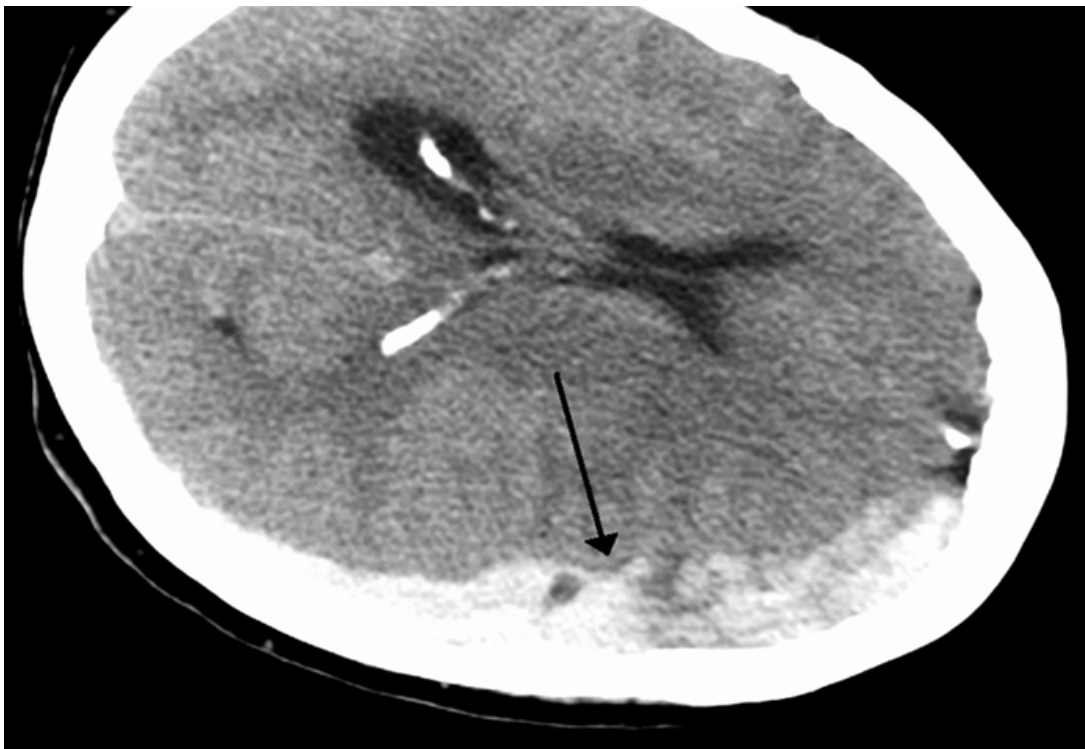


Intracranial Hemorrhage: Different Types and Epidemiology

[See online here](#)

Intracranial hemorrhage is a medical emergency that occurs in adults, but can also occur in children and neonates. As the name suggests, intracranial hemorrhage is bleeding and the accumulation of blood within the skull at an abnormal location leading to the formation of a hematoma. A hematoma is the collection of blood outside of blood vessel. Intracranial bleeding can lead to stroke, neurological deficit, brain matter herniation, and even death.



Epidemiology of Intracranial Hemorrhage

Bleeding within the cranial cavity causes hemorrhagic stroke, and is one of the leading causes of death. Intracranial hemorrhages (ICH) can be a **complication of hypertension**. They occur in about 12-15 per 100,000 individuals, including 350 hypertensive hemorrhages per 100,000 elderly individuals. There are roughly 7,000 surgical operations to remove intracranial hemorrhages in the US every year. Factors that increase the risk of ICH include **male sex** and **age over 55 years**. In younger patients, **arteriovenous malformations** are usually the cause of ICH. Intracranial hemorrhages (ICH) can be a **complication of hypertension**. They occur in about 12-15 per 100,000 individuals, including 350 hypertensive hemorrhages per 100,000 elderly individuals. There are roughly 7,000 surgical operations to remove intracranial

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Types of Intracranial Hemorrhage

There are **four types** of intracranial hemorrhages according to the location:

- Epidural hematoma
- Subdural hematoma
- Subarachnoid hemorrhage
- Intracerebral hemorrhage

The brain is covered by **3 protective layers** called **meninges** - the **pia mater**, **arachnoid mater**, and **dura mater**. Dura mater is the outermost membrane covering the brain, located just below the skull. Dura mater contains the major blood vessels which divide into capillaries within the pia mater. The arachnoid layer of meninges is the middle layer cushioning the brain like a loosely fitted sac inside which lies the **cerebrospinal fluid (CSF)**. The **subarachnoid space** under the arachnoid layer also contains **blood vessels** which too divide into capillaries in the pia mater.

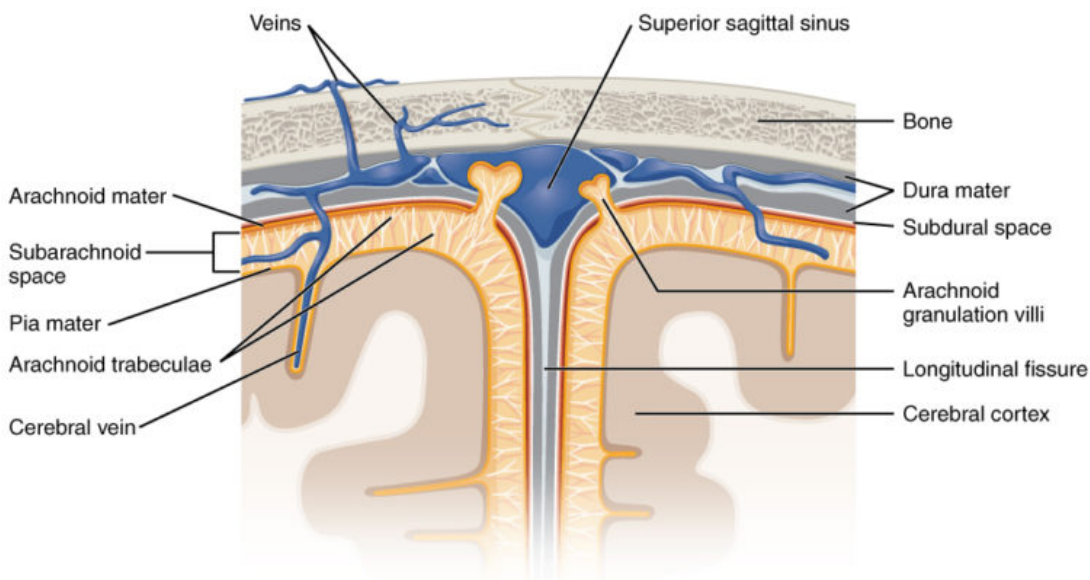


Image: "Meningeal layers" by OpenStax. License: [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/)

Epidural Hemorrhage

Epidural hemorrhage is bleeding outside/on top of the dura mater - right below the skull. It occurs mostly after **direct trauma** to the head. Patients present with **loss of consciousness** after a direct blow to the head and, occasionally, **altered mental status**. Trauma to the head can **fracture the skull** and **rupture major vessels** leading to **hematoma formation**. This hematoma can cause **increased pressure on the brain**. Since all three meninges also cover the **spinal cord**, epidural hematomas can also occur in around the spinal cord.

Common sites

90-95 % cases of epidural hematomas are **unilateral**, however, multiple hematomas can also be formed. More than 95 % are **supratentorial**: temporoparietal (60 %), frontal (20 %) and parietooccipital (20 %). Less than 5 % are located infratentorially in the posterior fossa. The most common site of epidural hematoma is the pterion - the temporoparietal locus.

The **pterion** is the site where the parietal, temporal, frontal and sphenoid bones of the skull meet. The bony part of the skull at pterion is relatively thinner and direct trauma to the head can result in the fracture or dislocation of the suture at this site. The **middle meningeal artery** emerges from the neck region and travels across the pterion to divide into its branches. Other sites of epidural intracranial bleeds include the frontal area involving **anterior ethmoidal arteries**, the occipital area involving **transverse or sigmoid sinus**, and the vertex involving the **superior sagittal sinus**.

Clinical presentation

Patients present after trauma to the head associated with an episode of **loss consciousness** followed by a normal level of consciousness and ongoing headache (called the **lucid interval**). The duration of the lucid interval without neurological deterioration in epidural hemorrhage is generally short and ranges from several minutes to hours. The lucid interval is dangerous because patients will believe that nothing is wrong, but if the hematoma gets large enough, it can cause a **brain herniation** and death.

It is comparatively not as common as other types of intracranial bleeds but can be dangerous and lead to **increased intracranial pressure (ICP)**. A unilateral cause of ICP can cause a **midline shift of the brain** because the hematoma pushes the brain towards the opposite side. Midline shifts are associated with a skull fracture in approximately 75 % of cases.

Both **CT and MRI scan** can be used to view epidural hematomas, but CT scans are faster and less expensive. CT scan shows a **biconvex lens-like** hematoma that **cannot cross the suture lines**.

Treatment

Epidural bleed can be treated conservatively or can be **surgically** evacuated. As a whole, this condition has a good prognosis if diagnosed early and managed as soon as possible.

Hematoma type	Epidural	Subdural
Location	Between the skull and the outer endosteal layer of the dura mater	Within the meningeal layer of the dura mater
Involved vessel	Temporoparietal locus (most likely) - middle meningeal artery Frontal locus - anterior ethmoidal artery Occipital locus - transverse or sigmoid sinuses Vertex locus - superior sagittal sinus	Bridging veins
Symptoms (depend on severity)	Lucid interval followed by unconsciousness	Gradually increasing headache and confusion
CT appearance	Biconvex lens	Crescent-shaped

Subdural Hemorrhage

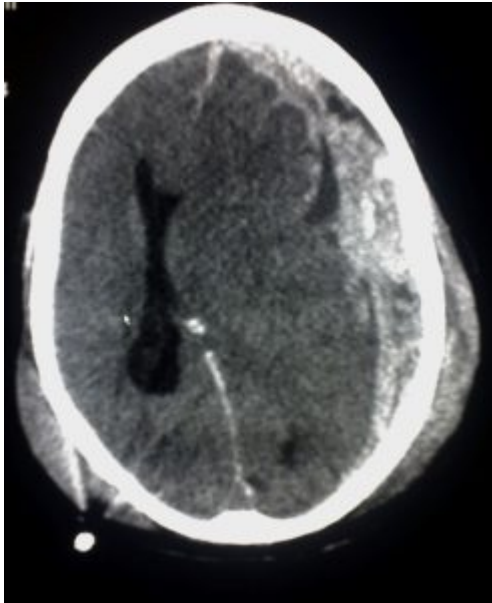


Image: "This CT scan is an example of subdural hemorrhage caused by trauma." by Glitzy queen00.
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Subdural hemorrhages occur **below the dura mater** and are usually **more chronic** compared to epidural hemorrhages.

Epidemiology

Subdural hemorrhages usually occur in **car accidents**. When the rapid head movement in one direction is suddenly stopped, for example, in a car accident or child abuse, leakage/tearing of veins leads to blood accumulating below the dura mater.

The **etiology** of subdural hematoma is **different in different age groups**. Subdural hematoma in infants is due to non-accidental injury, in young adults, the causes are a bike or car accidents and in old age subdural bleed usually follows after a fall. Minor head trauma can also cause subdural hemorrhage in patients receiving anticoagulants.

Subdural hemorrhage occurs **between dura and arachnoid mater** and involves the **tearing of bridging veins**. Leakage of **blood** from the bridging veins causes the accumulation of blood below the dura mater **compressing the brain matter and raising the intracranial pressure**. A **crescent-shaped** subdural hematoma that **can cross suture lines** is seen on the CT scan.

In contrast to epidural hematoma, subdural hematomas can cross the suture lines but are **limited by reflections of dura mater**, (falx cerebri, tentorium, and falx cerebelli). A patient with a subdural hemorrhage usually presents with **severe headache** and **confusion**.

Clinical features

- Small-sized subdural hematomas can be asymptomatic and managed without surgical evacuation.
- A large acute subdural hematoma can present with stupor or coma, hemiparesis, and unilateral pupillary enlargement and causes significant

morbidity and mortality despite surgical evacuation.

- Chronic or sub-acute presentation following minor or even unnoticed trauma can occur in elderly days to weeks after injury.

Subarachnoid Hemorrhage

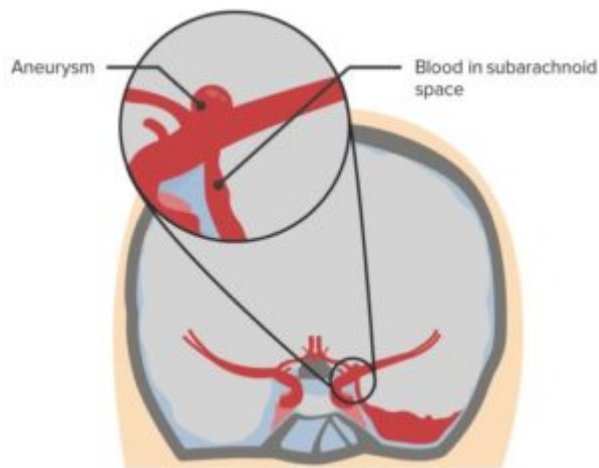


Image: "Subarachnoid hemorrhage in CT. One can see the blood hyperattenuating in the basal cisterns." by Hellerhoff. License: [CC BY-SA 3.0](https://creativecommons.org/licenses/by-sa/3.0/)

This type of hemorrhage occurs in the **subarachnoid space just outside the pia mater**. Patients with subarachnoid hemorrhages present with **severe, sudden and sharp headache followed by vomiting and unconsciousness** (commonly referred to as "the worst headache of their life"). This type of intracranial hemorrhage can be associated with a family history. It is also common in [alcoholics and drug abuse](#) patients.

One of the causes of subarachnoid hemorrhage is a **rupture of an aneurysm or arteriovenous malformations** in the brain. Aneurysms in the brain include saccular (berry) aneurysms, fusiform aneurysms, and microaneurysms (Charcot-Bouchard). Almost 2% of adults have intracranial aneurysms Reference: Harrison's 20/e).

Saccular (berry) aneurysms vary in size from a few mm to cm {classified as small-less than 10 mm, large-10 to 25mm, and giant-greater than 25 mm} (Reference: Harrison's 20/e) are spherical shaped and involve only a portion of the vessel wall (they look like a berry popping out of a vessel). They can often **contain a thrombus**.



"Subarachnoid Hemorrhage. Structural and Clinical Considerations" Image created by Lecturio

Charcot-Bouchard aneurysms are microaneurysms, which occur in small blood vessels (< 300-micrometer diameter), most often the small vessels of the basal ganglia. They are associated with **chronic hypertension**. Common sites of aneurysms are in the **anterior cerebral artery** (part of the **Circle of Willis**) and at the **internal carotid artery**. The classical presentation of subarachnoid hemorrhage is a sudden, severe **"thunderclap" headache**. Urgent **neurological evaluation and intervention** are required. Even after the intervention, there is high incidence of mortality and permanent neurological deficits in severe cases. The severity of subarachnoid hemorrhage is graded from 1 to 5 using the Hunt-Hess/World Federation of Neurosurgical Societies classification.

Intracerebral Hemorrhage

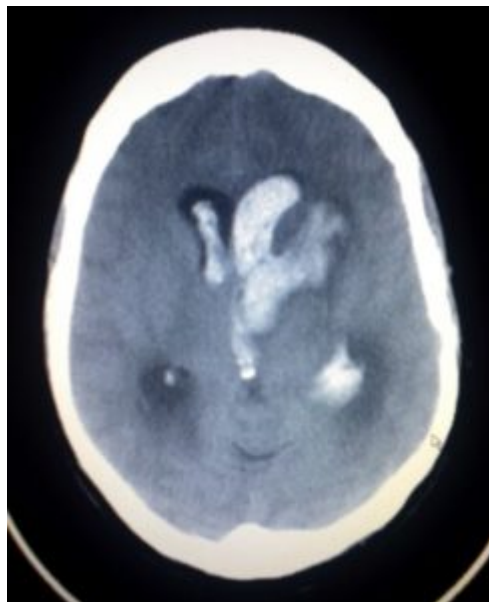


Image: "This image shows an intracerebral and intraventricular hemorrhage of a young woman. The woman was one week postpartum, with no known trauma involved." by Glitzy queen00. License: [Public Domain](#)

Bleeding inside the brain matter is called an intracerebral hemorrhage. Patients present with **neurological symptoms/deficits** depending on the area of the brain involved. Common symptoms include **headache, nausea, vomiting**, focal neurological

deficit and **altered state of consciousness**. These types of hemorrhages are usually associated with **hypertension**. 35–45% of patients with intracerebral hemorrhage die within 30 days.

Common sites for intracranial hemorrhage are basal ganglia (especially the putamen), thalamus, cerebellum, and pons.

Causes and risk factors of ICH

Lifestyle changes in the past decade have increased the risk of ICH. Numerous factors that can increase the risk of ICH include:

- Family history
- Alcohol abuse
- Uncontrolled hypertension
- Smoking
- Drug abuse particularly amphetamines and cocaine (increases BP)
- Coagulopathy
- Race: Asians/Blacks.

Investigation of choice

CT-scan of the head/brain is the investigation of choice for the diagnosis of intracranial hemorrhages because it is **fast and accurate enough** to diagnose bleeds, **specifically non-contrast CT-scan**.

Epidural - convex lens that does not cross the suture lines, can cross the midline

Subdural - concave lens that can cross the suture lines, can cross the midline

Subarachnoid - blood in lateral ventricles

Intracerebral - blood within brain matter

Emergency management of intracranial hemorrhage

- Airway management
- Blood pressure maintenance, systolic to less than 140mm using non-vasodilating IV drugs such as nicardipine, labetalol, or esmolol.
- Presumptive treatment for elevated ICP in especially stuporous or comatose patients: tracheal intubation and sedation, administration of osmotic diuretics such as mannitol or hypertonic saline, and elevation of the head of the bed while surgical consultation is obtained
- Reversal of coagulopathy
- Neurosurgical evaluation for surgical evacuation of the hematoma.

References

[Intracranial Hemorrhages](#) via healthline.com

[Intracranial Hemorrhage](#) via emedicine.medscape.com

[Intracranial Hemorrhage, Cerebral Hemorrhage and Hemorrhagic Stroke](#) via

my.clevelandclinic.org

[Extradural Haemorrhage](#) via radiopaedia.org

[Subdural Haemorrhage](#) via radiopaedia.org

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