Discharge Outcome After Stroke Rehabilitation

Carl V. Granger, MD; Byron B. Hamilton, MD, PhD; and Roger C. Fiedler, PhD

**Background and Purpose:** The purpose of this study was to examine the relations between host characteristics (age and side of body affected) and program variables (lengths of stay in acute care and rehabilitation, levels of functional ability at admission and discharge, and rates of community discharge).

**Methods:** A sample of 7,905 patients was drawn from medical rehabilitation facilities enrolled in the Uniform Data System for Medical Rehabilitation who were admitted and discharged for the first time between January 1988 and June 1989. Data were analyzed using either \( \chi^2 \) tests or \( t \) normal tests of proportions, and analyses of variance (ANOVA) and/or \( t \) tests. Significance was set at \( p<0.05 \), and statistically significant \( F \) ratios were examined using Student-Newman-Keuls tests.

**Results:** The average age of patients was 70.7 years (24% <65 years, 53% 65-79 years, and 23% >79 years). Lengths of stay in acute care and rehabilitation, admission and discharge functional independence ratings, and rates of community discharge were generally inversely related to patient age. Patients with bilateral paresis had lower rates of community discharge than those with unilateral paresis, although this distinction was not evident in the older group.

**Conclusions:** Results showed that older age and bilateral paresis are negatively associated with levels of independence at admission and discharge and with rates of community discharge. (Stroke 1992;23:978-982)

**Key Words** • rehabilitation • stroke assessment • stroke outcome

Investigators of stroke rehabilitation have been concerned with the effects of age of the patient and side of the lesion on improvement in function and discharge destination. In a 1984 study, Andrews et al found a higher mortality rate in stroke patients over age 74 years of age and, among survivors, only 30% of those over age 75 returned home compared with 73% of patients under age 65. Further, Kotila et al found that 12 months after stroke, 90% of patients less than 65 years old were at home, as opposed to 66% of those 65 and older. Furthermore, 84% of those under age 65 were judged to be independent in activities of daily living compared with 52% in the older group. Similarly, in a study by Lindmark, older stroke patients did not recover motor function as quickly or as completely as younger patients with equivalent impairment.

Age was found by Wade et al in 1984 to have some value in predicting 2-year survival, but its effect was far outweighed by that of severity of stroke (measured by walking ability) and history of myocardial infarction. In 1983, the same investigators found age to be one of the five variables having the greatest predictive value for stroke outcome, along with the presence of hemianopia, urinary incontinence, upper limb motor deficit, and decreased sitting balance. Barer and Mitchell also found clinical observation of variables such as motor strength in the involved arm and continence to be of prognostic significance. However, in a recent Australian study by Shah et al, neither age nor side of paralysis proved to have great value for predicting attainment of rehabilitation success in stroke patients.

Addressing more directly the question of effect of age on stroke outcome, Wade et al in another 1984 study found little association between age and the presence of previous cardiovascular disease, severity of stroke, or functional status at 6 months. However, length of hospital stay was highly correlated with age, with those under age 65 having an average length of stay of 55 days compared with 120 days for those 65 and over.

A later study by Wade et al identified advanced age as second only to urinary incontinence as a predictor of poor short-term outcome. This supports the results of Henley et al, who found advanced age to be the most significant predictor of poor stroke outcome, followed by prolonged coma, conjugate gaze deviation, incontinence, poor muscle tone, and perseveration. When the investigators used these findings to modify criteria for admission to their rehabilitation program, the average length of stay was reduced by 3.5 weeks for patients who eventually returned home and by 11.4 weeks for those who required transfer to long-term care facilities.

Novack et al found that psychological tests, along with age, gender, and functional status at admission, aided in predicting functional outcome as measured by Barthel Index scores at discharge. It was apparent that the predictive capacity of psychological test variables alone was limited. However, tests of motor persistence, which are more sensitive to right hemisphere lesions, predicted functional outcome for patients with presumed left hemisphere involvement. Similarly, half-hour recall (a test of memory), which is more sensitive

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to left hemisphere lesions, predicted functional outcome for patients with presumed right hemisphere involvement. The results indicated that individuals with impairment of one hemisphere resulting from stroke, as reflected by motor involvement of the opposite side, had better rehabilitation outcomes if there was no evidence of cognitive impairment suggestive of dysfunction of the other cerebral hemisphere.

For this study, we hypothesized that increasing age and bilateral hemiparesis compared with unilateral hemiparesis would be associated with longer lengths of stay, lower level of functional ability at rehabilitation admission and discharge, and lower rates of community discharge. This study analyzes six categories of stroke patients undergoing medical rehabilitation based on a combination of age (<65 years, 65–79 years, and >79 years) and side of the body manifesting peripheral abnormalities (left, right, or bilateral). The subjects are those reported to the Uniform Data System for Medical Rehabilitation, which operates a Data Management Service (managed by the Center for Functional Assessment Research, Department of Rehabilitation Medicine, School of Medicine and Biomedical Sciences, State University of New York at Buffalo) to collect data from inpatient rehabilitation programs and provides confidential reports to subscribing facilities. Currently, the data base contains over 300 hospital subscribers and more than 200,000 patient records on file, making it a large source for uniform patient descriptors on rehabilitation admission, discharge, and follow-up. Integral to the system is the Functional Independence Measure (FIM; see “Appendix”), which is the 18-item, seven-level scale used to assess severity of disability. The scores may range from a low of 18 to a high of 126.12–14

In a study of persons with multiple sclerosis, the FIM, the Barthel Index, and the Incapacity Status Scale scores correlated highly with the minutes of help that the person needed per day.15

The availability of a large, contemporary, ongoing data base of patients who have undergone medical rehabilitation, in which common data elements, including measurement of disability, have been used presents an opportunity for periodic analysis and reporting on outcomes.

**Subjects and Methods**

In June 1989, the data base contained information on over 9,000 stroke patients from facilities reporting since January 1, 1988. This included dates of onset, rehabilitation admission, discharge, and follow-up; FIM scores on rehabilitation admission, discharge, and follow-up; and host characteristics such as age, gender, and race. Stroke patients who had a previous rehabilitation facility admission or who were outliers, with time between onset and admission beyond 1 year, were removed from further analysis. These exclusion criteria resulted in a sample of 7,905 stroke patients. Follow-up status was assessed 110±44.3 (mean±SD) days after discharge but was available only for 1,258 (16%) cases and thus was not included in this analysis. The number of patients was approximately equally distributed between free-standing hospitals and rehabilitation units of acute-care hospitals.

Areas of interest were the effects of age and side of body affected on functional scores at admission and discharge, lengths of stay, and discharge destination. Also of interest was the relation between discharge functional score and discharge destination. It was interesting to note that the large sample size of this data base considerably reduced the standard errors involved in mean difference tests. Thus, some tests of relatively small differences in means were statistically significant without having substantive clinical meaning. However, all statistical results reported below were also clinically meaningful. Tables with values presented in percentages were selectively analyzed for group differences using either χ² tests or z normal tests of proportions, and tables of group means are reported with standard deviations and selectively analyzed using analyses of variance (ANOVA) and/or t tests. The alpha criterion for significance was set at p<0.05 for all tests, and any ANOVA mean difference results that produced statistically significant F ratios were further examined using Student-Newman-Keuls tests.16

No analysis of International Classification of Diseases codes is being presented.

**Results**

Of the 7,905 stroke cases, paresis was on the left side of the body in 46%, on the right side in 43%, and bilateral in 3%; the remaining 8% were either not parietic or not specified. Characteristics and days from onset to rehabilitation by age categories are shown in Table 1. The mean days from onset by age group ranged from 18.3 to 27.2 days. For all patients, the mean±SD time from onset of stroke to rehabilitation admission was 22.2±32.2 days, and the median was 13 days. In 8–9% of cases the rehabilitation program was interrupted by transfer to acute care for a period of less than 30 days for all age groups (data not shown).

The average time from acute onset to rehabilitation discharge was shorter for older age groups (Table 2). Within age groups <65 and 65–79, there were also significant time differences between unilateral and bilateral involvement subgroups, but not within the >79 years group.

The mean±SD length of stay for all patients was 32±22.4, with a median of 28 days. Table 3 shows that length of stay was shorter for older age groups, with

<table>
<thead>
<tr>
<th>Table 1. Stroke Patient Characteristics by Age Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
</tr>
<tr>
<td>n</td>
</tr>
<tr>
<td>Percent of total</td>
</tr>
<tr>
<td>Within age categories</td>
</tr>
<tr>
<td>Percent male</td>
</tr>
<tr>
<td>Percent married</td>
</tr>
<tr>
<td>Percent widowed</td>
</tr>
<tr>
<td>Percent living alone before stroke</td>
</tr>
<tr>
<td>Days from onset to rehabilitation admission (mean±SD)</td>
</tr>
</tbody>
</table>
significant differences between age groups. Average length of stay for patients <65 years old with bilateral paresis was significantly longer than for left or right hemiparetic patients in the same age group. Admission and discharge mean and median functional scores decreased with increasing age for left, right, and bilateral paresis, with some exception in bilaterally involved patients due to the small numbers (2–4% by age category) (Table 4). Older patients started with lower functional scores and made less gain than younger patients. Looking down each of the columns in Table 4, patients with left hemiparesis tended to have slightly higher admission and discharge functional scores than those with right hemiparesis, with less difference between left and right at discharge than at admission and, accordingly, less gain in function. Bilaterally involved patients generally had the lowest FIM admission, discharge, and change scores within each age group represented.

The percentages of all patients discharged to the community diminished significantly as age increased (Table 5). Of those <65 years old, 83% returned to the community compared with 75% of those 65–79 and only 64% of those >79 years and older. The proportions were similar for patients with unilateral paresis regardless of side affected, but among patients with bilateral involvement, only 74% of the younger group returned to the community.

Within age groups, for patients <65 years old, rate of discharge to the community for bilateral paresis (74%) was significantly lower than for left hemiparesis (85%), and lower than right hemiparesis (82%), although not significantly lower. Percent of discharges to nursing homes for bilateral paresis (13%) was higher than for left (5%) but not significantly higher than right hemiparesis (7%). Percentage of patients who died was higher for bilateral paresis than for left or right hemiparesis.

For patients 65–79 years old, the bilateral paresis patients' rate of discharge to the community (69%) was lower, but not significantly so, than for left (75%) or right (75%) hemiparesis. Percentage of patients discharged to live alone (data not shown) was significantly lower for those with bilateral paresis than for those with left or right hemiparesis.

For patients older than 79 years (data not shown), percentage of those discharged to live alone was lower, but not significantly so, for bilateral paresis than for left or right hemiparesis.

Table 6 shows that a higher FIM score on discharge for stroke patients was more likely to be associated with return to the community. For example, 37% of patients with discharge scores between 40 and 49 returned to the community, whereas 77% of patients with discharge scores between 80 and 84 returned to the community.

Discussion

Our findings are in agreement with those of Wade et al and Henley et al that advancing age adversely affects recovery after stroke, and with those of Novack et al that bilateral hemisphere involvement tends to have a less favorable rehabilitation outcome than unilateral involvement. As expected, older age and bilateral involvement were associated with lower function on admission and discharge and lower rates of discharge to the community. While it was expected that patients with bilateral involvement would have longer lengths of stay, it was unexpected that older age would be associated with both shorter time from onset and rehabilitation lengths of stay.
TABLE 5. Discharge Disposition by Age Group

<table>
<thead>
<tr>
<th>Type of discharge</th>
<th>Age (years)</th>
<th>&lt;65</th>
<th>65–79</th>
<th>&gt;79</th>
</tr>
</thead>
<tbody>
<tr>
<td>To community</td>
<td>All patients*</td>
<td>83</td>
<td>75</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>Left stroke*</td>
<td>85</td>
<td>75</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>Right stroke*</td>
<td>82</td>
<td>75</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Bilateral stroke</td>
<td>74†</td>
<td>69</td>
<td>66</td>
</tr>
<tr>
<td>To nursing home</td>
<td>All patients*</td>
<td>6</td>
<td>13</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Left stroke*</td>
<td>5</td>
<td>14</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Right stroke*</td>
<td>7</td>
<td>13</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Bilateral stroke</td>
<td>13‡</td>
<td>16</td>
<td>21</td>
</tr>
<tr>
<td>To acute care</td>
<td>All patients</td>
<td>7</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Left stroke</td>
<td>7</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Right stroke</td>
<td>8</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Bilateral stroke</td>
<td>8</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>Died</td>
<td>All patients</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Left stroke</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Right stroke</td>
<td>&lt;1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Bilateral stroke‡</td>
<td>4§</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Values are percent.
*Student-Newman-Keuls (p<0.05) showed differences between all age groups.
‡Student-Newman-Keuls (p<0.05) showed a difference between the left and bilateral groups.
§Student-Newman-Keuls (p<0.05) showed the <65 age group different from both the older groups.
¶Student-Newman-Keuls (p<0.05) showed the bilateral group different from both unilateral groups.

Total functional scores for patients with left hemiparesis were slightly higher at admission and discharge than for right hemiparesis in all three age groups. Additional group comparisons showed that this was due to statistically significantly lower subscores for communication and social cognition in the case of right hemiparetics, most likely affected by aphasia (Table 7).

TABLE 7. Mean Functional Independence Measure Communication and Social Cognition Subscores for Admission and Discharge According to Side of Body Affected

<table>
<thead>
<tr>
<th>Subscore</th>
<th>Admission</th>
<th>Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Left</td>
<td>Right</td>
</tr>
<tr>
<td>Communication*</td>
<td>10.3</td>
<td>7.8</td>
</tr>
<tr>
<td>Cognitive†</td>
<td>12.9</td>
<td>11.1</td>
</tr>
</tbody>
</table>

*Student-Newman-Keuls (p<0.05) showed all paresis group means different.
†Student-Newman-Keuls (p<0.05) showed left paresis group mean different from the other group means.

In the present study, as age increased, length of rehabilitation stay decreased. There are several possible explanations. First, because older persons may not have the motor or cognitive learning capacity of younger persons, they reached a plateau of functional gain sooner. Second, it may be that higher comorbidity in older patients limited their ability to vigorously participate in the rehabilitation process. However, this study did not examine the effects of comorbidity. Reding17 concludes from a review of the literature and from his own study of 81 patients that the more carefully patients are matched for absence of comorbid medical problems and severity of neurological impairment, the less relevant age becomes as a factor in rehabilitation outcome.

A US Department of Health and Human Services study documents that older individuals have more limited functional capability in the community population. For example, the study found that difficulties with activities of daily living and instrumental activities of daily living (managing one’s household tasks) are infrequent for persons 55–64 years of age, but the rate increases after age 65 and climbs sharply after age 80. Thus, we may expect that many older persons with strokes may have had preexisting limitations and, consequently, lower admission functional scores.

Another factor that possibly influenced shorter lengths of stay for older patients might have been administrative pressure on staff to reduce length of stay to the shortest possible time, such as when functional gain has plateaued. Additionally, it would be interesting to know whether there is a geriatric “generation gap” bias. In this case, in the view of younger rehabilitation care providers, older patients may appear not to have the potential to benefit to the same extent as younger patients. Therefore, it might seem appropriate to discharge the older patient sooner. Further research needs to be done to explore whether age may be serving as a proxy measure for other factors that may be exerting influences to reduce functional attainment or length of stay. Additional studies of patients’ responses to the rehabilitation process will help to clarify the role of age.
Appendix

FUNCTIONAL INDEPENDENCE MEASURE

<table>
<thead>
<tr>
<th>FIM</th>
<th>COMPLETE INDEPENDENCE (Timely, Safely)</th>
<th>MODIFIED INDEPENDENCE (Device)</th>
<th>MODIFIED DEPENDENCE</th>
<th>SUPERVISION</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Complete Independence (Timely, Safely)</td>
<td>Modified Independence (Device)</td>
<td>Modified Dependence</td>
<td>Supervision</td>
</tr>
<tr>
<td>6</td>
<td>Complete Independence (Timely, Safely)</td>
<td>Modified Independence (Device)</td>
<td>Modified Dependence</td>
<td>Supervision</td>
</tr>
<tr>
<td>5</td>
<td>Complete Independence (Timely, Safely)</td>
<td>Modified Independence (Device)</td>
<td>Modified Dependence</td>
<td>Supervision</td>
</tr>
<tr>
<td>4</td>
<td>Complete Independence (Timely, Safely)</td>
<td>Modified Independence (Device)</td>
<td>Modified Dependence</td>
<td>Supervision</td>
</tr>
<tr>
<td>3</td>
<td>Complete Independence (Timely, Safely)</td>
<td>Modified Independence (Device)</td>
<td>Modified Dependence</td>
<td>Supervision</td>
</tr>
<tr>
<td>2</td>
<td>Complete Independence (Timely, Safely)</td>
<td>Modified Independence (Device)</td>
<td>Modified Dependence</td>
<td>Supervision</td>
</tr>
<tr>
<td>1</td>
<td>Complete Independence (Timely, Safely)</td>
<td>Modified Independence (Device)</td>
<td>Modified Dependence</td>
<td>Supervision</td>
</tr>
</tbody>
</table>

SELF-CARE

A. Eating
B. Grooming
C. Bathing
D. Dressing - Upper Body
E. Dressing - Lower Body
F. Toileting

SPHINCTER CONTROL

G. Bladder Management
H. Bowel Management

MOBILITY

Transfer:
I. Bed, Chair, Wheelchair
J. Toilet
K. Tub, Shower

LOCOMOTION

L. Walk/Wheelchair
M. Stairs

COMMUNICATION

N. Comprehension
O. Expression

SOCIAL COGNITION

P. Social Interaction
Q. Problem Solving
R. Memory

<table>
<thead>
<tr>
<th>TOTAL FIM</th>
<th>HELPER</th>
</tr>
</thead>
</table>

Note: Leave no blanks; enter 1 if patient not testable due to risk.

Acknowledgments

We are indebted to Carol Russell and Dr. Glen Gresham for editorial assistance and to the staffs of the hospitals submitting data to the Uniform Data System for Medical Rehabilitation.

References

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