Epidemiological and clinical characterization of patients hospitalized for decompensated heart failure with reduced ejection fraction

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DOI: https://doi.org/10.36104/amc.2020.1233

Abstract

Objective: to describe the clinical and biochemical characteristics and treatment of patients with decompensated heart failure with reduced ejection fraction hospitalized during 2015 at the Hospital Militar Central in Bogotá.

Methods: a descriptive study reviewing the clinical records of patients over the age of 18 who were hospitalized due to decompensated heart failure with reduced ejection fraction during 2015. Clinical, biochemical, echocardiographic and treatment variables were recorded. A univariate analysis was performed reporting percentages for qualitative variables, measures of central tendency for quantitative variables, and medians and first and third quartiles for variables with a non-normal distribution.

Results: the medical records of 114 patients were analyzed (average age 74.8 years; 69.3% males). The etiology of the heart failure was hypertension in 66.7% and ischemia in 60.5%. Noncompliance was the main precipitating factor for decompensation. High adherence to management guidelines was seen on discharge, with medications at suboptimal doses and ambulatory titration in 32% of patients; 38% were readmitted at least once during the first 30 days. Altogether, 25.4% required ICU care, with a mortality rate of 18%; there was a 16% mortality rate for early readmissions and 3% for patients with late admissions.

Conclusion: the clinical profile in this study is similar to what is reported in other research. Adherence to management guidelines is adequate, but at suboptimal doses. There is a high percentage of recorded readmissions and hospital mortality. **(Acta Med Colomb 2020; 45. DOI: https://doi.org/10.36104/amc.2020.1233).**

Key words: *heart failure, patient readmission, mortality*

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Received: 28/VI/2018 Accepted: 29/I/2020

Introduction

Heart failure is a highly prevalent disease and its incidence is expected to increase, along with a rise in cardiovascular risk factors (1-2). In Colombia, cardiovascular disease continues to be the first cause of death at 136 per 100,000 population, with heart failure being one of its main drivers. There are an estimated 1.1 million patients with a diagnosis of heart failure, with a prevalence of 2.3%, in Latin America (3). From 2009 to 2012 (4), emergency room admissions due to decompensated heart failure increased 121%, outpatient consults increased 10% and hospitalized patients increased 43%. This is a reflection of population aging, increasing the use of the healthcare system´s resources, as shown in the Ministry of Health and Social Protection statistics.

In addition, some national publications report low use of medications such as beta blockers, angiotensin converting enzyme inhibitors, and angiotensin II receptor blockers (5); poor follow up of patients being treated with devices such as resynchronizers and implantable defibrillators; and an annual hospital readmission rate of 40.8% in a population of patients seen at a general hospital, with an average cost of 6,427,887 COP per hospitalization (6).

The recommendations for care of patients with heart failure are established and documented in the literature and include pharmacological treatment, lifestyle changes, inpatient treatment, outpatient follow up and palliative care (7-10). However, despite these widely available guidelines for healthcare workers, hospital admission rates continue to be high. Therefore, in order to prevent symptom exacerbations, hospitalizations and readmission, the gaps in care and needs must be determined and the direct care provider must be involved as a main actor in their assessment. Thus,

heart failure programs are needed to maintain the continuity of intervention measures beyond hospital discharge, or to prevent hospital or intensive care admission.

The Hospital Militar Central (HMC) lacks robust statistics on the prevalence of the disease, clinical follow up, optimized management, or patient outcomes. However, the diagnosis of heart failure continues to be one of the top 10 reasons for hospitalization.

Thus, the characterization and knowledge of this high cost, high morbidity and high mortality group is a priority, in order to propose a structured follow up plan such as a Heart Failure Clinic at HMC. This plan would meet the needs of the population, aiming for quality and efficiency standards, since the prognosis may be substantially modified through medical interventions, the use of devices and heart transplantation, decreasing care costs and hospital admission rates and impacting both mortality and morbidity.

Methods

This is a descriptive, retrospective cohort study in patients with decompensated heart failure with reduced LVEF admitted to a quaternary level armed forces hospital in Colombia over a one year period.

The inclusion criteria were adults over the age of 18 with a diagnosis of decompensated heart failure with an ejection fraction less than 40%. The exclusion criteria were patients diagnosed with heart failure with an ejection fraction greater than 40%, or less than 40% without decompensation.

All patient records with ICD 10 heart failure diagnosis codes I500-I509 from January 1 to December 31, 2015 were considered. A total of 459 patient records with these diagnoses were found, and each medical chart was reviewed to determine if the registered code matched a clinical diagnosis of heart failure, and whether the patient´s admissions were due to decompensation. Likewise, the transthoracic and transesophageal echocardiograms of each patient were selected to confirm the criterion of reduced ejection fraction. A total of 114 patients fulfilled the inclusion criteria.

A data collection form was designed which included patient identification information, date of admission, date of discharge, clinical characteristics (etiology of the disease, comorbidities, precipitating factors, admission physical exam), paraclinical tests, echocardiographic findings, length of hospitalization, days in ICU, death and outpatient optimization.

To measure the outcome of death, all medical records were reviewed, and patients who did not have a record of appointments in 2016 were called to confirm their survival during the follow up period.

Results

The HMC medical records system was searched for patients hospitalized in 2015 with a heart failure diagnosis (I500-I501) among their ICD 10 codes, and 509 patients were found. The diagnosis of heart failure was confirmed in 459 patients. Within this group, echocardiograms were reviewed, finding a reduced LVEF (defined as ≤40%) in 28.3%, or 130 patients. In this rLVEF population, at least one admission for decompensated heart failure was found in 114 patients during 2015, who were then included for analysis (Figure 1).

Sociodemographic and clinical characteristics and comorbidities (Table 1)

Sixty-two percent of patients had an ejection fraction <30%, and 38% had an EF <40%. The mean age of the sample was 74.8 years, 42% of the population was 80 or older, and 69.3% were men. The etiology of the heart failure was hypertension in 66.7%, ischemia in 60.5%, valvular in 20.2% and other in 8.8% of cases. Treatment noncompliance was the main precipitant, with 50% of the cases, followed by an infectious factor in 28.1% of cases and acute coronary syndrome in 21.9%. The patients had significant comorbidities: 92.1% had arterial hypertension, 61.4% had coronary disease, 52.6% chronic kidney disease, 49.1% hypo- or hyperthyroidism, 45.6% COPD, 43% pulmonary hypertension and 29.8% type II diabetes mellitus.

Most of the patients were in NYHA functional class III (48.2%) and IV (41.2%), and 80.6% were admitted in Stevenson B, with documented pulmonary congestion in 49.1% of cases; 81.6% were in AHA Stage C and 14.9% were in Stage D. The average systolic arterial pressure on admission was 131 mmHg and 76.6% of patients had a heart rate greater than 70 bpm.

Heart failure onset

Altogether, 86.8% of patients had known heart failure which had decompensated, and 7.9% presented with acute *de novo* heart failure.

Blood biochemistry

The average hemoglobin was found to be 11.6 g/dL (± 2.51), in the anemic range, with a hematocrit of 35.7 (± 7.45). The electrolytes showed hyponatremia with a median sodium of 133.5 mEq/L (IQ range 6.25), and normal potassium at 4.77 mEq/L (IQ range 0.75). However, the mean BUN was 44.2 mg/dL (SD 22.5) with a median creatinine of 1.54 mg/dL (IQ range 0.87), compatible with kidney failure. The median lactate was also elevated at 2.6 mg/dL (1, 8). The TSH was measured in 53% of patients; of these, 58% had values above the upper limit of normal. There were insufficient data for ferritin, transferrin saturation, bilirubins, lipid profile, uric acid and natriuretic peptides (Table 2).

Echocardiographic characteristics

Left ventricle

In general, the average patient had a left ventricular diameter in the dilated range. Volumes were reported in 60% of the reviewed echocardiograms; GLS was reported in only 19% of cases; left atrial volume was reported in

90% of the cases with a mean of 54.3 mL/m^2, (±22.3); 71.9% of patients had some degree of diastolic dysfunction; mitral regurgitation was reported in 83.3% of cases (mostly mild, 47.4%); and aortic regurgitation was found in 61.4% of cases (mild in 43.9%) (Table 3).

Right ventricle

Altogether, 85.1% of patients had some degree of tricuspid regurgitation, mostly mild; a median PASP of 50 mmHg was found; the 72.8% of patients with a reported TAPSE on echocardiogram had a median of 17 mm; there were insufficient data on fractional area change and systolic tricuspid annular velocity.

Pharmacological treatment

While 71.1% of the patients were being treated with ACE inhibitors or ARBs, only 10.5% were taking optimal ACE inhibitor doses. A total of 88.6% were taking beta blockers, mostly carvedilol (70.2%); however, only 3.5% were receiving an optimal dose. The second most frequently used beta blocker was metoprolol tartrate and only 7% were receiving optimal doses. Altogether, 57.6% of patients were on aldosterone antagonists (100% on spironolactone), of whom 1.7% were receiving optimal doses. 71.9% of patients were discharged on loop diuretics at 40 mg/day, 16.7% were on digoxin, 60.5% on statins and 56.1% on antiplatelets; 7.9% of patients received a dose of levosimendan during their hospitalization (Table 4).

With regard to the use of devices, 45.6% had an ICD, 31.6% a pacemaker and 22.8% cardiac resynchronization therapy.

The median hospital stay was nine days (IQ range of 20 days). Out of all the patients reviewed, 25.4% required ICU care, with an average of 6.6 (SD 5.08) days. Inpatient mortality was reported at 18%. Seventy-five percent of the patients were members of the armed forces (army).

Most of the hospitalized patients were admitted by the internal medicine service (73%) followed by cardiology (27%).

Outpatient optimization was carried out for 32% of patients, and no medication titration during follow up appointments was found for the remaining 68%.

Ninety-two percent of patients who were seen in the emergency room required admission, and the remaining 8%

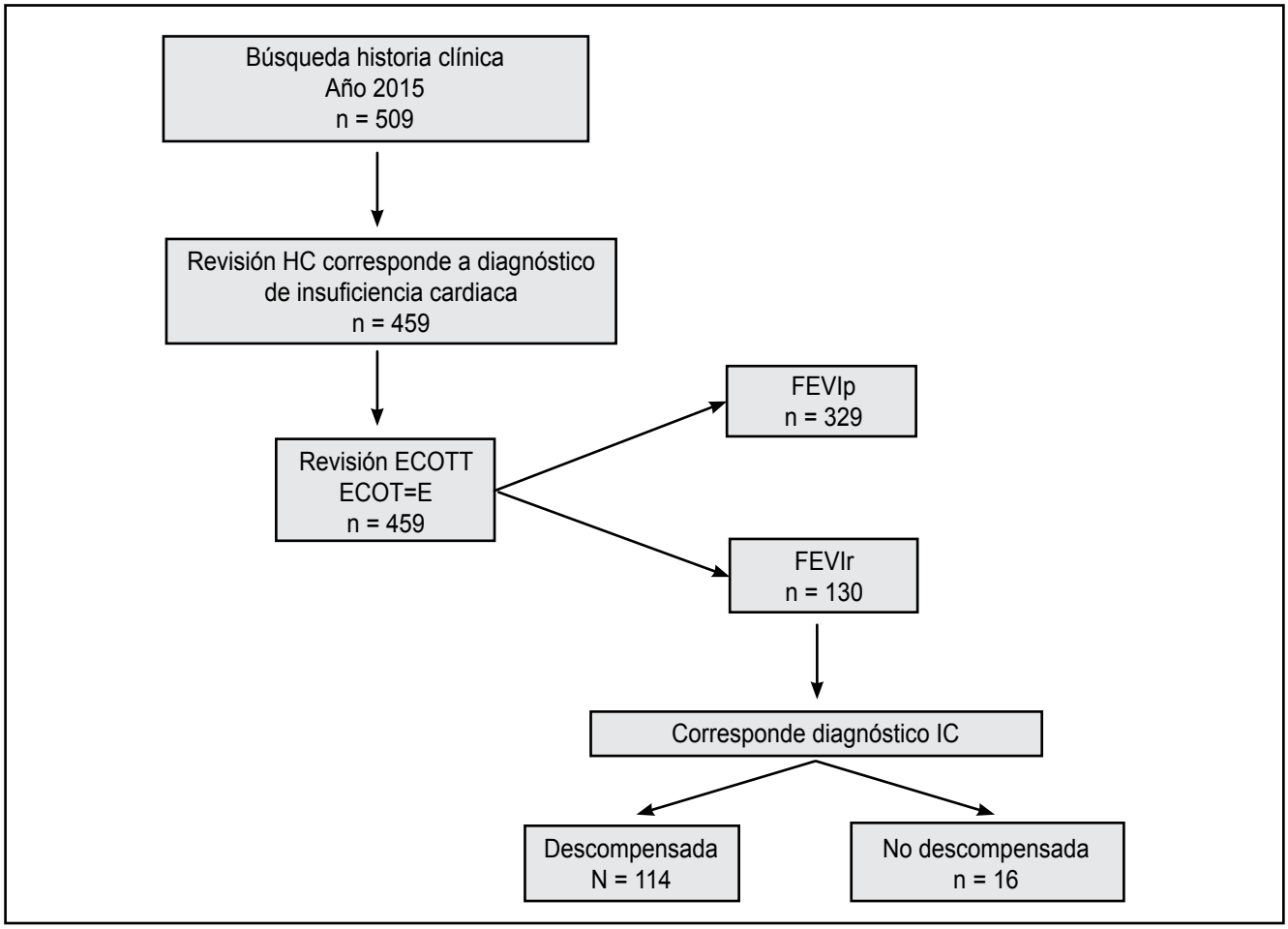

Figure 1. Clinical record selection. (Patient selection; PC, patient chart; TTECHO, transthoracic echocardiogram; TE-ECHO, transesophageal echocardiogram; LVEFp/r, left ventricular ejection fraction preserved/reduced; HF, heart failure).

Table 1. *Sociodemographic and clinical characteristics, and comorbidities.*

	n	%
Age	**74.8**	**11.8**
Sex (male)	**79**	**69.3**
Etiology		
Hypertensive	76	66.7
Ischemic	69	60.5
Valvular	23	20.2
Other	10	8.8
Chagas	8	7
Idiopathic	3	2.6
Tachycardiomyopathy	4	3.5
Precipitant		
Noncompliance	57	50
Infectious	32	28.1
ACS	25	21.9
Arrhythmia	20	17.5
Valvular	11	96
Comorbidity		
HTN	105	92.1
Coronary disease	70	61.4
CKD	60	52.6
Hypo/hyperthyroidism	56	49.1
COPD	52	45.6
PAH	49	43
DM2	34	29.8
AF	31	27.2
DLD	25	21.9
DVT	15	13.2
Cancer	10	8.8
Liver disease	9	7.9
CVA/TIA	8	7
PTE	3	2.6
OSAHS	3	3.6
Stevenson		
A	10	8.8
B	92	80.6
C	10	8.8
L	2	1.8
NYHA		
II	11	9.6
III	55	48.2
IV	47	41.2
Stage		
B	2	1.8
C	93	81.6
D	17	14.9
Physical exam		
Average SAP mmHg	131.8	24.7
Average DAP mmHg	76.6	16.8
HR* bpm		
Onset		
Chronic decompensated	99	86.8
De novo	9	7.9
Number of hospitalizations		
One	71	62.4
Two	27	23.7
Three	11	9.6
Four	2	1.7
Five	2	1.7
Seven	1	0.9

ACS, acute coronary syndrome. HTN, arterial hypertension. CKD, chronic kidney disease. COPD, chronic obstructive pulmonary disease. PAH, pulmonary arterial hypertension. AF, atrial fibrillation. DLD, dyslipidemia. DVT, deep vein thrombosis. CVA/TIA, cerebrovascular accident / transient ischemic attack. PTE, pulmonary thromboembolism. OSAHS, obstructive sleep apnea/hypopnea syndrome
** Data reported as median and IQ range.. **SAP,** systolic arterial pressure. **DAP,** diastolic arterial pressure. **HR,** heart rate*

were patients who were seen in the emergency room for less than one day before discharge. Thirty-eight percent of the 114 patients were readmitted at least once; of these, most (68%) were readmitted within the first 30 days. Mortality for early readmissions was 16% and 3% for late admissions (Table 5).

In the bivariate analysis for the outcome of hospital mortality, the variables with statistical significance were: AHA stage D (OR= 3.68, 95% CI 1.14-11.8, p= 0.028), statins (OR= 0.34, 95% CI 0.12-0.95, p= 0.035), ASA (OR= 0.17, 95% CI 0.046-0.65, p= 0.035), and beta blockers (OR= 0.23, 95% CI 0.67-0.83, p= 0.033), which are presented in Table 5.

Discussion

This is the first study of patients hospitalized for decompensated heart failure with reduced ejection fraction carried out at the Hospital Militar Central. The descriptive analysis characterizes patients with this disease in order to establish the determining factors leading to heart failure decompensation and propose alternative treatments which would impact the care provided to our population, considering that this is one of the leading causes of emergency room visits and hospital admissions. Despite being a descriptive study, the possible variables related to mortality were also explored.

The average age was 74.8 years, and there was a high proportion of comorbidities such as HTN, coronary disease, chronic kidney disease, thyroid disease, COPD and pulmonary hypertension. The two most frequent causes of heart failure were found to be HTN and ischemic disease, similar to what has been reported in Colombia and Latin America (11, 12). However, our study differed from these studies and others reported in the global literature (13) in that males

Table 2. *Blood biochemistry characteristics.*

	Mean/Median*	SD/IQ Range*
Biochemistry		
Hemoglobin g/dL	11.6	2.52
Hematocrit %	35.77	7.45
RDW%*	16.20	3.13
Sodium mEq/L*	133.50	6.25
Potassium mEq/L*	4.77	0.75
Troponin ng/mL*	0.04	0.05
BUN mg/dL	44.20	22.50
Creatinine mg/dL	1.55	0.87
Lactate mg/dL* (n = 84)	2.6	1.8
TSH mUI/L* (n = 61)	5.2	8.5
Lymphocytes /mm^3	1,957.02	654.0
Platelets /mm^3	226,517.54	111,132.4
Magnesium mEq/L (n = 85)	1.81	0.3
Glucose mg/dL (n = 79)	100.45	29.7

predominated, as found in the Chilean heart failure registry where 73.7% were males, similar to the 69.3% found in our study. However, the current study may have been affected by the fact that the members of the armed forces are mostly men.

With regard to precipitating factors for heart failure, treatment noncompliance continues to be one of the main causes of decompensation, which posits the importance of educating these patients and assessing their social support network to strengthen adherence to pharmacological and non-pharmacological treatment. Nonetheless, noncompliance has been previously described as a factor associated with short hospital stays (14). The second and third most frequent causes of decompensation described in our study were infections and acute coronary syndrome, respectively.

Table 3. *Echocardiographic characteristics.*

	Mean/Median*	SD/IQ Range*
Echocardiography		
EDD cm	5.53	0.90
ESD cm	4.64	1.04
GLS %* (n = 22)	-7.00	-3.00
LAV mL/m2	54.34	22.30
PASP*mmHg (n = 102)	50.00	17.30
TAPSE*cm (n = 83)	1.70	0.60
	n	**%**
Diastolic dysfunction		
Type I	30	26.3
Type II	23	20.2
Type III	29	25.4
Absent	32	28.1
Mitral regurgitation		
Mild	54	47.4
Moderate	29	25.4
Severe	12	10.5
Absent	19	16.7
Aortic regurgitation		
Mild	50	43.9
Moderate	16	14
Severe	4	3.5
Absent	44	38.6
Tricuspid regurgitation		
Mild	65	57
Moderate	26	22.8
Severe	6	5.3
Absent	17	14.9

***EDD**: end diastolic diameter, **ESD**: end systolic diameter, **GLS**: global longitudinal strain, **LAV**: left atrial volume, **PASP**: pulmonary arterial systolic pressure*

Most of the patients had known chronic heart failure with an intercurrent decompensation.

A significant percentage of patients had pulmonary congestion on admission (49.1%). With this in mind, it is important to diagnose and intensively treat pulmonary congestion during the emergency room and/or hospital stay, as there is evidence that persistent pulmonary congestion at discharge causes an increased risk of death and readmissions for heart failure (15).

With regard to the severity of the decompensation on admission, a high percentage of patients had an NYHA functional class III - IV (89.4%). This could partially explain the longer hospital stay seen in this study, which could also affect mortality and the ensuing large number of complementary tests (complete blood count, biochemistry, coagulation, blood gases, chest x-ray, electrocardiogram, cardiac enzymes). In addition, elevated troponin in acute heart failure is multifactorial (sepsis, arrhythmias, anemia) and, in many cases, reversible; therefore, its usefulness as a single or sequential measurement in these patients has not yet been determined (16).

It is worth noting that heart failure biomarkers such as BNP or NT-proBNP were not measured, despite having proven to be a highly sensitive marker for diagnosing acute heart failure, and an important predictor of prognosis and response to treatment, while helping determine the patient´s admission, whether or not to perform an echocardiogram and therapeutic decision making. (17-18). Changing this situation needs to be a priority in the near future, with these biomarkers becoming a part of daily clinical practice at HMC.

The echocardiogram results were foreseeable for a heart failure population with reduced ejection fraction. However, the guidelines on chamber quantification regarding left ventricular volumes must be adhered to in order to establish future comparative studies to identify reverse remodeling criteria associated with pharmacological treatment, education and cardiac rehabilitation. Likewise, studies should be encouraged that include strain as an etiological and prognostic marker in this group of patients, along with a complete assessment of right ventricular function and screening of pulmonary hypertension with elevated pulmonary resistance, which is important in diagnostic and therapeutic guidelines for this group of patients.

It should be highlighted that evidence-based pharmacological treatment recommended by clinical practice guidelines was ordered at discharge for a large percentage of cases. Thus, an ACE inhibitor or an ARB was ordered in 71.1% of cases, a beta blocker in 88.6% and an aldosterone antagonist in 57.6%. However, a very low percentage of patients were discharged on the optimal recommended doses (10.5% for ACE inhibitors [enalapril], 3.5% for beta blockers [carvedilol] and 1.7% for AAs [spironolactone]), which reflects the need to implement prescription strategies in light of their proven benefit in these patients´ morbidity and mortality (19-21).

Table 4. *Pharmacological treatment.*

Treatment prior to admission	n	%
ARBs	40	35.1
ACE inhibitors	41	36
2.5 mg BID	10	8.8
5 mg BID	18	15.8
10 mg BID	1	0.87
20 mg BID	12	10.5
Beta Blockers	101	88.6
Carvedilol	80	70.2
6.25 mg BID	44	38.6
12.5 mg BID	17	14.9
25 mg BID	4	3.5
3.12 mg BID	15	13.1
Metoprolol tartrate	19	16.6
25 mg BID	5	4.4
50 mg BID	8	7
Aldosterone Antagonists	66	57.6
25 mg/day	47	41.2
50 mg/day	2	1.7
12.5 mg/day	15	13.1
Furosemide		
40 mg/day	82	71.9
Digitalis	19	16.7
O/SCAC	25	21.9
Statins	69	60.5
Nitrates	6	5.3
Amiodarone	25	21.9
Levosimendan	9	7.9
Antiplatelets	64	56.1
O/SCA : oral/subcutaneous anticoagulants		

Table 5. *Readmissions.*

	N / Median*	%/IQ Range*
Total patients with readmissions	**31**	**38**
Early readmissions (less than 30 days)	21	68
Late readmissions (31-90 days)	10	32
Total mortality, readmissions	**6**	**19**
Mortality early readmissions (1-30 days)	5	16
Mortality late readmissions (31-90 days)	1	3
Number of readmissions*	1	1
Time elapsed to readmission (days)*	20	89

A greater adherence to management guidelines has been described when the admitting service is cardiology, although our present study does not have a large enough sample size to determine differences by admitting service and thereby improve the care processes (22, 23).

If we consider that the analyzed patients have systolic dysfunction, and, as we have seen, most present with peripheral hypoperfusion (NYHA II-IV, pulmonary congestion, decreased kidney function, elevated lactate), together with the fact that many of them are probably resistant to diuretics and/or vasodilators, it seems reasonable to expect a greater use of medications such as levosimendan, given its proven clinical and hemodynamic benefits (24-26). However, the degree of severity of decompensation (mostly Stevenson B) could also explain the low frequency of inotrope use (27).

The assessed optimization of outpatient drug therapy should be analyzed according to the possibility that patients hospitalized for decompensation will receive drug titration every two weeks after discharge, a model which has proven to be cost-effective in outpatient heart failure clinics.

The lack of complete information regarding electrocardiographic findings, together with the high percentage of patients with suboptimal drug therapy doses, make it impossible to determine if all patients with an indication for cardiac resynchronization therapy have it. This is also due to the fact that the study was conducted within the hospital setting.

However, if the number of patients receiving optimal medical treatment were increased, the percentage of the population who would really have an indication for and benefit from cardiac resynchronization could be determined. For defibrillators, titration to the maximal doses substantiated by clinical trials could lead to reduced appropriate discharges (28, 29).

In another vein, the median hospital stay was within the mean number of days reported in other studies. However, the interquartile range reported in the current study reflects the dispersion of the data obtained.

Although most patients who consult to the emergency room require hospitalization, which is related to their Stevenson decompensation stage (with B being the most frequent), it is thought that guideline-driven pharmacological management of decongestion or drug titration would reduce hospitalizations, especially if this titration process is continued on an outpatient basis (30).

Hospital mortality was higher than the average in Latin American countries (Brazil 8.5%, Mexico 2.9%) and North America (2.7%) (31). However, these mortality records are mostly analyzed using hospitalizations as the unit of analysis rather than the individual outcome per patient.

The percentage of readmissions is comparable to the figures in various registries (32, 33) which show readmissions in up to 25% of patients within the first 30 days, with a mortality close to 10% in this period. However, the high number of readmissions (38%) presenting within the so-called «vulnerable phase», the first 30 days after discharge, is notable. This is a high mortality period which could

be prevented through early outpatient assessment (ideally within the first seven days after discharge) to strengthen preventative education on self-care along with titration to optimal or maximum tolerated drug doses, which have proven to decrease morbidity and mortality in patients with heart failure.

Understanding the inherent limitations of the study, the results of the bivariate analysis of possible association of ASA platelet antiaggregation, statins and beta blockers could be explained by a higher percentage of patients with ischemic heart disease (60.5%), as this was one of the most frequent etiologies of heart failure in the present description.

Once the characteristics of the population with heart failure with reduced ejection fraction, the most frequent causes of decompensation, comorbidities, clinical profile and high percentage of readmissions are understood, they become an interesting target for early, active interventions during hospitalization and early outpatient assessment by a multidisciplinary team within the framework of the care model proposed by heart failure clinics. These programs have amply demonstrated their benefits and are covered by both national and international clinical practice guidelines.

Study limitations

This is a descriptive study carried out in 2015 on a fixed population of armed forces members and their families, and thus it is a single-center study. However, as the national reference center, it has a diverse population which represents the country as a whole, and allows follow-up of patients who would only be seen in the armed forces health care network for decompensations. Not having natriuretic peptide levels limits the diagnostic exclusion capability of heart failure patients, compared to other studies, although all patients had echocardiograms which supported the diagnosis.

The sample size could limit the determination of associated factors, although as a descriptive study, this is not part of its purpose.

Conclusions

This study described the main characteristics of patients with decompensated heart failure with a reduced ejection fraction admitted to a quaternary hospital. The clinical profile of the patients is similar to that reported in other studies; however, the male sex predominated at admission. Adherence to management guidelines on admission was adequate but at suboptimal doses, with intervention needed in the immediate post-discharge phase due to the high percentage of readmissions as well as inpatient mortality reported. These findings suggest the need to create a heart failure clinic for outpatient management to decrease the number of admissions, readmissions and hospital days; as well as the need for easy access to services and timely follow-up of patients.

The size of the registry must be increased in order to analyze associated factors, outcomes and knowledge building.

Acknowledgements

To the Hospital Militar Central and the cardiologists Juan Pérez Rapalino and Margarita Blanco for their support in this study.

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