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Heart failure subjects among Africans: Any contributions from coronary artery diseases? An electrocardiographic and echocardiographic analysis

Adeseye A. Akintunde[1,2]

1 *Department of Medicine, Faculty of Clinical Sciences, College of Health Sciences, Ladoke Akintola University of Technology (LAUTECH) & LAUTECH Teaching Hospital, Ogbomoso, Nigeria*

2 *Goshen Heart Clinic, Osogbo, Nigeria*

Abstract

Background: Despite the rise in risk factor burden for coronary artery disease (CAD) and heart failure among Africans, post myocardial infarction heart failure is rarely reported. **Aim and Objectives:** We aim to use major electrocardiographic indices suggesting old myocardial infarction and echocardiographic evidence of relative wall motion abnormalities to determine the possible contribution of CAD to the aetiology of heart failure among Africans. **Study Design:** Prospective observational study. **Setting:** Goshen Heart Clinic, Osogbo, Nigeria. **Methods:** 129 consecutive subjects with heart failure diagnosed using the Framinghams's criteria were included in this study seen at the Goshen Heart Clinic, Osogbo, Nigeria. They had ECG and echocardiography among other investigations. Old Myocardial infarction (MI) on ECG was assessed using standardized criteria using the Third Universal definition of MI while relative wall motion abnormalities were assessed during echocardiography. Statistics: Statistical Package for Social Sciences 17.0 was used for statistical analysis. **Results:** The mean age of the study participants was 62.1 ± 13.7 years. There were 57 females (44.2%). Possible CAD was identified in 18 (13.95%) of study participants and they were more likely to be significantly older, had a lower ejection fraction , a higher fasting blood sugar and a higher left ventricular chamber walls dimensions compared to those without possible CAD. **Conclusion:** CAD may be a significant contributor to the aetiology of heart failure subjects among Africans and it is important to look for possible significant coronary atherosclerosis and treat appropriately even among Africans with heart failure. Concerted treatment for CAD risk factors is an important way to reduce the increasing burden of CAD among Nigerians.

Keywords: Coronary artery diseases (CAD), Electrocardiographic, Echocardiographic, Morphine.

INTRODUCTION

Morphine addiction is Heart failure has been described as the cardiovascular epidemic of the 21st century.[1-2] There is also reported increased incidence in most parts of Africa mainly due the increasing prevalence of many cardiovascular risk factors such as hypertension, diabetes, obesity etc. [3-4] Coronary artery disease/ ischaemic heart disease has earlier being reported to be rare among Africans is fast becoming an important cause of morbidity and mortality in Africa with similar risk factor profile and prognosis as in the Caucasians. [5,6] it has been postulated that Africans may not present classically with the angina pain in CAD due to genetic and/or environmental factors.[7] Some significant proportion of coronary artery disease patients who gets to the hospital care ultimately presents with heart failure.[8,9] The management of heart failure is an important milestone in the post-infarction stages of CAD patients.[10,11] Due to the scarcity of cardiac catheterization laboratories in most parts of Africa, coronary angiographies are not routinely done for many heart failure patients that could have benefitted from them. The aetiology of heart failure in Africa are mainly related to hypertension, cardiomyopathy and rheumatic valvular heart disease.[12] Among 1006 Africans with heart failure from 9 countries, ischaemic heart disease was reported to be an uncommon cause of acute heart failure.[5,13] It is possible that some might suffer silent ischaemic heart disease without its classical chest pain. Africans also possibly have a higher pain threshold and may therefore present later with sequeale of loss of significant myocardial mass presenting with features of heart failure. It is postulated that a significant proportion of our heart failure subjects may have electrocardiographic indices of silent coronary ischaemia/infarction and or echocardiographic indication of relative wall motions abnormalities. According to the Third Universal definition of myocardial infarction released recently by the European Society of Cardiology (ESC), electrocardiographic abnormalities and echocardiographic abnormalities are adjuncts in the diagnosis of

***Corresponding author:**
Dr. Adeseye A. Akintunde
Department of Medicine, Faculty of Clinical Sciences, College of Health Sciences, Ladoke Akintola University of Technology (LAUTECH) & LAUTECH Teaching Hospital, Ogbomoso, Nigeri

CAD in subjects.[14]

We therefore aimed at using 12-lead ECG of patients with heart failure(both with reduced and preserved ejection fraction) and echocardiography to identify those with likely CAD and therefore those who may likely benefit from coronary revascularization and optimized medical therapy to reduce the associated morbidity and mortality.

MATERIALS AND METHODS

The clinical records of all heart failure seen between May 2011 and December 2014 in a private Cardiology clinic in Osogbo, South West Nigeria were retrieved. The study centre is Goshen Heart Clinic, Osogbo, Nigeria. All potential subjects were included if they were >18 years old. Subjects with previous ECG diagnosis of left bundle branch block or other serious co-morbidities including cancers, advanced kidney disease and stroke were excluded. Subjects with metabolic abnormalities such as hyperkalaemia, those taking tricyclic antidepressants, early repolarisation abnormalities, history suggestive of pulmonary embolism were also excluded from the analysis. Information obtained from the clinical records include age, gender, occupation, clinical features of heart failure, drug history, history of hypertension and diabetes mellitus, smoking history, alcohol history and duration of symptoms. Height, weight, waist circumference, average systolic and diastolic blood pressure and pulse rate were obtained. Electrocardiography was done using ECG 1200 by Contec Medical systems, China. Echocardiography was performed using the HP Sonos 2500 by HP inc. USA with a 2.7/3.5MHz probe. All echocardiography were performed according to standardized American Society of Echocardiography guideline on quantification and evaluation of systolic and diastolic parameters and chambers assessment.[14,15] The following parameters were obtained: left ventricular internal dimension in diastole (LVIDd), left ventricular internal dimension in systole (LVIDs), left ventricular posterior (PWTd) and septal wall dimension (IVSd) in diastole, ejection fraction (EF), fractional shortening (FS), left atrial dimension (LAD), right ventricular wall dimension (RVD), aortic root dimension(AOD) and aortic cusp separation (ACS). Global and regional assessment for wall motion abnormalities were made visually and reported. The electrocardiography was interpreted by the author blinded to the clinical data of the subjects. Parameters such as heart rate, rhythm, QRS axis, PR interval and QTc were obtained. Left ventricular hypertrophy was defined using either the Sokolow Lyon criteria and/or the Araoye criteria.[16-18] Fasting blood sugar, lipid profile including high density lipoprotein- cholesterol, low density lipoprotein cholesterol, total cholesterol and triglycerides were obtained using a rapid point of care, strip based test LipidPro by Infopia Ltd, Korea.

Possible contribution from coronary artery diseases were identified using the criteria from the Third Universal definition for acute myocardial infarction as any of the following.[19]

1. ECG changes of left bundle branch block
2. Persistent Reciprocal ST-T changes in at least two contiguous ECG leads
3. Pathologic Q waves on the 12 lead ECG
4. Echocardiographic evidence of regional wall motion abnormalities

The ECG criteria for prior myocardial infarction was defined as

1. Any Q wave ≥ 0.02sec or QS complex in V2/V3 OR
2. Q wave≥ 0.03 sec or ≥ 0.1mV deep or QS complex in leads I, II, aVL, aVF or V4-V6 in any 2 leads of contiguous lead grouping (I, aVL, V1-V6; II, III, aVF) OR
3. R wave ≥ 0.04 sec in V1-V2 and R/S ≥1 with a concordant positive T wave.

A patient was classified as having an old myocardial infarction if he/she has any significant ECG change including any of the three criteria above or echocardiographic evidence of relative wall thickness.

Data was analysed using the Statistical Package for Social Sciences SPSS version 17.0. Numerical data were summarized as mean ± standard deviation. Qualitative data were summarized as frequency and percentages. Student t-test, Analysis of variance and chi square test were used as appropriate to determine differences between groups. P <0.05 was taken as statistically significant.

RESULTS

Table 1 shows the clinical, electrocardiographic and echocardiographic characteristics of the study participants. The mean age was 62.1 ±13.7 years and females constituted 43.4% of the study population. The mean systolic blood pressure was 136.6 ±28.6 mmHg while the mean diastolic blood pressure was 83.2 ±17.6 mmHg. The mean fasting blood sugar was 4.7±2.2 mmol/l. With respect to ECG markers of old MI, R wave abnormalities as stated in the methodology section was found in 11(8.5%), while relativewall motion abnormalities on echocardiogram was detected in 8(6.2%) of study participants. Pathologic Q waves in contiguous leads and left bundle branch bloc were found in 13(10.1%) and 3(2.3%) respectively. ST-T wave abnormalities were however found in majority of heart failure subjects 68(52.7%). The frequency of study participants with at least one of the three major criteria used to identify old MI was 18 (13.95%). ST-T changes was not used because of its non specificity while left bundle branch block was not used due to the fact that it could not be substantiated that it developed recently or was caused by other pathologies.

Table 1: clinical characteristics of study participants

Variables	
Age (years)	62.1 ±13.7 years
Female Gender (n)	56 (43.4%)
Systolic blood pressure (mmHg)	136.6 ±28.6 mmHg
Diastolic blood pressure (mmHg)	83.2 ±17.6 mmHg
Fasting blood sugar (mmol/l)	4.7±2.2 mmol/l
LVDD (mm)	49.0± 11.9
LVSD (mm)	37.3±12.7
PWTd (mm)	12.6 ±1.9
IVSd (mm)	12.7±2.4
EF (%)	56.2 ± 12.4%
RVD (mm)	29.5± 5.4
LAD (mm)	45.9± 9.2
R wave abnormalities (n)	11(8.5%)
Relative wall motion abnormalities (n)	8(6.2%)
ST-T wave abnormalities	68(52.7%)
Pathologic Q wave in contiguous leads (n)	13(10.1%)
Left bundle branch block (n)	3(2.3%)
Proportion of those with possible silent old CAD(n)	18/129 (13.95%)

KEY TO WORDS- LVDD-left ventricular internal dimension in diastole, LVSD- left ventricular end systolic dimension,, PWTd- posterior wall thickness in diastole, IVSd-interventricular septal thickness, EF-Ejection fraction, RVD-right ventricular dimension, Left atrial dimension, CAD-coronary artery disease.

Table 2 shows the clinical, demographic and echocardiographic differences between subjects identified with possible old MI and those without. Those with possible old MI were more likely to be significantly older in age, (65.44 ± 10.3 years vs. 61.3 ± 14.6, P<0.05), more likely to be males and had a significantly lower ejection fraction (41.11± 10.5% vs. 48.0 ± 12.1%, p<0.05) compared to those without possible old MI. The histories of previous diagnosis of diabetes mellitus or hypertension

were not significantly different between the two groups. The mean fasting blood sugar was significantly higher among those with possible old MI compared to those without possible old MI as shown in table 2. Left ventricular chamber wall dimensions were significantly higher among those without possible old MI in the study population. Left ventricular end diastolic internal dimension was significantly higher among those with possible old myocardial infarction compared to those without possible old MI (51.4± 9.9mm vs. 48.6± 12.6, p<0.05 respectively).

Table 2: clinical characteristics of heart failure subjects with silent old MI compared to those without

Variable	Those with silent MI (18)	Those without ECG/Echo features of silent MI	P value
Age(years)	65.44 ± 10.3	61.3 ± 14.6	0.0351*
Gender (F/M)	6/12 (33.3%)	49/62 (44.1%)	0.390
NYHA III/IV (n)	6/18	36/111	0.284
Previous diagnosed T2DM (n)	3/18	21/111	0.567
LVDD (mm)	51.4± 9.9	48.6± 12.6	0.048*
EF (%)	41.11± 10.5	48.0 ± 12.1	0.034*
PWTd (mm)	11.7 ±1.7	12.8± 2.5	0.0219*
IVSd (mm)	12.0 ±1.5	12.7± 2.0	0.0307*
History of HTN (n)	14/18	87/111	0.954
Fasting blood sugar (mmol/l)	6.3± 2.3	5.4 ± 1.7	0.04*

*- statistically significant

KEY TO WORDS- LVDD-left ventricular internal dimension in diastole, LVSD- left ventricular end systolic dimension, PWTd- posterior wall thickness in diastole, IVSd-interventricular septal thickness, EF-Ejection fraction, HTN- hypertension, NYHA- New York Heart Association, T2DM- Type 2 Diabetes Mellitus

DISCUSSION

Heart failure is a significant and relatively common complication of acute myocardial infarction. In a national registry of myocardial infarction patients, 20.4% were admitted with heart failure and an additional 8.6% developed HF subsequently. [20] In the Valsartan in Acute Myocardial Infarction Trial (VALIANT Trial) heart failure after admission was recorded in 23.1% of patients. [21] this increased to 36% over a mean follow up of 7.6 years in the Framingham heart study.[22] In other reports, heart failure complicates up to 60% of myocardial infarction and those that are at greatest risk include elderly, females and those with previous myocardial infarction. Long term mortality remains high in them. [23]

This study revealed that a sizable proportion of heart failure subjects in Nigeria have electrocardiographic and /or echocardiographic features of silent old Myocardial infarction/coronary heart disease despite the absence of significant chest pain suggesting same in their previous medical history. This is significant because these are likely subjects whose heart failure prognosis can greatly be improved by revascularization and other ancillary therapy for coronary heart disease. Heart failure among Africans has been predominantly linked to hypertension, rheumatic heart disease and cardiomyopathies in aetiology. [24,25,26] The prognosis of heart failure is equally dismal like in developed countries. [27]

In the INTERHEART study, CAD has been related to similar risk factors among Blacks and whites in more that 95% of cases including hypertension, dyslipidaemia, obesity and physical inactivity.[28] Recent report have suggested that CAD is continually being reported among Africans.[29,30] Therefore it is not out of place to suggest that a sizable fraction of patients with CAD may actually present with heart failure following acute coronary syndrome/ myocardial infarction. We suggest that there may be a variation in the pain sensitivity among Black Africans so that they present with little or no pain during acute coronary syndrome or due to the widespread availability of analgesics, most patients would have abuse them and may lead to lack of presentation in the usual way.

Despite growing recognition of increasing burden of cardiovascular disease in low and middle income countries, trends in the prevalence of acute myocardial infarction in sub-Saharan Africa has not been well described mainly due to the lack of cardiac catheterization laboratories for coronary angiography. In a review of studies reporting acute myocardial infarction in sub-Saharan Africa defined by elevation of cardiac enzymes and ECG changes, a prevalence of 0.1% to 10.4% was reported. [31] This suggest that Acute myocardial infarction is not too uncommon afterall among Africans .

This study underscores limited report of post myocardial infarction heart failure from Africa. Kolo et al. reported 3/13 (23.1%) of subjects who had myocardial infarction in University of Ilorin Teaching Hospital in North Central Nigeria, over a four year period developed chronic left ventricular systolic failure. Coronary artery disease is all the same not too rare in Nigerians. Johnson et al. reported the prevalence of CAD among Nigerians who had coronary angiography in a private facility in Lagos Nigeria as 52.6% with 96.3% of them having significant stenosis and were candidates for revascularization. [32] in other dime except in Africa, ischaemic heart disease was reported to be the most common cause of heart failure. [33]

This study also revealed that those with likely silent CAD among heart failure subjects were more likely to be significantly older, more likely to be females ,had a significantly larger left ventricular internal dimension in diastole and a higher fasting blood sugar compared to those with no ECG /echocardiographic indication of CAD. Posterior wall thickness, interventricular septal diameter were significantly higher among those with silent MI while ejection fraction was significantly lower among those with silent MI compared to those without MI. This further lends credence to the fact that those with silent MI may have a greater burden of disease and may be at a greater cardiovascular risk compared to their counterpart. Revascularization may likely improve the prognosis of such patient over time as it has been shown in many studies. It is noteworthy that no differences were reported for frequencies of diabetes mellitus or hypertension among subjects with silent CAD compared to those without it in this study. Most of these are in keeping with the pattern described among Caucasians except that the gender association in males described in this study may be particularly related to the increased burden of CV risk factors among men in Africa. Although ST-T wave abnormalities were very common among heart failure subjects, we suggest they are due to repolarisation abnormalities, subendocardial ischemia and possible electrolyte abnormalities associated with heart failure and/or its management.

CONCLUSIONS

This study therefore concludes that a sizable proportion of heart failure subjects seen in a specialty outpatient clinic had ECG/echocardiographic pointers of possible old MI/ CAD and this might have contributed as aetiology of their heart failure with potential benefit from coronary angiography and revascularization. It also suggests that these subjects had a higher cardiovascular burden and seem to have a worse disease association. Therefore, ischemic heart disease should be borne in mind as a possible aetiology in heart failure among Africans especially among those with advanced diseases.

Author's contribution

AAA designed the study, collected the data, analysed the data and wrote the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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