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Learning Series - #24



Making sense of Stroke classification: Ischemic and Hemorrhagic

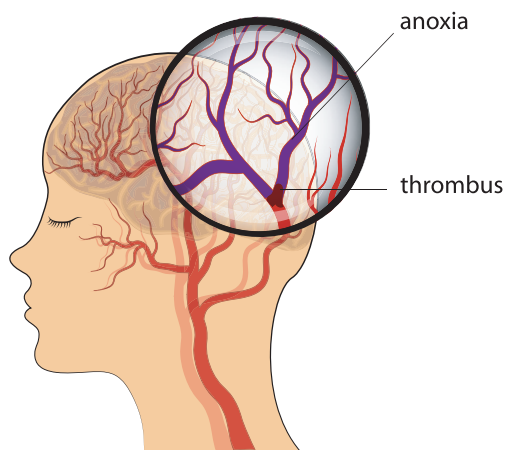
The brain represents just 2% of a person's body weight but uses about 20% of the body's oxygen supply via the carotid arteries. The symptoms of brain ischemia may be transient, lasting seconds to minutes, or can persist for longer periods of time.

Symptoms remain indefinitely if the brain becomes irreversibly damaged (infarction). Neurologic symptoms do not accurately reflect the presence or absence of infarction. Approximately 80% of strokes are due to ischemic cerebral infarction and 20% to brain hemorrhage.

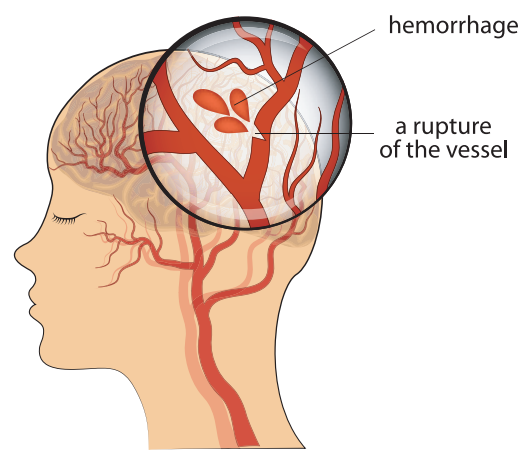
The categories of stroke, **ischemic** and **hemorrhagic**, are diametrically opposite conditions:

- **ischemia** is characterized by too little blood to supply an adequate amount of oxygen and nutrients to a part of the brain (due to thrombosis, embolism, or systemic hypoperfusion)
- **hemorrhage** is characterized by too much blood within the closed cranial cavity (due to intracerebral hemorrhage-ICH- or subarachnoid hemorrhage-SAH)

ISCHEMIC AND HEMORRHAGIC STROKE



ISCHEMIC STROKE



HEMORRHAGIC STROKE

The ischemia can affect a small region of the brain, or it may affect a large region or even the entire brain:

- **Focal ischemia** - a specific area of the brain. Focal ischemia can be the result of a thrombus or embolus.
- **Global ischemia** - a wider area of the brain. Global ischemia occurs when the blood supply to the brain has been drastically reduced, for example with cardiac arrest.



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STROKE – ISCHEMIC subtypes

- A. Thrombotic
- B. Embolic
- C. Systemic hypoperfusion

Risk factors for ischemic stroke include:

1. High blood pressure
2. Smoking tobacco
3. Obesity
4. Hyperlipidemia
5. Diabetes
6. Previous TIA
7. Atrial fibrillation
8. Family history of premature deaths from atherosclerosis.

A. Thrombotic stroke

Definition	Subtypes
Pathologic process giving rise to thrombus formation in an artery reducing blood flow distally (low flow) or by an embolic fragment that breaks off and travels to a more distant vessel (artery-to-artery embolism).	• Large vessel disease - both the extracranial and intracranial arterial system; atherothrombosis (most common pathologic process). • Small vessel disease - penetrating arteries that arise from the distal vertebral artery, the basilar artery, the middle cerebral artery stem, and the arteries of the circle of Willis. Penetrating artery (small vessel) disease can result in small deep infarcts referred to as lacunes. (See "Lacunar infarcts")

Lacunar infarcts are small (2-15 mm in diameter) noncortical infarcts caused by occlusion of a single penetrating branch of a large cerebral artery. These branches arise at acute angles from the large arteries of the circle of Willis, stem of the middle cerebral artery (MCA), or the basilar artery. Not all small deep infarcts are lacunar, and the diagnosis of lacunar infarction also requires the exclusion of other etiologies of ischemic stroke. Most lacunes occur in the basal ganglia, thalamus, subcortical white matter, and pons.

Risk factors – The main mechanism for lacunar stroke is related to a chronic vasculopathy associated with systemic hypertension. Other likely risk factors include diabetes mellitus and possibly smoking.

The radiologic diagnosis of lacunar infarction relies upon finding a small noncortical infarct on computed tomography (CT) or magnetic resonance imaging (MRI) whose location is consistent with the clinical lacunar syndrome. Brain MRI with diffusion-weighted imaging (DWI) and conventional MRI are obtained when head CT is nondiagnostic for clinically lacunar infarction.

Cerebral sinus venous thrombosis (CSVT) is a **less common** type of stroke, a rare form of venous thromboembolism (VTE). CSVT has an estimated incidence of < 2.5 per 100,000 annually, 78% of patients who develop the condition are younger than 50 years of age with female-to-male ratio of 3:1.

The major **risk factors** for CVT in adults are prothrombotic (hypercoagulable) conditions, oral contraceptives, pregnancy and the puerperium, malignancy, obesity, infection, head injury, and mechanical precipitants.

Risk factors associated with CSVT are very similar to other sources of venous thrombosis. The long-term prognosis of CSVT depends primarily on the presence or absence of underlying thrombophilia and residual neurologic deficit.

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B. Embolic stroke	
Definition	Categories
Particles of debris originating elsewhere that block arterial access to a particular brain region. Since the process is not local (as with thrombosis), local therapy only temporarily solves the problem; further events may occur if the source of embolism is not identified and treated.	Embolic strokes – categorize by source • source that is cardiac • possible cardiac or aortic source based upon transthoracic and/or transesophageal echocardiographic findings • arterial source • unknown source in which these tests are negative or inconclusive

C. Systemic Hypoperfusion	
Definition	Causes
A more general circulatory problem, manifesting itself in the brain and perhaps other organs.	Reduced perfusion can be due to cardiac pump failure caused by: • cardiac arrest, ischemia or reduced cardiac output related to arrhythmia, pulmonary embolism, pericardial effusion, or bleeding. • hypoxemia may further reduce the amount of oxygen carried to the brain.

STROKE – HEMORRHAGIC subtypes

Each of these categories can be divided into subtypes that have somewhat different causes, clinical pictures, clinical courses, outcomes, and treatment strategies.

As an example, intracranial hemorrhage can be caused by intracerebral hemorrhage (ICH), also called parenchymal hemorrhage, which involves bleeding directly into brain tissue, and subarachnoid hemorrhage (SAH), which involves bleeding into the cerebrospinal fluid that surrounds the brain and spinal cord.

Stroke type	Risk factors	Causes
Intracerebral hemorrhage	• Hypertension • Trauma • Bleeding diatheses • Illicit drugs (e.g., amphetamines, cocaine) • Vascular malformations	Main causes listed under Risk factors Less frequent causes: • bleeding into tumors • aneurysmal rupture • vasculitis. Neurologic symptoms usually increase gradually over minutes or a few hours
Subarachnoid hemorrhage	• Smoking • Hypertension • Moderate to heavy alcohol use • Genetic susceptibility (e.g., polycystic kidney disease, family history of subarachnoid hemorrhage) • Sympathomimetic drugs (e.g., cocaine)	Rupture of arterial aneurysms Other causes with less abrupt bleeding: • vascular malformations • bleeding diatheses • trauma • amyloid angiopathy • illicit drug use There are usually no important focal neurologic signs at presentation unless bleeding occurs into the brain and CSF at the same time (meningocerebral hemorrhage)

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STROKE – TRANSIENT (no focal damage) subtypes

Transient brain ischemia (TIA)

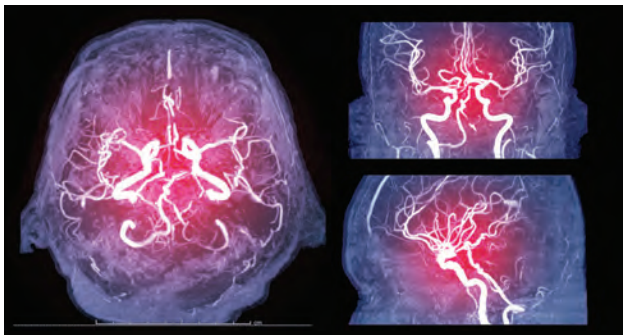
TIA is **currently** defined as a transient episode of neurologic dysfunction caused by focal brain, spinal cord, or retinal ischemia, without acute infarction.

This **tissue-based definition** of TIA relies on the absence of end-organ injury as assessed by imaging or other techniques. Its advantage is that the **defined end point** is **biological (tissue injury)** rather than an arbitrary timeline (24 hours).

Individuals with transient ischemic attack (TIA) or minor (i.e., nondisabling) stroke are at increased risk of recurrent stroke and therefore require urgent evaluation and treatment since immediate intervention may substantially reduce the risk of recurrent stroke.

Clinical diagnosis -The diagnosis is subjective because the symptoms of TIA are transient, variable and often minor. A TIA could be considered a syndrome divided into three main mechanisms:

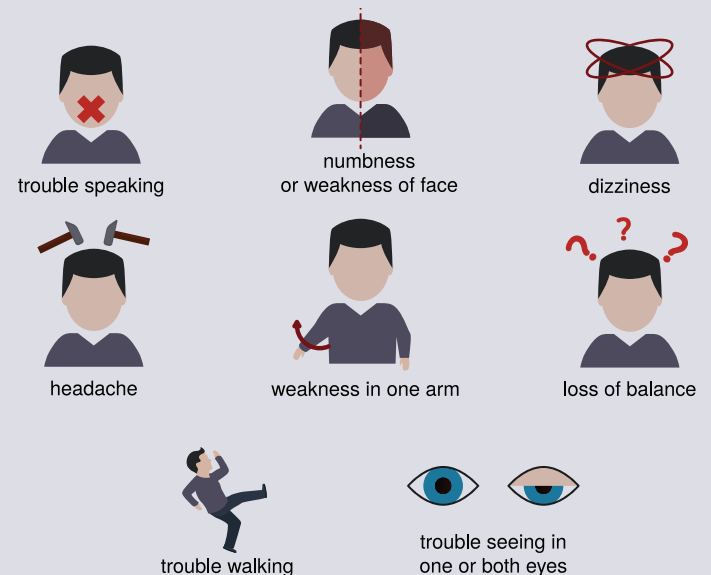
- Embolic TIA, which may be artery-to-artery, or due to a cardioaortic or unknown source
- Lacunar or small penetrating vessel TIA
- Large artery, low-flow TIA



MRA brain

Typical TIA	Atypical TIA
• Amaurosis fugax (transient monocular blindness) • Aphasia • Hemianopia (partial blindness) • Hemiparesis and/or hemisensory loss (complete or partial)	Isolated neurological symptoms such as: • Vertigo • Ataxia (abnormal movement/gait) • Diplopia (double vision) • Speech disturbance (slurred speech) without aphasia • Bilateral decreased vision • Unilateral sensory loss (one body part)

Stroke symptoms



Differential diagnosis may include: TGA (transient global amnesia), seizure, syncope, metabolic disorder (eg hypoglycemia), myasthenia gravis, etc.





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Diagnostic tools

- Imaging:
 - brain – diffusion weighted MRI (preferred) or CT scan
 - vascular – MRA or CTA – to identify extracranial or intracranial arterial cause.
- Cardiac evaluation (ECG; cardiac monitoring, echocardiogram) to identify atrial fibrillation or other cardioembolic source.
- Laboratory tests to rule out metabolic and hematologic causes including hypoglycemia, hyponatremia, and thrombocytosis.

Transient global amnesia (TGA) - Although often lumped in with TIA, transient global amnesia (TGA) deserves special mention given its distinct presentation (sudden and isolated inability to formulate new memories, lasting on the order of hours and often following exercise) and more favorable prognosis. TGA has a low rate of recurrence (6% per year) and, more importantly, significantly lower rates of stroke, MI and death as compared to TIA.

The results of standard diagnostic testing (MRI of the brain, echocardiogram, carotid Dopplers, electroencephalogram) are most often unremarkable.

STROKE is linked to many different diseases or irregularities. They may also include the following:

- Sickle cell anemia or other blood diseases
- Malformed blood vessels
- Congenital heart defects
- Arrhythmias
- Low blood pressure

Underwriting considerations

- The classic TIA definition, although still widely used, is inadequate because even relatively brief ischemia can cause permanent neurologic or retinal injury. A substantial proportion of patients with a classically defined TIA (<24 hours in duration) have corresponding ischemic lesions on diffusion-weighted or perfusion-weighted MRI that could explain the transient clinical manifestations.
- Traditionally defined TIA and minor ischemic stroke are associated with a high early risk of recurrent stroke. The stroke risk in the first two days after TIA is approximately 1.5 to 3.5%.
- Transient global amnesia (TGA) has a more favorable prognosis.
- Strokes in young people may have lower mortality risk since there is no atherosclerotic process involved
- Some types of hormone-based contraception carry an increased risk of stroke in young women.
- Silent cerebrovascular disease is a common condition affecting older adults and is associated with risk for brain ischemia—often referred to as « silent strokes ».
- The long-term prognosis of CVT depends primarily upon the presence or absence of underlying thrombophilia and residual neurologic deficit.
- Ultimate prognosis for a cerebrovascular accident is related to the degree of residual damage and the extent to which each of the risk factors has been controlled.

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