The Measure of Balance in Sitting in Stroke Rehabilitation Prognosis

To test the hypothesis that recovering stroke patients with initially good sitting balance or those who develop good sitting balance during rehabilitation have better Barthel Index-based functional assessment outcomes than recovering stroke patients with poor sitting balance, we prospectively studied 24 of 25 consecutive stroke patients admitted to a tertiary-care hospital rehabilitation unit. Sitting balance, a prerequisite for most functional activities, was scored using a four-point scale evaluating static and dynamic sitting balance on admission to the rehabilitation unit and weekly until discharge. Functional status was assessed using the Barthel Index 4 or 12 weeks after the stroke. We found a strong positive correlation between Barthel Index score and each weekly sitting balance score. Multiple evaluations over time identified those patients whose sitting balance improved during rehabilitation in our unit; after grouping the patients into those with normal, improved, and poor sitting balance, we found a significant difference in the Barthel Index scores among the three groups. The group of patients whose sitting balance improved had higher Barthel Index scores than the group whose sitting balance did not improve. Ongoing evaluation of sitting balance can be helpful in anticipating functional status at discharge in stroke patients undergoing comprehensive rehabilitation. (Stroke 1990;21:82–86)

Physiatrists have struggled to define the relation between various aspects of functional status and overall rehabilitation outcome in stroke patients. Many studies have correlated patient characteristics present at the initial examination with long-term functional improvement; other studies have been unable to document a sufficiently high correlation to precisely predict outcome. Anderson et al. showed that perceptual loss, low motivation, confused and disoriented thinking, withdrawn and apathetic behavior, an extended time since stroke onset, previous stroke, low blood pressure, and an extended period of unconsciousness at the time of the stroke are important variables related to improvement. Lehmann et al. showed that family income and family involvement supporting the patient predicted discharge disposition. There is a paucity of data concerning the value of specific, ongoing functional assessment techniques in identifying those stroke victims who will do well in inpatient rehabilitation units.

We report the results of a prospective study of 24 of 25 consecutive stroke patients admitted to the rehabilitation unit of an acute-care hospital. We serially evaluated sitting balance to test the hypothesis that recovering stroke patients with initially good sitting balance or those who develop good sitting balance during rehabilitation do better on a Barthel index-based functional assessment of outcome than recovering stroke patients with consistently poor sitting balance.

Subjects and Methods

Twenty-five patients who had had a stroke were admitted to the rehabilitation unit from May 2 to September 5, 1988. Twenty-four were referred from St. Luke's Episcopal Hospital, a large tertiary-care teaching hospital emphasizing medical and surgical treatment of cardiovascular disease and the site of the rehabilitation unit. The other patient was referred from the outpatient clinic of our department. One patient had a hip fracture in addition to a stroke and he was required to wear a thigh abduction splint at all times. Because his sitting balance could have been affected by his fracture, his stroke, or his postoperative orthopedic equipment, this patient was deleted from the cohort.

The same physiatrist obtained informed consent from each patient or a family member, tested the patient's sitting balance, and assessed the patient's Barthel Index score (see below).

Sitting balance was tested using the standard technique for evaluating static and dynamic sitting balance. The patient sat on the side of a hospital
bed, feet on the floor, back unsupported, and hands on the lap. If the patient could hold this position without assistance for 15 seconds, he was nudged by the physiatrist anteriorly, posteriorly, and laterally using approximately 5–10 foot-pounds of force. The physiatrist guarded the patient from falling with his free hand. The patient’s sitting balance was scored as 4, normal: able to perform the above testing without any physical assistance; 3, good: able to maintain a static position without difficulty but requiring assistance in righting from the hemiplegic side; 2, fair: able to maintain a static position without difficulty but requiring assistance in all righting tasks; or 1, poor: unable to maintain a static position. Sitting balance was evaluated on admission to the rehabilitation unit and every week while the patient was in the hospital.

The Barthel Index, an ordinal scale that comprises scores for feeding, mobility, personal care, ambulation or wheelchair skills, bowel and bladder abilities, and dressing skills, was used to assess each patient’s rehabilitation outcome. The Barthel Index was selected because of its ease of administration, its proven reliability, and its good track record in the functional evaluation of patients with stroke. The Barthel Index score was generated by physiatric examination in conjunction with rehabilitation nursing evaluation exactly 4 weeks after the onset of hemiparesis due to stroke in 21 of the 24 patients and 12 weeks after stroke onset in three patients with extremely long hospital stays before admission to the rehabilitation unit.

Each patient’s discharge disposition (to home without or with assistance, to retirement home, to extended-care facility/nursing home, or back to the acute-care hospital) was recorded.

The percentage of the cohort with given demographic and clinical characteristics was calculated. The mean, standard deviation (SD), range, median, and mode were calculated for the time variables age, time from stroke onset to admission to rehabilitation unit, time to initial sitting balance evaluation, and time in rehabilitation unit. The correlation coefficient (r) for sitting balance score versus Barthel Index score was calculated and evaluated using the two-tailed r test. The mean±SD Barthel Index scores for defined groups of patients were calculated and compared using the two-tailed r test.

### Results

Of the 24 patients, 16 (66.7%, five men and 11 women) had left hemiparesis and eight (33.3%, four men and four women) had right hemiparesis; 22 (91.7%) strokes were thromboembolic and two (8.3%) consisted of capsular hemorrhage that resulted in left hemiparesis. This was the first stroke in 23 patients. The patient who had already had several minor strokes was functioning normally at the time of the stroke under consideration. The mean±SD age of the 24 patients was 70.7±8.3 (range 51–82) years. The demographic and clinical data are summarized in Table 1.

The 24 patients were admitted to the rehabilitation unit an average of 17.0 (SD 12.9, range 3–60) days after their stroke (Table 1); the median and mode were 14 days. Sitting balance was initially evaluated an average of 3.5 (SD 2.9, range 0–11) days after admission to the rehabilitation unit; the median was 3 days. The time from the onset of stroke to the initial sitting balance evaluation averaged 20.5 (SD 12.8) days; the median was 16.5 and the mode 16 days.

The 24 patients underwent a median of two (range 1–4) sitting balance evaluations while in the rehabilitation unit (Table 1). Table 2 gives the frequency distributions of the sitting balance scores for each evaluation.

Because the Barthel Index scores for three patients were obtained 12 weeks after the stroke, the statistical analyses were performed first by including and then by omitting the results from those three patients. Because there was no significant difference in the results between analyses, we report the analysis of all 24 patients. The Barthel Index score averaged 75 (SD 17, range 35–95); the median and mode were 80.

Of the 24 patients, 18 (75%) were discharged to home with help, including stand-by assistance, and one (4.2%) was discharged to independent home care. Two patients (8.3%) were discharged to extended-care facilities and one (4.2%) to a retirement home. Two patients (8.3%) returned to the acute-care hospital, where one later died.

Correlation analysis of the Barthel Index score and the first sitting balance scores yielded r=0.699; (p<0.001). Similar correlation analyses of Barthel Index score and the second and third sitting balance scores gave r=0.933 (p<0.001) and r=0.839 (p<0.01), respectively.

There was no significant difference in Barthel Index scores between the 19 patients discharged to home (mean±SD score 77±16) and the five patients discharged to retirement or nursing homes or to the acute-care hospital (mean±SD score 65±21) (Table 1).

We grouped the patients by their sitting balance scores at each evaluation; the normal group comprised patients with a score of 4, and the less-than-normal group comprised those scoring 3, 2, or 1. Comparing the Barthel Index scores of the two groups revealed a significant difference. As shown in Figure 1, mean Barthel Index score at the first sitting balance evaluation was 85 for the normal group and 68 for the less-than-normal group (p<0.01). At the second evaluation the means were 87 and 55, respectively (p<0.001), and at the third they were 82 and 53, respectively (p<0.02).

For additional analysis the patients were divided into three groups: Group A, patients with sitting balance scores of 4 or 3 at the first evaluation and at discharge (n=15, 62.5%); Group B, patients with sitting balance scores of 2 or 1 at the first evaluation who improved by at least two points so that their sitting balance score at discharge was 4 or 3 (n=4,
### Table 1. Summary of Demographic and Clinical Data for 24 Stroke Patients Admitted to Rehabilitation Unit

<table>
<thead>
<tr>
<th>Age/sex</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stroke onset to rehabilitation (days)</td>
<td>Sitting balance score</td>
<td>Barthel Index score</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>60/M</td>
<td>60</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>79/M</td>
<td>15</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>67/M</td>
<td>9</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>82/F</td>
<td>10</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>71/F</td>
<td>12</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>62/M</td>
<td>15</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>80/F</td>
<td>40</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>76/M</td>
<td>42</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>64/F</td>
<td>10</td>
<td>17</td>
<td>4</td>
</tr>
<tr>
<td>74/F</td>
<td>14</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>74/M</td>
<td>17</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>81/F</td>
<td>14</td>
<td>18</td>
<td>4</td>
</tr>
</tbody>
</table>

**Discussion**

We planned this study within the framework of the usual clinical situation, using only routinely available assessment tools. Because patients come to a reha-

### Table 2. Sitting Balance Scores for Serial Evaluations of 24 Stroke Patients

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Sitting balance score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 (poor)</td>
</tr>
<tr>
<td>N</td>
<td>n</td>
</tr>
<tr>
<td>First</td>
<td>24</td>
</tr>
<tr>
<td>Second</td>
<td>20</td>
</tr>
<tr>
<td>Third</td>
<td>10</td>
</tr>
<tr>
<td>Fourth</td>
<td>2</td>
</tr>
</tbody>
</table>
bilitation unit at various times after their stroke, the onset of the stroke rather than admission to the rehabilitation unit was used as time \( t = 0 \). Four weeks after the stroke was arbitrarily chosen as the time for the Barthel Index assessment (except in those patients with very long prerehabilitation hospital stays). Given an average of 17 days from stroke onset to rehabilitation unit admission and an average rehabilitation stay of 17.5 days (total 34.5 days), the Barthel Index scores represent the patient's functional status 1 week before discharge. This time frame seems to be clinically relevant since discharge planning frequently begins in earnest approximately 1 week before discharge.

Our cohort may have been slightly less impaired than patients in other rehabilitation units. The average length of stay (17.5 days) was somewhat less than that in the rehabilitation unit of a similar private, academic hospital elsewhere in our medical center (unpublished data). Similarly, the average Barthel Index score (75) was somewhat higher than that in other stroke patients undergoing rehabilitation.

A strong correlation between Barthel Index score and any weekly sitting balance score is not surprising. The Barthel Index is weighed heavily toward activities (dressing, bowel and bladder abilities, and wheelchair skills) that require good sitting and transfer skills. Wade et al.\(^8\) identified sitting balance along with age, hemianopsia, urinary incontinence, and arm motor deficit as variables that related to 6-month Barthel Index score in a study of 83 patients with stroke.

Additional information about this cohort is derived from our serial evaluation of sitting balance. Our stroke patients' sitting balance scores improved between the first and second evaluations, but then the rate of improvement leveled off. Most likely, sitting balance improved from the first to the second evaluations because of neurologic and functional recovery in the cohort, but there also may have been some practice effect.

It is of particular interest that there was a significant difference in Barthel Index score among the three groups of patients. Certainly patients with good sitting balance are expected to do well on the Barthel Index. There was also a group of patients with initially poor sitting balance whose scores improved while on the rehabilitation unit. From the data available, however, we found no significant variables (such as age or length of rehabilitation stay) that differed between those patients whose sitting balance scores improved and those whose scores remained poor or fair. Only serial sitting balance evaluations identified those patients whose sitting balance scores improved and in turn had higher Barthel Index scores.

Additional work needs to be done to identify other serially evaluable functional tasks that may indicate which patients will do well during stroke rehabilitation. Serial assessment of other functional activities such as toileting ability, cooking, etc., rather than a one-time assessment, may better highlight those who will do well after stroke rehabilitation. One such

### Figure 1
Bar graph. Barthel Index score for stroke patients with normal sitting balance (open bars) compared with those with poor, fair, or good sitting balance (shaded bars) on three weekly evaluations. Probability of difference between groups assessed by two-tailed \( t \) test.

### Figure 2
Bar graph. Barthel Index scores for Groups A, B, and C. Probability of difference from Group B assessed by two-tailed \( t \) test.
study of trunk control in stroke patients is in progress (S. Moore, personal communication).

Acknowledgments

Special thanks to Laura M. Montgomery, PhD, for expert assistance with computer analysis, to Thomas Krouskop, PhD, for editing assistance, and to the nursing staff of the rehabilitation unit of St. Luke's Episcopal Hospital.

References


KEY WORDS • cerebrovascular disorders • rehabilitation
The measure of balance in sitting in stroke rehabilitation prognosis.

K J Sandin and B S Smith

Stroke. 1990;21:82-86
doi: 10.1161/01.STR.21.1.82

Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 1990 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://stroke.ahajournals.org/content/21/1/82