Stroke

Stroke, an infarct in the brain, is the fifth-leading cause of death in the United States.[1] An estimated 87% of strokes are ischemic in origin and result from occlusion of a cerebral artery by an embolus or thrombus.[2] Hemorrhagic strokes are either intracerebral or subarachnoid and occur when blood from a ruptured vessel damages brain tissue. Venous strokes, due to thrombosis of the venous dural sinuses, are less common but may be associated with hypercoagulability, dehydration, and the use of estrogen.

A transient ischemic attack (TIA) produces similar signs and symptoms but is, by definition, transient. It often resolves completely within 30-60 minutes, although symptoms may last several hours or longer. In contrast to a stroke, a TIA will have no evidence of infarction on brain imaging.[3] Occurrence of a TIA indicates a need for thorough neurologic and cardiovascular evaluation of stroke risk.

Symptoms of stroke include the following sudden changes:

- Numbness (paresthesia) or weakness (paresis) of the face, arm, or leg, usually on one side of the body.
- Confusion, difficulty speaking (dysarthria or aphasia) or understanding.
- Visual disturbances, which may include partial or complete vision loss.
- Dizziness and/or ataxia.
- Severe headache with no known cause—particularly with hemorrhagic strokes.

Risk Factors

Compared with whites, blacks and Native Americans have higher a prevalence of stroke, and blacks, Asians, Native Americans, and Latinos have higher stroke mortality.[4] It is unclear whether these differences are due to environmental (e.g., differential access to medical care) or genetic causes. Other risk factors include:

Age. The risk of stroke doubles every 10 years beyond age 55.[5] ,[6]

Gender. Women have a slightly higher incidence of stroke, compared with men, and case-fatality rates due to stroke are also higher in women.[7]

Hypertension. As the most important modifiable risk factor, especially for hemorrhagic stroke, both systolic hypertension and diastolic hypertension are associated with an increased risk. (For more information, see Hypertension chapter.)

Smoking. Cigarette smoking increases risk for ischemic stroke, intracerebral hemorrhage, and subarachnoid hemorrhage.

Overweight. Excess body weight is associated with increased ischemic stroke risk.[8]

Diabetes.

Dyslipidemia.

Sedentary lifestyle. Higher levels of occupational or leisure-time physical activity protect against stroke.[9] A study of women undergoing coronary angiography found that those with higher activity levels were at significantly lower risk for cardiovascular events, including stroke.[10]

Poor nutrition. High-fat, high-sodium diets and a lack of key nutrients such as folic acid have been associated with increased risk for stroke (see Nutritional Considerations below).

Carotid stenosis. Both symptomatic and asymptomatic stenoses of the internal carotid arteries are associated with

increased risk for ischemic stroke.[11]

Atrial fibrillation. In the Framingham Study, patients with atrial fibrillation had 5-fold greater risk of stroke than did their healthy counterparts.[12] Further, the attributable risk of stroke due to atrial fibrillation increased with age from 1.5% for persons aged 50-59 years, to 23.5% for those aged 80-89 years.[8]

Sickle cell anemia.

Migraine. Studies have found that migraines with aura were strongly associated with risk of stroke and TIA.[13] Hemiplegic and basilar migraines are also risk factors.

Alcohol abuse.

Drug abuse. Use of cocaine and amphetamines may result in ischemic or hemorrhagic strokes.

Hormone replacement therapy. Combined and unopposed estrogen therapies raise stroke risk. Low-dose oral contraceptives slightly increase the otherwise low risk in otherwise healthy young women.[14]

Heart disease, vasculitis, elevated homocysteine levels, anticoagulant use, and bleeding disorders also raise the risk of stroke. Stroke risk is elevated during pregnancy and the postpartum period.

Diagnosis

Evaluation should include a detailed history of symptom onset, a thorough physical (including neurologic) examination, and imaging tests to determine whether the stroke is hemorrhagic or ischemic. It is helpful to use a validated scoring system such as the National Institutes of Health Stroke Scale. Evaluation of the cardiac rhythm is also essential. Paroxysmal atrial fibrillation may easily be missed if the patient is not closely monitored. Patients should be admitted to dedicated acute care “stroke units” if available in the admitting facility. These units typically provide closer monitoring with neurological and cardiac telemetry monitoring.

Laboratory tests normally include a complete blood count (CBC), blood glucose, erythrocyte sedimentation rate (elevated in temporal arteritis or other vasculitides), lipoprotein and triglyceride levels, and coagulation tests. Young patients and those without cardiovascular risk factors need to be screened for abnormal antiphospholipid antibodies (specifically, lupus anticoagulant).

A noncontrast CT scan of the brain helps determine whether a stroke is hemorrhagic or ischemic and is the initial study of choice. However, areas of infarct due to ischemia are often not acutely visible. Lumbar puncture may help diagnose small subarachnoid hemorrhages, if computed tomography (CT) scan or magnetic resonance imaging (MRI) is negative. CT is necessary before considering thrombolysis, which must be performed within 3-4.5 hours of the earliest symptom onset. Newer intravascular techniques may extend this window, but currently they are available only in tertiary care settings.

When a subarachnoid hemorrhage is visualized on CT scan, an aneurysm needs to be ruled out. Aneurysms and other vascular malformations can often be identified by CT scan or by MRI, but cerebral angiogram (conventional or CT angiogram) is the preferred method, particularly for identification of aneurysms. MRI (diffusion- and perfusion-weighted images) is best for detecting ischemic strokes and can show damaged areas that are at risk even at the earliest stages of stroke.

Carotid duplex ultrasonagraphy, arteriography, or magnetic resonance angiography (MRA) of the carotid system may determine if stroke has occurred as a result of carotid occlusion. MRA is generally more accurate than carotid duplex studies.

Treatment

Daily aspirin prophylaxis is generally recommended in patients at risk for stroke. The benefits of prophylaxis must be weighed against the increased risk for gastrointestinal bleeding.

Basic life supportive stabilization and treatment are important in suspected stroke. Fever could be an indication of infection and should be investigated. Blood sugar should be regulated. Permissive hypertension should be supported in the acute phase of the stroke to maintain cerebral perfusion. Airway maintenance is vital and intubation is sometimes necessary. Patients should not be allowed to consume food until their swallowing ability can be validated.

Because the intensity of stroke rehabilitation efforts is associated with the degree of recovery, many hospitals have specialized stroke-recovery units.[15] Speech therapy, physical therapy, and occupational therapy are important treatments during rehabilitation and should be instituted as early as possible. Regular monitoring and assessment are important to track progress and identify skill sets that may require additional rehabilitation resources.

Transient Ischemic Attack

Because the risk of recurrent strokes is high in patients who have suffered a transient ischemic attack (TIA) or stroke, it is essential to identify the cause and implement therapy to reduce risk.

- Antiplatelet therapy with aspirin or its alternatives (e.g., clopidogrel or aspirin plus dipyridamole) can reduce stroke risk.
- Anticoagulation is indicated if cardiac thrombi or atrial fibrillation is identified. Unless contraindicated, new anticoagulants are preferred over warfarin. Investigation for cardiac abnormalities (including right to left shunts) should be considered, particularly in young patients with stroke or TIA, or if there is a high index of suspicion for embolus.
- Patients at high risk for stroke may require carotid endarterectomy within 2 weeks of the TIA if stenosis is > 70% (and sometimes > 50%) on the symptomatic side. Treatment of stenosis in asymptomatic patients remains controversial; very high-grade stenoses may warrant intervention if surgical risks are low.
- If hypercoagulability is suspected (particularly in young individuals with few stroke risk factors), screening for hypercoagulability is appropriate.

Ischemic Stroke

Ischemic stroke may lead to rapid secondary (2-5 days) neurologic deterioration resulting from cerebral edema or hemorrhagic conversion of infarct, and patients may be at risk for brain herniation if the infarct is large enough. Close monitoring should occur in the intensive care unit using the Glasgow coma scale, regular CT imaging, and possibly intracranial pressure monitoring.

Thrombolytic agents (alteplase) dissolve artery-blocking clots in the brain during the critical early stages of stroke. They are of proven benefit only when administered intravenously within 3-4.5 hours of stroke onset. After this time, the risk of intracerebral hemorrhage outweighs benefit. There are multiple inclusion and exclusion criteria for administration, and adverse effects can include potentially serious intracranial bleeding. Patients will require very close monitoring in an intensive care unit after receiving thrombolysis. Endovascular thrombectomy may be performed at specialized stroke centers.

Antiplatelet agents (e.g., aspirin, aspirin-dipyridamole, clopidogrel) should be given after 24 hours of stroke if there is no contraindication.

Treatment with anticoagulation, such as low-molecular-weight heparin, warfarin, or newer anticoagulants, is generally reserved for strokes with ongoing thromboembolism. In addition, their use requires initial evaluation to exclude intracranial hemorrhage and baseline evaluation of the international normalized ratio (INR), partial thromboplastin time, platelet count, and other tests to assess coagulation status, if indicated.

There is growing recognition of the value of aggressive lipid lowering for stroke prevention in at-risk patients and for the management of acute ischemic strokes.[16] In most circumstances, patients should be considered for

interventions immediately after recognition of their high-risk status. Beginning treatment very early after a cerebrovascular event leads to better outcomes.

Neuroprotective agents have failed to show benefits, thus far, in clinical trials.

Hemorrhagic Stroke

Treatment of intracerebral hemorrhage depends on the extent of the hemorrhage, as well as its cause and location. Medical or surgical management may be indicated.

Subarachnoid hemorrhage due to an aneurysm or arteriovenous malformation requires urgent evaluation and may warrant surgery, depending on the patient's age, clinical status, and risk of rebleeding.

Nutritional Considerations

The role of dietary factors in stroke is apparent from the disorder's pathophysiology. Because ischemic strokes are caused by atherosclerosis, they are more common in the presence of high blood cholesterol concentrations, which, in turn, are strongly linked to dietary saturated fat and cholesterol and a low fiber intake, among other contributors to cardiovascular risk. Similarly, hypertension contributes to both ischemic and hemorrhagic stroke, so diets that are high in saturated fat or sodium or low in potassium would tend to increase risk. A diet high in potassium, low in sodium, and rich in vegetables, fruits, cereal fiber, and whole grains may be ideal for reducing stroke risk.[17]

In epidemiologic studies, the following factors are associated with reduced stroke risk:

A healthy dietary pattern. Healthy dietary patterns are defined by the relative absence of foods that are energy-dense, high in saturated fats (e.g., meat and full-fat dairy products), fried, processed, high in glycemic load, and by the presence of higher amounts of fruits, vegetables, soy foods and other legumes, nuts, unsaturated fats, and foods that are low in energy density and high in fiber, among other characteristics. Several systematic reviews and meta-analyses have examined the relationship between Western diets, healthy/prudent diets, Mediterranean diets, and stroke incidence. Although none of these have found significant associations with a Western dietary pattern, high compared with low adherence to either a Mediterranean pattern[18] or a healthy/prudent pattern[19] was associated with a 32% lower and 23% lower stroke risk, respectively.

Replacement of saturated fat and cholesterol with monounsaturated fat from olive oil. Individuals with higher blood cholesterol concentrations (who consume meat and other foods high in saturated fat and cholesterol) tend to have higher stroke risk.[20] ,[21] Accordingly, consuming roughly 3.5 ounces per day of red meat is associated with an 11% greater risk for stroke, while eating half that much unprocessed red meat is associated with a 13% greater risk, compared to the lowest levels of intake.[22] In women with diabetes sampled from the Nurses' Health Study, higher intakes of saturated fat and cholesterol—which raise blood cholesterol concentrations—were related to an increased risk for cardiovascular disease (CVD), including stroke.[23] It is currently unknown if lowering LDL cholesterol is effective for the prevention of stroke.[24] However, unsaturated fats have well-known hypocholesterolemic effects, and reviews that have compared high with low intakes of olive oil for the impact on stroke have concluded that the risk was reduced by between 17%[25] and 26%.[26]

Fish intake. Reviews have concluded that fish consumption and the intake of long chain omega 3 fatty acids is inversely associated with cerebrovascular disease risk[27] and that higher compared with lower intakes significantly reduce the risk for ischemic stroke risk in both men and women and total stroke risk in women.[28]

Diets rich in fruits, vegetables, and dietary fiber and low in refined carbohydrates. Higher intakes of fruits and vegetables are inversely associated with the risk for stroke. A dose-response relationship exists between these, so that for every 200 g per day increment in fruits consumption or vegetable intake, the risk for stroke decreased by 32% and 11% respectively. Although this meta-analysis attributed a great part of stroke protection to citrus fruits, apples/pears, and leafy vegetables,[29] another review found that higher compared with lower dietary intakes or

blood levels of levels of lycopene (a carotenoid found almost exclusively in tomato products) were associated with an almost 20% lower stroke risk.[30] In addition to carotenoids such as lycopene, these foods provide dietary fiber, vitamin C, vitamin E, folate, and flavonoids, all of which have been associated with reduced stroke risk in epidemiologic studies.[31] ,[32] ,[33] ,[34] ,[35] ,[36]

Dietary fiber intake is inversely associated with stroke risk, 31 although this effect is not attributable to the intake of whole grains.[37] ,[38]

Consuming less sodium and more potassium. Higher (compared with lower) sodium intakes are associated with an almost 25% greater risk for stroke.[39] Conversely, potassium intake is inversely associated with the risk for stroke.[40]

Maintenance of healthy body weigh t. The risk for stroke increases with the degree of overweight,[41] and a meta-analysis of studies including over two million individuals concluded that risk for stroke is 64% greater in obese individuals and 22% higher in overweight persons, compared to those who are at normal weight.[42] Evidence supports the ability of losing excess weight to reduce future stroke risk.[43]

Limiting alcohol consumption. Alcohol consumption may be more associated with ischemic than hemorrhagic stroke. Compared with no alcohol consumption, having 1-2 drinks per day was associate with a roughly 10% lower risk for ischemic stroke; however, consuming more than two and up to 4 drinks per day and more than 4 drinks per day was associated with an 8% and 14% greater risk, respectively. Having > 4 drinks/day was associated with a 67% and 82% greater for intracerebral hemorrhage and subarachnoid hemorrhage.[44] Alcohol also increases risk for other diseases, including certain (breast, esophageal) cancers.

Vitamin D status. Compared with individuals with the highest blood level of vitamin D, those with the lowest level have a 64% greater risk for stroke.[45]

Exercise caution with vitamin E and calcium supplements. Vitamin E supplements appear to reduce the risk for ischemic stroke by only 10%; however, they also appear to increase the risk for hemorrhagic stroke by 22%.[46] Calcium supplements appear to increase stroke risk by between 12% and 20%, an effect that is not reduced by coadministration with vitamin D.[47]

Choice of beverage. Compared with the lowest category of tea intake, consumption of three cups of tea each day was associated with an almost 20% lower stroke risk.[48] When comparing those who do not drink coffee, individuals consuming two or more cups of coffee per day have a 13% lower risk for stroke, an association that changes little with the additional consumption of up to another 4 cups (total 6 cups/day). Beyond this level of intake, the relationship becomes nonsignificant.[49]

After stroke occurs, adequate nutrition is an essential part of clinical care. Malnutrition is frequently observed after a stroke has occurred, and while roughly 20% of patients with acute stroke have been found malnourished on admission, other studies have shown that between 56% and 61% develop malnutrition at some point during hospital stays of > 3 weeks.[50] In the FOOD Trial Collaboration, poor nutritional status was associated with worse outcomes at 6 months post-stroke.[51]

Patients who have had a stroke should have an assessment of their swallowing ability before resuming eating or drinking. One study found that between 42% and 67% of stroke patients have dysphagia.[52] If they cannot take food and fluids orally, they should receive enteral feedings using a nasogastric, nasoduodenal, or PEG tube to maintain hydration and nutrition while undergoing efforts to restore swallowing.[53] Typically, adequate swallowing mechanics return within the first 2 weeks post-stroke. Nutritional supplements do not appear to be necessary or beneficial in these patients, unless required for an indication other than stroke. In undernourished stroke patients however, protein-calorie-micronutrient supplement combinations significantly improved motor function and allowed a significantly higher proportion of patients to return home, when compared with those not given supplements.[54]

Apart from dysphagia, reduced level of consciousness, poor oral hygiene, depression, reduced mobility, arm or facial weakness, and post-stroke depression can all influence food intake and nutritional status. However, the use of serum proteins (e.g., albumin) are not reliable indicators of nutritional status because it is unclear whether these decrease

due to malnutrition or inflammation.[50]

Although (as noted above) obesity is a risk factor for stroke, paradoxically, being overweight or obese is associated with significantly lower mortality 5 to 10 years after stroke than being either normal weight or overweight. This does not imply a health benefit of obesity so much as a higher morbidity that comes from the negative long-term effects of a stroke and their impact on appetite and food intake.[55]

Orders

Sodium intake less than 2 grams daily.

Physical/occupational therapy consultation for home safety evaluation.

Stroke rehabilitation, speech and swallowing therapy, as appropriate.

What to Tell the Family

Stroke occurs more frequently among those of advanced age and those who have blood vessel disease, family or previous history of stroke, and poor blood pressure control. However, persons who eat diets rich in fruits, vegetables, and fiber and low in saturated fat, cholesterol, and sodium decrease their risk for stroke, as do those who quit smoking, drink alcohol minimally, and engage in regular physical activity. It is important for the patient and family to follow a similar, healthful diet in order to decrease the risk of future stroke. In addition, family members should be aware of the warning signs of stroke and immediately call 911 if these signs occur. Timing of care is critical to treatment success.

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