Motor and Perceptual Impairments in Acute Stroke Patients: Effects on Self-Care Ability

Birgitta Bernspång, OT, Kjell Asplund, MD, Sture Eriksson, MD, and Axel R. Fugl-Meyer, MD

The relative importance of motor, perceptual, and some cognitive functions for self-care ability was analyzed in a representative sample of 109 subjects within 2 weeks of acute stroke. Forty-nine patients (45%) were dependent or partly dependent in self-care. Profound motor dysfunction was present in 39%, low-order perceptual deficits in 10%, high-order perceptual deficits in 60%, and disorientation in time and space in 13% of the patients. There was a significant covariation between motor function and self-care ability and between low-order perception and orientation function. Low-order and high-order perception covaried only weakly. Discriminant analyses showed that the actual level of self-care proficiency could be correctly predicted in 70% of the cases by the 4 indexes of motor function, low-order perception, high-order perception, and orientation. The dominating predictor was motor function, and the next highest was high-order perception. When a program for early training is designed with the aim to alleviate long-term self-care disability after stroke, correct assessment of motor and perceptual functions in the individual stroke patient is essential.

There is now considerable evidence that early mobilization and activation of patients with stroke is of benefit for their long-term functional outcome. However, most studies have been performed on patients selected for qualified rehabilitation weeks or months after the cerebrovascular accident. In such patients, some major determinants for not attaining a high level of self-care have been identified: age, severe motor impairment, perceptual deficit, incontinence, difficulties in psychological adjustment, and lack of family involvement.

All members of the stroke team have essential roles in the early activation and retraining of the stroke patient. One of the major tasks of the occupational therapist is to diagnose and classify impairments within the spheres of mobility, sensing, and cerebral integration. This is a prerequisite when designing a treatment program.

According to ecological perceptual psychology, perception should be regarded as a quality of sensing. Using multifactorial analysis, we have found previously that each of 12 different items used to describe visual perception could be assigned to one of two factors. One factor characterizes low-order perception; the other composite factor mainly describes high-order, meaningful perceptual functions. There is little overlap between the two factors.

In the present investigation, the effects of impairment of motor control, perception, and cognition on the ability to manage self-care in the first 2 weeks after stroke have been studied in a carefully characterized patient sample. Particular emphasis has been placed on perceptual deficits at low- and high-order levels. This investigation is part of a prospective 5-year study of impairment, disability, and handicap after stroke.

Subjects and Methods

Every patient admitted to the Stroke Unit of Umeå University Hospital during a 3-year period was considered for the study. The 6-bed stroke unit admits patients with acute cerebrovascular disease, except subarachnoid hemorrhage, directly from the emergency room. The hospital is the only one in the district treating patients with acute stroke. The method for patient allocation yields a sample that is representative for all those admitted for acute stroke in the hospital catchment area with respect to age and sex, severity of neurologic deficits on admission, and prevalence of concomitant disorders. All patients in the stroke unit are subjected to a structured program for evaluation, nursing, medical treatment, and early activation. Diagnostic procedures include a computed tomography (CT) scan of each patient.

Inclusion and Exclusion of Patients

Figure 1 is a flow chart of excluded and included patients. Initially, 267 patients were considered for the study. Mean ± SD age was 72 ± 10 years, and mean length of stay in the stroke unit was 21 days. As this investigation was designed to be part of a 5-year follow-up of patients with manifest stroke, subjects with transient ischemic attack (TIA) or brain lesions on CT scan unaccompanied by persisting signs or symptoms were excluded. Patients who died within 1 month and

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Table 1. Clinical Characteristics of the Population-Based Stroke Patient Population and Study Group

<table>
<thead>
<tr>
<th>Clinical variable</th>
<th>Total population (N = 267)</th>
<th>Study group (n = 109)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of consciousness on admission</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alert</td>
<td>73</td>
<td>93</td>
</tr>
<tr>
<td>Drowsy</td>
<td>20</td>
<td>7</td>
</tr>
<tr>
<td>Stuporous</td>
<td>4</td>
<td>—</td>
</tr>
<tr>
<td>Comatose</td>
<td>3</td>
<td>—</td>
</tr>
<tr>
<td>Discharged to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>55</td>
<td>77</td>
</tr>
<tr>
<td>Long-term care</td>
<td>23</td>
<td>16</td>
</tr>
<tr>
<td>Other hospital clinic</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Death</td>
<td>19</td>
<td>3</td>
</tr>
</tbody>
</table>

n, number of patients; values in percent.

Table 2. Cerebrovascular Diagnosis at Discharge From Stroke Unit

<table>
<thead>
<tr>
<th>Cerebrovascular diagnosis</th>
<th>Total population (N = 267)</th>
<th>Study group (n = 109)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subarachnoid hemorrhage</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Intracerebral hemorrhage</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Nonembolic infarction</td>
<td>44</td>
<td>55</td>
</tr>
<tr>
<td>Embolic infarction</td>
<td>28</td>
<td>19</td>
</tr>
<tr>
<td>Transient ischemic attack</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Ill-defined cerebrovascular disease</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Diagnostic procedures and criteria described in detail in Ref. 1.

n, number of patients; values in percent.
Table 3. Items Used to Assess 109 Study Patients Within 2 Weeks After Stroke

Self-Care
- Grooming
  - Wash upper half of body
  - Wash lower half of body
  - Climb in and out of bathtub
  - Shower and dry oneself
  - Brush teeth, use tube of toothpaste
  - Comb hair
  - Cut nails
  - Manage in bathroom

Dressing
- Put on and take off shirt without buttons
- Put on and take off blouse/shirt
- Put on and take off socks
- Put on and take off shoes
- Put on and take off coat
- Put outdoor clothes on and off a clothes hanger
- Put on skirt and/or long trousers
- Pick up small objects from the floor

Eating
- Eat prepared food
- Drink from glass or cup
- Butter slice of bread

Visual Perception
- A. Size estimation
  - Identification
  - Recognition
- B. Form estimation
  - Identification
  - Recognition
- C. Color estimation
  - Identification
  - Recognition
- D. Point to body parts
- E. Spatial relations
  - Identification
  - Recognition
- F. Block design
- G. Figure-ground; embedded figures
- H. Draw a clock
  - Draw a person
  - Copy geometric figures
  - Complete a goblet
  - Object constancy
- Orientation in time and space
  - How long have you stayed here? (week, month, half-year)
  - What time of the day is it? (morning, afternoon, evening)
  - What time is it?
  - Where are you? (institution)
  - Where are you? (town)

Orientation in time and space. To evaluate aspects of the basic cognitive level, orientation in time and space was assessed by 5 items (Table 3). A normal answer was scored as 2 points. If the patient had to be presented with alternatives to give the right answer, the score was 1, and total inability to answer was scored as 0. Thus, the cumulative maximum score was 10 points.

Table 4. Impairment in 2 Indexes of Visual Perception and 1 Index of Cognition for 109 Study Patients Investigated Within 2 Weeks After Stroke

<table>
<thead>
<tr>
<th>Index</th>
<th>% impairment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-order perception</td>
<td>10</td>
</tr>
<tr>
<td>High-order perception</td>
<td>60</td>
</tr>
<tr>
<td>Orientation in time and space</td>
<td>13</td>
</tr>
</tbody>
</table>
function during ontogeny. It has previously been demonstrated that, in practice, the method measures this sequence of development, i.e., it is internally valid. The present finding that motor impairment assessed in this manner strongly predicts self-care ability after stroke confirms previous observations.

Visual perception showed only weak correlation with motor function. High-order perception also added to motor function to predict self-care ability early after stroke. Hence, perception and motor function should be assessed separately in stroke patients.

It has been suggested that perception, i.e., the ability to extract information from the environment, has been "picked up over an enormous history of evolutionary internalization." According to this concept, the organism "resonates" to incoming information. Intact perception at this higher level is necessary to organize the layout of the environment. Therefore, deficits in high-order perception adversely affect self-care ability after stroke, as demonstrated by the present results.

Table 6 also shows that motor function was that variable with the highest predictive power for self-care ability; high-order perception also contributed. The low predictive power of low-order perception in the Group I discriminant analysis (0.17) was further reduced when orientation in time and space was taken into account.

### Discussion

These results show that motor function, if appropriately measured, is by far the most important determinant of self-care ability during the first 2 weeks after stroke. In addition, complex perceptual qualities (here assessed as high-order perception) predict the level of self-care ability.

This prospective study is unique in that the patients were recruited from an unselected stroke population. The stroke unit admits patients who are representative of all those admitted for acute stroke within a strictly defined geographic area. However, it is not possible to assess perception in all patients early after stroke. In accordance with the eligibility criteria of the present study, the study group had a lower prevalence of death-related prognostic factors on admission than an unselected stroke population.

The theoretical basis for the method used to measure motor function is the sequential development of motor function during ontogeny. It has previously been demonstrated that, in practice, the method measures this sequence of development, i.e., it is internally valid. The present finding that motor impairment assessed in this manner strongly predicts self-care ability after stroke confirms previous observations.

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Low-order perception and orientation in time and space had similar, low predictive power for self-care ability. This suggests that poor sensing of the very simple stimuli used to test low-order perception reflects disorientation. It seems that some degree of cognition is necessary to sense simple stimuli that appear meaningless.

In stroke patients, a multitude of clinical problems have been ascribed to perceptual deficits. These include neglect, impaired spatial organization, right–left disorientation, dyspraxia, and the defense mechanism denial. Anosognosia, which is a general term involving both neglect and denial, has previously been reported to be present in 37–44% of unselected stroke patients during the acute phase of the disease. In the present study, a higher prevalence (57%) of perceptual

### Table 6. Discriminant Analyses of Actual vs. Predicted Memberships for Level of Self-Care Ability in 109 Patients

<table>
<thead>
<tr>
<th>Actual membership</th>
<th>Predicted Group I membership</th>
<th>Predicted Group II membership</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dependent</td>
<td>Partly independent</td>
</tr>
<tr>
<td>Dependent</td>
<td>26</td>
<td>22</td>
</tr>
<tr>
<td>Independent</td>
<td>60</td>
<td>15</td>
</tr>
</tbody>
</table>

Standardized canonical discriminant function coefficients: Group I, motor function 0.96, high-order perception 0.28, low-order perception 0.17; Group II, motor function 0.96, high-order perception 0.24, orientation in time and space 0.16, low-order perception 0.09. Actual membership as number of patients; predicted membership as %.
deficits was found. Yet perception was tested as a more specific and restricted function than anosognosia, and only patients with moderate impairment of higher cerebral integration were included (patients with severe aphasia and/or cognitive impairment were excluded). It appears that deficits in perception can be demonstrated in the majority of stroke patients, provided an appropriate testing procedure is used.

The relative importance of different functional deficits during the various phases of cerebrovascular disease probably has direct implications for rehabilitation. In the individual patient, detailed mapping of motor function and perception are important when designing a rehabilitation program. It has been demonstrated that perceptual treatment programs can accelerate the recovery of perceptual function after brain damage.27,28 The impact of training could be on specific perceptual domains such as visual analysis and organization29,30 and on behavioral anomalies, e.g., denial and distorted body reference.31

It previously has been shown that comprehensive programs for early reactivation and functional training after stroke improve long-term functional outcome and reduce the need for long-term institutional care.14 It is not clear exactly which constituents of such a composite treatment program are of major importance for improved outcome. The present demonstration that locomotor dysfunction and high-order perception together determine much of the self-care ability emphasizes that training of these functions is particularly important in the first weeks after stroke.

Appendix 1. Scoring for Perception

For items A, B, C, and E both recognition and identification are assessed (Table 3). Items H, I, J, and K all assess paper-and-pencil performance.

A. Size estimation. Three wooden cylinders are placed on a table in front of the patient who is asked to recognize, when presented with 2 duplicates, the correct length of the cylinders. The patient is then asked to identify the cylinders in order of length.

B. Form recognition. The patient is asked to identify 3 flat wooden figures of different shapes (triangle, square, and circle) without using her/his hands and to recognize 2 duplicates.

C. Color recognition. The patient is asked to identify 4 cards of different colors (blue, green, yellow, and red) and to recognize 2 duplicates.

D. Body parts. The patient is asked to point to or by other means to correctly identify left and right knees and both third fingers after the command "Show me your ...".

E. Spatial relations. The patient is shown 3 different cards each depicting a man with a ball in his hand, the hand being in different positions. The patient is first asked to identify the positions, then to identify (by comparison) 2 different duplicates.

F. Block design. The patient is given 6 cubes (3 blue, 1 red, 1 green, and 1 yellow) and asked to construct a simple L-shaped block design consisting of three cubes based on a design shown to her/him in a picture. She/he is told to use the minimum number of cubes necessary for the construction.

G. Figure–ground relations. The patient is shown a picture in which the upper part shows an embedded picture composed of 3 drawn objects, and the lower part displays 6 drawn objects. The patient is asked to identify the 3 objects which are also present in the upper picture (adapted from Ayres).

H. Draw a clock. The patient is asked to draw a clock in a predrawn circle.

I. Draw a person. The patient is asked to draw a frontal view of a person.

J. Copy figures. The patient is asked to copy 6 different geometric figures.

K. Complete a goblet. The patient is asked to complete the left and right sides of a predrawn half-goblet after seeing the complete picture.

L. Object constancy. The patient is asked to identify well-known everyday objects photographed from an unusual angle.

The total score for perceptual function ranges from 0 to 32.

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