Target Organ Damage in Black Hypertensives

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SUMMARY A representative sample of black hypertensives has been appraised to determine candidacy for hypertension treatment. A total of 1759 black residents were successfully screened at home. Forty-one percent of the males and 33% of the females had diastolic blood pressures of 95 mm Hg or greater. They were invited for secondary screening along with those hypertensives controlled on therapy. Clinical and laboratory evidence of cardiovascular disease was common among examined patients who were studied to determine their eligibility for therapy based on criteria of elevated blood pressure (> 104 mm Hg) at two visits, or evidence of end organ damage at lower blood pressure levels.

Of patients previously aware of their hypertension but not on therapy, 88% of the males and 67% of the females were considered candidates for therapy. Of patients not previously aware of their elevated blood pressure, 72% of the males and 67% of the females were considered candidates.

Since the landmark veterans administration trials of antihypertensive therapy\(^1\)\(^2\) clearly showed the beneficial effects of therapy for a selected group of middle-aged hypertensive males, there has been increasing concern with the identification of hypertensive patients and the development of therapeutic programs to implement secondary prevention for them. Additional investigations are now underway\(^3\)\(^4\) which may determine whether there are beneficial effects of therapy at lower levels of hypertension, in younger individuals, and in women. The results of these clinical trials should provide evidence to facilitate decisions in terms of initiating therapy in patients with a wider range of elevated blood pressure.

In the meantime, decisions to treat hypertensive patients with drug therapy are made on the basis of known prognostic factors associated with hypertensive complications; most important among these factors are the sustained high level of diastolic pressure, or manifestations of the presence of end organ damage at lower levels of blood pressure. The National High Blood Pressure Education Program\(^5\) has recommended that patients with average diastolic pressures of 105 mm Hg or greater be treated with antihypertensive drugs and that those with average diastolic pressures from 95 to 104 mm Hg be provided individualized therapy which could include the use of specific antihypertensive drugs, especially if complications of hypertension or other cardiovascular risk factors are present. Others have recommended antihypertensive treatment for individuals with sustained diastolic blood pressures of 100 mm Hg or even lower,\(^6\)\(^7\) particularly younger individuals.\(^8\)\(^9\) Taking into consideration the epidemiologic risk factors associated with severity of hypertension and its complications, Freis has recently proposed a point scoring system to be used in determining the eligibility of a patient for antihypertensive therapy.\(^10\) In addition to the level of blood pressure and the presence of end organ damage, this approach recognizes sex and race as meaningful risk factors and accords each one point in the scoring system irrespective of any additional attributes. The higher risk of complications experienced by black hypertensives has influenced Kaplan to suggest that antihypertensive treatment is probably necessary for all black men and women at any age with blood pressures greater than 140/90 mm Hg.\(^10\)

It is the purpose of this report to review the results of a blood pressure survey, followed by clinical examination of hypertensives in a black urban community, and to describe the proportion of identified and examined hypertensives who, on the basis of the diastolic blood pressure and the presence of end organ damage, would be candidates for an individualized hypertension treatment program.

Methods

The Baltimore group, one of 14 clinical centers collaborating in the National Hypertension Detection and Follow-up Program,\(^2\) also participated in the planning phase of this collaborative study, and the data in this report were collected during this planning phase. Since the design and preliminary epidemiologic findings of this community survey have been previously reported in detail,\(^11\)\(^12\) they will be briefly summarized here. In 1971-72, a 3.4% random sample of housing units was selected from 27 census tracts in West Baltimore. Over 75% of the residents aged 30 to 69 in the sample units were screened at home by trained interviewers. Blood pressure was measured using a mercury sphygmomanometer and three blood pressure readings were taken five minutes apart, on the right arm, with the patient in the sitting position. If the third diastolic reading (K5) was greater than 94 mm Hg, the resident was considered to be hypertensive and invited to a special clinic for a comprehensive cardiovascular examination. Also considered hypertensive and invited for examination were those with a lower diastolic blood pressure but who were on antihypertensive treatment; that is, those whose hypertension was under control at the time of the home visit.

During the clinic examination, blood pressure was again measured on the right arm in the lying, sitting, and standing positions. For the purposes of this study, the patient's clinic blood pressure consisted of the average of the second and third readings (K5) in the sitting position. A medical history and physical examination was completed. Laboratory tests and studies included a 12-lead electrocardiogram, a P-A chest X-ray, urinalysis, hematocrit, white blood count, serum sodium, potassium, cholesterol, creatinine, uric acid, and glucose. The electrocardiograms were interpreted by cardiologists and the chest X-rays were interpreted by staff members of the radiology department of the two par-
participating hospitals (University of Maryland Hospital and Provident Hospital).

The physician indicated his clinical impression at the end of the physical examination, before any laboratory test results were available.

**Results**

A total of 1759 black residents were successfully screened at home. The sex and age composition of this group are shown in table 1, and the cumulative distribution of the diastolic blood pressures at home is depicted in figure 1. Forty-one percent of the males and 33% of the females had home diastolic blood pressures of 95 mm Hg or greater. A diastolic blood pressure greater than 104 mm Hg was present in 23% of the males and 16% of the females; also, 6% of the males and 4% of the females had diastolic blood pressures greater than 119 mm Hg. When hypertensives satisfactorily controlled on therapy (i.e., diastolic blood pressure less than 95 mm Hg at home screen) are included with those whose home diastolic blood pressure was greater than 94 mm Hg, 45% of the males and 43% of the females were considered hypertensive and eligible for secondary screening at a special clinic.

Approximately two-thirds of those invited, or 517 of the 784 eligible patients, participated in clinic screening. The participation in the clinic examination was proportionately similar among males and females and among the groups on therapy or not on therapy for their hypertension at the time of home screening. Eighty-one percent of the participants not on therapy for hypertension also had clinic diastolic blood pressures greater than 95 mm Hg; this varied from 72% for those with home diastolic blood pressures 95 to 99 mm Hg to 89% for those with blood pressures greater than 110 mm Hg (unpublished data).

Clinical and laboratory evidence of cardiovascular disease was common among examined patients (table 2). A history of angina or prior heart attack, or ECG evidence of previous myocardial infarction was noted in 14% of the 208 males and the 309 females. Approximately 3% of both males and females gave a history of stroke with or without residual effects on physical examination. An elevated serum creatinine was noted in 9% of the males and 6% of the females. Abnormal electrocardiograms were noted more often in the males and cardiomegaly more often noted in the examined females. An elevated fasting blood glucose was noted in 15% of the males and 14% of the females.

The majority (75%) of electrocardiographic abnormalities were ST-T changes indicative of myocardial damage and/or ischemia (table 3). The electrocardiographic interpretation

![Figure 1. Proportion of black respondents, age 30-69, with diastolic blood pressure over specified levels at home screening, by sex. The height of the vertical columns indicates the percent of respondents with diastolic blood pressure over specified levels. The specified levels of diastolic pressure in mm Hg is indicated at the bottom of each pair of columns. For example, 33% of black females had diastolic blood pressures greater than 94 mm Hg.](http://circ.ahajournals.org/)

of left ventricular hypertrophy with some other electrocardiographic abnormality was noted in 26% of the males and 12% of the females. Eighty percent of the other electrocardiographic abnormalities were ST-T changes indicative of myocardial damage or ischemia. An additional 16% of the males and 4% of the females showed precordial QRS changes consistent with left ventricular hypertrophy, in the absence of ST-T changes. QRS changes of previous myocardial infarction were noted in the tracings of 8% of the males and 6% of the females.

The relationship between end organ damage and home diastolic blood pressure was examined only in those hypertensives not on therapy. Table 4 shows the expected findings that clinical and laboratory evidence of end organ damage among untreated hypertensives is found more often in male and female patients with the highest home diastolic blood pressure (greater than 114 mm Hg). A substantial proportion of males and females with modest elevations of their diastolic blood pressure (95–104 mm Hg) show clinical or laboratory evidence of end organ damage.

In view of the extent of cardiovascular morbidity in these

| Table 2. Percent of Examined Patients* with Selected Clinical Diagnoses and Laboratory Test Results |
|-------------------------------------------------|-----------------|-------------------|
| History of angina or prior heart attack          | 14.4            | 14.2              |
| History of stroke, with or without residual      |                 |                   |
| Serum creatinine >2.0 mg/100 ml                  | 3.4             | 2.9               |
| Abnormal electrocardiogram                       | 62.5            | 44.7              |
| X-ray evidence of cardiomegaly and/or left ventricular hypertrophy | 12.9            | 21.0              |
| Fasting blood glucose >120 mg/100 ml             | 15.0            | 13.7              |

*208 males; 309 females.
examined hypertensive patients, their clinic records were reviewed to determine their eligibility for antihypertensive therapy based on the criteria of sustained elevation of diastolic blood pressure at two visits or evidence of end organ damage at lower levels of blood pressure. These results are summarized in figure 2. Twenty-nine percent of the male patients were already on therapy, with their blood pressure either satisfactorily controlled (11%) or not (18%). An additional 29% of the males not on therapy had diastolic blood pressures of 105 mm Hg or greater, both at home and in the clinic. In the remaining patients, 17% showed evidence of end organ damage. Thus a total of 85.1% of all examined males would be considered candidates for an individualized hypertension treatment program, eight times as many as were originally controlled, or almost three times as many as were on treatment. Similarly, 82.8% of the examined females would be considered candidates for an individualized hypertension treatment program. However, a greater proportion of those were already under treatment or satisfactorily controlled.

In order to estimate the proportion of newly identified hypertensives who would qualify for treatment according to the criteria previously stated, we examined only untreated hypertensives according to prior awareness of hypertension and determined eligibility for treatment in these two groups of patients. These results are shown in figure 3. Of the 65 males who were previously aware of their hypertension, slightly over 50% had sustained diastolic blood pressures of 105 mm Hg or greater (both at home screening and at the time of clinic examination). An additional 35% showed evidence of end organ damage for a cumulative proportion of treatment candidates of 88%. Similarly, 67% of the females who were aware of their hypertension but were not on therapy showed either sustained elevation of diastolic pressure or evidence of end organ damage at lower levels of blood pressure.

Eighty-three males were examined who were previously unaware of their elevated blood pressure; 30% of these had sustained diastolic blood pressures greater than 104 mm Hg. An additional 42% showed evidence of end organ damage at lower levels of blood pressure for a total of 72% considered candidates for treatment. For the 71 examined females, 67% showed either home and clinic blood pressures of 105 mm Hg or greater, or evidence of end organ damage at lower blood pressure levels.

### Table 3. Proportion of all Electrocardiograms with Selected Interpretations

<table>
<thead>
<tr>
<th>ECG Interpretation</th>
<th>Males N %</th>
<th>Females N %</th>
<th>Total N %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>77 37.5</td>
<td>171 55.3</td>
<td>248 48.0</td>
</tr>
<tr>
<td>Myocardial damage*</td>
<td>89 42.8</td>
<td>115 37.2</td>
<td>204 39.5</td>
</tr>
<tr>
<td>LVH with other</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECG abnormality*</td>
<td>54 26.0</td>
<td>37 12.0</td>
<td>91 17.6</td>
</tr>
<tr>
<td>LVH (voltage change)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MI (old)*</td>
<td>17 8.2</td>
<td>17 5.5</td>
<td>34 6.6</td>
</tr>
<tr>
<td>BBB or hemiblock*</td>
<td>9 4.3</td>
<td>10 3.2</td>
<td>19 3.7</td>
</tr>
<tr>
<td>Digitalis effect*</td>
<td>4 1.9</td>
<td>14 4.5</td>
<td>18 3.5</td>
</tr>
<tr>
<td>Arrhythmia*</td>
<td>5 2.4</td>
<td>9 2.9</td>
<td>14 2.7</td>
</tr>
</tbody>
</table>

*These are not mutually exclusive categories.

†Depth of S wave over right precordium plus height of R wave over left precordium ≥ 35 mm.

Abbreviations: ECG = electrocardiogram; LVH = left ventricular hypertrophy; MI = myocardial infarction; BBB = bundle branch block.

### Table 4. Proportion of Black Hypertensive Patients, not on Antihypertensive Therapy, with Selected Clinical and Laboratory Findings, by Sex and Home Diastolic Blood Pressure

<table>
<thead>
<tr>
<th></th>
<th>All Males</th>
<th>All Females</th>
<th>95-104</th>
<th>105-114</th>
<th>&gt;114</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>N</td>
<td>Males</td>
<td>Females</td>
<td>Males</td>
</tr>
<tr>
<td>N</td>
<td>148</td>
<td>158</td>
<td>72</td>
<td>89</td>
<td>52</td>
</tr>
<tr>
<td>ASD</td>
<td>10.8</td>
<td>5.7</td>
<td>9.7</td>
<td>5.6</td>
<td>7.7</td>
</tr>
<tr>
<td>Stroke</td>
<td>2.0</td>
<td>1.3</td>
<td>1.4</td>
<td>1.1</td>
<td>1.9</td>
</tr>
<tr>
<td>LVH by ECG</td>
<td>41.9</td>
<td>10.1</td>
<td>38.9</td>
<td>8.9</td>
<td>34.6</td>
</tr>
<tr>
<td>N</td>
<td>138</td>
<td>145</td>
<td>68</td>
<td>85</td>
<td>47</td>
</tr>
<tr>
<td>Cardiomegaly or LVH by X-ray</td>
<td>13.7</td>
<td>15.2</td>
<td>14.7</td>
<td>9.4</td>
<td>6.4</td>
</tr>
<tr>
<td>Creatinine</td>
<td>147</td>
<td>153</td>
<td>72</td>
<td>88</td>
<td>51</td>
</tr>
<tr>
<td>% above 2.0 mg/100 ml</td>
<td>6.1</td>
<td>2.0</td>
<td>5.6</td>
<td>3.4</td>
<td>5.9</td>
</tr>
</tbody>
</table>

Abbreviations: ASD = arteriosclerotic heart disease as defined by history of angina or prior heart attack; Stroke = by history with or without residual effects; LVH by ECG = left ventricular hypertrophy by depth of S wave over the right precordium plus height of R wave over left precordium of greater than 35 mm, with or without other abnormalities.
Figure 3. Candidates for therapy in black hypertensives not on therapy, by awareness of hypertension and by sex. The vertical section of each column indicates the percent whose home and clinic diastolic blood pressure was 105 mm Hg or greater. The stippled portion of the bar graph indicates the percent with lower blood pressures, but with evidence of target organ damage. The pair of columns on the left depicts the results in participants who were previously aware of their hypertension. The pair on the right depicts the results in participants previously unaware of their elevated blood pressure.

Discussion

A comparison of the distribution of selected characteristics (age, sex, prevalence of hypertension in those community hypertensives who were examined and those who were not [refused examination or failed to keep an appointment]) have been described elsewhere and found to be comparable. In addition the target area studied included census tracts from a wide range of socioeconomic levels, so the results described may be viewed as applicable to black urban residents in most major metropolitan centers.

A higher proportion of these examined hypertensive patients showed electrocardiographic (ECG) abnormalities than has been reported in other studies. In a population based study of a rural county, McDonough, Garrison, and Hames noted ECG evidence of left ventricular hypertrophy (LVH) in 7.6% of 515 examined black males and females with diastolic blood pressure ≥ 100 mm Hg. Although sex-specific rates of LVH were not reported for these hypertensive patients, the authors did note that, for the total group of examined blacks (647 females and 537 males), ECG evidence of LVH was present three times as often in the females. As indicated in table 3, 17.6% of our examined hypertensives showed ECG changes of LVH with other ECG abnormalities, and an additional 8.9% showed only precordial voltage changes consistent with LVH. The higher rates of LVH in this report, in comparison with the Evans County Study, may be accounted for, in part, by the fact that different ECG criteria were used for LVH; their study was conducted during 1960-62 and the criteria then used for LVH was an R wave in lead I and an S wave in lead III with a combined amplitude exceeding 26 mV. The difference in ECG criteria used for LVH may also account, in part, for the disparity between the two studies in the prevalence of LVH by sex. As indicated in table 3, ECG evidence of LVH was more than twice as common among hypertensive males as females.

More recently a report from the Veterans Administration (VA) Cooperative Study Group on Antihypertensive Agents reported that 16.3% of 380 white and black hypertensive males showed ECG changes of LVH. The VA report did not indicate separate rates for LVH by race, but using the same criteria as that study, 19.6% of the black males in this report showed LVH. The comparable rate for black females was 8.1%.

In the Evans County Study, cardiac enlargement determined from a chest X-ray was present in 17.5% of examined blacks whose diastolic blood pressure was 100 mm Hg, a rate comparable to that found in this Baltimore study (table 2). Again, race specific rates for cardiomegaly were not reported among these black hypertensives, but of all examined patients, cardiomegaly was noted twice as often in females as in males, similar to our findings (table 2).

Chest X-ray evidence of cardiomegaly was exhibited by 25% of the hypertensive males in the VA Study, but again, separate rates for race were not given. Using comparable criteria, 21% of the black males of this Baltimore study had X-ray evidence of cardiomegaly (table 2). Using a combination of ECG and chest X-ray abnormality, the National Health Examination survey found that 19.1% of black males and 22.2% of black females had evidence of definite hypertensive heart disease.

In the VA Study, 7.1% of the males had sustained a myocardial infarction before the clinical trial was initiated, in comparison with the 13% of black males of this Baltimore study who showed ECG changes consistent with a prior myocardial infarction (table 3). Five percent of the VA Study patients had a clinical diagnosis of stroke, compared to 3.4% of the black males in this Baltimore study (table 1). Only three of the 380 (0.01%) VA patients had an elevated creatinine compared to 9.2% of all examined black hypertensives (table 2).

Although the blood pressures of these patients were determined at only two points in time (home screening and clinic examination), less intensive testing than recommended for evaluating patients with elevated blood pressure, the examination of all patients participating in this two-stage screen revealed considerable end organ damage. If a decision were to be made to treat black urban residents with sustained diastolic blood pressure of 90 mm Hg or greater, as has been suggested by Kaplan, and if patients with diastolic blood pressures of 90 mm Hg or greater at home screening maintain their pressure at secondary screening approximately in the same proportion as those with blood pressures of 95 mm Hg or higher (81% sustained), then medical evaluation would be indicated for as many as 50% of the males and 44% of the females age 30 to 69.

The similarity observed between the prevalence of hypertension in males and females and the extent of hypertensive end organ damage is consistent with previously published studies. At the same time, the fact that the incidence of cardiovascular disease events is lower among females than in males suggests that females may differ in either the number of additional cardiovascular risk factors or an increased tolerance to hypertensive disease, or both.

The results of this study of examined blacks with elevated home screening blood pressure can also be used to estimate the needs for hypertension screening and control in the community under study or in other similar communities (fig. 4).
Out of an estimated 64,280 black individuals aged 30 to 69 in the 27 census tracts of the study area, and with the same sex distribution and prevalence of elevated blood pressure as that of the interviewed participants (table 1), we would expect over 10,000 males and over 12,000 females to have diastolic blood pressures greater than 94 mm Hg at primary screening. Applying the estimates in figures 2 and 3 which indicate the proportion of participants with elevated blood pressure at primary screening who are not on therapy and the proportion with blood pressure greater than 104 mm Hg at both home and clinic screening, as well as the proportion with end organ damage at lower levels of blood pressure, we would expect 12,123 persons to be candidates for a hypertension treatment program, i.e., 19% of the total population 30 to 69 years of age (14% of all females and 26% of all males in that age range would be considered eligible for such treatment programs).

Conclusions

In this report, the examination results of a representative sample of black hypertensives from a major urban center have been appraised to determine the participant's candidacy for a hypertension treatment program. The criteria used to determine candidacy are a diastolic blood pressure of 105 mm Hg both at primary and secondary screening, or the presence of end organ damage at lower blood pressure levels. This approach to decision-making in patients with elevated blood pressure is based on the results of the classic VA study.

The results of other clinical trials, now in progress, should provide evidence to facilitate decisions in terms of initiating therapy in patients with a wider range of elevated blood pressure. Until then, the VA results and other epidemiologic data are guiding decision making. Assuming the criteria used in this report are appropriate for such decisions, we believe a high proportion of examined black adults would be candidates for a hypertension treatment program.

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