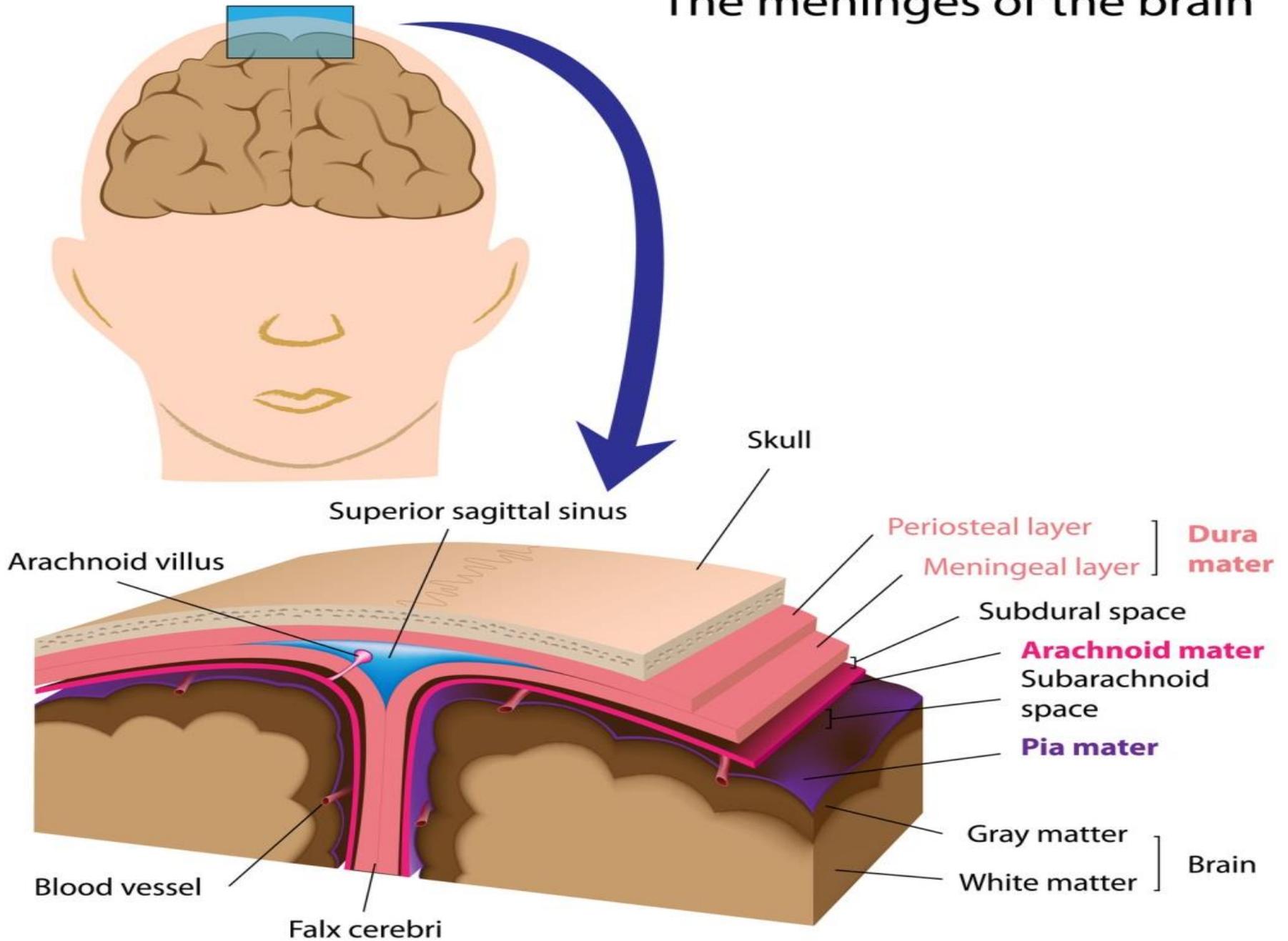


# **Stroke**

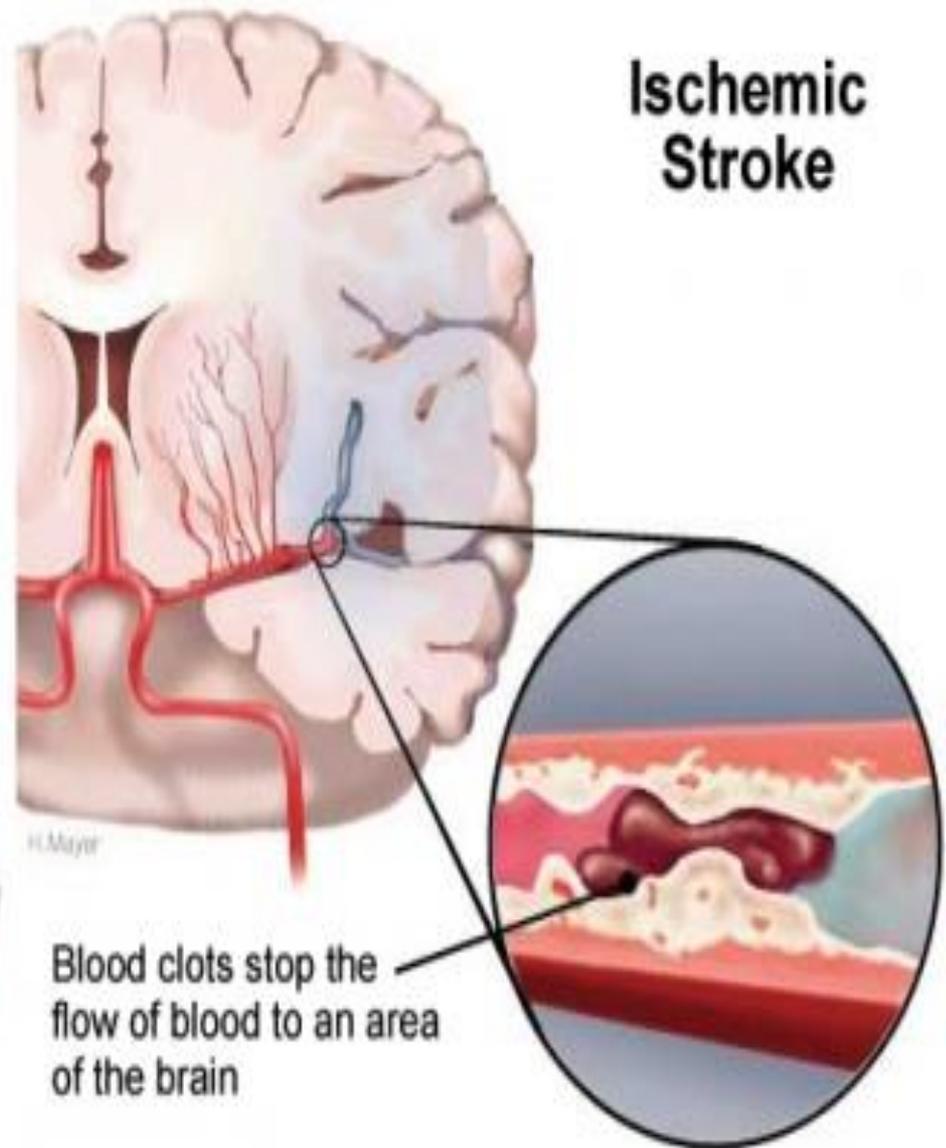
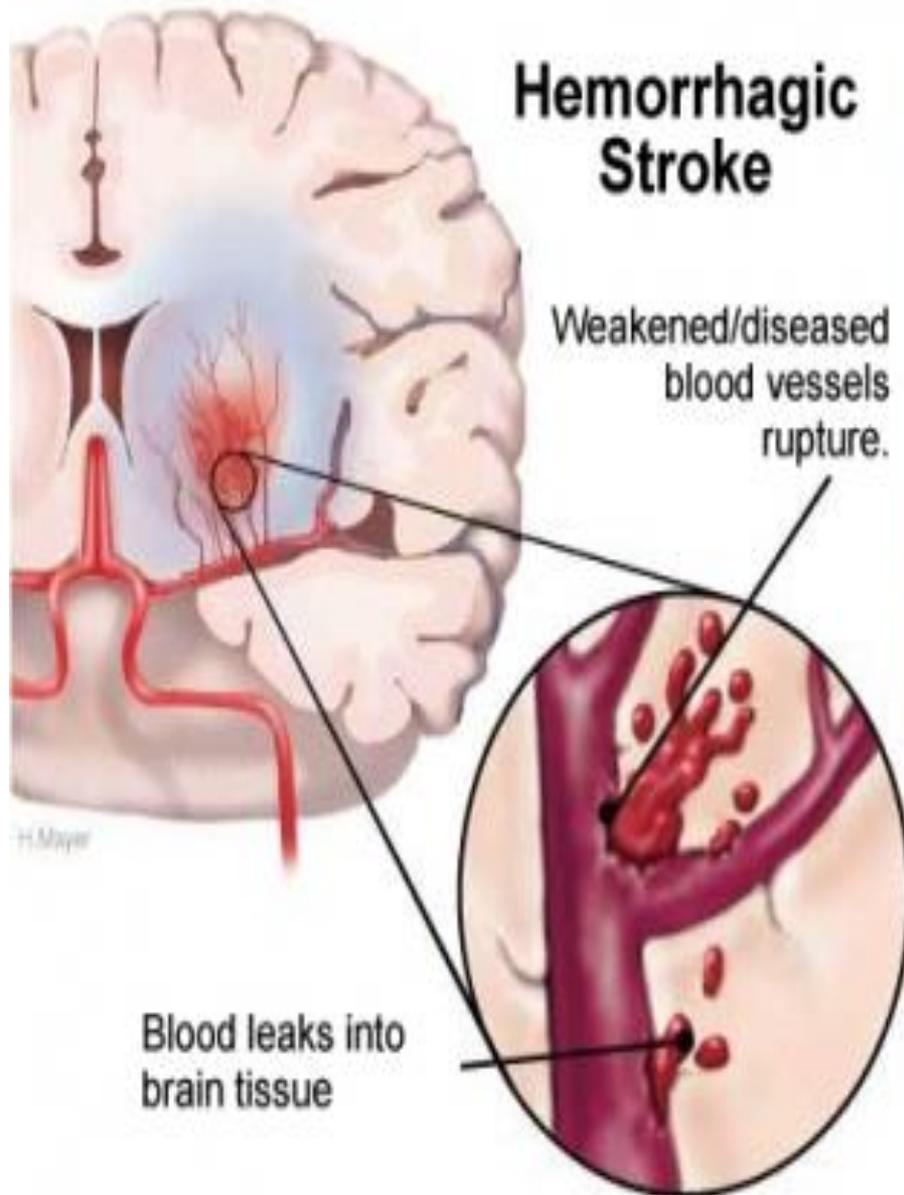
**By Dr. swathi swaroopa. B**

# The meninges of the brain

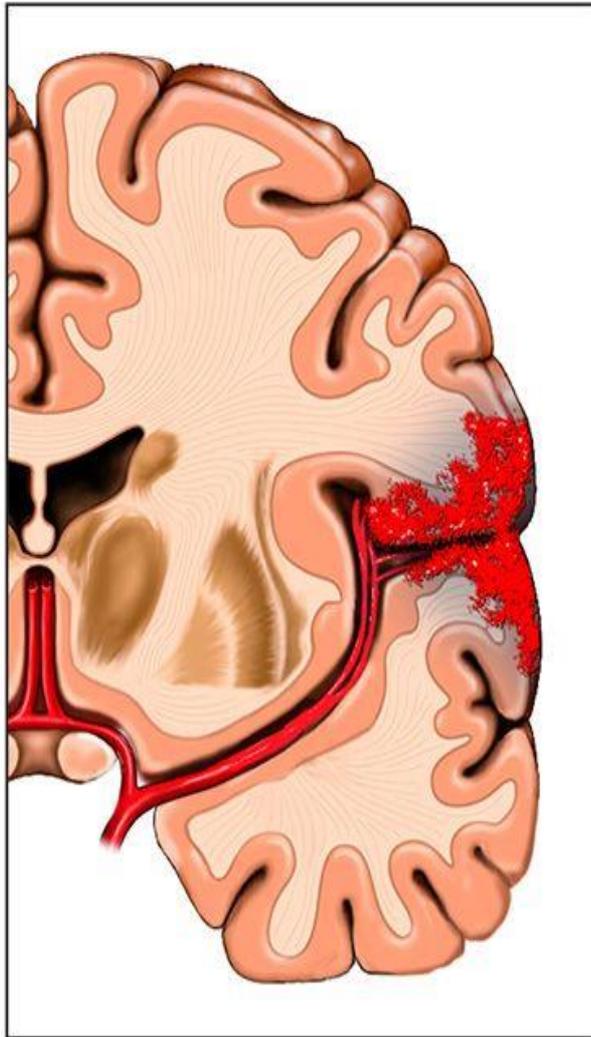


- **Stroke is defined as sudden onset of a focal neurologic deficit from a vascular mechanism**
- **Strokes are broadly classified as either hemorrhagic or ischemic**
  - **85% of strokes are ischemic**
  - **15% are primary hemorrhages**
    - **Subarachnoid hemorrhage**
    - **Intra parenchymal/cerebral hemorrhage**

# Ischemic & hemorrhagic Stroke

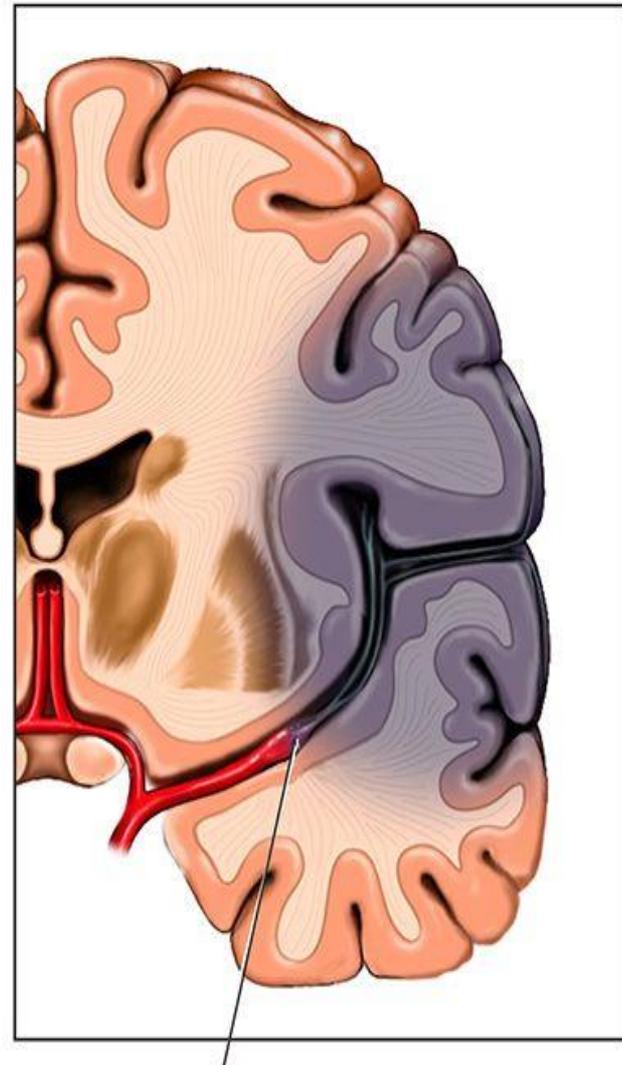


## Hemorrhagic Stroke



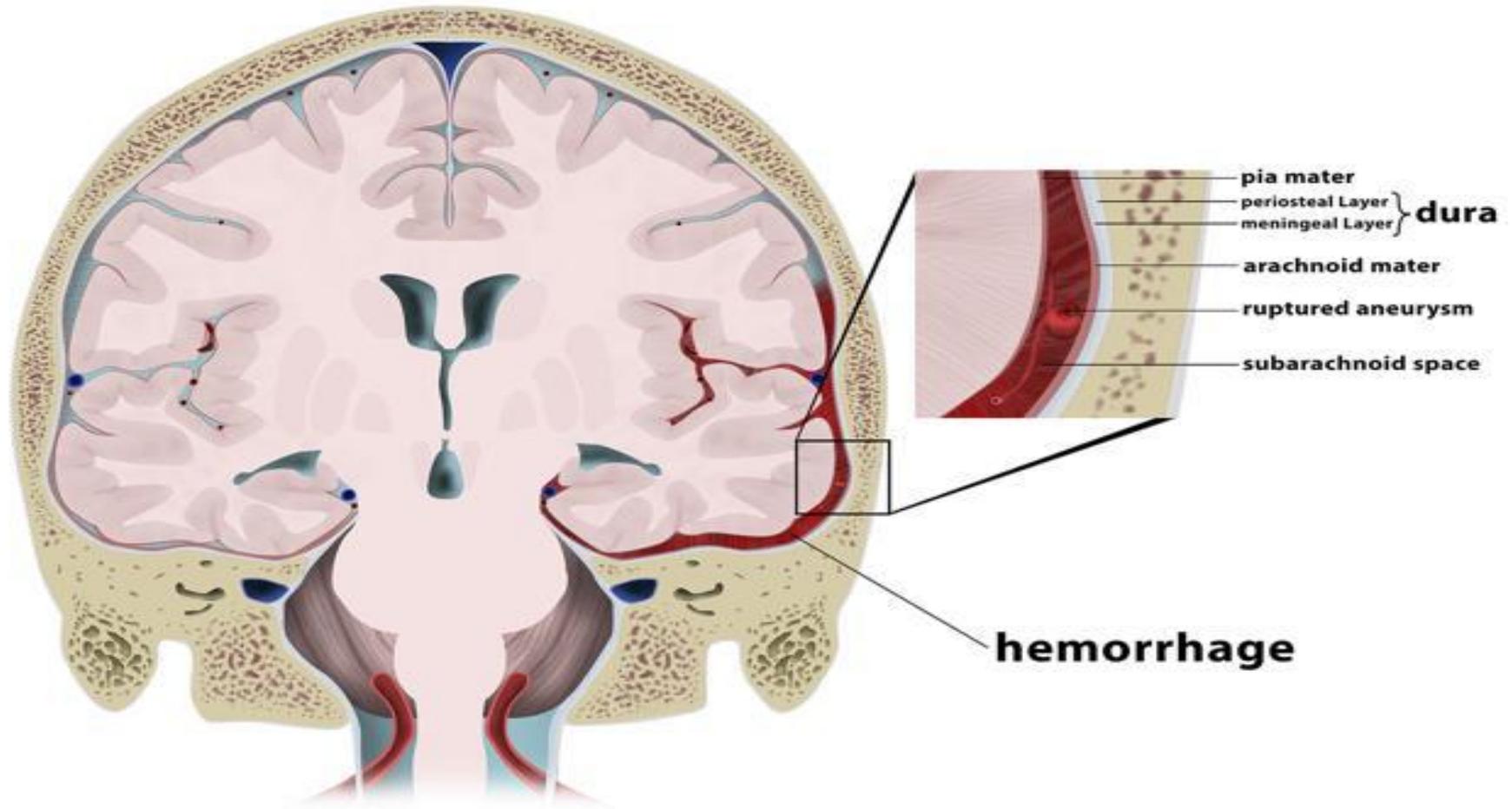
Hemorrhage/blood leaks  
into brain tissue

## Ischemic Stroke



Clot stops blood supply  
to an area of the brain

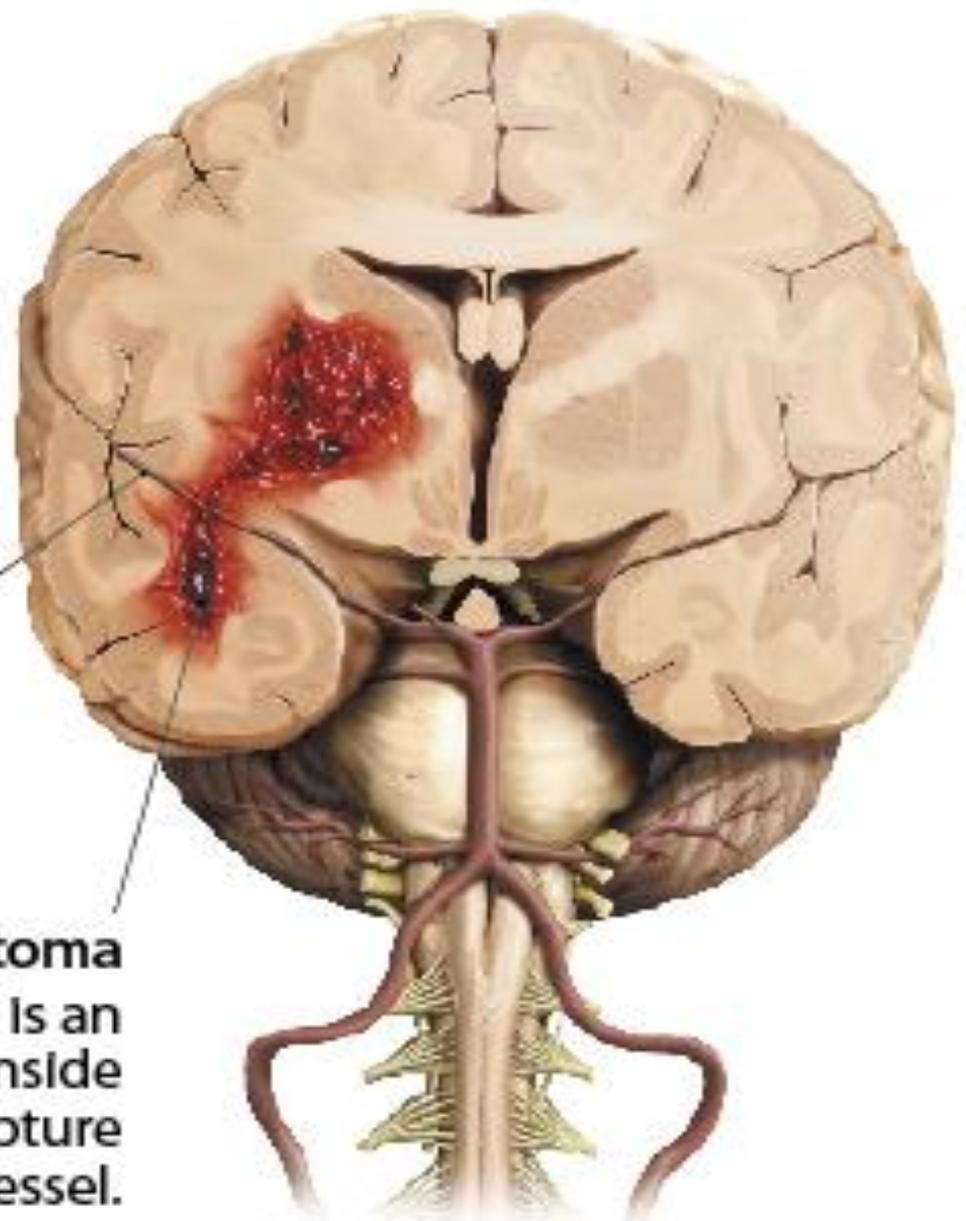
# Subarachnoid Hemorrhage



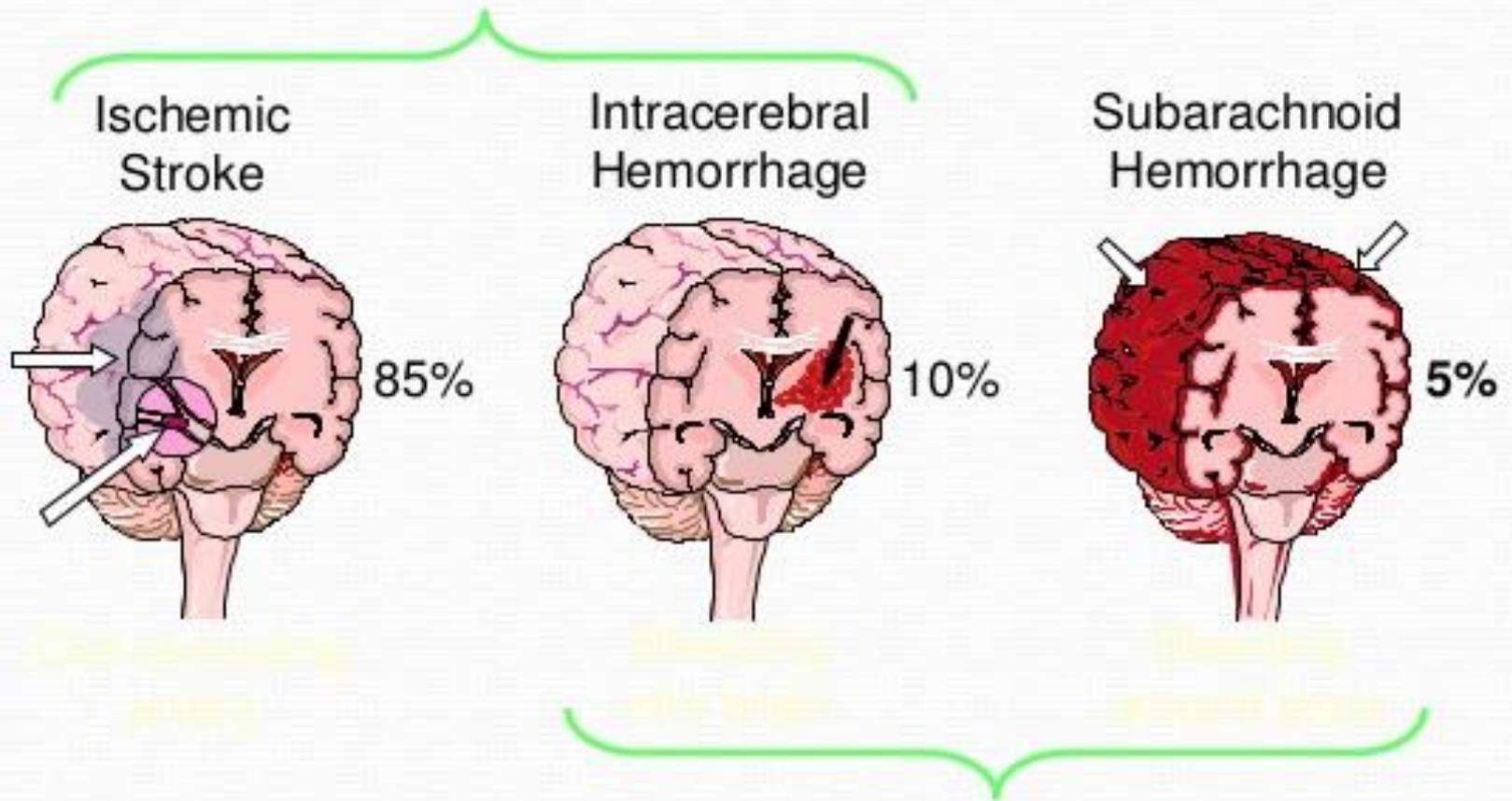
# Intracerebral hemorrhage

**Ruptured cerebral artery**

**Intracerebral hematoma**  
Intracerebral hematoma is an accumulation of blood inside the brain, caused by the rupture of a blood vessel.



# THREE STROKE TYPES



- **Strokes are the leading cause of serious long-term disability and the second leading cause of death world wide**
- **Men are at higher risk for stroke than women;**

# Ischemic Stroke

- Ischemic strokes are caused either by local **thrombus formation or by embolic phenomenon**, resulting in occlusion of a cerebral artery
- **Atherosclerosis**, particularly of the cerebral vasculature, is important cause, although 30% are cryptogenic
- **Emboli** can arise either from **intra- or extracranial arteries**

- **Cardiogenic embolism** is presumed to have occurred if the patient has concomitant
- **Atrial fibrillation,**
- **Valvular heart disease, or**
- **Any other condition of the heart that can lead to clot formation**

# Risk factors

- **Non-modifiable risk factors or risk markers**
  - **Age - Although stroke often is considered a disease of elderly 1/3<sup>rd</sup> of strokes occur in persons < 65 years**
  - **Gender - Men are at higher risk**
  - **Race - African Americans, Asian-Pacific Islanders, and Hispanics experience higher death rates**
  - **Family history of stroke**

- **Modifiable, well-documented**
  - **Hypertension—single most important risk factor for ischemic stroke**
  - **Atrial fibrillation—most important and treatable cardiac cause of stroke**
  - **Diabetes—-independent risk factor**
  - **Dyslipidemia**

- **Cigarette smoking & Alcohol abuse**
- **Sickle cell disease**
- **Asymptomatic carotid stenosis**
- **Postmenopausal hormone therapy**
- **Lifestyle factors—associated with stroke risk →  
Obesity, physical inactivity, diet**

- **Potentially modifiable, less-well documented**
  - **Oral contraceptives**
  - **Migraine**
  - **Drug abuse (cocaine)**
  - **Hemostatic and inflammatory factors—fibrinogen linked to increased risk**
  - **Homocysteine**

# Signs and Symptoms

- The patient may complain of **weakness on one side of the body, inability to speak, loss of vision, vertigo, or falling**

# Pathogenesis

- On the macroscopic level, ischemic stroke most often is caused by extracranial **embolism or intracranial thrombosis**, but it may also be caused by **decreased cerebral blood flow**
- On the cellular level, any process that disrupts blood flow to a portion of the brain initiates an
- **Ischemic cascade** → **death of neurons** → **cerebral infarction**



- Normal cerebral blood flow averages **50 mL/100g/min** and is maintained by a process called *cerebral autoregulation*
- Cerebral blood vessels **dilate and constrict in response to changes** in blood pressure, but this process can be impaired by atherosclerosis and acute injury, such as stroke

- When local cerebral **blood flow decreases below 20 mL/100g/min, ischemia ensues,**
- further reductions **below 12 mL/100g/min persist → *infarction***
- Tissue that is **ischemic but maintains membrane integrity** is referred to as **the ischemic *penumbra*** - potentially salvageable through therapeutic intervention

# Ischemic cascade

- **Reduction in blood flow → ischemia → reduction in nutrients to the ischemic cell → depletion of the high-energy phosphates (ATP) necessary for the maintenance of membrane integrity**
- **Subsequently, extracellular  $K^+$  accumulates; at the same time that  $Na^+$  and water are sequestered intracellularly → cell swelling and eventual lysis**
- **Electrolyte imbalance → depolarization of the cell and influx of calcium into the cell**

- The **depolarization of the neuron** → excess release of excitatory amino acids, such as glutamate and aspartate → neuronal damage
- **Increased intracellular calcium** → activation of lipases, proteases, and endonucleases and the release of FFA from membrane phospholipids
- **The accumulation of FFA**, including arachidonic acid, results in the formation of PGs, LTs, and free radicals

-

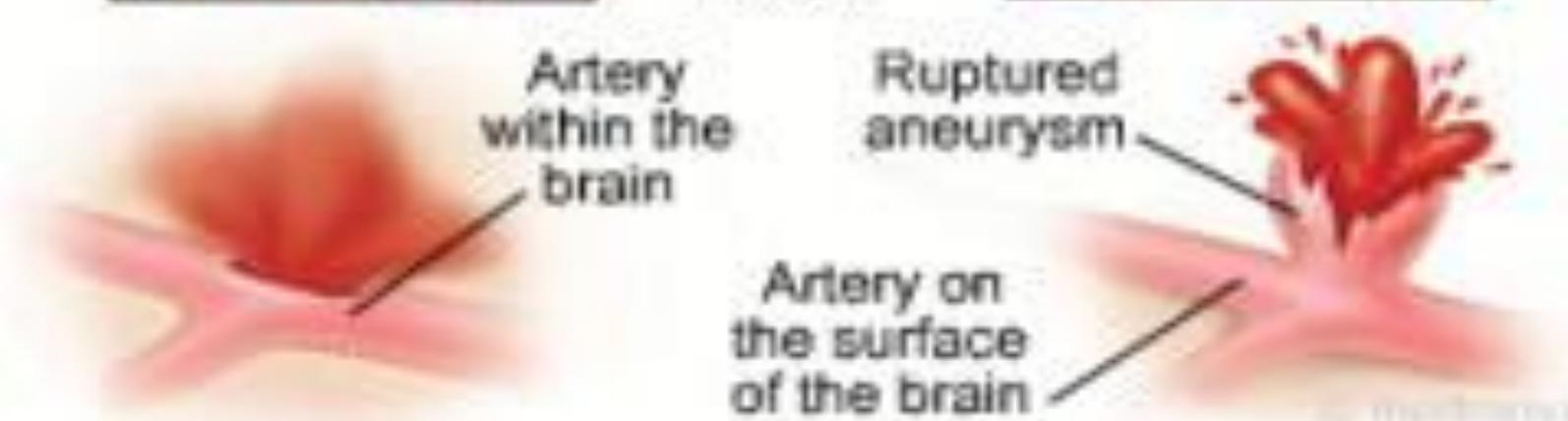
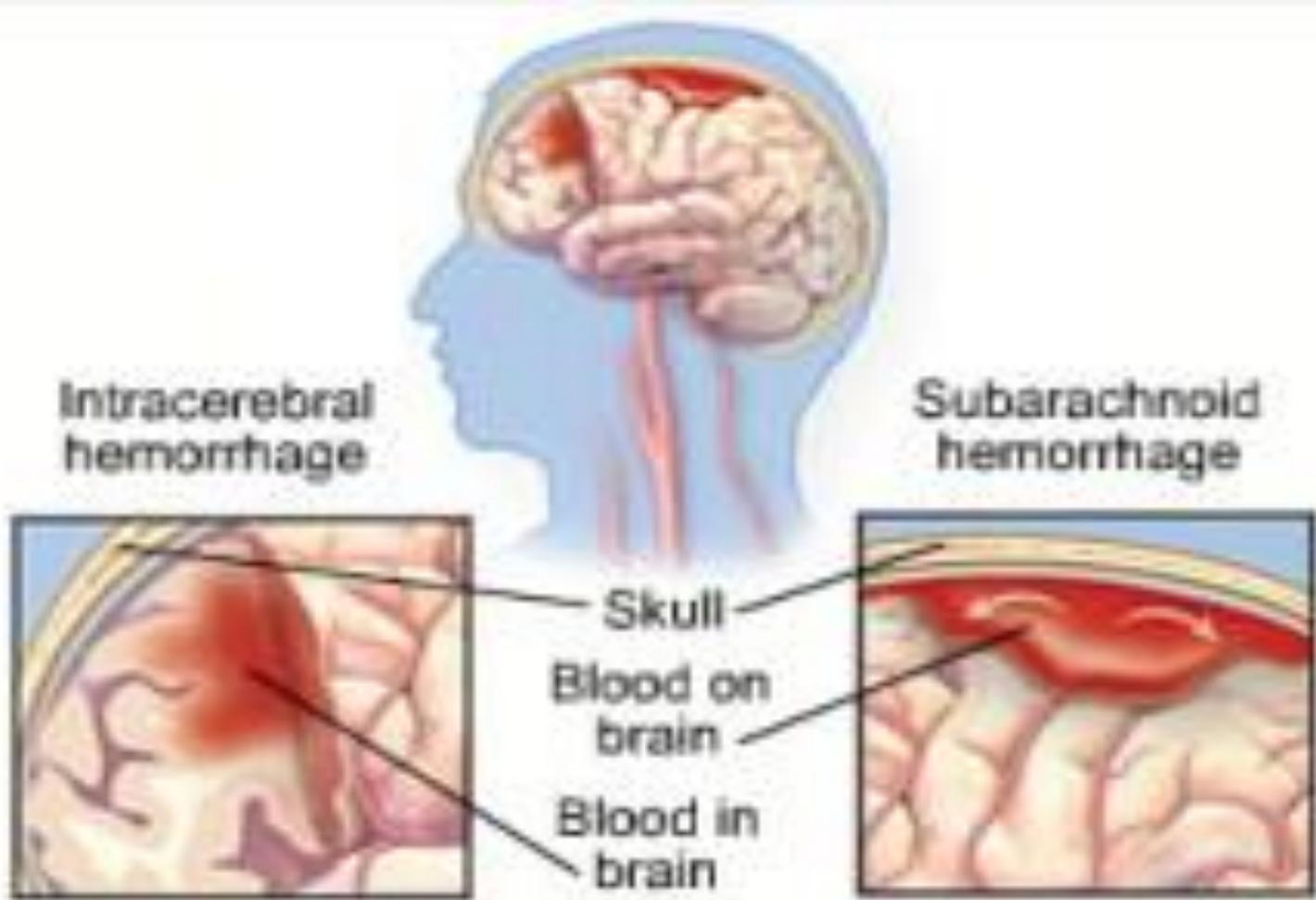
- In ischemia, the magnitude of free-radical production overwhelms normal scavenging systems → reactive molecules → attack cell membranes and contribute to the mounting **intracellular acidosis**
- All these events occur within 2 to 3 hours of the onset of ischemia and contribute to the **ultimate cell death**
- Later processes include **influx of activated inflammatory cells**, starting from 2 hours after the onset of ischemia and lasting for several days
- Also, the **initiation of apoptosis**, is thought to occur many hours after the acute insult and can **interfere with recovery and repair of brain tissue**

# **Hemorrhagic Stroke**

- **It is the third leading cause of death and the first leading cause of disability**
- **Morbidity is more severe and mortality rates are higher for hemorrhagic stroke than for ischemic stroke;**
- **Approx 50% of all deaths occur within the first 48 hours**

# Types

- *ICH* – 85%
- *SAH* – 15%



# Causes

- **Hypertension (up to 60% of cases)**
- 
- **Advanced age (risk factor)**
- 
- **Cerebral amyloidosis (in elderly up to 10%)**
- 
- **Coagulopathies**
- 
- **Anticoagulant therapy**
- 
- **Thrombolytic therapy for acute MI and acute ischemic stroke (can cause iatrogenic hemorrhagic stroke)**

- **Abuse of cocaine and other sympathomimetic drugs**
- 
- **Arteriovenous malformation**
- **Intracranial aneurysm**
- **Vasculitis**
- **Intracranial neoplasm**
- **History of prior stroke (risk factor)**

# Pathophysiology

- In HS, **bleeding occurs directly into the brain parenchyma**
- Presence of **blood in the brain parenchyma causes damage to the surrounding tissue** through the mechanical effect it produces and **the neurotoxicity of the blood components and their degradation products**
- Because of the mass effect, **increase in intra-cranial pressure results**

- **Hemorrhage volumes >60 mL are associated with 71% to 93% mortality at 30 days**
- **Much of the early mortality of hemorrhagic stroke (up to 50% at 30 days) is caused by the abrupt increase in intracranial pressure that can lead to herniation and death**
- **Early and late edema contributes to worsened outcome after intra-cerebral hemorrhage**

# Signs and Symptoms

- **Vary depending on the area of the brain affected and the extent of the bleeding**
- **More likely to exhibit symptoms of increased intracranial pressure**
  - **Headache, often severe and sudden onset**
  - **Nausea and/or vomiting**
- **Seizures are more common in hemorrhagic stroke**

- **Focal neurologic deficits**

- The type of deficit depends upon the area of brain involved
- If **dominant hemisphere** is involved → right hemiparesis, right hemisensory loss, left gaze preference, right visual field cut, and aphasia may result; and vice versa
- If the **cerebellum** is involved, the patient is at high risk of **herniation and brainstem compression**
- Other signs of **cerebellar or brainstem** involvement include the following:
  - Gait or limb ataxia
  - Vertigo or tinnitus
  - Nausea and vomiting

# The Results of Intracranial Hemorrhage

## Subdural Hemorrhage

Marked midline shift of ventricles and brain tissue

Contusions

Cerebral ventricles

Brain

Skull

L

R

Brain tissue is compressed as the hematomas expand



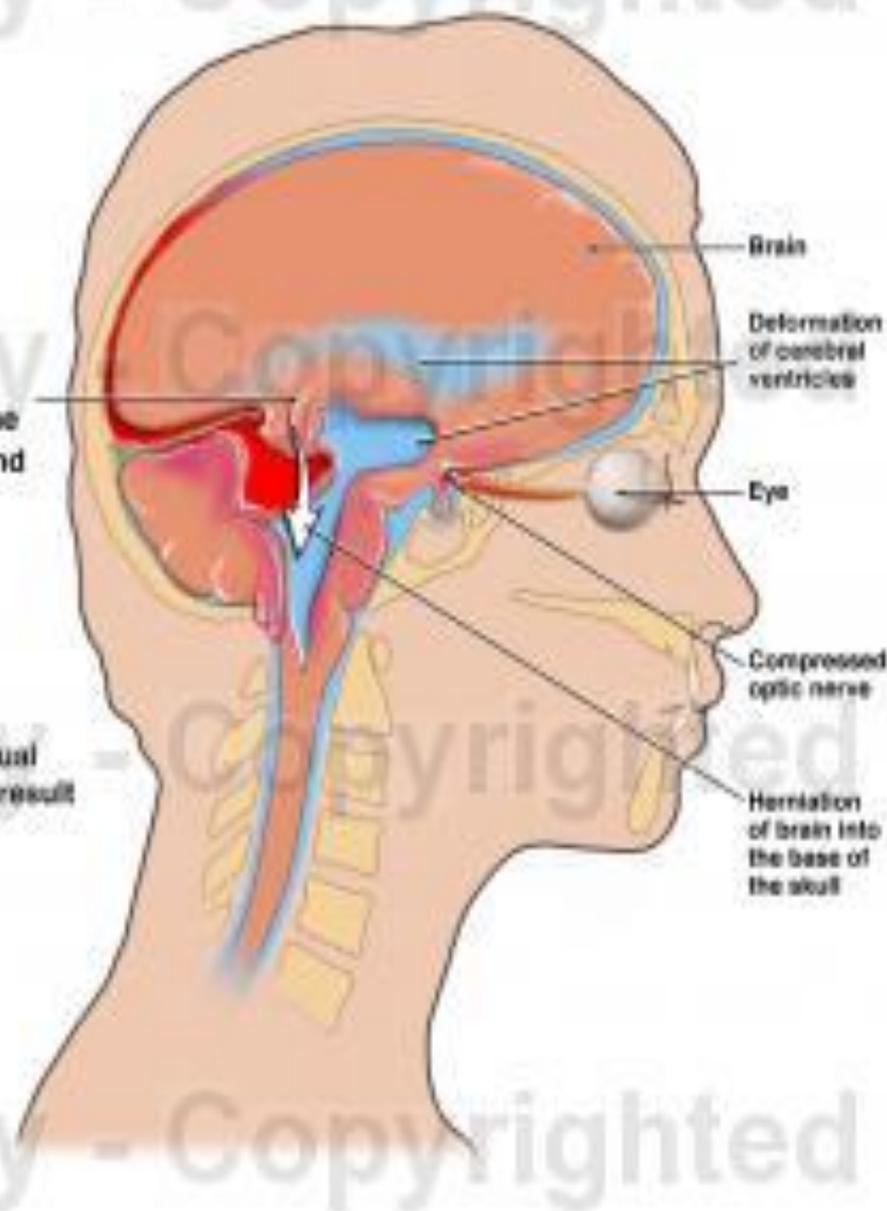
Cognitive and visual impairments that result are permanent

## Intracerebral Hemorrhage

Contusions

Brain

Skull



**F**ace



**A**rm



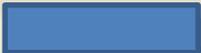
**S**peech



**Is it a stroke?  
Check these signs  
FAST!**

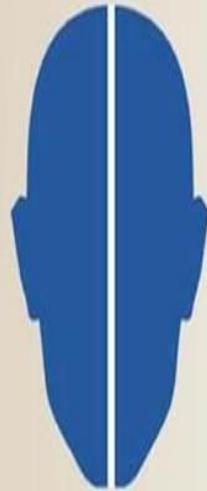
**T**ime



**Call  at any sign of stroke.**

# STROKE SYMPTOMS

[www.stroke.org](http://www.stroke.org)



**SUDDEN**  
numbness or  
weakness of  
face, arm or leg,  
especially on one  
side of the body



**SUDDEN**  
confusion,  
trouble  
speaking or  
understanding



**SUDDEN**  
trouble  
seeing in one  
or both eyes



**SUDDEN**  
trouble walking,  
dizziness, loss  
of balance or  
coordination



**SUDDEN**  
severe  
headache  
with no  
known cause

**Act FAST and CALL 9-1-1 IMMEDIATELY**