

## ACQUIRING AND MAINTAINING SELF-CARE SKILLS AFTER STROKE

### *The Predictive Value of Apraxia*

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**ABSTRACT.** The degree of self-care in 120 patients who had suffered unilateral cerebrovascular accident (CVA) was assessed at different stages of recovery. The level of ADL (activities of daily living) function was determined on admission and discharge. Patients with right-sided hemiplegia (r. hem.) were given a set of apraxia tests on admission to the hospital. The results of ADL evaluation showed improved ADL function between admission and discharge, but a worsening after returning home. There were some significant relationships between ADL function in hospital and apraxia. All the apraxia variables are significant as predictors of subsequent dependency. The results show the seriousness of problems related to apraxia in rehabilitation of stroke patients with a lesion in the left hemisphere. One conclusion is that the treatment procedure ought to be directed to the various symptoms of apraxia. The effect of apraxia on ADL in the domestic situation has to be given more attention. More treatment should be given in the home, as patients seem to have difficulty in transferring the skills learned in hospital to the home situation and in maintaining them.

*Key words:* stroke, apraxia, self-care

Apraxia after cerebral vascular accident (CVA) is commonly considered a serious obstacle to successful rehabilitation. Several forms of apraxia have been described, but the terminology and description vary between authors. Siev & Freishtat (19) reviewed the literature and cited the following definitions.

*Constructional apraxia:* "The inability to produce designs in two or three dimensions, by copying, drawing or construction, upon command or spontaneously" (19, p. 99).

*Dressing apraxia:* "Dressing apraxia is the inability to dress oneself, because of disorder in body scheme and/or spatial relations" (19, p. 100). Some scientists do not regard these two types as separate types of apraxia (Geschwind, 7).

*Ideomotor apraxia:* "The inability to imitate gestures or perform a purposeful motor task on command even though the patient fully understands the idea or concept of the task" (19, p. 100). Ge-

schwind considers it a symptom of the disconnection syndrome.

*Ideational apraxia:* "The inability to carry out activities automatically or on command because the patient no longer understands the concept of the act" (19, p. 100). Some scientists consider it a deficit in demonstrating individual movements, such as patients using a comb as a toothbrush (Hécaen, 11), while others consider it a defect in sequencing of acts to perform a complex task (Poock et al. 17).

*Motor apraxia* is a term used and defined by Siev & Freishtat as a defect in programming finer movements in the hand contralateral to the lesion site. In most cases the paresis makes it difficult to decide whether motor apraxia is present.

Luria (16) introduced the term *Kinetic apraxia* and defined it as the "inability to synthesize the motor elements into a single smooth consecutive melody" (p. 37). This deficit comprises function of both the non-affected and the affected hand.

The literature on the relationship between apraxia and ADL is sparse. Constructional apraxia is considered by Williams (23) and Warren (21) to correlate with dressing skills. Williams has reported that copying ability correlates with dressing skills, and Warren studied the relation between copying ability and body scheme dysfunction. She concluded that the two correlated with each other and with final dressing performance. According to Bell et al. (3), kinetic apraxia in the form of loss of fine movements in the non-affected hand predicts a poorer outcome in ADL skills. Diller et al. (4) mention motor speed in upper extremities as an important predictor.

Heilman et al. (13) found that motor learning is poorer in patients with ideomotor apraxia, compared with other CVA patients. Relatively few patients may be expected to have apraxia according to the above definitions if, by apraxia, one means the

Table I. Characteristics of the group of patients

| Hemi-<br>plegia | N  | Sex |    | Mean<br>age<br>(years) | Time<br>after<br>stroke<br>(days) |
|-----------------|----|-----|----|------------------------|-----------------------------------|
|                 |    | M   | F  |                        |                                   |
| Right           | 68 | 41  | 27 | 56.2                   | 185                               |
| Left            | 52 | 32  | 20 | 52.9                   | 124                               |

clinically observable features, and the patient has no other disturbances. Apraxia is thus often found in association with aphasia (9) or with visuospatial or intellectual disturbances, as in the high correlation of constructional apraxia with performance in the Raven test (2).

When sensitive neuropsychological tests are used to measure brain injury, the disturbed performances used to define different forms of apraxia are commonly found (14, 20). Although 'pure' cases of syndromes are of great theoretical interest, it is the disturbance of performance that one has to deal with in treatment. When reasonable care has been taken in excluding paresis, sensory loss, or ataxia, the neuropsychological tests of motor performances we have used in this study will be called 'tests of apraxia'.

We cannot assert that the tests are pure measures of motor function, as the uncontrolled presence of language- and other disturbances may influence the results.

#### *Hypotheses and Questions*

In untreated stroke patients, is there a relationship between severity of motor deficits measured with neuropsychological tests, and the level of self-care competence? After a period of rehabilitation, is this relationship still present?

Can the long-term level of self-care be predicted from neuropsychological test results? To test this hypothesis, the most relevant information on self-care is how the patient functions in his home environment.

The final hypothesis is that the Norwegian rehabilitation program leads to satisfactory transfer of skills learned in the hospital to the home.

Loid & Fugl-Meyer showed that most of their patients gained independence in the hospital but that function had deteriorated 1/2 year after discharge home. This was confirmed in a later study by Fugl-Meyer & Jääskø (6). The main area of

deterioration is in housework activities. Studies on American stroke patients by Anderson et al. (1) contradict the Swedish studies and report excellent retention of self-care skills. They do mention, however, that a previous study had indicated poor transfer of learned skills to the home environment, and as a result of this their rehabilitation programs had been modified.

## GENERAL METHODS

### *Subjects*

120 patients were available for study. There were 68 r.hem. (right-side hemiplegia) and 52 l.hem. (left-side hemiplegia) patients. In each patient, at least one upper limb was free from paresis, sensory loss, or ataxia, as assessed by a physician on the basis of clinical neurological examination. Characteristics of the patient groups are shown (Table I). There were no significant differences between the two groups of stroke patients concerning either age or time since the onset of stroke.

### *Testing*

Most stroke patients admitted to the hospital underwent neuropsychological testing, including aphasia testing when language disturbances were suspected. Patients who could not cooperate sufficiently in the test situation were excluded from the present study, but it was our experience that even severely aphasic patients were able to perform neuropsychological tests. Aphasia as such was therefore not considered a reason for exclusion.

### *Treatment*

Sunnaas Rehabilitation Hospital is a general rehabilitation hospital with 235 beds. R.hem. and l.hem. patients are admitted to separate wards in order to encourage team specialization. Stroke patients are treated by a full rehabilitation team consisting of doctors, nurses, physical and occupational therapists, social workers, and speech therapists. The occupational therapy comprises ADL training, functional training providing appropriate technical aids, and home visits. No treatment program was aimed specifically at the neuropsychological deficits for these patients, except for speech therapy given in cases of aphasia.

### *ADL evaluation*

Dressing and grooming ability were selected for consideration in this study. The factors taken into consideration when evaluating ADL ability were washing, combing one's hair, brushing one's teeth, shaving, putting on make-up, transfer between bed and chair or wheelchair, dressing and undressing own indoor clothes, eating breakfast and dinner. The source of information for this study was the informal detailed report from the occupational therapists. Since several occupational therapists did this evaluation, their criteria may have varied slightly. Status on admission and discharge was noted. For the further analysis the group of subjects was divided into two groups: dependent on help, and independent. The criterion for being classified as independent was managing

the self-care skills mentioned above (grooming, dressing, eating, etc.) without personal assistance on the hospital ward. The only help permitted was minor assistance with putting on the leg-braces.

#### Questionnaire

Evaluation of dressing and grooming ability at home was done by using a questionnaire sent to the patient ½ year after discharge. It consists of 25 questions to be answered 'yes' or 'no' by the patients or their relatives.

A study was undertaken to evaluate the validity of the questionnaire in relation to the evaluation of an experienced occupational therapist observing the home situation. Initial results show that the information derived from the questionnaire is sufficiently reliable to be used in studies on patient groups (reference note 1). As with ADL information, the answers derived from the questionnaire are divided into two groups, dependent and independent of assistance in personal dressing and grooming.

#### Study 1

This study, conducted to answer hypotheses 1 and 2, was a prospective investigation involving 58 of the 68 right hemiplegia (r.hem.) patients shown in Table I. R.hem. patients were chosen because the development of neuropsychological testing in our hospital has been intimately connected with the development of the r.hem. ward. It was therefore natural to select it for the first study with a new test. The 58 subjects were all those patients admitted to the r.hem. ward from the time the tests were elaborated until the conclusion of the study, provided they satisfied the other criteria outlined in the section on general methods.

#### Neuropsychological tests

Various tests of motor performance were used. In the following they are grouped according to the type of apraxia to which they appear most directly related.

#### Constructional tests (constructional apraxia)

Frostig copying test (Frostig (5)). In this task a grid of guidemarks is provided, marking those points at which lines may intersect. Such a copying task is interesting in view of the finding by Hécaen & Assal (12) that the presence of guidemarks aids constructional performance in patients with left—but not right—posterior injuries. Also the presence of grid reference points makes objective scoring easier, since each figure can be analysed as composed of a given number of linear units. The score is the number of line segments correctly copied (max. 100%). Copy a cross from the Halstead

Reitan Neuropsychological Battery (18) (max. score 5). Block-design from Wechsler Adult Intelligence Scale (22) (max. score 48).

*Gestural and imitative tasks (ideomotor apraxia)* (8). Demonstration of object use without the presence of the object (max. score 34). Imitating the same 17 movements as in the test above (max. score 34) (8). Imitating 8 meaningless gestures (max. score 8) (8). Imitating meaningless hand positions and movements (from Luria), (max. score 12).

*Object use or analysis of action sequences (ideational apraxia)*. Patient demonstrates the use of 6 objects by handling them (max. score 16) (8).

A test devised by the present authors, consisting of five series of 4–5 photos from everyday situations. The patient has to arrange them in their correct order (max. score 17). A similar test was found by Poeck & Lehmkuhl (17) to be closely related to clinically defined presence of ideational apraxia.

*Test of motor coordination (kinetic apraxia)*. Twenty-five grooved pegs or 'keys', all alike, from the Halstead Reitan Battery (18) must be fitted into a board with 25 holes. Scoring is by the number of seconds required to perform the task. A normal score is between 60 and 85 seconds. This test was performed with the non-affected hand.

#### Results

When comparing apraxia measures with dependency groups (Tables II and III), conventional *t*-tests were used. The fact that some variables can be seen to have large standard deviations probably indicates that the variables in question are not normally distributed. This is not expected to influence the results of the statistical tests (10, p. 185). A measure of association, the product-moment correlation, is also given. This has been calculated from the *t*-value by a conventional statistical formula. The procedure consists in assigning the values 0 and 1 to dependent and independent variables and deriving correlations of test scores from these dichotomous variables.

A comparison between apraxia measures and ADL status on admission is shown in Table II. Sixteen cases are missing here because of incomplete information on ADL status. (Table II).

With regard to test results and ADL function at the start of treatment, the following apraxia tests evidence a predictive value: grooved pegs, copy a cross, and imitate nonsense hand positions. The

Table II. Relationship between neuropsychological tests and ADL evaluation on admission

| Test                                 | Function on admission (ADL evaluation) |          |             |          |                 |          |
|--------------------------------------|--|----------|-------------|----------|-----------------|----------|
|                                      | Dependent                              |          | Independent |          | Difference      |          |
|                                      | $\bar{x}$                              | <i>s</i> | $\bar{x}$   | <i>s</i> | <i>t</i> -value | <i>r</i> |
| Grooved pegs                         | 201.4                                  | 96.49    | 125.0       | 68.82    | 2.95**          | 0.42     |
| WAIS block design                    | 15.0                                   | 10.14    | 20.9        | 11.07    | 1.15            | 0.18     |
| Frostig Spatial Relations            | 78.5                                   | 34.85    | 92.1        | 21.99    | 1.50            | 0.23     |
| Copy a cross                         | 3.4                                    | 1.36     | 4.5         | 0.72     | 3.33**          | 0.47     |
| Imitation of nonsense hand positions | 12.2                                   | 4.71     | 15.1        | 3.86     | 2.10*           | 0.31     |
| Goodglass A                          | 17.5                                   | 12.94    | 18.3        | 11.01    | 0.22            | 0.03     |
| Goodglass C                          | 25.9                                   | 9.11     | 26.0        | 9.45     | 0.03            | 0.01     |
| Goodglass D                          | 13.4                                   | 3.97     | 15.1        | 1.19     | 1.88            | 0.28     |
| Series                               | 9.8                                    | 5.89     | 12.4        | 4.12     | 1.47            | 0.23     |

\*  $p < 0.05$ , \*\*  $p < 0.01$ .

weak relationships are indicated by the fact that the highest correlation coefficient is 0.47. As shown in Table III, the relationship between apraxia measures on admission and ADL function 6 months after discharge is quite striking. Not only are all differences between the dependent and independent groups significant, but in one case, that of grooved pegs, the correlation coefficient of 0.71 is very high.

To ascertain whether practical indicators of future dependence could be established at the time of initial testing, we examined the distribution of the variables grooved pegs and photo series. By making a cut-off at 168 sec for grooved pegs, of the group performing above the cut-off point, 80% were independent. In the group performing below,

95% of the patients were dependent. When setting the cut-off at 11.5 on photo series, 91% of the patients with a better score were independent, and 95% of those with a poorer score were dependent. Note that this sample consists of r.hem. patients. These cut-off scores are established arbitrarily for the present sample, and it cannot be assumed that they would work equally well for a new sample.

#### Study 2

This study was conducted to answer hypothesis 3. It is a retrospective study based on hospital case records. All subjects who had received a sufficiently detailed ADL evaluation on admission and discharge and the follow-up questionnaire were in-

Table III. Relationship between neuropsychological tests and ADL evaluation 6 months after discharge

| Test                                 | Function 6 months after discharge (ADL) |          |             |          |                 |          |
|--------------------------------------|---|----------|-------------|----------|-----------------|----------|
|                                      | Dependent                               |          | Independent |          | Difference      |          |
|                                      | $\bar{x}$                               | <i>s</i> | $\bar{x}$   | <i>s</i> | <i>t</i> -value | <i>r</i> |
| Grooved pegs                         | 229.5                                   | 88.69    | 98.6        | 30.98    | 7.65**          | 0.71     |
| WAIS block design                    | 14.5                                    | 10.61    | 21.3        | 8.48     | 2.51*           | 0.32     |
| Frostig Spatial Relations            | 75.9                                    | 35.15    | 96.5        | 9.57     | 3.11**          | 0.38     |
| Copy a cross                         | 3.4                                     | 1.44     | 4.5         | 0.70     | 3.68**          | 0.44     |
| Imitation of nonsense hand positions | 11.4                                    | 3.90     | 15.9        | 3.39     | 4.52**          | 0.52     |
| Goodglass A                          | 13.2                                    | 11.18    | 24.8        | 8.45     | 4.36**          | 0.50     |
| Goodglass C                          | 23.0                                    | 10.42    | 30.5        | 4.57     | 3.57**          | 0.43     |
| Goodglass D                          | 13.4                                    | 3.70     | 15.4        | 0.99     | 2.86**          | 0.36     |
| Series                               | 7.7                                     | 5.59     | 14.2        | 2.53     | 4.98**          | 0.55     |

\*  $p < 0.05$ , \*\*  $p < 0.01$ .

Table IV. Relationship between ADL skills on admission and questionnaire

| Function according to ADL evaluation (admission) | Function according to questionnaire |           |       |
|--|-------------------------------------|-----------|-------|
|  | Independent                         | Dependent | Total |
| Independent                                      | 38                                  | 14        | 52    |
| Dependent  | 26                                  | 42        | 68    |
| Total  | 64                                  | 56        | 120   |

cluded. They are the 120 subjects described in Table I in the section on general methodology.

### Results

ADL performance on admission and discharge compared with perceived dependence 6 months after discharge are shown (Tables IV and V). The tables show that on admission 43% of the 120 patients were independent in primary ADL skills (dressing and grooming). At discharge, 78% were independent, but 6 months later only 53% were independent—according to the questionnaire.

## DISCUSSION

With respect to the hypotheses formulated initially, our first hypothesis is confirmed. In untreated patients we find a relationship between neuropsychological tests of apraxia and ADL function. The relationship is significant only for certain tests. Thus we confirm the reports of Bell et al. (3) and Williams (23) that both fine motor skills in the ipsilateral hand and copying ability correlate with dressing skill. The moderate strength of the relationship must be noted, however.

The relationship of apraxia measures to long-term dependency after rehabilitation is strong. The

patients were 4–6 months post stroke on admission. It seems likely that signs of apraxia present at this time are persisting, but data on recovery are lacking. We find it most reasonable to interpret the strong relationship observed as a disruptive influence of apraxia signs on maintaining or improving ADL skills in the face of elapsing time or the increased demands of a home environment. The significant relationship of all types of tests to reported dependence makes it likely that the disruptive factor is a severity factor rather than a reflection of any given type of deficit, but more work on the relationship between the different test variables is needed.

The findings on improvement in ADL skills as a result of rehabilitation are contrary to our third hypothesis. Functional skills improve during the treatment period in hospital, but in many cases function is not maintained at the same level after a period at home. This latter result may be due to errors of evaluation. It may be that the patients misrepresent their real functional capacity. Comparisons of reported dependence and evaluation in the home by an occupational therapist (reference note 1) does not indicate this to be a source of significant error.

Another possible error is that the therapist may evaluate function too optimistically in a hospital setting. The home environment may be more revealing of the existing problems. A finding indicating that this is the case is that more than one-third of the patients rated independent on admission reported themselves as dependent after discharge.

A third source of error is that our dichotomous classifications into dependent—dependent fail to do justice to what is in fact a continuum of degrees of dependence. Thus our findings do not contradict those of Lehmann et al. (15) who found that when different functional skills are rated on a five-point scale, lasting improvement is found. We have tried to choose our criteria so that only subjects with real functional independence are rated as 'independent', but this may mask functionally significant progress in some cases still rated as dependent. Although errors of judgement are likely to play some part in the present findings, we think there are characteristics of the stroke patient and of the present treatment programs in Norway and Sweden that are also important. It is expected that CVA patients have more problems in transferring knowledge to new situations than have patients without brain injury.

Table V. Relationship between ADL skills at discharge and questionnaire

| Function according to ADL evaluation (discharge) | Function according to questionnaire |           |       |
|--|-------------------------------------|-----------|-------|
|  | Independent                         | Dependent | Total |
| Independent                                      | 59                                  | 35        | 94    |
| Dependent  | 4                                   | 22        | 26    |
| Total  | 63                                  | 57        | 120   |

Another problem is the patients' psychological reactions to his injury. The patient and his family must learn to cope with a new situation and in many cases with altered appearance and intellect. Especially during the first months at home, the family members may be rather overprotective.

Present rehabilitation programs are based on the assumption that a relatively brief intensive intervention leads to lasting functional changes. One way of providing intensive treatment for large numbers of patients is to concentrate them in centrally located clinics as in-patients. The problems of carryover to the natural environment are solved by a domiciliary visit from the rehabilitation team and brief visits home by the patients, mainly at weekends.

The present study reveals the shortcomings of this type of rehabilitation program. Better continuity and follow-up in the home situation, both during the hospital stay and after discharge would be of value. We have suggested that apraxia signs may have a disrupting effect on maintaining ADL skills. If the suggestion is supported in further studies, then treatment models providing for the possibility of intermittent treatment to maintain long-term independence should be considered.

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