A Model Stroke Classification Scheme and Its Use in Outcome Research

Michael J. Reding, MD

The current International Classification of Disease #9 (ICD) categories for stroke are useless as a tool for functional outcome research.1 This classification's only minimally relevant distinction is between ischemic and hemorrhagic events. The distinction between extracranial occlusive disease and intracranial occlusive disease as the cause of stroke cannot be made unless there is proven complete occlusion of the internal carotid artery. The distinction between thrombotic and embolic events is based on clinical suspicion and has poor interrater reliability. There is no mechanism for specifying either the location or extent of the stroke. I am not aware of any study that shows a difference in functional outcome for any of the ICD stroke subcategories compared with the general category "Stroke, Not Otherwise Specified."

Several attempts at developing more meaningful categories have focused on the arterial distribution affected, such as internal carotid, middle cerebral, and anterior cerebral.2,3 With the advances in neuroimaging techniques and the resultant marked decrease in angiography, such studies are now very uncommon. They certainly do not recommend themselves as a research tool for the future.

Neuroimaging techniques have been used to estimate the volume of brain that is infarcted and/or the location of the infarct. These measures have been used to categorize patients into meaningful outcome groups.4,5 The time of the imaging study is critical because even with large lesions, those performed within the first 24–48 hours may be normal.6 Those done from Days 3–10 may overestimate the area of infarction because of associated edema. The ideal time for neuroimaging studies appears to be ≥3 weeks after stroke. Such delayed studies are rarely performed, because therapeutic decisions have been finalized and the patient is recovering.

Functional scales measuring activities of daily living (ADL) and mobility, such as the Barthel Index, have also been used to categorize patients.7 Patients with stroke with initial Barthel ADL-Mobility scores of ≤40 have been shown to have a significantly different outcome from those with scores from 41–60 or >60. This approach has the marked advantage of being essentially without cost and easily applied by any trained observer working with the patient. No consideration is given to the patient's neurological impairments, stroke location, or size. A patient with pure motor hemiplegia and depression, unmotivated for self-care, might have a Barthel ADL-Mobility score equal to a more severely affected patient with hemiplegia, hemihypesthesia, and hemianopsia.

We have used neurological impairments as a means of categorizing patients with stroke.8 Assessment is essentially without cost and can be accomplished by trained, nonphysician observers working with the patient. The spectrum of neurological impairments scored is a reflection of both the extent and location of the stroke. Basing the categorization schema on the patient's neurological impairments underlines the expectation that patients with similar impairments should have similar Barthel ADL-Mobility function scores. Such an approach focuses attention on patients whose Barthel ADL-Mobility function scores are significantly below those expected for their neurological impairments. One is forced to look for nonneurological explanations of why such patients are functioning so poorly (e.g., depression, cardiopulmonary decompensation, rheumatologic comorbidity). A description of such a classification schema has been published and is outlined below. It is presented to illustrate the clinical and research potential of more meaningful stroke classification efforts.8

Subjects and Methods

The study group comprises 95 consecutive patients with initial unilateral hemispheric stroke who were admitted to an inpatient stroke rehabilitation unit directly from an acute care hospital and who were examined by the participating neurologist.

Motor strength was assessed using the Medical Research council 0-to-5-point scale.9 If lower extremity proximal (iliopsoas) muscle strength was ≤4, the patient was scored as having a motor deficit.

Somatic sensation was assessed using a variation of the hand localization task.10 The index finger of the affected hand was displaced into the extremes of all four spatial quadrants. With the eyes occluded, the patient located the index finger of his or her affected

From Cornell University Medical College at the Burke Rehabilitation Center, White Plains, N.Y.
Address for correspondence: Michael J. Reding, MD, Cornell University Medical College at the Burke Rehabilitation Center, 785 Mamaroneck Avenue, White Plains, NY 10605.
(Stroke 1990;21(suppl II):II-35–II-37)
hand in the spatial quadrant with his or her unaffected hand. The error of the poorest performance was scored in inches. A mean error in the most-affected quadrant of ≥6 inches indicated somatic sensory deficit. Patients who were unable to comprehend this finger displacement task even after repeated gestural cues were scored as abnormal.

The presence or absence of homonymous hemianopsia was tested by confrontation visual-field testing. Globally aphasic patients were tested by visual-threat response.

Based on the above criteria, most patients could be categorized as having one of the following three spectra of neurological deficits: 1) motor deficit only (M deficit), 2) motor deficit plus somatic sensory deficit (MS deficit), and 3) motor deficit plus somatic sensory deficit plus homonymous visual deficit (MSV deficit). Patients with other combinations of deficits, that is, somatic sensory deficit plus homonymous visual deficit, motor deficit plus homonymous visual deficit, pure somatic sensory deficit, and pure homonymous visual deficit, are infrequently seen in inpatient rehabilitation populations.

Using the Barthel Index, outcome was measured prospectively at 2-week intervals by the rehabilitation therapy team, which was unaware of this study or its purpose. The Barthel Index defines independent ambulation and ability to walk 150 feet with assistance. The use of a cane and ankle brace do not constitute assistance. Patients require assistance when the presence of another individual for patient safety (i.e., contact guarding, minimal assistance, etc.) is needed. Actuarial life-table analysis was performed as described by Rimm et al., in which curves for subgroups were compared using the Mantel-Haenszel log-rank method.

Results

Figure 1 presents the life-table curve for independence in walking ≥150 feet for the three stroke groups. This outcome goal is a reasonable one for M-deficit patients as >90% reached this goal by 14 weeks after their stroke. Only 35% of MS-deficit patients and 3% of patients with MSV deficit reached this outcome goal even though they were followed up longer after their stroke (p<0.001).

Figure 2 presents the life-table curves for the ability to walk 150 feet with assistance for the three subgroups. This is a reasonable outcome goal, as >90% of the patients in each subgroup attained it. The mean time after stroke at which each subgroup reached this goal is significantly different: M-deficit subgroup, 14 weeks; MS-deficit subgroup, 22 weeks; and MSV-deficit subgroup, 28 weeks (p<0.001).

Discussion

From Figures 1 and 2 it is apparent that patients with M, MS, and MSV deficits have very different outcome probabilities for the outcome measures assessed. The time after stroke required to achieve the outcome goal is also significantly different among these subgroups.

Life-table analysis provides data for setting patient rehabilitation goals. Based on the data in Figure 1, patients entering the rehabilitation unit with only M deficit can be expected to be independent in ambulation by 14 weeks after the stroke; patients with MSV deficits have little likelihood of becoming independent ambulators irrespective of time after stroke. Figure 2 shows that patients with MSV deficits, although they will not be independent ambulators, will reach a point of walking with assistance for distances of ≥150 feet, which allows these patients to
move about within the home. They may take up to 28 weeks after stroke to reach this goal.

Life-table analysis curves can indicate otherwise unrecognized comorbid medical-behavioral problems. Figure 2 shows that a patient with only an M deficit who is not walking ≥150 feet with assistance by 8 weeks after stroke is in the lowest 20% of his or her outcome subgroup. If the patient is not walking ≥150 feet with assistance by 12 weeks, he or she is in the lowest 7% of his or her outcome subgroup. One would question the presence of confounding medical, neurological, or behavioral problems impeding the patient’s progress.

Once patients have been categorized into meaningful outcome probability subgroups, one can begin to compare the effect of rehabilitation techniques on life-table outcome curves. Such analysis allows the investigator to determine both the effect of the treatment on overall functional outcome and the time required to reach the desired outcome goal.

The stroke categorization schema presented above has also proven useful in studying the prevalence of other poststroke phenomena: shoulder-hand pain syndrome, urinary incontinence, and thromboembolic complications. The fact that the above outlined stroke classification schema not only predicts functional outcome but also predicts poststroke complications further supports its validity.

There is a pressing need for more objective criteria for determining rehabilitation outcome goals and the time required to reach these goals. Categorization of patients into readily verifiable subgroups and the use of life-table analysis data may meet this need.

References
9. Medical Research Council: Aids to the examination of the peripheral nervous system. London, Her Majesty’s Stationery Office, 1976

Key Words: classification • stroke outcome
Patterns of Care for Stroke Survivors

Charles J. Gibson, MD

Although the efficacy of rehabilitation for patients with stroke has not been proven to the satisfaction of all,1-3 there is general agreement that the rehabilitation process must either improve functional ability in patients or must reduce long-term cost. In examining the issue of patterns of care for stroke survivors who are discharged from an acute-care hospital, a useful measure in stroke outcome research is whether the patient is discharged to a private living situation or must enter a long-term care facility, most often a nursing home.

In determining posthospital patterns of care, it is essential to survey an entire community in order to avoid the selection bias that may accompany the partial survey. Although it is extremely difficult, there are at least four studies that have included all or nearly all of the hospitalized stroke patients within a community over a sufficient period of time to gather a sample size of at least 200. Patients with stroke in the United States and Canada who are not hospitalized are thought to be those with very mild strokes or with rapidly fatal events or who are already terminally ill and being managed at home. These patients can probably be safely omitted from consideration of patterns of care where cost is the major outcome variable, as few of them are likely to require the services of a long-term care facility.

Although there have been relatively few community-wide studies that shed light on the disposition site of stroke survivors who are discharged from an acute-care hospital, in North America the disposition options can usually be grouped into the categories of long-term care, rehabilitation, or private living (home). Given the fact that there are few studies examining immediate posthospital discharge site, it is not surprising that much less data is available regarding living arrangements at 6 or 12 months after onset of stroke. However, in Rochester, N.Y., we do have evidence that there are relatively few changes in living arrangements between the time of hospital discharge and the 6-month anniversary of the stroke.4

During the past 20 years, there has been a significant decrease in the incidence of stroke in the United States, and there also has been an apparent decrease in the hospital mortality rate. When one also considers the differences between communities in regard to social structures and institutions, including the availability of rehabilitation and home-care services, it is a bit surprising that the few available studies are as consistent as they seem to be. The four studies5-8 presented in this review vary in methodology (prospective versus retrospective), availability of imaging techniques to confirm the diagnosis of stroke, and the precise goal of the study. However, these studies are sufficiently similar that a general comparison is warranted.

The ideal study to test the efficacy of stroke rehabilitation would be a controlled clinical trial with half of the subjects receiving rehabilitation and the other half receiving no rehabilitation. It is now probably impossible to construct this type of study, and the withholding of all rehabilitation services would likely be considered unethical. Therefore, it is important to know the current "natural history" of stroke survivors for any study that proposes to test the effectiveness of the stroke rehabilitation process.

The four studies selected for comparison are summarized in Table 1. Potential confounding variables include age of the subjects and length of stay in the acute-care hospital. In addition, the studies are not consistent in reporting these variables as mean or median. Nevertheless, the average age of the subjects appears to be quite close between the studies, and there is also similarity in the length of hospital stay, with the possible exception of the mean length of stay in Montreal.

Table 2 reports discharge sites in the various studies in percentages. The death rate in Rochester, N.Y., is significantly higher than in the other studies, possibly reflecting the earlier time period of this study. However, in terms of discharge sites of stroke survivors, Table 3 demonstrates that direct discharge to the home is similar in all four studies. In communities with higher discharge rates to rehabilitation units, there appears to be a corresponding reduction in the rate of discharge to long-term care facilities. Obviously, it would be important to know the percentage of patients going to rehabilitation facilities who are then discharged to home.

Overall, the studies seem to indicate that the hospital mortality rate for stroke patients is now