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Original Article

The association between admission systolic blood pressure of heart failure patients with preserved systolic function and mortality outcomes

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ABSTRACT

Introduction: Heart failure is a major cause of death and disability and poses a significant public health concern. Approximately half of the patients admitted with heart failure, have preserved left ventricular ejection fraction. The association between systolic blood pressure (SBP) and long-term outcome in this group has not been well established.
Aim: The aim of our study is to evaluate the association between admission SBP and short term and long-term mortality outcomes in patients with heart failure and preserved systolic function.
Methods: 1230 consecutive patients presenting with preserved left ventricular (LV) systolic function (defined as an LV ejection fraction ≥40%) were included in this survey. Patients were divided into quartiles according to admission SBP: low admission SBP (<127 mm Hg), intermediate admission SBP (128–145 mm Hg), high admission SBP (146–170 mm Hg) and very-high admission SBP (>170 mm Hg). Primary outcome included in hospital, one and four year mortality rates.
Results: Elevated admission SBP was found to be associated with improved short and long-term mortality (HR = 0.25 95% CI — 0.09–0.7, p = 0.007 and HR = 0.7 95% CI — 0.56–0.88, p = 0.002 for the highest versus low SBP group, respectively). This finding was most notable in patients with acute heart failure and patients with ejection fraction ≥ 50%.
Conclusion: Elevated admission SBP is associated with a favorable short and long-term outcome in patients with heart failure and preserved systolic function.
Key message: Low admission SBP is an independent predictor for short and long-term mortality in patients with HF and PSF.

1. Introduction

Heart failure (HF) is a major cause of death and disability and thus poses a significant public health concern. According to published data, about 50% of patients admitted with acute decompensated HF, have preserved left ventricular (LV) ejection fraction (EF) or only mild systolic dysfunction (EF > 40%) [1,2]. Several previous studies have demonstrated an inverse association between systolic blood pressure (SBP) and mortality in both chronic [3–5] and acute [6–9] HF in patients with decreased systolic function. To date, only a handful of studies have evaluated the relationship between SBP and outcome in patients with HF and preserved systolic function (PSF) [6,7,10–13]. Most studies demonstrated an inverse association between SBP and mortality, while one study showed a U shape association between SBP and mortality [6]. However, earlier studies had some caveats, including relatively small sample size and lack of long-term follow-up data. Our hypothesis was that elevated SBP on admission would be associated with a better long-term outcome in this population.

We therefore evaluated the association between SBP on admission and long-term mortality, in a large cohort of Israeli patients with PSF, hospitalized due to heart failure.

2. Methods

2.1. Patient study population

The study protocol and patient selection was described in details elsewhere [11] (Fig. 1). Briefly, the survey was conducted during a consecutive 2-month period in 93 of the 98 hospital internal medicine wards and 24 of the 25 cardiology units in Israel. The survey was estimated to include more than 90% of hospitalized HF patients in Israel during the survey period.

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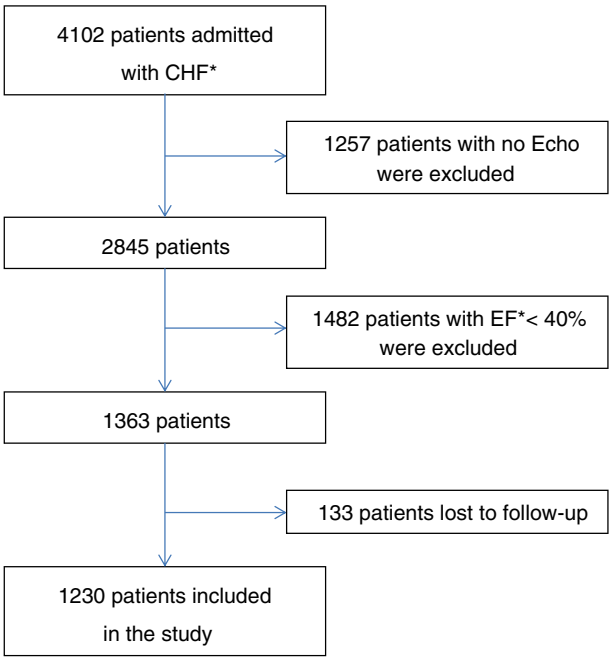

Fig. 1. Patient selection and study design. CHF — congestive heart failure, EF — ejection fraction.

2.2. Data collection

The survey included all patients with HF, either as the primary or secondary diagnosis, as determined by the local survey team in each center, according to a heart failure diagnosis category (DRG). Heart failure was diagnosed according to clinical presentation (symptoms, physical examination), radiography, echocardiography, radionuclide studies and cardiac catheterization findings. Detailed data regarding patients' characteristics, in-hospital course, management during hospitalization, pre-hospital and discharge medications and diagnoses were collected and recorded on pre-specified structured forms. Echocardiographic measurements, and LV function measurements were obtained and analyzed locally onsite in each of the participating hospitals (Fig. 1). Preserved LV systolic function was defined as LVEF ≥ 40%.

Patients were divided into quartiles according to admission SBP: low admission SBP (<127 mm Hg), intermediate admission SBP (128–145 mm Hg), high admission SBP (146–170 mm Hg) and very-high admission SBP (>170 mm Hg). Mortality outcomes were derived from the Population Registry of the Ministry of the Internal Affairs.

The protocol was approved by the ethics committee at each of the participating hospitals.

2.3. Statistical analysis

In the univariable analysis, percentages were calculated for categorical variables and means with SDs for continuous variables. The linear-by-linear association Chi-square test in case of categorical variables and the one-way analysis of variance (ANOVA) test, in case of

Table 1
Baseline characteristics by admission systolic blood pressure.

Characteristic	All N = 1230	Low (<127 mm Hg) N = 314	Intermediate (128–145 mm Hg) N = 308	High (146–170 mm Hg) N = 331	Very-high (<170 mm Hg) N = 277	p value for trend
Age	74 ± 10	73 ± 11.3	74 ± 11	76 ± 9	74 ± 9	0.01
Male gender (%)	48	53	49	47	43	0.01
Vital signs						
Systolic blood pressure (mm Hg)	149 ± 33	111 ± 13	136 ± 5	157 ± 8	195 ± 20	<0.001
Diastolic blood pressure (mm Hg)<	79 ± 17	66 ± 12	75 ± 10	81 ± 13	97 ± 17	0.001
Heart rate (BPM)	84 ± 21	82 ± 21	84 ± 21	83 ± 21	86 ± 22	0.09
BMI (kg/m^2)	29 ± 6	28 ± 7	28 ± 5	29 ± 5	29 ± 7	0.6
Co-morbidities (%)						
PVD	8	8	8	8	7	0.7
s/p MI	30	25	32	33	28	0.3
s/p stroke	13	10	12	14	14	0.1
DM	42	34	43	47	48	<0.001
Dyslipidemia	36	39	34	35	38	0.9
Hypertension	75	59	67	82	93	<0.001
COPD	20	21	19	19	20	0.6
Smoker/former smoker (%)	28	31	25	28	27	0.4
Laboratory findings						
Glucose (mg/dl)	160 ± 61	152 ± 77	169 ± 94	161 ± 77	160 ± 71	0.09
Sodium (mEq/l)	139 ± 7	137 ± 9	137 ± 11	138 ± 8	139 ± 7	0.1
GFR (ml/min/1.73 m^2)	55 ± 24	55 ± 25	59 ± 23	53 ± 23	53 ± 26	0.01
Potassium (mEq/l)	4.7 ± 5	4.9 ± 4.7	4.5 ± 2	4.8 ± 7.9	4.7 ± 3.8	0.7
Hb (g/dl)	12 ± 2	12 ± 2.2	12.2 ± 2.1	12 ± 1.7	12.2 ± 2	0.2
Medications (%)						
Furosemide	55	56	55	58	49	0.2
Beta blockers	49	48	48	51	51	0.3
CCB	33	24	29	38	40	<0.001
Aspirin/plavix	70	68	73	74	63	0.3
Spironolactone	10	13	10	8	7	0.01
ACE-I/ARB	56	52	58	57	56	0.3
Statin	33	31	39	33	31	0.7
Insulin	9	6	8	10	10	0.06
Enteral anti-glycemic drugs	28	24	29	30	31	0.05

PVD — peripheral vascular disease; MI — myocardial infarction; DM — diabetes mellitus; COPD — chronic obstructive lung disease; CCB — calcium channel blockers; ACE-I — angiotensin converting enzyme inhibitor; ARB — angiotensin receptor blocker; BMI — body mass index; GFR — glomerular filtration rate.