Cardiovascular Response in Black and White Hypertensives


SUMMARY Sixteen untreated black patients with mild to moderate hypertension and no evidence of target organ damage were matched for age, sex, casual blood pressure (BP), and socioeconomic status with 16 white hypertensives. All patients were studied under standardized conditions in the hospital where they underwent continuous intraarterial ambulatory monitoring of BP and assessment of BP control mechanisms. BP characteristics over prolonged periods of recording were similar for both groups, as were sinoaortic baroreflex activity and pressor response to isometric and dynamic exercise and to cold. Fasting cholesterol and triglyceride levels in both groups were similar. Resting plasma renin activity (PRA) was significantly lower in blacks, but no difference was observed in resting plasma norepinephrine levels. Urinary excretion of Na+ and K+ was also similar in both groups. Thus, results showed that casual BPs matched for black and whites, and recorded over a prolonged period, were similar in pattern, variability, and response to pressor stimuli. It appears that, if BP contributes to the different patterns of morbidity in blacks and whites, it is more likely to be the actual level of BP rather than differences in BP characteristics. (Hypertension 4: 817-820, 1982)

KEY WORDS • ambulatory blood pressure • reflex cardiac control • atheroma

THE observation that the black population in North America has a higher blood pressure (BP) than the white population1,2 has excited much interest. Associated with the higher BP is an increased incidence of target organ damage in blacks manifested as left ventricular hypertrophy (LVH),3 cerebrovascular accidents,4 and changes in optic fundi.5 The pathophysiological basis for raised BP in blacks and whites may differ, and reduced levels of plasma renin activity (PRA),6 resting heart rate (HR),7 and dopamine beta-hydroxylase (DBH)8 could reflect differences in activity of the central nervous system. In addition, pathological studies have shown a different distribution of atheroma in the arteries of blacks and whites,9,10 the former having an increased deposition in the cerebral arteries, but conversely the coronary arteries are relatively spared, and this might be related to different BP characteristics and control between the groups.

The purpose of this report is to compare the responses of matched black and white hypertensive pa-
tients, measured under standardized conditions using intraarterial ambulatory BP monitoring, and to assess the cardiovascular reflex responses to pressor stimuli.

Patients and Methods

Sixteen black patients with mild to moderate hypertension were matched for age, sex, casual BP, and socioeconomic status with 16 white hypertensives (table 1). All patients were gathered by general practitioners within the same catchment area of the hospital and were of socioeconomic groups IV and V (Registrar General, United Kingdom). Three of the blacks were smokers and six of the whites. The blacks were all of West Indian origin, the majority being born on the island of Jamaica. All 32 patients had casual BPs greater than 140/95 mm Hg on three separate outpatient visits. None of the patients had evidence of target organ damage defined as cerebrovascular disease, left ventricular hypertrophy, renal impairment, or accelerated hypertension. Patients without evidence of target organ damage were selected to reduce the effects on cardiac reflex mechanisms. Secondary hypertension was excluded by clinical examination, routine biochemistry, catecholamine excretion, and intravenous urography. No patient had received antihypertensive therapy.

All patients were admitted to the hospital for approximately 36 hours during which time 24-hour col-
grams of systolic BP (SBP) and diastolic BP (DBP) and electrolytes, and creatinine.

over the 24 hours. Blood pressure was analyzed beat to beat on a computer after periods of pressure artifact and damping had been excluded.12 Frequency histograms of systolic BP (SBP) and diastolic BP (DBP) were Gaussian in distribution for each patient. The mean and standard deviation of the histograms were then used to measure mean SBP and DBP and variability of BP respectively.13

Cardiovascular Reflexes

Responses to cardiovascular reflexes were measured in a quiet room after 30 minutes' rest, and at the same time of day for each patient. Blood pressure and heart rate (HR) were recorded with a Grass multi-channel recorder using a Gaeltec 3EA/a pressure transducer connected to the arterial cannula.

Baroreflex Sensitivity

Baroreflex sensitivity was measured in 14 pairs of patients by the method of Smyth et al.14 using phenylephrine. Baroreflex sensitivity was measured as the average slope of the regression line of pulse interval (msec) on SBP measured beat to beat.

Isometric Exercise

Isometric exercise was measured in eight pairs of patients. The response to squeezing a calibrated hand-grip dynamometer with the dominant hand, at 30% of the maximum voluntary contraction for 3 minutes, was measured with the patient sitting.

Dynamic Exercise

The response to dynamic exercise in 12 pairs of patients was measured as the average increase in BP and HR during the last 3 minutes of an upright bicycle exercise test of 8 minutes’ duration. The workload, which was constant, had previously been determined as that load resulting in 85% maximum HR in response to a multistage exercise test to exhaustion.

Cold Pressor Test

The cold pressor test was measured in 14 pairs of patients as the BP and HR change from control levels to the maximum levels measured during a 4-minute period of immersion of the hand in iced water.

Catecholamine and Plasma Renin Activity

Venous blood was drawn from an indwelling venous cannula after the period of rest prior to stress testing. Plasma norepinephrine levels were measured by the method of Peuler and Johnson15 in 10 pairs of patients, and PRA by the method of Waite16 in 11 pairs.

Plasma Cholesterol and Triglyceride Levels

Venous blood samples for cholesterol and triglyceride concentrations were drawn after overnight fast (9 hours). Data are presented as mean values ± one standard deviation. Standard methods were used for Student’s t test for paired observations. The Wilcoxon matched-pairs signed-ranks test17 was used where non-parametric statistics were appropriate.

Results

The mean age of blacks and whites was not significantly different nor was the mean casual BP (table 2). The black patients were, however, significantly heavier and had a greater body surface area.

Arterial Pressure and Variability

The mean awake intraarterial BP for both blacks and whites was significantly lower than mean casual BP (blacks plus whites, < 0.001). Blood pressure recorded during waking and sleeping was not significantly different between the groups, nor was variability of BP recorded during waking and sleeping (table 2).

<table>
<thead>
<tr>
<th>Table 1. Individual Patient Data</th>
<th>Blacks</th>
<th></th>
<th>Whites</th>
<th></th>
</tr>
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<tbody>
<tr>
<td>Patient</td>
<td>Age</td>
<td>Sex</td>
<td>Casual BP</td>
<td>Patient</td>
</tr>
<tr>
<td>EC</td>
<td>49</td>
<td>M</td>
<td>155/100</td>
<td>TC</td>
</tr>
<tr>
<td>HC</td>
<td>21</td>
<td>M</td>
<td>147/98</td>
<td>DR</td>
</tr>
<tr>
<td>CW</td>
<td>37</td>
<td>F</td>
<td>173/104</td>
<td>MJ</td>
</tr>
<tr>
<td>SH</td>
<td>23</td>
<td>F</td>
<td>148/99</td>
<td>AC</td>
</tr>
<tr>
<td>CH</td>
<td>37</td>
<td>F</td>
<td>155/100</td>
<td>RM</td>
</tr>
<tr>
<td>ZG</td>
<td>58</td>
<td>M</td>
<td>145/96</td>
<td>CB</td>
</tr>
<tr>
<td>WG</td>
<td>54</td>
<td>M</td>
<td>175/102</td>
<td>PK</td>
</tr>
<tr>
<td>CR</td>
<td>32</td>
<td>M</td>
<td>141/100</td>
<td>JT</td>
</tr>
<tr>
<td>EM</td>
<td>44</td>
<td>M</td>
<td>180/120</td>
<td>EP</td>
</tr>
<tr>
<td>RL</td>
<td>47</td>
<td>M</td>
<td>158/105</td>
<td>JD</td>
</tr>
<tr>
<td>CG</td>
<td>42</td>
<td>M</td>
<td>160/110</td>
<td>JW</td>
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<tr>
<td>JF</td>
<td>42</td>
<td>M</td>
<td>157/99</td>
<td>CK</td>
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<tr>
<td>MR</td>
<td>40</td>
<td>F</td>
<td>173/110</td>
<td>HE</td>
</tr>
<tr>
<td>ST</td>
<td>50</td>
<td>F</td>
<td>155/96</td>
<td>GH</td>
</tr>
<tr>
<td>DW</td>
<td>43</td>
<td>F</td>
<td>148/93</td>
<td>MB</td>
</tr>
<tr>
<td>NC</td>
<td>46</td>
<td>F</td>
<td>150/96</td>
<td>JS</td>
</tr>
</tbody>
</table>

Table 2. Mean Age, Weight, Body Surface Area, and Casual Blood Pressure of Blacks and Whites

<table>
<thead>
<tr>
<th>Blacks</th>
<th></th>
<th></th>
<th>Whites</th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>Mean</td>
<td>sd</td>
<td>Mean</td>
<td>sd</td>
<td>p</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42 ± 10</td>
<td>42 ± 11</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>82 ± 13</td>
<td>68 ± 12</td>
<td>&lt; 0.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BSA (kg/m²)</td>
<td>1.91 ± 0.19</td>
<td>1.74 ± 0.18</td>
<td>&lt; 0.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Casual BP (mm Hg)</td>
<td>158 ± 12</td>
<td>161 ± 14</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(mm Hg)</td>
<td>102</td>
<td>100</td>
<td>8</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

BSA = body surface area.
3). No significant differences in HR were seen between the blacks and whites during waking or sleeping.

Baroreflexes

The mean baroreflex activity of the black hypertensives was 8.4 ± 4.3 msec/mm Hg compared to 7.2 ± 3.5 msec/mm Hg in the whites, not reaching statistical significance.

Isometric Exercise

Results of the cardiovascular reflexes related to stress are shown in table 4. No difference existed in the load used between the groups and the responses of SBP, DBP, and HR were similar.

Dynamic Exercise

Results during bicycle ergometry again showed no significant difference in response of SBP, DBP, and HR.

Cold Pressor Test

No significant differences in BP or HR were seen between the two groups in response to this stress.

Plasma Renin Activity

The median resting PRA of the black hypertensives was 0.6 nmole/liter/min, range 0.2 to 3.8 nmole/liter/min, significantly lower than that of the whites of 2.8 nmole/liter/min, range 0.6 to 11.3 nmole/liter/min (p < 0.01, Wilcoxon matched-pairs signed-ranks test).

Plasma Norepinephrine

The median resting plasma norepinephrine of the blacks was 2.02 nmole/liter (range 0.3-6.48 nmole/liter) not significantly different from that of the whites at 1.52 nmole/liter (range 0.77 to 3.6 nmole/liter) (Wilcoxon matched-pairs signed-ranks test).

<table>
<thead>
<tr>
<th>TABLE 4. Response to Cardiovascular Reflexes (Mean ± sd)</th>
</tr>
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<tbody>
<tr>
<td>Test</td>
</tr>
<tr>
<td>Isometric exercise</td>
</tr>
<tr>
<td>Δ SBP (mm Hg)</td>
</tr>
<tr>
<td>Δ DBP (mm Hg)</td>
</tr>
<tr>
<td>Δ HR (bpm)</td>
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<tr>
<td>Load (Kgf)</td>
</tr>
<tr>
<td>Dynamic exercise</td>
</tr>
<tr>
<td>Δ SBP (mm Hg)</td>
</tr>
<tr>
<td>Δ DBP (mm Hg)</td>
</tr>
<tr>
<td>Δ HR (bpm)</td>
</tr>
<tr>
<td>Load (watts)</td>
</tr>
<tr>
<td>Cold pressor</td>
</tr>
<tr>
<td>Δ SBP (mm Hg)</td>
</tr>
<tr>
<td>Δ DBP (mm Hg)</td>
</tr>
<tr>
<td>Δ HR (bpm)</td>
</tr>
</tbody>
</table>

Plasma Cholesterol and Triglyceride Levels

The mean fasting plasma cholesterol and triglyceride levels of the blacks were 5.4 ± 1.5 mmole/liter and 0.95 ± 0.42 mmole/liter respectively, not significantly different from those of the whites at 5.1 ± 1.1 mmole/liter and 1.28 ± 0.63 mmole/liter.

Urinary Electrolytes

The mean 24-hour urinary Na+ excretion for the blacks was 112 ± 49 mmole/24 hrs, not significantly different from that of the whites at 87 ± 41 mmole/24 hrs. Mean urinary K+ excretions were identical (blacks = 44 ± 11 mmole/24 hrs; whites = 44 ± 8 mmole/24 hrs). The mean creatinine clearance, which was available for 25 of the 32 patients, was 132 ± 52 ml/min. Six of the 11 patients with urinary Na+ excretion less than 90 mmole/24 hrs had creatinine clearance greater than 100 ml/min, suggesting that the relatively low Na+ excretions were not explained by incomplete urine collections but by modest Na+ intake.

Discussion

In this study, black and white hypertensives when matched for casual BP have shown remarkably similar levels of BP recorded during 24-hour continuous intraarterial monitoring. The BP levels during wakefulness and sleep have proved to be well matched and the changes of BP that occur from waking to sleep have also been similar, comparable with changes seen during previously reported series.8 These findings are of importance since if there had been large differences between blacks and whites during prolonged periods of BP recording the relevance of much of the data based on casual BP recording would be questionable.

Variability of BP over these periods has also been shown to be comparable — during the awake period
and during sleep. Control of BP by means of the sino-
aortic baroreceptors and the response of BP to the
stress of dynamic and isometric exercise and to the
cold pressor stimuli have again been shown to be very
similar in the groups of blacks and whites studied.

Morbidity and mortality in blacks and whites do differ, however, in relation to different cardiovascular
diseases.19, 20 Autopsy data comparing black and white
cadavers showed a difference in the distribution of
atherosclerosis,8, 10 the blacks had a much higher inci-
dence of atherosclerosis in the intracranial arteries
while the whites had a greater deposition in the aorta
and coronary arteries. The differential distribution
might well explain the frequency of clinical syndromes
in both groups of patients, but the etiology of the
variation in distribution has not yet been explained.

The results of this study show that BP recorded over
prolonged periods, its variability, and the responses to
pressor stimuli have similar characteristics in blacks
and whites and if BP is to contribute to the differential
distribution of atherosclerosis it is more likely to be
actual level of BP rather than differences in BP
characteristics.

Factors other than hypertension that are implicated
in atherogenesis include cholesterol and triglyceride
levels and cigarette smoking. It has been suggested
that differences in lipid metabolism may contribute to
the differential distribution of atheroma21-
and, while the numbers here are small, we could show no signifi-
cant difference between fasting cholesterol and triglyc-
eride levels of blacks and whites. The number of white
smokers exceeded the number of black smokers by 2:1
in this study, although it has been suggested that cigara-
ette smoking in blacks is almost as common as in
whites in the UK.23

As previously reported,6 we have also found PRA to
be significantly lower in the black hypertensives. It has
been suggested that the lower PRA is related to a
diminished sympathetic tone in blacks,24 but in this
study we found no evidence of a significant difference
in resting plasma norepinephrine levels. The pressor
responses to exercise and cold were also similar. We
could also show no difference in heart rate between the
groups.

In conclusion, these observations suggest that the
pattern of BP responses does not account for observed
differences in morbidity and mortality between black
and white hypertensives, and it may be that some of the
hypertensive complications seen in blacks are partly
attributable to the higher levels of blood pressure seen
in this ethnic group. It is also interesting to note that
both male and female black hypertensives benefited
particularly from stepped care follow-up in the HDFP
study,25 and this might imply that more energetic anti-
hypertensive therapy in this group will prevent some of
the target organ damage.

Acknowledgments
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