Does Age Affect Benefits of Stroke Unit Rehabilitation?

Lalit Kalra, PhD, MRCP

Background and Purpose The influence of age on benefits of stroke unit rehabilitation is largely unknown.

Methods A prospective controlled study was undertaken in 245 stroke survivors randomized to a stroke unit or to general wards 2 weeks after stroke. Patients were divided into older (75 years and over) and younger (under 75 years) age groups, and their characteristics, prognosis, duration, and type of therapy input and outcome were compared in different settings.

Results Younger (n=101) and older (n=144) stroke patients were comparable for neurological and functional deficits and were distributed equally between the stroke unit and general wards. The duration of therapy input was similar in younger patients in either setting. Older patients received more occupational therapy in both settings (10.7±2.4 versus 7.9±0.4) and more physiotherapy (18.4±9.6 versus 15.2±7.8) on general wards. Younger patients on the stroke unit showed a better outcome compared with those on general wards (discharge home, 83% versus 60%; median Barthel score, 17 versus 13; median length of hospital stay, 27 versus 56 days) and with older patients on the stroke unit (discharge home, 83% versus 65%; median Barthel score, 17 versus 14). Outcome in older stroke patients was similar in both settings except for a shorter median length of hospital stay on the stroke unit (36 versus 84 days). Outcome in younger patients managed on general wards was worse than that in older patients with similar prognostic expectations (discharge home, 41% versus 61%; median Barthel score, 11 versus 13).

Conclusions Younger stroke patients benefited more by stroke unit rehabilitation compared with older patients, not only because of their age but also because of differences in the multidisciplinary input available for elderly patients outside the stroke unit. (Stroke. 1994;25:346-351.)

Key Words • aging • rehabilitation • stroke outcome

Age is an important consideration in the epidemiology and management of stroke. Demographic trends and epidemiologic data suggest that stroke in the elderly will be a major health issue in the near future, with significant cost implications. The hospital costs of stroke are predicted to rise out of proportion to the overall number of stroke patients because of the higher proportion of elderly stroke patients who will require hospitalization for nursing, rehabilitation, and social reasons. It is also expected that elderly patients, because of their higher incidence of recurrent stroke and additional disabilities, will have a poorer outcome compared with younger stroke patients. The challenge, then, is to develop strategies for stroke management aimed at maximizing the extent and speed of functional recovery in this age group.

One of the strategies gaining increasing popularity is the establishment of specialist units for stroke rehabilitation. Several studies on the benefits of stroke units suggest that stroke units speed functional recovery and shorten hospital length of stay. Stroke patients, however, are a heterogeneous group varying in age, stroke severity, and additional disability, factors that may affect the rehabilitation process. Despite the possibility of variable benefits from stroke unit rehabilitation in different groups of stroke patients, little information is available on the influence of these factors on stroke unit rehabilitation.

The benefits of stroke units may be influenced by the age of patients, not only because of factors related to aging but also because of the availability of resources in other settings. The additional needs of elderly people and nihilistic attitudes on general wards may make them the patient group most likely to benefit from specialist stroke unit rehabilitation. Conversely, they may represent a group less likely to benefit from such efforts because of problems associated with the aging process. As little is known about this aspect of stroke rehabilitation, a randomized controlled study was undertaken to examine the effects of age on benefits of stroke unit rehabilitation.

Subjects and Methods

Stroke was defined using World Health Organization criteria as the acute onset of neurologic deficit lasting more than 24 hours or leading to death, with no apparent cause other than cerebrovascular disease. Patients with first as well as recurrent stroke were included in the study. The diagnosis of stroke was based on history and clinical examination. Computerized tomographic (CT) scanning was not routinely undertaken except when indicated by defined criteria.

Stroke patients were admitted to general wards during the acute phase of their illness for initial management and stabilization. The district in which this study was conducted, in common with several districts in Britain, has an age-related admissions policy according to which patients over 75 years of age are admitted to different wards from those who are under 75 years of age regardless of admission diagnosis or the time of admission.

The study was undertaken in 245 stroke patients who remained in the hospital on geriatric medical wards 2 weeks after stroke. Patients who died during the acute phase

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References

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(first 2 weeks after stroke) or those with mild deficits secondary to reversible ischemic neurological disease who were discharged within 2 weeks of admission were not included in the study. Details of age, gender, side of stroke, power in the arm and leg on the affected side (Medical Research Council grading), hemianopia, dysphasia, dysphagia, sensory deficits, inattention (visual/sensorial), continence, and mobility and Barthel activities of daily living (ADL) scores were recorded.

Cognitive state was assessed using Hodkinson's abbreviated mental test score (MTS). The MTS is a well-validated test widely used in British medical practice that consists of 10 items assessing memory and verbal ability. The test was conducted on the ward with the patient responding verbally to questions asked by the observer. When dysphasia was present, patients were expected to respond appropriately by speech or signs to spoken or written answers suggested by the observer.

Stroke survivors were stratified for expected outcome according to the Orpington Prognostic Score. This score was derived from a multivariate analysis of determinants of functional outcome and incorporates measures of motor deficit, proprioception, balance, and cognitive function. The score ranges from 1.6 (best prognosis) to 6.8 (worst prognosis).

Younger or older patients were randomly allocated to a 13-bed stroke rehabilitation unit or continued to be managed on general medical or geriatric wards according to existing practices. Despite different settings, all stroke patients had access to nursing care, physiotherapy, and occupational therapy. The type of physiotherapy used was based on Bobath techniques modified by the physiotherapists' experience and adapted to the needs of individual patients. Physiotherapy and occupational therapy input was provided by therapists of comparable seniority (Senior I grade) who were assisted by therapy aides in both settings. Input was also available from speech therapists, social workers, and nursing home placement officers for patients unable to return home. Multidisciplinary discussions on patients' progress and therapy strategies took place every morning on the stroke unit. Similar discussions took place on a weekly basis on geriatric wards. There was no formal multidisciplinary discussion on general medical wards.

Subjects were followed up from entry into the study until discharge from the hospital. Objective assessments for neurological deficit, cognitive function, continence, and ADLs were undertaken at weekly intervals. Outcome measures included mortality during the remaining hospital stay, the percentage of patients discharged home, the percentage of patients discharged to long-term institutional care, and the length of hospital stay. Barthel ADL score at discharge, the change in Barthel ADL score from the time of inclusion in the study until discharge, and the proportion of patients with a Barthel ADL score of >11 at discharge were also recorded.

It is possible that the process of rehabilitation will affect outcome. As there are no accepted measures of process, measures of physiotherapy and occupational therapy input (major and universally available components of rehabilitation) were defined for the study. These included the duration and type of therapy given to individual stroke patients that were recorded by therapists working with the patients. Duration was measured in 30-minute time units of face-to-face contact with the patient. The major categories of the type of treatment given to stroke patients were agreed upon by the therapists, and the type of time devoted to different activities within each discipline was recorded. Therapists involved in the assessment and day-to-day management of stroke patients were unaware of their participation in the study or expected outcome.

Group homogeneity was analyzed with a χ² test for gender, neurological deficits, dementia, recurrent strokes, and prognostic classification in each group. Age on admission, motor power on affected side, and Barthel ADL scores on initial assessment were analyzed by the Mann-Whitney U test. Mortality, destination of discharge, differences in the type of therapy received, and the proportion of patients with a Barthel ADL score >11 at discharge in each group were analyzed using the χ² test. The length of hospital stay, amount of therapy received, discharge Barthel scores, and change in Barthel score during rehabilitation were analyzed by the Mann-Whitney U test. The study was approved by the District Ethics Committee.

**Results**

**Patient Characteristics**

Of the 245 patients in the study, 101 (41.2%) were under 75 years of age and 144 were aged 75 years or more (Table 1). The majority of patients (87%) did not have a history of previous stroke. Dementia was present in 22 (9%) patients before the stroke. Sixty-one (25%) patients included in the study had CT scans. CT scanning was more common in younger than in older patients (43 versus 18; P<.01).

Younger and older stroke patients were equally distributed between the stroke unit and general medical or geriatric wards, and the baseline characteristics of each age group were comparable between the two settings (Table 1). The extent of neurological deficit, mobility, and functional abilities at the initial assessment in patients of both age groups treated on the stroke rehabilitation unit were comparable to their counterparts treated on general medical or geriatric wards.

Recent stroke and/or dementia were significantly more common in stroke patients over 75 years as a group regardless of rehabilitation setting (8 versus 39; P<.05). There was also a significantly greater proportion of women in the older age group (38% versus 72%; P<.05), which was equally distributed between general wards and the stroke unit (Table 1). The site of stroke, neurological deficit, and functional disability as measured by Barthel scores at initial assessment were comparable between the two age groups and the two settings for each group (Table 1). Although prognostic scores were significantly higher (P<.01) for older patients as a group, suggesting a poorer prognosis in these patients, the three prognostic groups were equally distributed between the stroke unit and general wards in both age groups (Table 1). Patients with an intermediate prognosis formed the largest group irrespective of age or setting.

**Process**

Younger stroke patients treated on general medical wards received the same duration of physiotherapy and occupational therapy on average as those of the same age treated on the stroke unit (Table 2). A greater proportion of physiotherapy and occupational therapy input was directed toward individual needs in younger patients treated on the stroke rehabilitation unit compared with general medical wards (Table 2).

The average duration of physiotherapy received by older stroke patients was similar to that received by younger patients on the stroke unit. A greater proportion of physiotherapy input on the stroke unit was devoted to more basic activities (eg, transfers) in older patients compared with younger patients, in whom more time was devoted to gait correction and individual rehabilitation (Table 2). Despite the significantly longer mean duration of physiotherapy in older stroke patients treated on geriatric wards, the proportion of time spent...
Table 1. Baseline Characteristics of Younger and Older Stroke Patients

<table>
<thead>
<tr>
<th>Clinical Features</th>
<th>Younger (&lt;75 y)</th>
<th>Older (≥75 y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>SU 53, GMW 48</td>
<td>SU 71, GMW 73</td>
</tr>
<tr>
<td>Age, y</td>
<td>71.4±4.1</td>
<td>82.6±4.5</td>
</tr>
<tr>
<td>Gender, % female</td>
<td>36%</td>
<td>71%</td>
</tr>
<tr>
<td>Recurrent strokes</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Dementia</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Recurrent stroke and dementia</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Left hemiplegia</td>
<td>26</td>
<td>33</td>
</tr>
<tr>
<td>Right hemiplegia</td>
<td>26</td>
<td>29</td>
</tr>
<tr>
<td>Brain stem/cerebellar</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Mean power in affected arm*</td>
<td>2.4±1.6</td>
<td>2.0±1.4</td>
</tr>
<tr>
<td>Mean power in affected leg*</td>
<td>3.1±1.8</td>
<td>3.2±1.2</td>
</tr>
<tr>
<td>Perceptual deficits</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>Hemianopia</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td>Dysphasia</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>Dysphagia</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Median Barthel score (range)</td>
<td>5 (0-10)</td>
<td>4 (0-12)</td>
</tr>
<tr>
<td>Prognostic groups</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPS score &lt;3</td>
<td>20</td>
<td>11</td>
</tr>
<tr>
<td>OPS score 3-5</td>
<td>28</td>
<td>47</td>
</tr>
<tr>
<td>OPS score &gt;5</td>
<td>5</td>
<td>13</td>
</tr>
</tbody>
</table>

SU indicates stroke unit; GMW, general medical ward; and OPS, Orpington Prognostic Scale. Values are mean±SD where appropriate.

on different activities was comparable to older patients treated on the stroke unit.

Older patients as a group received more occupational therapy input compared with younger patients regardless of setting (Table 2). There were no significant differences in the proportion of time spent on various occupational therapy activities between younger and older patients on the stroke unit or between older patients cared for on the stroke unit or general wards (Table 2). A significantly greater proportion of time was spent on personal ADLs in younger patients on general medical wards compared with the stroke unit, where a greater proportion of time was devoted to individual rehabilitation (Table 2).

Outcome

There were significant differences between stroke patients under 75 years of age treated on general medical wards compared with those treated on the stroke unit (Table 3). A greater number of patients were discharged home from the stroke unit, with the majority of patients achieving a Barthel score >11 (Table 3). The median discharge Barthel score and the change in Barthel score were also significantly greater in younger patients treated on the stroke unit. There were, however, no significant differences in mortality between general wards (n=3) and the stroke unit (n=3) in this age group (Table 3). Older patients (aged over 75 years) showed a significantly higher mortality on general wards (n=12) compared with the stroke unit (n=6). There were no significant differences in functional abilities at discharge or the destination of discharge in survivors treated on the stroke unit or general wards (Table 3).

The median length of hospital stay of younger and older patients cared for on the stroke unit was significantly less than in those cared for on general medical or geriatric wards. Outcome in any setting or age group was not influenced by the gender of the patient.

A comparison between younger and older stroke patients treated on the stroke unit showed significantly better outcome in younger patients (Table 3). A higher proportion of younger patients were discharged home and achieved higher Barthel scores during their hospital stay. There were no significant differences in outcome between younger stroke patients on general medical wards and older stroke patients on geriatric wards, except for a shorter duration of hospital stay in younger patients (Table 3).

The significant differences in prognostic composition between younger and older patients (Table 1) could confound differences due to age. Hence, outcome in the "middle prognostic group" (the most sensitive to therapy intervention) was compared in the two age groups. The differences in outcome between younger and older stroke patients treated on the stroke unit and younger patients treated on the stroke unit and general wards continued to be significant despite standardization for prognosis (Table 4). However, younger patients on
TABLE 3. Outcome in All Younger and Older Stroke Patients Treated on Stroke Units or General Medical Wards

<table>
<thead>
<tr>
<th>Measures</th>
<th>Younger (&lt;75 y)</th>
<th>Older (≥75 y)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SU (n=53) I</td>
<td>GMW (n=48) II</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>SU (n=71) III</td>
<td>GMW (n=73) IV</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>I versus</td>
<td>II versus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>IV</td>
<td></td>
</tr>
<tr>
<td>Mortality</td>
<td>3 (6%)</td>
<td>3 (6%)</td>
<td>NS</td>
</tr>
<tr>
<td>Discharge home</td>
<td>44 (83%)</td>
<td>20 (60%)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Long-term care</td>
<td>6 (11%)</td>
<td>16 (33%)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Discharge BADL &gt;11</td>
<td>46 (87%)</td>
<td>33 (69%)</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Median discharge BADL*</td>
<td>17</td>
<td>13</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Median change in BADL*</td>
<td>12</td>
<td>9</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Median length of stay, d</td>
<td>27</td>
<td>56</td>
<td>&lt;.01</td>
</tr>
</tbody>
</table>

SU indicates stroke unit; GMW, general medical ward; and BADL, Barthel Activities of Daily Living score. Values for outcome measures are number of patients (percent of total).

*Barthel score measured in survivors.

Discussion

Patients under 75 years of age on the stroke unit showed the best outcome on a number of measures. The outcome in patients over 75 years of age cared for on the stroke unit was not as good as in their younger counterparts and was comparable to patients cared for on general geriatric wards, even after standardization for prognostic factors. Patients under 75 years of age on general medical wards had a poorer outcome than older patients with similar prognostic expectations on general geriatric wards, suggesting that younger stroke patients benefited more by stroke unit rehabilitation compared with patients over 75 years of age.

These differences in outcome could be due to age per se or differences in patient characteristics, rehabilitation input, or prognostic expectations between the two groups. In keeping with demographic trends,27 a significantly greater proportion of older stroke patients were women, although this did not appear to influence outcome in this study. A higher prevalence of disabilities due to generalized osteoarthritis, visual and/or auditory impairment not related to stroke, and other degenerative processes could have been additional contributing factors to the older age group's poorer outcomes.28 A significantly higher percentage of elderly stroke patients had evidence of recurrent stroke or dementia compared...
with younger patients, regardless of management setting (Table 1). Despite these differences, deficits due to the present stroke and the initial Barthel ADL scores were comparable between the two age groups, suggesting that there were no significant functional differences between the two groups. The limited sensitivity of Barthel ADL scores and the poor correlation of neurological deficits to functional disability, however, must be acknowledged. Differences in the process of stroke rehabilitation may have been another factor responsible for the differences in outcome between the two age groups (Table 3). Younger patients on the stroke unit could have received more therapy time, which might have favorably influenced outcome in this group. Results, however, showed no major differences in the duration of therapy input or the type of treatment received between the two age groups managed on the stroke unit. Similarly, there were no differences between the average duration of therapy received by younger stroke patients in either setting. A greater proportion of therapy time on general wards, however, was devoted to transfers and personal ADL abilities compared with the stroke unit, where a significant proportion of time was devoted to the specific needs of individual patients. There were no significant differences in therapy input between the stroke unit and general geriatric wards in older stroke patients.

The prognostic composition of younger and older stroke patients was different in both settings, with the older age group being skewed toward a poorer prognosis. This heterogeneity in prognosis could not only explain the poorer outcome in older patients on the stroke unit but could also have masked more subtle differences between the two groups. It was not possible to study the effects of age within each prognostic grouping because of the small sample size of the “good” and “poor” prognostic groups. The sample size of the “intermediate” prognostic group was, however, adequate to allow analysis and confirmed the differences in outcome between the two age groups treated on the stroke unit as well as the comparability of outcome in older patients managed in either setting. Whereas outcome was similar between general medical and geriatric wards when prognosis was not controlled (Table 3), significant differences emerged after standardization of prognosis (Table 4).

Operational differences in service provision on general wards, where age may lead to segregation of stroke patients (eg, in Britain), may also be an important consideration. The differences between stroke patients cared for on general medical or geriatric wards could not be explained by patient characteristics, prognosis, or therapy input. The organization and coordination of available therapy resources have been criticized and may have contributed significantly. Therapy on general medical wards appeared to be uncoordinated, with emphasis on achieving minimum standards for early discharge. In contrast, there was evidence of an established rehabilitation philosophy based on multidisciplinary practices on general geriatric wards. It is quite possible that some of the age differences between younger patients managed on the stroke unit or general wards may have been reduced if coordinated multidisciplinary input had been available to younger stroke patients outside the stroke unit.

This study suggests that age is important in stroke unit rehabilitation, not only as an independent variable but also because it can determine the level of multidisciplinary rehabilitation input available to stroke patients not treated on the stroke unit. The benefits of stroke units in hastening functional recovery regardless of age without increased therapy resources have been observed. The psychological advantages of quicker recovery and the support provided to patients and care givers on the stroke unit, in any age group, also cannot be underestimated. However, it may not always be possible to develop stroke rehabilitation units because of funding or logistic considerations. In such circumstances, closely supervised and directed multidisciplinary rehabilitation input on general wards, rather than isolated and noncoordinated therapies, may improve outcome in stroke patients treated in this setting.

### Table 4. Outcome in the Middle Group of Younger and Older Stroke Patients Treated on Stroke Units or General Medical Wards

<table>
<thead>
<tr>
<th>Measures</th>
<th>Stroke Units</th>
<th>General Medical Wards</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;75 (n=28) I</td>
<td>≥75 (n=47) II</td>
<td></td>
</tr>
<tr>
<td>Mortality</td>
<td>1 (4%)</td>
<td>1 (2%) NS</td>
<td></td>
</tr>
<tr>
<td>Discharge home</td>
<td>23 (82%)</td>
<td>33 (70%) &lt;.05</td>
<td></td>
</tr>
<tr>
<td>Long-term care</td>
<td>4 (14%)</td>
<td>13 (28%) &lt;.05</td>
<td></td>
</tr>
<tr>
<td>Discharge BADL &gt;11</td>
<td>26 (93%)</td>
<td>35 (74%) &lt;.01</td>
<td></td>
</tr>
<tr>
<td>Median discharge BADL*</td>
<td>17</td>
<td>14 &lt;.05</td>
<td></td>
</tr>
<tr>
<td>Median change in BADL*</td>
<td>12</td>
<td>11 NS</td>
<td></td>
</tr>
<tr>
<td>Median length of stay, d</td>
<td>36</td>
<td>43 NS</td>
<td></td>
</tr>
</tbody>
</table>

BADL indicates Barthel Activities of Daily Living score. The middle group (n=146) had an Orpington Prognostic Score of 3 through 5. Values for outcome measures are number of patients (percent).

*Barthel score measured in survivors.
References


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