Hemorrhagic Stroke (Cerebrovascular Accident, CVA) — Symptoms and Treatment

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Hemorrhagic stroke is the second most common form of acute strokes. Patients can develop a hemorrhagic stroke due to many risk factors which include hypertension, cerebral amyloid angiopathy, neoplastic diseases and cerebral aneurysms. Hemorrhagic strokes can be classified into subarachnoid or intracerebral hemorrhage depending on the site of the hematoma formation. The semiology is usually similar to ischemic stroke; therefore, adequate brain imaging is very important for proper diagnosis and management.

Definition of Hemorrhagic Stroke

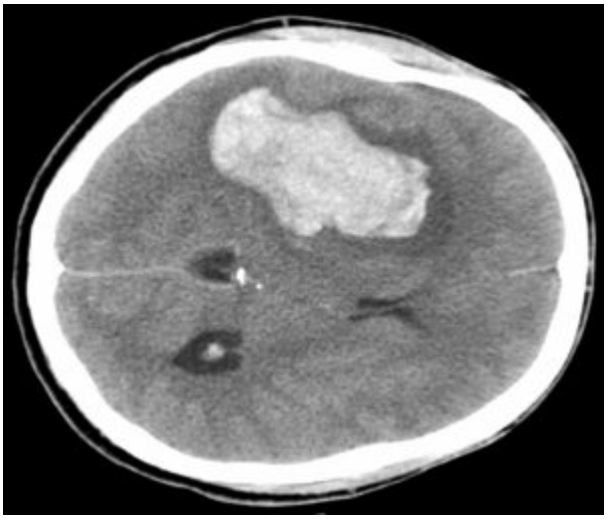

Image: “An intraparenchymal bleed with surrounding edema.” by James Heilman, MD. License: CC BY-SA 4.0

A stroke/cerebrovascular accident (CVA) is characterized by the rapid appearance of a focal deficit of the brain, with or without higher cerebral dysfunctions, such as aphasia, hemisensory loss, and visual field defects. A CVA can either be an ischemic stroke (more than 85% of cases) or a hemorrhagic stroke (fewer than 15% of cases).

The simplest definition of hemorrhagic stroke is an **acute neurologic injury** as a **consequence of intracranial bleeding**.

Classification of hemorrhagic strokes

Per the definition above, the bleeding might be:

1. Within the parenchyma, also known as **intracerebral hemorrhage**
2. In the cerebrospinal fluid surrounding the brain, known as **subarachnoid hemorrhage**

Epidural and subdural hemorrhages are not considered part of the hemorrhagic stroke spectrum.

Hemorrhagic strokes are also classified based on the area of the brain involved:

- The basal ganglia (66%)
- Thalamus
- Cerebellum

Hemorrhagic stroke may also be classified based on the vessel involved in:

- Anterior circulation stroke
- Posterior circulation stroke
- Large vessel disease
- Small vessel disease

The most common stroke is an **ischemic stroke**, while the second most common cause is a hemorrhagic stroke. **Hemorrhagic stroke is implicated in about 15% of all stroke cases**. Mortality rates associated with intracerebral hemorrhage are considered significantly higher than ischemic stroke.

Hemorrhagic stroke mortality seems to be highest within the first three weeks after the event. Current estimates indicate the mortality risk is similar for both hemorrhagic and

ischemic strokes 3 months after the CVA.

Hypertension is considered the most common cause of spontaneous intracerebral hemorrhage in adults. **Cerebral amyloid angiopathy**, **cerebrovascular malformations**, **arteriovenous malformations,** and **neoplastic disease** are other risk factors for hemorrhagic stroke.

Cerebral aneurysms are more commonly associated with **subarachnoid hemorrhage** rather than intracerebral hemorrhage; however, up to 30% of bleeding aneurysms might cause an intracerebral hemorrhage.

Risk factors are:

- Hypertension
- AVMs
- Cocaine use
- Amyloid angiopathy
- Metastatic tumors

Etiology of Hemorrhagic Stroke

Several diseases might be complicated by hemorrhagic stroke. The most common etiology of primary intracerebral hemorrhage is hypertension. **Prolonged hypertension** increases the pressure on the small arteries arising from the middle cerebral, thalamic, and pontine arteries. This increased pressure leads to **intimal hyperplasia**, **degeneration, and eventually necrosis of the small arteries**. At some point, the small arteries can **rupture,** and intracerebral bleeding occurs.

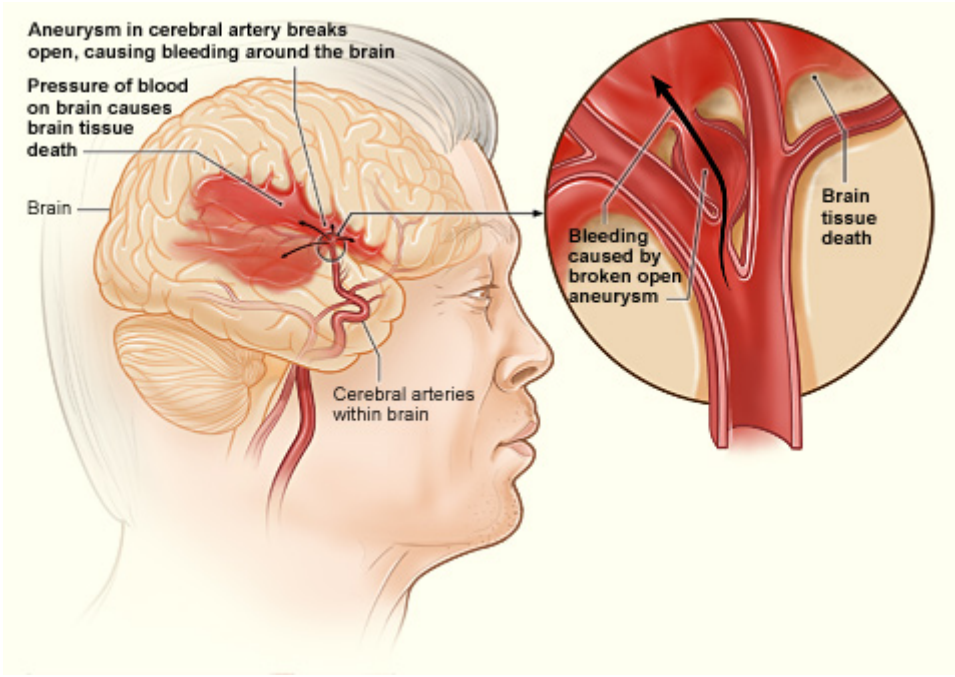

Image: “Hemorrhagic Stroke.” by National Heart Lung and Blood Institute (NIH). License: Public Domain

People **older than 60 years** of age are at risk of developing **cerebral amyloid angiopathy**, another condition commonly associated with hemorrhagic stroke. **Beta-amyloid** is deposited in small and medium-sized cerebral arteries, especially in the **basal ganglia**. The affected blood vessels degenerate and undergo **necrosis,** which puts them

at risk of rupture. If the vessels rupture, the patient will develop an intracerebral hemorrhage.

Developmental venous anomalies, **arteriovenous malformations, capillary telangiectasias,** and **cavernous malformations** result from abnormal fragile blood vessels. These blood vessels can bleed and cause an intracerebral hemorrhage. **Larger arteriovenous malformations** have deep venous drainage, are in the eloquent cortex, and are very likely to bleed.

Neoplastic tissue is **hypervascular,** and these blood vessels are usually pathological. They are **fragile,** can undergo **necrosis,** and put the patient at risk of intracerebral bleeding. The most common cause of neoplastic related intracerebral hemorrhage is **metastatic brain disease from melanomas, lungs, kidneys, and thyroid gland**.

Pituitary adenoma, **glioblastoma,** and **ependymoma** are the most common primary brain tumors associated with intracerebral hemorrhage.

Hemorrhagic infarction is defined as the transformation of an ischemic infarct into a hemorrhagic infarct. The blood vessels within the ischemic brain tissue are fragile and can rupture. If this happens, the patient might develop a hemorrhagic infarction. A **parenchymal hematoma** might form, which can have drastic consequences on the patient's clinical outcome.

Aneurysmal rupture is more likely to be associated with subarachnoid hemorrhage rather than intracerebral hemorrhage. Patients usually are younger and describe a **sudden-onset severe headache**.

Clinical Presentation of Hemorrhagic Stroke

Patients who develop subarachnoid hemorrhage and remain conscious usually describe a **severe headache** that is classically described as the worst headache in their lives. In addition to the severe headache, patients usually have **nausea** or **vomiting**. **Focal neurological deficits** and **impaired consciousness** are also associated with hemorrhagic stroke. **Seizures** due to cortical irritation by the blood can occur. Patients can also develop **neck rigidity** and **fever,** which are signs suggestive of **meningism**.

Intracerebral hemorrhage can cause headaches and nausea. However, more often, **it is impossible to differentiate intracerebral hemorrhage and ischemic stroke based on the clinical picture**. Focal neurological deficits, impaired consciousness, and the sudden onset of semiology occur in both ischemic and hemorrhagic strokes.

Because of the **overlap of the symptoms** between hemorrhagic and ischemic strokes, prompt and early **brain imaging** is essential for differentiating between the two conditions because they have **different treatment plans**.

Diagnostic Workup for Hemorrhagic Stroke

Computed tomography without contrast remains the first-line diagnostic imaging modality to evaluate the acute stroke patient despite recent advances in magnetic resonance imaging. Computed tomography imaging in acute hemorrhagic stroke due to hypertension reveals an **oval or round hyperintense mass**.

Image: “Subarachnoid hemorrhage in CT. One can see the blood hyperattenuating in the basal cisterns.” by Hellerhoff. License: CC BY-SA 3.0

If the patient presents very early in the disease process, the mass might be **heterogeneous** due to ongoing bleeding. Patients presenting in the subacute stage can have an **isodense mass** instead of the typical hyperdense mass seen in acute hemorrhagic stroke.

Patients who undergo **magnetic resonance imaging** with a new device that is fast enough for emergencies can have a hyperintense or isointense mass in the hyperacute and acute stages. In the subacute stage, up to one week after the hemorrhagic event, a hyperintense mass will remain visible on magnetic resonance imaging. At the **chronic stage**, the picture becomes similar to chronic ischemic stroke, i.e. **hypointense**.

Computed tomography imaging is also helpful in the diagnostic work-up of patients presenting with **subarachnoid hemorrhage**. The typical picture of subarachnoid hemorrhage on computed tomography is that of **hyper-attenuation** that is confined to the subarachnoid space. The **hyperintensity** is present within the **sulci**, **fissures,** and **basal cisterns**. Magnetic resonance imaging can also show hyperintensity in the subarachnoid space in the case of subarachnoid hemorrhage.

Treatment of Hemorrhagic Stroke

The management of hemorrhagic stroke **depends on the hematoma size**, **hematoma expansion rate,** and the **computed tomography angiography sign**.

Patients with **large intracerebral hematomas** are at the highest risk of immediate and 30-day mortality. **Medical management** mainly consists of **anticonvulsants** to prevent seizures, **anti-hypertensive drugs** to lower the blood pressure in case of hypertension, and **osmotic diuretics**. The decision to lower systolic blood pressure in acute intracerebral hemorrhage of <140 to <180 mm Hg or below is still under extensive research.

Patients with **posterior fossa intracerebral hemorrhage** usually have a worse prognosis; therefore, **early surgical intervention for decompression** is recommended. Patients who have hematoma expansion on repeated imaging might need **Factor VII infusion**.

Patients who have small, 1 to 2 mm foci of intense enhancement inside the hematoma on computed tomography angiography are most likely to have **ongoing bleeding** and may benefit from **embolization therapy** in addition to **better blood pressure control**. Additionally, these patients are at an increased risk of **hematoma expansion;** hence, the decision to **monitor** them more closely with repeated brain imaging is justifiable.

Managing subarachnoid hemorrhage is largely dependent on **blood pressure control** and decreasing intracranial pressure by **osmotic diuresis**.

Patients with subarachnoid hemorrhage due to **head trauma** usually have a slightly better prognosis than those with aneurysmal subarachnoid hemorrhage. Patients should receive good **analgesia,** but opioids should be avoided if possible because they mask signs of neurological signs of ongoing bleeding.

References

Smith, Scott D. and Clifford J. Eskey. 2011. “Hemorrhagic Stroke.” Radiologic Clinics of North America 49(1):27–45.

Notes