Blood Pressure Course In Patients With Acute Stroke and Matched Controls

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SUMMARY The natural course of blood pressure (BP) was studied after emergency hospitalization in 209 consecutive stroke patients and as many age and sex matched controls. Histories of hypertension were more common among patients than controls (46% vs 26%). On admission 69% of the stroke group and 36% of the controls had BP ≥ 170/100 mm Hg. In the first four days there was a spontaneous BP decline, which was greater the higher the initial values. During the whole hospitalization though, stroke patients with previous hypertension had the highest BP levels and previously normotensive controls the lowest.

Even if WHO as well as the Joint Committee for Stroke have recommended cautious antihypertensive therapy in stroke patients with extreme hypertension, such therapy is not evaluated. If this is to be done, the present findings have to be taken into consideration. Stroke controls, matched according to the initial BP level, will thus be required.

The question of treatment must be answered in the light of knowledge about the spontaneous BP course. Wallace et al. found a gradual decrease of BP in 334 stroke patients referred to them for treatment. Our aim was to study consecutive, nonselected patients and to evaluate whether the BP reaction was specific for stroke patients. Or was it merely a common response to acute disease and hospitalization in elderly subjects? A comparison was therefore made with age and sex-matched controls admitted for acute disorders other than stroke.

Material and Methods

Included in this study were 209 patients consecutively admitted to the Stroke Unit at the Medical Department of Serafimer Hospital in Stockholm. The hospital served all inhabitants in a defined area of Stockholm and the unit admitted a representative part of the stroke cases. In the group studied were 113 men (mean age 71, range 50–94 years) and 96 women (mean age 76, range 50–96 years).

As admission criteria, acute onset of focal neurological deficit was required. Attacks of vertigo or syncope without focal neurological deficit were not included. In addition to fulfillment of the admission criteria, the following diagnostic definitions were used: cerebral hemorrhage — hemorrhagic cerebrospinal fluid (CSF) or intracerebral hemorrhage at CT scan; atherothrombotic brain infarction — bleeding had been excluded with CSF analyses or CT scan; cerebral embolus — the same as for atherothrombotic

FROM CLINICAL EXPERIENCE it is well known that patients with acute stroke, even without a history of previous hypertension, often have a very high blood pressure (BP) on arrival at hospital. Mechanisms and effects of the BP elevation are unclear. Is the BP response harmful to the brain by increasing the tendency of blood-brain barrier disruption and edema formation? Or is it a beneficial response to increased demands of perfusion? The Joint Committee for Stroke has concluded that extremely high BP levels should be treated, but no limits are given. WHO has recommended cautious therapy in patients with extreme hypertension, down to BP levels about 170/100 mm Hg. Neither the Joint Committee for Stroke nor WHO have concluded. In addition to fulfillment of the admission criteria, the following diagnostic definitions were used: cerebral hemorrhage — hemorrhagic cerebrospinal fluid (CSF) or intracerebral hemorrhage at CT scan; atherothrombotic brain infarction — bleeding had been excluded with CSF analyses or CT scan; cerebral embolus — the same as for atherothrombotic
brain infarction plus an embolic source like atrial fibrillation, valvular disease or myocardial infarction within the last month; TIA — focal neurological deficit with duration of less than 24 hours; acute but ill defined cerebrovascular disease — the above investigations missing or impossible to interpret. Subarachnoid hemorrhages were not included.

In accordance with this criteria, the following distribution of stroke diagnoses was seen: Cerebral hemorrhage 8%, cerebral thrombosis 59%, cerebral embolism 20%, TIA 11% and acute but ill defined cerebrovascular disease 2%.

Controls were recruited from the Surgical Department of the hospital. Patients admitted via the Casualty Department, the same as for the stroke patients, to a general ward for acute surgical problems were matched to the stroke patients by age (± 1 year) and sex. The distribution of diagnoses for the controls can be seen in table 1.

Patients as well as controls were evaluated by means of a standard form including data about previous illnesses, current medication and results of physical examination. BP was measured on admission to the Casualty Department. On day 1, BP was measured in both arms and then in the right arm, or the one with the highest BP if there was any difference. All BP compared during the hospital stay were measured in the morning with the patient at rest in a recumbent position. A standard mercury sphygmomanometer was used, and the measurement was always done by one of three specially trained nurses. Appearance of the Korotkoff's sound phase V was used as the diastolic blood pressure. No new antihypertensive drugs were given during the first four days. Patients on previous medication were maintained on it, apart from less than ten patients who lost the ability, or were not allowed for surgical reasons, to swallow their pills. The antihypertensive drugs used were in accordance with Swedish traditions. Diuretics were used in all and beta adrenergic blocking agents (preferably propranolol) in about 10% of the patients treated for hypertension. Less than 15 patients had calcium blocking agents (verapamil) or vasodilators (hydralazine).

The statistical methods used were: Student's t-test, chi-square and linear regression analysis. Significance levels considered were 5, 1 and 0.1%.

### Results

Among the stroke patients 46% had a history of hypertension, as compared to 26% of the controls ($p < 0.001$). On admission to hospital 69% of patients and 36% of controls had a systolic BP $\geq 170$ mm Hg or a diastolic BP $\geq 100$ mm Hg. In table 2 it can be seen that, irrespective of the level chosen to define hypertension, this was always much more common among patients than controls.

If patient and control groups were divided according to history or no history of hypertension, it was obvious that the BP levels were higher if a history of hypertension was present (fig. 1). During the first four days of the stay in hospital, stroke patients without a history of hypertension exhibited higher BP levels than controls with such a history.

Mean BP gradually decreased with the time after hospitalization. In all groups, patients and controls

### Table 1 Distribution of Diagnoses in 209 Surgical Control Patients

<table>
<thead>
<tr>
<th>Diagnoses</th>
<th>Number of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer</td>
<td>17</td>
</tr>
<tr>
<td>Gastrointestinal diseases</td>
<td>85</td>
</tr>
<tr>
<td>Urinary tract diseases</td>
<td>14</td>
</tr>
<tr>
<td>Low back pain</td>
<td>7</td>
</tr>
<tr>
<td>Traumatic disorders</td>
<td></td>
</tr>
<tr>
<td>fractures</td>
<td>59</td>
</tr>
<tr>
<td>other traumatic disorders</td>
<td>14</td>
</tr>
<tr>
<td>Circulatory diseases</td>
<td></td>
</tr>
<tr>
<td>congestive heart failure</td>
<td>3</td>
</tr>
<tr>
<td>aortic aneurysm</td>
<td>1</td>
</tr>
<tr>
<td>arteriosclerosis of leg arteries</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>209</td>
</tr>
</tbody>
</table>

### Table 2 BP Levels in Stroke Patients and Controls on Admission, Day 1 and Day 4. For Patients Discharged after Day 4, BP at Discharge is Also Presented

<table>
<thead>
<tr>
<th></th>
<th>Admission</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stroke</td>
<td>Control</td>
<td>Stroke</td>
<td>Control</td>
<td>Stroke</td>
<td>Control</td>
<td>Stroke</td>
<td>Control</td>
</tr>
<tr>
<td></td>
<td>n=207</td>
<td>p=188</td>
<td>n=207</td>
<td>p=204</td>
<td>n=198</td>
<td>p=169</td>
<td>n=173</td>
<td>p=100</td>
</tr>
<tr>
<td>BP levels (% of n)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 205/115</td>
<td>21</td>
<td>*</td>
<td>3</td>
<td>*</td>
<td>11</td>
<td>*</td>
<td>2</td>
<td>NS</td>
</tr>
<tr>
<td>≥ 195/110</td>
<td>35</td>
<td>*</td>
<td>11</td>
<td>*</td>
<td>20</td>
<td>*</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>≥ 185/105</td>
<td>49</td>
<td>*</td>
<td>21</td>
<td>*</td>
<td>28</td>
<td>*</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>≥ 175/100</td>
<td>64</td>
<td>*</td>
<td>33</td>
<td>*</td>
<td>43</td>
<td>*</td>
<td>17</td>
<td>27</td>
</tr>
<tr>
<td>BP missing (no)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>deceased</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>11</td>
<td>0</td>
<td>35</td>
<td>0</td>
</tr>
<tr>
<td>discharged or other reasons</td>
<td>2</td>
<td>21</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>40</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Significance of difference between stroke and controls is given between the figures: *$p < 0.001$; †$p < 0.05$; NS = not significant. BP levels ≥ means systolic or diastolic BP similar to or above the given figures. All numbers in the table concerning “BP levels” represent a percentage of the total number (n) in that group, and the numbers in the table concerning “BP missing” represent a number of patients in each group.
BLOOD PRESSURE IN ACUTE STROKE/Bråton et al

200-1

d and

0-100

0-100

80

Systolic BP mm Hg

Diastolic BP mm Hg

120

140

160

180

200

220

SH

SNH

CH

CNH

Admission

Day 1

Day 4

Discharge

FIGURE 2. Regression line between systolic BP decline (BP on admission reduced by BP on day 4) and systolic BP on admission for stroke patients with a history of hypertension. means one observation. two observations and O three observations.

Discussion

High BP levels with a marked spontaneous decline were found in acute stroke patients after hospitalization. The highest values were recorded in previously hypertensive subjects. This is in accordance with the findings of Wallace et al., although the materials differed. Their patients were mainly male, veterans, and had a lower mean age. Some were transferred from other hospitals, wherefore admission was delayed. Still, this main conclusion can be drawn from both studies and are further supported by data in a recent abstract.7

The same type of BP reaction was noted in the controls. In spite of a thorough search, we have not been able to find any documentation about the spontaneous BP course in patients hospitalized for acute illnesses, neither as regards normotensive nor hypertensive subjects. Nor have the studies here referred to been able to find earlier documentation on the subject. The 28 male controls included in Wallace's study were not admitted as emergencies.6 Their previous BP status was not mentioned and mean BP on admission (about

with as well as without a history of hypertension, there was a significant (p < 0.001) difference between BP on admission and at day four (fig. 1). The decline was greater the higher the initial BP. Regression lines were computed between admission BP and degree of decline for the four groups of subjects, and for systolic as well as diastolic BP. In figure 2, the regression line for systolic BP in stroke patients with previous hypertension is presented. Regression was similar for patients and controls, for systolic and diastolic BP, and irrespective of previous hypertension or not.

After day four, the BP decline diminished, as did the BP difference between patients and controls (table 2). However, even at discharge previously hypertensive stroke patients had the highest BP and normotensive controls the lowest (fig. 1).

There was no statistically significant difference between men and women as regards BP course, mean systolic and mean diastolic BP. The 17 patients with cerebral hemorrhage had a significantly higher mean diastolic BP on admission, day 1 and day 4, than patients with other stroke diagnoses (table 3).

During the stay in hospital, 35 of the stroke patients died. Their mean BP on admission was 178/97 mm Hg, compared to 179/95 mm Hg for those who survived (NS). Controls without BP recording on day four did not differ from the remainder on admission or day one. These withdrawals from the groups therefore should not have influenced the results to any important degree. Discharge BP in the controls is based on only half of the initial group. Thus it is more uncertain, although this half did not differ from the other half group at the earlier recordings.

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140/80 mm Hg) was remarkably low. No reaction was seen and perhaps was not possible under the existing conditions. Similar objections can be raised against the findings concerning 49 controls only described in an abstract. Hossman et al have demonstrated BP decline, less dramatic than in the present series, in 12 hypertensive but otherwise healthy males during a planned hospital stay.

From the present study, it is obvious that a spontaneous BP decline takes place after emergency hospitalization for various diseases. The higher the initial BP the greater the decline. This might partly be explained by the phenomenon of regression towards the mean. However, most patients with initial BP in the lowest range further declined during hospitalization. This indicates a negligible influence from the regression towards the mean. Previously hypertensive subjects maintain a higher BP level than normotensive. Stroke patients hypertensive and normotensive have higher BP than comparable patients with other diseases. This might represent preexisting higher BP in both stroke groups as compared with the controls. However, it is also probable that a specific physiological response to the brain damage adds to the stress of acute illness and hospitalization, seen in all patients. The spontaneous BP decline might be explained by gradually diminishing stress due to the patient’s adaptation to disease and environment. Among stroke patients a reduction of initially increased demands of brain perfusion may also contribute.

The acute stroke patients, as well as many other patients with acute disorders, have an increased sympathetic activity. It is unknown, however, if the increase is correlated to the BP course or if this is merely a consequence of other mechanisms.

It is still questionable whether it is beneficial to treat hypertension in acute ischemic or haemorrhagic stroke. A study needs to be done as to whether acute lowering of the BP versus the natural lowering would be more efficacious. In that study it is important to show that treatment brings about a faster or greater BP decline than the spontaneous one. Thus untreated stroke patients must be used as controls and all subjects stratified according to initial BP level.

In the clinical situation today, the physicians must take the spontaneous BP decline into account, when considering the need to lower the BP, because in the acute phase this procedure might be hazardous.

### References

3. Cerebrovascular Diseases: Prevention, treatment and rehabilitation. WHO Techn Rep Ser No 469, 1971
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