Blood pressure and intellectual function in elderly subjects

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Abstract

Objective: to assess the relationship between hypertension and cognitive function in elderly subjects.
Methods: 17 subjects with uncomplicated hypertension (nine male, eight female) and 27 control subjects with similar educational level and age (18 male, nine female) were studied. These individuals were recruited, according to strict selection criteria, from a random sample of 120 elderly subjects living in the community, who had a normal Mini Mental State score. An extensive neuropsychological test battery, sensitive to mild cognitive impairment, was administered in standard conditions to measure attention, concentration and judgement, psychomotor speed, memory and learning. Affective disorders were also evaluated. In all patients a computed tomography scan was performed.
Results: subjects with high blood pressure had lower mean levels of performance in attentional measures: tapping test (inhibition of incorrect answers), three words-three shapes test (attempts; incidental memory) and reaction time to multiple stimuli. They also scored worse in clusters 1 and 2 of the Hamilton rating scale for depression. Confluent white matter lesions were found in nine hypertensive subjects (52.9%) and five controls (18.5%; P = 0.0170). Lacunes were demonstrated in 11 hypertensive (64.7%) and four normotensive people (14.8%; P = 0.0007). In a multivariate analysis (logistic regression), three cognitive variables (tapping, Hamilton cluster 2 and Hamilton total score) remained significantly associated with hypertension, independently of the presence of cerebral lesions.
Conclusions: in elderly otherwise normal hypertensive subjects, an attentional impairment may occur, which appears to be functional and possibly reversible rather than structural and progressive.

Keywords: hypertension, psychometric impairment, elderly patients

Introduction

Hypertension can lead to cognitive impairment by producing cerebral ischaemic lesions and is the most powerful risk factor for vascular dementia [1]. Some deficits in cognitive performance (attention, perception, memory, reasoning, visuo-spatial organization, cognition) have also been observed in hypertensive patients free from symptomatic infarctions [2–6]. In elderly people, however, the reports on the relationship between hypertension and psychomotor impairment are conflicting. Some authors report significant impairment in elderly hypertensive subjects [7–10], while others suggest that mild hypertension may prevent age-related decline in cognitive performance [11, 12].

The pathogenesis of the supposed hypertension-related impairment is also still debated. Several mechanisms have been proposed: altered cerebral metabolic processes, cerebral blood flow autoregulation or other physiological changes leading to, or resulting from, hypertension [13–16]; or confluent white matter lesions (leukoaraiosis), whose prevalence is higher in hypertensive than in normotensive subjects of the same age. However, it is not known whether white matter lesions relate to psychomotor impairment [17–20].

This study assesses the relationship between hypertension and psychomotor impairment in elderly subjects, as well as the possible role played by white matter lesions. For this purpose we studied a selected population of elderly subjects, normotensive and with uncomplicated hypertension, with computed tomography (CT) and an extensive neuropsychometric evaluation.

Subjects and methods

In order to avoid a Berkson's bias, the subjects were
recruited from 120 elderly relatives of patients hospitalized in our department. The resulting sample, compared with previous demographic data, was representative of the elderly population living in the community with regard to disease, self-sufficiency and socio-cultural conditions. Inclusion criteria were: (i) age > 60 years, (ii) educational level (3-10 years of schooling) and (iii) score > 23 on the Mini Mental State Examination [21].

On the basis of history, physical observation, medical recordings and, if needed, supplementary laboratory or instrumental examinations, the following conditions were excluded: (i) dementia (DSM-III-R criteria) [22]; (ii) previous stroke or transient ischaemic attack; (iii) neurological diseases (Parkinson's disease, epilepsy, etc.); (iv) psychiatric disorders; (v) poorly controlled diabetes; (vi) renal insufficiency (creatinine > 2.5 mg/dl); (vii) severe chronic diseases, such as liver cirrhosis, respiratory insufficiency, heart failure, malignancy, anaemia (Hb < 10 g/dl), endocrine disorders, etc.; (viii) sensory or motor impairments influencing the ability to perform the tests in the protocol; and (ix) alcohol abuse or regular intake of drugs interfering with cerebral function.

On the basis of these criteria, 44 healthy subjects (27 males and 17 females) were included in the study. Informed consent was obtained from all the patients according to the Helsinki declaration.

**Blood pressure and vascular risk factors**

All patients were submitted to blood pressure evaluation with at least three measurements performed in standard conditions, on two different occasions. For each patient, the mean of these measurements was used in the subsequent assessments.

Blood pressure was measured by the auscultatory method, with the patient sitting upright and the arm held in the horizontal position, using a random zero sphygmomanometer. The diagnosis of hypertension was made in patients with an established history of hypertension, or who were treated with anti-hypertensive drugs or had systolic values > 165 mmHg and/or diastolic values > 95 mmHg on sphygmomanometric measurements. On the basis of these criteria the original sample was subdivided in two groups: (i) normotensive group, 27 patients (61.3%), 18 males (66.6%) and nine females (33.3%), mean age 77.3 ± 5.5 years; (ii) hypertensive group, 17 patients (38.6%), nine males (52.9%) and eight females (47.0%), mean age 75.1 ± 5.5 years.

Of these patients, only five had newly diagnosed hypertension, with ranges of systolic and diastolic blood pressure of 180–196 and 85–100 mmHg respectively.

The sample was also dichotomized according to hypercholesterolaemia (> 6.22 mmol/l) and/or hypertriglyceridaemia (> 1.94 mmol/l), smoking (> 5 cigarettes/day), diabetes mellitus (history and treatment) and being overweight (body mass index > 30).

**Psychometric evaluation**

This was performed in all cases by a skilled psychogeriatrician blind to the blood pressure status of the subjects in a single morning session lasting about 90 min.

In treated hypertensive patients (seven out of 17) all drugs were discontinued for 2 weeks and placebos used to reduce the anxiety associated with discontinuation of treatment. Since both groups consisted of substantially healthy subjects, the only drugs given during the study period were oral hypoglycaemic agents for diabetic patients.

Beverages containing caffeine and alcohol were restricted from the evening before testing. A range of cognitive functions, including attention and concentration, psychomotor speed, memory and learning, was assessed. The tests were selected from standard neuropsychological test batteries as being sensitive enough to detect mild cerebral dysfunction.

Attentional capacity was assessed by several tests, exploring specific and differential aspects of this cerebral function: digit span from the Wechsler adult intelligence scale, for vigilance and concentration [23, 24], word list generation for perseveration [25, 26], tapping and reaction times for ability of inhibition of incorrect answers and susceptibility to interference [27, 28] and visual research for selective attention [25]. The structure of memory function was assessed according to Buschke-Fuld [29] and incidental memory was tested by the three words-three shapes test [27]. Abstraction and conceptual reasoning skills were assessed by the Weigl sorting test [25] and depression evaluated by the Hamilton rating scale [30]. Short summaries of the tests follow.

**Digit span**

Sequences of numbers are read to the subject, who must repeat them to the observer. This continues with sequences of increasing length until two consecutive errors are made for a given sequence length. In the second part, the subject must repeat numbers in reverse sequence. The maximum score is 10.

**Word list generation test**

The task is to generate words of the same category (e.g. animals). Normal adults with high-school education can produce an average of 36 words over 3 min.

**Tapping**

The examiner asks the patient to place the hand on the table and to raise the index finger in response to a single tap, while holding still in response to two taps. The score ranges from 0 to 12.
Simple visual reaction time

After practice trials, subjects are informed which of four coloured lights (blue, green, red, white) will be displayed on a screen and asked to turn the light off as quickly as possible by pressing a button. Five trials of each colour are administered. Mean reaction times in ms are computed for the 20 test trials across the four colour conditions.

Choice visual reaction time (multiple stimuli)

This test is administered in a similar fashion to the simple reaction time task, except that the subjects are not informed which of the four coloured lights will be illuminated. Mean reaction times in ms are computed for the 20 test trials across the four colour conditions.

Visual search test

The subject must find and cancel a number from a random array of numbers on a page. This is followed by two other tests which involve cancelling two or three numbers simultaneously. The test is scored for accuracy and speed of completion.

Selective verbal reminding according to Buschke-Fuld

A 10 word list is presented over a series of 18 trials, or until all the words are successfully recalled on two consecutive trials. The entire list is shown only in the first trial. Subsequently, only those words that were not recalled in the immediately preceding trial are presented. Words that are remembered in two consecutive trials without further presentation are presumed to be in long-term storage; words recalled only after 'reminding' are assumed to be retrieved from short-term storage. No cues are given during the test, so all the subjects are free to adopt their own encoding strategies. After a 15 min interval, during which a non-verbal task is performed, the subject is invited to recall as many words as possible without further reminding. The selective retrieval at the end of learning is a clear demonstration of retrieval efficiency.

In the Buschke-Fuld test the following parameters were considered: (i) the total number of different items recalled without further reminding at least once during the task (long-term storage); (ii) the number of items recalled on successive trials without presentation (retrieval from short-term storage), divided into total, consistent and delayed.

Three words-three shapes test

The patient is first asked to copy the six test stimuli, without being told that memory is to be tested. Immediately after copying, the stimuli are removed and the patient is asked to reproduce them from memory (incidental memory). Patients who do not succeed are allowed a 30 s examination of the six stimuli, this time being told that their memory will be tested (immediate memory). Patients who again fail in the task are allowed repeated study periods, either until the criterion of five or six items is reached or until five study periods have elapsed. Delayed recall is tested after 30 s and 15 min.

Weigl sorting test

In this test, the examiner displays to the patient 12 wooden pieces of different form (circles, squares, triangles); colour (red, yellow, blue, green); suit (hearts, flowers, squares); thickness (4-12 mm); dimension (30-120 mm). In the first step (active) the patient is invited to group the wooden pieces into one category (i.e. all for the same colour). If the patient is not able to find any possibility for grouping the examiner passes to the second step. In the second step (passive) the grouping of pieces is done by the examiner and the patient is invited to explain the criterion adopted for categorization.

Hamilton rating scale for depression

This is a questionnaire of 21 items, subdivided in four clusters, which explore: (i) retarded depression, (ii) agitated depression, (iii) anxiety reaction and (iv) abnormal personalities. In normal subjects the score ranges from 0 to 18.

Neuroradiological evaluation

In all patients a CT scan was performed without contrast medium, with standard axial 5 mm slices. Leukoaraiosis was defined as the presence of ill-defined, patchy or diffuse, white matter periventricular hypodensities. Lacunes were defined as well demarcated lesions, following specific vascular territories and usually involving the internal capsule, basal ganglia, corona radiata or thalamus, with a maximum diameter < 1 cm². Each CT scan was analysed independently and blindly by two experienced neuroradiologists, with full agreement in distinguishing leukoaraiosis and infarcts [17].

Statistical analysis

Unless otherwise stated, all deviations from the mean were expressed as one standard deviation. Since many variables had a non-Gaussian distribution, non-parametric tests were used: the Mann-Whitney test for the comparison between groups, the χ² test for the comparison between percentages and Spearman's correlation coefficient for simple correlation analysis. Multivariate analysis was carried out by stepwise unconditional logistic regression models. A backward elimination procedure was adopted to ascertain which variables remained independently associated with hypertension. Two-tailed tests were used throughout.
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Table 1. Relevant features of the two study groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Normotensive (n = 27)</th>
<th>Hypertensive (n = 17)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>77.3 ± 5.5</td>
<td>75.1 ± 5.5</td>
<td>0.2781</td>
</tr>
<tr>
<td>Mini Mental State score</td>
<td>26.7 ± 2.0</td>
<td>25.8 ± 1.7</td>
<td>0.1695</td>
</tr>
<tr>
<td>Educational level (years)</td>
<td>4.3 ± 1.4</td>
<td>3.9 ± 0.9</td>
<td>0.3670</td>
</tr>
<tr>
<td>Distribution of characteristics (no. and % of subjects)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male sex</td>
<td>18 (66.7%)</td>
<td>9 (52.9%)</td>
<td>0.3626</td>
</tr>
<tr>
<td>Smoking</td>
<td>12 (44.4%)</td>
<td>8 (47.1%)</td>
<td>0.8653</td>
</tr>
<tr>
<td>Hyperlipidaemia</td>
<td>3 (11.1%)</td>
<td>3 (17.6%)</td>
<td>0.5385</td>
</tr>
<tr>
<td>Overweight</td>
<td>9 (33.3%)</td>
<td>9 (52.9%)</td>
<td>0.1977</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>2 (7.4%)</td>
<td>5 (29.4%)</td>
<td>0.0520</td>
</tr>
<tr>
<td>Lacunes</td>
<td>4 (14.8%)</td>
<td>11 (64.7%)</td>
<td>0.0007</td>
</tr>
<tr>
<td>Leukoaraiosis</td>
<td>5 (18.5%)</td>
<td>9 (52.9%)</td>
<td>0.0170</td>
</tr>
<tr>
<td>Blood pressure (mmHg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic</td>
<td>140.8 ± 12.9</td>
<td>174.6 ± 16.0</td>
<td></td>
</tr>
<tr>
<td>Diastolic</td>
<td>74.2 ± 10.7</td>
<td>91.1 ± 6.8</td>
<td></td>
</tr>
</tbody>
</table>

Deviations from means are 1 standard deviation.

and P values less than 0.05 were considered significant. All tests were performed with BMDP software [31].

Results

The main clinical and computed tomographic characteristics of hypertensive and normotensive subjects are summarized in Table 1. The two groups did not differ in age, sex distribution, Mini Mental State score, educational level, smoking habit, blood lipids or body mass. In hypertensive patients the prevalence of lacunes and leukoaraiosis was significantly greater than in normotensive subjects. The prevalence of diabetes was also greater in those with high blood pressure, with a P value close to significance.

In psychometric evaluation, the following significant differences were observed between hypertensive and normotensive subjects (Tables 2 and 3):

1. More inhibition and attentional errors on the tapping test, revealing a trend towards an attention defect;
2. More attempts and worse scores in incidental memory (P close to significance) in the three words-three shapes test;
3. Higher scores in the Hamilton rating scale for depression, which were significant in clusters 1 and 2;

Table 2. Psychometric evaluation: attention

<table>
<thead>
<tr>
<th>Group</th>
<th>Normotensive (n = 27)</th>
<th>Hypertensive (n = 17)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digit span</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward</td>
<td>4.4 ± 0.7</td>
<td>4.2 ± 0.8</td>
<td>0.3922</td>
</tr>
<tr>
<td>Backward</td>
<td>2.8 ± 0.7</td>
<td>2.5 ± 0.9</td>
<td>0.3114</td>
</tr>
<tr>
<td>Word production test</td>
<td>12.8 ± 2.1</td>
<td>12.6 ± 3.1</td>
<td>0.5230</td>
</tr>
<tr>
<td>Tapping (no. of errors)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhibition</td>
<td>2.1 ± 1.5</td>
<td>3.2 ± 1.9</td>
<td>0.0553</td>
</tr>
<tr>
<td>Attentional</td>
<td>0.1 ± 0.3</td>
<td>0.5 ± 0.7</td>
<td>0.0827</td>
</tr>
<tr>
<td>Visual search test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of correct answers</td>
<td>34.4 ± 8.5</td>
<td>30.9 ± 12.6</td>
<td>0.2912</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.3609 ± 0.2226</td>
<td>0.3336 ± 0.2137</td>
<td>0.4765</td>
</tr>
</tbody>
</table>

Deviations from means are 1 standard deviation.
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Table 3. Psychometric evaluation: memory, depression, abstraction and judgement, speed of reaction

<table>
<thead>
<tr>
<th>Group</th>
<th>Normotensive (n = 27)</th>
<th>Hypertensive (n = 17)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Memory</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buschke-Fuld</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTS</td>
<td>103.3 ± 24.2</td>
<td>102.3 ± 36.4</td>
<td>0.8505</td>
</tr>
<tr>
<td>LTRt</td>
<td>77.8 ± 24.7</td>
<td>78.2 ± 32.3</td>
<td>0.8802</td>
</tr>
<tr>
<td>LTRc</td>
<td>33.4 ± 24.6</td>
<td>28.9 ± 24.2</td>
<td>0.4510</td>
</tr>
<tr>
<td>LTRd</td>
<td>6.6 ± 2.1</td>
<td>6.6 ± 2.0</td>
<td>0.8901</td>
</tr>
<tr>
<td><strong>Three words-three shapes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incidental</td>
<td>4.7 ± 1.2</td>
<td>3.8 ± 1.7</td>
<td>0.0652</td>
</tr>
<tr>
<td>Immediate</td>
<td>5.4 ± 0.6</td>
<td>4.9 ± 1.1</td>
<td>0.2101</td>
</tr>
<tr>
<td>Attempts</td>
<td>0.4 ± 0.8</td>
<td>0.9 ± 0.8</td>
<td>0.0349</td>
</tr>
<tr>
<td>30 s</td>
<td>5.4 ± 0.7</td>
<td>5.2 ± 0.8</td>
<td>0.5549</td>
</tr>
<tr>
<td>15 min</td>
<td>4.9 ± 1.1</td>
<td>5.0 ± 1.1</td>
<td>0.7449</td>
</tr>
<tr>
<td><strong>Depression (Hamilton rating scale)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total score</td>
<td>5.9 ± 7.0</td>
<td>8.8 ± 6.8</td>
<td>0.0745</td>
</tr>
<tr>
<td>Cluster 1</td>
<td>1.1 ± 1.8</td>
<td>1.8 ± 1.5</td>
<td>0.0454</td>
</tr>
<tr>
<td>Cluster 2</td>
<td>3.1 ± 3.6</td>
<td>5.5 ± 4.2</td>
<td>0.0454</td>
</tr>
<tr>
<td>Cluster 3</td>
<td>3.0 ± 4.0</td>
<td>4.7 ± 4.7</td>
<td>0.1252</td>
</tr>
<tr>
<td>Cluster 4</td>
<td>1.6 ± 2.2</td>
<td>2.6 ± 2.8</td>
<td>0.1515</td>
</tr>
<tr>
<td><strong>Abstraction and judgement</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weigl sorting test</td>
<td>9.7 ± 2.8</td>
<td>9.3 ± 3.2</td>
<td>0.7540</td>
</tr>
<tr>
<td><strong>Reaction time</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple stimuli</td>
<td>391.5 ± 126.4</td>
<td>434.5 ± 123.5</td>
<td>0.3000</td>
</tr>
<tr>
<td>Multiple stimuli</td>
<td>525.3 ± 141.3</td>
<td>600.1 ± 113.4</td>
<td>0.0329</td>
</tr>
</tbody>
</table>

Deviation from means are 1 standard deviation.

LTS, long-term storage; LTR, long-term retrieval (t = total; c = consistent; d = delayed).

4. Longer reaction time to multiple stimuli, which expresses a slower psychomotor speed.

The structure of memory (Buschke-Fuld), abstraction and judgement (Weigl) were unimpaired in hypertensive patients.

The psychomotor performance of those subjects who were receiving drug treatment for hypertension prior to the placebo run-in period was similar to that of newly-diagnosed hypertensive patients who had never previously been treated for hypertension.

In order to ascertain which variables were independently associated with hypertension, a multiple logistic regression was performed, which included as a dependent variable hypertension and, as possible independent variables, all the variables which differed between hypertensive and normotensive subjects with P values less than 0.10 (Table 4). This analysis was

Table 4. Variables independently associated with hypertension in multiple logistic regression

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Correlation coefficient ± SE</th>
<th>R²</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lacunes⁴</td>
<td>3.892 ± 1.196</td>
<td>0.2135</td>
<td>0.0011</td>
</tr>
<tr>
<td>Tapping (no. of attentional errors)</td>
<td>2.531 ± 0.105</td>
<td>0.1376</td>
<td>0.0126</td>
</tr>
<tr>
<td>Hamilton cluster 2</td>
<td>0.852 ± 0.356</td>
<td>0.1281</td>
<td>0.0167</td>
</tr>
<tr>
<td>Hamilton total score</td>
<td>0.508 ± 0.215</td>
<td>0.1254</td>
<td>0.0181</td>
</tr>
</tbody>
</table>

⁴0 = no, 1 = yes.
The initial model also included the following variables, which were removed according to a backward elimination procedure: diabetes, leukoaraiosis, tapping (no. of inhibition errors; reaction time to multiple stimuli), Hamilton cluster 1, three words-three shapes (incidental; attempts).
performed only to test associations, not cause-effect relationships. Eleven variables were included in the initial model: diabetes, lacunes, leukoaraiosis, tapping (number of inhibition errors and number of attentional errors), reaction time to multiple stimuli, three words—three pictures (incidental and attempts) and Hamilton rating scale (total score, cluster 1 and cluster 2). After a backward elimination procedure, only lacunes and three psychometric tests—tapping (number of attentional errors), Hamilton cluster 2 and Hamilton total score—remained significantly associated with hypertension.

When a similar analysis was performed without lacunes and leukoaraiosis in the initial model, the same three psychometric tests remained significantly associated with hypertension.

Discussion

The relationship between hypertension and psychomotor impairment in elderly people has been addressed in several studies with conflicting results [32]. A significant and progressive cognitive decline has been reported [7, 8, 20, 33] in elderly hypertensive patients. Other investigators have shown that older people with hypertension exhibit only subtle changes in psychomotor performance [34, 35] or that such an impairment is less evident and non-progressive, compared with that in younger people [6, 36–40]. It has even been suggested that mild hypertension may prevent age-related decline of psychomotor performance [11, 12].

Several factors may account for these discrepancies [35]. Studies have used different selection criteria and sample characteristics, such as age, gender, education, health habits, medical disorders, neurological disorders or psychopathology; others are related to hypertension characteristics, such as blood pressure levels, duration, target organ damage and treatment. Moreover, the methods used for neuropsychological evaluation have varied widely, making a comparison of results difficult.

In the present study strict selection criteria were used. Participants were self-sufficient and cognitively competent, randomly selected from the general population; medical, neurological or psychiatric disorders were excluded; psychometric evaluation was carried out in standard conditions, with a battery of tests validated in elderly people. Age, gender, educational level and drug treatment were also excluded as confounding variables.

Our results show that hypertension does not interfere with the structure of memory (long-term storage and retrieval are unaffected) or with the abilities of abstraction and judgement. On the contrary, attentional abilities are clearly impaired in hypertensive patients compared with normotensive subjects, as shown by the higher number of inhibition and attentional errors on the tapping test and from the worse scores in incidental memory (which is strictly dependent on attention).

The association found in previous studies between hypertension and poor performance in psychomotor tests might have been due to changes in mental activity variables (attention, arousal, activity rate), rather than to a true impairment of intellectual function (receptivity, thinking, memory, expressiveness). The presence of low-level deficits (e.g. in attention) needs to be taken into account when interpreting performance in higher level tasks, such as those involving memory [41].

Unfortunately, few studies have followed a hierarchical approach to psychomotor testing, so that the interpretation of results is often difficult [42].

Why is cognitive function disturbed in essential hypertension? Some suggest that a hypertension-related reduction in cerebral blood flow or dysfunctions in autoregulatory mechanisms might adversely affect neuropsychological functioning [13, 14, 43]. According to other studies neurochemical alterations in prefrontal, limbic or hypothalamic regions could be responsible for both the development of hypertension and the impairment of a variety of neuropsychological functions [15, 16]. Finally, according to Kuusisto et al. [33], hyperinsulinaemia seems to identify a subgroup of hypertensive subjects with a particularly poor performance in neuropsychological tests requiring complex cognition, such as semantic memory, problem solving and abstraction.

The role played by silent cerebral lesions is another unresolved question. The prevalence of lacunar brain infarcts, caused by occlusion of perforating arteries, and of white matter hypodensities, associated with ischaemia in deep watershed areas, is higher in hypertensive subjects than in normotensive people of the same age [17, 44]. However, the clinical significance of these tomographic findings remains unclear: some authors report that in elderly subjects they are associated with neuropsychological deficits [18, 20, 45, 46], while others have failed to find any relationship between white matter changes and cognitive abnormalities [19, 47–50].

In our study the prevalence of subclinical lesions in CT scan was found to be higher in hypertensive patients. However, in multivariate analysis, which included tomographic findings, psychometric tests remained significantly associated with hypertension, suggesting that cognitive impairment is linked to high blood pressure independently of the presence of cerebral lesions. This in turn might indicate that such an impairment is functional and reversible rather than structural and progressive. The lack of correlation of the changes in psychomotor performance with the duration and severity of hypertension would be in agreement with the functional hypothesis [5, 37, 38, 51].

In this perspective, depressed mood could play a
relevant role. Depression is a frequent finding in hypertension and it may be associated with an impairment of cognitive function [2, 35, 37, 52–54]. It could therefore be the primary determinant of the attentional impairment and related incidental memory defects and of the slower psychomotor reaction, as illustrated by our hypertensive patients. The significant relationship found between depression scores and other psychometric tests is in agreement with this hypothesis.

The functional nature of cognitive impairment in hypertension suggests that an improvement may be achieved with adequate control of blood pressure, provided that the drugs used do not interfere with psychomotor performance [10, 55].

Key points

- Hypertension in older people does not affect long-term memory or abstraction/judgement ability.
- Hypertension is associated with depression and defects in attention and incidental memory.
- The cognitive impairment associated with depression is independent of the presence of cerebral lesions.

References

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