Arm and Leg Paresis as Outcome Predictors in Stroke Rehabilitation

Tom Skyhøj Olsen, MD

I used leg and arm paresis to predict outcome measured as extremity function in a prospective study of 75 consecutive hemiplegic patients admitted to an inpatient stroke rehabilitation unit. In each patient, extremity paresis was quantified according to the five-point scoring system advised by the Medical Research Council, upper extremity function was quantified using the Barthel Index subscore for feeding and dressing the upper body, and lower extremity function was quantified according to a five-point scoring of the ability to walk. Improvement was recorded for upper extremity function in 52% of the patients and for lower extremity function in 89%. Best extremity function was reached a mean±SEM of 9±3 and 10±4 weeks after stroke for the upper and lower extremities, respectively. In patients experiencing complete recovery, this occurred a mean±SEM of 7±2 weeks (for both upper and lower extremities) after the stroke. Only 8–11% of the patients with paresis scores of ≤2 regained independent extremity function after rehabilitation. Half of the patients with paresis scores of ≥3 regained independent extremity function after rehabilitation, while the other half were able to perform extremity function with only minimal assistance. As predictors of extremity function, the Barthel Index subscore was slightly better (r=0.64) than paresis score (r=0.58). However, because evaluation of extremity paresis is easy, it appears to be useful as a preliminary predictor of outcome following stroke. (Stroke 1990;21:247–251)

Improvement of both upper and lower extremity function is one of the major objectives of stroke rehabilitation since extremity function greatly affects the overall outcome. My investigation was undertaken to study upper and lower extremity function after rehabilitation for stroke and the time to reach maximum extremity function. Another purpose of my study was to predict outcome measured as extremity function on the basis of a simple bedside evaluation on admission, that is, the degree of weakness in the paretic arm and leg.

Subjects and Methods

This was a prospective study of consecutive patients admitted to an inpatient stroke rehabilitation unit. I excluded patients who were admitted >60 days after their stroke, those who did not have paresis, and those who had strokes involving both cerebral hemispheres. Seventy-five patients satisfied these criteria. From this population, I established two overlapping groups to test the effect of upper and lower extremity paresis independently. One group was made up of 66 patients with unilateral upper extremity paresis who on admission were unable to feed themselves and/or to dress their upper body independently; seven patients with lower extremity paresis but no upper extremity paresis and two patients with unreliable scoring of upper extremity function were excluded. The second group was made up of 72 patients with unilateral lower extremity paresis who on admission were unable to walk independently; three patients who had upper extremity paresis but no lower extremity paresis were excluded. Computed tomography or magnetic resonance imaging was performed in all patients before referral to rehabilitation.

On admission to the rehabilitation unit, all patients had a full neurologic examination including evaluation of proximal (hip and shoulder flexion) and distal (ankle and finger flexion) leg and arm paresis scored according to the system advised by the Medical Research Council (1: a trace of contraction, 2: active movement with gravity eliminated, 3: active movement against gravity, 4: active movement against gravity and resistance, and 5: normal power).1

Upper extremity function was evaluated according to the Barthel Index2 using subscores for the patients’ ability to prepare a tray and feed themselves (6: can feed self a meal placed within reach, can put on an assist device if used, can cut food, spread butter, and

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Received November 3, 1988; accepted August 21, 1989.
Table 1. Characteristics of 75 Stroke Patients

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Patients with upper extremity paresis (n=66)</th>
<th>Patients with lower extremity paresis (n=72)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>68±10</td>
<td>67±11</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Males</td>
<td>33</td>
<td>39</td>
</tr>
<tr>
<td>Side affected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>30</td>
<td>39</td>
</tr>
<tr>
<td>Right</td>
<td>36</td>
<td>33</td>
</tr>
<tr>
<td>Stroke mechanism</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hematoma</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Infarct</td>
<td>63</td>
<td>68</td>
</tr>
<tr>
<td>Admission after stroke (weeks)</td>
<td>4±2</td>
<td>4±2</td>
</tr>
<tr>
<td>Length of stay (weeks)</td>
<td>9±3</td>
<td>9±3</td>
</tr>
</tbody>
</table>

Data are mean±SEM or number.

Use salt/pepper; 4: some help required, but can feed self once food is cut up; and 0: unable to feed self) and to dress their upper body (5: able to put on, fasten, and remove clothing; 3: needs help, but able to do at least half the work; and 0: performance worse than described). The sum of the two Barthel Index subscores was considered to be a measure of upper extremity function. Patients who scored 11 were independent in both upper extremity functions. Those who scored 9 were independent in one function and needed only minimal assistance with the other. Patients who scored 7 and 3 or 4 needed assistance in performing both functions. Patients with the lowest possible function score, 0, needed maximal help of another individual in performing both upper extremity functions. Function thus refers to both extremities, the paretic as well as the non-paretic one, while motor impairment refers to the paretic extremity only.

Lower extremity function was evaluated by scoring the patients' ability to walk (1: nonambulatory, 2: can walk <50 feet with assistance, 3: can walk 50-150 feet with assistance, 4: can walk >150 feet with assistance, and 5: can walk independently). Patients were said to require assistance when they needed the presence of another individual for safety such as contact guarding, minimal assistance, etc. Use of a brace and a cane did not constitute assistance.

Overall stroke severity was assessed by determining the Barthel Index score of each patient on admission.

Statistical analysis was performed using linear regression analysis and the Mann-Whitney test.

Results

Patient characteristics are listed in Table 1. Leg and arm paresis score on admission correlated significantly with extremity function score on discharge (proximal upper extremity: r=0.58, proximal lower extremity: r=0.53, distal upper extremity: r=0.55, distal lower extremity: r=0.54; p<0.01). Proximal and distal paresis scores were found to be equally good in predicting outcome measured as function score. Only the relations between proximal paresis scores and outcome are given below.

On admission, 40 patients had upper extremity paresis scores of ≤2 (Table 2). Three (8%) regained independence in both upper extremity functions (scored 11 on discharge), and nine (23%) regained independence in at least one function (scored 9 or 11 on discharge). Eleven (42%) of the 26 patients with upper extremity paresis scores of ≥3 regained independence in both upper extremity functions, and 21 (81%) regained independence in at least one function.

On admission, 38 patients had lower extremity paresis scores of ≤2 (Table 3). Four (11%) regained the ability to walk independently (scored 5 on discharge), and 19 (50%) became able to walk >150 feet with assistance (scored 4 on discharge). Of the 34 patients who had paresis scores of ≥3, independent walking was regained by 19 (56%) and all 34 became able to walk >150 feet with assistance or independently.

The Barthel Index score on admission correlated significantly with function score on discharge (upper extremity: r=0.64, lower extremity: r=0.65; p<0.01). Among the 28 patients with Barthel Index scores of <40, only one (4%) regained independence in both upper extremity functions, and only six (21%) regained independence in at least one function (Table 4). Independence in both upper extremity functions was regained by 13 (34%) of the 38 patients who had Barthel Index scores of ≥40, and 24 (63%) regained independence in at least one function.

Table 2. Proximal Upper Extremity Paresis on Admission and Upper Extremity Functional Outcome in 66 Stroke Patients

<table>
<thead>
<tr>
<th>Paresis score on admission</th>
<th>0</th>
<th>3/4</th>
<th>7</th>
<th>9</th>
<th>11</th>
<th>Total n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5</td>
<td>8</td>
<td>10</td>
<td>4</td>
<td>2</td>
<td>29</td>
<td>44</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>11</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>7</td>
<td>7</td>
<td>15</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>14</td>
<td>17</td>
<td>16</td>
<td>14</td>
<td>66</td>
<td>100</td>
</tr>
</tbody>
</table>

Paresis score by Medical Research Council system; function scored by Barthel Index subscores.
Table 5 shows that among 28 patients with Barthel Index scores of 80-100, only one (4%) regained the ability to walk independently, while 11 (39%) were able to walk >150 feet with assistance after rehabilitation. Of the 44 patients with Barthel Index scores of 60-79, 22 (50%) regained independent walking and 3 (7%) were not able to walk 150 feet, even with assistance, or independently after rehabilitation. All four patients with Barthel Index scores of 40-59 were able to walk >150 feet with assistance after rehabilitation. Approximately 40% of these patients were recruited from those with more severe strokes, usually 20% of the stroke population.

Table 6 shows the time to maximum extremity function score in the patients who recovered. Upper extremity function improved during rehabilitation in 34 patients (52%), while lower extremity function improved in 60 patients (89%). The patients who improved were discharged a mean±SEM of 2±1 weeks after they had reached their maximum extremity function score. Maximum score was reached 9±3 (for the upper extremity) and 10±4 (for the lower extremity) weeks after the stroke; 95% of the patients had achieved their best extremity function within 14 weeks after their stroke. Patients who recovered completely (achieved independent extremity function) did so 7±2 weeks after the stroke, while patients who recovered only incompletely reached best extremity function 10±3 (for the upper extremity) and 10±4 (for the lower extremity) after the stroke. This difference in time to maximum score is significant (p<0.03 and p<0.002, respectively, by the Mann-Whitney test). There was no significant difference between patients with paresis scores of ≤2 and those with scores of ≥3 in the time to maximum extremity function score (p>0.05 by the Mann-Whitney test).

**Discussion**

Functional outcome in this series was less favorable than that reported for the average stroke population since no more than 21% and 32% regained independent upper and lower extremity function, respectively. In unselected patients with stroke, approximately 70% are able to feed and dress themselves independently and >80% are able to walk independently 6 months after the event. Wade et al assessed lower extremity weakness 3-4 weeks after a stroke in 196 unselected patients and found that 86% had either no or only mild weakness. In my study, this occurred in approximately 24% (paresis score of 4), which indicates that these patients were recruited from those with more severe strokes, usually 20% of the stroke population.

Arm and leg paresis are easy to determine and appear to be useful predictors of functional outcome. Severe extremity paresis (Medical Research Council scores of ≤2 on admission) predicts a bad outcome. Neither independent upper extremity function nor independent walking should be expected by patients with paresis of that degree. Only 8% and 11% of my patients with paresis scores of ≤2 on admission performed upper extremity functions and walked independently after rehabilitation. Approximately 40% were not able to walk 150 feet, even with assistance, and upper extremity function outcome was even worse; >75% of the patients with paresis scores of ≤2 on admission still needed significant assistance with upper extremity function after rehabilitation.

Mild extremity paresis (Medical Research Council scores of ≥3 on admission) predicts a relatively good functional outcome. About half of these patients...
regained independent extremity function. After rehabilitation, all were able to walk >150 feet with assistance or independently and 80% were either independent or needed only minor assistance with upper extremity functions.

Extensive work using the Barthel Index as a predictor of outcome has demonstrated a close relation between the score on this index (i.e., overall function) at admission and outcome.3–5,14 The Barthel Index cannot be established at the bedside on admission since it requires observation of the patient over several days. The Barthel Index seems to be slightly better than extremity paresis in delineating those patients who will be unable to perform upper extremity functions or to walk independently after rehabilitation. In accordance with the findings of Granger et al,9 in my study such functionally impaired patients comprised only 4% of those with Barthel Index scores of <40 compared with 8–11% of those with Medical Research Council paresis scores of ≤2. The Barthel Index is also better in predicting walking outcome in “high-level” patients (those with a Barthel Index score of >80).

Improvement may occur as long as 6–12 months after a stroke,3,15–18 but the majority of functional recovery occurs within the first 3 months. Studying 39 stroke patients with hemiplegia, Newman19 found that little recovery took place later than 14 weeks after the stroke and that the average interval from stroke onset to 80% of final recovery was 6 weeks. Prescott et al20 studied 100 patients with moderate-severe strokes from 4 weeks after the stroke until discharge; 89% had reached their best functional outcome ≤16 weeks after their stroke. Wade et al17 studied arm function in 92 patients over 2 years following their stroke; statistically significant improvement was seen only during the first 3 months. In 135 stroke patients studied by Andrews et al,18 maximum improvement for walking was reached within 8 weeks after the stroke in 88% of the patients. These findings are in accord with my findings. Best upper and lower extremity function was obtained on average 9 and 10 weeks, respectively, after the stroke, and 95% of the patients had reached their best upper and lower extremity function within 13 and 14 weeks, respectively.

Stroke severity affects the time required to obtain maximal recovery. Length of stay in a rehabilitation unit is directly related to the severity of paresis on admission.21,22 Patients with a low Barthel Index score on admission recover more slowly than patients with a high score.21 In my study, complete recovery of
extremity function was achieved on average 7 weeks after the stroke, whereas recovery progressed for an average of 10 weeks in patients who achieved only incomplete recovery.

Andrews et al18 showed that approximately one third of moderately or severely disabled stroke patients had improvement of their walking between 3 and 6 months after their stroke. In my study, the patients were discharged an average of 2 weeks after maximum improvement was achieved. Although the majority of the patients thus seemed to have reached their best possible outcome on discharge, some patients may continue to improve. However, the process of recovery may be so slow in these patients that recordable improvement of function requires >2 weeks of observation during inpatient rehabilitation.

Acknowledgments

Thanks to Dr. Fletcher H. McDowell and Dr. Michael J. Reding for invaluable advice during preparation of the manuscript.

References


KEYWORDS • cerebrovascular disorders • paresis • rehabilitation
Arm and leg paresis as outcome predictors in stroke rehabilitation.

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Stroke. 1990;21:247-251
doi: 10.1161/01.STR.21.2.247

Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0039-2499. Online ISSN: 1524-4628

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World Wide Web at:
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