NEUROLOGY *FOR* POSTGRADUATE MEDICAL STUDENTS

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Cerebrovascular Diseases
Part I

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STROKE

- The Definition Of Stroke
- Classification of Strokes

The Definition Of Stroke

The Definition Of Stroke

(It is impossible to cure a severe attack of apoplexy, and difficult to cure a mild one.)

Hippocratic Aphorism

Hippocrates could never have imagined the progress made in stroke care since this statement, yet the world is still unable to agree on a universal definition.

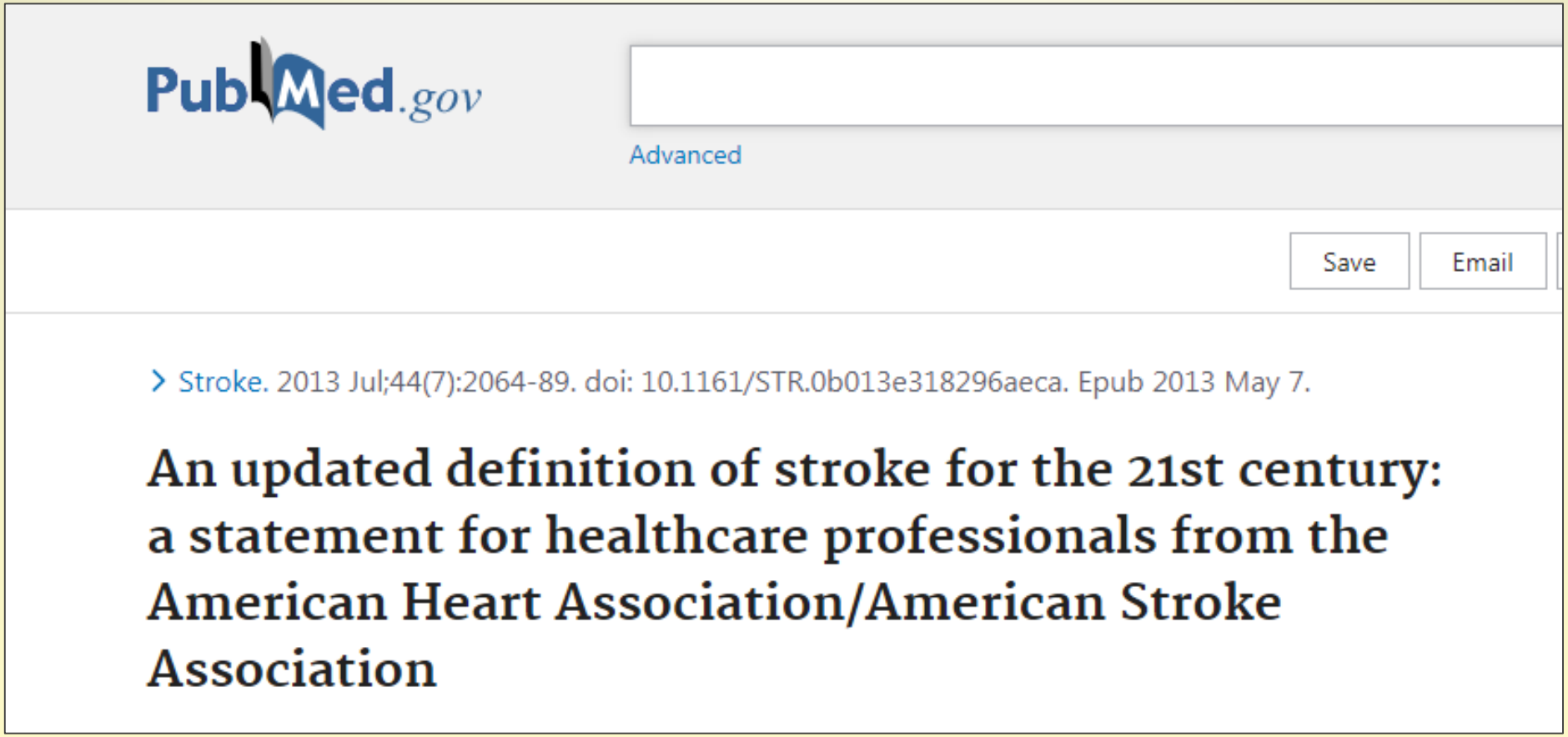
Stroke vs Apoplexy

- The first recorded use of **'stroke'** as a lay term was in 1599, attributing the sudden onset of symptoms to a **'stroke of God's hande'.**
- It was not adopted into the medical lexicon of the time and physicians used the term **'apoplexy',** a diagnosis that had been in existence since the Hippocratic writings.
- The word **'stroke'** is related to the Greek word **'apoplexia'** which implies being struck with a deadly blow, but it would be incorrect to draw direct parallels between our modern concept of stroke and what has been classically referred to as apoplexy.

The World Health Organization's Definition

- **In 1970, the World Health Organization defined stroke as:**
- 'rapidly developed **clinical** signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than of vascular origin'.
- **Although still widely used,** the World Health Organization definition relies heavily on clinical symptoms and is now considered outdated.

New definitions



New definitions

The term “stroke” should be broadly used to include all of the following:

- **Definition of CNS infarction**
- **Definition of ischemic stroke:**
- **Definition of silent CNS infarction:**
- **Definition of intracerebral hemorrhage:**
- **Definition of stroke caused by intracerebral hemorrhage:**
- **Definition of silent cerebral hemorrhage:**
- **Definition of subarachnoid hemorrhage:**
- **Definition of stroke caused by subarachnoid hemorrhage:**
- **Definition of stroke caused by cerebral venous thrombosis:**
- **Definition of stroke, not otherwise specified:**

New definitions

- **Definition of CNS infarction:** CNS infarction is brain, spinal cord, or retinal cell death attributable **to ischemia**, based on:
  1. Pathological, imaging, or other objective evidence of cerebral, spinal cord, or retinal focal ischemic injury in a defined vascular distribution; **or**
  2. Clinical evidence of cerebral, spinal cord, or retinal focal ischemic injury based on symptoms persisting ≥24 hours or until death, and other etiologies excluded.
- (Note: CNS infarction includes hemorrhagic infarctions, types I and II; see "Hemorrhagic Infarction.")

New definitions

- **Definition of ischemic stroke:** An episode of neurological dysfunction caused by focal cerebral, spinal, or retinal infarction. (Note: Evidence of CNS infarction is defined above.)
- **Definition of silent CNS infarction:** Imaging or neuropathological evidence of CNS infarction, without a history of acute neurological dysfunction attributable to the lesion.

New definitions

- **Definition of intracerebral hemorrhage:** A focal collection of blood within the brain parenchyma or ventricular system that is not caused by trauma.(Note: Intracerebral hemorrhage includes parenchymal hemorrhages after CNS infarction, types I and II—see “Hemorrhagic Infarction.”)
- **Definition of stroke caused by intracerebral hemorrhage:** Rapidly developing clinical signs of neurological dysfunction attributable to a focal collection of blood within the brain parenchyma or ventricular system that is not caused by trauma.

New definitions

- **Definition of silent cerebral hemorrhage:** A focal collection of chronic blood products within the brain parenchyma, subarachnoid space, or ventricular system on neuroimaging or neuropathological examination that is not caused by trauma and without a history of acute neurological dysfunction attributable to the lesion.

New definitions

- **Definition of subarachnoid hemorrhage:** Bleeding into the subarachnoid space (the space between the arachnoid membrane and the pia mater of the brain or spinal cord).
- **Definition of stroke caused by subarachnoid hemorrhage:** Rapidly developing signs of neurological dysfunction and/or headache because of bleeding into the subarachnoid space (the space between the arachnoid membrane and the pia mater of the brain or spinal cord), which is not caused by trauma.

New definitions

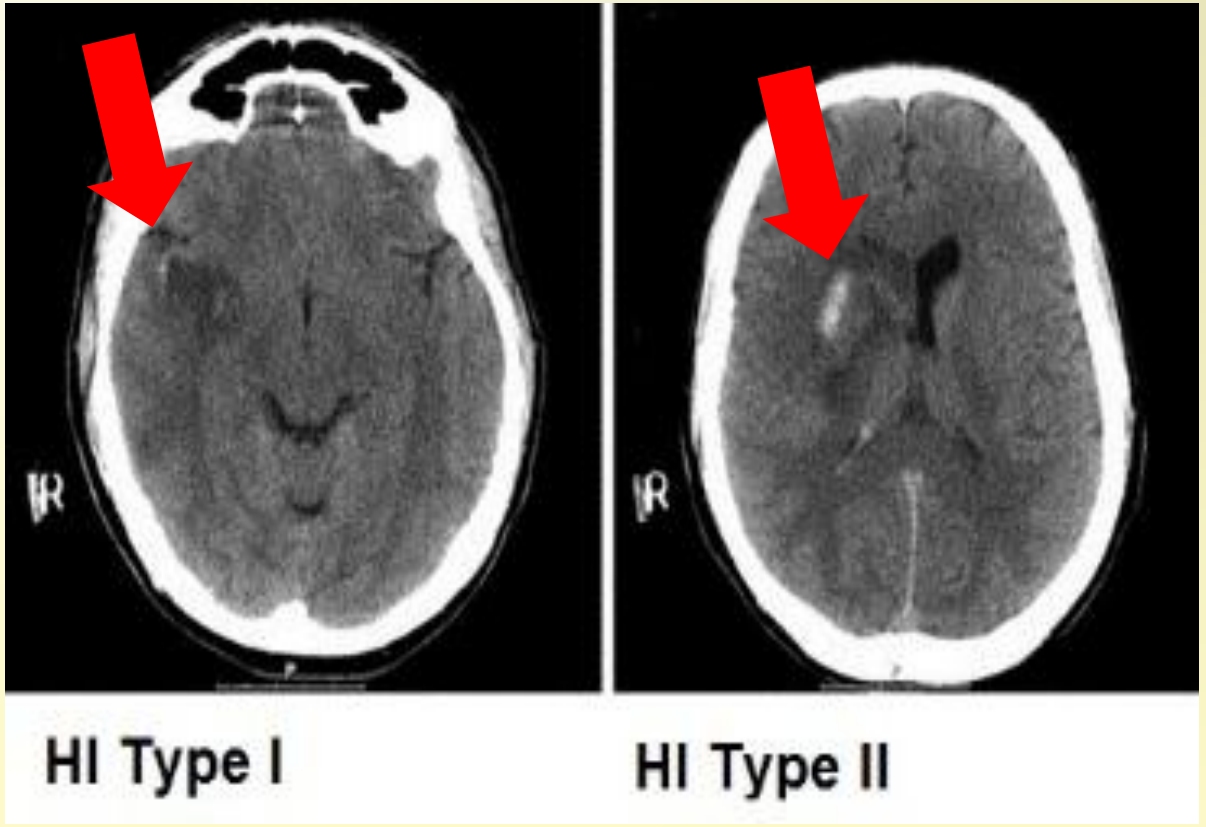
- **Definition of stroke caused by cerebral venous thrombosis:** Infarction or hemorrhage in the brain, spinal cord, or retina because of thrombosis of a cerebral venous structure. Symptoms or signs caused by reversible edema without infarction or hemorrhage do not qualify as stroke.
- **Definition of stroke, not otherwise specified:** An episode of acute neurological dysfunction presumed to be caused by ischemia or hemorrhage, persisting ≥24 hours or until death, but without sufficient evidence to be classified as one of the above.

Hemorrhagic Infarction

- **Hemorrhage may occur after infarction**, either **spontaneously** or caused by **antithrombotic or thrombolytic therapy**.
- **Hemorrhage after infarction ranges in severity** from minor petechial bleeding to hemorrhage causing mass effect and secondary injury.
- **This has been referred to as "hemorrhagic infarction," "hemorrhagic transformation of infarction," "hemorrhagic conversion of infarction,"** and **"intracerebral hemorrhage,"** which leads to confusion among clinicians.
- **A more standardized approach has been used** in clinical trials that is well suited for clinical practice as well: **Hemorrhagic Infarction** and **Parenchymal Hemorrhage**.

Hemorrhagic Infarction

- **Hemorrhagic infarction** is characterized by its lack of mass effect.
- **Hemorrhagic Infarction (HI) type I** is defined by scattered petechiae of blood along the margins of the infarction without a space-occupying effect.
- **Hemorrhagic Infarction (HI) type II** has confluent petechiae within the infarction but without a space-occupying effect.



Parenchymal Hemorrhage after Infarction

- **In contrast** to hemorrhagic infarction, **Parenchymal Hemorrhage** is defined by the presence of mass effect, similar to the ICH definition of a focal collection of blood.
- **Parenchymal Hemorrhage (PH) type I** is a confluent hemorrhage limited to ≤30% of the infarcted area with only mild space-occupying effect,

PH Type I

Parenchymal Hemorrhage after Infarction

- **Parenchymal Hemorrhage (PH) type II** is >30% of the infarcted area and/or exerts a significant space-occupying effect.
- **These parenchymal hemorrhages** may present with signs and symptoms of mass effect and may require reversal of antithrombotic therapy, aggressive antihypertensive therapy, and/or anti-edema therapy, all of which are distinctly atypical for infarctions but are common recommendations for the treatment of ICH.
- **Therefore, parenchymal hemorrhages** should be considered ICHs.

PH Type II

Differentiating stroke and Transient Ischaemic Attacks (TIAs)

- In the 1960s, **Transient Ischaemic Attacks (TIAs)** were considered to be:

  Sudden onset of a focal neurologic symptom and/or sign lasting less than 24 hours and caused by reversible cerebral ischemia.

- A stroke was considered to have occurred if a neurological deficit remained for more than seven days.
- Those neurological events that lasted between 24 h and the seven-day stroke threshold were classified as a **Reversible Ischaemic Neurological Deficit** – a term now rendered obsolete.
- Its removal from the clinical lexicon arose when it was proven that most events lasting 24 h to seven days were associated with cerebral infarction and thus should carry the diagnosis of stroke.

New definition of Transient Ischemic Attacks (TIAs)

- **Transient ischemic attack (TIA)** is now defined as a transient episode of neurologic dysfunction caused by focal brain, spinal cord, or retinal ischemia, without acute infarction

Classification of Strokes

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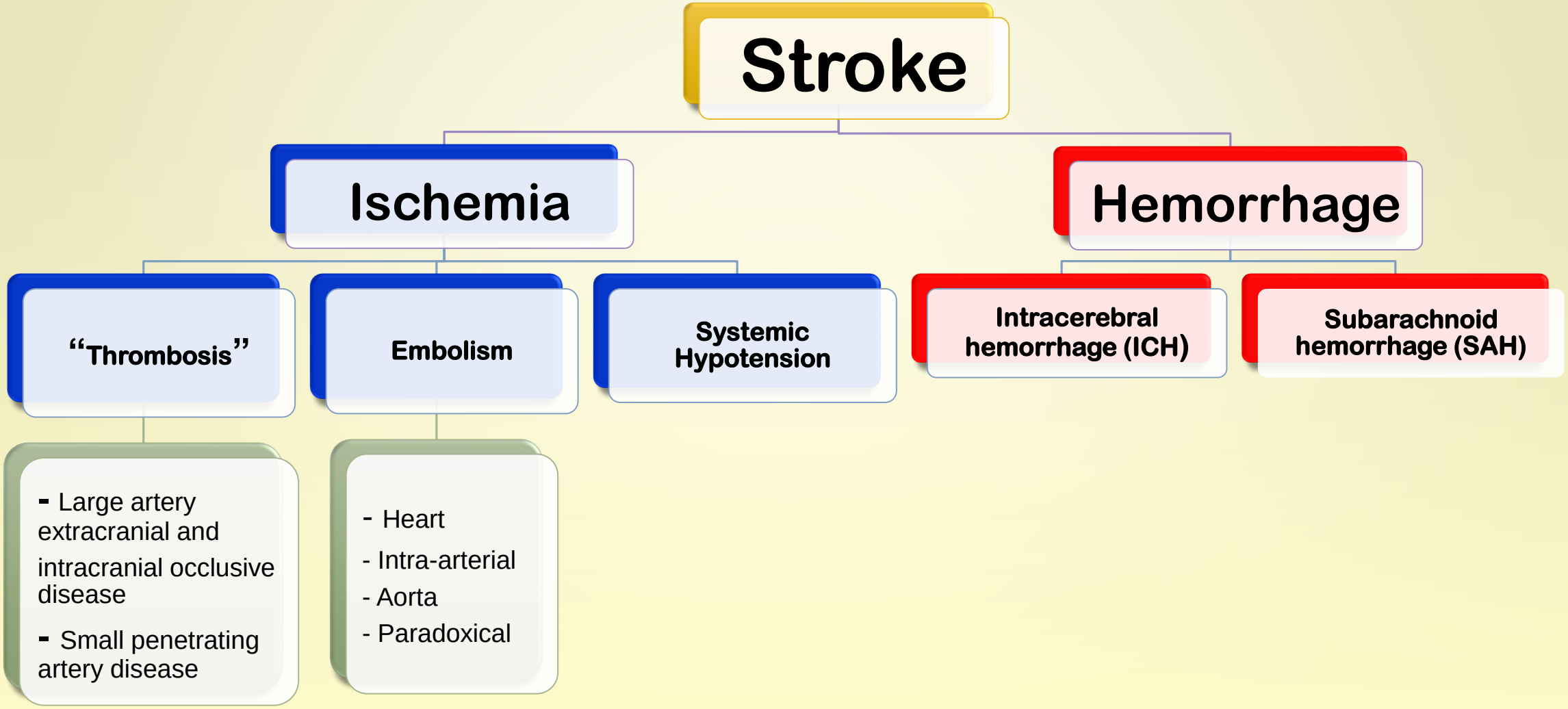

Ischemia

- Brain ischemia results from the occlusion of cervicocranial vessels or hypoperfusion to the brain caused by various processes: atherothrombosis, embolism, or hemodynamic instabilities.
- **Atherothrombosis** occurs in the large cervicocranial arteries in the neck and head and in the small penetrating arteries of the brain.
- **A localized thrombus** is formed in situ on an atherosclerotic arterial narrowing; it impedes distal blood flow and causes ischemia and ensuing infarction of the brain tissue supplied by the artery.
- **The neurological symptoms and signs** depend on the location of the brain vessel affected.

Ischemia

- **In Brain Embolism**, a brain artery is suddenly blocked by embolic material that has developed more proximally in the **heart (cardiogenic)**, **aorta**, **proximal arteries (intraarterial),** or **venous system (paradoxical)**.
- **These donor sites give rise to** various types of particulate matter (white platelet-fibrin and red erythrocyte-fibrin thrombi, cholesterol crystals, fragments of atherosclerotic plaques, calcific fragments of valves and plaques, air, fat, myxomatous tumor fragments, and bacterial vegetations), which then travel within the cervicocranial arteries to reach a recipient site.
- **If the embolic material lodges at a recipient site**, the resulting hypoperfusion causes an infarct that often becomes hemorrhagic when the embolus moves distally or fragments and reperfusion occurs.
- **The clinical findings depend on** the location of the recipient brain artery affected.

Ischemia

- **Watershed infarction** develops when cerebral blood flow is critically lowered (too severe to be compensated by cerebral autoregulation mechanisms), as in cardiac pump failure or severe hypovolemia.
- During such episodes, most patients are hypotensive and infarction develops in the border zones between the major cerebral arteries.
- There is also widespread bilateral cerebral dysfunction.

Hemorrhage

- **Rupture of a brain vessel causes leakage of blood into** the brain parenchyma, cerebrospinal fluid (CSF) spaces around the brain, or both.
- Bleeding injures the neighboring tissues by interrupting and cutting vital brain pathways, by exerting local pressure on the surrounding brain structures, and by causing ischemia of tissues adjacent to the hematoma.
- Further increase in intracranial pressure (ICP) causes shifts and herniations of brain tissues and may compress the brain stem.
- **There are two large subcategories** of spontaneous intracranial hemorrhages.
- **Intracerebral Hemorrhage (ICH)** is bleeding in the brain parenchyma, and **Subarachnoid Hemorrhage (SAH)** refers to bleeding around the brain into the subarachnoid spaces and CSF.
- **These two types of hemorrhages** have different etiologies, clinical courses, and outcomes and thus require different management strategies.

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Thank You