STROKE OCCURRENCE

SYMPTOMS OF STROKE

The symptoms of stroke depend on what part of the brain is affected and how large an area is involved. A stroke is a sudden event accompanied by one or more of the following signs:

- Numbness or weakness, especially on one side of the body
- Loss of consciousness or altered consciousness
- Decreased vision in one or both eyes
- Language difficulties, either in speaking or understanding
- Difficulty walking; loss of balance or coordination
- Confusion or loss of memory
- Swallowing difficulties
- Paralysis of any body area, including face
- Sudden, severe headache with no known cause
- Neck pain
- Nausea and vomiting

Time is critical in the treatment of stroke; it is therefore important that individuals recognize its symptoms. A large population-based telephone survey conducted in Cincinnati in 1995, however, found large gaps in the public's knowledge about stroke (10). When asked to list the most common stroke warning signs, only 57% correctly listed at least one sign; of these 28% correctly listed two or more signs, and only 8% listed three or more signs. Sixty percent (60%) of respondents younger than 75 correctly listed at least one sign, compared with only 47% of older respondents.

STROKE TESTS

When a patient presents at the emergency room with a suspected stroke, there are several tests available to the doctor to determine the type, location, and severity of the event. Testing depends on the doctor's assessment of the patient and is done on a case-by-case basis. Available tests include:

- Head CT or head MRI – Used to determine if a stroke has occurred and, if so, what type, i.e., ischemic or hemorrhagic. Can define the location and extent of the stroke and determine if there have been previous strokes.

- Angiography – Radiographic imaging with dye injected directly into an artery. Can show narrowing of the vessel and detect the location and size of aneurysms and vascular malformations.

- Doppler ultrasound/carotid duplex imaging – Use of high-frequency sound waves to detect blockages in the carotid arteries.

- ECG (electrocardiogram) or echocardiogram – may be used to diagnose underlying heart disease or if a cardiac embolus is suspected.

STROKE TREATMENT

Ischemic Stroke

A person coming to the hospital with stroke symptoms will normally be given a CT scan to determine is he or she has had an ischemic or hemorrhagic stroke. If an ischemic stroke is detected, the standard treatment is the intravenous (IV) administration of a clot-busting (thrombolytic) medication such as t-PA (tissue plasminogen activator). T-PA, however, must be administered within three hours of a stroke onset, necessitating that the patient go to the hospital at the first signs of a stroke event. Data from the National Institute of Neurological Disorders and Stroke (NINDS) indicate that patients treated with t-PA within the three-hour window were at least 33% more likely than untreated patients to recover with little or no disability (11). The NINDS study showed that the average length of stay was shorter (10.9 days) for t-PA treated patients than for nontreated patients (12.4 days); t-PA treated patients were also more likely than others to return home following discharge rather than to a rehabilitation center or nursing home (12). It is estimated, however, that only about 2% of stroke sufferers, however, get to the hospital in time for t-PA therapy and qualify as candidates for t-PA (13).

The most serious risk associated with IV t-PA is bleeding. An estimated 25% of patients will experience some bleeding (14), mostly minor (such as gum or nose bleeding). The NINDS study found that 6.4% of patients suffered bleeding in the brain (15). Other published studies have found both lower percentages and higher percentages of bleeding in the brain, for example, 3.3% in the FDA-mandated Standard Treatment with Alteplase [t-PA] to Reverse Stroke (STARS) Study and 15.7% in a 1997-98 study of two major Cleveland hospitals (15). Because of the risk of bleeding, not all patients can receive t-PA; some of the contraindications include history of intracranial bleeding, major surgery within the past 14 days, serious head trauma, dental extractions within seven days, and pregnancy. Other thrombolytic agents are currently under investigation that might have fewer contraindications than t-PA.

Intra-arterial (IA) administration of t-PA involves the delivery of the drug directly into the clot or the region surrounding the clot through the insertion of a catheter into the affected artery. Intra-arterial therapy has been shown in clinical trials to be more effective in treating intracranial blockages than IV treatment and lengthens the window for treatment to six hours (16); however, because of the specialized resources (i.e., equipment and physician expertise in stroke and neurointervention techniques) necessary to perform the procedure, it is limited in its availability. Until the procedure receives FDA approval, it is primarily confined to clinical trials and large stroke centers.

Research into mechanical clot retrieval is also ongoing; one such device, the MERCI retriever (mechanical embolus removal in cerebral ischemia) is undergoing testing for FDA approval (17). The device is inserted into a leg artery in a catheter tube and threaded up to the brain and the clot. Inside the tube is a wire that coils into a corkscrew shape when pushed out. The wire grips the clot; at the same time a tiny balloon is inflated to stop blood flow and avoid a second stroke should pieces break off the clot. The clot is then sucked into the tube and removed. Scientists see several benefits to mechanical clot retrieval, including avoiding the risk of drug-induced bleeding, extending the window of treatment to eight hours, and a faster treatment time.

Another area of treatment currently under investigation is the use of neuroprotective drugs. The initial damage during an ischemic stroke takes place in what is called the "ischemic core," where blood flow is 20% or less and cells face irreversible damage within minutes. Surrounding the core is an area of brain tissue called the "ischemic penumbra," where blood flow is between 20 to 50% of normal. These cells are endangered but not yet irreversibly damaged. Some neuroprotective drugs are designed to limit damage to cells in the penumbra, others to prevent potential damage associated with the return of blood flow after the thrombus has been dissolved following IV or IA clot-busting treatment. These drugs are currently in clinical trials to determine their safety and efficacy.

Current research on other stroke therapies ranges from the development of a stroke vaccine for at-risk individuals to minimize the extent of damage should a stroke occur (18) to a neural implant trial under way at the University of Pittsburgh's Medical College, where scientists are investigating the possibility of injecting laboratory-grown nerve cells into the stroke patient's brain in the hope the cells would multiply, allowing patients to regain lost functions (19). Additional projects include the NIH's Institute for Neurological Disease and Stroke "Neuroprotheses Project" examining the use of electronics as "neural bridges" (20).

Hemorrhagic Stroke

If a CT or MRI scan has detected bleeding in or around the brain itself, i.e., a hemorrhagic stroke, immediate treatment is also imperative. Both cerebral and subarachnoid hemorrhages can be more deadly than ischemic strokes. The causes of a hemorrhagic stroke include hypertension, a ruptured or leaking aneurysm, a leaking vascular malformation, or anticoagulation medication.

For patients with anticoagulation-induced bleeding, those medications are immediately stopped, and protamine, vitamin K, or fresh frozen plasma may be given to reduce bleeding. Ruptured aneurysms or arteriovenous malformations are generally treated surgically by the use of detachable microcoils or by microsurgical clipping. Microsurgical clipping is the more well-established and longer-used technique. It involves performing a craniotomy, locating the aneurysm and clipping the base to stop blood from entering the aneurysm. Microcoils use an endovascular technique, during which a catheter is threaded into the affected artery using a cerebral angiogram to guide its path. The catheter contains tiny platinum coils that are released into the aneurysm, inducing clotting to prevent further bleeding. The technique used depends upon the assessment of the patient's medical team.

STROKE EFFECTS

The effects of a stroke vary widely depending on the type of stroke, the part of the brain affected, and the severity or extent of the stroke. Stroke injury can affect vision, motor activity, sensory levels, speech, chewing and swallowing food, thinking, and emotions. **Paralysis** or weakness on one side of the body may occur. **Aphasia** is the impairment of language ability, i.e, to talk, comprehend, read, or write, and most commonly occurs when injury is on the left side of the brain. **Dysarthria** is a condition in which the muscles used in speech are affected, causing slurring or slowed speech**. Dysphagia**, or difficulty in swallowing, occurs in about 45% of victims of acute stroke (21). **Memory loss** can affect both short- and long-term memories, making even simple daily activities confusing and frustrating to carry out. **Emotional lability** refers to the sudden and extreme mood swings that can follow a stroke. **Depression** is common among stroke victims; in fact, depression was found by Ramasubbu et al. to be the only treatable condition independently associated with limitations in physical functioning (22). It has also been shown to increase the risk of death from stroke (22), underlying the need to effectively treat depression soon after stroke to optimize rehabilitation potential. A Danish study of 1,197 stroke patients published in *Neurology Reviews* in 2003 reported that one-third of those patients developed **dementia** within three months of their stroke (23). Researchers found that older age, hypertension, and recurrent stroke to be the most significant risk factors for predicting dementia after stroke.

There are several scales that are used to quantify the degree of disability caused by a stroke, including the Modified Rankin Scale, the Barthel Activities of Daily Living Scale, the NIH Stroke Scale, and the Hunt and Hess Classification of Subarachnoid Hemorrhage, to name only a few. These scales are used to evaluate the patient following an acute stroke. The measurement of neurological dysfunction permitted by these assessment tools is useful in predicting stroke outcome, that is, the degree of recovery that can be expected, and determine interventions and treatment.

Stroke recovery is seldom complete; researchers estimate that approximately 40% of patients who are able to return home need some help in everyday living (24). Most survivors of a first ischemic stroke who receive rehabilitation services return home (84%) but few are able to return to work (25, 26). Kelly-Hayes et al. used Framingham Heart Study data to assess disability in ischemic stroke survivors at six months following their strokes (27). Results showed that 43% of all elderly (aged 65 and older) survivors had moderate to severe neurological deficits, with women more disabled than men. When the researchers controlled for age and stroke subtype, however, they found that it was older age that accounted for the severity of the disability, and women are more likely to be older when they suffer a stroke. The Framingham data showed that, at six months post-stroke, 50% of survivors had some one-sided paralysis, 26% were dependent in activities of daily living, 30% were unable to walk unassisted, 35% were depressed, 19% had aphasia, and 26% were in a nursing home.

STROKE REHABILITATION

The majority of gains in a stroke sufferer's ability to function that occur within the first 30 days following the stroke are due to spontaneous recovery (28). Additional gains are often achieved, however, through rehabilitation. Successful rehabilitation depends on several factors including the extent of injury to the brain, the survivor's attitude, the skill of the rehabilitation team, and the support of family and friends.

The goal of rehabilitation is to allow the stroke survivor to be as independent as possible, overcoming or mitigating disability due to stroke damage. **Physical therapy** is usually an important component of rehabilitation. Relearning daily activities such as eating, dressing, and bathing, is often accomplished through **occupational therapy**. **Speech therapy** can help patients with aphasia to overcome problems understanding or forming speech.