Left ventricular geometric patterns in hypertensive Nigerians: a systematic review

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Abstract

Introduction: Several studies on left ventricular hypertrophy (LVH) and LV geometric patterns in hypertensive subjects have been carried out in Nigeria, but the results vary widely. The present article aims to systematically review published studies carried out in Nigeria on the prevalence and pattern of LV geometry in hypertensive subjects as determined using echocardiography.

Methods: Relevant English language papers published up to 15th November 2012 were searched for in Medline, African Journals on Line, Google Scholar and several other websites, and enquiries were made from colleagues. Study quality was assessed using a condensed version of the Downs and Black checklist. LVH was defined in most of the studies as LV mass index (LVMI) >96g/m² in women and >116g/m² in men, or LVMI >125g/m² for both sexes.

Results: A total of 148 records were initially obtained after excluding duplicates, but 138 articles had to be excluded (126 for lack of relevance; 12 abstracts for lack of full length articles) while data in the remaining 10 were extracted, further analysed and discussed. Out of a total of 1722 persons in all the included studies, 621 (36.1%) subjects had LVH, while 496 (28.8%) had concentric remodelling and the remaining 605 (35.1%) subjects had normal geometry. Of those with LVH, 321 (51.7%) of them had eccentric hypertrophy while the remaining 300 (48.3%) had concentric hypertrophy.

Conclusion: The findings in the present study have important clinical implications in the choice of antihypertensive treatments to control the blood pressure, induce regression of LVH and reduce overall cardiovascular morbidity and mortality, as recommended in standard guidelines.

Key words: hypertension; LV geometry; systematic review; Nigeria

Introduction

The burden of hypertension worldwide is indeed enormous; it affects approximately one billion people at present and this figure is likely to increase with the aging of the world’s population.1 Hypertension, one of the diseases previously considered a ‘western disease’, is now a common problem in developing countries like Nigeria, and the prevalence rates in both societies are approaching similar levels. The prevalence rate of hypertension in the United States of America (USA) is about 30% while considered to be between 20% and 25% in the Nigerian adult population (using the BP cut-off values of ≥140/90 mmHg).2,3

Hypertension is an important cause of morbidity and mortality worldwide. In the Framingham study for example, hypertensive patients as compared with normotensive controls, were six times more likely to develop a stroke, and three times more likely to develop coronary heart disease (CHD) and heart failure (HF), while peripheral arterial disease was twice as common.4

In the past three decades, echocardiography has become widely available in various health centres in Nigeria, and as a result, several studies have been published across the country on the echocardiographic characteristics of hypertensive and other heart diseases. These studies are single-centre based hence the results vary significantly.

Left ventricular hypertrophy (LVH) is a major component of hypertensive heart disease (HHD) and is associated with significant morbidity and mortality.5 The prevalence of LVH and LV geometric patterns among hypertensive patients is influenced by several factors, including blood pressure levels, peripheral vascular resistance, stroke volume, body mass index (BMI) and possibly age and gender.6

Consideration of the level of LV mass index (LVMI) and of the LV wall thickness/ chamber radius ratio (relative wall thickness (RWT)) has identified four different geometric patterns of LV adaptation to hypertension.6 These are concentric LV hypertrophy (CH) (increased LVMI and wall thickness), eccentric hypertrophy (EH) (increased LVMI, normal relative wall thickness), concentric remodelling (CR) (increased relative wall thickness with normal LVMI) and normal LV geometry (NG) (see Figure 1).6

Figure 1: Determination of LV geometric patterns using LV mass index and relative wall thickness.
The prevalence of hypertensive LVH, primarily the eccentric form, is increased 1.5- to 2-fold by coexisting obesity. Patients with eccentric hypertrophy tend to have increased cardiac output with minimal or no elevation of peripheral resistance. The blood pressure in hypertensive patients with concentric LVH is principally elevated by increased peripheral resistance with slightly above normal cardiac output. Patients with concentric LV remodelling have relatively mild hypertension despite markedly elevated peripheral resistance because cardiac output is subnormal. Sex-specific criteria for LVMI had identified LVH more in women than men with systemic hypertension in earlier studies, but recent studies have shown conflicting results.

A long-term follow up study has revealed that subjects with CH had the highest rates of all-cause mortality and cardiovascular morbid events, followed by patients with EH and then CR, while the lowest rates were in the group with normal LV geometry. Several studies on LVH and LV geometric patterns in hypertensive subjects using echocardiography have been carried out in Nigeria, but the results vary widely. The present article aims to systematically review published studies carried out in Nigeria on the prevalence and pattern of LV geometry in hypertensive subjects as determined using echocardiography. The article will also identify areas for future research on the subject matter.

### Methods

#### Search strategy and selection criteria

To build up and standardize data for this systematic review article, relevant English language papers published up to 15th November 2012 were searched for in Medline, African Journals on Line, Google Scholar and several other websites, and enquiries were made from colleagues. The following search terms were used: “hypertensive heart disease Nigeria”; “left ventricular geometry Nigeria”; “hypertension Nigeria”; “heart failure hypertension Nigeria". Studies were further assessed for inclusion if they had satisfied the following criteria:

1. Article’s objective(s) clearly described.
2. LV geometric patterns were determined using echocardiography.
3. On adult Nigerians, at least 18 years of age.
4. Carried out in Nigeria.

#### Results

Data ascertained and extracted included the authors of the study, year of publication, total number of participants, gender distribution, mean age, body mass index and LV ejection fraction (LVEF) of the participants in each of the included studies, number of subjects with the various LV geometric patterns and the quality indices of the studies.

#### Study quality

Study quality was assessed using a condensed version of the Downs and Black checklist, which is a validated tool for the assessment of the methodological quality of both randomized and non-randomized studies.

#### Study flow

Following the above-described steps, a total of 148 records were initially obtained after excluding duplicates (see Figure 2), but a total of 138 articles had to be excluded (126 for lack of relevance; 12 abstracts without full length articles) while data in the remaining 10 were extracted, further analysed and discussed.

#### Characteristics of included studies

Ten studies were included in the present systematic review, and the total number of persons studied was 1722, out of which 911 (52.9%) were males while the remaining 811 were females (see Table 1). All the studies were carried out in cosmopolitan cities in Nigeria. The median average age for all the studies was 55.95 years, with a range of 51.0 to 62.8 years. Overall, 621 (36.1%) subjects had LVH, while 496 (28.8%) had CR and the remaining 605 (35.1%) subjects had NG. Of those with LVH, 321 (51.7%) of them had EH while the remaining 300 (48.3%) had CH. The median of mean LVEF for all the studies was 64.45% with a range of 51.4% to 73.2%.

All the included studies defined LVMI and LV geometry in a similar way. LVH was defined in most of the studies as LVMI >96g/m² in women and >116g/m² in men, or LVMI >125g/m² for both sexes.

<table>
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<th>Authors/year</th>
<th>N</th>
<th>M/F</th>
<th>F(%)</th>
<th>Age; yrs</th>
<th>BMI; Kg/m2</th>
<th>LVH; N(%)</th>
<th>EH; N(%)</th>
<th>CH; N(%)</th>
<th>CR; N(%)</th>
<th>NG; N(%)</th>
<th>LVEF; N%</th>
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<td>26.0</td>
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<td>55.95</td>
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<td>17.50%</td>
<td>18.35%</td>
<td>28.30%</td>
<td>36.85%</td>
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Salako et al prospectively studied hypertensive subjects who were consecutively recruited over 2 years at UCH Ibadan, Nigeria, to primarily determine the prevalence and pattern of LVH among hypertensive subjects on treatment. Subjects were reviewed six times at intervals of 6 weeks, and blood pressure (BP) control was determined at the end of the study using average BP over the study period. The subjects were then categorized into 3 groups (hypertensives with controlled and uncontrolled BP, and non-hypertensive apparently healthy controls), and echocardiography was carried out at the end of the study. Out of the 250 recruited hypertensive subjects, only 58 had controlled BP, while BP in the remaining 192 was uncontrolled. These were compared to 77 controls. There was however no data on the types of antihypertensive drugs given to the patients.

Akinduro et al assessed the patterns of LV geometry among hypertensive subjects on treatment in a cross-sectional study carried out in Ladoke Akintola University of Technology (LAUTECH) Teaching Hospital, Osogbo, Nigeria. It was a cross-sectional study, and 188 subjects were consecutively recruited and classified into "early" hypertensives if the duration of hypertension was less than one year. Those with a duration of >5 years were categorized as "long term" while all the others were categorized as "intermediate". This was the only study that defined LVH as LVMI ≥134g/m2 for males or ≥110g/m2 for females.

In the another study, Karaye et al assessed the prevalence, determinants and correlates of right ventricular (RV) systolic and diastolic dysfunction (RVS and RVDD, respectively) in hypertensives, stratified by LV geometric patterns. It was a cross-sectional study carried out in the echocardiography laboratory of Aminu Kano Teaching Hospital, Kano, and 128 subjects were serially recruited.

Discussion

In the present systematic review, ten articles with satisfactory study quality and involving 1722 hypertensive subjects were reviewed. The median prevalence of LVH was 36.4%, 17.5% for EH, 18.4% for CH, 28.3% for CR, and 36.9% for NG. Four out of the ten studies exclusively recruited untreated hypertensives, while the others recruited all patients. The patients therefore resemble those encountered in daily clinical practice.

The median prevalence of LVH of 36.4% among Nigerian hypertensives obtained in the present review is high and similar to what was reported by Ganau et al (35%) who recruited relatives of hospital patients. Although the studies included in the present review did not assess the relationship between LVH or LV geometric patterns

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Studies by Aje et al, Ogah et al, Adebayo et al and Adamu et al were exclusively on untreated hypertensive subjects while the others included both the untreated and those on treatment.

Although Adebiyi et al primarily studied correlates of left atrial size in Nigerian hypertensive subjects; the study also provided data on LV geometric patterns. The study was carried out on 361 hypertensive subjects who were being followed up at the Cardiology Unit of the University College Hospital (UCH), Ibadan, Nigeria.

The study by Aje et al had a case-control design, and primarily aimed to determine LV geometric patterns among hypertensive subjects. They consecutively recruited 100 untreated adult hypertensive subjects at UCH Ibadan over a 6 month period. Normal controls were recruited from among hospital staff and relatives of hospital patients.

Ogah et al primarily assessed the relationship between LVH with strain pattern in the ECG and LV geometry and function in Nigerian hypertensive patients. It was a case-control study involving 191 subjects carried out over 8 months in UCH, Ibadan, Nigeria. Eligible patients were classified into 3 groups: untreated hypertensive subjects with LVH and strain pattern in ECG (group A), untreated hypertensive subjects with LVH but no strain pattern (group B) and apparently normal subjects who served as controls (group C).

Adebayo et al primarily assessed early changes in the left atrial size and function in hypertension, and its relationship with left ventricular geometry and other factors that may influence left atrial size. They recruited 100 untreated hypertensive subjects and compared them to 50 apparently healthy non-hypertensive subjects in UCH, Ibadan, Nigeria.

Karaye et al primarily studied the prevalence of LVH and LV geometric patterns among hypertensives in Kano, Nigeria. It was a cross-sectional study carried out over 7 months in 3 echocardiography laboratories, and 186 patients with hypertension and without other cardiac disorders were serially recruited.

In a cross-sectional study, Adamu et al evaluated the relationship between the parameters of LV diastolic function and the geometric patterns in 150 hypertensive patients, and compared them to 150 apparently healthy, non-hypertensive controls. It was carried out in University of Ilorin Teaching Hospital, Ilorin, Nigeria, and subjects were serially recruited.
and mortality, the study carried out in New York by Koren et al involving 253 patients followed up for 140 months showed that subjects with NG had the best prognosis (no deaths; cardiovascular (CV) events in 11%) while those who had CH had the highest mortality (20%) and CV events (31%). However, it is important to note that in the regression analysis, LV dysfunction (systolic or diastolic), which is an important independent predictor of mortality in hypertensive patients, was not included. The impact of LVEF (or systolic function) and LV diastolic dysfunction on the relative differences in prognosis for the various LV geometric patterns have not been well studied. Therefore, the issue of severity of prognosis ascribed to any LV geometric pattern remains inconclusive until LV and RV dysfunctions are taken into consideration, and these dysfunctions appear to be common in hypertensives as discussed below.

The study by Karaye et al has shown that of the 73 hypertensive patients with LV systolic dysfunction (LVEF <50%), 52 (71.2%) had EH, 10 (13.7%) had CH, 8 (11.0%) had CR while 3 (4.1%) had NG. The mean LVEF ranged from 39.1% in subjects with EH to 65.3% in subjects with NG. The study also showed that out of the 56 subjects with grades II or III diastolic dysfunction, 31 (55.4%) had EH, 13 (23.2%) had CH, 5 (8.9%) had CR while the remaining 7 (12.5%) had NG. In the other study, Karaye et al have shown that subjects with EH had the highest prevalence of RV systolic dysfunction (RVSD) (52.63%), while those with CH had the lowest prevalence (20.69%) (p<0.01). By contrast, the prevalence of RV diastolic dysfunction (RVD) was high across the four groups without significant statistical differences; as high as 68.52% in subjects with NG and as low as 42.86% in those with CR. Adamu et al also studied systolic and diastolic function among the hypertensive studies but excluded subjects with heart failure, therefore direct comparison can’t be made with the results by Karaye et al who included many subjects with heart failure. Unlike in the study by Karaye et al, Adamu et al showed that the mean LVEF and diastolic function were similar across the 4 geometric patterns. Although Aje et al didn’t exclude heart failure subjects, the mean LVEF in the 4 groups ranged from 67.1 to 72.2%, with statistically significant differences, suggesting that the heart failure was predominantly with preserved LVEF. Akintunde et al didn’t also exclude heart failure patients but the mean LVEF ranged from 52% in subjects with EH to 70.3% in patients with CR. The number of subjects with heart failure in these two studies was not mentioned, while all the other studies included in the present systematic review didn’t provide data on LV or RV function among the subjects.

The findings in the present study have important clinical implications in the choice of antihypertensive treatments to control the BP, induce regression of LVH and reduce overall CV morbidity and mortality, as recommended in standard guidelines. For similar BP reductions, angiotensin II receptor blockers, angiotensin converting enzyme inhibitors and calcium antagonists have been found, in randomized comparative studies, to be more effective than beta-blockers. In the LIFE study, which selected only hypertensive patients with LVH, the therapeutically induced reduction of LVM was significantly associated with CV event reduction.

Areas for future research would include studying the long-term prognosis of LVH and geometric patterns among hypertensive subjects in Nigeria, and the study should ideally be community-based. Reverse remodeling and the effect of anti-hypertensive treatment on it among hypertensive subjects should also be studied.

**References**

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