The Influence of Stroke Unit Rehabilitation on Functional Recovery From Stroke

Lalit Kalra, PhD, MRCP(UK)

Background and Purpose  
Shorter lengths of hospital stay in stroke units could be due to quicker functional recovery or mechanisms of expediting hospital discharge. 

Methods  
Stroke survivors with an intermediate prognosis at 2 weeks after stroke (n=146) were randomized for management in a stroke rehabilitation unit or in general wards. Barthel scores were monitored at weekly intervals until hospital discharge. The duration and type of physiotherapy and occupational therapy received by patients in either setting was identical. The rate of change of Barthel scores, therapy input, and the duration of hospital stay were compared between the two settings.

Results  
Neurological deficits and median initial Barthel scores were comparable between patients in the stroke unit (n=73) and general wards (n=68). Median discharge Barthel scores were also recorded. The rate of change of Barthel scores were comparable between the two settings.

Treatment of stroke is expensive and accounts for 10% of the district bed-day costs in Britain.1,2 Because the majority of inpatient costs of stroke are incurred in meeting the acute rehabilitation needs of these patients,3,4 there has been an increasing emphasis in recent years on developing cost-effective strategies in this area. One of the strategies gaining increasing acceptance is the establishment of specialist units for stroke rehabilitation.5-7 There have been several studies on the benefits of stroke units,6,15 and a recent meta-analysis of several trials14 has shown a significant decrease in mortality in stroke units. The effects of stroke unit rehabilitation on functional recovery, however, remain controversial.

There is some evidence that stroke units hasten discharge from hospitals.5,6,12,13,15-17 Shorter lengths of hospital stay in stroke units could be due to quicker functional recovery,5,13 or could be a result of better organization and coordination between the patient, care-givers, and professionals in expediting discharge from the hospital.16,17 The debate between these two aspects of stroke unit rehabilitation has not been unequivocally resolved.6

The objective of this study is to compare the rate of functional recovery and therapy input in stroke patients managed in a stroke rehabilitation unit with that of similar patients managed in general wards. The contribution of the rate of functional recovery to the length of hospital stay has also been assessed.

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Dysphagia

TABLE 1. Demographic Characteristics of Stroke Patients in the Intermediate Prognostic Group (Orpington Prognostic Scale 3-5) Managed in the Stroke Unit or General Wards

<table>
<thead>
<tr>
<th>Clinical Features</th>
<th>SU</th>
<th>GW</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>73</td>
<td>68</td>
<td>NS</td>
</tr>
<tr>
<td>Age, mean±SD y</td>
<td>78.4±7.6</td>
<td>78.4±8.6</td>
<td>NS</td>
</tr>
<tr>
<td>Sex, % female</td>
<td>58%</td>
<td>62%</td>
<td>NS</td>
</tr>
<tr>
<td>Left hemiplegia</td>
<td>36</td>
<td>34</td>
<td>NS</td>
</tr>
<tr>
<td>Right hemiplegia</td>
<td>35</td>
<td>32</td>
<td>NS</td>
</tr>
<tr>
<td>Brain stem/cerebellar</td>
<td>4</td>
<td>5</td>
<td>NS</td>
</tr>
<tr>
<td>Mean power in affected arm (triceps)*</td>
<td>2.0±1.4</td>
<td>2.2±1.3</td>
<td>NS</td>
</tr>
<tr>
<td>Mean power in affected leg (quadriceps)*</td>
<td>3.1±1.3</td>
<td>3.1±1.0</td>
<td>NS</td>
</tr>
<tr>
<td>Perceptual deficits</td>
<td>24</td>
<td>23</td>
<td>NS</td>
</tr>
<tr>
<td>Hemianopia</td>
<td>28</td>
<td>26</td>
<td>NS</td>
</tr>
<tr>
<td>Dysphasia</td>
<td>15</td>
<td>13</td>
<td>NS</td>
</tr>
<tr>
<td>Dysphagia</td>
<td>4</td>
<td>3</td>
<td>NS</td>
</tr>
<tr>
<td>Urinary incontinence</td>
<td>25</td>
<td>24</td>
<td>NS</td>
</tr>
<tr>
<td>Median Barthel ADL score (range)</td>
<td>4 (0-12)</td>
<td>4 (0-8)</td>
<td>NS</td>
</tr>
</tbody>
</table>

SU indicates stroke unit; GW, general wards; and ADL, activities of daily living.

*Medical Research Council grading for power.

Results

The baseline demographic characteristics of the 73 patients on the stroke rehabilitation unit and 68 patients on general wards were comparable (Table 1). The extent of neurological deficit, frequency of urinary incontinence, and Barthel scores at the initial assessment in patients treated in the stroke rehabilitation unit did not differ significantly from those of patients treated in general wards (Table 1).

The median discharge Barthel score of patients managed in the stroke rehabilitation unit was significantly higher than that of patients managed in general wards (15 versus 12). Despite a similar median Barthel score for both groups at the start of the study, median Barthel scores, measured at weekly intervals, were significantly higher for patients managed in the stroke rehabilitation unit compared with those in general wards (Table 2). The increase in median Barthel score in the stroke unit group was initially slow but rose rapidly after 2 weeks, reaching a plateau at median discharge Barthel score at 6 weeks (Fig 1). Median Barthel score for patients in general wards showed little improvement for 3 weeks, after which they improved linearly until the median discharge Barthel score was achieved at 12 weeks (Fig 1). The rate of change of median Barthel score during the linear phase was significantly slower in patients in general wards (0.9/wk) compared with those in the stroke unit (2.2/wk) and is reflected in the differences in the slopes of their Barthel curves (Fig 1). The mean±SD value of Barthel scores of individual patients at 4 weeks as a proportion of their Barthel score at discharge was 0.79±0.22 in the stroke unit compared with 0.66±0.22 in general wards (P<.01).

Patients managed in the stroke unit had significantly shorter lengths of hospital stay compared with those in general wards (48.7±17.2 versus 104.6±28.6 days; P<.001). There were no significant differences between the percentage of patients discharged from the stroke unit (50%) and general wards (45%) up to the time taken to achieve median discharge Barthel score in each group. However, there were significant differences in the time taken to discharge patients remaining in general wards (20 weeks) compared with the stroke rehabilitation unit (6 weeks) once this level was achieved for the group. The mean±SD value of the time taken to achieve discharge Barthel scores by individual patients as a proportion of the duration of their hospital stay after randomization was 0.9±0.4 for patients in the stroke unit compared with 0.65±0.27 for patients in general wards (P<.01).

Differences in the speed of functional recovery also were seen when median Barthel scores of patients remaining in the stroke rehabilitation unit and general ward were plotted against time (Fig 2). There was a shift to the right in the curve that represented median Barthel scores in the general ward group, suggesting slower changes. The peak of the Barthel score curve coincided with the beginning of the sharp rise in the discharge curve both in the stroke unit and general wards, confirming that patients with poorer functional recovery stayed longer in hospitals regardless of setting (Fig 2).

Patients treated in general wards received significantly more physiotherapy on average than patients on the stroke rehabilitation unit during their hospital stay (Table 3). There were no differences in the average amount of occupational therapy received by patients in either setting. Although there was a trend toward a higher proportion of occupational therapy time being spent on specific needs of individual patients in the stroke rehabilitation unit compared with general medi-
### TABLE 2. Median Barthel Scores and Discharge Rates on a Weekly Basis in Stroke Patients Managed in the Stroke Unit or General Wards

<table>
<thead>
<tr>
<th>Time of Assessment, wk</th>
<th>Median Barthel ADL Score (Range)</th>
<th>Percent Discharges</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SU</td>
<td>GW</td>
</tr>
<tr>
<td>0</td>
<td>4 (0-12)</td>
<td>4 (0-8)</td>
</tr>
<tr>
<td>1</td>
<td>6 (0-13)</td>
<td>4 (0-12)</td>
</tr>
<tr>
<td>2</td>
<td>9 (0-15)</td>
<td>4 (0-13)</td>
</tr>
<tr>
<td>3</td>
<td>11 (0-18)</td>
<td>5 (0-16)</td>
</tr>
<tr>
<td>4</td>
<td>13 (0-20)</td>
<td>6 (0-17)</td>
</tr>
<tr>
<td>6</td>
<td>14 (3-20)</td>
<td>8 (2-18)</td>
</tr>
<tr>
<td>8</td>
<td>15 (4-20)</td>
<td>9 (2-18)</td>
</tr>
<tr>
<td>10</td>
<td>15 (6-20)</td>
<td>10 (2-18)</td>
</tr>
<tr>
<td>12</td>
<td>15 (6-20)</td>
<td>12 (2-18)</td>
</tr>
<tr>
<td>20</td>
<td>...</td>
<td>12 (2-18)</td>
</tr>
<tr>
<td>28</td>
<td>...</td>
<td>12 (2-18)</td>
</tr>
<tr>
<td>32</td>
<td>...</td>
<td>12 (2-18)</td>
</tr>
<tr>
<td>Discharge</td>
<td>15 (6-20)</td>
<td>12 (2-18)</td>
</tr>
</tbody>
</table>

ADL indicates activities of daily living; SU, stroke unit; and GW, general wards.

cal wards, this did not achieve statistical significance (Table 3).

### Discussion

This study shows that functional recovery, as measured by Barthel scores, is not only greater but also significantly more rapid on a stroke rehabilitation unit compared with general wards. This improvement is achieved without any additional physiotherapy and occupational therapy input in the specialist setting. The shorter hospital stay in the stroke rehabilitation unit also may have been due to a mechanism of expediting discharges in appropriate patients as a result of closer liaison between the patient, care-givers, and the professionals in this setting.

The analysis was limited to patients in the intermediate prognostic group because this group has been shown to be most sensitive to stroke unit intervention in a previous report. Patients in the best prognostic group were considered inappropriate for the study because of the high initial Barthel scores and the short duration of hospital stay in both settings. Analysis was not possible in the group with the worst prognosis because of the small sample size, high mortality, and the small change in median Barthel score between admission and discharge in this group regardless of setting.

The reasons that stroke rehabilitation units shorten hospital lengths of stay have not been clear in the past. Although quicker functional recovery has been suggested, the possibility of organizational aspects resulting in better coordination and early discharges as the sole contributing factor also has existed. The faster rate of functional improvement seen in this study also has

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Fig 1. Line graph shows weekly median Barthel scores and discharge rates of stroke survivors in stroke unit (n=73) and general wards (n=69). The symbol • indicates median Barthel score (stroke unit); ●, percent discharges (stroke unit); ○, median Barthel score (general wards); □, percent discharges (general wards); A, median discharge Barthel score of stroke unit group; and B, median discharge Barthel score of general wards group.

Fig 2. Line graph shows weekly median Barthel scores of the remaining stroke inpatients in the stroke unit and general wards shown against the rate of discharge. BADL indicates Barthel activities of daily living; ○, Barthel score (general wards); ●, discharge rates (general wards); ●, Barthel score (stroke unit); □, discharge rates (stroke unit); A, median discharge Barthel score of stroke unit group; and B, median discharge Barthel score of general wards group.
been reported previously, although therapy input was not quantified in that study. In addition, the time after which patients remaining in the hospital were discharged after the median discharge Barthel score was achieved was significantly longer in general wards (Table 2), providing objective evidence of poor organization suspected in previous reports. The group observations of speedier recovery and quicker discharges once functional potential was achieved in the stroke unit were supported by data on the proportion of change in Barthel scores occurring in the first 4 weeks and the proportion of time spent in the hospital once discharge Barthel scores were achieved in individual patients.

There is a risk that average lengths of hospital stay may be artificially shortened by discharging stroke patients before they achieve their functional potential. This risk is even greater in specialist settings such as a stroke unit, providing objective evidence of poor organization suspected in previous reports. The group observations of speedier recovery and quicker discharges once functional potential was achieved in the stroke unit were supported by data on the proportion of change in Barthel scores occurring in the first 4 weeks and the proportion of time spent in the hospital once discharge Barthel scores were achieved in individual patients.

An inherent weakness in this study is that functional assessments were undertaken by therapists involved in treating patients. It would have been desirable to “blind” assessment procedures for the purposes of the study, but this was not possible because of the logistic problems of conducting several assessments in a large group of patients at timed intervals. However, bias in favor of either setting is unlikely because of the large number of assessments undertaken, the consistency between serial assessments, and the correlation between Barthel score and outcome in individual patients. The probability of bias is further reduced by the fact that therapists conducting these assessments were unaware of a possible comparison between settings at a later date.

This study provides the basis for developing a service model for functional recovery from stroke and its relation to hospital stay. Changes in the median Barthel score of stroke patients undergoing rehabilitation were initially slow but then rose linearly and reached a plateau once the median discharge Barthel score had been achieved. The plot of discharge of stroke patients from the hospital shows a similar pattern but follows functional improvement. The steep phase of the discharge curve began only when median discharge Barthel levels were achieved by the patient group (Fig 1). The rapid discharge phase was associated with a rapid fall in median Barthel scores of the remaining patients (Fig 2). This model generates measures by which the functional efficacy of stroke settings (different stroke units or different specialist and nonspecialist settings) can be assessed. The suggested measures (which need to be applied to patient groups of comparable deficits and prognosis) are (1) the median discharge Barthel score (measure of the extent of functional recovery in the setting); (2) time required by the patient group to achieve this score (measure of the rate of functional recovery in the setting); (3) time required to discharge the remaining stroke patients once the group achieves the median discharge Barthel score (measure of mechanisms to expedite discharges from the setting); and (4) the rate of decrease of median Barthel score of patients remaining in the unit after median Barthel scores are achieved (measure of appropriateness of discharges from the setting).

It is possible that other assessments (eg, motor, functional, and social) in stroke show similar patterns and relations to discharges. It may also be possible that some of these measures are affected by stroke unit rehabilitation, whereas others are relatively immune to such influences. Further research in this area will allow a more precise understanding of how stroke units affect rehabilitation and will help to develop better strategies of stroke management.

References


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