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Death of a region of brain cells due to poor blood flow For other uses, see Stroke (disambiguation). Medical conditionStrokeOther namesCerebrovascular accident (CVA), cerebrovascular insult (CVI), brain attackCT scan of the brain showing a prior right-sided ischemic stroke from blockage of an artery. Changes on a CT may not be visible early on.

[1]SpecialtyNeurology, stroke medicineSymptomsInability to move or feel on one side of the body, problems understanding or speaking, dizziness, loss of vision to one side[2][3]ComplicationsPersistent vegetative state[4]CausesIschemic (blockage) and hemorrhagic (bleeding)[5]Risk factorsHigh blood pressure, tobacco smoking, obesity, high blood cholesterol, diabetes mellitus, previous TIA, end-stage kidney disease, atrial fibrillation[2][6][7]Diagnostic methodBased on symptoms with medical imaging typically used to rule out bleeding[8][9]Differential diagnosisLow blood sugar[8]TreatmentBased on the type[2]PrognosisAverage life expectancy 1 year[2]Frequency42.4 million (2015)

[10]Deaths6.3 million (2015)[11] A stroke is a medical condition in which poor blood flow to the brain causes cell death.[5] There are two main types of stroke: ischemic, due to lack of blood flow, and hemorrhagic, due to bleeding.[5] Both cause parts of the brain to stop functioning properly.[5] Signs and symptoms of a stroke may include an inability to move or feel on one side of the body, problems understanding or speaking, dizziness, or loss of vision to one side.[2][3] Signs and symptoms often appear soon after the stroke has occurred.[3] If symptoms last less than one or two hours, the stroke is a transient ischemic attack (TIA), also called a mini-stroke.[3] A hemorrhagic stroke may also be associated with a severe headache.[3] The symptoms of a stroke can be permanent.[5] Long-term complications may include pneumonia and loss of bladder control.[3] The main risk factor for stroke is high blood pressure.[6] Other risk factors include high blood cholesterol, tobacco smoking, obesity, diabetes mellitus, a previous TIA, end-stage kidney disease, and atrial fibrillation.[2][6][7] An ischemic stroke is typically caused by blockage of a blood vessel, though there are also less common causes.[12][13][14] A hemorrhagic stroke is caused by either bleeding directly into the brain or into the space between the brain's membranes.[12][15] Bleeding may occur due to a ruptured brain aneurysm.

[12] Diagnosis is typically based on a physical exam and supported by medical imaging such as a CT scan or MRI scan.[8] A CT scan can rule out bleeding, but may not necessarily rule out ischemia, which early on typically does not show up on a CT scan.[9] Other tests such as an electrocardiogram (ECG) and blood tests are done to determine risk factors and rule out other possible causes.[8] Low blood sugar may cause similar symptoms.[8] Prevention includes decreasing risk factors, surgery to open up the arteries to the brain in those with problematic carotid narrowing, and warfarin in people with atrial fibrillation.[2] Aspirin or statins may be recommended by physicians for prevention.[2] A stroke or TIA often requires emergency care.[5] An ischemic stroke, if detected within three to four and half hours, may be treatable with a medication that can break down the clot.[2] Some hemorrhagic strokes benefit from surgery.[2] Treatment to attempt recovery of lost function is called stroke rehabilitation, and ideally takes place in a stroke unit; however, these are not available in much of the world.[2] In 2013, approximately 6.9 million people had an ischemic stroke and 3.4 million people had a hemorrhagic stroke.[16] In 2015, there were about 42.4 million people who had previously had a stroke and were still alive.[10] Between 1990 and 2010 the number of strokes which occurred each year decreased by approximately 10% in the developed world and increased by 10% in the developing world.[17] In 2015, stroke was the second most frequent cause of death after coronary artery disease, accounting for 6.3 million deaths (11% of the total).[11] About 3.0 million deaths resulted from ischemic stroke while 3.3 million deaths resulted from hemorrhagic stroke.[11] About half of people who have had a stroke live less than one year.[2] Overall, two thirds of strokes occurred in those over 65 years old.[17] Classification There are two main categories of strokes. Ischemic (top), typically caused by a blood clot in an artery (1a) resulting in brain death to the affected area (2a). Hemorrhagic (bottom), caused by blood leaking into or around the brain from a ruptured blood vessel (1b) allowing blood to pool in the affected area (2b) thus increasing the pressure on the brain. A slice of brain from the autopsy of a person who had an acute middle cerebral artery (MCA) stroke Strokes can be classified into two major categories: ischemic and hemorrhagic.[16] Ischemic strokes are caused by interruption of the blood supply to the brain, while hemorrhagic strokes result from the rupture of a blood vessel or an abnormal vascular structure. About 67% of strokes are ischemic, the rest being hemorrhagic. Bleeding can develop inside areas of ischemia, a condition known as "hemorrhagic transformation." It is unknown how many hemorrhagic strokes actually start as ischemic strokes.[2] Definition In the 1970s the World Health Organization defined stroke as a "neurological deficit of cerebrovascular cause that persists beyond 24 hours or is interrupted by death within 24 hours",[19] although the word "stroke" is centuries old. This definition was supposed to reflect the reversibility of tissue damage and was devised for the purpose, with the time frame of 24 hours being chosen arbitrarily. The 24-hour limit divides stroke from transient ischemic attack, which is a related syndrome of stroke symptoms that resolve completely within 24 hours.[2] With the availability of treatments that can reduce stroke severity when given early, many now prefer alternative terminology, such as brain attack and acute ischemic cerebrovascular syndrome (modeled after heart attack and acute coronary syndrome, respectively), to reflect the urgency of stroke symptoms and the need to act swiftly.[20] Ischemic Main articles: Cerebral infarction and Brain ischemia In an ischemic stroke, blood supply to part of the brain is decreased, leading to dysfunction of the brain tissue in that area. There are four reasons why this might happen: Thrombosis (obstruction of a blood vessel by a blood clot forming locally) Embolism (obstruction due to an embolus from elsewhere in the body).[2] Systemic hypoperfusion (general decrease in blood supply, e.g., in shock)[21] Cerebral venous sinus thrombosis.[22] A stroke without an obvious explanation is termed cryptogenic (of unknown origin); this constitutes 30–40% of all ischemic strokes.[2][23] There are various classification systems for acute ischemic stroke. The Oxford Community Stroke Project classification (OCSP, also known as the Bamford or Oxford classification) relies primarily on the initial symptoms; based on the extent of the symptoms, the stroke episode is classified as total anterior circulation infarct (TACI), partial anterior circulation infarct (PACI), lacunar infarct (LACI) or posterior circulation infarct (POCI). These four entities predict the extent of the stroke, the area of the brain that is affected, the underlying cause, and the prognosis.[24][25] The TOAST (Trial of Org 10172 in Acute Stroke Treatment) classification is based on clinical symptoms as well as results of further investigations; on this basis, a stroke is classified as being due to (1) thrombosis or embolism due to atherosclerosis of a large artery, (2) an embolism originating in the heart, (3) complete blockage of a small blood vessel, (4) other determined cause, (5) undetermined cause (two possible causes, no cause identified, or incomplete investigation).[26] Users of stimulants such as cocaine and methamphetamine are at a high risk for ischemic strokes.[27] Hemorrhagic Main articles: Intracerebral hemorrhage and Subarachnoid hemorrhage CT scan of an intraparenchymal bleed (bottom arrow) with surrounding edema (top arrow) There are two main types of hemorrhagic stroke:[28][29] Intracerebral hemorrhage, which is basically bleeding within the brain itself (when an artery in the brain bursts, flooding the surrounding tissue with blood), due to either intraparenchymal hemorrhage (bleeding within the brain tissue) or intraventricular hemorrhage (bleeding within the brain's ventricular system). Subarachnoid hemorrhage, which is basically bleeding that occurs outside of the brain tissue but still within the skull, and precisely between the arachnoid mater and pia mater (the delicate innermost layer of the three layers of the meninges that surround the brain). The above two main types of hemorrhagic stroke are also two different forms of intracranial hemorrhage, which is the accumulation of blood anywhere within the cranial vault; but the other forms of intracranial hemorrhage, such as epidural hematoma (bleeding between the skull and the dura mater, which is the thick outermost layer of the meninges that surround the brain) and subdural hematoma (bleeding in the subdural space), are not considered "hemorrhagic strokes".[30] Hemorrhagic strokes may occur on the background of alterations to the blood vessels in the brain, such as cerebral amyloid angiopathy, cerebral arteriovenous malformation and an intracranial aneurysm, which can cause intraparenchymal or subarachnoid hemorrhage.[31] In addition to neurological impairment, hemorrhagic strokes usually cause specific symptoms (for instance, subarachnoid hemorrhage classically causes a severe headache known as a thunderclap headache) or reveal evidence of a previous head injury. Signs and symptoms Stroke symptoms typically start suddenly, over seconds to minutes, and in most cases do not progress further. The symptoms depend on the area of the brain affected. The more extensive the area of the brain affected, the more functions that are likely to be lost. Some forms of stroke can cause additional symptoms. For example, in intracranial hemorrhage, the affected area may compress other structures. Most forms of stroke are not associated with a headache, apart from subarachnoid hemorrhage and cerebral venous thrombosis and occasionally intracerebral hemorrhage.[31] Early recognition Various systems have been proposed to increase recognition of stroke. Different findings are able to predict the presence or absence of stroke to different degrees. Sudden-onset face weakness, arm drift (i.e., if a person, when asked to raise both arms, involuntarily lets one arm drift downward) and abnormal speech are the findings most likely to lead to the correct identification of a case of stroke, increasing the likelihood by 5.5 when at least one of these is present. Similarly, when all three of these are absent, the likelihood of stroke is decreased (– likelihood ratio of 0.39).[32] While these findings are not perfect for diagnosing stroke, the fact that they can be evaluated relatively rapidly and easily make them very valuable in the acute setting. A Centers for Disease Control and Prevention public service announcement on emergency medical treatment after or during a stroke from 2021. A mnemonic to remember the warning signs of stroke is FAST (facial droop, arm weakness, speech difficulty, and time to call emergency services).[33] as advocated by the Department of Health (United Kingdom) and the Stroke Association, the American Stroke Association, the National Stroke Association (US), the Los Angeles Prehospital Stroke Screen (LAPSS)[34] and the Cincinnati Prehospital Stroke Scale (CSPSS).[35] Use of these scales is recommended by professional guidelines.[36] FAST is less reliable in the recognition of posterior circulation strokes.[37] For people referred to the emergency room, early recognition of stroke is deemed important as this can expedite diagnostic tests and treatments. A scoring system called ROSIER (recognition of stroke in the emergency room) is recommended for this purpose; it is based on features from the medical history and physical examination.[36][38] Subtypes If the area of the brain affected includes one of the three prominent central nervous system pathways—the spinothalamic tract, corticospinal tract, and the dorsal column–medial lemniscus pathway, symptoms may include: hemiplegia and muscle weakness of the face numbness reduction in sensory or vibratory sensation initial flaccidity (reduced muscle tone), replaced by spasticity (increased muscle tone), excessive reflexes, and obligatory synergies.[39] In most cases, the symptoms affect only one side of the body (unilateral). Depending on the part of the brain affected, the defect in the brain is usually on the opposite side of the body. However, since these pathways also travel in the spinal cord and any lesion there can also produce these symptoms, the presence of any one of these symptoms does not necessarily indicate a stroke. In addition to the above CNS pathways, the brainstem gives rise to most of the twelve cranial nerves. A brainstem stroke affecting the brainstem and brain, therefore, can produce symptoms relating to deficits in these cranial nerves:[citation needed] altered smell, taste, hearing, or vision (total or partial) drooping of eyelid (ptosis) and weakness of ocular muscles decreased reflexes: gag, swallow, pupil reactivity to light decreased sensation and muscle weakness of the face balance problems and nystagmus altered breathing and heart rate weakness in sternocleidomastoid muscle with inability to turn head to one side weakness in tongue (inability to stick out the tongue or move it from side to side) If the cerebral cortex is involved, the CNS pathways can again be affected, but also can produce the following symptoms: aphasia (difficulty with verbal expression, auditory comprehension, reading and writing; Broca's or Wernicke's area typically involved) dysarthria (motor speech disorder resulting from neurological injury) apraxia (altered voluntary movements) visual field defect memory deficits (involvement of temporal lobe) hemineglect (involvement of parietal lobe) disorganized thinking, confusion, hypersexual gestures (with involvement of frontal lobe) lack of insight of his or her, usually stroke-related, disability If the cerebellum is involved, ataxia might be present and this includes: altered walking gait altered movement coordination vertigo and or disequilibrium Associated symptoms Loss of consciousness, headache, and vomiting usually occur more often in hemorrhagic stroke than in thrombosis because of the increased intracranial pressure from the leaking blood compressing the brain. If symptoms are maximal at onset, the cause is more likely to be a subarachnoid hemorrhage or an embolic stroke. Causes Thrombotic stroke Illustration of an embolic stroke, showing a blockage lodged in a blood vessel. In thrombotic stroke, a thrombus[40] (blood clot) usually forms around atherosclerotic plaques. Since blockage of the artery is gradual, onset of symptomatic thrombotic strokes is slower than that of a hemorrhagic stroke. A thrombus itself (even if it does not completely block the blood vessel) can lead to an embolic stroke (see below) if the thrombus breaks off and travels in the bloodstream, at which point it is called an embolus. Two types of thrombosis can cause stroke: Large vessel disease involves the common and internal carotid arteries, the vertebral artery, and the Circle of Willis.[41] Diseases that may form thrombi in the large vessels include (in descending incidence): atherosclerosis, vasoconstriction (tightening of the artery), aortic, carotid or vertebral artery dissection, various inflammatory diseases of the blood vessel wall (Takayasu arteritis, giant cell arteritis, vasculitis), noninflammatory vasculopathy, Moyamoya disease and fibromuscular dysplasia. Small vessel disease involves the smaller arteries inside the brain: branches of the circle of Willis, middle cerebral artery, stem, and arteries arising from the distal vertebral and basilar artery.[42] Diseases that may form thrombi in the small vessels include (in descending incidence): lipohyalinosis (build-up of fatty hyaline matter in the blood vessel as a result of high blood pressure and aging) and fibrinoid degeneration (a stroke involving these vessels is known as a lacunar stroke) and microatheroma (small atherosclerotic plaques).[43] Sickle-cell anemia, which can cause blood cells to clump up and block blood vessels, can also lead to stroke. A stroke is the second leading cause of death in people under 20 with sickle-cell anemia.[44] Air pollution may also increase stroke risk.[45] Embolic stroke An embolic stroke refers to an arterial embolism (a blockage of an artery) by an embolus, a traveling particle or debris in the arterial bloodstream originating from elsewhere. An embolus is most frequently a thrombus, but it can also be a number of other substances including fat (e.g., from bone marrow in a broken bone), air, cancer cells or clumps of bacteria (usually from infectious endocarditis).[46] Because an embolus arises from elsewhere, local therapy solves the problem only temporarily. Thus, the source of the embolus must be identified. Because the embolic blockage is sudden in onset, symptoms usually are maximal at the start. Also, symptoms may be transient as the embolus is partially resorbed and moves to a different location or dissipates altogether. Emboli most commonly arise from the heart (especially in atrial fibrillation) but may originate from elsewhere in the arterial tree. In paradoxical embolism, a deep vein thrombosis embolizes through an atrial or ventricular septal defect in the heart into the brain.[46] Causes of stroke related to the heart can be distinguished between high and low-risk:[47] High risk: atrial fibrillation and paroxysmal atrial fibrillation, rheumatic disease of the mitral or aortic valve disease, artificial heart valves, known cardiac thrombus of the atrium or ventricle, sick sinus syndrome, sustained atrial flutter, recent myocardial infarction, chronic myocardial infarction together with ejection fraction



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