

Subarachnoid Hemorrhage (SAH) basic level

Overview

Subarachnoid hemorrhage (SAH) is a kind of stroke caused by bleeding into the spaces around the brain - a very life-threatening situation. A stroke occurs when the brain is deprived of the oxygen it needs due to an interruption of its blood supply. SAH can be caused by a ruptured aneurysm, head trauma, or leaking arteriovenous malformation (AVM). One third of the patients who suffer a SAH will survive with good recovery; one third will survive with a disability or stroke; and one third will die. Treatment focuses on stopping the bleeding, restoring normal blood flow, and relieving the pressure on the brain.

What is a subarachnoid hemorrhage?

The subarachnoid space is the area between the brain and the skull. It is normally filled with cerebrospinal fluid (CSF), which acts as a floating cushion to protect the brain (see Anatomy of the Brain). When blood is released into the subarachnoid space it increases the pressure on the brain making the person confused and lethargic. As blood spills into the subarachnoid space the area of brain that artery was supplying is now deprived of blood - called a stroke. The pool of blood may form a clot, called a hematoma, which irritates and may damage surrounding brain cells (Fig. 1). Most common causes of SAH:

- **Aneurysm:** a balloon-like bulge or weakening of an arterial wall.
- **AVM:** a congenital defect, which consists of a tangle of abnormal arteries and veins with no capillaries in between.
- **Head trauma:** fractures to the skull and penetrating wounds (gunshot) can damage an artery and cause bleeding.

A common complication of SAH is vasospasm, which is a narrowing (spasm) of an artery that may occur 3-14 days following a SAH. Vasospasm reduces the blood flow to the region of the brain that artery feeds. If left untreated, vasospasm can cause a stroke.

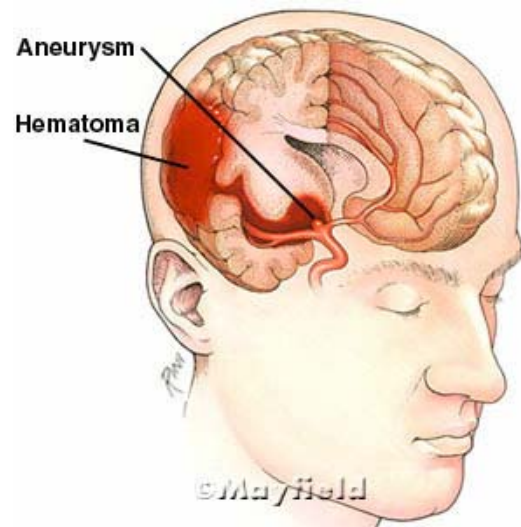


Figure 1. A subarachnoid hemorrhage caused by a ruptured aneurysm. As blood fills the spaces, a hematoma, or blood clot forms causing increased pressure on the brain.

What are the symptoms?

If you experience the symptoms of a SAH, call 911 immediately!

- sudden onset of a severe headache (often described as "worst headache of their life")
- popping or snapping sensation in head
- nausea and vomiting
- stiff neck
- transient loss of vision or consciousness
- seizures

Who is affected?

SAH occurs in 1 out of 10,000 people each year. Women have a slightly higher risk than men; average age of 50 years.

- 77% of SAH are caused by aneurysms
- 5-10% of strokes are caused by SAH

How is a diagnosis made?

When you or a loved one are brought to the emergency room with a SAH, the doctors will learn as much about your symptoms, current and previous medical problems, current medications, family history, and perform a physical exam. Diagnostic tests help determine the source of the bleeding.

Computed Tomography (CT) scan: The first test performed is a CT scan, a noninvasive X-ray to review the anatomical structures within the brain to see if there is any blood in the brain. A newer technology called CT angiography involves the injection of contrast into the blood stream to view the arteries of the brain.

Lumbar puncture: If the CT scan does not show evidence of bleeding but your symptoms are typical for SAH, a lumbar puncture may be performed to detect blood in the cerebrospinal fluid (CSF). A hollow needle is inserted into the subarachnoid space of your spinal canal. The doctor will collect between 5 to 20 ml of CSF in 2 to 4 tubes.

Angiogram is an invasive procedure, where a catheter is inserted into an artery and passed through the blood vessels to the brain. Once the catheter is in place, a contrast dye is injected into the bloodstream and the X-ray images are taken.

Magnetic resonance imaging (MRI) scan is a noninvasive test, which uses a magnetic field and radio-frequency waves to give a detailed view of the soft tissues of your brain. An MRA (Magnetic Resonance Angiogram) is the same non-invasive study, except it is also an angiogram, which means it also examines the blood vessels, as well as the structures of the brain.

Hunt-Hess Grading Scale

In addition to radiological tests, the overall condition of the patient is assessed using the Hunt-Hess scale. The Hunt-Hess scale grades the severity of the SAH. If the patient has a serious systemic disease such as hypertension or cardiopulmonary disease one grade level is added.

- **Grade 1** - alert, mild headache, stiff neck
- **Grade 2** - alert, vision problems, moderate to severe headache, stiff neck
- **Grade 3** - lethargy or confusion, weakness or partial paralysis on one side of body
- **Grade 4** - stupor, moderate to severe paralysis on one side of body
- **Grade 5** - comatose

What treatments are available?

Treatment should begin as soon as possible—there is a 20% chance of recurrent hemorrhage within 14 days. Once the cause of the bleeding (aneurysm, AVM, trauma) is identified, surgery or coiling may be performed to stop the bleeding, restore normal blood flow, and relieve the pressure on the brain.

Pain medication will be given to alleviate headache, anticonvulsant medication may be prescribed to prevent or treat seizures, and a vasodilator will be prescribed to prevent vasospasm.

Controlling intracranial pressure

Until the bleeding vessel can be repaired, the doctors lower your blood pressure to reduce further bleeding. A ventricular catheter may be placed in the ventricles (fluid filled areas deep within the brain) to drain fluid and relieve intracranial pressure (ICP) and hydrocephalus, or swelling of the brain.

Controlling vasospasm

Three to 14 days following a SAH the patient may develop vasospasm. Vasospasm narrows the artery and reduces the blood flow to the region of the brain that artery feeds. If left untreated, vasospasm can cause a stroke. In the ICU you will be monitored every hour or so for signs of vasospasm which include weakness in an arm or leg, confusion, sleepiness, or restlessness. If vasospasm is suspected the doctor will use a transcranial doppler (TCD) ultrasound to measure the flow of blood through the arteries. This test can show which arteries are in spasm and the severity. To control vasospasm, patients are given the drug nimodipine for 14-21 days. Additionally, Triple H therapy is used:

- **Hypertension:** increasing the blood pressure to force blood through the narrowed arteries.
- **Hypervolemia:** increasing IV fluids to make more blood volume.
- **Hemodilution:** making the blood thin and watery and easier to flow through narrowed arteries.

If Triple H therapy doesn't work a drug called papaverine can be injected into the artery to make it relax and open. This is done through a catheter during an angiogram. Sometimes angioplasty is used to stretch open the artery.

Recovery

Immediately after SAH, the patient will stay in the intensive care unit (ICU) for at least two weeks where doctors and nurses can watch them closely for signs of rebleeding, vasospasm, hydrocephalus, and other potential complications. There is a 20% chance of recurrent hemorrhage within 14 days. Once their condition is stable, the patient is transferred to a regular room.

SAH patients may suffer short-term and/or long-term deficits as a result of the bleed or the treatment. Some of these deficits may disappear over time with healing and therapy. The recovery process is long and may take weeks, months, or years to understand the level of deficits you incurred and regain function.

Survival rates according to the Hunt-Hess scale of SAH severity (1)

- **grade 1** – 75% good outcome
- **grade 2** - 60% good outcome
- **grade 3** - 50% good outcome
- **grade 4** - 30% good outcome
- **grade 5** - 10% good outcome

Clinical Trials

Clinical trials are research studies in which new treatments—drugs, diagnostics, procedures, vaccines, and other therapies— are tested in people to see if they are safe and effective. Research is always being conducted to improve the standard of medical care and explore new drug and surgical treatments. You can find information about current clinical investigations, including their eligibility requirements, protocol, and participating locations on the web: the National Institutes of Health (NIH) at clinicaltrials.gov, sponsors many trials; private industry and pharmaceutical companies also sponsor trials <http://www.centerwatch.com/>

Current Studies

For information about clinical trials conducted by our doctors at local Cincinnati hospitals call 1-800-325-7787 ext. 5260. On the web at www.mayfieldclinic.com/ClinicalTrials.htm

Sources & Links

If you have more questions, please contact the Mayfield Clinic at 800-325-7787 or 513-221-1100. Additional information is available on the web.

Links

National Brain Aneurysm Foundation
www.bafound.org
National Stroke Association
www.stroke.org
American Stroke Association
www.strokeassociation.org

Sources

1. Kassell: Outcome prediction in SAH. J Neurosurg 73:18-36, 1990

Glossary

aneurysm: a bulge or weakening of an arterial wall.
angioplasty: a procedure to insert an inflatable balloon to stretch open a blocked or narrowed artery; performed during an angiogram.
hematoma: a blood clot.
hydrocephalus: swelling in the brain due to a blockage of cerebrospinal fluid.
papaverine: a vasodilator drug used to relax blood vessels during vasospasm.
subarachnoid hemorrhage: bleeding in the space surrounding the brain; may cause a stroke.
transcranial doppler (TCD): an ultrasound device used to measure blood flow through an artery in the brain.
vasospasm: abnormal narrowing or constriction of arteries due to irritation by blood in the subarachnoid space.
ventricular drain: a catheter placed in the ventricle of the brain to drain excess cerebrospinal fluid.

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