Cerebrovascular diseases (transient disorders of cerebral circulation, ischemic and hemorrhagic strokes).

Cerebral Circulation

- Blood flow to CNS
  - delivers O_2, glucose, nutrients
  - removes CO_2, lactic acid, metabolites
- Cerebral vasculature
  - unique anatomy & physiology
  - safety mechanisms
- Brain highly vulnerable to disrupted blood flow

Brain Blood Supply Features

- High oxygen requirement.
  - Brain 2% of body weight - 15% of cardiac output
  - 20% of total body oxygen.
- Continuous oxygen requirement
  - Few minutes of ischemia - irreversible injury.
- Neurons - Predominantly aerobic.

Cerebral autoregulation

- CBP remain constant despite moderate variations in perfusion pressure
- Cerebral autoregulation plays important protective role against hypoxia at low perfusion pressure and risk of brain edema at high arterial pressure
- Lower and upper limit of autoregulation at mean arterial pressure of 60 and 180 mmHg in normotensive human

What is a stroke?

A sudden onset of focal neurological deficit with signs and symptoms lasting greater than 24 hours (or resulting in death) where the cause is thought to be vascular

TIA

Transient neurological symptoms or signs lasting less than 24 hours which may serve as a warning sign of infarction in the next few weeks or months.

Stroke Risk Factors

- Age
- Gender
- Genetic predisposition
- Hx of Stroke or TIA

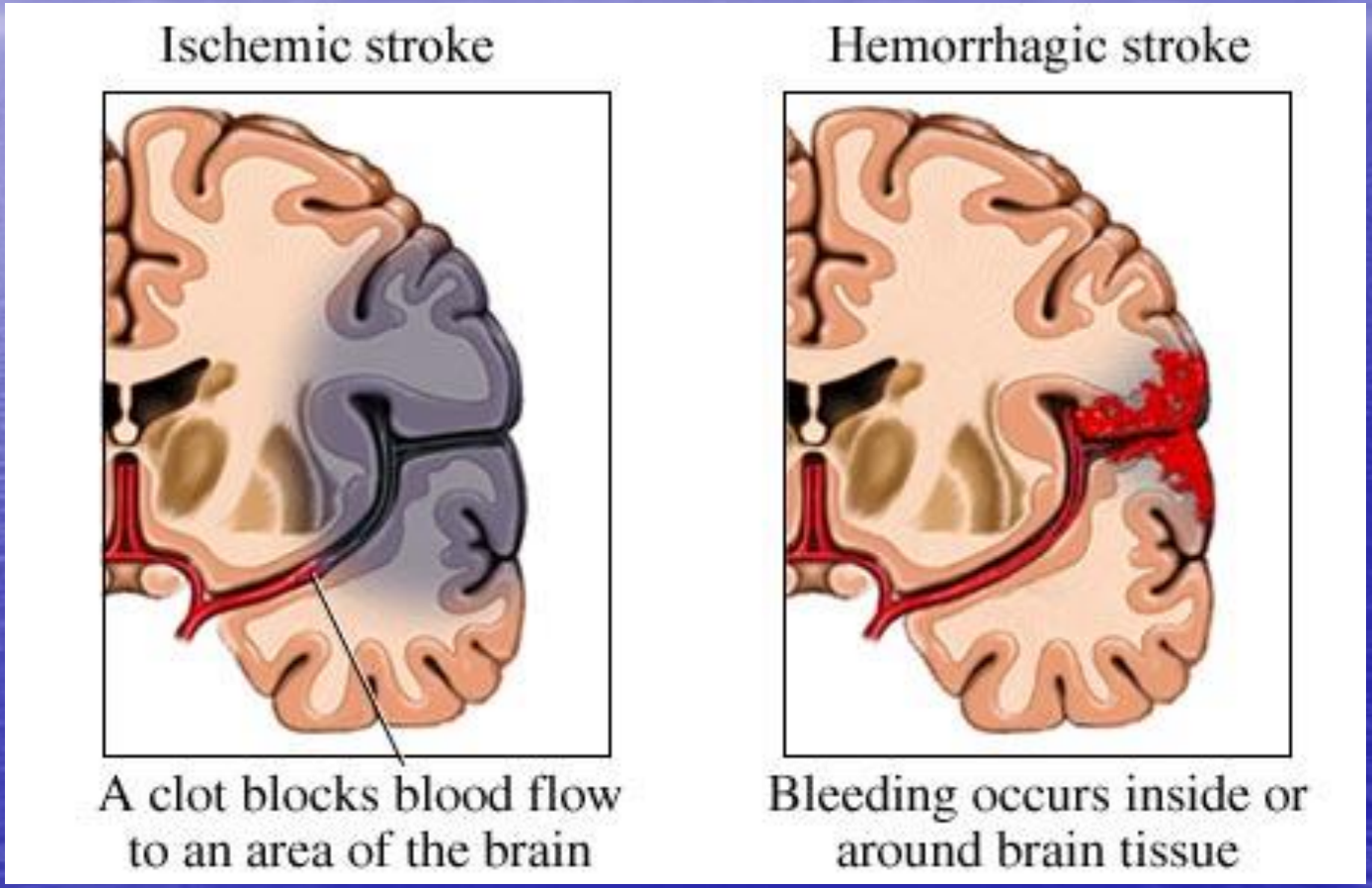
Stroke Risk Factors

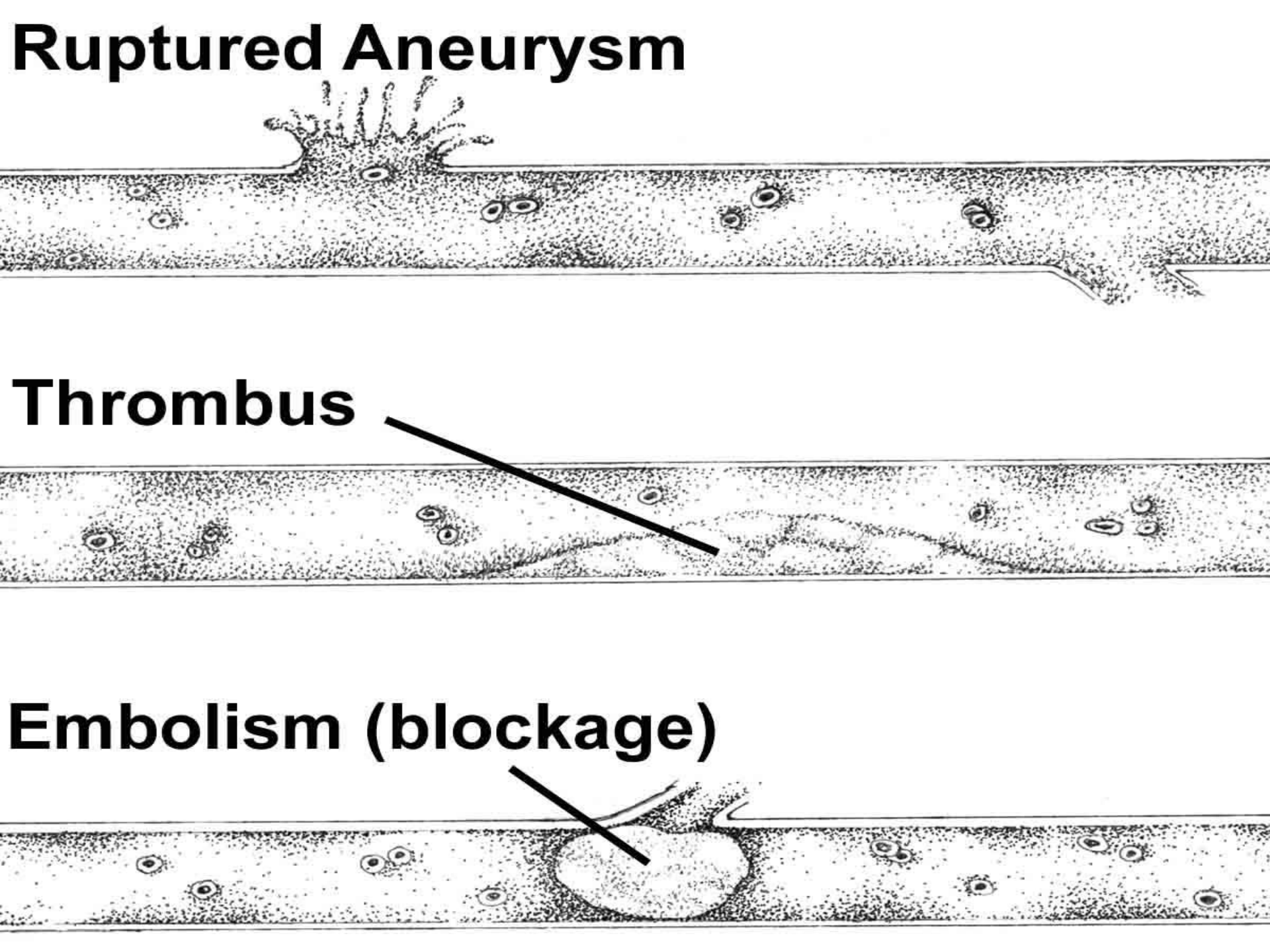
- Hypertension
- Cardiovascular Diseases
- Diabetes
- Hypercoagulable States
- Cigarette smoking
- Alcohol use
- Physical activity
- Diet

Six risk factors

- Myocardial infarction
- Atrial fibrillation
- Diabetes mellitus
- Blood lipids
- Asymptomatic carotid artery stenosis

Two Major Types




Ruptured Aneurysm
Thrombus
Embolism (blockage)

3 Types of ischemic strokes

1. Thrombotic stroke
2. Embolic stroke
3. Systemic Hypoperfusion

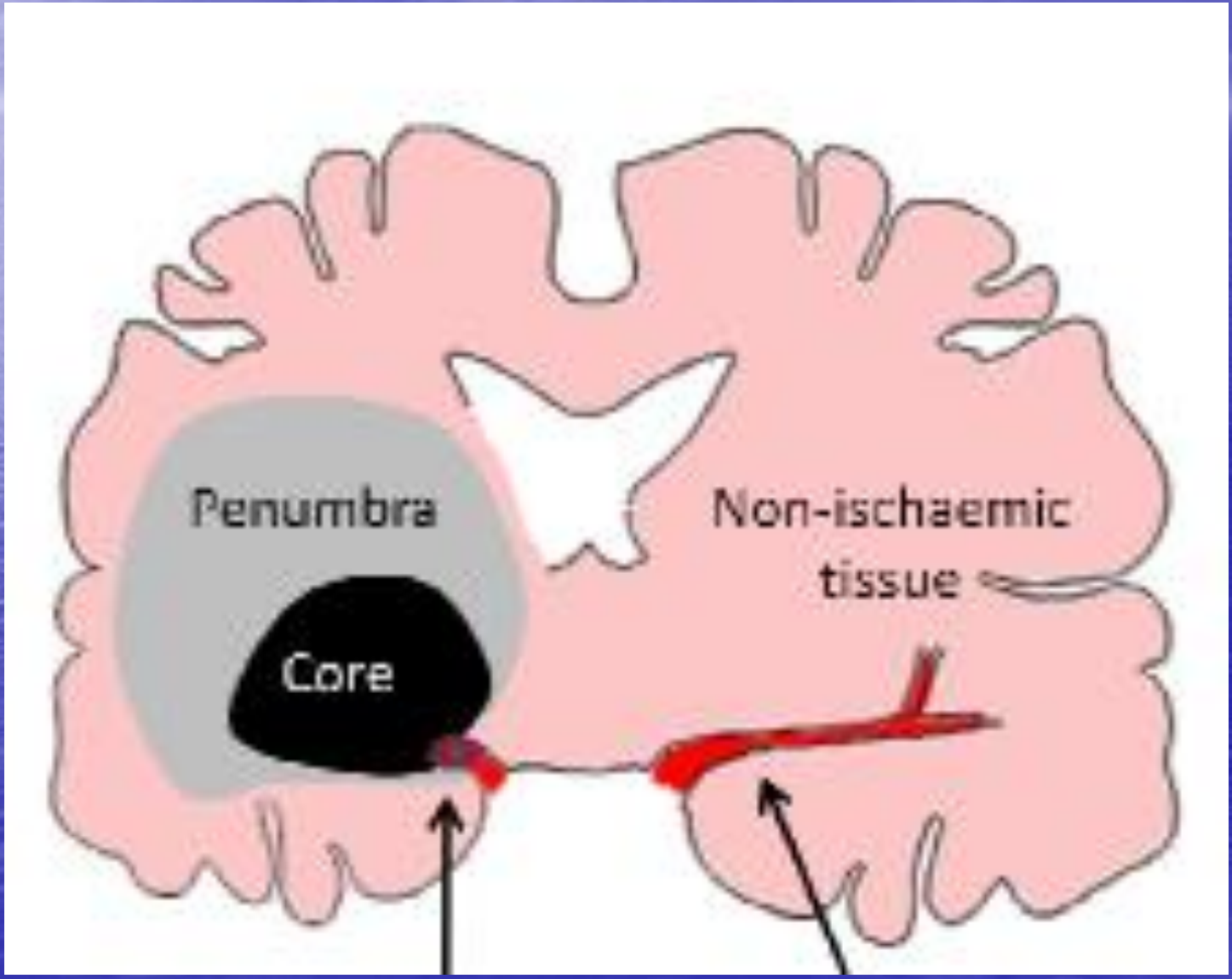
Cause of Cerebral infarction

- **Embolus**
  - Carotid atheroma
  - Cardiac
    - Atrial fibrillation
    - Mural thrombus
    - Patent foramen Ovale
- **Thrombosis**
  - Abnormality of vessels
    - Atherosclerosis
    - Autiimmune disease
    - Vasculitis
    - Wall dissection
  - Abnormal clotting
    - Polycythemia
    - Thrombocythemia
    - Hyperviscosity
    - Clotting disorders
      - Inherited
      - acquired

Penumbra

- In the central core of the infarct, the severity of hypoperfusion results in irreversible cellular damage occurred.
- Around this core, there is a region of decreased flow in which either:
  - The critical flow threshold for cell death has not reached
  - Or the duration of ischemia has been insufficient to cause irreversible damage.
- This region is called the "ischemic penumbra."

Penumbra



ISCHEMIC STROKE SYNDROMES

LARGE VESSEL

- **Middle cerebral artery**

  motor (face>arm>leg)

  sensory, fluent and non-fluent aphasia

  neglect

  apraxia

- **Anterior cerebral artery**

  leg weakness, abulia, muteness

ISCHEMIC STROKE SYNDROMES

LARGE VESSEL

- **Basilar/vertebral arteries:**

  vertigo
  diplopia
  ataxia

- **Posterior cerebral arteries:**

  cortical blindness
  field cuts
  prosopagnosia

ISCHEMIC STROKE SYNDROMES

SMALL VESSEL DISEASE

- pure motor
- pure sensory
- clumsy hand dysarthria
- ataxic hemiparesis

All patients:

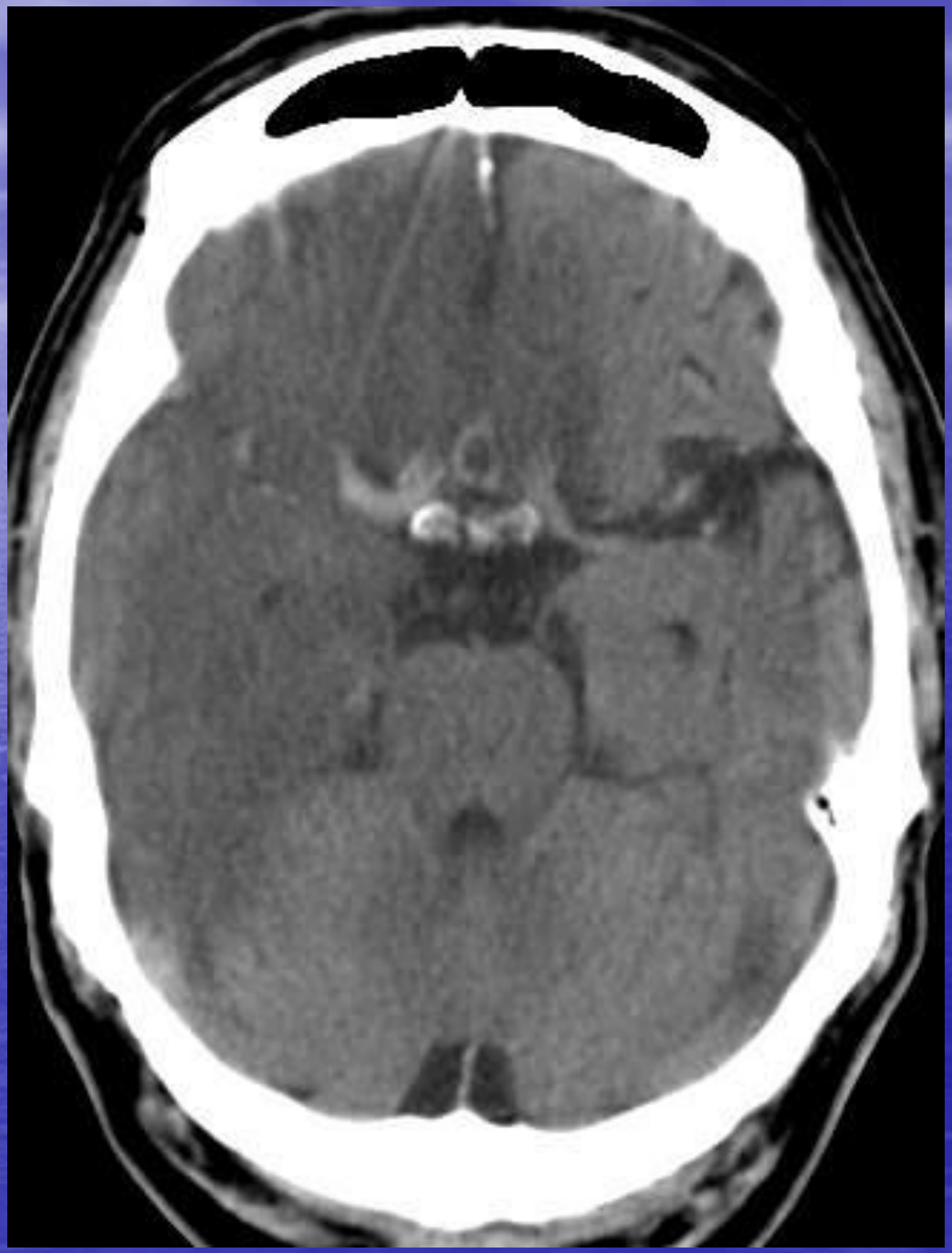
- Brain CT (brain MRI could be considered at qualified centers)
- Electrocardiogram
- Blood glucose
- Serum electrolytes
- Renal function tests
- Complete blood count, including platelet count
- Prothrombin time/international normalized ratio
- Activated partial thromboplastin time

CT scan within 24 hours

Acute stroke

Infarct

Haemorrhage

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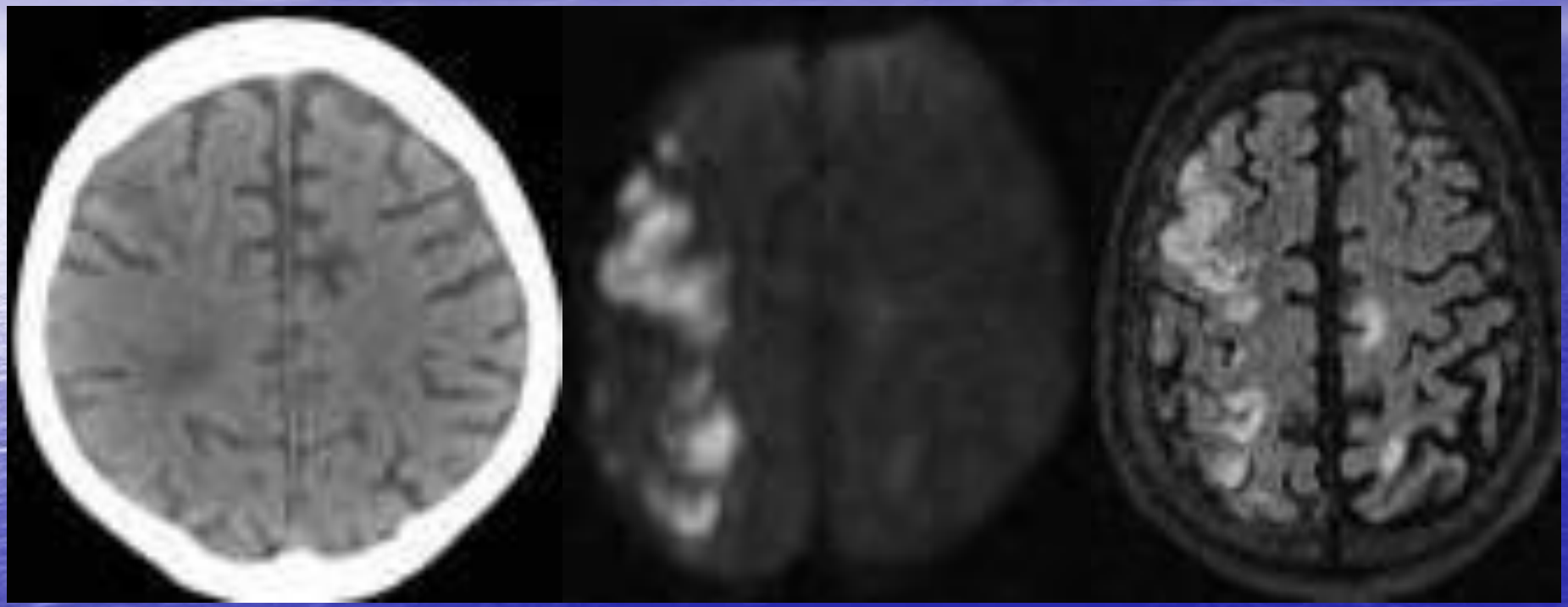

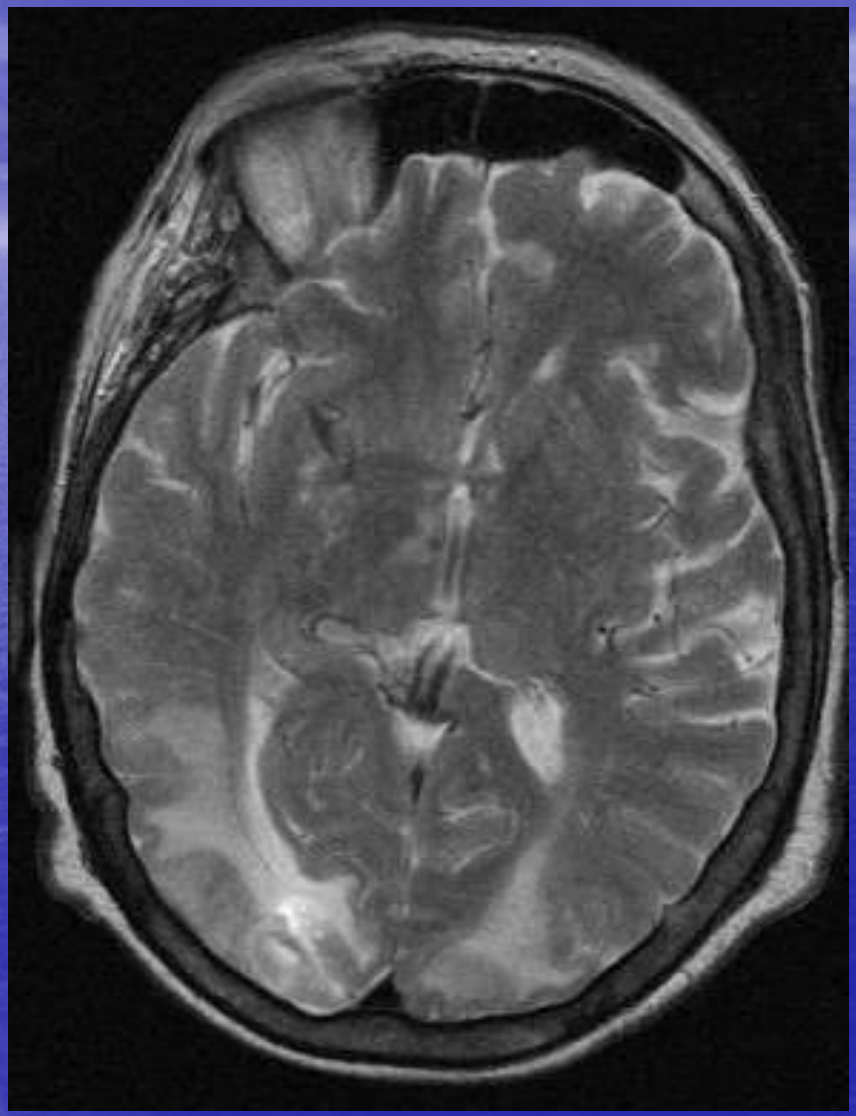

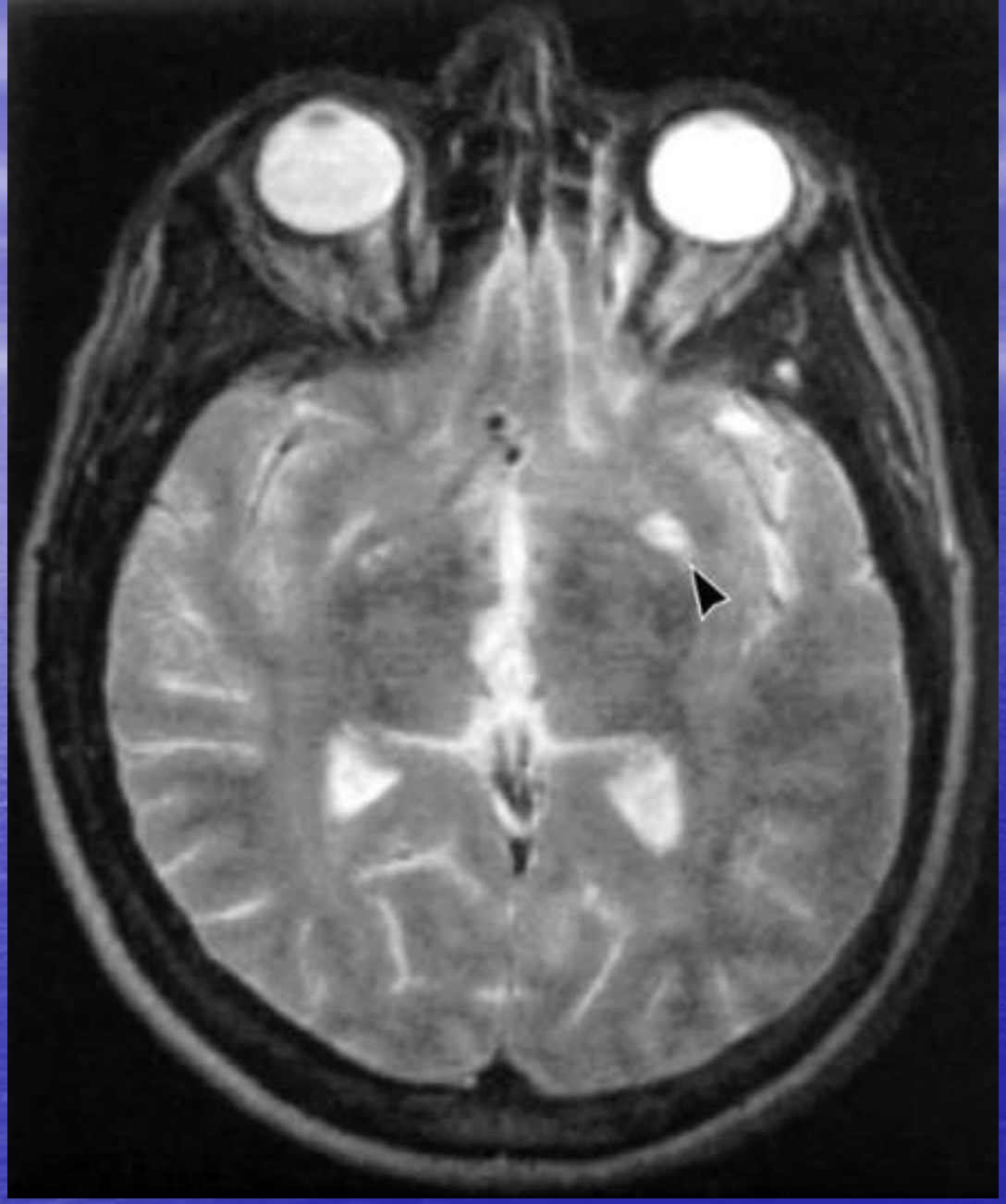

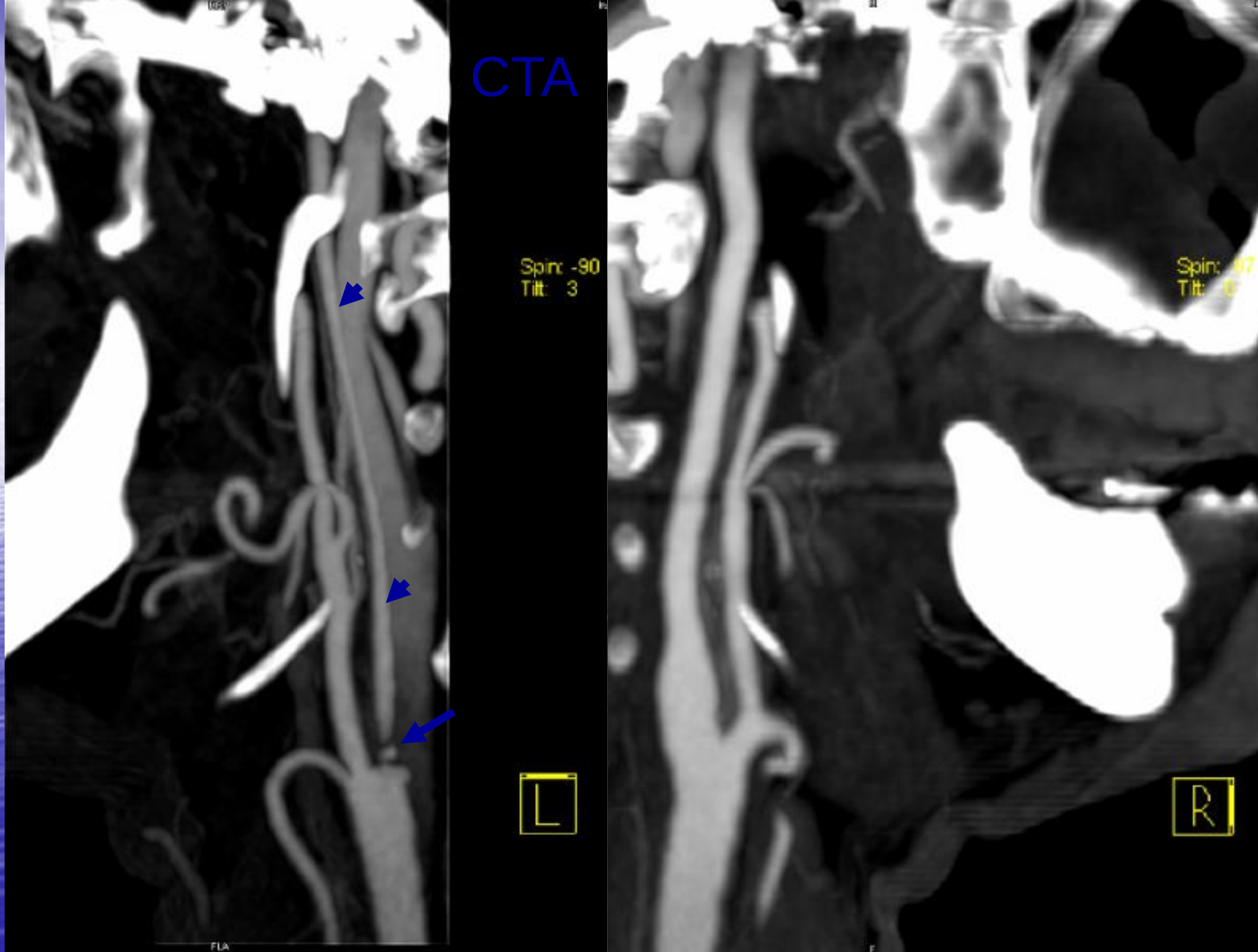
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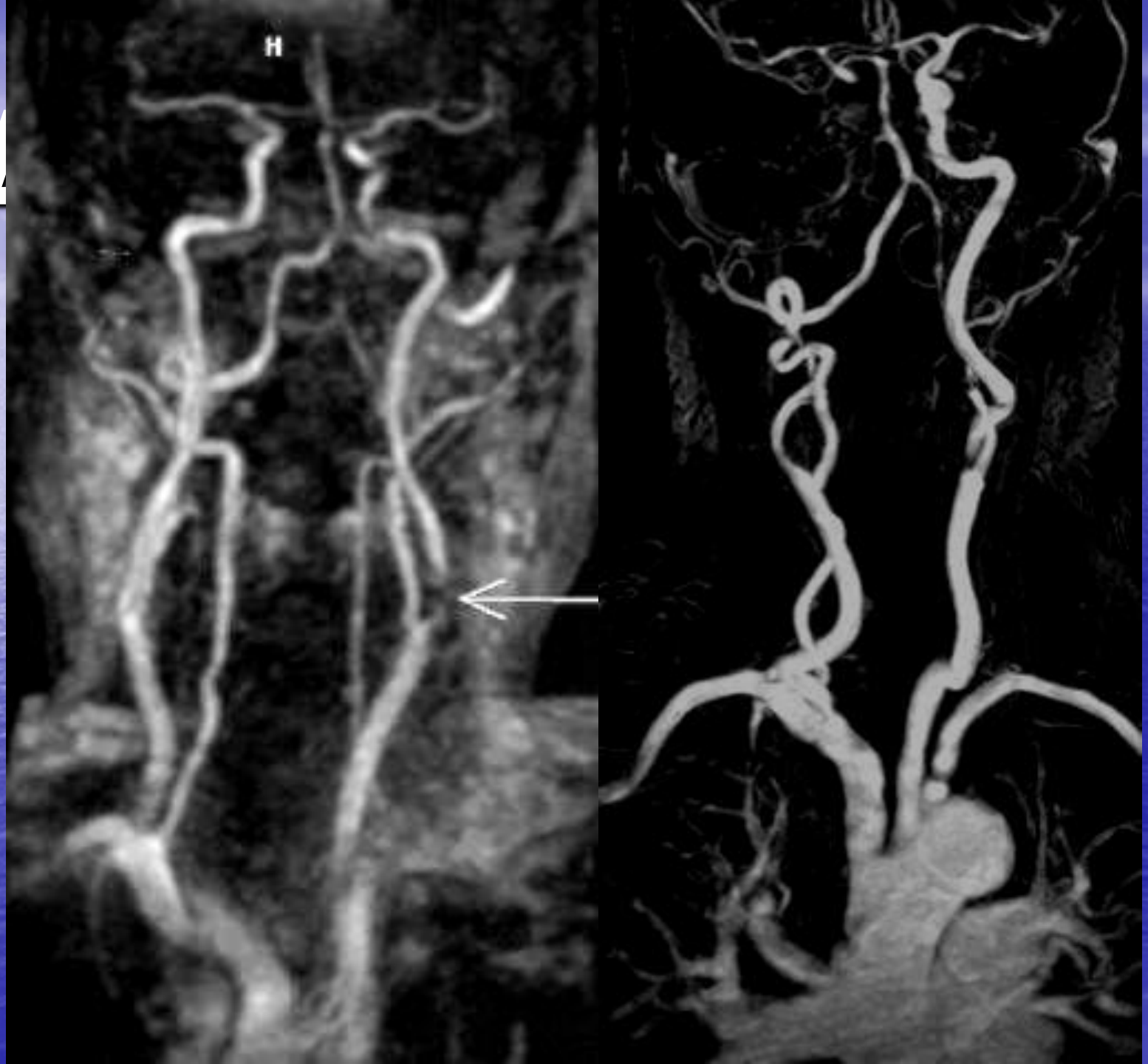
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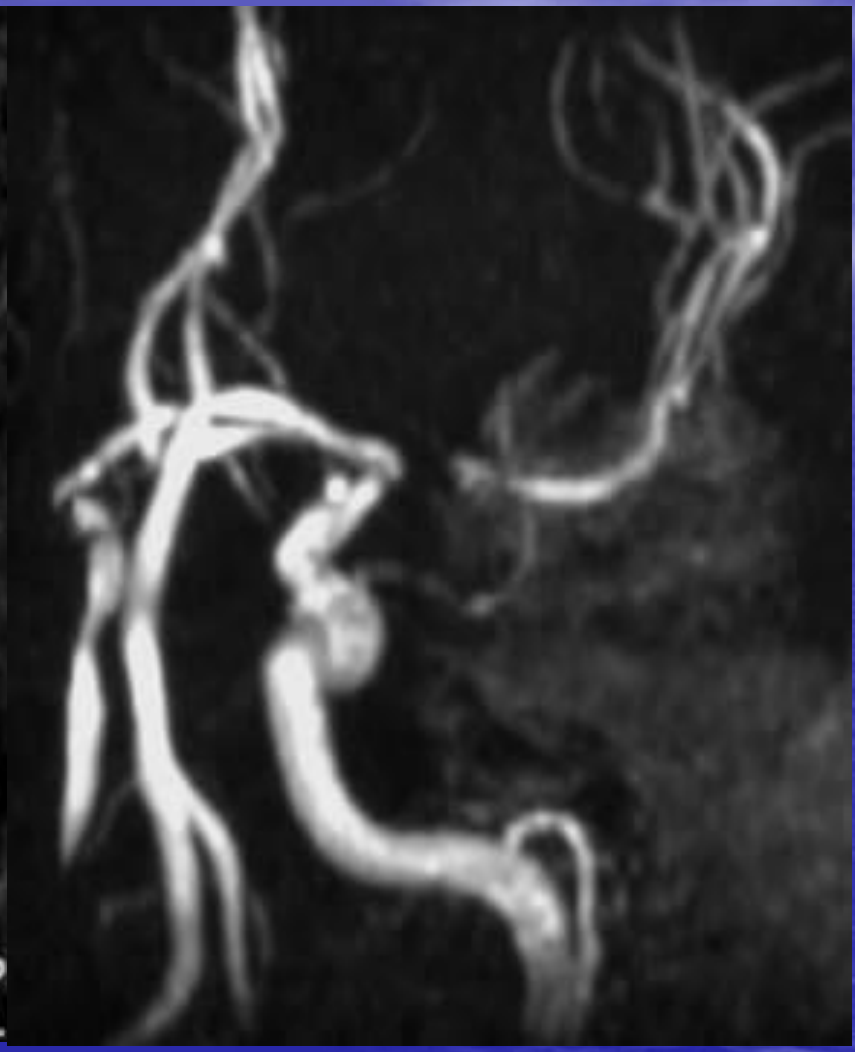
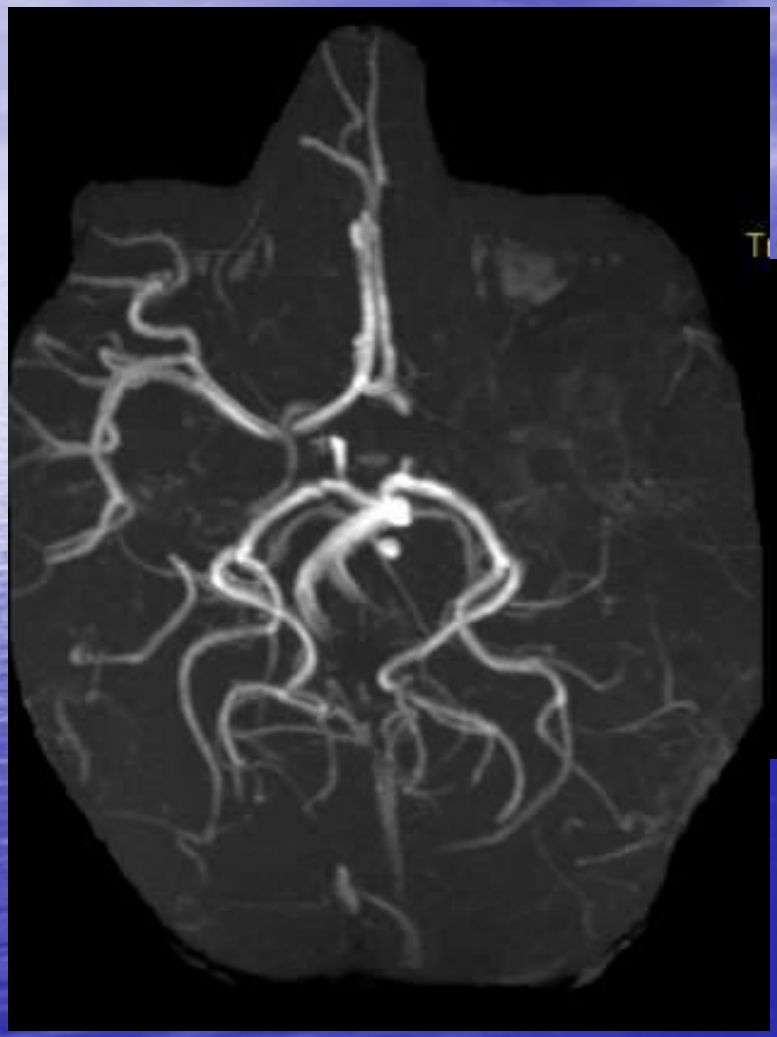
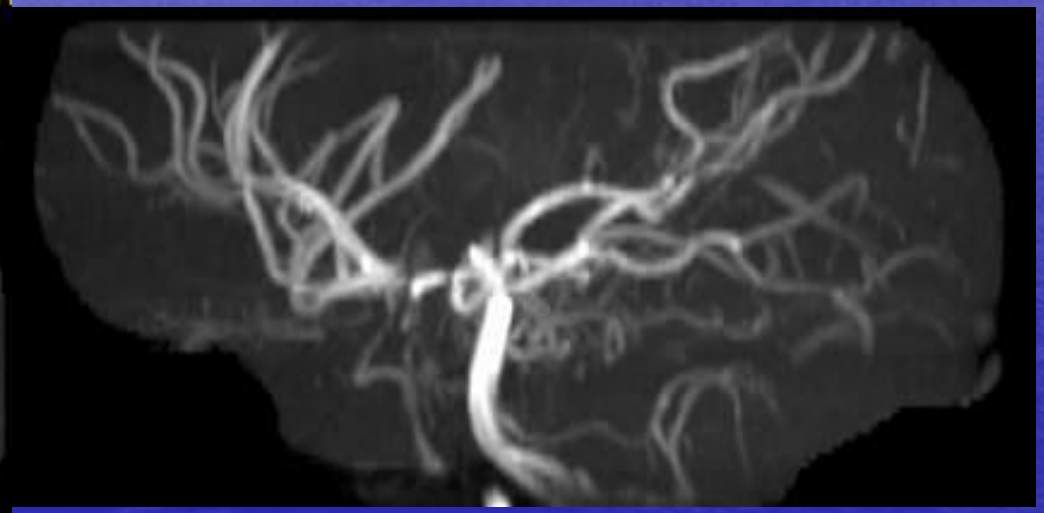
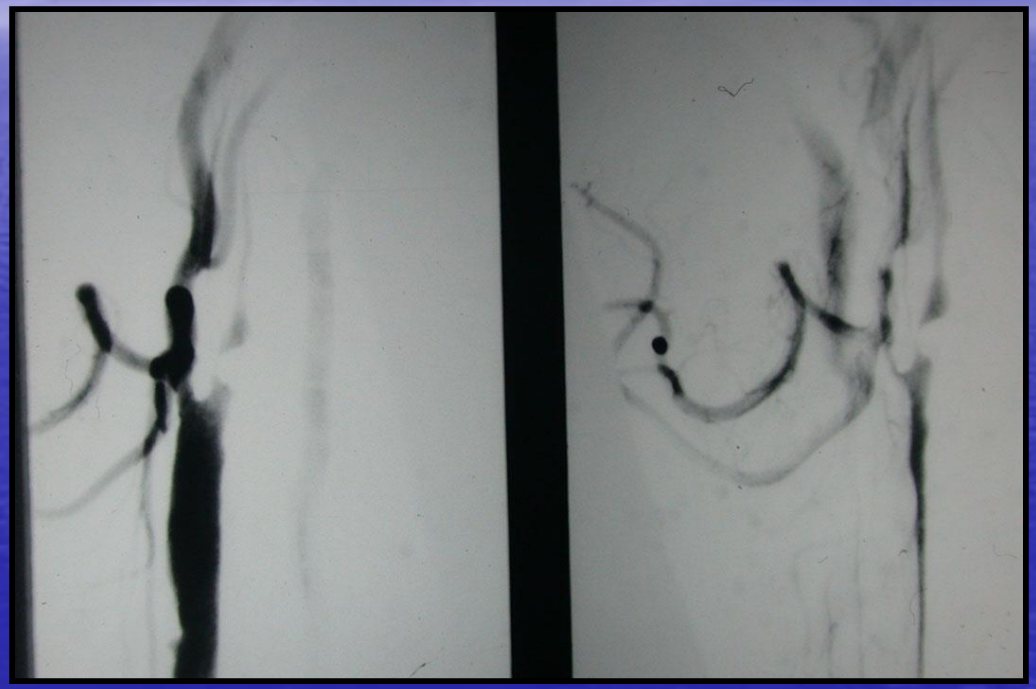








ISCHEMIC STROKE

Salvage the penumbra

- Reperfusion
- Do not lower BP unless > 210 or cardiac reasons (official recommendations)
- Maintain euthermia and euglycemia

ISCHEMIC STROKE

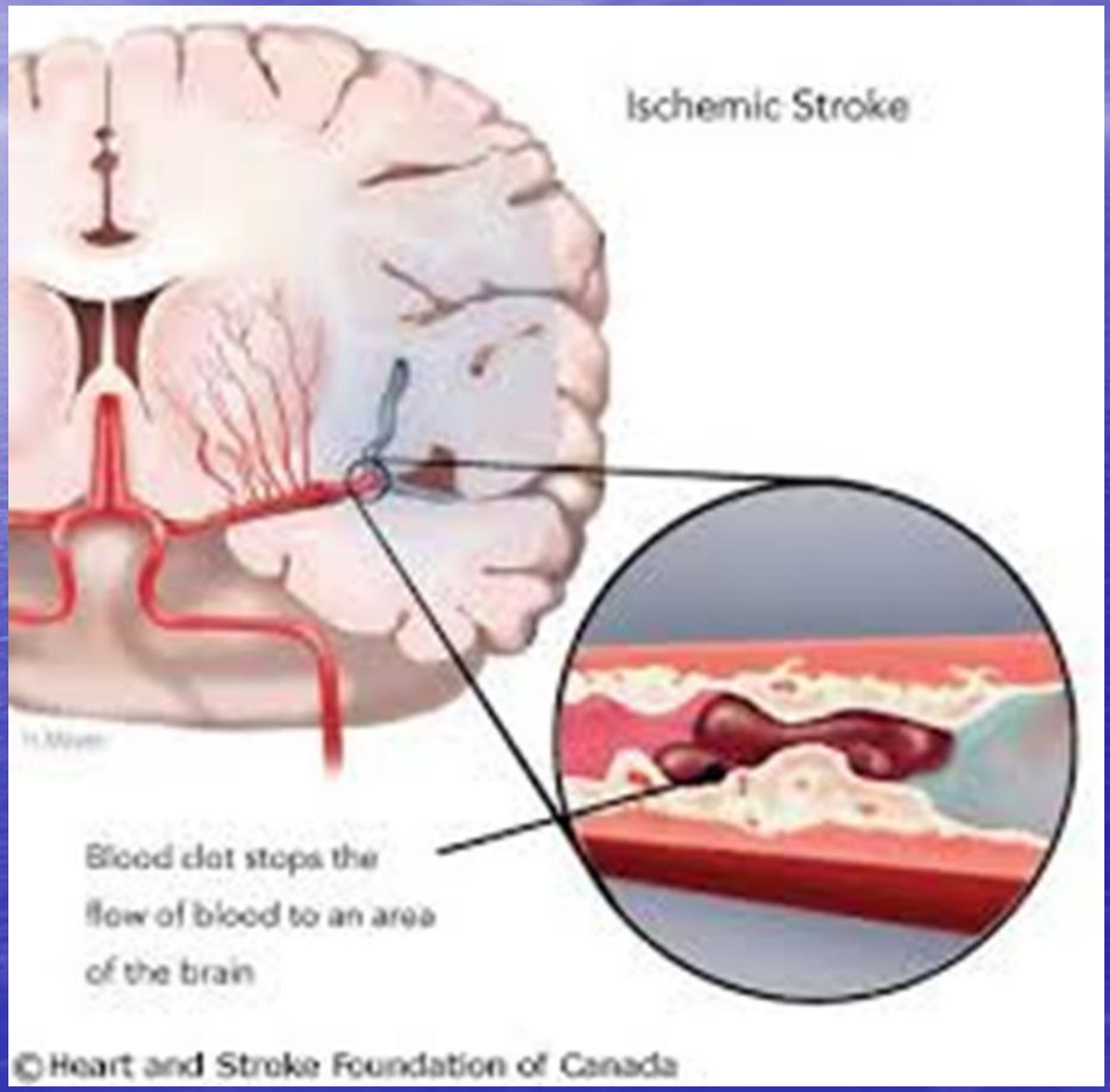
Avoid complications further morbidity

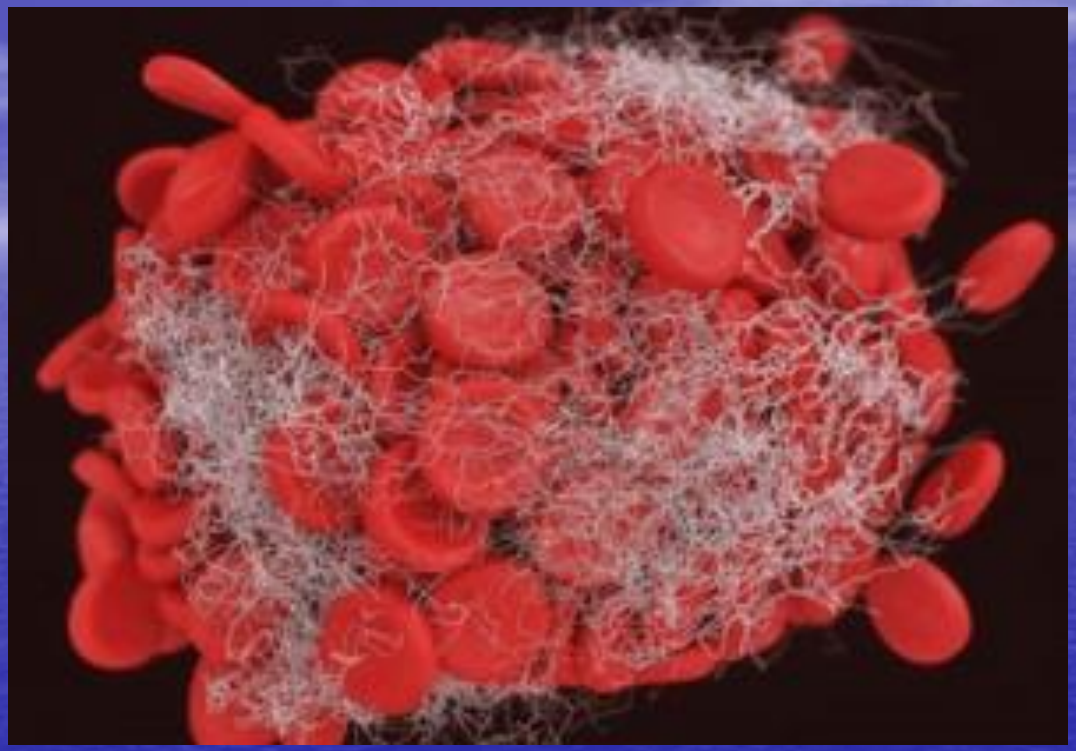
- Dysphagia screen
- DVT prophylaxis

Secondary prevention

- Antithrombotics
- Anticoagulation for all atrial fibrillation, cardio embolic
- Lipid profile and statin initiation

Reperfusion



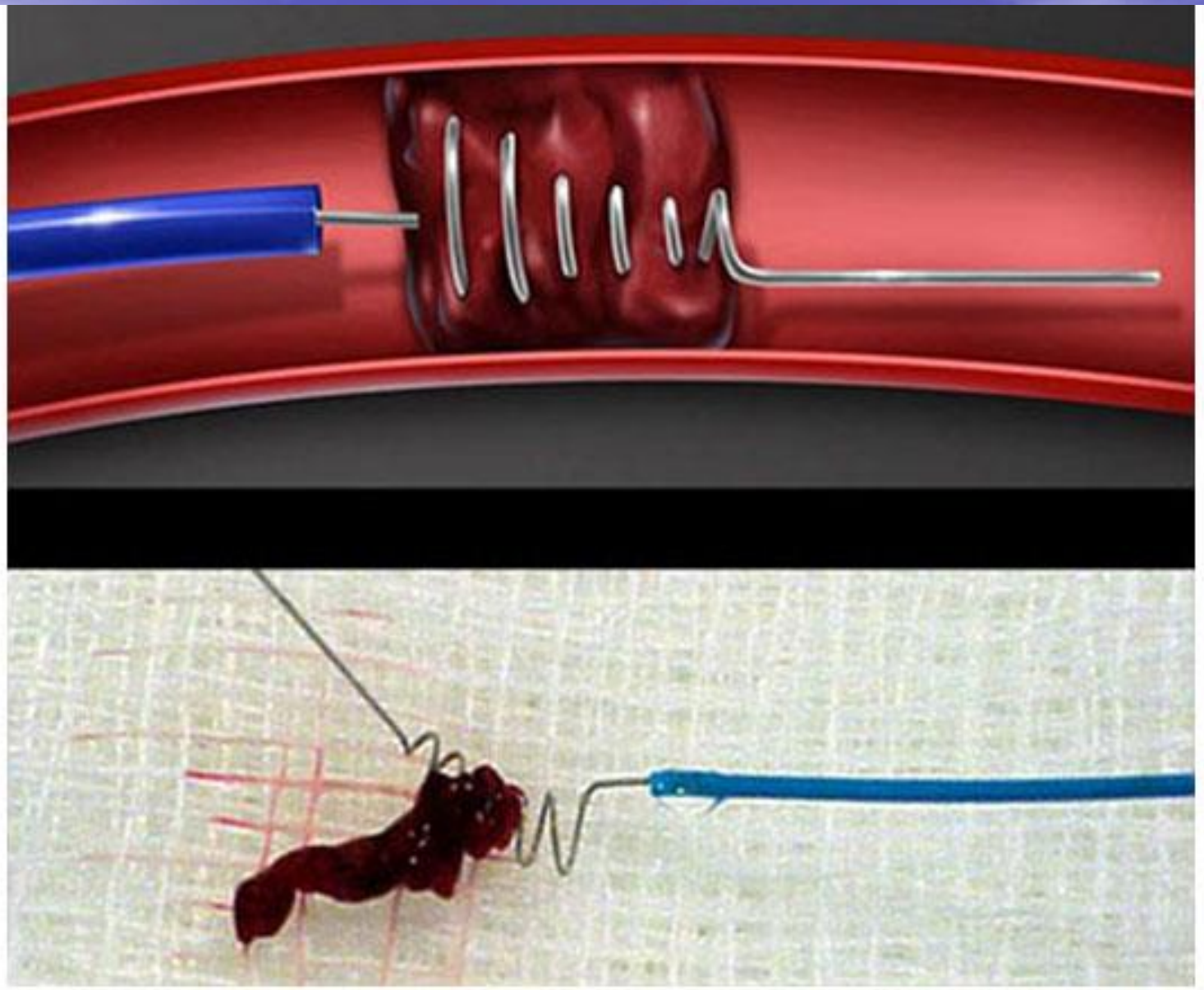


IV TPA DOSAGE

- Dose: 0.9 mg/kg (max not > 90 mg)
- 10% given as bolus over 1 min
- 90% given as infusion over 60 minutes

Intra-Arterial Thrombolysis

North Memorial Medical Center

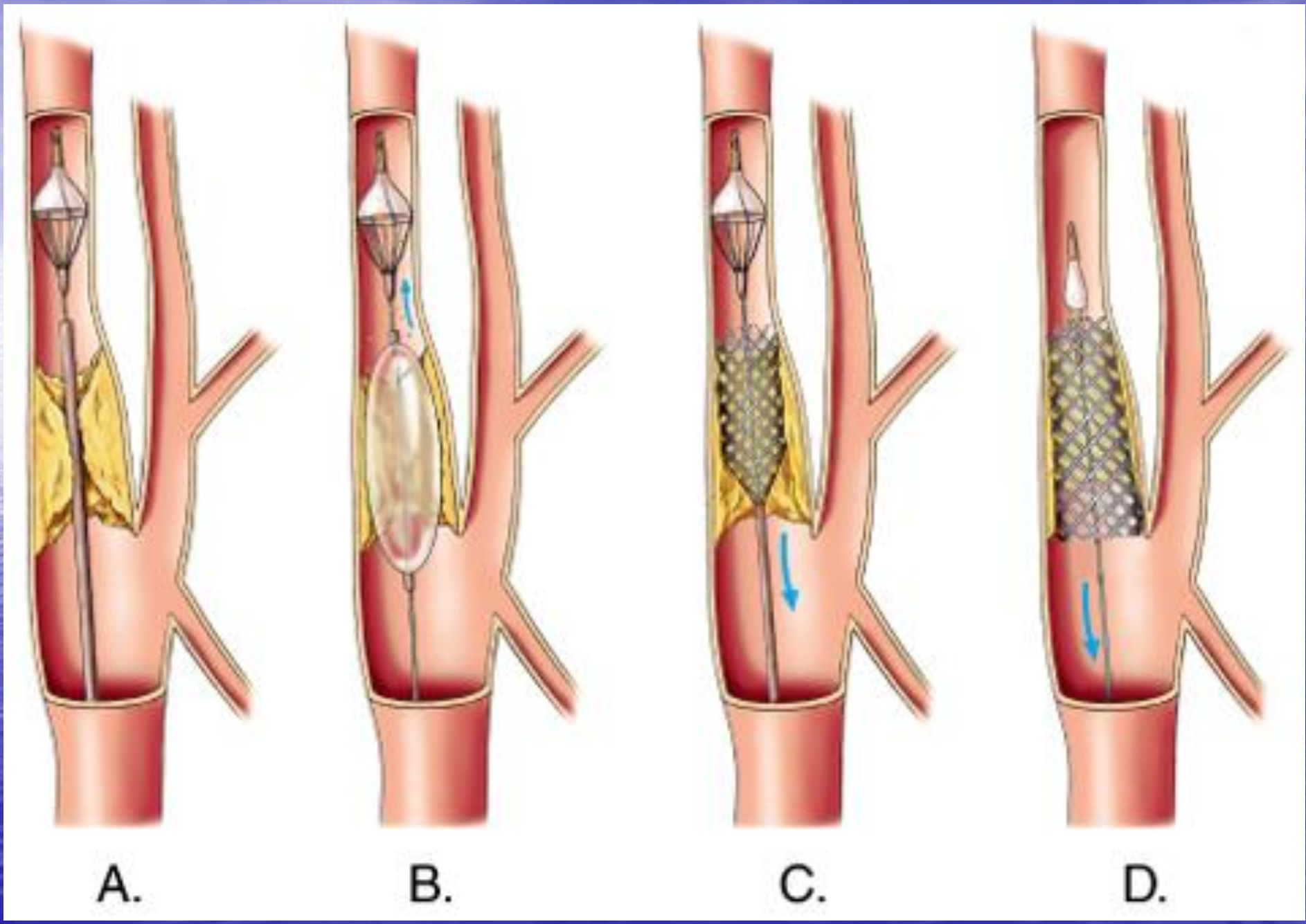


Technique

MERCI

PENUMBRA

STENTREIVERS- SOLITAIRE, TREVO…..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B.
C.
D.

Acute Stroke Management

Blood pressure management

- drugs of choice
  - labetolol - 10 to 20 mg IV (drip 2 - 8 mg / min.)
  - enalapril - 1.25 mg IV
  - nicardipine – 5 to 15 mg IV / hour

Acute Stroke Management

Fluid management

- 1/3 of stroke patients dehydrated
- glucose-containing solutions worsen ischemic damage
- normal saline - fluid of choice.

EDEMA

- SX: 3-5 days out in large cortical strokes or cerebellum: drowsiness, pupil asymmetry, sighing, yawning, periodic breathing
- TX: hyperventilation pCO2 30-35 (only temporary, can cause ischemia and rebound)
- osmotic agents: mannitol (.5-1 gm/kg q 6 hrs), hypertonic saline
- surgery early hemispherectomy.

Intracranial hemorrhage

- **Intracerebral hemorrhage**
  - Arterial hypertention (hemorrhagic stroke)
  - Rupture of aneurysm of cerebral vessel
  - Coagulopathies
  - Vasculitis
- **Subarachnoid hemorrhage**
  - Rupture of aneurysm of cerebral vessel
  - Bleeding from Arterio-venous malformation

Clinical signs of hemorrhagic stroke

- Sudden and fast onset (seconds – minutes)
- Unconsciousness (semicoma-coma)
- Severe neurological deficit
- Vegetative symptoms: high arterial pressure; bradycardia, red face and cyanotic limbs, sweating.

Conservative treatment

- **Respiration control**
  - Intubation for comatose patients
  - Supplementary oxygen
- **Arterial pressure control**
  - Severe hypertention must be treated gently – decrease pressure to mild hypertention during several hours
- **Coagulative status control and correction**

ICH TREATMENT

- ICP, fluids, agitation, pain, fever, hyperglycemia
- Monitor for hydrocephalus or herniation

Surgical treatment

- Removal of intracerebral hematoma
- Ventricular draining in case of occlusive hydrocephalus

Clinical presentation of SAH

- Sudden onset
- Severe headache
- Meningeal signs
- Minimal focal neurological deficit

Diagnostic procedures for SAH

- CT
- Lumbar puncture with CSF examination
  - Blood in the CSF
  - High pressure of CSF
  - SAH and possible intracerebral hemorrhage
- Angiography – the main to reveal the cause of SAH – aneurisms and arterio-venous malformations

Surgical treatment of aneurism

- Any aneurism should be excluded from circulation as early as possible
  - Putting clips on the neck of aneurism
  - Endovascular embolisation of aneurism
    - With coils
    - With balloons

Any questions?