Intracerebral Hemorrhage (ICH)

Overview

Intracerebral hemorrhage (ICH) is caused by bleeding within the brain tissue itself — a life-threatening type of stroke. A stroke occurs when the brain is deprived of oxygen and blood supply. ICH is most commonly caused by hypertension, arteriovenous malformations, or head trauma. Treatment focuses on stopping the bleeding, removing the blood clot (hematoma), and relieving the pressure on the brain.

What is an intracerebral hemorrhage?

Tiny arteries bring blood to areas deep inside the brain. High blood pressure (hypertension) can cause these thin-walled arteries to rupture, releasing blood into the brain tissue. Enclosed within the rigid skull, clotted blood and fluid buildup increases pressure that can crush the brain against the bone or cause it to shift and herniate (Fig. 1). As blood spills into the brain, the area that artery supplied is now deprived of oxygen-rich blood – called a stroke. As blood cells within the clot die, toxins are released that further damage brain cells in the area surrounding the hematoma.

An ICH can occur close to the surface or in deep areas of the brain. Sometimes deep hemorrhages can expand into the ventricles – the fluid filled spaces in the center of the brain. Blockage of the normal cerebrospinal (CSF) circulation can enlarge the ventricles (hydrocephalus) causing confusion, lethargy, and loss of consciousness.

What are the symptoms?

If you experience the symptoms of an ICH, call 911 immediately! Symptoms usually come on suddenly and can vary depending on the location of the bleed. Common symptoms include:

- headache, nausea, and vomiting
- lethargy or confusion
- sudden weakness or numbness of the face, arm or leg, usually on one side
- loss of consciousness
- temporary loss of vision
- seizures

What are the causes?

- **Hypertension:** elevated blood pressure may cause tiny arteries to burst inside the brain. Normal pressure is 120/80 mm Hg.

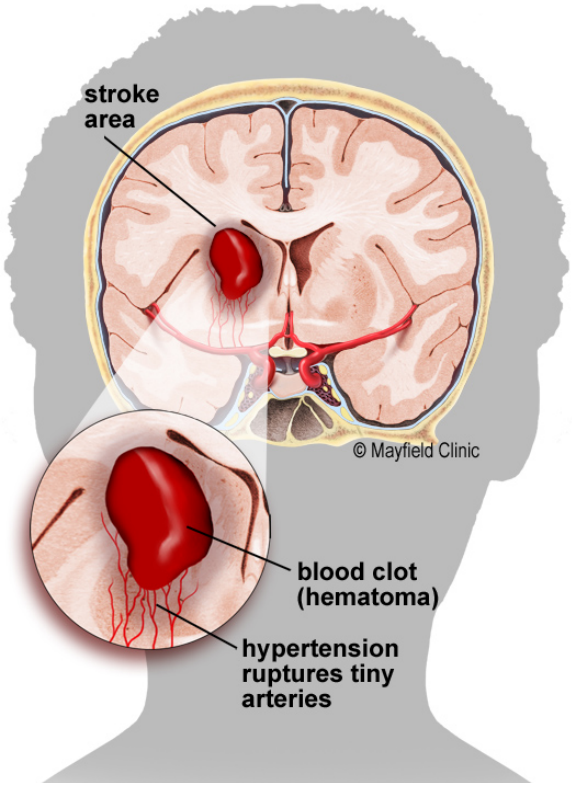

Figure 1. An intracerebral hemorrhage (ICH) is usually caused by rupture of tiny arteries within the brain tissue. As blood collects, a hematoma or blood clot forms causing increased pressure on the brain.

- **Blood thinners**: drugs such as coumadin, heparin, and warfarin used to prevent clots in heart and stroke conditions may cause ICH.
- **AVM**: a tangle of abnormal arteries and veins with no capillaries in between.
- **Aneurysm**: a bulge of an artery wall.
- **Head trauma**: fractures to the skull and penetrating wounds (gunshot) can damage an artery and cause bleeding.
- **Bleeding disorders:** hemophilia, sickle cell anemia, DIC, thrombocytopenia.
- **Tumors**: highly vascular tumors such as angiomas and metastatic tumors can bleed into the brain tissue.
- **Amyloid angiopathy**: a buildup of protein within the walls of arteries.
- **Drug usage**: alcohol, cocaine and other illicit drugs can cause ICH.
- **Spontaneous**: ICH by unknown causes.

Who is affected?

Ten percent of strokes are caused by ICH. ICH is twice as common as subarachnoid hemorrhage (SAH) and has a 40% risk of death. ICH occurs slightly more frequently among men than women and is more common among young and middle-aged African Americans and Japanese. Advancing age and hypertension are the most important risk factors for ICH. Approximately 70% of patients experience long-term deficits after an ICH.

How is a diagnosis made?

When a person is brought to the emergency room with a suspected brain hemorrhage, doctors will learn as much about his or her symptoms, current and previous medical problems, medications, and family history. The person's condition is assessed quickly. Diagnostic tests will help determine the source of the bleeding.

Computed Tomography (CT) scan is a noninvasive X-ray to review the anatomical structures within the brain and to detect any bleeding. A CT angiography involves the injection of contrast into the blood stream to view arteries of the brain.

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, contrast dye is injected into the bloodstream and X-rays 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) involves the injection of contrast into the bloodstream to examine the blood vessels as well as the structures of the brain.

What treatments are available?

Treatment may include lifesaving measures, symptom relief, and complication prevention. Once the cause and location of the bleeding is identified, medical or surgical treatment is performed to stop the bleeding, remove the clot, and relieve the pressure on the brain. If left alone the brain will eventually absorb the clot within a couple of weeks – however the damage to the brain caused by ICP and blood toxins may be irreversible.

Generally, patients with small hemorrhages (<10 cm^3) and minimal deficits are treated medically. Patients with cerebellar hemorrhages (>3 cm^3) who are deteriorating or who have brainstem compression and hydrocephalus are treated surgically to remove the hematoma as soon as possible. Patients with large lobar hemorrhages (50 cm^3) who are deteriorating usually undergo surgical removal of the hematoma.

Medical treatment

The patient will stay in the stroke unit or intensive care unit (ICU) for close monitoring and care.

- If the patient was on blood thinners, reversal drugs will be given to restore clotting factors.
- Blood pressure is managed to decrease the risk of more bleeding yet provide enough blood flow (perfusion) to the brain.
- Controlling intracranial pressure is a factor in large bleeds. A device called an ICP monitor may be placed directly into the ventricles or within the brain to measure pressure. Normal ICP is 20mm HG.
- Removing cerebrospinal fluid (CSF) from the ventricles helps control pressure. A ventricular catheter (VP shunt) may be placed to drain CSF fluid and allow room for the hematoma to expand without damaging the brain.
- Hyperventilation also helps control ICP. In some cases, coma may be induced with drugs to bring down ICP.

Surgical treatment

The goal of surgery is to remove as much of the blood clot as possible and stop the source of bleeding if it is from an identifiable cause such as an AVM or tumor. Depending on the location of the clot either a craniotomy or a stereotactic aspiration may be performed.

- **Craniotomy** involves cutting a hole in the skull with a drill to expose the brain and remove the clot. Because of the increased risk to the brain, this technique is usually used only when the hematoma is close to the surface of the brain or if it is associated with an AVM or tumor that must also be removed.

- **Stereotactic clot aspiration** is a minimally invasive surgery for large hematomas located deep inside the brain. The procedure uses a stereotactic frame to guide a needle or endoscope directly into the clot. Stereotactic guidance is like the GPS system in your car. It is a navigation based on your presurgical imaging scans. The CT scan helps pinpoint the best trajectory into the hematoma. In the OR, the surgeon drills a small burr hole about the size of quarter in the skull. With the aid of the stereotactic frame, a hollow cannula is passed through the hole, through the brain tissue, directly into the clot. The hollow cannula is attached to a large syringe to withdraw the liquid portion of the blood clot (Fig. 2). A smaller catheter is then inserted to continue draining over the next days to weeks (Fig. 3).

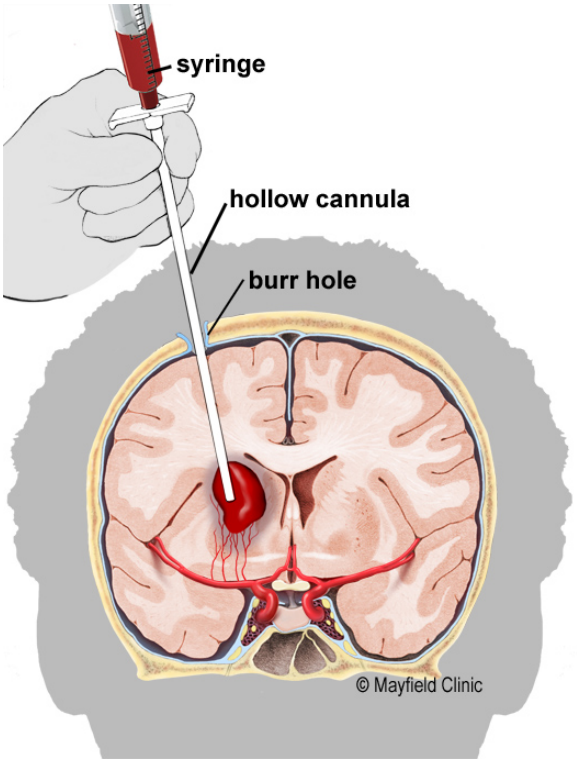

Figure 2. Clot aspiration through a catheter to reduce the mass effect and pressure in the brain.

Recovery & prevention

Immediately after an ICH, the patient will stay in the intensive care unit (ICU) for several weeks where doctors and nurses watch them closely for signs of rebleeding, hydrocephalus, and other complications. Once their condition is stable, the patient is transferred to a regular room.

ICH 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 may take weeks, months, or years to understand the level of deficits incurred and regain function.

Clinical trials

Clinical trials are research studies in which new treatments—drugs, diagnostics, procedures, 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. Information about current clinical trials, including eligibility, protocol, and locations, are found on the Web. Studies can be sponsored by the National Institutes of Health (see clinicaltrials.gov) as well as private industry and pharmaceutical companies (www.centerwatch.com).

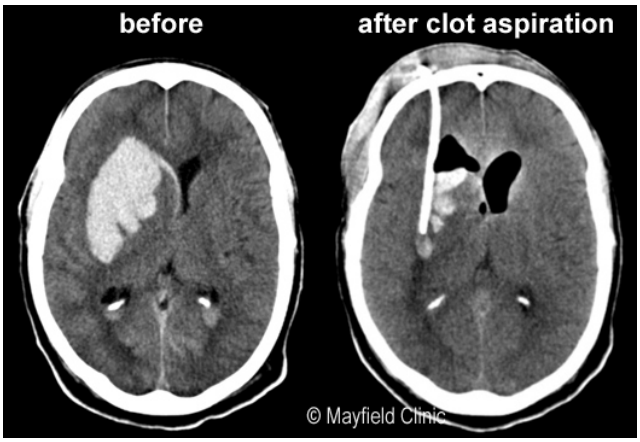

Figure 3. CT scan of a large ICH before and after clot removal. A catheter remains in the space to continue draining for several days.

Sources & links

If you have questions, please contact Semmes Murphey at 901-522-7700.

Sources

1. Guidelines for the Management of Intracerebral Hemorrhage. Stroke 46:2032-60, 2015.
2. Fewel ME, Thompson BG, Hoff JT: Spontaneous Intracerebral Hemorrhage:a review. Neurosurg Focus 15: 2003.

Links

National Stroke Association www.stroke.org

www.strokeassociation.org

www.strokecenter.org

Glossary

craniotomy: surgical opening of a portion of the skull to gain access to intracranial structures and replacement of the bone flap.
hematoma: a blood clot
hydrocephalus: swelling in the brain due to a blockage of cerebrospinal fluid.
intracranial pressure (ICP): pressure within the skull.
ICP monitor: a device used to measure intracranial pressure inside the brain.
stereotactic: a precise method for locating deep brain structures by the use of 3-dimensional coordinates.
ventricles: hollow areas in the center of the brain containing cerebrospinal fluid.
ventriculoperitoneal (VP) shunt: a catheter placed in the ventricle of the brain to drain excess cerebrospinal fluid.

updated > 4.2018
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