A Randomized Controlled Trial of Early Supported Discharge and Continued Rehabilitation at Home After Stroke
Five-Year Follow-Up of Patient Outcome

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Background and Purpose—The optimal organization of rehabilitation services after discharge from a stroke unit has not been determined. This study sought to evaluate the effect of early supported discharge and continued rehabilitation at home (ESD), in terms of patient outcome 5 years after stroke and changes in selected data over time.

Methods—Eighty-three patients from Southwest Stockholm, mildly or moderately impaired 5 to 7 days after acute stroke, were enrolled in a randomized controlled trial. The core components of the ESD service were initial treatment in a stroke unit and the involvement of an outreach team to deliver and coordinate home-based rehabilitation in partnership with the patient. At the 5-year follow-up, measures used to assess patient outcome included survival, motor capacity, dysphasia, activities of daily living (ADL), social activities, subjective dysfunction, and self-reported falls.

Results—Fifty-four patients (30 in the intervention group and 24 in the control group) were evaluated 5 years after stroke, at which time a significantly larger proportion of patients in the intervention group were independent in extended ADL and active in household activities.

Conclusions—This ESD service has a beneficial effect on extended ADL 5 years after stroke for mildly to moderately impaired patients. (Stroke. 2005;36:297-302.)

Key Words: cerebrovascular accident • home care services • outcome assessment • randomized controlled trials • rehabilitation

Randomized controlled trials (RCTs) have shown that care of stroke patients in dedicated stroke units improves outcome, compared with alternative forms of care,1 and that beneficial effects are still detectable 5 and 10 years after stroke.2,3 However, the optimal organization of postdischarge stroke rehabilitation services is not known. Studies of early supported hospital discharge and continued rehabilitation at home (ESD) have described the initial benefits of this regimen,4 but results of follow-ups longer than 12 months after stroke have not yet been published.

In southwest Stockholm, we have implemented a post-stroke ESD service designed to allow patients to share the control over their rehabilitation.5 The intervention was evaluated in a RCT;3–8 the patient involvement was subsequently confirmed in a descriptive study.9

Follow-up studies of the southwest Stockholm ESD service have all shown similar results: that an intervention thus implemented significantly reduces the length of hospital stay, yet provides services whose effectiveness 12 months after onset is similar to that attained by conventional rehabilitation.8 Also, the experience during ESD of involvement and control appears to foster in patients a capacity to solve future problems independently.

The optimal time point for evaluating a poststroke rehabilitation regimen is not known. The purpose of this study was to assess survival and functional outcome 5 years after stroke as well as changes in selected data over time for 5-year survivors.

Materials and Methods
In our RCT of ESD after stroke, patients admitted to the stroke unit of the Neurology Department of Huddinge University Hospital in Stockholm, Sweden, from September 1993 to April 1996, and diagnosed with first or recurrent stroke according to clinical criteria for acute stroke of the World Health Organization,10 were screened for inclusion 5 to 7 days after stroke onset. Descriptions of selection criteria and baseline data for patients in the original RCT and procedures of recruitment, discharge, and randomization to a home rehabilitation group (HRG) or a conventional rehabilitation group

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Both HRG and CRG received initial medical care and rehabilitation in the stroke unit. An outreach team of occupational therapists, physiotherapists, and a speech-and-language pathologist provided ESD service to HRG. The duration, frequency, and content of the intervention were decided on together with the patient and his or her family. The mean duration of the intervention program was 14 weeks; the mean number of home visits was 12; and the most common foci of home visits were speech and communication, activities of daily living (ADL), and ambulation.

If required, and after evaluation by specialists, patients in CRG received additional rehabilitation in the Geriatrics or Rehabilitation Department. The content and duration of this rehabilitation did not adhere to a standardized program but rather reflected services available within the District Health Authority.

Patients included in the original RCT who had participated in the 1-year follow-up and who 5 years after stroke were alive and residing in Stockholm County were contacted by telephone; they were informed of the follow-up study and were asked to participate. After informed consent was obtained, a home visit was scheduled. Patients declining a home visit were asked if they or a family member could provide information by telephone interview.

**Data Collection**

Information on length of initial hospital stay and deaths up to 5 years from the date of stroke onset was collected from the computerized registry of the Stockholm County Council. At the 5-year follow-up visit (median, 61.5 months; range, 58.5 to 69 months), patients were evaluated by an external assessor, a purpose-trained physiotherapist (A.-M.T.). Measurements were chosen with a view to evaluating body functions, activity, participation, personal factors, and subjective dysfunction. Body functions refer to the physiological functions of body systems, activity to the execution of a task or action by an individual, and participation to involvement in a life situation.

The following instruments were used: the Mini-Mental State Examination (MMSE), a measure of cognitive function; the Lindmark Motor Capacity Assessment (LMCA); the Nine-Hole Peg Test (NHPT), a measure of manual dexterity; time to walk 10 m; the Barthel ADL Index; the Katz ADL Index; the Katz Extended ADL Index, which includes Katz ADL Index supplemented by the 4 instrumental activities cooking, transportation, shopping, and cleaning; the Frenchay Activities Index (FAI), a measure of the frequency of social activities that requires initiative on the part of the patient; the Sense of Coherence Scale (SOC), a measure of coping capacity; and the Sickness Impact Profile (SIP), a measure of subjective dysfunction. Information on falls and their consequences, during the 6 months preceding the follow-up visit, was collected during interviews.

In addition, an external assessor, a purpose-trained research speech-and-language pathologist, evaluated patients experiencing from aphasia using the Reinvang Aphasia Test. Both assessors were blind to group assignment and neither had been involved in the randomization procedure or the rehabilitation. The battery of assessment measures described above was used at baseline and at the 3-month, 6-month, 12-month, and 5-year follow-ups; data acquired regarding motor capacity, extended ADL, frequency of social activities, and subjective dysfunction were analyzed for changes over time during the 5-year follow-up.

**Statistical Analysis**

Survival was assessed by a χ² test; survival curves were generated using the Kaplan–Meier method and compared using the log-rank test. Differences between groups were assessed using the Mann–Whitney U test, a χ² test, or Fisher exact test, and changes within groups over time by the Wilcoxon signed rank test. Patients with submaximal scores on the Katz Extended ADL and Barthel ADL indexes were categorized as “dependent.” FAI items were dichotomized; patients with a frequency >0 were categorized as “active.” Scores at randomization for patients who had died or been lost to follow-up were compared with scores for all patients in both groups; deceased patients and patients lost to follow-up were not included in the analysis unless stated. Statistical analysis was performed using the software programs EPI Info 6 and SPSS 10.1 for Windows; uncorrected P values <0.05 were considered statistically significant. The study was approved by the ethics committee of Huddinge University Hospital.

**Results**

In the original RCT, the mean age at stroke onset was 72 years (71 in HRG, 72 in CRG). The groups were similar at baseline in all respects, except for a higher frequency of stroke-associated conditions before onset and a lower median SOC score in the intervention group. All 83 patients, except for 1 in CRG, could be traced 5 years after stroke; the untraceable CRG patient was categorized as alive in survival analysis. Exactly 5 years after date of stroke, 17 patients had died (6 in HRG, 11 in CRG) and 66 were alive.

Figure 1 depicts survival curves for the end point death from any cause for patients in HRG and CRG during 5-year poststroke follow-up.

![Figure 1. Kaplan-Meier cumulative survival plot for the end point death from any cause for patients in HRG and CRG during 5-year poststroke follow-up](http://stroke.ahajournals.org/)

Five years after stroke, 54 patients (30 in HRG, 24 in CRG) were evaluated for 1 in CRG, could be traced 5 years after stroke; the untraceable CRG patient was categorized as alive in survival analysis. Exactly 5 years after date of stroke, 17 patients had died (6 in HRG, 11 in CRG) and 66 were alive.

Baseline characteristics 5 to 7 days after stroke onset for the 54 patients followed up at 5 years are presented in Table 1. The groups were similar with regard to sociodemographic characteristics, medical history, and impairments and disabilities despite the following differences: a greater proportion of HRG patients had a history of conditions associated with stroke, particularly transient ischemic attack and diabetes mellitus; and HRG patients were more likely to have had an abnormal computerized tomography scan and lesions in left hemisphere on admission. Mean initial hospital stay was significantly shorter in HRG (14 days versus 30 days;
P = 0.027). At 5 years after stroke, the median MMSE score was 28 in both groups, and median SOC scores were 78 and 80 in HRG and CRG, respectively. These scores were similar to those recorded at baseline.

**Patient Outcome at 5 Years**

Function, activity, participation, and subjective dysfunction at 5 years after stroke in HRG and CRG are outlined in Table 2. The percentage of patients independent in extended ADL was significantly higher in HRG, and HRG patients scored more favorably regarding motor capacity. FAI-assessed frequency of social activities was similar in the 2 groups, but significantly more HRG patients were active in the items washing dishes (P = 0.006), washing clothes (P = 0.04), and reading books (P = 0.01). Regarding subjective dysfunction, both groups were most affected in the domains ambulation, household management, and recreation and pastime. Data regarding falls and their consequences were similar in the groups; ≈60% of patients had fallen during the past 6 months.

**Intragroup Changes Over Time**

In both groups, the total score for motor capacity was significantly lower at 5 years than at 1 year; median LMCA scores at 5 years and 1 year were 137 and 146 in HRG (P < 0.001) and 129 and 147 in CRG (P < 0.001). During the first 12 months after stroke, the proportion of independent patients, according to Katz Extended ADL Index, increased in both groups but did not reach prestroke levels in either; subsequent decreases, between 12 months and 5 years, were statistically significant in both HRG (P = 0.003) and CRG (P = 0.008).

**Discussion**

To our knowledge, this study represents the first 5-year follow-up of a RCT of ESD after stroke in which both intervention and control groups received the benefits of acute care in a stroke unit. The results of the study suggest that outcome 5 years after stroke in extended ADL is more favorable after ESD than after conventional rehabilitation. These results should be interpreted with caution, however, given the short duration of the intervention and the long duration of the subsequent follow-up. In other words, it is possible that differences observed between HRG and CRG are caused by confounding factors introduced during follow-up and unrelated to the rehabilitation regimens.

The most striking finding was that a significantly larger proportion of HRG patients were independent in extended ADL, a difference observable very early in the follow-up, at both 6 and 12 months. At 5 years, HRG patients were also significantly more active in two FAI-assessed household activities. Two possible explanations for these differ-
ences are that the activities in question were practiced during rehabilitation in the patient’s home and that the home is the ideal setting for relearning household chores. Despite a higher preonset frequency of stroke-associated conditions (conditions also associated with adverse long-term outcome) HRG patients performed better than CRG patients, albeit nonsignificantly, 5 years after stroke in motor capacity, manual dexterity, time to walk 10 m, personal ADL, and subjective dysfunction; these results cannot be explained by the characteristics of patients who died or were lost to follow-up (Table 3). Whereas early discharge without organized support appears to increase mortality after stroke, the results of our 5-year follow-up rather suggest that the ESD service investigated in this study decreases mortality compared with conventional care (Figure 1).

<table>
<thead>
<tr>
<th>Variable</th>
<th>HRG (n=30)</th>
<th>CRG (n=24)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age, y</td>
<td>71</td>
<td>71</td>
<td>0.85</td>
</tr>
<tr>
<td>Men/women</td>
<td>15/15</td>
<td>14/10</td>
<td>0.74</td>
</tr>
<tr>
<td>Living with spouse</td>
<td>22</td>
<td>17</td>
<td>0.92</td>
</tr>
<tr>
<td>Swedish/other origin</td>
<td>27/3</td>
<td>22/2</td>
<td>1.0</td>
</tr>
<tr>
<td>Basic/higher education</td>
<td>25/5</td>
<td>23/1</td>
<td>0.31</td>
</tr>
<tr>
<td>Working/retired or other</td>
<td>3/27</td>
<td>4/20</td>
<td>0.69</td>
</tr>
<tr>
<td>Economically affluent</td>
<td>17</td>
<td>14</td>
<td>0.88</td>
</tr>
<tr>
<td>Sense of coherence (13–91)</td>
<td>76 (65–84)*</td>
<td>81 (77–87)*</td>
<td>0.11</td>
</tr>
<tr>
<td>Before stroke</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of social activities (0–45)</td>
<td>29 (23–32)*</td>
<td>27 (21–32)*</td>
<td>0.77</td>
</tr>
<tr>
<td>Independence in extended ADL</td>
<td>23</td>
<td>19</td>
<td>0.91</td>
</tr>
<tr>
<td>Medical history</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stroke</td>
<td>6</td>
<td>1</td>
<td>0.12</td>
</tr>
<tr>
<td>Transient ischemic attack</td>
<td>8</td>
<td>1</td>
<td>0.03</td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>14</td>
<td>10</td>
<td>0.93</td>
</tr>
<tr>
<td>Cardiac insufficiency</td>
<td>6</td>
<td>3</td>
<td>0.72</td>
</tr>
<tr>
<td>Hypertension</td>
<td>16</td>
<td>9</td>
<td>0.38</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>7</td>
<td>1</td>
<td>0.06</td>
</tr>
<tr>
<td>Musculoskeletal disorder</td>
<td>7</td>
<td>5</td>
<td>0.91</td>
</tr>
<tr>
<td>Respiratory disorder</td>
<td>4</td>
<td>2</td>
<td>0.68</td>
</tr>
<tr>
<td>CT abnormal on admission</td>
<td>22</td>
<td>10</td>
<td>0.04</td>
</tr>
<tr>
<td>Clinico-radiological diagnosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infarction/hemorrhage</td>
<td>29/1</td>
<td>23/1</td>
<td>1.0</td>
</tr>
<tr>
<td>Right/left hemisphere</td>
<td>13/16 (1 cerebellum)</td>
<td>16/6 (2 cerebellum)</td>
<td>0.09</td>
</tr>
<tr>
<td>One week after stroke</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSS Prognostic</td>
<td>20 (19–21)*</td>
<td>20 (19–20)*</td>
<td>0.8</td>
</tr>
<tr>
<td>SSS Long-term</td>
<td>38 (35–42)*</td>
<td>40 (38–44)*</td>
<td>0.13</td>
</tr>
<tr>
<td>SSS Maximal (0–58)</td>
<td>48 (45–52)*</td>
<td>50 (48–54)*</td>
<td>0.13</td>
</tr>
<tr>
<td>Cognitive function (0–30)</td>
<td>27 (27–29)*</td>
<td>28 (27–29)*</td>
<td>0.45</td>
</tr>
<tr>
<td>Motor capacity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total motor-capacity score (0–153)</td>
<td>119 (83–136)*</td>
<td>126 (114–139)*</td>
<td>0.43</td>
</tr>
<tr>
<td>Able to perform NHPT on affected side</td>
<td>21</td>
<td>15</td>
<td>0.77</td>
</tr>
<tr>
<td>Able to walk 10 m</td>
<td>22</td>
<td>19</td>
<td>0.93</td>
</tr>
<tr>
<td>Without/with aid</td>
<td>10/12</td>
<td>9/10</td>
<td>0.85</td>
</tr>
<tr>
<td>Median walking time, s</td>
<td>14 (8–20)</td>
<td>14 (9–17)</td>
<td>0.81</td>
</tr>
<tr>
<td>Presence of aphasia</td>
<td>6</td>
<td>2</td>
<td>0.42</td>
</tr>
<tr>
<td>Independence in extended ADL</td>
<td>12</td>
<td>13</td>
<td>0.45</td>
</tr>
</tbody>
</table>

*Median (interquartile range).

CT indicates computerized tomography; SSS, Scandinavian Stroke Scale; NHPT, Nine-Hole Peg Test.
Physical and psychosocial elements of the environment influence patients’ ability to perform desired activities and attain targeted levels of participation during rehabilitation. It has also been suggested that patient involvement in and control of rehabilitation influences outcome; that reducing patient control has an adverse effect on emotional and physical health; and that the latter relation increases with the age of the patient. We have reported that a larger proportion of HRG patients rated themselves active in the planning of their rehabilitation; further, the ESD service encouraged patients to be active partners in their rehabilitation process and to help solve any problems encountered. Participation by patients in the rehabilitation process may increase their autonomy and improve their problem-solving capacity; thus, differences reported here between the groups at 12-month and 5-year follow-ups, in independence in extended ADL and frequency of household activities, may be partly attributable to the greater degree of patient involvement in the rehabilitation process in HRG.

The results of our previous follow-ups have been included in a meta-analysis, the results of which demonstrate that compared with conventional care, ESD services are associated with a significant reduction in the length of hospital stay and similar patient outcome 6 months after stroke. Moreover, 12 months after stroke, our ESD service was suggested to be effective with regard to both extended ADL and cost. Optimal length of follow-up for an evaluation of the efficacy of poststroke rehabilitation is not known. Long-term follow-up is relevant for measuring effects of rehabilitation intervention, particularly when one of the aims is to influence behavior. To accumulate more evidence about the efficacy of ESD, future trials should include long-term follow-ups.

We conclude that our ESD service (whose core components are initial treatment in a stroke unit and the involvement of an outreach team to deliver and coordinate tailor-made home-based rehabilitation in partnership with the patient) has a significant beneficial effect on extended ADL 5 years after stroke for patients with mild to moderate impairments. These findings, despite uncertainties about causal mechanisms, will have implications for further research on allocation of healthcare resources including provision of informal care.

**Acknowledgments**

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**References**


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