AFRICAN JOURNAL OF MEDICINE and medical sciences

VOLUME 32 NUMBER 4 DECEMBER 2003

EDITOR
B. O. OSOTIMEHIN

ASSISTANT EDITOR
A. O. UWAIFO

ISSN 1116—4077

Afr J Med med Sci (2003) 32, 395-399

Relation of electrocardiographic left ventricular hypertrophy to blood pressure, body mass index, serum lipids and blood sugar levels in adult Nigerians

OG Opadijo[1],ABO Omotoso[1] and AA Akande[2],
[1]Departments of Medicine and Chemical Pathology[2], University of Ilorin, P.M.B. 1515, Ilorin, Nigeria.

Summary

Left ventricular hypertrophy (LVH) is considered an independent risk factor even in the absence of systemic hypertension. Electrocardiographic (ECG) LVH with repolarisation changes has been found in some countries to carry more coronary risk than LVH alone. How far this observation is true among adult Nigerians is not known. We therefore decided to study adult Nigerians with ECG – LVH with or without ST-T waves changes and compare them with normal age matched controls (without ECG-LVH) in relation with established modifiable risk factors such as systemic hypertension (BP), body mass index (BMI), fasting blood sugar (FBS) and serum lipids such as total cholesterol (Tc), low density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C) and triglyceride (TG). Adult Nigerians who were consecutively referred to the ECG laboratory were randomly recruited. Three hundred patients were studied. Their blood pressures (BP) as well as body mass indices were recorded after recording their resting 12 read ECG using portable Seward 9953 ECG machine. Their waist-hip ratio (WHR) was also recorded. Blood samples were taken to determine their fasting blood sugar and serum lipids. Their ECG tracings were read by the cardiologists involved in the study while the blood samples were analysed by the chemical pathologist also involved in the study. At the end of the ECG reading, the patients were divided into 3 groups according to whether there was no ECG-LVH (control group A), ECG-LVH alone (group B), and ECG-LVH with ST-T waves changes (group C). One hundred and fifty (50%) patients belonged to group A, 100 (33.3%) patients to group B and 50 (16.7%) group C. Group B patients were found to have higher modifiable risk factors in form of systemic BP, Tc, LDL-C, and WHR compared to group A. However, the group C patients had increased load of these coronary risk factors in terms of BP elevation, higher BMI, FBS, and serum cholesterol compared to group B. In addition, more female patients were involved in group C. The mean age of group C patients compared to group B was also significantly higher ($P<0.001$) even though no significant age difference was noted between group C and group A patients. It is concluded that Nigerians with ECG-LVH with ST-T waves changes have increased risk of cardiovascular risk factors compared to normal group A patients and even patients with EGC-LVH (group B) alone. Hence, they represent subset of patients to be aggressively followed up with multiple risk factors intervention.

Keywords: *Electrocardiogram, left ventricular hypertrophy, ST-T waves changes, cardiovascular risk factors, adult Nigerians.*

Résumé

L'hypertrophie du ventricule gauche (LVH) est considerée comme un facteur à risque indépendent meme en absence de l'hypertension systémique. L'électrocardiographie (ECG) du LVH avec des variations de repolarisation a été trouvé dans certains pays ayant plus de risque coronaire que le LVH seulement. Dans ce but, nous avons décidé d'étudier l'ECG-LVH des adultes nigérian sans ou ayant les variations d'ondes ST-T et comparés à ceux des sujects normaux. En relation avec l'index de masse corporelle(BMI), le taux de sucre à jeune(FBS) et le taux de lipide dans le serum tels que la quatité de cholestérol (LDL-C), la densité du cholestérol lipoprotéine (HDL-C) et du triglyceride (TG). Trois cent nigérian adultes étaient choisis au harzard et récruités pour faire l'ECG. Douze enregistrements du ECG étaient faite utilisant la machine ECG, Seward 9953. La tension artérielle et d'autres indices corporels étaient enregistrés. Les courbes du ECG etaient interpretés par un cardiologue et les échantillons de sang par un technicien patholohgiste. Les patients étaient divisés en 3 groupes : Groupe A, B et C. 50 % des patients appartenait au groupe A, 33.33% au groupe B et 16.7% au groupe C. Le groupe B avait plus de facteurs de risque modifié du BP, TC, LDL-C et WHR comparé au groupe A. Cependant, le groupe C avait un poids élevé de risque coronaire en terme de l'élévation du BP, BMI élevé , FBS et le cholestérol au serum que le groupe B. Plus des patients femele se retrouvait dans le groupe C. la moyenne d'age au groupe C comparé au groupe B était aussi significative elevée ($P<0.001$) bien que aucune différence significative était noté entre le groupe C et A. Il a été conclu que les nigérians ayant l'ECG-LVH avec des changements d'ondes ST-T augmentent le risque des facteurs cardiovasculaires comparés au groupe de ceux normal (Groupe A) et meme les patients ayant l'ECG-LVH seulement(Groupe B). Ainsi, ils representent un sous-groupe des patients à etre suivit aggressivement avec des risques à facteur multiples d'intervention.

Introduction

Left ventricular hypertrophy (LVH) is considered a cardiovascular risk factor [1-5]. It has been found to predispose to left ventricular dysfunction [6], left heart failure [7], ventricular arrhythmias[8] and sudden cardiac death [1,2,9,10]. It's devastating effect may become more aggravated when LVH is associated with other cardiovascular/coronary risk factors such as elevated body mass index (BMI), increased serum lipids, systemic hypertension and serum fasting blood sugar. Does this association of LVH with cardiovascular events has any relationship with changes in the ST segment and or T-wave?

We decided to study adult Nigerians with electrocardiographic (ECG) (LVH) with or without ST-T wave changes and relate this with other established and modifiable cardiovascular risk factors such as systemic hypertension, body mass index, fasting serum glucose and lipids levels.

Materials and method

One hundred and fifty adult Nigerians with electrocardiographic (ECG) left ventricular hypertrophy (LVH), using Araoye's proposed criteria for LVH in blacks [11] with or without ST-T wave changes were compared with 150 age matched controls without ECG-LVH making a total of 300 patients studied. The study was carried out at the Cardiology Unit of the University of Ilorin Teaching Hospital, Ilorin, Nigeria.

Correspondence: Dr O.G. Opadijo, Department of Medicine, University of Ilorin, P.M.B. 1515, Ilorin, Nigeria.

Table 1: Comparing the characteristics of group B and the Controls (group A)

Characteristics	Study group B M	F	T	Controls (group A) M	F	T	BvA Pvalue
Number	46	54	100	78	72	150	-
Mean age(yr)	51.0±10.2	47.3±8.8	49.0±6.7	50.6±10.1	51.0±10.4	50.8±7.3	0.1
Number with B.P ⊕ 140/90mmHg	34	45	79	41	43	84	0.0001
Number with Obesity (BMI ⊕25-27kg/m^2	21	42	63	23	49	72	0.001
Females with WHR ⊕0.83	-	50	50	-	66	66	0.01
Males with WHR ⊕0.95	7	-	7	20	-	20	0.001
Mean SBP	157.6±31.5	147±26.9	151.9±20.5	142.8±27.5	154.4±30.9	148.4±20.6	0.1
Mean DBP	97.8±19.6	89.8±16.4	93.5±12.6	93.5±12.6	91.0±18.2	91.06±12.6	0.1
Hypercholesterolaemia (Tc ⊕5.2 or LDL-C ⊕ 3.4)	20	26	46	4	22	26	0.001
No with fasting blood Glucose ⊕ 6mmol/L	20	9	29	4	11	15	0.0001
Mean BMI	26.9±5.3	28.9±5.3	28.0±3.7	25.1±4.8	28.8±5.8	27.1±3.8	0.1
Mean Tc	4.49±0.88	4.23±0.77	4.35±0.58	4.27±0.82	4.42±0.88	4.35±0.60	0.1
Mean LDL-C	2.80±0.55	2.61±0.48	2.70±0.58	1.81±0.35	2.61±0.52	2.13±0.30	0.0001
Mean FBS	4.0±0.78	7.13±1.32	5.65±0.76	4.73±0.93	5.26±1.05	5.0±0.70	0.001

Note:
BMI = *Body Mass Index*
WHR = *Waist – hip ratio*
SBP = *Systolic Blood Pressure*
DBP = *Diastolic Blood Pressure*
Tc = *Total Cholesterol*
LDL-C = *Low Density lipoprotein cholesterol*
FBS = *Fasting Blood Sugar*

The patients were consecutively referred to the ECG laboratory and were randomly recruited for the study. Those consenting patients (both verbal and written consents) were weighed and their heights recorded to determine their body mass indices (BMI); their blood pressures (BP) were taken in the setting position after 30 minutes using the right arm with mercury (accoson type) sphignomanometer. The phase I krotokovs was taken as the systolic BP and phase V as the diastolic B.P. Three BP readings were taken at two weeks interval and the average taken as the individual BP. Their waist and hip measurements were taken as defined by Larrson *et al* [12] in the erect position to determine the waist-hip ratio (WHR).

Their electrocardiograms were then recorded using portable Seward 9953 machine with sensitivity of 10 min to 20 mm and speed of 25 mm/second to 50mm/second. Their resting electrocardiograms were then recorded using portable Seward 9953 machine with sensitivity of 10 min to 20min and paper speed of 25 mm/second to 50mm/second.

Their blood samples were collected for fasting blood sugar estimation using colorimetric method. Blood samples were also analysed in the laboratory for fasting lipids profile such as total cholesterol (TC), low density lipoprotein cholesterol (LDL-C), and high density lipoprotein cholesterol (HDL-C) using R-A 50 machine.

The ECG was read by both cardiologists. Based on the ECG findings, the patients were then sub-divided into 3 groups namely: group A=patients with normal ECG (without ECG-LVH) n=150, group B=patients with ECG-LVH alone (n=100) and group C=patients with ECG-LVH with ST-T wave changes (N=50). Excluded from the study were pregnant women, Patients with established ischaemic heart disease and or acute coronary heart disease.

Data were analysed using chi-square test of statistical significance and paired t-test was used in comparing means of results where necessary. *P* value of ≤0.05 was taken as being statistically significant.

Result

Their hundred patients were studied. There were 150 males and 150 females. Their ages ranged between 25 years and 76 years

Table 2: Comparing group C and the Controls (group A)

Characteristics	Study group C			Controls (group A)			CvA
	M	F	T	M	F	T	Pvalue
Population	25	25	50	78	72	150	-
Mean age(yr)	46.9±13.0	57.9±15.6	52.6±10.1	50.6±10.1	51.0±10.4	50.8±7.3	0.1
Number with B.P⊕140/90	12	34	46	41	43	84	0.0001
Number with Obesity (BMI ⊕ 25-27kg/m²)	13	21	34	23	49	72	0.001
Female population with WHR ⊕0.83	-	23	23	-	66	66	0.001
Male population with WHR ⊕0.95	4	-	4	20	20	20	0.001
Mean SBP (mmHg)	162.1±43.3	187.3±52.6	174.3±33.5	142.8±27.5	154.4±30.9	148.4±20.6	0.02
Mean DBP (mmHg)	102.1±27.3	119.6±33.2	110.6±21.3	90.9±17.5	91.0±18.2	91.0±12.5	0.03
No with Hypercholesterolaemia	25	13	38	4	22	26	0.0001
No with fasting blood Glucose ⊕ 6.0mmo/L	9	11	20	4	11	15	0.0000
Mean BMI(kg/m²)	27.3±7.4	31.0±8.4	30.1±5.7	25.1±4.8	28.8±5.8	27.1±3.8	0.001
Mean TG mmOl/L	1.61±0.43	1.62±0.43	1.61±0.30	1.25±0.24	1.52±0.30	1.38±0.19	0.001
Mean Tc "	5.53±1.48	4.94±1.32	5.23±0.99	4.27±0.82	4.42±0.88	4.35±0.60	0.02
Mean LDL-C "	3.55±0.95	3.15±0.84	3.35±0.63	1.81±0.35	2.61±0.52	2.13±0.30	0.000
Mean HDL-C "	1.28±0.34	1.77±0.47	1.52±0.29	2.1±0.40	1.5±0.0.30	1.8±0.25	0.001
Mean FBS	5.76±1.54	6.0±1.6	5.87±1.11	4.73±0.93	5.26±1.05	5.0±0.70	0.00
Mean WHR	0.92±0.25	0.90±0.24	0.91±0.17	0.88±0.17	0.90±0.18	0.89±0.12	0.1

with a mean age of 50.4 ± 4.4 years. The group A (Normal FCG) patients had their ages ranged between 29 years and 76 years with a mean age of 50.8 ±7.4 years as against combined groups B (ECG-LVH) and C(ECG-LVH with ST-T were changes) with age range 25 years to 76 years and mean age of 50.2 ± 5.6 years t±0.5 and *P*⊕0.1 Group B patients had their ages ranging between as 25 years and 76 years with a mean age 49.0± 6.7 years. Comparing group A and B. t = 1.29 and *P*>0.1. (Table I) The age of group C patients ranged between 33 years and 65 years with a mean age of 52.6±10.1 years. Comparing with group A patients t =0.818 and *P*>0.01 (Table 2).

Group A patients had 78 males with 72 females, where as group B had 46 males and 54 females and group C had equal number of males and females (25 each).

Group A patients had their body mass indices (BMI) ranged between 17.4 kg/m² and 41.9 kg/m² with a mean BMI of 27.1 ± 3.8 kg/m². Group B had their range between 16.1 kg/m² and 38 7 kg/m² with a mean of 28.0 ±3.7 kg/m² t=0.88 ands p> 0.05. Where as group C had their BMI ranged between 20.6 and 41.8 kg/m² with a mean of 30.1± 5.7 kg/m² t=1.86 and P<0.01.

Seventy-two (48.0%) of group A patients (M:F = 23:49) had BMI greater than 27 Kg/m² and 25kg/m² for male and female respectively according to Burton *et al* [13] whereas, 63 (63.0%) (M:F=21:42) of the group B were obese $x^2 = 5.43$ and *P*<0.001. In comparison to group A, group C had 34 (68.0%) (M:F = 13:21) obese individuals $x^2 = 3.29$ and $P < 0.001$. (Tables 1and 2). The overall mean WHR for the groups are as follows:- Group A=0.89±0.12 (range=0.79 – 1.0); Group B = 0.91 ± 0.12 (range =0.83-1.08) and group C = 0.91± 0.17 (range = 078-0.99) t = 0.61 and 0.41 and *P*> 0.05 respectively.

Sixty-six (44.0%) females of the group A patients had WHR > 0.83 (range=0.79 – 1.0). In comparison, 50 (33.3%) group B female patients had WHR > 0.83 (range = 0.86 – 1.08) $x^2 = 0.04$ and $P < 0.01$. Whereas, 23(46.0%) of group C females had WHR ≈ 0.83(range = 0.78 – 0.99). $x^2 = 0.003$ and *P*<0.01 For males, 20(13.3%) group A, (range 0.80 – 0.97), 7(7.0%) group B (range = 0.83 – 0.98) and 4 (8.0%) group C (range = 0.86 – 0.97) had WHR > 0.95 $x^2 = 1.85$, 0.98 and *P*<0.001 and 0.01 respectively (Tables 1&2).

Group A systolic blood pressure (SBP) ranged between 110 – 210 mmHg with a mean SBP of 148.4 ± 20.6 mmHg. Groups B and C had their mean SBP of 151.9 ± 20.5 mmHg (range 110 – 220 mmHg) and 174.3 ± 33.5 mmHg (range 130 – 200 mmHg) t= 0.62 and 2.78, *P*>0.5 and *P*< 0.002 respectively.

Likewise, the mean diastolic blood pressure (DBP) for the groups were (group A) 91.0 ± 12.6 (range = 60 – 110 mmHg). Group B = 93.5 ± 12.6 (range 70 – 110 mmHg) and group C = 110.6 ± 21.3 mmHg (range 80 – 120 mmHg) t = 0.72 and 3.35, *P*>0.05 and *P*< 0.02 respectively.

Of the 150 group A patients, 84 (56.0%) M:F = 41:43) had blood pressure ≈ $^{140}/_{90}$ mmHg using WHO ISH of 1999 [14] as against 79 (79.0%) (M:F: 34:45) of the group B.$X^2 = 14.0$, *P*<0.00001. Whereas, 46 (M: F:12:34) (92.0%) group C had B.P ≈$^{140}/_{90}$ mmHg $x^2 = 21.4$ and $P < 0.00001$.

The mean total cholesterol (TC) for group A was 4.35 ± 0.60 mmol/L (range = 1.8 – 7.0 mmol/L); group B had a mean of

4.35 ± 0.58 mmol/L (range = 2.3 – 7.8 mmli/L) while group C had a mean of 5.23 ±0.99 mmol/L(range = 1.8 – 9.3 mm01/l) t=o and 3.26 and $P > 0.05$ and $P < 0.02$.

The mean LDL-C for the 3 groups were 2.13 ± 0.30 mm01/L (range = 0.07 – 5.62); 2.70 ± 0.36 (range = 0.10 – 5.0) and 3.35 ± 0.63 mmol/L (range 0.26 – 5.70) t = 6.33 and 7.58; $P <$ 0.0001 respectively.

Of the 110 (16.7%) patients with hypercholes terolaemia (Total cholesterol ⊕ 5.2. mm01/lL and or LDL-C ⊕ 3.4 mmol/L) [15], 26 (23.6%) belonged to group A; 46(41.87%) group B and 38 (34.5%) group C. $X^2 = 2.64$ and 11.16 and $P < 0.001$ and <0.0001 respectively.

Table 3: Comparing group C and B

Characteristics	Group C n = 50	Group B n = 100	BvC P Value
Mean age (yr)	52.6±10.1	49.0±6.7	0.001
Number with B.P ⊕ 140/90mmHg	46	79	0.001
Number with Obesity (BMI ⊕27)	34	63	0.1
Female with WHR ⊕ 0.83	23	50	0.1
Male with WHR ⊕ 0.95	4	7	0.1
Mean SBP	174.3±33.5	151.9±20.5	0.00001
Mean DBP	110.5±21.8	93.5±12.6	0.00001
No with hypercholesterole amia Tc ⊕5.2 or LDL-C⊕3.4)	38	46	0.001
No with fasting blood glucose ⊕6.0mmOl/L)	20	29	0.001
Mean BMI (kg/m²)	30.1±5.7	28.0±3.7	0.001
Mean TG(mmol/L)	1.61±0.30	1.54±0.15	0.1
Mean Tc "	5.23±0.99	4.35±0.58	0.001
Mean LDL-C "	3.35±0.63	2.70±0.36	0.001
Mean HDL-C "	1.52+0.29	1.40±0.19	0.01
Mean FBS	5.87±1.11	5.65±0.76	0.01
Mean WHR	0.91+0.17	0.91±0.12	0.1

The mean serum triglyceride levels stood at group A = 1.38 ± 0.19 mmol/l (range = 0.39 – 2.80); group B 1.14 ± 0.15 mmol/L (range 0.40 – 3.31) and group C = 1.161 ± 0.30 mmol/ L (range = 0.34 – 4.40) .t = 5.16 and 2.77 . $P < 0.0001$ and $P <$ 0.001 respectively. The mean HDL-C were group A = 1.8 ± 0.25 mmol/L (range = 0.56-5.20); group B = 1.4 + 0.19(range = 0.04 – 5.23) and group C = 1.52 ± 0.29 mmol/L (range = 0.04 – 5.58) . t= 6.67 and 3.11, $P<0.001$ and $P<0.001$ respectively.

The mean fasting blood sugar for the groups were A = 5.0 ±0.70 mmol/L (range = 2.9 – 10.1); B = 5.65 ± 0.76 mmol/ L (range = 3.0 – 19.4) and group C = 5.87±1.11 mm01/L (range = 3.5 – 9.7) . t = 3.25 and 2.82 with $P < 0.001$ respectively.

Sixty-four (21.3%) patients had their fasting blood sugar > 6.0 mmol/L as defined by WHO [16]. Of these 64, 15 (M:F = 4:11) (23.4%) belonged to group A, 29 (M:F=20:9) (45.3%) group B and 20 (M:F = 9:11) (31.3%) group C. $x^2 = 14.94$ and 23.38 and $P<0.0001$ and $P < 0.00001$ respectively.

Discussion

This study has shown us that LVH is a coronary risk factor in adult Nigerians compatible with previous documentation [1-5]. This is due to the fact that adult Nigerians with LVH tend to have other coronary risk factors than people without LVH (Table 1,2,3). However, these coronary risk factors such as obesity, hyperglycaemia, and systemic hypertension are also potentials in the development of LVH and sudden death [1,17]

This also reveals the conferment of more cardiovascular risk when LVH is associated with ST-T wave changes compatible with previous observations among Caucasians [1,18]. This is because the group C patients had higher mean body mass index, higher mean systolic and diastolic blood pressures, higher mean fasting serum total cholesterol, mean triglyceride, mean LDL-C, and mean fasting blood glucose when compared to normal group A patients and group B patients with LVH. (Table 2 & 3). Even though increasing age has been found to be associated with LVH in adult Nigerian hypertynsives [19], the increased coronary risk found in group C patients can not be explained totally in terms of age because, there is non-significant age difference between group C and group A patients, where more group C patients had elevated systemic blood pressure; this relatively higher blood pressure was also observed with group B patients.

Similarly, the number of patients in group C with higher fasting blood sugar and hyper cholesterolaemia were more than patients in groups A or B. Likewise, the mean values of both blood sugar and serum cholesterol were higher in group C patients compared to both groups A or B. These metabolities are potent predictors of ST-T wave changes than normal group A in this study. There were more female patients with LVH with or without ST-T wave changes than normal group A in this study even though the sample size was relatively small. This finding may be due to the fact that females with adjusted relative coronary risks tend to outnumber their male counterparts especially when there is associated systemic hypertension [17]. It is evident from this study that female populations with blood pressure ⊕ $^{140}/_{90}$mmHg (groups B + C) outnumber their male counterparts (79:46). Again more females in group B were hypercholesterolemia compared to females in group A (Table 1). The mean systolic blood pressure in group C patients and especially in females is higher than in both groups A and B (Tables 2 & 3). Persistent systolic blood pressure load has been found to correlate well with LVH [19-20]. This may explain in parts the ST-T wave changes in group C and a higher probability of increased coronary risk. Even though the total number of patients with WHR above normal (0.83 and 0.95) for females and male respectively [12] were more in group C than in normal group A, there is no statistically significant difference between group C and B indicating that the WHR does not pose additional risk effect in group C patients though it a risk factor for LVH in this study as the total number of patients with WHR above normal are in group B compared to group A (Table 1). However, the mean serum HDL-C was higher in group A compared to group C indicating coronary protection for group A patients than group C.

In conclusion, LVH with ST-T wave changes signifies higher coronary risk in adult Nigerians. This is due to the fact that patients with LVH and ST-T wave changes tend to have higher systemic blood pressure, elevated fasting blood glucose, higher mean body mass index and hypercholesterolemia than normal individuals without LVH or patients with LVH alone. However, the significant higher mean age in group C as against group B patients may also account for the increased probability of higher coronary risk (Table 3). Hence the subset of adult Nigerians with LVH and ST-T wave changes constitutes higher risk group and needs very close monitoring or follow up with a view to modifying the observed associated risk factors in order to reduce mortality [21].

References

1. Seigel D, Cheitlia MD, Black Dun, Seeley D, Hearst M, Hulley SB, Risk of Ventricular arrhythmias in hypertensive men with left ventricular hypertrophy. Am. Jl. Cardiol 1990;65:742-747.

2. Yongago Ogda Eni, Juma FD, Cardiovascular risk factors profile in mild toi moderatre hypertensive seen at Kenyatta National Hospital. East African Journal of Medicine 1993;70 (11):693-695.
3. Opadijo OG, Risk factors associated with cardiovascular disease and death in adult Nigerians with essential hypertension. Nigeria Journal of Internal Medicine. 2000;3(2): 41-45.
4. Levy D, Salomon M, D'Agostino RB, Delanger AJ, Kannel WB, Prognostic implications of base line electrocardiographic features and their serial changes in subjects with left ventricular hypertrophy. Circulation 1994; 10: 1786-93.
5. Dunn FG, Mclenachan J, Isles GG, Brown 1, Davgie HJ, Lever Af et al. Left ventricular hypertrophy and mortality in hypertension; an analysis of data from the Glasgow Blood Presure Clinic. J. Hypertension 1990;8:775-82
6. Kostuk KWJ, Kazamias TM, Gander MP, Simon AL, RossJ. Left ventricular size after acute myocardial infarction: serial changes and their prognostic significance. Circulation 1973;47:1174-1179.
7. Bernhards Maiach. Ventricular remodeling. Cardiol ogy 1996;87 (suppl): 2-10.
8. Masserli FHG, Ventura HO, Elizardi DJ, Dunn FG, Frolilich ED, Hypertension and sudden death: increased ventricular ectopic activity in left ventricular hypertrophy. Am J Med 1984;77:18-22
9. Gradman A, Deedwania P, Cody R *et al.* Predictors of total mortality and sudden death in mild to moderate heart disease. The Framingham study. Ann Inter Med. 1970;72;813-819.
10. Kannel HB, Gordonn T, Castelli WP, Margolis JR. Electrocardiographic left ventricular hypertrophy and the risk of coronary heart disease. The Framingham study. Ann inter med. 1970;72:813-819.
11. Araoye MA. Left Ventricular Hypertrophy by electrocardiography: A code system applicable to Negroes. Nigerian Postgraduate Medical Journal 1996; 3:9297.
12. Larrson B. Svardsudd K, Wein K, Bjornturp P.Tubbin. Abdominal adipose tissue deposition, obesity and risk of cardiovascular disease and death: 13 year follow up of men born in 1913. British Medical Journal 1984; 288: 1401-1404.
13. Burton BT, Forster WR, Hirsch J, Van Itallie TB. Health Implication of Obesity. International Journal of Obesity 1985; 9(3): 155-170.
14. World Health Organisation – International Society of Hypertension Guidelines for the management of hypertension. Journal of Hypertension 1999; 17: 151-183.
15. Summary of the Second report of the National Cholesterol Education Program (NCEP). Expert panel on detention, evaluation and treatment of high blood cholesterol in adults. Journal of American Medical Association 1993; 269: 3015-3023.
16. World Health Organisation. Diabetes Mellitus: Report of a WHO study group. Geneva, Switzerland: WHO; 1985.
17. Raj Padwal, Sharon E. Straus, Finlay A, McAlister. Cardiovascular risk factors and their effects on the decision to treat hypertension: evidence based review. B.M.J. 2001; 322: 977-980.
18. Ichihara-Y, Sugino-M, Hatton-R, Anno-T, Mizuno-Y, Yokoi-M et al. Relation of electrocardiographic left ventricular hypertrophy with and without T-wave changes to systemic blood pressure, body mass, and serum lipids and blood glucose levels in Japanese men. Am J Cardiol. 1997 Sept 15; 80(6); 730-5.
19. Opadijo OG, Omotoso ABO, Araoye MA. Q-T prolongation left ventricular hypertrophy and ventricular arrhythmias in adult Nigerians with essential hypertension. Nigerian Postgraduate Medical Journal (In press).
20. Schillaci C, Verdecchia P, Borgioni C, Cinecci A, et al. Association between persistent pressure overload and ventricular arrhythmias in essential hypertension. Hypertension 1996; 28: 284-289.
21. Multiple Risk Factor Intervention Trial Research Group. Multiple risk factors intervention trial in mild hypertension. Risk-factor changes and mortality. Journal of America Medical Association 1982; 248: 1465-1477.