

# Cerebrovascular disease

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## 1 Overview

A **stroke**, or **cerebrovascular accident**, is an emergency medical condition characterized by an **acute** compromise of the cerebral perfusion or vasculature. The leading cause of ischemic stroke is hypertension whereas clotting disorders, carotid dissection, and illicit drug abuse are common causes in the younger populations.

## 2 Introduction

A stroke, ictus or cerebrovascular accident (CVA) is an acute compromise of the cerebral perfusion or vasculature. Approximately 85% of strokes are ischemic and rest are hemorrhagic. Stroke is the leading cause of adult disability worldwide.

It is critical to recognize stroke early and treat it rapidly to prevent or minimize morbidity and mortality. There are many causes of stroke. Hypertension is the leading cause of ischemic stroke. In the younger population, there are numerous causes of stroke including clotting disorders (arterial thrombosis), carotid dissection, and illicit drug abuse.

In the acute setting, a quick history and examination should be performed. It is very important not to waste any time. As acute stroke management is evolving rapidly, one must consider patients for intravenous thrombolytic drugs up to 4.5 hours or mechanical thrombectomy for up to 6 hours in case of ischemic stroke.

### 3 Etiology

There are two types of strokes:

1. **Ischemic stroke** (80%) is due to cessation of arterial flow.
2. **Hemorrhagic stroke** (20%) is due to bleeding into the brain by the rupture of a blood vessel. Blood from an artery suddenly begins bleeding into the brain.

**NOTE** An ischemic stroke can evolve to a hemorrhagic stroke.

**Ischemic** etiologies can further be divided into embolic, thrombotic, and lacunar. In general, the common risk factors for stroke include hypertension, diabetes, smoking, obesity, and drug use. Of all the risk factors, hypertension is the most common modifiable risk factor for stroke. Lifestyle measures such as weight loss, salt restriction, taking more fruits and vegetables (such as the Mediterranean diet) are helpful in decreasing the blood pressure.

The rest 20% of strokes are **hemorrhagic** in nature. Hemorrhagic etiologies can be from hypertension, aneurysm rupture, arteriovenous malformations, venous angiomas, bleeding due to illicit drugs like cocaine, hemorrhagic metastasis, amyloid angiopathy, and other obscure etiologies.

**Lacunar strokes** is a type of an ischemic strokes and result from occlusion of the small penetrating branches of the middle cerebral artery, vertebral or basilar artery. Typical causes of lacunar strokes include microemboli, fibrinoid necrosis secondary to vasculitis or hypertension, amyloid angiopathy, and hyaline arteriosclerosis.

### 4 Pathophysiology

Stroke is the result of ischemia in an area of the brain, both in ischemic and hemorrhagic ones.

In the case of an artery rupture, the hematoma disrupts the neurons and glia. This results in oligoemia, neuro-transmitter release, mitochondrial dysfunction, and cellular swelling. The primary injury is due to the compression of brain tissue by the hematoma and an increase in the intracranial pressure.

In either case, secondary injury is contributed to by inflammation, disruption of the blood-brain barrier, edema, overproduction of free radicals such as reactive oxygen species (ROS), and cytotoxicity.

### 5 Clinical presentation

Overall, an stroke can be identified by including some of the following symptoms or deficits: visual function, level of consciousness, motor function, cerebellar dysfunction, language dysfunction.

The common presentations of stroke are headache, aphasia, hemiparesis, and facial palsy. Acute onset headache, vomiting, neck stiffness, increases in blood pressure, and the rapidly developing neurological signs: a stroke is usually acute and progressing. Symptoms can lead to the extent and location of hemorrhage.

Some symptoms:

- Sensorimotor deficits.
- Headache, vomiting indicates raised intracranial pressure.

- Coma occurs in the involvement of the reticular activating system of the brainstem, but also numbness, lethargy, and weakness.
- Seizure, aphasia, and hemianopsia are seen in lobar hemorrhage.
- Ptosis, unreactive pupil.

A physician can localize the stroke with a good history and physical exam, identifying several stroke syndromes:

**Anterior Cerebral Artery (ACA) Infarction** There is significant collateral blood supply in the ACA territory. Patients present with motor aphasia, personality issues, and contralateral leg/arm weakness and numbness. Hand and face are usually spared.

**Middle Cerebral Artery (MCA) Infarction** Contralateral arm and facial numbness and weakness, gaze deviation towards the affected side. Aphasia in the left-sided lesions and neglect in the right-sided lesions.

**Posterior Cerebral Artery (PCA) Infarction** Hemianopsia, hypersomnolence, cognitive issues.

**Cerebellar Infarction** The patients with cerebellar strokes present with ataxia, dysarthria, nausea, vomiting, and vertigo.

**Lacunar strokes** Lacunar strokes are due to occlusion of small perforating vessels and can be a pure motor, pure sensory and ataxic hemiparetic strokes. In general, these strokes don't impair memory, cognition, level of consciousness or speech.

### A special case: transient ischemic attack (TIA)

It is defined as a transient episode of neurologic dysfunction due to the focal brain, spinal cord, or retinal ischemia, without acute infarction or tissue injury. A TIA typically lasts less than an hour, more often minutes. TIA can be considered as a serious warning for an impending ischemic stroke; the risk is highest in the first 48 hours following a transient ischemic attack. Transient ischemic attacks are usually associated with a focal neurologic deficit and/or speech disturbance in a vascular territory due to underlying cerebrovascular disease. It is always sudden in onset. Evaluation of TIA should be done urgently with imaging and laboratory studies to decrease the risk of subsequent strokes.

## 6 Diagnosis and evaluations

The initial workup of a stroke patient involves stabilizing the Airway, Breathing, and Circulation (ABC). This is followed by a rapid, concise, history and physical exam. Blood samples for laboratory parameters should be collected.

The patient should then get a stat non-contrasted head computed tomogram (CT) or a combination of head CT, CT Angiography, and perfusion imaging. It is key to determine whether the stroke is ischemic or hemorrhagic to choose the proper therapy and management.

## 7 Treatment

All patients suspected of having an acute ischemic stroke should be admitted for a full neurological workup and Neurology consultation should be obtained in a specialized **Stroke Unit**.

1. Acute ischemic stroke patients who meet the criteria for fibrinolytic therapy (also known as intravenous thrombolytic therapy) with Alteplase (recombinant tissue-type plasminogen activator or rtPA) should receive the drug. Only for ischemic stroke, Alteplase within 4.5 hours of stroke onset is the standard of care.
2. Patients who have large vessel occlusions should be evaluated for possible endovascular intervention, i.e., mechanical thrombectomy with a stent retriever.

A notable potential complication after fibrinolytic therapy is hemorrhagic transformation. Hemorrhagic transformation is classified as hemorrhagic infarction and parenchymal hematoma.

**Aspirin** is recommended within 24-48 hours after stroke onset. Support management includes oxygen supplementation, management of both hypo- and hyperglycemia, diuretics in case of significant cerebral edema than can occur after stroke. Also, seizures occur in about 15% of patients within the first few days of the stroke.

In the case of a hemorrhagic stroke:

- Blood pressure (BP) Management
- Hemostatic therapy is given to reduce the progression of hematoma. This is especially important to reverse the coagulopathy in patients taking anticoagulants.
- Surgery: The different types of surgical treatment for hemorrhagic stroke are craniotomy, decompressive craniectomy, stereotactic aspiration, endoscopic aspiration, and catheter aspiration