Morbidity and Mortality Associated With Stroke

Robert J. Pokorski, MD, FACP
Vice President, Medical Research
Swiss Re America

Extrapolation from the Auckland Stroke Study suggests that in a population of 1 million people, 1250 will experience a first-ever stroke each year, and an additional 350 people will have a recurrent stroke. Of these 1600 people, only 880 will survive 6 months. 640 will be living in a private residence and the remaining 240, mostly heavily dependent elderly patients, will be in long-term care institutions. About one-third of the 640 individuals will have residual difficulties caring for themselves. The remaining two-thirds will be living independently at home and will have regained their pre-stroke functional status. These are the people most likely to apply for insurance.

This paper will analyze data pertinent to this latter group. Sources quoted in this review were chosen because they provided long-term morbidity and mortality statistics for patients who survived the first 6 months or 1 year after a stroke and who were not significantly disabled.

DEFINITIONS

The World Health Organization definition of stroke is "rapidly developing clinical signs of focal or global disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than of vascular origin." This definition excludes transient ischemic attack (TIA), subdural hematoma, and hemorrhage or infarction caused by infection or tumor.

Strokes are categorized as either ischemic or hemorrhagic. Approximately 90% of strokes are ischemic. This group is further divided into two broad categories: thrombotic (41%) and embolic (59%). Most thrombotic strokes are due to atherosclerosis of intracranial and extracranial arteries. Less common causes include venous thrombosis (especially in young people and in women), arteritis, arterial dissections, and hematologic disorders. The emboli responsible for embolic strokes usually originate from the carotid or vertebral arteries, or the heart. Cardiac causes of emboli include prior myocardial infarction, arrhythmia (particularly atrial fibrillation), acquired and congenital valvular heart disease, prosthetic heart valve, congestive heart failure, and bacterial endocarditis. Some classifications of ischemic stroke have a third category: vasoconstriction. Stroke due to migraine is the most important disorder in this group. As a general rule, mortality following recovery from an ischemic stroke remains significantly elevated compared to general population mortality because of greater susceptibility to myocardial infarction and other cardiovascular diseases, as well as the risk of recurrent stroke.

Primary intracerebral hemorrhage (ICH) accounts for the remaining 10% of strokes, and a relatively higher percentage of strokes in China and Japan. In this disorder, there is bleeding directly into the brain tissue due to rupture of an intracerebral blood vessel. Causes include hypertension, cerebral amyloid angiopathy in the elderly (weakening of blood vessel walls due to amyloid deposition), anticoagulant treatment, hematologic disorders, and cocaine or amphetamine use. There is a high initial mortality following ICH and survivors are often severely disabled. As with ischemic stroke, excess mortality persists following recovery.

EPIDEMIOLOGY

In most industrialized populations, stroke is the third leading cause of death and an important cause of hospital admission and long-term disability. Stroke morbidity is a particular concern in Japan, Taiwan,
and other Asian countries where the incidence of stroke exceeds that of coronary heart disease (CHD).

Strokes are most common at the older ages; incidence rates rise from about 3 per 10,000 population in the third and fourth decades to almost 300 in the eighth and ninth decades. Epidemiologists predict an increase in the absolute number of strokes in countries where the age of the population is increasing.

Gender comparisons reveal that almost 1 in 4 men and nearly 1 in 5 women aged 45 years will have a stroke if they live to age 85. Stroke is the cause of death in 8% of men and 16% of women. Gender differences in morbidity and mortality reflect the fact that strokes are less common in women but more often fatal because they occur at older ages.

Age-standardized stroke mortality rates in people aged 40 to 69 years vary ten-fold from countries with high rates (24.0 and 14.4 per 10,000 population in men and women, respectively, in Bulgaria) to those with low rates (2.9 and 1.8 in Switzerland). Death rates from stroke have fallen dramatically in recent decades in most industrialized countries. Japan has experienced the most precipitous fall. Stroke ranked first among all causes of death for three decades after 1951. It dropped to second behind cancer in 1981 and third behind heart disease deaths in 1985. In contrast, stroke death rates have increased over the past two decades in some eastern European countries, e.g., Bulgaria, Hungary, and Czechoslovakia (now the Czech Republic and Slovakia). Trends in stroke mortality are probably due to changing risk factor levels over time.

Long-Term Survival Following A First-Ever Stroke

Most reports of long-term post-stroke survival represent hospital-based cohorts that included sicker patients with severe or recurrent strokes, or those with other serious illnesses. For this reason, these studies do not reflect survival patterns of an average patient. Better estimates are obtained from community-based studies.

The Oxfordshire Community Stroke Project (United Kingdom) prospectively followed 675 unselected first-ever stroke patients to determine their long-term prognosis. Mean age was 72 years; 47% were male. Subjects were followed for a minimum of 2 years and up to 6.5 years. Strokes were categorized as cerebral infarction (81%), primary intracerebral hemorrhage (10%), subarachnoid hemorrhage (5%), and unknown (approximately 5%. The total exceeds 100% due to rounding.). Mortality comparisons were based on age- and sex-specific mortality rates for Oxfordshire.

There was a nonsignificant trend for women to have a worse prognosis than men, but this disappeared after correcting for difference in age. Among patients who survived the first year, the highest relative mortality rate was in subjects aged 54 years or younger (based on very few deaths). Patients who survived at least 30 days had approximately a three-fold greater risk of dying in the next year compared to the general population. Over the entire period of follow-up, patients surviving for 30 days had a relative mortality risk of 2.3.

For those who survived 30 days, the long-term risk of death was similar for cerebral infarction and primary intracerebral hemorrhage. Among participants who survived the first year and died during follow-up, the causes of death were listed as first stroke (8%), recurrent stroke (16%), nonstroke cardiovascular (40%), nonvascular (35%), and unknown (1%). Thus, most late deaths were cardiac, a pattern generally observed in other studies.

Long-term (5 years or longer) survival data from other community-based cohorts have been published by investigators in Japan, Russia, and medical centers in the United States. Each study found excess mortality even after eliminating deaths during the first 30 days following the stroke.

Stroke Recurrence

Patients who have had a stroke continue to be at risk for subsequent strokes at the rate of 5% to 9% per year, with approximately 25% to 45% of patients having another stroke within 5 years of the original event. If the first stroke was associated with atherosclerotic stenosis of the proximal internal carotid artery, the stroke risk correlates with percent stenosis; for every 10% increase in stenosis beyond 70%, the risk of stroke increases. Recurrent strokes are often fatal. A study from Stockholm, Sweden observed a mortality rate of approximately 50% in people with recurrent strokes, a rate more than twice as high as for initial strokes.

The Oxfordshire Community Stroke Project reported the likelihood of recurrent stroke. Of the 675 patients with a first-ever stroke, 180 recurrent strokes occurred during follow-up (135 first recurrences, 39 second recurrences, 5 third recurrences, and 1 fourth recurrence). There was no significant differ-
ence in the risk of recurrence between men and women, and no clear increase in risk with older age. Among the subjects with a first recurrence, 24% recovered within 1 week, 39% experienced a severe stroke, and 17% died within 30 days. The risks of a first recurrent stroke are listed in Table 1. These data are in general agreement with those from other population-based studies that found a higher recurrence rate in the first year post-stroke and an annual stroke risk of between 4% and 6%.

The risk of first recurrence remained significantly higher than the risk of a first stroke in the general population for every year except the fifth. There was a trend for the absolute risk of first recurrence to decrease with time. The likelihood of recurrence was similar for cerebral infarction and primary intracerebral hemorrhage.

Risk factors for stroke recurrence have not been clearly identified. It is thought that many of the same variables associated with first-ever stroke — smoking, hypertension, cardiac disease, diabetes mellitus, and heavy alcohol consumption — may also predict stroke recurrence. The presence of multiple risk factors may be more important than any single risk factor. In the Oxfordshire Community Stroke Project, only current smoking (at the time of the recurrence) was associated with an increased likelihood of recurrent stroke.

**Experience In A Young Population**

Approximately 3% to 4% of all ischemic strokes occur in people between 15 and 45 years of age. This small percentage belies the importance of this group since these are the individuals who are most likely to apply for insurance after a stroke.

There have been 13 studies of the prognosis of stroke in young adults; annual death and recurrence rates varied dramatically due to methodological differences. One of the best series was the Iowa Registry of Stroke in Young Adults. Investigators followed 296 patients aged 15 to 45 years who had an ischemic stroke between 1977 and 1992. Most were of European ancestry. Strokes were categorized as large vessel carotid atherosclerosis, embolic, small vessel carotid disease, hemolytic, other, and unknown.

During the mean follow-up of 6.0 years, average annual mortality from vascular death (fatal stroke or death from cardiac disease, including sudden death) was 1.7%. Mortality was significantly higher among patients whose stroke was due to large vessel atherosclerosis and significantly lower in patients with stroke of unknown cause. No patients aged 25 years or younger at the time of the stroke died during follow-up compared to 18% of patients age 26 to 46 years of age. Of subjects who survived the initial stroke, 16% later experienced vascular death, recurrent stroke, or nonfatal myocardial infarction (mean of 2.6% per year). Those whose initial stroke was due to large vessel atherosclerosis were at greater risk for one of these outcomes. In addition, annually, another 3.1% of patients received medical treatment for heart disease or needed major vascular surgery. Overall, on a yearly basis, one of every 17 young adults who survived their initial stroke had another serious vascular event.

Quality of life was often affected even though most patients were not disabled. Approximately 50% of patients complained about residual problems with their physical or social functioning, current and prior depression were common, and only 42% of patients had a job. This finding concurs with experience from Italy, where 80% of young stroke patients had no or minimal neurologic residuals but only 43% returned to work. In summary, this series indicated that ischemic stroke in young adults is not a benign impairment. Only 49% of patients had minimal or no disability and were free of recurrent vascular events.

Another study reported the experience of 172 Portuguese patients aged 45 years or younger (mean follow-up 43.1 months) who experienced first-ever strokes. One group had a particularly favorable prognosis, namely, young subjects who had either a stroke or a TIA and no cause could be found. The reason for the good prognosis was probably related to the fact that a detailed medical evaluation failed to detect evidence of serious cardiac, vascular, or systemic disease. An important point worth emphasizing is that the workup required to identify the favorable cases was generally "state of the art," i.e., it included computed tomography (CT) or magnetic resonance imaging (MRI) to visualize the nature and extent of cerebral ischemia; sonography and/or 4-vessel angiography to investigate extracranial and intracranial disease; transthoracic or transesophageal echocardiography to rule out a cardiac source of emboli; and laboratory tests to identify rare causes of stroke. In spite of favorable survival in many subjects, there was a disproportionately high retirement rate in the presence of little or no functional disability. The authors suggested that this phenomenon may have been related to medico-legal considerations or misinformation concerning prognosis and recurrence rate as understood by the attending physician.

A report from Minneapolis, Minnesota discussed survival in 61 young adults who experienced a stroke...
between 1970 and 1975.\textsuperscript{21} Thirty-eight men (mean age 43.7 years) and 23 women (mean age 31.7 years) were followed for 2.4 to 3.0 years. Prognosis was poor in subjects with comorbid atherosclerotic vascular disease (e.g., CHD, myocardial infarction, arteriosclerosis obliterans, cerebrovascular atherosclerosis). This group was comprised primarily of men in their mid-40s (the youngest patient was 36-years-old) with a high frequency of atherosclerotic risk factors. Outcome was favorable in women if the stroke was due to hormonal contraceptives and no other cause could be determined. The mean age of this group was 23 years, with a range of 16 to 33 years. (Although stroke due to birth control pills is becoming less common with current formulations of hormonal contraceptives, these medications are still associated with a substantial increase in the risk of stroke.\textsuperscript{22}) One of the most pertinent observations was that 9 patients initially classified as "stroke of unknown etiology" were later reassigned to the atherosclerotic group. These individuals were predominantly men in their early- to mid-40s with a high incidence of atherosclerotic risk factors. The authors suggested that cardiac angiography might have classified the patients correctly if it had been performed. This caveat serves as a reminder that favorable morbidity and mortality cannot be assumed in high risk individuals without a thorough medical evaluation.

Mortality Associated With Functional Impairment

Stroke often causes temporary and/or permanent disability. Population-based studies indicate that recovery following stroke is fastest in the first few weeks and slower for the next 3 to 6 months. Thereafter, further improvement is noted in only a small percentage of patients between 6 to 12 months, and in a very limited number between 1 and 2 years following the stroke. The ability to recover may be related to age. A community-based series from Akita Prefecture, Japan found that subjects aged 65 or older at the time of stroke were less likely to demonstrate functional improvement than were younger patients.

The best early unfavorable prognostic factor for functional recovery is the presence of urinary incontinence shortly after stroke; this identifies patients who are likely to die or need long-term care. Other early indicators of an unfavorable outcome include impairment of swallowing, loss of consciousness, severe motor loss, and any combination of motor and cognitive deficits. A few specific intermediate-term prognostic variables have been identified. Absence of any active hand grip at 3 weeks means that no useful function will return, and the inability to recognize non-speech sounds (e.g., the ringing of a telephone) soon after stroke is associated with severe long-term problems with communication.\textsuperscript{23}

The degree of functional impairment also predicts long-term survival. A hospital-based study from Worcester, Massachusetts followed 648 patients (mean age 67 years) who were alive 3 months after a stroke.\textsuperscript{24} The observation period averaged 14 years (range 9 to 19 years). Four functional classifications were used to grade the extent of neurologic deficit at the time of stroke and the completeness of immediate recovery:

- Classification 1- Complete recovery from a minor neurologic deficit such as difficulty speaking, cranial nerve involvement, or weakness or loss of sensation in one limb.
- Classification 2- Complete recovery from a major neurologic deficit, e.g., weakness or paralysis of one side of the body.
- Classification 3- Minimal residual disability.
- Classification 4- More extensive and severe residual disability.

The prognosis for patients in Classification 1 was good for the first 4 years post-stroke, deteriorated from years 4 thru 10, and was indistinguishable from the other groups by year 10. Outcomes in Classifications 2, 3, and 4 were less favorable and not significantly different from each other. Recurrent stroke and heart disease were the causes of death in 41% and 30%, respectively. Forty-two percent of deaths in Classification 1 were due to heart disease, perhaps because subjects with smaller strokes lived longer, only to die from other manifestations of diffuse atherosclerotic disease.

A community-based study in New Zealand reported 3-year follow-up of 635 people who had a stroke in Auckland during a 1-year period in 1981-1982.\textsuperscript{25} The cohort reflected a typical stroke population, i.e., only two-thirds of patients were hospitalized and more than half of the survivors were discharged within 3 weeks. For patients alive 1 week after the stroke, survival was strongly related to the degree of motor deficit regardless of the side (left or right) of the deficit. This finding agrees with data from the previously mentioned study in Russia, as well as with similar observations made by many other investigators.

Independent living after stroke in elderly people is determined by social factors as much as by severity of disability.\textsuperscript{26} In Framingham subjects who survived at least 30 days after a stroke (mean age 74 years), factors
related to institutionalization (nursing home or other chronic care facility) included extent of impairment, marital status, and education. For men, not being married was the one variable associated with institutionalization. In women, institutionalization was associated with age, extent of impairment, and level of education. The explanation given for the differing effects of marriage by gender was that older women were more willing and able to provide care for their spouses than were men. The likelihood of institutionalization after a stroke will undoubtedly vary in different countries depending on family attitudes and the types of chronic care facilities that are available.

One of the best scales for evaluating the degree of functional impairment following a stroke is the Rankin Disability Scale. Disability is divided into 5 grades:

Grade 1- No significant disability; able to carry out all usual duties of daily living.
Grade 2- Slight disability; unable to carry out some previous activities but able to look after own affairs without assistance.
Grade 3- Moderate disability; requiring some help but able to walk without assistance.
Grade 4- Moderately severe disability; unable to walk and to attend to own bodily needs without assistance.
Grade 5- Severe disability; bedridden, incontinent, and requiring constant nursing care and attention.

Comorbidity

Comorbid disorders are very common in patients who have had a stroke, and long-term survival is often determined by these impairments rather than by the stroke itself. A partial listing of frequently associated disorders includes CHD, myocardial infarction, left ventricular hypertrophy, carotid and vertebral artery stenosis, arteriosclerosis obliterans, congestive heart failure, valvular heart disease, cardiac arrhythmia, diabetes mellitus, and hypertension. In some cases these diagnoses are known prior to the stroke; at other times they are discovered at a later date.

The Framingham study reported poorer post-stroke survival in patients with comorbid CHD or congestive heart failure. This finding concurs with data from many other studies in which cardiac disease was the leading cause of death among patients who survived a stroke. South African investigators noted that stroke is usually a marker of generalized atherosclerosis. Since CHD (symptomatic or asymptomatic) tends to develop about 10 years before stroke, most people who survive their stroke die of CHD or other cardiac complications. Framingham investigators also found that hypertension prior to the stroke predicted long-term survival in men but not women; this observation was not confirmed by the Worcester study.

A community-based study in Rochester, Minnesota followed 1382 cases of first-ever stroke during the years 1960-1984. Variables that were significant independent predictors of death within 5 years included older age, prior myocardial infarction, atrial fibrillation present at the time of stroke, and congestive heart failure diagnosed at any time before the stroke. Recurrent stroke was associated with cardiac valve disease and a history of congestive heart failure.

At least 20% of patients with atrial fibrillation who experience a stroke will have another stroke within the next year. For longer periods of follow-up, there are conflicting opinions regarding the ability of atrial fibrillation to predict survival and stroke recurrence. The Oxfordshire Community Stroke Project analyzed the effect of chronic atrial fibrillation on subjects who survived 30 days after a first-ever stroke. After adjusting for age and size of infarction, atrial fibrillation remained a weak predictor of death from all causes during long-term follow-up. This finding is in agreement with data from the Rochester study and a hospital case series in Italy. In each of the latter two reports the relative risk of death was approximately 1.7 for subjects with prior stroke and current atrial fibrillation. Neither the Oxfordshire nor the Rochester studies found that atrial fibrillation was a significant independent predictor of recurrent stroke, a conclusion supported by other long-term studies that reported life table risks for recurrent stroke.

Seizures after stroke occur in 5% to 10% of patients. For prognostic purposes, a distinction is made between early and late seizures. Early seizures develop during the acute stages of the stroke, generally within the first 2 weeks, and are usually isolated events. Recurrent seizures are uncommon, although the long-term risk of epilepsy (chronic seizures) is higher than in the general population. Late seizures occur months to years after the stroke and are the result of structural changes in the brain caused by the stroke. The majority of these patients develop epilepsy.

Post-stroke dementia is a predictor of decreased long-term survival. Columbia-Presbyterian Medical Center (New York City) recruited 251 subjects aged 60 years or older to participate in a study of the prognostic importance of dementia detected 3 months after stroke. During the 5-year follow-up, dementia was found to have a significant adverse impact on life expectancy. This association was independent of age,
stroke severity, stroke subtype, and comorbid disorders such as cardiac disease and hypertension. Other authors have also reported that patients with dementia due to cerebrovascular disease have decreased survival relative to the general population.33

For gender, many of the differences in post-stroke survival rates that are reported in the literature can be explained by age. In general, women are significantly older at the time of stroke and post-stroke survival is correspondingly reduced. Long-term survival is generally superior in women compared to men for subjects who are the same age at the time of stroke.

**Treatment**

In patients with minor stroke or TIA due to atherosclerotic vascular disease, antiplatelet drugs such as aspirin and ticlopidine reduce the risk of recurrent stroke, but the benefit is modest.34 Neither dipyridamole nor sulfipyrazone alone or when added to aspirin have documented benefit in the prevention of stroke recurrence.35 The value of anticoagulant agents (e.g., warfarin) in patients who have had a minor stroke or TIA is uncertain.

The beneficial effect of carotid endarterectomy in patients with significant carotid stenosis and a prior TIA or minor stroke was evaluated in two very large international studies: the North American Symptomatic Carotid Endarterectomy Trial (NASCET)36 and the European Carotid Study Trial (ECST).37 Patients were divided into medically and surgically treated groups, each of which had a high prevalence of comorbid cardiovascular diseases and risk factors. At 30-month (NASCET) or 36-month (ECST) follow-up, the risk of stroke was much lower for patients with carotid stenosis of 70% or greater that had been treated with carotid endarterectomy. The stroke rate of 2% to 3% per year following successful carotid endarterectomy was still well above first-ever stroke rates in the general population. However, there was no significant difference in total mortality between medically and surgically treated patients. The likely explanation is that mortality in patients with symptomatic carotid stenosis is determined in large part by the presence and severity of associated impairments. Among patients in the control group (unoperated), stroke risk was highest for carotid stenosis of 70% or greater.

**Mortality Compared To The General Population**

The National Survey of Stroke (United States) compared mortality following stroke with general population mortality.38 Participants included 1846 subjects (1089 men and 757 women) chosen from stroke patients discharged from the hospital during the years 1971, 1973, 1975, and 1976. Hospitals were selected to provide a representative sample of the national population; all types of stroke were included. Mortality data are shown in Table 2.39 For patients alive 6 months after stroke, there is significant excess mortality during the next 4.5 years. Mortality ratios are generally higher at the younger ages. These results do not necessarily apply to all stroke cases since the study cohort consisted of patients who were hospitalized and later discharged. Not included were minor strokes not requiring hospitalization and massive strokes that were fatal before reaching the hospital.

In the Worcester study, life expectancy began to approximate that of the general population 6 years after stroke. The degree of excess mortality did not vary significantly by age, although the number of subjects at the younger ages was limited. Many participants had associated hypertension, CHD, congestive heart failure, or diabetes mellitus.

Other studies have observed that the excess mortality associated with stroke extends for only 2 years, and life expectancy thereafter is similar to that of an age- and sex-matched population. It should be emphasized that population mortality rates are much higher than insured lives mortality rates. This means the excess mortality due to stroke is higher and persists for a longer period of time than would be indicated by comparisons with the general population, especially for young and middle-aged applicants.

**Insured Lives Mortality Data**

In the Medical Impairment Study 1983, the mortality ratio for substandard males with a history of cerebrovascular accident (stroke or transient ischemic attack) was 134% (32 policy deaths).40 The mortality ratio for standard males was 179% (based on only 10 deaths). Mortality ratios for policyholders aged 40-49 years were somewhat higher than for those aged 50-59 years (again, based on a small number of deaths). There were insufficient data to report separately on females. When data on standard and substandard lives were
analyzed by cause of death, excess mortality was observed for heart/circulatory causes (163%) and cancer (129%). It is difficult to draw firm conclusions from this experience. It is likely that less favorable risks were considered uninsurable and hence not included in these data. Other risks may have been disproportionately favorable because this category included cases with subarachnoid hemorrhages where the brain aneurysm was surgically clipped.

The Life Insurance Association of Japan analyzed the mortality experience of applicants with a history of stroke whose application for insurance was declined. The date of death was confirmed by examining local death certificates. Mortality ratios were higher at the younger ages except for ages less than 30 years. The more favorable mortality in this youngest group may have been due to the absence of comorbid disorders and the occurrence of strokes that were either (1) less severe or unlikely to recur (migraine, trauma), or (2) amenable to surgical cure (subarachnoid hemorrhage). Mortality ratios were highest in the first 2 years following the insurance application and remained significantly elevated during the remaining 3 years of the study (5 years total). Excess mortality strongly correlated with increasing severity of systolic and diastolic hypertension. Causes of death (in decreasing order) were stroke, heart disease, and cancer. It is likely that heart disease has become a relatively more common cause of post-stroke death in the two decades since this study was performed. The reason is because ischemic stroke (which is strongly associated with comorbid cardiac disease) is now more common than primary intracerebral hemorrhage in Japan.

UNDERWRITING CONSIDERATIONS

Long-Term Survival

- Mortality risk is highest in the first year after stroke.
- Cardiac disease is usually the leading cause of death in patients who survive a stroke. Most deaths are due to myocardial infarction.
- Long-term survival is often determined by associated impairments rather than by the stroke itself. Prognosis is less favorable if there is a history of CHD, myocardial infarction, congestive heart failure, or current atrial fibrillation. Hypertension prior to stroke predicted long-term survival in some studies.
- Post-stroke dementia is associated with poorer long-term survival.
- When corrected for age, survival and recurrence rates are fairly similar for men and women.
- For patients who survive the first 30 days, long-term survival rates are similar for ischemic stroke and primary intracerebral hemorrhage.
- The underwriting evaluation should focus on known cardiovascular risk factors and/or impairments, the possibility of undetected cardiac disease, adequacy of the post-stroke medical evaluation, and the degree of functional and cognitive impairment.

Stroke Recurrence

- Recurrent strokes are more likely to be fatal or disabling than first-ever strokes.
- Risk of recurrence is highest in the first year post-stroke.
- The risk of recurrent stroke remains well above first-ever stroke rates in the general population for at least 4 years.
- If the first stroke was associated with atherosclerotic stenosis of the proximal internal carotid artery, the stroke risk correlates with percent stenosis. For every 10% increase in stenosis beyond 70%, the risk of stroke increases.
- For patients who survive the first 30 days, stroke recurrence rates are similar for ischemic stroke and primary intracerebral hemorrhage.
- Some studies have found that hypertension, cardiac disease, diabetes mellitus, heavy alcohol consumption, and current smoking increase the likelihood of stroke recurrence.
- Young People (ages to 39 years)
- Ischemic stroke and primary intracerebral hemorrhage are very serious impairments in young people. There is a high incidence of recurrent stroke, vascular death, and cardiovascular morbidity.
- Mortality is significantly higher if the stroke was due to large vessel carotid atherosclerosis or if there is comorbid atherosclerotic vascular disease.
- Comorbid atherosclerotic vascular disease is more likely in the presence of atherosclerotic risk factors (e.g., smoking, elevated cholesterol, hypertension), especially in males.
- Mortality is significantly lower if a detailed medical evaluation fails to find a cause for the stroke. However, there is still a disproportionately high retirement rate in these subjects despite little or no functional disability.
Outcome is often favorable in women less than 35 years of age if the stroke was due to hormonal contraceptives or migraine, and no other cause could be determined.

Work status cannot always be predicted by extent of recovery. Many patients do not return to work even though they have little or no residual neurologic deficit.

Stroke but the benefit is modest. The value of anticoagulants in patients who have had a minor stroke or TIA is uncertain.

Carotid endarterectomy in patients with significant carotid stenosis and a prior TIA or minor stroke reduces the risk of future stroke. However, long-term survival is not significantly improved. Death usually results from myocardial infarction.

Morbidity

Very little recovery occurs after the first 6 months post-stroke.

Long-term survival is related to degree of functional impairment. The most favorable prognosis is in those who recover completely following minor neurologic deficits (e.g., difficulty speaking, cranial nerve involvement, or weakness or loss of sensation in one limb). Prognosis deteriorates with increasing degrees of residual disability.

Independent living after stroke in elderly people is determined by social factors as much as by severity of disability.

Epilepsy is likely if seizures occur after the first 2 weeks post-stroke.

TREATMENT

Antiplatelet drugs reduce the risk of subsequent

Mortality Comparisons

Excess mortality persists for at least 5 years post-stroke.

In patients who survive a stroke (ischemic or primary intracerebral hemorrhage), excess mortality is higher in younger patients and with shorter durations since stroke.

Acknowledgments

The author wishes to thank the following individuals who reviewed this paper: Dr. R.K. Illango (Swiss Re America); Dr. Hiroshi Makino (Swiss Re Tokyo); Professor Michael Swash (Swiss Re UK); André Chuffart and Manfred Fessel (Swiss Re Zurich); and Erik Grossman (Swiss Re Southern Africa).

Table 1. Risk Of A First Recurrent Stroke Within Defined Time Intervals After The First Stroke

<table>
<thead>
<tr>
<th>Duration Since Stroke</th>
<th>Ages Under 65</th>
<th>Ages 65-74</th>
<th>Ages 75-84</th>
<th>Ages 85 and Older</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Risk</td>
<td>% Cumulative Risk</td>
<td>Number at Risk</td>
<td>% Risk</td>
</tr>
<tr>
<td>0-6 Months</td>
<td>8.6</td>
<td>13.2</td>
<td>675</td>
<td>8.6</td>
</tr>
<tr>
<td>6-12 Months</td>
<td>4.6</td>
<td>19.9</td>
<td>463</td>
<td>4.6</td>
</tr>
<tr>
<td>2 Years</td>
<td>6.7</td>
<td>24.9</td>
<td>420</td>
<td>6.7</td>
</tr>
<tr>
<td>3 years</td>
<td>5.0</td>
<td>28.2</td>
<td>339</td>
<td>5.0</td>
</tr>
<tr>
<td>4 Years</td>
<td>3.3</td>
<td>23.2</td>
<td>217</td>
<td>3.3</td>
</tr>
<tr>
<td>5 Years</td>
<td>1.3</td>
<td>167</td>
<td></td>
<td>1.3</td>
</tr>
</tbody>
</table>

Source: Burn et al.

Table 2. Mortality By Age At Onset And Duration Since Stroke For Persons Alive 6 Months After Stroke

<table>
<thead>
<tr>
<th>Duration Since Stroke</th>
<th>Ages Under 65</th>
<th>Ages 65-74</th>
<th>Ages 75-84</th>
<th>Ages 85 and Older</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mortality Ratio</td>
<td>Excess Deaths Per 1000/Yr</td>
<td>Mortality Ratio</td>
<td>Excess Deaths Per 1000/Yr</td>
</tr>
<tr>
<td>6 mos.-1 year</td>
<td>1.3</td>
<td>13.2</td>
<td>675</td>
<td>1.3</td>
</tr>
<tr>
<td>1-2 years</td>
<td>1.3</td>
<td>13.2</td>
<td>675</td>
<td>1.3</td>
</tr>
<tr>
<td>2-3</td>
<td>1.3</td>
<td>13.2</td>
<td>675</td>
<td>1.3</td>
</tr>
<tr>
<td>4-5</td>
<td>1.3</td>
<td>13.2</td>
<td>675</td>
<td>1.3</td>
</tr>
</tbody>
</table>


Mortality ratios (%) are based on comparison with United States 1974 population death rates.

* Data in this row are average annual mortality ratios and excess death rates for any 1-year period during this 4-year interval.

20
ADDENDUM:

Tests Used To Screen For Carotid Artery Stenosis

Patients with cerebrovascular diseases are often screened for carotid artery stenosis with one or more of the noninvasive tests listed below. A recent review concluded that the best tests for detecting severe carotid stenosis were carotid Doppler ultrasonography, carotid duplex ultrasonography, and magnetic resonance angiography. With Doppler studies false positive and false negative results sometimes occur even in experienced centers.

- Carotid Doppler ultrasonography assesses the velocity changes in blood flow associated with stenosis in the carotid arteries.
- Real-time B-mode ultrasonographic imaging allows for direct visualization of the carotid artery and calculation of the widths of obstructed and unobstructed arteries and of the lesions themselves, as well as the percentage of stenosis.
- Duplex ultrasonography combines the direct visualization capabilities of B-mode ultrasonography and the blood flow velocity measurements of Doppler ultrasonography.
- Magnetic resonance angiography directly assesses both carotid and intracranial arterial stenosis.
- Supraorbital Doppler ultrasonography indirectly assesses blood flow from collateral branches of the internal carotid artery through the supraorbital vessels. The test is done by placing a directional Doppler probe over a supraorbital artery and observing the flow with and without compression of neighboring arteries.
- Oculoplethysmography indirectly evaluates the patency of the internal carotid artery by graphically recording ocular pulses obtained from corneal cups held in place by mild suction.

References

2. Another common cerebrovascular disease is subarachnoid hemorrhage due to rupture of an intracranial aneurysm or bleeding from an arteriovenous malformation. Subarachnoid hemorrhage will not be discussed in this paper because it has a number of unique characteristics (e.g., onset at younger ages, more favor-


37 European Carotid Surgery Trialists' Collaborative Group. MRC European Carotid surgery trial: interim results for symptomatic patients with severe (70-99%) or with mild (0-29%) carotid stenosis. Lancet 1991;337:1235-43.


