Prevalence, Types and Clinical Presentation of Heart Failure among Hypertensive Patients Seen at a Tertiary Hospital in Dar Es Salaam, Tanzania

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Abstract

Background: Heart failure (HF) is a common complication in patients with hypertension who may present as HF with preserved ejection fraction (HFrEF) or HF with reduced ejection fraction (HFrEF). These categories have different clinical presentations and may require special attention to diagnose, especially when the presentation is HFrEF. The aim of this study was to assess the prevalence, types and clinical presentation of HF among hypertensive patients being followed-up at a tertiary hospital in Tanzania.

Methods: We included all known and newly diagnosed hypertensive adults (≥ 18 years) referred for echocardiogram examination at the Muhimbili National Hospital - Mloganzila, between June and December 2019. A detailed cardiovascular history, physical, laboratory and echocardiogram examination was performed in all patients. HF was diagnosed according to the Framingham criteria and was further categorized as HFrEF (EF ≥ 50%) or HFrEF (EF < 50%), according to the echocardiographic findings. Patients from these two groups were then compared in terms of demographic, clinical, laboratory and echocardiographic characteristics. The chi-square and Student’s t test was used to compare categorical and continuous data respectively. A p-value of < 0.05 indicated a statistically significant difference.

Results: Out of 633 hypertensive patients seen during the study period, 346 (54.7%) fulfilled the inclusion criteria and were enrolled. Mean ± SD age was 58.3 ± 12.4 years, and 60.4% were women. Mean ± SD systolic and diastolic BP was 152 ± 23 and 91 ± 15, respectively. A total of 102 (29.5%) patients were found to have HF. Three quarters of HF patients (74.5%) had HFrEF and the remaining (25.5%) had HFrEF. In comparison, patients with HFrEF were more likely to be outpatients, older, obese, and with higher mean BP and more concentric left ventricular hypertrophy when compared to those with HFrEF, all p < 0.05.

Conclusion: The prevalence of HF among hypertensive patients seen at a tertiary hospital in Tanzania is 29.5%, majority of them having HFrEF. HFrEF differs from HFrEF in terms of BP levels, obesity status and some echocardiographic parameters. These factors need to be carefully examined when HF is suspected in otherwise less symptomatic patients.

Keywords

Heart failure, Hypertension, Heart failure with preserved ejection fraction, Heart failure with reduced ejection fraction, Diastology, Echocardiogram, Sub Saharan Africa, Tanzania

Introduction

Heart failure (HF) is a global pandemic that affects approximately 64.3 million people worldwide [1], representing an important cause of morbidity and mortality [2]. The age-standardized prevalence rates of HF is increasing, and is accompanied with an increase in mortality and years lived with disability, especially in low and middle income countries (LMIC) [1]. The increasing HF burden is especially significant in sub Saharan Africa (SSA), including Tanzania, which is experiencing a change in epidemiology of diseases from communicable to non-communicable diseases [3]. Hypertension is by far the most common underlying cause contributing to the increase of HF burden in SSA [4], being present in 14.9% to 29.8% of the adult population [5,6], and in up to 50% of those aged ≥ 55 years [5]. Furthermore, hypertension in SSA is more severe and results in early end-organ damage, including HF, chronic kidney dis-
ease and stroke [7].

Regardless of the type, a diagnosis of HF carries a significant morbidity and mortality risk [8,9], and efforts should be made to diagnose HF earlier than later. With the aid of echocardiogram, HF has been classified into two major categories: HF with preserved ejection fraction (HFpEF) and HF with reduced ejection fraction (HFrEF) [10]. Among patients with hypertension, studies have found HFpEF to be more common, mainly due to diastolic dysfunction of the hypertrophied left ventricle [11,12]. HFpEF needs careful attention to diagnose, as traditionally HF was defined as a presence of reduced ejection fraction on echocardiogram. Ascertaining the proportion of hypertensive patients with HFpEF is important as it will increase awareness among clinicians of this otherwise obscured disease [13]. However, only few studies have reported on the types of HF among hypertensive patients in SSA [8,14,15], and most of previous studies did not systematically look for HF symptoms therefore may have missed those with mild to moderate symptoms. Furthermore, no previous study in Tanzania has reported on the types of HF among exclusively hypertensive patients. This study was therefore set out to determine the prevalence, types and clinical characteristics of HF in a population of hypertensives attending a tertiary hospital in Tanzania.

Methodology

Data collection process and definition of terms

A structured questionnaire was used to collect patients’ socio-demographic and clinical data. Information collected included gender, age of the patient, area of residence, cardiovascular risk factors, symptoms of HF, etc. A thorough physical examination was done and cardiovascular signs like ankle edema, upper quadrant abdominal tenderness, chest rales, S3 gallop, and jugular venous pulse were looked for and recorded whether present or not. The Framingham criteria was used to assess for the presence of HF among patients [16].

Blood pressure (BP) was measured according to guidelines [17], using a standard automated BP machine (Heuer Company, from USA). Hypertension was defined as systolic BP of ≥ 140 mmHg and/or diastolic BP of ≥ 90 mmHg, or known hypertensive on medications, and was categorized as grade 1 (140-159/90-99 mmHg), grade 2 (160-179/100-109 mmHg) and grade 3 (≥ 180/≥ 110 mmHg) according to European Society of Cardiology guidelines [17]. Height, weight, waist and hip circumferences were measured following standard guidelines.

For each patient, a 10 ml of venous blood was collected and analyzed for cholesterol, glucose, creatinine, urea nitrogen and hemoglobin levels. High triglyceride levels were defined when serum triglyceride was > 1.69 mmol/l, raised LDL-C was defined when serum LDL-C was > 3.34 mmol/l, high total cholesterol was defined when serum total cholesterol was > 5.2 mmol/l and low HDL-C was defined when serum HDL-C was < 1.04 mmol/l, according to the Muhimbili National Hospital’s laboratory reference values. Estimated glomerular filtration rate (eGFR) was calculated from CKD-EPI equations [18] and renal dysfunction was considered to be present when a patient had eGFR of less than 60 ml/min/1.73 m². Anemia was defined as hemoglobin of less than 13 g/dl in men and 12 g/dl in women according to the World Health Organization [19].

Echocardiograms were performed using a General Electric (GE) Vivid S3 echocardiogram machine equipped with a 3.5 MHZ transducer, and the protocol followed the American Society of Echocardiography recommendations [20]. Left ventricular (LV) hypertrophy (LVH) was considered present when LV mass (LVM) indexed to body surface area (LVMI) was > 95 g/m² in women and > 115 g/m² in men. LVEF was determined using M-mode guided parasternal long-axis images of the left ventricle and was taken as a measure of LV systolic function. EF of < 50% was considered as systolic dysfunction [20]. LV filling was obtained by determining peak early velocity (E) at the level of the mitral leaflets’ tips, and the medial early diastolic mitral annular velocity (E’) was measured by spectral tissue Doppler imaging in apical four-chamber views. The ratio of E to E’ velocity (E/E’ ratio) was taken as an estimation of LV filling pressure and diastolic dysfunction was considered present when the E/E’ was ≥ 15 [21].

Patients with HF as per Framingham criteria were further categorized as HFrEF (when EF < 50%) or HFpEF (EF ≥ 50%) [10]. The diagnosis of HFpEF required the following conditions to be satisfied: (i) Positive diagnosis of HF as per Framingham criterion; (ii) LV EF ≥ 50%; (iii) LV diastolic dysfunction, i.e. E/E’ ≥ 15. The diagnosis of HFrEF was reached when the following conditions were satisfied (i) Positive diagnosis of HF as per Framingham criterion and (ii) Reduced LV systolic function on echocardiogram (i.e. LV ejection < 50%) [10].

Data handling and analysis

All questionnaires were scanned for completeness and coded before being entered into the dataset. Statistical package of Social Science for Windows (SPSS) version 21 was used for statistical analysis. Continuous variables were expressed as the mean ± SD, and categorical variables as n (%). The χ² or Fisher’s exact test was used to compare categorical variables, as appropriate. Student’s t test was used to compare the mean values. For statistical tests a two-tailed p-value < 0.05 was considered significant.

Ethical considerations

This study was conducted in accordance with the Helsinki Declaration of studies on human subjects. Ethical approval to conduct the study was obtained from...
Table 1: Demographic, clinical and laboratory characteristics of the study population.

| Variable                        | n (%) or mean ± SD |
|---------------------------------|--------------------|
| **Mean ± SD Age (years)**       | 58.3 ± 12.4        |
| **Age Categories, n (%)**       |                    |
| 18-40                           | 28 (8.1)           |
| 41-54                           | 100 (28.9)         |
| ≥ 55                            | 218 (63)           |
| **Female Sex, n (%)**           | 209 (60.4)         |
| **Place Of Referral, n (%)**    |                    |
| Outpatient                      | 305 (88.1)         |
| Inpatient                       | 41 (11.9)          |
| **Cardiovascular Risk Factors, n (%)** |                  |
| Diabetes                        | 44 (12.7)          |
| Smoking                         | 34 (9.8)           |
| Alcohol                         | 146 (42.2)         |
| **Family History of Cardiovascular Disease** | 152 (43.9) |
| **Anthropometric Variables**    |                    |
| Mean ± SD Height (cm)           | 166.2 ± 9.2        |
| Mean ± SD Weight (kg)           | 75.9 ± 16.2        |
| Mean ± SD BMI (kg/m²)           | 27.8 ± 5.3         |
| **Obesity Status, n (%)**       |                    |
| Normal Weight                   | 127 (36.7)         |
| Overweight                      | 113 (32.7)         |
| Obese                           | 106 (30.6)         |
| Mean ± SD Duration of hypertension | 6.8 ± 9.1         |
| Mean ± SD Systolic BP (mmhg)(mmhg) | 152 ± 23          |
| Mean ± SD Diastolic BP (mmhg)   | 91 ± 15            |
| **Hypertension Stage, n (%)**   |                    |
| Normal (Controlled) BP          | 100 (28.9)         |
| Stage 1                         | 98 (28.3)          |
| Stage 2                         | 85 (24.6)          |
| Stage 3                         | 63 (18.2)          |
| Mean ± SD Pulse Rate (beats/min) | 80 ± 15           |
| Tachycardia (≥ 100b/min), n (%) | 47 (13.6)          |
| **Laboratory Findings**         |                    |
| Mean ± SD Triglyceride (mmol/L) | 1.5 ± 0.7          |
| Raised Triglyceride, n (%)      | 120 (34.7)         |
| Mean ± SD Cholesterol (mmol/L)  | 5.3 ± 3.4          |
| Raised Cholesterol, n (%)       | 165 (47.7)         |
| Mean ± SD LdL-C (mmol/L)        | 3.6 ± 1.2          |
| Raised LDL-C, n (%)             | 202 (58.4)         |
| Mean ± SD HdL-C (mmol/L)        | 1.1 ± 0.2          |
| Low HDL-C, N (%)                | 154 (44.5)         |
| Mean ± Hemoglobin (g/dl)        | 12.6 ± 2           |
| Anemia, n (%)                   | 110 (31.8)         |
| Mean ± SD eGFR (ml/min/1.73 m²) | 72.7 ± 22          |
| Mean ± SD Urea Nitrogen (mmol/L)| 10.9 ± 7.7         |
| Proportion With Renal Dysfunction, n (%) | 85 (24.5)   |

BMI: Body Mass Index; BP: Blood Pressure; LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein; eGFR: Estimated Glomerular Filtration Rate
Prevalence of HF

One hundred and eight out of the 346 studied population fulfilled the Framingham criteria for HF. Among the 108 patients who met clinical criteria for HF, 26 had EF < 50%, while 82 had EF ≥ 50% in echocardiogram. Of the 82 participants with clinical HF and EF ≥ 50%, 6 did not meet the echocardiographic definition of diastolic dysfunction and therefore they did not have HF, leaving 102/346 (29.5%) as the true prevalence of HF in this population. Among 102 patients with HF, 76 (74.5%) had HFP EF and the remaining 26 (25.5%) had HFrEF (Figure 2).

Table 2: Symptoms and signs of HF among study patients.

| Variable                           | n  | (%) |
|------------------------------------|----|-----|
| **Symptoms**                       |    |     |
| Shortness of breath                | 185| 53.5|
| Palpitation                        | 182| 52.6|
| Lower limb swelling                | 132| 38.2|
| Nocturnal cough                    | 65 | 18.8|
| Orthopnea                          | 47 | 13.6|
| Paroxysmal nocturnal dyspnea       | 34 | 9.8 |
| Right upper quadrant pain          | 7  | 2   |
| **Signs**                          |    |     |
| Lower limb edema                   | 69 | 19.9|
| Gallop                             | 24 | 6.9 |
| Shift of apex beat                 | 16 | 4.6 |
| Raised jugular venous pressure     | 8  | 2.3 |
| Heaving apex beat                  | 19 | 5.5 |
| Basal crepitation                  | 10 | 2.9 |
| Tenderness of right upper quadrant | 4  | 1.2 |

Figure 1: Types of drugs used by hypertensive patients.

ARB: Angiotensin Receptor Blocker; CCB: Calcium Channel Blocker; ACEI: Angiotensin Converting Enzyme Inhibitor
significantly more concentric LV geometry, while those found to have HFrEF had significantly higher left atrial volume index as well as left ventricle internal diameter, indicating larger LV dimensions all p < 0.05 (Table 4).

**Discussion**

HF is a common complication of hypertension, and its burden may be higher in SSA due to the increased hypertension prevalence [5,6], late hospital presentation [3] and limited ability to diagnose the early disease [1]. In this cross-sectional study of hypertensive patients attending a referral hospital in Tanzania, we highlight 3 important findings that add to the current knowledge of hypertensive heart disease in the region. First, the prevalence of HF among hypertensive patients seen at a referral hospital in Tanzania is 29.5%; second, majority of hypertensive patients with HF have HFpEF; and third, hypertensive patients with HFpEF differ from those with HFrEF in a number of demographic and clinical characteristics.

The prevalence of HF found in this study is in keeping with the findings from a meta-analysis of 23 blood pressure-lowering clinical trials involving 193,424 hypertensives, in whom HF occurred in 28.9% [22]. The present findings also echo our understanding that hypertension is the most common underlying risk factor for HF in SSA accounting up to 45% of HF cases [4]. In population studies, hypertension confers a 2-3 folds increased hazard to HF development [23], indicating very strong links between hypertension and HF. The mechanism of HF in hypertension has been termed to involve chronic pressure overload that leads to the development of left ventricular hypertrophy and fibrotic changes that lead to progressive diastolic dysfunction and failure, while another subset of patients progresses to systolic dysfunction in the presence of chronic volume and pres-

**Table 3:** Echocardiographic findings of the study population.

| Variable                                      | n (%) or mean ± SD |
|-----------------------------------------------|-------------------|
| Interventricular Septum in Diastole (cm)      | 1.18 ± 0.2        |
| LV Posterior Wall in Diastole (cm)            | 1.12 ± 0.3        |
| LV Internal Diameter in Diastole (cm)         | 4.6 ± 0.7         |
| LV Mass Index (g/m²)                          | 111.1 ± 37.3      |
| Proportion with LV Hypertrophy                | 183 (52.9)        |
| Fractional Shortening (%)                     | 37.7 ± 8.6        |
| EF (%)                                        | 66.8 ± 12.4       |
| Proportion with Reduced EF                    | 33 (9.5)          |
| Left Atrial Diameter (cm)                     | 3.8 ± 0.6         |
| Left Atrial Volume Index (ml/m³)              | 30 ± 12           |
| Proportion with Left Atrial Enlargement       | 97 (28)           |
| E (m/s)                                       | 0.6 ± 0.2         |
| A (m/s)                                       | 0.75 ± 0.1        |
| E/A Ratio                                     | 0.9 ± 0.5         |
| Deceleration Time (ms)                        | 155 ± 62.1        |
| Isovolumic Relaxation Time (ms)               | 101 ± 22          |
| E’ (m/s)                                      | 0.08 ± 0.2        |
| E/E’ Ratio                                    | 12 ± 22           |
| Proportion with E/E’ ≥ 15                     | 71 (20.5)         |

LV: Left Ventricular; EF: Ejection Fraction

**Figure 2:** Distribution of HFpEF and HFrEF among hypertensive patients with HF.
to the current findings [15]. The difference between ours and the study by Ogah is likely due to the differences in the study population, as HF registry tend to include patients with end stage hypertensive heart disease, where those with diastolic dysfunction progress to have LV dilatation and eventual systolic dysfunction at the end of the hypertensive heart disease spectrum.

Table 4: Comparison between hypertensive patients with HFpEF and HFrEF.

| Variables                                | HFpEF n = 76 | HFrEF n = 26 | p value |
|------------------------------------------|--------------|--------------|---------|
| Mean ± SD age (years)                    | 61 ± 11      | 57 ± 14      | 0.113   |
| Age ≥ 55 years, n (%)                    | 57 (75)      | 14 (53.8)    | 0.023   |
| Women, n (%)                             | 49 (64.5)    | 15 (58)      | 0.64    |
| Inpatients, n (%)                        | 14 (18.4)    | 11 (42.3)    | 0.02    |
| Diabetes, n (%)                          | 10 (13.2)    | 6 (23.1)     | 0.348   |

**Symptoms, n (%)**

- Shortness of breath: 68 (89.5) vs 25 (96.2) (p = 0.442)
- Palpitation: 48 (63.2) vs 16 (61.5) (p = 0.912)
- Orthopnea: 51 (67.1) vs 18 (69.2) (p = 0.987)
- PND: 17 (22.4) vs 15 (57.7) (p = 0.001)
- Lower limb swelling: 48 (63.2) vs 15 (57.7) (p = 0.367)
- Right upper quadrant pain: 3 (4) vs 3 (11.4) (p = 0.334)
- Nocturnal cough: 42 (55.3) vs 20 (76.9) (p = 0.051)

**Physical findings**

- Mean ± SD Pulse rate (beats/min): 79 ± 18 vs 86 ± 17 (p = 0.063)
- Mean ± SD SBP (mmHg): 157 ± 23 vs 142 ± 28 (p = 0.011)
- Mean ± SD DBP (mmHg): 92 ± 23 vs 89 ± 17 (p = 0.258)
- Mean ± SD BMI (kg/m²): 29 ± 6.4 vs 26.2 ± 6.6 (p = 0.058)
- Obesity, n (%): 33 (43.4) vs 6 (23.1) (p = 0.001)

**Signs, n (%)**

- Raised JVP: 6 (7.9) vs 3 (11.5) (p = 0.690)
- Shifted Apex beat: 13 (17.1) vs 12 (46.2) (p = 0.005)
- Gallop rhythm: 11 (14.5) vs 20 (76.9) (p = 0.000)
- Basal crepitation: 3 (3.9) vs 7 (26.9) (p = 0.002)
- Lower limb edema: 30 (39.5) vs 13 (50) (p = 0.367)

**Laboratory findings**

- Mean ± SD Hemoglobin (g/dl): 12.4 ± 1.6 vs 11.6 ± 2 (p = 0.001)
- Mean ± SD Creatinine (µmol/l): 121.5 ± 87 vs 130.7 ± 117 (p = 0.11)
- Mean ± SD BUN (mmol/l): 12 ± 12.7 vs 12.2 ± 8.8 (p = 0.15)
- Mean ± SD eGFR (ml/min/1.73 m²): 68.6 ± 24 vs 70.6 ± 30 (p = 0.204)
- Renal dysfunction, n (%): 22 (28.9) vs 10 (38.5) (p = 0.463)

**Echocardiographic findings**

- Interventricular septum in diastole (cm): 1.35 ± 0.2 vs 1.1 ± 0.3 (p = 0.001)
- LV internal diameter in diastole (cm): 4.6 ± 0.6 vs 5.6 ± 0.8 (p = 0.000)
- Left atrial volume index (ml/m²): 32.5 ± 12 vs 43.4 ± 16 (p = 0.001)
- Proportion with LVH, n (%): 57 (75) vs 22 (84.6) (p = 0.419)
- Proportion with enlarged LA n (%): 32 (42.1) vs 16 (61.5) (p = 0.112)
- Mean ± SD E/E’: 15.8 ± 5 vs 20.9 ± 11 (p = 0.002)

BMI: Body Mass Index; PND: Paroxysmal Nocturnal Dyspnea; JVP: Jugular Venous Pressure; n: Number; SD: Standard Deviation, HFpEF: Heart Failure with Preserved Ejection Fraction; HFrEF: Heart Failure with Reduced Ejection Fraction.

Our finding that majority of patients with hypertensive HF have HFpEF is similar to many previous studies that studied hypertensive-only HF cohorts [25-27], and underscores the importance of diastolic HF in this population. However, Ogah, et al. found a 35% proportion of HFpEF in a hypertensive HF registry in Nigeria contrary to the current findings [15]. The difference between ours and the study by Ogah is likely due to the differences in the study population, as HF registry tend to include patients with end stage hypertensive heart disease, where those with diastolic dysfunction progress to have LV dilatation and eventual systolic dysfunction at the end of the hypertensive heart disease spectrum.

sure overload [24].
Nevertheless, active search for HF among hypertensive patients is recommended as most of the patients with HFrEF could have been missed if only ejection fraction was used to categorize HF. Of note, the diagnosis of HFrEF is tricky and it requires thorough assessment of diastolic function to determine presence of increased LV filling pressures. Our definition of diastolic dysfunction as E/E’ of ≥ 15 indicate marked raise in LV filling pressures, and therefore true diastolic dysfunction. Of note, these patients had similar proportion of dyspnea which is the hallmark of HF, similar to patients with HFrEF (Table 4). As suggested by guidelines, patients with diastolic HF require similar medications and follow-up as for those with HFrEF.

In this study, hypertensive patients found to have HFrEF were more likely to be older adults (≥ 55 years), obese and with higher mean systolic BP when compared to those with HFrEF. These findings are similar to current knowledge of this subset of HF patients, and our findings confirms this observation also among native Tanzanian hypertensives. However, other risk factors including diabetes mellitus and female gender did not show significant associations as previously reported, most likely due to the fact that the current study was not powered to detect these associations, and only trends could be seen. Not surprisingly, clinical signs of shifted apex beat, gallop rhythm, basal crepitations which signify more volume overload were more frequently seen in HFrEF when compared to the group found to have HFrEF, in keeping with previous studies in literature.

As expected, patients with HFrEF had more concentric LV geometry on echocardiogram, which is the underlying cause of diastolic dysfunction in hypertensive patients. Of note, while the mean LA volume was high in both groups, those with HFrEF had higher volumes, indicating that patients with HFrEF are at the end spectrum of hypertensive HF, and they are likely to have passed the LV diastolic dysfunction before progressing to HFrEF. This is also confirmed by the higher mean E/E’ in the HFrEF group. In short, patients with HFrEF also have diastolic dysfunction while patients with HFrEF have diastolic dysfunction without systolic dysfunction, confirming the notion that diastolic and systolic HF are not independent or separate entities, rather HF is a single continuous disease spectrum and systolic and diastolic HF are phenotypes at two extremes; as advocated by the single syndrome hypothesis of HF.

The strength of this study include its prospective nature which allowed for objective and thorough assessment of clinical and echocardiographic parameters, therefore likely to have captured most of hypertensive patients with HF. We did not systematically determine biomarkers of HF like NT-Pro BNP levels in this study, therefore it is possible that some of the HF symptoms could have been due to other conditions like chronic obstructive pulmonary disease. However, the use of the Framingham criteria together with echocardiogram must have offset most of these biases.

Conclusion

In conclusion, the prevalence of HF among hypertensive patients being followed-up at a tertiary hospital in Tanzania is high, and the majority of patients with HF present as HFrEF. We recommend active screening for HF especially in the obese, elderly and uncontrolled hypertensive patients, as they may present with HFrEF which can pass unnoticed.

Disclosure Statement

The authors report no conflicts of interest.

Funding Details

Not applicable.

Competing Interests

The authors declare that they have no competing interests.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors’ Contributions

GN and PC conceived the research idea. GN recruited patients and did data entry. GN and PC performed echocardiogram, analyzed and interpret data. Both authors drafted the manuscript, have read and approved the final manuscript.

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