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# Prognostic Role of Cardiac, Pulmonary and Systematic Congestion in Patients Hospitalized for Acute Heart Failure

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## Abstract

Clinical congestion is the main driver of heart failure (HF) decomposition and hospitalization. The combined assessment of congestion status at admission, through clinical examination, echocardiography and lung ultrasound, should be used to better recognize the type and the site of congestion. Different congestion locations may be related to a different outcome. The study evaluated: 1) Cardiac, pulmonary and systematic congestion occurrence in heart failure with reduced ejection fraction (HFrEF) and heart failure with preserved ejection fraction (HFpEF); 2) The prognostic role of different congestion (Cardiac vs. Pulmonary vs. Systematic in terms of cardiovascular death or re-hospitalization during 6-month of follow up). Multi-centre, Observational study was implemented, including patients with the diagnosis of acute heart failure (AHF) according to the recent HF guidelines. A total of 230 patients with AHF (135 HFrEF and 95 HFpEF) were included in the analysis. Systemic congestion was significantly prevalent In HFrEF with respect to HFpEF due to the evidence of increased ICV size (22 ± 5 vs. 17 ± 4 mm; $p \le 0.05$) and a lower rate of reduced IVC collapse in HFrEF compared with HFpEF (47% vs 32%; $p \le 0.01$). Congestion status was different between HFrEF and HFpEF patients. The systemic congestion was related to poorer outcomes. There is a linear trend among single, double and triple congestion sites and increased risk for adverse events. Further studies should investigate what the best decongestion strategy by serial and qualitative measurement of congestion localization in AHF is.

## Subject Areas

Cardiology

## Keywords

Cardiac, Pulmonary, Systemic Congestion, Heart Failure, Hospitalization

## 1. Introduction

Acute Heart Failure (AHF) is the onset or worsening of signs and symptoms of Heart Failure (HF) that requires emergency treatment and is one of the main causes of morbidity and mortality around the world [1]. Despite the variation among clinical profiles and the heterogeneity of the underlying causes, the majority of patients with AHF present signs/ symptoms of pulmonary and systemic congestion rather than low cardiac output [2] [3].

Clinical congestion is the main driver of heart failure (HF) decompensating and hospitalization [4]. The combined assessment of congestion status at admission, through clinical examination, echocardiography and lung ultrasound, should be used to better recognize the type and size of congestion. Different congestion locations may be related to different outcomes [5] [6].

Multiple studies conducted on both admitted patients with AHF show that congestion is present in over 90% of cases, regardless of the left ventricular ejection fraction.

Therefore, the main objective of this study was to evaluate: 1) Cardiac, pulmonary and systemic congestion occurrence in heart failure with reduced ejection fraction (HFrEF) and heart failure with preserved ejection fraction (HFpEF). 2) The prognostic role of different congestion (Cardiac vs. Pulmonary vs. Systemic) in terms of cardiovascular death or re-hospitalization during 6 months of follow-up.

## 2. Methods

This was a multi-centre, observational study including patients with the diagnosis of acute heart failure (AHF) according to the recent Heart Failure guideline. All patients underwent to: 1) Clinical examination evaluating typical HF congestion signs (rales, jugular vein distension, hepatomegaly, peripheral oedema, third heart sound). 2) Trans-thoracic echocardiography evaluating left ventricular ejection fraction (LVEF), diastolic function, pulmonary artery systolic pressure (PASP), Inferior cave vein (ICV) size and collapse. 3) Lung ultra-sound through 8 thoracic spaces evaluating the number of B-lines. Patients were followed 6 months after discharge for cardiovascular death or re-hospitalization.

### 2.1. Study Area

This study was carried out at Afya medicare and Bahamme Hospitals locate in Makambako, Njombe and Morogoro regions in Tanzania respectively. These hospitals serve as specialty clinics for people in the surrounding area.

### 2.2. Study Design

To achieve the study aims, an observational study in multi-centres was implemented to gather essential information from the medical diagnosis done to the patients with AHF hospitalized and a continuous follow-up after 6-months of discharge was done.

### 2.3. Data Source

The population for this trial was made up of Afya medicare and Bahamme hospitals patients with cardiac, Pulmonary and systemic congestion Heart Failure.

Data were acquired from the medical charts of Afya medicare and Bahamme hospitals for Cardiac, pulmonary and Systemic congestion Heart Failure patients from May 1, 2021 to April 2022. The timing of the death of congestive acute heart failure patients was the survival end point of interest.

## 3. Results

A total of 230 patients AHF (135 HFrEF and 95 HFpEF) were included in the analysis. Systemic congestion was significantly prevalent In HFrEF with respect to HFpEF due to the evidence of increased ICV size (22 ± 5 vs. 17 ± 4 mm; $p \leq 0.05$) and a lower rate of reduced IVC collapse in HFrEF compared with HFpEF (47% vs. 32%; $p \leq 0.01$) No significant differences were found between HFrEF and HFpEF in terms of total B-Illness number and E/e' ratio. Figure 1 below explains the risk factors of HFpEF. Univariate analysis showed that B-illness ≥30 and ICV ≥21 mm were significantly related to poor prognosis (respectively HR = 2.3 and HR = 1.7; $p \leq 0.05$); these results were confirmed by the multivariable analysis after the adjustment for cardiovascular risk factors, LVEF and NYHA class (respectively HR = 1.5 and HR = 1.7; $p \leq 0.05$). Among three congestion subtypes, only the systematic congestion resulted significantly related to a worse outcome at univariate analysis (HR = 1.9, $p \leq 0.05$).

HFpEF due to left ventricular diastolic dysfunction is very common in both community and hospital settings. It is associated with morbidity and mortality approximately equal to that of HFrEF but is much harder to diagnose because of the complexity of interpretation of diastolic function on echocardiography [5] [6] [7]. A high index of clinical suspicion is required. Delay in diagnosis leads to advanced disease with a poor prognosis, while early detection may allow treatment of underlying causes. Clinical clues, as well as echocardiography, should be used for the early diagnosis of this condition [8] [9]. Increased awareness of this condition among the public, as well as within primary healthcare, is essential to halt the global epidemic of HFpEF. Identifying individuals who are at risk of developing this condition and effecting prevention using education, physical

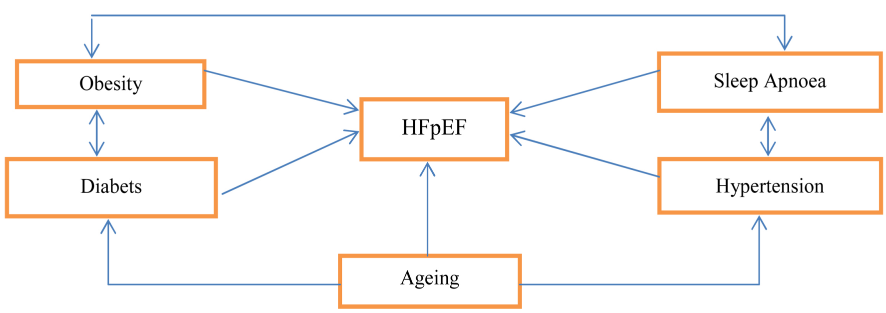


Figure 1. Heart Failure with preserved ejection with Interlinked risk factors.

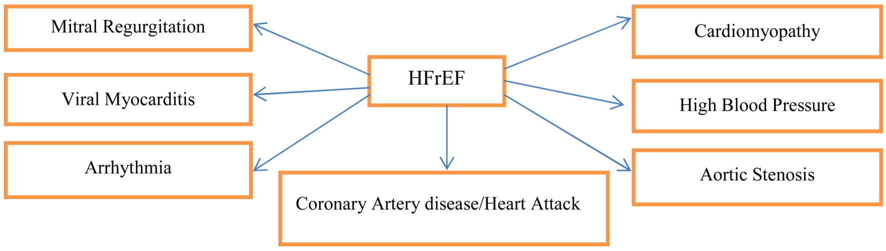


**Figure 2.** Heart Failure with reduced ejection causes.

exercise and aggressive risk factor control are the keys to achieving this goal [10] [11].

Heart failure with reduced Ejection Fraction happens when the muscle of the left ventricle is not pumping as well as normal. The ejection fraction is 40% or less [12].

The amount of blood pumped out of the heart is less than the body needs. A reduced ejection can happen because the left ventricle is enlarged and cannot pump normally. Figure 2 above illustrates some of the causes of HFrEF [13] [14] [15].

## 4. Conclusion

Congestion status was different between HFrEF and HFpEF patients. The systemic congestion was related to poorer outcomes. There is a linear trend among single, double and triple congestion sites and increased risk for adverse events. Systemic congestion appears to be much more related to adverse prognosis. In hospital, HF was often associated with uncompleted systemic and pulmonary congestion resolution. Further studies should investigate what the best decongestion strategy by serial and qualitative measurement of congestion localization in AHF is.

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## Availability of Data and Materials

The datasets analyzed during the current study are available from the corresponding author upon reasonable request.

## Ethics Approval

The review was conducted after approval by the joint ethical research committee of the Bahamme and Afya Medicare Specialized Clinic, administration particularly the department of Internal Medicine and community medicine and research.

## Competing interests

The author declares that they have no competing interest.

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## Abbreviations

AHF: Acute Heart Failure, CI: Confidence Interval, HR: Hazard Ratio, HFrEF: Heart Failure with reduced Ejection Fraction, HFpEF: Heart Failure with preserved Ejection Fraction, HF: Heart Failure, ICV: Inferior Cave Vein, PASP: Pulmonary Artery Systolic Pressure, LVEF: Left Ventricular Ejection Fraction.