Pattern of ECG abnormalities in Nigerian hypertensive patients seen in University of Port Harcourt Teaching Hospital

D.I. Agomuoh and O. J. Odia

Abstract

Objective: The aim of the study was to document the pattern of ECG abnormalities in the hypertensive patients in Port Harcourt and to compare their prevalence with what obtains in the apparently normal population as documented in previous studies.

Methods: The electrocardiographic profile of one hundred and thirty two consecutive hypertensive patients seen at the consultant medical clinic of the University of Port Harcourt Teaching Hospital were studied prospectively. All patients were above 15 years of age with blood pressures above 140/90 mmHg taken at more than two visits. As part of their investigations, twelve lead surface electrocardiograms were recorded. They were interpreted by either of the authors and data were analyzed by simple statistical methods. P value was taken as significant if up to or below 0.5.

Results: The abnormalities identified were left ventricular hypertrophy (LVH) in 37.1%, left axis deviation (LAD) in 30.3%, sinus tachycardia 25.0%, left atrial enlargement (LAE) in 21.2%, atrial fibrillation (AF) in 3.8%, right bundle branch block (RBBB) in 1.5% and left anterior hemiblock (LAH) in 0.8%. There were no cases of myocardial infarction nor pathological Q waves.

Conclusion: The study concluded that ECG abnormalities are prevalent in our hypertensive patients and given their prognostic significance, the surface ECG remains relevant as one of the first line investigations in these patients.

Key words: Nigerians, Hypertension, ECG abnormalities, Prevalence, Port-Harcourt

Introduction

The electrocardiogram (ECG) is the surface recording in graphic form of the changes in electrical potentials produced by the heart. The impulses result in the production of weak electrical currents that diffuse throughout the body which acts as a volume conductor. Electrodes applied to the body surface record and pass the currents to the electrocardiograph which is basically a galvanometer. Electrocardiography was introduced into clinical medicine by Einthoven in 1901. The normal ECG is composed of a series of wave forms each of which has its own characteristics and may be influenced in different ways by a variety of pathological and physiological factors.

Electrocardiography plays an essential role in the diagnosis and investigation of heart disease. It's main value lies in the elucidation of cardiac arrhythmias and conduction defects, and in the diagnosis and location of myocardial infarction. It also provides important information about problems such as digitalis effects, electrolyte disturbances and hypertrophy and enlargement of the various chambers of the heart. It is one of the methods of assessing the effect of hypertension on one of its target organs - the heart. It remains one of the most sensitive methods of establishing left ventricular hypertrophy and is often abnormal even when there is no left ventricular heave and chest X-ray shows no classical or obvious left ventricular enlargement.

This study aims to describe common ECG abnormalities in hypertensive patients seen in University of Port-Harcourt Teaching Hospital (UPTH) and to compare their prevalence with
those in the apparently normal population in previous studies for this centre and elsewhere.

Materials and Methods

ECG strips of 132 hypertensive patients seen prospectively and consecutively at one of the consultant medical clinics of the University of Port-Harcourt Teaching Hospital over a 12-month period -1" November 2003 to 31" October 2004 were studied. Hypertensives were defined as patients with blood pressures above 140/90mmHg on two or more occasions. Hypertensive heart failure was diagnosed if in addition to the raised blood pressure, the patients were found to have features of either left or biventricular failure. The diagnosis of congestive heart failure(CHF) required at least two of the following major criteria according to the Frammingham studies. The major criteria include: paroxysmal nocturnal dyspnoea or orthopnoea, neck vein distension, rales, cardiomegaly, acute pulmonary oedema, triple rhythm and positive hepato-jugular reflux. CHF was also present when there was one major and any two of the following minor criteria: ankle oedema, night cough, dyspnoea on exertion, hepatomegaly, pleural effusion and tachycardia defined as a pulse rate of 100/minute or more. Cardiomegaly was defined clinically as a laterally displaced apex beat with the trachea central, and radiologically as cardiothoracic ratio greater than 0.50. The socio-economic class of the patients were documented based on the Nigerian civil service scale or its equivalent. Exclusion criteria were patients below 15 years of age, pregnant women and those within six months post-partum as well as diabetic patients.

Twelve lead surface electrocardiograms were recorded on all the patients after they had rested for about 10 minutes using a portable Seward single channel machine model 9952. The ECGs were read by both authors and the findings documented. Cardiac axis (mean QRS axis) was calculated using the hexaxial reference system and classified according to Marriott as follows:

- Normal axis : O° to 90°
- Left axis deviation : O° to 90°
- Right axis deviation : +90° to +180°
- Indeterminate axis deviation : 90° to +180°

Left ventricular hypertrophy was diagnosed using Araoye's criteria because it is more suited to the negroid ECG and had both sexes represented.

Statistical analysis

Data were analysed using simple percentages and the chi squared test for determining the significance between two proportions. The level of statistical significance was set at 0.05 and below.

Results

Table 1 shows the ECG abnormalities identified in the study population. There were 33 (25.0%) with sinus tachycardia as defined by heart rate above 100 beats per minute. There were no cases of sinus bradycardia. Five (3.8%) had atrial fibrillation, 40 (30.3%) had left axis deviation, 2 (1.5%) had complete right bundle branch block (RBBB) and 1 (0.1%) had a combination of RBBB and left anterior hemi block (RBBB & LAH). There were no cases of complete left bundle branch block (LBBB) and no pathological Q waves. Nine (6.8%) of the study population had ventricular ectopic beats.

Left atrial enlargement (LAE) was found in 28 (21.2%), left ventricular hypertrophy (LVH) in 49 (37.1%) and inverted T waves in the left ventricular leads (so called left ventricular strain pattern or ischaemia) was found in 15 out of the 49 cases of LVH (30.6%).

Table 2 shows the ECG findings in those hypertensives in heart failure and those who were not. Except for LVH, there were obviously more abnormalities in the patients in heart failure (71.9% against 54.2%). All the 5 patients with atrial fibrillation were found to be in heart failure.

Table 3 shows the socio-economic class distribution of the study population.

Discussion

Left ventricular hypertrophy (LVH) was
documented for 49 (37.1%) of the hypertensive patients. It was the most prevalent abnormality in the study population and also the only one which was more prevalent in the group that was not in heart failure (Table 2). This is because by the time the heart fails, most of the hypertrophy has given way to dilatation. The prevalence of LVH in the normal black population of Rivers State was 4.5%.

As LVH continues, the T waves become of lower amplitude and this is followed by slight depression of the ST segment and eventually the asymmetrical inversion of T waves in the left ventricular leads. Some studies have shown that ECG LVH with or without ST T changes is an independent risk factor

### Table 1. Abnormal ECG findings in study population

<table>
<thead>
<tr>
<th>ECG Findings</th>
<th>No</th>
<th>Percentage of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left ventricular hypertrophy</td>
<td>49</td>
<td>37.11%</td>
</tr>
<tr>
<td>Left axis deviation</td>
<td>40</td>
<td>30.3%</td>
</tr>
<tr>
<td>Sinus tachycardia</td>
<td>33</td>
<td>25%</td>
</tr>
<tr>
<td>Left atrial enlargement</td>
<td>28</td>
<td>21.2%</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>5</td>
<td>3.8%</td>
</tr>
<tr>
<td>RBBB</td>
<td>2</td>
<td>1.5%</td>
</tr>
<tr>
<td>RBBB and LAH</td>
<td>1</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

**RBBB** - Right Bundle Branch Block

**LAH** - Left Anterior Hemi Block

### Table 2. ECG findings in study population

<table>
<thead>
<tr>
<th>ECG Findings</th>
<th>Hypertensives</th>
<th>Total</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In heart failure</td>
<td>Not in heart failure</td>
<td></td>
</tr>
<tr>
<td>Sinus rhythm</td>
<td>52 (88.1%)</td>
<td>67 (91.8%)</td>
<td>119 (90.2%)</td>
</tr>
<tr>
<td>Sinus tachycardia</td>
<td>28 (47.5%)</td>
<td>5 (6.9%)</td>
<td>33 (25.0%)</td>
</tr>
<tr>
<td>Ventricular ectopics</td>
<td>6 (10.2%)</td>
<td>3 (4.1%)</td>
<td>9 (6.8%)</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>5 (8.5%)</td>
<td>0</td>
<td>5 (3.8%)</td>
</tr>
<tr>
<td>Sinus arrhythmia</td>
<td>2 (3.4%)</td>
<td>-</td>
<td>2 (1.5%)</td>
</tr>
<tr>
<td>Normal QRS axis</td>
<td>36 (61.0%)</td>
<td>56 (76.7%)</td>
<td>92 (69.7%)</td>
</tr>
<tr>
<td>Left axis deviation</td>
<td>23 (39.0%)</td>
<td>17 (23.3%)</td>
<td>9 (6.8%)</td>
</tr>
<tr>
<td>Left ventricular hypertrophy</td>
<td>13 (22.0%)</td>
<td>36 (49.3%)</td>
<td>49 (37.1%)</td>
</tr>
<tr>
<td>Left atrial enlargement</td>
<td>18 (30.5%)</td>
<td>10 (13.7%)</td>
<td>28 (21.2%)</td>
</tr>
<tr>
<td>RBBB</td>
<td>2 (3.4%)</td>
<td>-</td>
<td>1 (1.4%)</td>
</tr>
</tbody>
</table>

**RBBB** - Right Bundle Branch Block

**LAH** - Left Anterior Hemi Block

### Table 3. Socio-economic class of study population

<table>
<thead>
<tr>
<th>Socio-Economic Class</th>
<th>Hypertensives</th>
<th>Total</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With heart failure</td>
<td>Without heart failure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No %</td>
<td>No %</td>
<td>No %</td>
</tr>
<tr>
<td>Lower</td>
<td>46</td>
<td>78.9</td>
<td>30</td>
</tr>
<tr>
<td>Middle</td>
<td>11</td>
<td>18.6</td>
<td>22</td>
</tr>
<tr>
<td>Upper</td>
<td>2</td>
<td>3.4</td>
<td>21</td>
</tr>
</tbody>
</table>

Total: 59 100 73 100 132 100
for mortality in hypertensive patients.  

Left axis deviation (LAD) was found in 40 (30.3%) of the study population and is significantly higher than what obtains in the normal Nigerian population (3%) as reported by Araoye, 1.9% by Onwubere and 6% by both Seriki and Smith. It is known that the common denominators in the pathogenesis of left axis deviation are ischaemia or fibrosis of the left anterior fascicle of the bundle of His, left ventricular hypertrophy and left bundle branch block. Ischaemic heart disease is however still considered rare among Nigerians In blacks a possible aetiological factor for LAD is cryptogenic cardiomyopathy.

Sinus tachycardia was the third most prevalent ECG finding among these hypertensives, occurring in 25% of the study population. This is quite high compared to the situation in the normal black population here in Port Harcourt where it was as low as 0.3%. This is the rhythm that results when the sino-atrial node discharges impulses faster than an arbitrarily chosen normal maximum rate of 100 beats/min. It may be normal in infants and children and may be caused by exercise, emotional stimuli, congestive cardiac failure, blood or fluid loss, constrictive pericarditis and high output states. Twenty eight out of the 33 (47.5%) with sinus tachycardia were in heart failure as against 5 (6.9%) who were not. This was statistically significant (p = 0.00, Table 2). It is likely that most of them were as a result of the increased sympathetic drive found in heart failure.

Left atrial enlargement (LAE) was found in 28 (21.2%) of the study population. Eighteen (64.3%) of these patients were in heart failure. An interpeak duration of 0.04s has been found to be insensitive but almost 100% specific when compared to left atrial enlargement confirmed on M mode echocardiography.

Ventricular ectopic beats were recorded in 9 (6.8%) of the study population and compared to 0.83% in the apparently normal population, here in Port Harcourt is quite high. They were mostly unifocal and none exhibited the R on T phenomenon.

Prevalence of atrial fibrillation (AF) among the hypertensives was 3.8%. Among the normal adult local black population in Port Harcourt, it was 0.5%. AF was found in only those patients who were in heart failure. It is a well known precipitating or aggravating factor for heart failure. It is also a risk factor for ischaemic strokes. Common causes include hypertension, coronary artery disease, valvular heart disease and thyrotoxicosis.

RBBB was found in only two patients (1.5%) of the study population. It is a conduction abnormality affecting the right fascicle of the bundle of His. It is known to occur in normal individuals but it may also indicate coronary heart disease, atrial septal defect, right ventricular overload and occurs transiently in acute pulmonary embolism and carditis. There was no evidence for any of these in the study population. Other studies on hypertensives like the one by Smith in Lagos had reported a low occurrence of RBBB; only one being recorded in that series.

RBBB and left anterior hemi-block (bifascicular block) was found in only one patient (0.8%) in the study. Common causes of bifascicular block include ventricular conduction abnormalities as obtains in hypertension, coronary heart disease, fibrosis of the conduction system and primary myocardial diseases.

Left anterior hemi-block (LAH) has been found to be strongly associated with hypertension in Nigerians. In this series at University of Lagos Teaching Hospital, they found 66 patients with LAH. Out of these, 51.5% were hypertensive.

The absence of pathological Q waves (old infarction pattern) suggests that coronary heart disease is still not common among Nigerians as was reported by Williams in 1971. The westernization of our lifestyle has brought with it increasing prevalence of coronary heart disease but this is not reflected in the study. This may be due to the fact that most of the patients that were involved in the study belong to the lower socio-economic class. It may also be due to the fact that most of the patients were non smokers. A similar study in one of the multi-national companies may reveal a very different picture because of their bigger pay cheques and sedentary lifestyles.

This study concludes that ECG abnormalities are prevalent in hypertensives in Port Harcourt and so electrocardiography is still very relevant for

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the assessment of the effect of hypertension on the heart. Considering the prognostic significance of some of the changes like left ventricular hypertrophy, left atrial enlargement and LBBB, ECG is cost effective for the proper evaluation and follow-up of cardiac complications in hypertension.

References

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