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The role of echocardiography in the management of patients with congestive heart failure. "Tanzanian experience"

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Abstract

Objectives: To evaluate the usefulness of echocardiography in managing patients with congestive heart failure (CHF) and identify risks of mortality and heart failure re-admissions during follow up.
Design: A descriptive prospective hospital based study.
Setting: Muhimbili National Hospital and Hindul Mandal Hospital in Dar es Salaam, Tanzania.
Subjects: 360 patients (198male and 162 female) admitted due to congestive heart failure had echocardiography done.
Main Outcome Measures: Identifying and characterizing echocardiographic features specific for evaluating patients with congestive heart failure. The patients were followed up for at leas one year.
Results: 122 patients had normal left ventricular ejection fraction (LVEF) and 238 patients had reduced left ventricular fraction. Patients with normal LVEF tended to be older and female and were more likely to have a history of hypertension whereas patients with reduced LVEF had a longer history of heart failure due to dilated cardiomyopathy or valvular heart disease. Seventy nine patients (21.9%) died. Patients with depressed ejection fraction had a higher death rate during follow up as compared with preserved ejection fraction.
Conclusion: We had demonstrated that echocardiography is a useful non-invasive tool for assessing patients with CHF due to systolic or diastolic dysfunction.

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Introduction

Congestive heart failure (CHF) is a major public health problem that is associated with markedly diminished survival.[1,2] The reported proportion of CHF patients with normal left ventricular systolic function has ranged from 13% to 75% and the reported annual mortality rate has varied from 1.3% to 17.5%.[3] This implies that abnormal left ventricular diastolic function is the mechanism responsible for producing congestive symptoms in these patients.[3] The approach to treatment may differ depending on whether systolic or diastolic dysfunction is predominant. Because clinical findings fail to distinguish patients with systolic or diastolic dysfunction,[4] several institutions recommend echocardiography in all patients with suspected congestive heart failure.[5]

Unfortunately, no data are available on use and outcome of patients studied with echocardiography, in the management of congestive heart failure in our region. Therefore, we prospectively assessed the relative proportions of normal versus impaired left ventricular systolic function among persons with CHF in a hospital based study sample and assessed the risks of mortality and heart failure re-admissions during follow up.

Materials and Methods

Patients Selection.
We screened consecutive patients admitted to Muhimbili National Hospital and Hindu Mandal Hospital between April 1999 and March 2004, who were above eight years of age and admitted with a diagnosis of congestive heart failure. This study was approved by the ethical committees of both hospitals. All patients, in whom modified Framingham diagnostic criteria[6] for congestive heart failure were met, were included in the study. Physicians' notes were examined for indication of major and minor criteria for congestive heart failure. The major diagnostic criteria included: paroxysmal nocturnal dyspnea; orthopnea; abnormal jugular venous distension; rales; cardiomegaly; pulmonary oedema in the presence of the third heart sound and central venous pressure of more than 16 cm of water. The minor criteria included: oedema; night cough; dyspnoea on exertion; hepatomegaly; pleural effusion; tachycardia and weigh loss of 4.5kg or more in five days. Persons were assigned a diagnosis of congestive heart failure if two

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major criteria were present or alternatively, if one major and two minor criteria were present concurrently. Patients excluded were those having congestive heart failure secondary to high output state or non-cardiac disease.

Clinical Observation.
Patients were interviewed within three days of admission for demographic information and baseline functional status. The age at diagnosis, gender and specific clinical characteristics were recorded. The presence of underlying cardiovascular disease such as hypertension, valvular heart disease of coronary heart disease was noted. The subsequent medical therapy prescribed after the diagnosis was recorded.

After a thorough medical history and physical examination, 12 lead electrocardiogram, full blood picture and blood biochemistry test were done. Two dimensional echocardiography was performed on study participants at the entry of the study and after one year.

Echocardiographic Methods.
At the index examinations, all participants routinely underwent M-mode, two dimensional and Doppler echocardiography. Echocardiograms were performed at Hindu Mandal Hospital Echocardiographic laboratory according to the recommendations of the American Society of Echocardiography.[7] For the purpose of this study, congestive heart failure patients were divided into two groups: those with normal left ventricular systolic function (LVEF≥0.50) and those with impaired left ventricular systolic function (LVEF<0.50). For convenience these two groups are referred to as "preserved EF" and "depressed EF) groups respectively.

Follow Up.
All study subjects were routinely followed for up to one year. The duration of follow up was defined as, the interval from the date of the index examination at which the echocardiogram was obtained, to the date of death or the date of last contact.

Statistical Methods.
Data was entered and analysed using the Statistical Package for Social Sciences (SPSS/PCT version 10) for the IBM/AT microcomputer. Demographic, clinical characteristics and medications were candidate covariates. These were compared between patients with preserved EF and depressed EF using the Pearson Chi-square test for categorical variables and the Wilcoxon rank-sum test for continuous variables. Association between selected outcomes and ordinal categories of EF (≤ 25, 26 to 36, 37 to 49 and ≥ 50) were tested using the Chi-square for trend. Multivariable modes wre generated adjusting for covariates with a p value <0.20. The covariates eligible for entry in the final model included age, gender, duration of CHF, history of coronary artery disease, history of stroke, cigarette smoking, *diabetes mellitus*, pulmonary disease, atrial fibrillation, valvular disease, systolic and diastolic blood pressure and left ventricular hypertrophy on the electrocardiogram. A p value of <0.050 was considered statistically significant.

Results

A total of 390 subjects with congestive heart failure (CHF) were studied. Of the 390 subjects with CHF, 30 subjects (7.7%; 13 men and 17 women) were excluded. Twelve subjects because they did not attend any follow up examination during the study period, and 18 subjects because of inadequate echocardiograms. Three hundred and sixty (92.3%, 198 men and 162 women) congestive heart failure patients had adequate echocardiogram after the onset of CHF and were eligible for the present investigation. The median duration of CHF at the time of echocardiographic assessment was 1.4 years (range 0.2 to 11 years) and was similar for men and women.

On physical examination, third and fourth heart sounds were more common in the "depressed EF" group. On chest radiography, interstitial pulmonary oedema and bilateral pleural effusions were more common in the "depressed EF" group, whereas cardiomegaly was present equally in the depressed EF groups. Electrocardiographic features were similar in the two groups (Table I).

Table I: Baseline clinical characteristics of congestive heart failure patients.

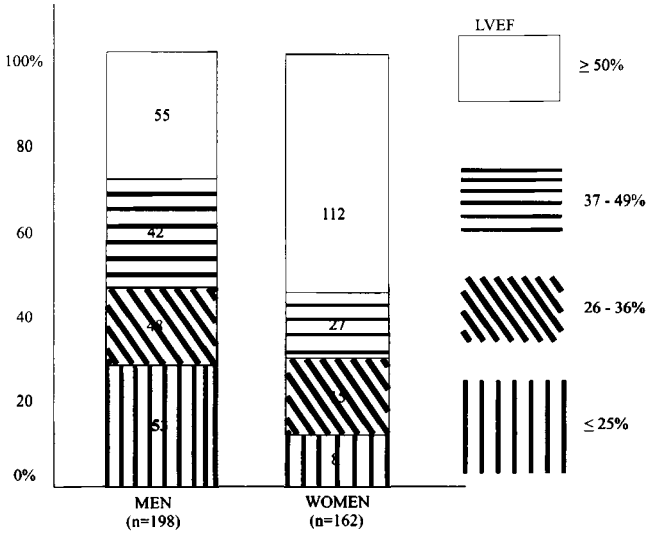
Characteristics	Preserved EF (n=122)	Depressed EF (n=238)	p value
• Age (years)	72±5	60±8	0.01
• Male gender	10 (8.2%)	118 (78.9%)	0.0001
Cardiac History			
• Any previous hospitalization for FH	18 (15.6%)	114 (47.9%)	0.001
• Years of heart failure	1.2±2.8	3.1±2.9	0.003
• Hypertension	91 (74.5%)	130 (54.6%)	0.001
• Arrhythmia	11 (9%)	74 (31%)	0.004
• Angina pectoris	10 (8.2%)	26 (11.9%)	0.89
• Myocardial infarcation	7 (5.7%)	21 (8.8%)	0.04
• CABG	1 (1.0%)	19 (7.9%)	0.01
• Valvular heart disease	21 (17.2%)	105 (44%)	0.001
Non Cardiac History			
• Renal insufficiency	8 (6.6%)	31 (13%)	0.01
• Respiratory disease	10 (8.2%)	21 (8.8%)	0.75
• *Diabetes mellitus*	12 (9.8%)	48 (20.2%)	0.01
• CVA/Stroke	6 (4.9%)	12 (5.0%)	0.75
Physical Examination			
• Elevated JVP	55 (45%)	138 (57.9%)	0.01
• Third heart sound	11 (9%)	121 (50.8%)	0.001
• Fourth heart sound	4 (3.3%)	71 (29.8%)	0.0001
Chest Radiography			
• Cardiomegaly	82 (67.2%)	212 (89.1%)	0.01
• Interstial pulm. oedema	33 (27%)	126 (52.9%)	0.001
• Pleural effusion	31 (25.4%)	114 (47.9%)	0.001
Electrocardiogram			
• AF and atrial flutter	24 (19.7%)	62 (26.1%)	0.32
• LBBB	10 (8.2%)	19 (7.9%)	0.78
• LVH	54 (44.3%0	21 (8.8%)	0.05
• Any MI pattern	17 (13.9%)	57 (23.9%)	0.05
Laboratory values			
• Creatinine ≥200μmol/l	17 (13.9%	107 (44.9%)	0.001
Medications Discharge			
• Diuretics	38 (31.1%)	221 (92.9%)	0.001
• Digoxin	40 (32.8%)	195 (81.9%)	0.001
• ACE inhibitors	26 (21.3%)	155 (65.0%)	0.001
• Beta blockers	49 (40.2%)	81 (34.0%)	0.20
• Nitrates	15 (12.3%)	35 (14.7%)	0.09
• Vasodilators	9 (7.4%)	28 (11.8%)	0.14
• Warfarin	7 (5.7%)	62 (26.0%)	0.001
• Asprin	36 (29.3%)	80 (33.1%)	0.41

Data presented as the mean value _ SD or number (%) of subjects.
ACEI - Angiotension converting enzyme inhibitor.
CABG - Coronary artery bypass graft.
CVA - Cerebrovascular accident.
AF - Atrial fibrillation.
EF - Ejection fraction.
HF - Heart failure.
LBBB - Left bundle branch block.
LVH - Left ventricular hypertrophy.

One hundred and twenty two CHF cases (33.9%, 95% CI 21% to 43%) had normal LVEF, whereas 238 CHF cases (66.1%, 95% CI 52% to 74%) hand reduced LVEF. Of the 162 women with CHF in the study sample, only 50 (30.9%, 95% CI 15% to 49%) had reduced LVEF. In contrast of 198 men with CHF, 143 (72.2%; 95% CI 57% to 87%) had reduced LVEF.

The distribution of values of LVEF among CHF cases is depicted in Figure I. Patients with "preserved EF" tended to be older and female and were more likely to have a history of hypertension, whereas patients with "depressed EF" were more likely to have a longer history of heart failure due to dilated cardiomyopathy or valvular heart disease. Among the CHF cases, multiple logistic regression analysis revealed an association of female gender with the presence of a normal LVEF (odd ratio for reduced LVEF 25%; 95% CI 11% to 73%).

Figure I: The distribution of left ventricular ejection fraction (LVEF) values among men and women with congestive heart failure is displayed in the figure. One hundred and forty three of 198 men (72.2%) had a reduced LVEF (< 50%) compared with only 50 of 62 women (30.9%).



Patients in the "preserved EF" group were less likely to be treated with angiotensin converting enzyme inhibitor, digoxin or anticoagulant drugs, but they were as likely to be treated with diuretic agents. Twelve patients underwent valve replacement within 12 months after diagnosis of CHF. It is noteworthy that over 52% of normal systolic CHF cases were taking digoxin without a history of atrial fibrillation.

A total of 150 patients (41.7%) were re-admitted for any cause with 65 (43.3%) re-admitted for heart failure. After adjusting for age, gender, history of heart failure, years of heart failure, baseline creatinine and discharge medications (ACE inhibitors, diuretics, beta blockers and digoxin) "preserved EF" was not associated with an increased risk of all-cause re-admission (HR 1.02; 95% CI 8% to 14%; p=0.85). A total of 79 patients (21.9%) died. Patients with depressed EF had a higher death rate during follow up as compared with patients with preserved EF (28.6% to 9.0%, p=0.001).

Table II: Unadjusted outcomes at 12 months follow up.

Clinical Outcomes	Preserved (EF (n=122)	Depressed (EF (n=238)	p value
Mortality			
• Death during follow up	11 (9%)	68 (28.6%)	0.01
• Death during index	4 (3.3%)	2 (1.0%)	0.61
Readmissions			
• Readmission (any)	35 (28%)	115 (48.3%)	0.02
• Readmission (HF)	26 (40%)	39 (60%)	0.13

Data are presented as the number (%) of subjects or mean value ±SD.

The proposition of patients who died decreased with greater EF; EF≤ 25% (31% n=32); EF 26% to 36% (15% n=26); EF 37% to 47% (13% n=8); EF ≥50% (11% n=13) (p=0.005 for trend). The cause of death could be ascertained in 64 of the 79 subjects who died on follow up. Fifty percent of deaths among CHF patients with a normal LVEF and 74% of deaths among CHF patients with a reduced LVEF were attributed to cardiovascular events.

Discussion

Although the epidemiology of CHF has been well characterized,[1,2] the relative contributions of impaired versus intact LV systolic function to the prevalence of this disease in our region, where infectious cardiology is common, is unknown. Using echocardiography, we found that 33.9% of the CHF cases in our sample had normal LVEF. Our results confirmed prior findings from hospital-based series[1,8,9] which highlighted the frequent presence of normal left ventricular systolic function among CHF patients.

Women with CHF were more likely than men to have a normal LVEF. Among CHF cases, 69.12% of the women had a normal LVEF compared with 27.78% of men. This finding is consistent with prior reports of a female preponderance among patients with CHF and normal left ventricular systolic function.[10,11]

The assessment of systolic function provided by echocardiography is critical to the management of patients with heart failure. After echocardiography, patients were treated more frequently with the four major classes of drugs known to improve symptoms diuretics, digoxin, ACE inhibitors and beta-adrenergic blockers and much more frequently with ACE inhibitors (65% vs 25%), the drug known to prolong life in CHF. ACE inhibitors are indicated in patients with an EF< 40%, regardless of their symptoms.[12,13] Although the recently published digoxin trial did not demonstrate an effect on survival, digoxin therapy did decrease the subsequent hospitalization for congestive heart failure in patients with abnormal systolic function and symptoms of heart failure.[14]

Most authorities agree that digoxin probably is not indicated in patients with heart failure and normal systolic function in the presence of normal sinus rhythm. Also echocardiography may guide therapy by identifying patients with advanced diastolic dysfunction who may experience complications if treated aggressively with vasodilator or diuretic agents.[15]

Patients with diastolic dysfunction generally have a better outcome than do patients with systolic dysfunction.[16] This was true in our study where the mortality of the patients with normal left ventricular systolic function was 9.0% compared to 19.5% for those with depressed left ventricular systolic function. Certainly the greater the degree of systolic dysfunction, the poorer the outcome so that estimation of ejection fraction is, of course, a critical variable in prognosis.

Limitation

Although we screened consecutive hospital admissions, we probably did not capture the full spectrum of heart failure patients, particularly those with less severe symptoms, which may impact the generalizability of our findings. The Framingham criteria are specific but relatively insensitive to define congestive heart failure status especially early manifestations.[17] The selection of a partition value of 50% for separating normal from reduced LVEF may be criticised. It is uncertain for instance if an LVEF value of 45% is depressed enough to initiate the maladaptive changes associated with the syndrome CHF. We chose this partition value because it is the most frequently utilized cut off point in published reports for separating normal left ventricular systolic function from from systolic dysfunction.[3]

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