2.
Stroke as a Clinical Problem

2. Stroke as a Clinical Problem

THE EXTENT OF THE PROBLEM

Stroke (completed cerebral infarction) is the third most common cause of death in the United States. In addition to its importance as a cause of mortality, stroke and associated disorders affecting the central nervous system account for a significant burden of illness treated by the medical care system. A major cause of stroke is carotid artery disease (a common manifestation of cerebrovascular disease), which is often diagnosed through digital subtraction angiography (DSA) examination.

Several studies have reported that the incidence of stroke has declined over the last several years in the United States *(40,41,79,95).* Future projections of the need for diagnostic or therapeutic technologies for treating stroke need to take these trends into account. However, the age-specific death rates from these conditions, taken as a whole, have continued to be significantly higher for persons beyond the age of 55 than for younger persons (see table 2-1). Likewise, the volume of diagnostic procedures used in the care of persons suspected of having cerebrovascular disease is higher among those older age groups.

Table 2-1.—Death Rates for Cerebrovascular Diseases by Age Groups, United States, 1980 (number of deaths per 100,000 resident population)

Total, **all ages,** adjusted	41.5
Total, all ages, crude	76.6
Under 1 year	3.8
1-14 years	0.3
15-24 years	1.2
25-34 years	2.7
35-44 years	8.6
45-54 years	26,1
55-64 years	67.8
65-74 years	222.4
75-84 years	834.7
85 years and older	2,094.0

SOURCE: U.S Department of Health and Human Services, National Center for Health Statistics, *Health, United States,* **1982,** table 19, p 67

Cerebrovascular disease in general has been estimated to have an annual incidence of 195 per 100,000 population per year (62). The Office of Graduate Medical Education of the U.S. Department of Health and Human Services (DHHS) convened a special panel of experts to consider the number of neurological care physicians needed to care for this volume of illness on an annual basis *(42).* This panel concluded that *967* hours of neurological specialty care would be required annually per 100,000 population. This level of medical specialty care would also be provided by types of health personnel other than neurologists—physiatrists (specialists in rehabilitation medicine), physical therapists, speech pathologists, occupational therapists, and others *(42).*

Cerebrovascular disease occupies a significant portion of the practice of primary care physicians as well. Although stroke is not among the top *25* outpatient diagnostic encounters recorded by family physicians, cerebrovascular disease (ICD-9 Code 336: "Acute, but ill-defined, cerebrovascular disease") is the second most common diagnosis for hospital patients of office-based general practice and family physicians in the United States (43). It has been estimated that 13 percent of all hospital patients have a primary and/or secondary necrologic diagnosis (113), and that at least 50 percent of these diagnoses are for cerebrovascular disorders *(46).* This situation reflects the frequency with which stroke patients require long-term institutional care.

The costs of stroke are enormous. In 1975, the direct and indirect costs of stroke were estimated to be approximately $9.5 billion annually *(103).* Because many patients with a stroke have losses of intellect and locomotion that require long-term institutionalization, prevention of stroke is a major health care objective at this time.

TREATMENT OF STROKE

Once a completed stroke has occurred, no known treatment can repair damaged tissue to restore function. Thus, preventive care is essential in the management of patients with cerebrovascular disorders. Since completely effective preventive therapy—the elimination of hypertension and atherosclerosis—is not available at this time, "half-way" preventive therapies are currently employed. These include general medical measures, such as control of hypertension and cardiac arrhythmias, if present, as well as surgical measures, such as endarterectomy (the surgical removal of cholesterol plaque from the inner surfaces of arteries) or cerebral bypass surgery.

The dominant theory underlying preventive therapies for stroke is the identification of stroke-prone individuals who have had transient ischemic attacks (TIAs). A TIA is a reversible episode of cerebrovascular insufficiency that usually lasts less than one hour, and always lasts (by definition) less than *24* hours. These "warning spells" have an incidence of **30 per 100,000 total population per year** *(62).* The interval between episodic attacks varies from several hours to several months or longer. While the episodes often follow a stereotyped pattern in a given patient, their modes of occurrence vary. It is most commonly thought that they arise from the passage of microemboli of fibrin-platelets or cholesterol into the cerebral circulation.

Although TIAs area form of physiologic disturbance, they are generally grouped on an anatomic basis by clinicians according to the visible symptoms. TIAs include those of carotid artery origin, those of vertebral and basilar artery origin, and those of indeterminate origins. It should be noted that a physician rarely witnesses a TIA and is dependent for clinical diagnosis upon the patient's recall and medical history. The hallmark of a TIA is the localized disturbance of brain function that is associated with specific physiologic symptoms. A hand or foot may become numb, or one side of the body may show such symptoms. One eye may become blind, or partly blind, or double vision (diplopia) may occur. Vertigo and dizziness, disturbances of speech and language, and episodes of leg weakness, are other symptoms that may reflect the occurrence of a TIA.

When a TIA is suspected, a clinician performs a complete physical neurological examination and searches for evidence of heart disease or disease of the carotid/vertebrobasilar systems. A murmur (bruit), audible with a stethoscope, over a major artery in the neck is often **a** sign of turbulent blood flow resulting from atherosclerosis of the underlying vessel. This sign is a good bedside indicator of arterial narrowing (stenosis), but both the presence or absence of a bruit may be misleading. For example, it is known that as a vessel becomes progressively narrowed, the loudness of a bruit may actually diminish, so that when disease is severe and advanced, no bruit maybe audible. Other bedside signs include a difference of greater than 15 percent between the blood pressures recorded in both arms, absence of a palpable branch of the external carotid artery, or the visualization of embolic material in the retinal circulation with an ophthalmoscope.

To supplement bedside testing, a number of "noninvasive" tests (requiring neither arterial nor venous punctures) are currently employed to assess the extracranial circulation. Ophthalmodynamometry enables physicians to record the blood pressure in the ophthalmic artery, the first major intracranial branch of the carotid artery itself. A computed tomography (CT) scan may demonstrate a stroke in the brain. Such a test suggests that the clinical impression of TIA was in error, and that a completed cerebral infarction, or stroke, has actually occurred. Strokes may be ischemic (reduced CT density), hemorrhagic (increased CT density), or both. Thermography may show a diminished temperature over the medial forehead, which may indicate carotid artery disease. Real-time ultrasound (also known as a B-scan, a test which measures the anatomical structure of vessels), and a Doppler device (an imaging device for measuring the flow velocity of blood through the arteries), may provide evidence of the extent of arterial lumen compromise and disturbance of blood flow.

If the physician decides that the patient is at significant risk for a stroke, and that surgery may be indicated to relieve arterial obstruction, an arteriogram (also called an angiogram) has always heretofore been indicated. This is an "invasive" test requiring direct arterial puncture. The overall complication rate of this test is 1.7 to 3.7 percent. The radiation exposure is approximately *20* REM per arteriogram *(24).* Apart from risk of associated morbidity, the conventional arteriogram is uncomfortable for the patient and usually requires a period of inpatient hospitalization to observe the patient for possible complications arising from the procedure. Most practicing physicians recommend consultation with a neurologist and/or surgeon for the majority of patients who are possible candidates for arteriography to determine: a) that symptoms are due to TIA; b) that a significant risk of stroke remains if no therapy is provided; and c) that surgery is feasible if arteriography demonstrates a significant lesion. Because of careful screening, carotid lesions are usually demonstrated in 75 to *80* percent of all patients having arteriograms following carotid TIAs *(24).*

For patients who are not surgical candidates (before or after arteriography), anticoagulant drug therapy is usually considered. Another possible therapy includes medications that inhibit platelet aggregation (e.g., aspirin or dipyridamole). Available data suggest that TIAs maybe prevented with long-term medical prophylaxis, especially in men, but the effectiveness of this therapy to prevent strokes due to extracranial vascular disease remains uncertain **(103,104).**