The Profile Of Recovery From Stroke And Factors Influencing Outcome

Mervi Kotila, M.D., Olli Waltimo, M.D., Marja-Liisa Niemi, M.A., Ritva Laaksonen, M.A., and Maire Lempinen, B.A.

SUMMARY The recovery from stroke of 154 survivors out of 255 stroke patients was analyzed. The outcomes documented were: discharge from hospital, activities of daily living (ADL) and return to work. A clear improvement in neurological and neuropsychological deficits was seen from the acute stage to three months, and this continued to twelve months, but to a lesser degree. 69% and 78% respectively of the patients were at home three and twelve months after stroke. Independence in ADL increased from 32% acutely to 62% and 68% by three and twelve months, respectively. Of those gainfully employed prior to stroke, 55% had returned to work after twelve months.

As a group, SAH patients seemed to recover better, but, for those that could be age-matched with infarction patients, there was no difference in outcome. Old age, acute stage hemiparesis, impairment of intelligence and memory, visuospatial deficits, nonadequate emotional reactions, and living alone all had a major negative influence on outcome.

This study suggests that neurological and neuropsychological deficits, as well as emotional reactions, influence the outcomes after stroke, and all should be taken into consideration in prognosis.

Patients and Methods

A stroke register was kept in the towns of Espoo and Kauniainen, Finland, from April 1, 1978 to March 31, 1980. The mean population during the study period was 136,850 (mean January 1, 1979). Altogether, 255 new stroke patients were registered. All hospitals in the district were visited once a week throughout the study period in order to reach all new stroke cases. The mortality and the details of the register are discussed in another article. The number of survivors after 3 and 12 months was 165/255 (65%) and 154/255 (60%), respectively. The profile of recovery made by the 154 survivors is analyzed in this article. The onset of stroke all patients were admitted into hospital within 24 hours. Of these patients, 33% were admitted to the University Central Hospital of Helsinki, the rest to well equipped regional hospitals of the district studied.

Intensive rehabilitation was given according to individual needs. Available rehabilitation resources included physiotherapy, occupational therapy, neuropsychological rehabilitation and speech therapy.

The patients were evaluated at the time of hospital admission, and after 3 and 12 months from onset. Previous medical, social and occupational history, and neurological signs and symptoms were registered. The neurological findings at the acute stage were recorded at the time of maximum impairment during the first 24 hours after onset. The diagnosis was based on an examination by a physician, in addition to which CSF-examination was made in 69%, EEG in 31%, brain scan in 36%, CT in 16% and cerebral angiography in...
TABLE 1  Diagnostic and Age Distribution of 154 Patients

<table>
<thead>
<tr>
<th>Type of stroke</th>
<th>Patients</th>
<th>&lt;65 years</th>
<th>≥65 years</th>
<th>Mean age (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAH</td>
<td>18</td>
<td>18</td>
<td>0</td>
<td>41</td>
</tr>
<tr>
<td>ICH</td>
<td>12</td>
<td>8</td>
<td>4</td>
<td>59</td>
</tr>
<tr>
<td>INF</td>
<td>122</td>
<td>51</td>
<td>71</td>
<td>63</td>
</tr>
<tr>
<td>NUD</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>79</td>
</tr>
<tr>
<td>Total</td>
<td>154</td>
<td>77</td>
<td>77</td>
<td>61</td>
</tr>
</tbody>
</table>

16%. Special examinations were mainly performed on younger patients with SAH and ICH, and when there were difficulties in differential diagnosis.

After 3 and 12 months from the onset of stroke, patients under 65 years were examined by a neurologist and neuropsychologist. All patients were neurologically investigated, but psychological examinations could not be made all because some were in poor condition. Some patients could be examined only partially. The neuropsychological testing methods included the Wechsler Adult Intelligence Scale Subtests, the Wechsler Memory Scale and the Benton Visual Retention Test. Tests for detection of specific neuropsychological deficits included clock-face and map tests, visuoconstructual drawing tasks, tests for speech, reading, writing and calculation and praxis of simple hand movements. The methods used to evaluate the emotional reactions were clinical interview, Gainotti's Systematic Observation and Beck's Depression Inventory. The emotional reactions were assessed as nonadequate, when the patient had marked depression or other marked features such as emotional lability, indifference, euphoria or anosognosia.

In the case of patients over 65 years, the information concerning neurological status and outcome after 3 and 12 months was collected by interviewing them and their relatives.

The end-points for the outcome of stroke were: discharge from hospital, independence in activities of daily living (ADL) and return to work. ADL included ambulation, self feeding, dressing and personal hygiene. The disability grading system was: fully independent in ADL, needs some help, needs much help, totally disabled. In the cases of house wives and students, return to work was defined by their ability to continue housework or studies as before. The degree of recovery after 3 and 12 months was also analyzed by comparing age-matched patients in different stroke subgroups.

Data processing was carried out at the Computing Center of The University of Helsinki with a Burroughs 7800 Computer. The chi-square test was applied as the statistical test of significance.

**Results**

Out of a total of 255 new stroke cases, the 154 patients (70 women, 84 men) who survived for one year were examined. The mean age of these 154 was 61 years (range 17–90). The number under 65 years was 77, those over 65, 77. During the follow-up period, 8 patients (5.2%) had recurrence of stroke. Most of the patients had a brain infarction. The exact distributions by diagnostic groups and age can be seen in table 1. The lesion was located in the left hemisphere in 40% and in the right hemisphere in 39%. It was vertebrobasilar in 10% and it could not be defined in 11%

45% of the patients had comorbid hypertension and 65% had elevated blood pressure at the acute stage. 40% had heart diseases, and 14% myocardial infarction in their previous medical history, 24% had had previous transient ischemic attacks and 16% had diabetes. 34% of the patients were smokers and 24% were overweight. The distribution by social classes was consistent with that of the general population of the district studied.

The frequencies of some important neurological signs at the acute stage, 3 and 12 months after stroke can be seen in figure 1. The frequencies of neuropsychological deficits at 3 and 12 months after onset is seen in figure 2. The frequency of hemiparesis decreased from 73% to 37% during the follow-up period of one year. Table 2 presents the numbers of patients with hemiparesis in different stroke subgroups at the acute stage and after 3 and 12 months. The downward trend was also seen in neuropsychological deficits, e.g. visuoperceptual deficits decreased from 60% (at 3 months) to 41% (at 12 months).

The profile of recovery according to the outcome criteria was: 107/154 (69%) of the patients were at home after 3 months and 120/154 (78%) after 12 months. As shown in figure 3, at the acute stage only

![Figure 1. The profile of neurological findings from the acute stage to 3 and 12 months (N=154).](http://stroke.ahajournals.org/content/15/6/1040_F1)

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The profile of recovery according to the outcome criteria was: 107/154 (69%) of the patients were at home after 3 months and 120/154 (78%) after 12 months. As shown in figure 3, at the acute stage only
50/154 (32%) were independent in ADL. After 3 months the number of independent patients was 95/154 (62%), and after 12 months, 105/154 (68%). Of those gainfully employed prior to stroke, 58/77 under 65 years, 18/58 (31%) had returned to work after 3 months and 32/58 (55%) after 12 months. The number of bedridden patients declined from 54/154 (35%) to 17/154 (11%) between the acute stage and one year later.

As a group, patients under 65 had better outcomes than those over 65 years, as shown in table 3. When compared to older patients, the younger group were more often at home and more independent in ADL after 3 months (p < 0.01) and this difference increased at one year (p < 0.001).

As a group, SAH-patients had better outcomes than ICH- and infarction-patients, as seen in table 4. However, when SAH-patients were age-matched with infarction patients (age deviation for matched pairs was ± 2 years) they did not have different kinds of outcomes in discharge from hospital, ADL or return to work (table 5). Other subgroups of stroke were also age-matched, and no difference of outcome was seen, albeit the groups were small.

Patients with hemispheric stroke did not have different outcomes compared to patients with brain stem stroke, but the brain stem group was small. In addition, patients with left hemispheric lesions did not differ from those with right hemispheric lesions.

Transient ischemic attacks prior to stroke and comorbid hypertension did not influence outcome. At 3 months after stroke, there was no difference in discharge from hospital when patients with comorbid heart diseases were compared to those without. After 12 months, however, patients with comorbid heart diseases were more often in hospital (20/62) than those without (14/92; p < 0.05). Patients with heart diseases were also more dependent in ADL after 3 and 12 months (30/62 and 27/62, respectively) than patients without heart diseases (29/92 and 22/92, respectively). These differences were both significant at the level of p < 0.05.

Hemiparesis at the acute stage significantly influenced all the outcomes (table 6). Patients without hemiparesis were more often at home after 3 months (p < 0.01) and after 12 months (p < 0.05). They were also more independent in ADL after 3 months (p < 0.001) and after 12 months (p < 0.01). From 58 patients gainfully employed prior to stroke, those without hemiparesis returned to work more frequently than those with hemiparesis (p < 0.01 at 3 months and p < 0.001 at 12 months). Patients with lower level of consciousness at the acute stage were more often in hospital after 3 months (14/32) than conscious patients (33/122; p < 0.05). After 12 months, however, there was no significant correlation. There was no significant correlation between initially unconscious and conscious patients in ADL independence after 3 months, but after 12 months initially unconscious patients (15/32) were more often dependent in ADL than conscious patients (34/122; p < 0.05).

As seen in table 7, patients without impairment of intelligence were more often at home (p < 0.01 at 12 months) and more independent in ADL (p < 0.01 at 3 months; p < 0.001 at 12 months) than those with impairment. Also, they returned to work better than patients having impairment of intelligence (p < 0.001 at 3 and 12 months). Impairment of memory hampered mainly the return to work. 21/44 and 13/44 who were working prior to stroke had memory impairment after 3 and 12 months, respectively. From these patients only 3/21 and 3/13 had returned to work. From those not having impairment of memory (23/44 and 31/44) 10/23 and 23/31 patients had returned to work after 3 and 12 months (p < 0.05 and p < 0.01 respectively).

As for specific neuropsychological disturbances, visuoperceptual deficits had the greatest influence on outcome. 39/65 and 25/61 had visuoperceptual deficits after 3 and 12 months, respectively (fig. 2). Of these 24/39 and 18/25 were independent in ADL. Patients without visuoperceptual deficits were more often independent in ADL: 24/26 and 35/36 (p < 0.01 at 3 and 12 months).

As seen in table 8, the nonadequate emotional reactions, especially those other than depression, correlated with poorer discharge from hospital and with

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**Table 2. The Number of Patients with Hemiparesis in Different Stroke Subgroups at the Acute Stage, After 3 and 12 Months**

<table>
<thead>
<tr>
<th>DG</th>
<th>N</th>
<th>Acute</th>
<th>3 Mo</th>
<th>12 Mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAH</td>
<td>18</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>ICH</td>
<td>12</td>
<td>9</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>INF</td>
<td>12</td>
<td>102</td>
<td>66</td>
<td>47</td>
</tr>
<tr>
<td>NUD</td>
<td>2</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Total</td>
<td>154</td>
<td>112</td>
<td>77</td>
<td>57</td>
</tr>
</tbody>
</table>
dependence in ADL. Patients with adequate reactions were more often at home \( (p < 0.01 \text{ at 3 months}, p < 0.05 \text{ at 12 months}) \) and more independent in ADL \( (p < 0.01 \text{ at 3 and 12 months}) \).

There was a highly significant correlation between living circumstances prior to stroke and discharge from hospital: from patients living alone, only 30/56 (54%) and 34/56 (61%) were at home after 3 and 12 months, respectively, as compared to 77/98 (79%) and 84/98 (86%) who were living with their family \( (p < 0.001 \text{ at 3 and 12 months}) \).

**Discussion**

Over two thirds of these patients had a brain infarction, which is slightly more than in the previous study done in the same region. The number of surviving patients over 65 years was the same as the number under 65. This is probably due to the fact that highest mortality occurred among those over 65 years. The number of men and women was almost equal.

Many studies have proved that hypertension is the strongest risk factor for stroke. In this study, 45% of the patients had comorbid hypertension and 65% elevated blood pressure at the acute stage.

All neurological deficits had clearly improved by 3 months and continued to improve up to one year, though not so much. These results are in agreement with earlier studies. The number of patients with dysphasia decreased up to 3 months, but not thereafter. This is in agreement with the findings of Demeurisse. Most earlier studies have stressed the importance of the usual neurological findings, e.g. hemiparesis, dysphasia etc., while neuropsychological disturbances have received less attention. Our results support some earlier studies which state that neuropsychological disturbances play an important role in the recovery from stroke. The profile of the improvement occurring in neuropsychological disturbances resembles that of the neurological disabilities. In most neuropsychological deficits a clear improvement was seen.

69% and 78% of the patients were already at home after 3 and 12 months, respectively. This good result may be due in part to the young age structure of the group. Some patients also had only mild disabilities. The role of rehabilitation is also to be considered even though it cannot be quantitated.

62% and 68% of the patients were independent in ADL after 3 and 12 months, respectively. This result is somewhat better than that of Feigenson and might again reflect the younger age structure and milder disabilities in our series. In a recent stroke study from East Central Finland, the number of patients independent in ADL after 6 months from stroke was 56% and there was only minimal change 12 months after stroke. In that study, patients were somewhat older than in ours. In Garraway's study, 62% of the patients in a stroke unit were independent after two months, while after one year the proportion of independent patients had actually fallen to 55%.

After 3 months, 32% of the patients who were gainfully employed prior to stroke had returned to work; a similar result was seen in the previous study of the district. In our study, 55% of the patients had returned to work after one year. This result is better than in Sivenius's study in which 40% of the patients had returned to work one year after stroke.

As a group, younger patients (< 65 years) recovered better than older (≥ 65 years); this is in agreement with earlier studies.

Although it seemed that SAH-patients recovered...
**TABLE 4** Outcome in Different Subgroups of Stroke after 3 Months and 12 Months

<table>
<thead>
<tr>
<th>DG</th>
<th>N</th>
<th>3 Mo</th>
<th>12 Mo</th>
<th>3 Mo</th>
<th>12 Mo</th>
<th>N</th>
<th>3 Mo</th>
<th>12 Mo</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>At home</td>
<td>Independent in ADL</td>
<td>Returned to work*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAH</td>
<td>18</td>
<td>14</td>
<td>16</td>
<td>15</td>
<td>17</td>
<td>16</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>ICH</td>
<td>12</td>
<td>10</td>
<td>12</td>
<td>7</td>
<td>8</td>
<td>7</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>INF</td>
<td>122</td>
<td>82</td>
<td>92</td>
<td>71</td>
<td>79</td>
<td>35</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>NUD</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Total</td>
<td>154</td>
<td>107</td>
<td>120</td>
<td>95</td>
<td>105</td>
<td>58*</td>
<td>18</td>
<td>32</td>
</tr>
</tbody>
</table>

*The number of patients gainfully employed before stroke was 58/77 under 65 years.

**TABLE 5** The Outcome of 15 Age-Matched SAH- and Infarction-Patients 3 and 12 Months After Stroke

<table>
<thead>
<tr>
<th>DG</th>
<th>Mean age</th>
<th>At home</th>
<th>Independent in ADL</th>
<th>Returned to work</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAH* (N = 15)</td>
<td>43 years</td>
<td>12</td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td>INF (N = 15)</td>
<td>44 years</td>
<td>12</td>
<td>14</td>
<td>12</td>
</tr>
</tbody>
</table>

*Three young SAH-patients (aged 23, 29 and 29 years) could not be age-matched because of only a few young infarction patients in the series.

**TABLE 6** The Influence of Acute Stage Hemiparesis on Outcome After 3 and 12 Months

<table>
<thead>
<tr>
<th>3 Mo</th>
<th>12 Mo</th>
<th>3 Mo</th>
<th>12 Mo</th>
<th>3 Mo</th>
<th>12 Mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>No hemiparesis (N = 42)</td>
<td>36 (86%)† 38 (93%)*</td>
<td>35 (83%)‡ 36 (88%)†</td>
<td>N = 25</td>
<td>13 (52%)‡ 21 (84%)‡</td>
<td></td>
</tr>
<tr>
<td>Hemiparesis (N = 112)</td>
<td>71 (63%) 81 (72%)</td>
<td>60 (54%) 67 (61%)</td>
<td>N = 33</td>
<td>5 (15%) 11 (33%)</td>
<td></td>
</tr>
</tbody>
</table>

*<i>p < 0.05;</i> †<i>p < 0.01;</i> ‡<i>p < 0.001.</i>

§The number of patients gainfully employed prior to stroke was 58/77 under 65 years.

**TABLE 7** Impairment of Intelligence at 3 and 12 Months and its Correlation with the Outcome

<table>
<thead>
<tr>
<th>3 Months</th>
<th>12 Months</th>
<th>3 Mo</th>
<th>12 Mo</th>
<th>3 Mo</th>
<th>12 Mo</th>
<th>3 Mo</th>
<th>12 Mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>No impairment of intelligence</td>
<td>20/22 (91%)</td>
<td>21/22 (95%)*</td>
<td>8/18 (44%)†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impairment of intelligence</td>
<td>27/37 (73%)</td>
<td>24/37 (65%)</td>
<td>4/26 (15%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>47/59 (80%)</td>
<td>45/59 (76%)</td>
<td>12/44 (27%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No impairment of intelligence</td>
<td>36/36 (100%)*</td>
<td>36/36 (100%)†</td>
<td>23/30 (77%)†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impairment of intelligence</td>
<td>17/23 (74%)</td>
<td>15/23 (65%)</td>
<td>3/14 (21%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>53/59 (90%)</td>
<td>51/59 (86%)</td>
<td>26/44 (59%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < 0.01; †p < 0.001.

‡From those gainfully employed prior to stroke (N = 58) 44 were neuropsychologically examined.

better as a group, it is notable that when they were age-matched with infarction patients they did not have a different kind of outcome.

In this study, patients with hemispheric stroke did not have different outcomes than patients with brain stem stroke, but the brain stem group was small. Patients with right hemispheric lesion did not differ functionally from patients with left hemispheric lesion. This differs from the findings of Lehman,23 who reported that patients with right hemispheric lesions have less favourable functional outcomes than patients with left hemispheric lesions.

Patients with comorbid heart diseases remained in hospital more often and were more dependent in ADL after 3 and 12 months. Opposing views have previously been stated regarding the influence of heart diseases.4-5 25 Transient ischemic attacks prior to stroke and comorbid hypertension did not influence outcome. In the previous Finnish study,26 hypertension did not have any correlation with ADL either.

Acute stage hemiparesis was a clearly negative prognostic sign for all the outcomes. The negative influence of hemiparesis in recovering from stroke has been reported by other investigators.4-5 21 Though primary level of consciousness is an important prognostic indicator for survival,1 3 8 it did not have much influence on outcome among survivors. Lowered level of consciousness influenced discharge from hospital after 3 months from stroke: patients unconscious at the acute stage stayed more often in hospital after 3 months than conscious patients, but the difference no longer existed after one year.

Clearly, impairment of overall intelligence, impairment of memory functions and visuoperceptual defi-
predicts had a negative effect on outcome. Earlier reports show similar results.4-27 Such nonadquate emotional changes as emotional lability, indifference, euphoria and anosognosia were much more persistent and had a more prominent influence on outcome than depression. Zarit and Kahn28 and Diller and Weinberg29 have reported similar results concerning persistence of these changes, as well as their influence on recovery. Depression decreased after 3 months and thus seemed to be associated with the emotional crisis or grief reactions after severe illness.30

Patients living alone stayed significantly more often in hospital than those living with their families, which is in agreement with earlier results.25 It seems that family involvement is one important predictor of the final disposition of the stroke patient.

This study shows that, among stroke survivors, a clear improvement of neurological and neuropsychological deficits is seen from the acute stage to 3 months, and that this improvement still goes on up to one year, albeit to a lesser degree. A longer follow-up time is needed in order to see how long this improvement continues. This study suggests that neurological and neuropsychological deficits, as well as emotional reactions, influence the outcomes after stroke, and we think that they should all be taken into consideration in prognostication.

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