Recovery of Motor Function After Stroke

Ruth Bonita, MPH, PhD, and Robert Beaglehole, MD, FRACP

The natural history of recovery of motor function after stroke is described using data from a 1-year community-based study in Auckland, New Zealand. Of 680 patients, 88% presented with a hemiparesis; the proportion of survivors with a persisting deficit declined to 71% at 1 month and 62% at 6 months after the onset of the stroke. At onset, there were equal proportions of people with mild, moderate, and severe motor deficits, but the majority (76%) of those who survived 6 months had either no or only a mild deficit. Recovery of motor function was associated with the stroke severity but not with age or sex; patients with a mild motor deficit at onset were 10 times more likely to recover their motor function than those with a severe stroke. Our results confirm the reasonably optimistic outcome for survivors of stroke and further suggest that recovery of motor function is confined to patients whose motor deficit at onset is either mild or moderate. (Stroke 1988; 19:1497-1500)

Cerebrovascular disease (stroke) is an important cause of mortality and morbidity in many industrialized countries. Epidemiologic information on the natural history of stroke is important, not only to serve as a baseline for the evaluation of preventive or therapeutic measures, but also for health care planning.

Previous assessments of the natural history of stroke have been largely restricted to selected patients, such as those hospitalized or referred for rehabilitation.1-3 An accurate assessment of the natural history of recovery after stroke requires the inclusion of the patients with more severe strokes, who do not survive beyond the first few days, as well as the patients with mild strokes, for whom referral for rehabilitation might not be warranted.

We describe the natural history of recovery of motor function during the 6 months following an acute stroke using data from a large community-based stroke register, one of the few studies to meet the criteria of the "ideal" study design.4

Subjects and Methods

A community-based study of stroke was undertaken among residents aged 15 years or older in Auckland, New Zealand (1981 census population 829,545) to document the incidence, case-fatality rate, and natural history of the disease. Full details of the study population and methods have been published.5,6 Stroke was defined, according to the World Health Organization's definition, as the acute onset of a focal or global neurologic deficit, presumably of vascular origin, lasting ≥24 hours or leading to death. This definition includes spontaneous subarachnoid hemorrhage but excludes subdural and extradural hematomas and transient ischemic attacks. Apart from subarachnoid hemorrhage, we made no attempt to validate the different subcategories of stroke.

We used multiple sources (lists of all daily hospital admissions and discharges, all death certificates, hospital postmortem and autopsy reports, as well as regular contact with general practitioners, private hospitals, rest homes, locum and emergency services to identify patients who might not have been admitted to one of the three main general hospitals) to identify all possible cases of stroke. A neurologist reviewed the case notes for adjudication of any patient for whom there was doubt as to the criteria. We are confident that we identified all eligible patients.5,6

Information was obtained as soon after the event as possible by trained nurse interviewers using a standard precoded questionnaire administered to either the patient or a close relative. Survivors were followed up at 1 and 6 months after the initial event.

Hemiparesis was recorded as present or absent; if present, the severity of hemiparesis was categorized according to observation at each interview. Following consultation with clinicians and physiotherapists, three categories were used, and physiotherapy supervisors trained the nurse interviewers using demonstrations and specific tests to help
differentiate categories of weakness so that categories were assigned with a high degree of reliability. The three categories were mild, functionally insignificant impairment of finer movement but with controlled and normal movements through the full range; moderate, presence of muscle contraction and movement against gravity or resistance but limited in range and not in a controlled fashion; and severe, little or no active movement in the affected side. This categorization closely approximates the Rankin assessment scale, in which Grade I refers to no deficit and Grade II, Grade III, and Grades IV and V are equivalent to our mild, moderate, and severe categories, respectively. For patients who died having been unconscious for some hours before death and for those who were very drowsy initially, presence of a hemiparesis noted by the attending physician was accepted as evidence of a motor deficit.

We used the presence or absence of a motor deficit at onset (regardless of severity) in calculating motor deficit rates. We examined the effects of stroke severity (motor deficit category at onset) on outcome (survival, improvement, or recovery) to investigate the likely prognosis for various subsets of patients. All analyses relating to stroke severity were restricted to those people who survived 1 week.

We calculated odds ratios (ORs) to show the degree of association between variables; we calculated 95% confidence intervals (CIs) around the ORs using a test-based method. We used the Mantel-Haenszel method to control confounding.

### Results

Stroke event rates are compared with motor deficit rates at onset and at 1 month and at 6 months after the onset of the stroke in Table 1. Of the 680 patients registered, a motor deficit was recorded at onset in 597 (88%). The motor deficit rate declined from 190 per 100,000 population aged 15 years and older at onset to 106 and 75 per 100,000 at 1 and 6 months, respectively.

The proportion of survivors with a motor deficit at 1 week and at 1 and 6 months after the onset of the stroke is shown in Table 2. The proportions were similar in the categories mild, moderate, and severe motor deficit at 1 week; no significant differences were found between the sexes except in the group aged 75 years and older, in which women were significantly more likely than men to have a severe deficit (p<0.01). The proportion of survivors with a persisting deficit declined significantly between 1 week and 1 month for both men and women; a further significant improvement between 1 and 6 months occurred for women but not for men. By 6 months, three quarters of the survivors were categorized as having either no or only a mild motor deficit.

We examined the outcome of patients according to stroke severity to investigate whether the decline in the proportion with motor deficit at 6 months after the onset of the stroke was due to a differential recovery of motor function or to a differential case-fatality rate. Table 3 indicates that one third (34%) of those with a mild stroke recovered their motor function by 1 month compared with 13% and 5% of those with moderate and severe strokes, respectively (p<0.001). Differences in recovery rate are even more dramatic by 6 months; almost half (46%) of all survivors with a mild stroke had apparently fully recovered their motor function by 6 months compared with only 22% and 7% of survivors with moderate and severe strokes, respectively.

To avoid the possibility of confounding, both age and stroke severity were controlled when calculating the percentage of survivors who recovered. As no significant differences were observed between the sexes, men and women were combined. Small numbers precluded stratification by age into more than two groups (<75 and ≥75 years). Recovery was associated with stroke severity (p<0.001) but not with age.

A person with a mild stroke was more than 10 times as likely (OR=10.8, 95% CI 8.5–13.7) to recover motor function than a person with a severe stroke, after controlling for age. The likelihood of dying by 6 months was almost four times as great (OR=3.8, 95% CI 2.6–5.5) for people with a severe stroke as for those with a mild stroke.

Left- and right-sided hemiparesis was equally represented in all age and sex groups and deficit categories except that more young men had right-sided than left-sided weakness (p<0.01).
**Discussion**

We found that 88% of all people in a large community-based stroke register who suffered a stroke presented with a motor deficit. The rate of early spontaneous recovery of motor function was substantial among the Auckland population. Most of the overall improvement occurred within the first month, although improvement continued among women for up to 6 months.

The measures we used have been used elsewhere to describe the pattern of severity of motor deficits following a stroke. Such measures would not be specific enough to register small changes in individuals resulting from a treatment program, but they are sufficient to monitor broad changes over time in large groups of patients. Most scores for assessing clinical deficit are based on hospitalized patients who have survived the acute phase and are not necessarily generally applicable. Restricting the points on the scales used for assessing the degree of deficit minimizes the effects of interobserver variation and minimizes the short-term variations in performance and disability levels within individual patients.

If health planning is to be effective, information about the rate of recovery after stroke is essential; this information is also important for designing studies that attempt to evaluate the effect of therapy. The proportion of survivors with a significant disability following a stroke varies from study to study depending on the patients included, the length of follow-up, and the definitions of disability. As has been demonstrated, the recovery rate in our study was related to the motor deficit at the onset of the stroke and not to age or sex. Recovery also appears to contribute more than death to the change in the proportion of those with a persisting motor deficit at 6 months. Our findings have implications for determining the most appropriate place of care for those requiring long-term care; for example, in the Auckland study patients with a severe motor deficit that persisted 6 months were largely cared for in private hospitals.

While our study focuses on motor deficits that may be more readily and accurately measured, they should be seen in the context of other, more subtle changes (such as hemianopia, sensory loss, and perception, cognitive, and mood disorders) and thus should be regarded as only partial indicators of the true impact of stroke. It is possible that apparent recovery of motor deficit is too crude a measure of outcome since it might be more difficult to move from a severe to a mild deficit category than to move from a mild deficit category to one of no deficit at all. However, the method we used to categorize neuromuscular deficit together with knowledge about the likelihood of recovery that our study supplies should assist in making more accurate prognoses for recovery at 6 months given the initial severity of the stroke; maximum functional recovery is likely to have been achieved within 3 months and certainly within 6 months. It is the patients who survive 6 months who will determine the need for ongoing support and care.

Our results from a community-based survey of stroke suggest a less gloomy outcome for survivors of stroke, as defined by severity of motor deficit, than is generally provided by studies of only hospitalized patients. Our information on the pattern of recovery of motor function after stroke provides a guide for predicting the outcome of individual patients as well as providing information for health planners to determine the resources required to care for survivors of stroke.

**Acknowledgments**

M.A. Ford contributed to the statistical analysis; Drs. D.E. Richmond and J.J. Baskett provided critical comments on this paper.

**References**


**KEY WORDS**  • cerebrovascular disorders  • hemiplegia  • motor skills
Recovery of motor function after stroke.
R Bonita and R Beaglehole

_Stroke_. 1988;19:1497-1500
doi: 10.1161/01.STR.19.12.1497

_Stroke_ is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 1988 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/19/12/1497

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in _Stroke_ can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to _Stroke_ is online at:
http://stroke.ahajournals.org/subscriptions/