data from two periods at our institution, we observed an important decrease in mortality during the first year of follow-up (from more than 50% to the current 25.8%). This result was parallel to that recorded in Spain, where mortality from 1991 to 1996 was 24%, and was reduced to 16% in 2000 and 2001[20].

Along with mortality, HF patients have high rates of hospital readmission, and approximately 30% of those who required a new hospitalization for HF decompensation were readmitted during the first year of follow-up[9,10]. The seriousness of the heart disease and the treatment prescribed play a central role in these readmissions. In a seriously ill population such as the one we analyzed, the rate was high and more than 50% of the patients needed emergency care after being discharged from hospital. By comparing data from the two periods collected at our Institution, there was also a reduction in these readmissions.

A more detailed study of patients allows us to identify populations at higher or lower risk. Multivariate analysis helped us identify that HF, Chagas' disease, and renal failure patients were those with the highest mortality rates[12,13,17-19,21].

The superior long-term clinical progress we have observed

is probably the result of a more aggressive treatment prescribed in the compensation phase, as well as the policies adopted by our State and our Institutions (Hospital das Clínicas and Instituto do Coração) which, on a monthly basis, provide the medications these patients need. Patients are discharged from our ward with a prescription for a full dose of ACE inhibitor, ARB, and beta-blocker, which should also result in better clinical progress, especially if we bear in mind that this was not common practice during the 1990's. Taking into consideration that the main cause of hospitalization is inadequate treatment due to lack of patient compliance or a non-optimized prescription, these findings indicate that guidance and an early start of treatment could have a significant impact on the Government's expenses with healthcare and on the quality of life of patients who would not spend such a long time in the hospital.

In conclusion, despite the advances in diagnosis and treatment of HF, morbidity and mortality rates due to the disease are still high. In our study, one-third (85/263) of the patients died during the first year of follow-up, and of those who were discharged from treatment, approximately 50% (123/240) needed to be seen at the Emergency Department. A little over 30% (76/240) of the patients needed to be readmitted within one year after hospital discharge. Although the numbers may suggest that HF prognosis is improving with the current treatments available, they also signal that HF is a disease that continues to progress with high morbidity and mortality, and deserves the highest level of attention from cardiologists.

Potential Conflict of Interest

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

Sources of Funding

There were no external funding sources for this study.

Study Association

This study is not associated with any graduation program.

References

1. Cleland JG, Khand A, Clark A. The heart failure epidemic: exactly how big is it? Eur Heart J. 2001; 22: 623-6.
2. McMurray JJV, Stewart S. The burden of heart failure. Eur Heart J Suppl. 2002; 4 (Suppl D): D50-D58.
3. Fonarow GC, Heywood T, Heidenreich PA, Lopatin M, Yancy CW, ADHERE Scientific Advisory Committee and Investigators. Temporal trends in clinical characteristics, treatments, and outcomes for heart failure hospitalizations, 2002 to 2004: findings from acute decompensated Heart Failure National Registry (ADHERE). Am Heart J. 2007; 153: 1021-8.
4. Gislason GH, Rasmussen JN, Abildstrom SZ, Schramm TK, Hansen ML, Buch P, et al. Persistent use of ebvidence-based pharmacotherapy in heart failure is associated with improved outcomes. Circulation. 2007; 116: 737-4.
5. Albanesi Filho FM. O que vem ocorrendo com a insuficiência cardíaca no Brasil? Arq Bras Cardiol. 2005; 89: 155-6.
6. Rudiger A, Harjola VP, Muller A, Mattila E, Saila P, Nieminen M, et al. Acute heart failure: clinical presentation, one-year mortality and prognostic factors. Eur J Heart Fail. 2005; 7: 662-70.
7. Pocock SJ, Wang D, Pfeffer MA, Yusuf, S, McMurray JJ, Swedberg KB, et al. Predictors of mortality and morbidity in patients with chronic heart failure. Eur Heart J. 2006; 27: 65-75.
8. Freitas HGF, Chizzola PR, Paes AT, Lima ACP, Mansur AJ. Risk stratification in a Brazilian hospital-based cohort of 1220 outpatients with heart failure: role of Chagas' disease. Int J Cardiol. 2005; 102: 239-47.
9. Shahar E, Lee S, Kim J, Duval S, Barber C, Luepker RV. Hospitalized heart failure: rates and long term mortality. J Card Fail. 2004; 10: 374-9.
10. Solomon SD, Dobson J, Pocock S, Skali H, McMurray JJV, Granger CB, et al. Influence of nonfatal hospitalization for heart failure on subsequent mortality in patients with chronic heart failure. Circulation. 2007; 116: 1482-7.
11. Pereira-Barretto AC, Nobre MRC, Wajngarten M, Canesin MF, Ballas D, Serro-Azul JB. Insuficiência cardíaca em grande hospital terciário de São Paulo. Arq Bras Cardiol. 1998; 71 (1): 15-20.
12. VillaCorta H, Mesquita ET, Cardoso R, Bonates T, Maia ER, Silva ACM, et al. Preditores de sobrevida obtidos na unidade de emergência em pacientes atendidos por insuficiência cardíaca descompensada. Rev Port Cardiol. 2003; 22: 495-507.
13. Blackledge HM, Tomlinson J, Squire IB. Prognosis for patients newly admitted to hospital with heart failure: survival trends in 12220 index admissions in Leicestershire 1993-2001. Heart. 2003; 89: 615-20.
14. Rohde LE, Clausell N, Ribeiro JP, Goldraich L, Netto R, Dec GW, et al. Heath outcomes in decompensated congestive heart failure: a comparison of tertiary hospitals in Brazil and United States. Int J Cardiol. 2005; 102: 71-7.
15. Baker DW, Einstadter D, Thomas C, Cebul RD. Mortality trends for 23505 medicare patients hospitalized with heart failure in Northeast Ohio, 1991 to 1997. Am Heart J. 2003; 146: 258-64.
16. Siirila-Waris K, Lassus J, Melin J, Peuhkurinen K, Nieminen MS, Harjola VP for the FINN-AKVA study group. Characteristics, outcomes and predictors of 1-year mortality in patients hospitalized for acute heart failure. Eur Heart J. 2006; 27: 3011-7.
17. Nieminen MS, Brutsaert D, Dickstein K, Drexler H, Follat F, Harjola VP, et al. EuroHeart Failure Survey II (EHFS II: a survey on hospitalized acute heart failure patients: description of population. Eur Heart J. 2006; 27: 2725-36.
18. Fonarow GC, Adams KJ, Abraham WT, Yancy CW, Boscardin WJ for the ADHERE Scientific advisory committee, study group and investigators. Risk stratification for in-hospital mortality in acutely decompensated heart failure: classification and regression tree analysis. JAMA. 2005; 293: 572-80.
19. Del Carlo CH, Pereira-Barretto AC, Cassaro-Strunz C, Latorre MRDO, Ramires JAF. Serial measures of cardiac troponin T levels for prediction of clinical events in decompensated heart failure. J Card Fail. 2004; 10: 43-8.
20. Shamagian LG, Gonzalez-Juanatey JR, Roman AV, Acuna JMG, Lamela AV. The death rate among hospitalized heart failure patients with normal and depressed left ventricular ejection fraction in the year following discharge: evolution over a 10-year period. Eur Heart J. 2005; 26: 2251-8.
21. Jong P, Vowinckel E, Liu PL, Gong Y, Tu JV. Prognosis and determinants of survival in patients newly hospitalized for heart failure. Arch Intern Med. 2002; 162: 1689-94.
22. Heidenreich PA, Fonarow GC. Are registry hospitals different? A comparison of patients admitted to hospitalas of a commercial heart failure registry with those from national community cohorts. Am Heart J. 2006; 152: 935-9.
23. Philbin EF, Rocco TA, Lynch LJ, Rogers VA, Jenkins P. Predictors and determinants of hospital length of stay in congestive heart failure in ten community hospitals. J Heart Lung Transplant. 1997; 16: 548-55.