The predictive efficacy of multidimensional prognostic index in the elderly with heart failure and reduced ejection fraction in a real world sample: the Post-Acute Long-Term Care setting

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Abstract

The multidimensional prognostic index (MPI) is an accurate predictor of mortality validated in hospitalized older patients.

Aim of this study was to evaluate the reliability of the MPI in predicting short- and long-term mortality in patients with heart failure (HF), particularly in those with reduced left ventricular ejection fraction (HFrEF).

The study population included all patients older than 65 years admitted in a Post-Acute Long-Care Unit from 2013 to 2018. Patients were divided into two groups: patients with HF (N=143) and patients without HF as controls (N=1254). Furthermore, patients affected by HF were subdivided according to echocardiographic left ventricular ejection fraction (LVEF), i.e. reduced, mid-range and preserved LVEF (respectively HFrEF, HFmrEF, HFpEF). All patients underwent a comprehensive geriatric assessment (CGA) to calculate the MPI based on information on functional, cognitive, nutritional and mobility status, comorbidity, poli-pharmacy and co-habitation.

Mortality rates in the HF group was 46% in patients MPI-1 or MPI-2 groups *versus* 59% in patients included in the MPI-3 group. In particular, of 32 HF patients with HFrEF 67.7% were in the MPI-3 class compared to 43% of 14 patients with HFmrEF group and to 41% of 63 patients with HFpEF.

These findings suggest that MPI is a reliable predictor of mortality in HF patients and that it was particularly useful in the subgroup of patients with HFrEF.

Introduction

Heart failure (HF) is a clinical syndrome characterized by typical symptoms that may be accompanied by signs caused by a structural and/or functional cardiac abnormality, resulting in a reduced cardiac output and/or elevated intracardiac pressures at rest or during stress.[1]

HF has a prevalence of 1-2% in developed countries with around 20 million cases worldwide. It affects about 10% of patients over 70 years, representing one of the main cause of hospitalization in this age group.[2]

Although the available treatments have allowed an improvement in mortality, HF continues to have a poor prognosis with a high mortality both in hospitalized patients and in the outpatient care setting.[3]

Studies have shown that patients discharged from the hospital with a diagnosis of HF have a high risk of mortality (11.3% at 30 days and 33.1% at 1 year)[4,5] and rehospitalization (about 40% in the 6-month follow-up period after their index hospitalization).[6]

The Cardiovascular Health Study, a U.S. longitudinal cohort of community-dwelling older adults, reported 1-year, 5-year, and 10-year mortality rates of 19%, 56%, and 83% following the onset of HF, respectively.[7] Administrative data from the Canadian Chronic Disease Surveillance System confirm that once HF develops, mortality increases exponentially with age.[8]

This study focused on HF patients admitted to a Post-Acute Long-Term Care (LPA) Unit. The majority of patients were older subjects. Given their complexity, the great number of comorbidities and the high rate of frailty, all patients included in the study underwent a standardized comprehensive geriatric assessment (GCA) with the calculation of the Multidimensional Prognostic Index (MPI). The MPI is based on CGA information on the following eight domains: Basic Activities of Daily Living (B-ADL), Instrumental Activities of Daily Living (I-ADL), Short Portable Mental Status Questionnaire (SPMSQ), Mini Nutritional Assessment (MNA), Exton-Smith scale to evaluate the risk of bedsores, Cumulative Illness Rating Scale (CIRS) to evaluate comorbidity, the number of medications taken and the co-habitation status (alone, in institution, with family).[9]

We choose to use MPI because it has been demonstrated to be a strong and independent predictor of mortality in hospitalized older subjects.[10] Moreover, studies proved its accuracy and reliability in older patients with cardiovascular disease,[11] aortic stenosis who underwent a transcatheter valve implantation (TAVI),[12,13] atrial fibrillation[14,15] as well as in older patients hospitalized for HF.[16]

The aim of the present study was to assess whether the MPI could be a reliable predictor of mortality in older subjects with HF, particularly in those HF patients with reduced LVEF.

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Materials and Methods

Study population

All patients older than 65 years (N=1397) consecutively admitted to the Post-Acute Care Unit of the Santissima Annunziata Hospital in Sassari (Italy) from January 1, 2013 to December 31, 2018 were subdivided in two groups according to their ICD-9 codes: i) group 1: patients with a diagnosis of HF (N=143 patients); ii) group 2 without a diagnosis of HF as control sample (N=1254 patients).

Patients with HF were then classified based on the measurements of the LVEF according to the recent European Society of Cardiology (ESC) Practice Guidelines[1] as follows: i) HF with reduced ejection fraction - HFrEF (LVEF <40%); ii) HF with mid-range ejection fraction - HFmrEF (LVEF 40-49%); iii) HF with preserved ejection fraction - HFpEF (LVEF >50%).

Multidimensional prognostic index

Within 24 h from the admission, the multidimensional prognostic index (MPI)

was administered to each patient. MPI was calculated from a set of parameters that evaluates eight domains, *i.e.* Basal and Instrumental activities of Daily Living (B-ADL, I-ADL), short Portable Mental Status Questionnaire (SPMSQ), Mini Nutritional Assessment (MNA), Exton-Smith scale (ESS), Cumulative Illness rating Scale (CIRS), number of medications taken and the cohabitation status (alone, in institution, in family). The score of each scale was processed through a computerized numerical calculation (MPI Index) using the software of the MPI system which allows to obtain a value of risk of mortality with great prognostic value: i) Mild risk MPI-1: MPI values between 0.01 and 0.33; ii) Moderate risk MPI-2: values between 0.34 and 0.66; iii) Severe risk MPI-3: values between 0.67 and 1.0.

Outcomes

Mortality was assigned based upon recorded data from municipalities in the wider Sassari metropolitan area. We assessed mortality after 30 days and after 1 year of follow-up.

Statistical analysis

Statistical analyses were performed using STATA 11 software (StataCorp, College Station, TX, USA).

Results were expressed as mean ± SD. Student's t-test and τ-square test were used to compare the differences between groups. The values of P<0.05 were considered statistically significant.

Further analysis was carried-out to explore potential differences in the ability to predict mortality between MPI and LVEF. It has been implemented a logistic regression analysis model by subdividing HF patients in preserved-LVEF (HFpEF) *versus* altered-LVEF patients (that include both HFmrEF and HFrEF patients) and keeping the division of MPI patients, *i.e.* middle-low risk (MPI 1+2) and high risk (MPI 3) patients.

Results

The general characteristics of study population divided according to the presence of HF are shown in Table 1. A significant higher percentage of patients with HF was transferred from Internal Medicine and Geriatrics Units than controls (P<0.05). Age, sex, comorbidity and co-habitation status were similar in the two groups of patients. Interestingly, patients with HF demonstrated to be less compromised compared to patients in the control group in terms of B-ADL (total dependence 43.4% *versus* 61.3%, P<0.0001) and I-ADL (total dependence 42.7% *versus* 60.4%, P<0.0001), cognitive status (severe impairment 11.9% *versus* 29.7%, P<0.0001), risk of pressure sores (high risk 36.4% *versus* 56.7%, P<0.0001), advanced malnutrition (62.9% *versus* 74.8%, P=0.002); conversely HF patients had a higher number of medication (mean value 10.7 *versus* 9.1, P<0.0001).

The mean value of the MPI score was similar in the two groups (0.73 in HF patients *versus* 0.70 in controls; P=0.096). Since the number of patients included in the MPI-1 group was small, we decided to combine patients in MPI-1 and MPI-2 group in order to focus our attention to the major risk subjects. The percentage distribution of patients according to the MPI classes demonstrated that HF patients were more represented in the MPI-1/2 classes compared to controls (35% *versus* 25.7%, P=0.017).

Table 1. General features of Control and HF group.

		Control group	HF group	P
Patients, n°		254 (89.76%)	143 (10.24%)	
Provenience department, n°	Internal Medicine Geriatric Others	553 (44.1%) 335 (26.7%) 366 (29.2%)	98 (68.5%) 26 (18.2%) 19 (13.3%)	0.01
Age, average, years [DS]		80.0 [±9.7]	81.6 [±7.7]	0.067
Men, n°		656 (52.3%)	81 (56.6%)	0.326
MPI, average [DS]		0.73 [±0.2]	0.70 [±0.2]	0.096
MPI 1 e MPI 2, n°		322 (25.7%)	50 (35.0%)	0.017
MPI 3, n°		932 (74.3%)	93 (65.0%)	0.017
B-ADL, average [DS]		1.13 [±1.9]	1.49 [±1.9]	0.037
B-ADL, total dependence, n°		769 (61.3%)	62 (43.4%)	0.000
I-ADL, average [DS]		1.35 [±2.3]	1.60 [±2.0]	0.199
I-ADL, total dependence, n°		756 (60.4%)	61 (42.7%)	0.000
SPMSQ, average [DS]		5.79 [±3,7]	4.49 [±3.3]	0.0001
SPMSQ, severe cognitive impairment, n°		405 (29.7%)	17 (11.9%)	0.000
Exton Smith, average [DS]		10.1 [±3.9]	11.4 [±3.6]	0.0001
Exton Smith, high risk of pressure sores, n°		711 (56.7%)	52 (36.4%)	0.000
CIRS, average [DS]		5.2 [±1.9]	5.3 [±1.8]	0.628
MNA, average [DS]		12.1 [±6.0]	14.4 [±5.6]	0.000
MNA, severe malnutrition, n°		939 (74.8%)	90 (62.9%)	0.002
N° drug, average [DS]		9.1 [±3.3]	10.7 [±2.8]	0.000
Social state, n°	Alone Family Institute	130 (10.7%) 970 (77.3%) 148 (12.0%)	19 (13.3%) 112 (78.3%) 12 (8.4%)	0.330
Motor state, bedridden, n°		1006 (83.0%)	104 (72.7%)	0.176

n°, number of patients; %, percentage; DS, standard deviation.

In the HF patients the mortality rates were assessed (Table 2). 46% of HF patients with MPI-1/2 died during follow-up (43% within 1 month and 78% within 12 months) from the administration of the test compared to 59% of HF patients included in the MPI-3 group (47% at 1 month and 89% after 1 year of follow-up).

Dividing HF patients according to their LVEF parameters (Table 3), 32 patients (22%) had reduced LVEF, 14 patients (10%) had mid-range LVEF, and 63 patients (44%) had preserved LVEF; in 35 patients (24%) LVEF was not available. The mean EF were found to be 45%.

In HFrEF group 32.3% of patients were in MPI-1 or MPI-2 classes, while 67.7% were in the MPI-3 class. Indeed, the 26% of patients died during hospital-stay. In HFmrEF group 57% were in the MPI-1 or MPI-2 classes, while 43% were at high risk of mortality (MPI-3 class). 7% of patients died during hospital-stay. In HFpEF group, 35% were in MPI-1 or MPI-2 and 65% were in the MPI-3 class. In-hospital mortality rate of patients was 24%.

Furthermore about patients died in ward, 19 of them had MPI 2-3.

In addition, from the logistic regression analysis has emerged that the relationship between the outcome risk of mortality and the variable MPI-3 demonstrated an OR=1.35. Even if the value was not statistically significant, this finding suggests an increased capacity to predict risk of mortality 35% greater by using MPI. Conversely, the relationship between risk of mortality and altered LVEF showed a risk reduction (OR=0.5), although also in this case the value was not statistically significant.

Discussion

Similarly to previous studies[16,17] the mortality rate in our Post-Acute Long-Term Care Unit was 10%, while in HF patients this percentage resulted significantly higher being equal to 54%.

Our data shows that the average risk of short and long term mortality, assessed by using the MPI score, was high in both groups. The study confirms that the MPI is a reliable tool to assess the risk of short and long-term mortality especially in HF patients with HFrEF; indeed, they had an high MPI value and the 67.7% had a high risk of mortality.

The analysis shows that the majority of patients admitted to our department had a high risk of short-term and long-term mortality due to underlying diseases, comorbidities and frailty.

According with previous studies,[11-14] we found that MPI is a reliable predictor of mortality in hospitalized older patients. Our study focused attention on the HF older patients and our findings are in agreement with recent studies in older people, reporting that the MPI, derived from a CGA, is a powerful tool to estimate the risk of mortality in HF older patients.[16] Moreover we divided patients into groups based on different grade of severity of EF at the LV echocardiography.

As reported, results suggest that in HFrEF group more than half of patients had an high risk of mortality (MPI-3 class) and in this class is assessed, the highest mortality during hospital-stay.

This study had some limitations. First, the population enrolled in our study includes only hospitalized older patients, it is possible that our findings may not be applicable to other settings. Second, this is an observational retrospective study that classified HF patients according to LVEF and other factors could influence the HF classification (such as NT-PRO-BNP level in blood). Moreover, the cohort of patients came from a specific care setting, *i.e.* a long-term department, recruited from a single hospital.

In conclusion, we demonstrated that MPI index is a useful sensitive predictor of mortality in the real-life of hospitalized older patients with different grade of LVEF that strictly related to HF conditions, especially in those patients that have the highest risk of mortality. On one hand, the possibility to identify more quickly the HF patients with high risk of mortality using a simple tool as the MPI, could reduce the time to start an appropriated therapy and prevents complications. From other hand, the minor risk patients could directed towards screening and prevention programs or therapies.

Logistic regression analyses revealed that MPI was a stronger predictor of mortality in HF patients compared to LVEF valuation. This finding confirms that it may be useful to adopt multiparameter indeces, such as MPI, in assessing these complex patients. Indeed, the results of strumental examinations, such as LVEF, although important, were not sufficient suggesting the importance to integrate instrumental data with multidimensional information in these complex and frail older patients. To evaluate the potential clinical usefulness of this prognostic index in taking decisions are needed further studies.

Table 2. Correlation between MPI - level and risk of mortality in the HF group.

MPI	Risk of mortality	Died within 1 month	Died within 1 year	Number of deaths on the total
1 + 2	Medium Low	10 (43%)	18 (78%)	23 (46%)
3	High	26 (47%)	49 (89%)	55 (59%)

Table 3. Correlation between LVEF levels and risk of mortality.

LVEF	Patients no.	Medium-low risk of mortality (MPI 1+2)	High risk of mortality (MPI 3)	Died in the ward
Reduced	32 (22%)	10 (32.3%)	22 (67.7%)	9 (26%)
Mid range	14 (10%)	8 (57%)	6 (43%)	1 (7%)
Preserved	63 (44%)	22 (35%)	41 (65%)	15 (24%)
Unknown	35 (24%)	21 (59%)	14 (41%)	

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