



## Original article

# Prognostic impact of preexisting hypertension and high systolic blood pressure at admission in patients hospitalized for systolic heart failure



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## ARTICLE INFO

## Article history:

Received 3 May 2015

Received in revised form 10 July 2015

Accepted 1 August 2015

Available online 8 September 2015

## Keywords:

Hypertension

Heart failure

Systolic blood pressure

## ABSTRACT

**Background:** Higher systolic blood pressure (SBP) has been reported to be associated with a better prognosis in heart failure (HF) patients. This study aimed to investigate the prognostic impact of hypertension in patients hospitalized with systolic HF.

**Methods:** Pooled analysis of data from three Korean observational studies was performed. Patients  $\geq 18$  years hospitalized with systolic HF (ejection fraction  $\leq 45\%$ ) ( $n = 3538$ ) were compared for the incidence of 1-year all-cause mortality according to the presence of preexisting hypertension and SBP quartiles on admission.

**Results:** Patients with hypertension (prevalence, 51.6%) presented more often with diabetes (43.9% vs. 23.0%,  $p < 0.001$ ) and chronic kidney disease (14.1% vs. 5.7%,  $p < 0.001$ ). During the 1-year follow-up, patients with hypertension showed similar cumulative incidences of all-cause mortality as those without hypertension (8.3% vs. 8.4%,  $p = 0.900$ ). Conversely, patients with higher SBP on admission had a lower incidence of all-cause death (quartile 4 vs. 1: 6.7% vs. 11.3%,  $p$  for trend = 0.004). In the multivariate analysis, an increase in SBP of 10 mmHg was associated with an 8.5% risk reduction of all-cause death (hazard ratio: 0.915, 95% confidence interval: 0.853–0.981,  $p = 0.013$ ).

**Conclusions:** Higher SBP on admission was independently associated with a lower risk of 1-year all-cause mortality in systolic HF.

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## Introduction

Hypertension is known to have a great impact on the development of heart failure (HF), accounting for 39% of HF events in men and 59% in women [1]. Longer duration of hypertension and older age are associated with a higher incidence of HF [1,2], and long-term control of hypertension has been shown to reduce the risk of HF [3]. The current guidelines consider hypertension as the single most important modifiable risk factor

for HF [4]. Interestingly, once HF develops, patients with higher systolic blood pressure (SBP) are reported to have a better prognosis [5,6]. This paradoxical trend has been observed with both SBP at admission and at discharge [7–9]; however, the mechanism of this so-called ‘SBP paradox’ is still not clearly understood.

Effective medical treatment of HF has resulted in an approximate 30% reduction in mortality during the past few decades [10]. Patients with hypertension may tolerate higher doses and combinations of medical treatment better than those without hypertension. Particularly, since survival benefits of medical treatment have been demonstrated only in those with systolic HF [4,10–13], it is worth investigating the prognostic impact of hypertension in this population. In addition, there are currently limited data regarding this issue in East Asian populations. Thus,

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we planned to evaluate this paradoxical prognostic impact of preexisting hypertension and SBP on admission in established systolic HF patients by using a pooled analysis of Korean heart failure registries.

**Methods**

*Study population*

We performed a pooled analysis of 3 large HF registries in Korea: the KorHF (Korean Heart Failure registry), SUGAR (Survey of Guideline Adherence for Treatment of Systolic Heart Failure in Real World), and COAST (A Retrospective Observational Study on the Clinical Outcomes in Relation with Serum Sodium Level in Asian Patients Hospitalized for Heart Failure). KorHF is a nationwide, prospective, observational, multicenter registry for patients hospitalized for acute HF from June 2004 to April 2009 in 24 hospitals in Korea [11]. COAST is a multi-national, multicenter retrospective registry involving 8 centers in Korea, Taiwan, and China. The study population included all adult patients (age, ≥18 years) hospitalized for HF with a left ventricular ejection fraction (LVEF) ≤45% at admission since January 2009 [12]. The SUGAR trial is a multi-center, retrospective observational study on subjects admitted with systolic HF (LVEF ≤45%) in 23 university hospitals between January and December 2009 [13].

Adult patients (age, ≥18 years) hospitalized for symptomatic HF with an LVEF ≤45%, as measured by echocardiography, in the 3 registries were eligible for enrollment in this study. Patients with in-hospital mortality and without information about previous hypertension and LVEF were excluded. Further, the patients from China and Taiwan in COAST were excluded to create a homogenous study population. A flow chart of the selection process is depicted in Fig. 1. Each registry was approved by the Ethical Committees of the participating hospitals and conformed to the ethical guidelines of the 1975 Declaration of Helsinki. Written informed consent was obtained from each patient.

*Study design*

The design of the present study comprised two parts. First, we evaluated the prognostic impact of preexisting hypertension

history. We divided the enrolled patients into 2 groups according to the presence of preexisting hypertension history: the hypertension and non-hypertension groups. Patients who had ever been previously diagnosed with hypertension by their physician or who were under antihypertensive medication were assigned to the hypertension group. The primary endpoint was defined as all-cause mortality within 1 year, and we compared the incidence of the primary endpoint between the two groups.

Second, we evaluated the prognostic impact of SBP on admission. We classified the study population according to the quartiles of SBP on admission and compared the incidences of all-cause mortality within 1 year.

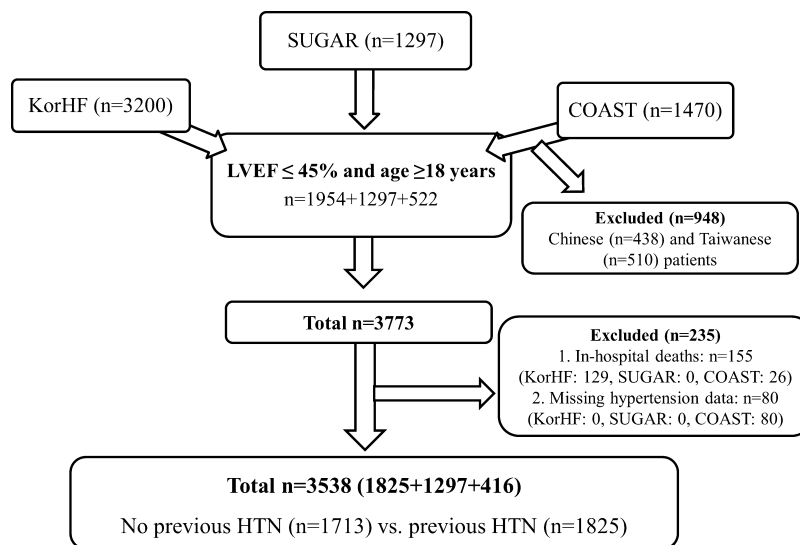
*Statistical analysis*

All continuous variables are presented as mean ± standard deviation (SD), and were analyzed using the Student's *t*-test or ANOVA. Categorical variables are presented as frequencies (percentage), and were analyzed using the Chi-square test. To adjust for covariates, a backward conditional Cox proportional hazards regression model was used for prediction of post-discharge mortality. The model was adjusted for age, sex, de novo HF, hypertension, SBP, diabetes mellitus, stroke, chronic obstructive pulmonary disease, ischemic etiology, myocardial infarction (MI), atrial fibrillation, LVEF, serum creatinine, hemoglobin, left bundle branch block, and discharge medication [angiotensin-converting enzyme inhibitor (ACEi) or angiotensin 2 receptor blocker (ARB), beta blocker, mineralocorticoid receptor antagonist]. A binary logistic regression model was used to estimate the association between hypertension and prescription of discharge medication. Statistical analyses were performed using SPSS version 20.0 (SPSS, Chicago, IL, USA). Survival function curves were depicted using MedCalc version 15.6.1 (MedCalc Software bvba, Ostend, Belgium).

**Results**

*Demographics*

A total of 3538 patients (hypertension group, *n* = 1713; non-hypertension group, *n* = 1825) were enrolled in the present study



**Fig. 1.** Selection of the study population. KorHF, Korean Heart Failure registry; SUGAR, Survey of Guideline Adherence for Treatment of Systolic Heart Failure in Real World; COAST, A Retrospective Observational Study on the Clinical Outcomes in Relation with Serum Sodium Level in Asian Patients Hospitalized for Heart Failure; LVEF, left ventricular ejection fraction; HTN, hypertension.

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