Cerebrovascular diseases

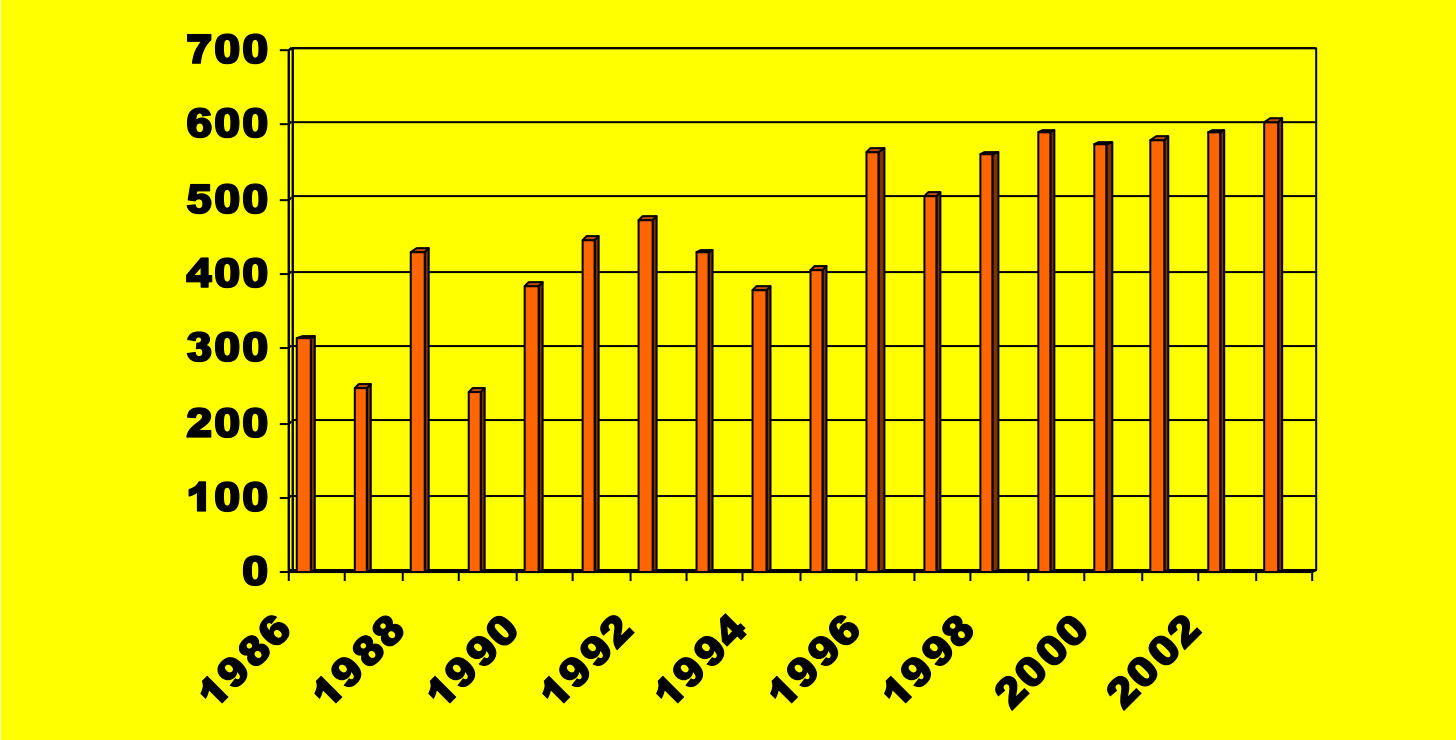
- Diseases with sudden onset, or rapid development, of focal cerebral dysfunction as the consequence of lesion of cerebral arteries. There are 2 types:
- Brain ischemia (stroke) or
- Brain haemorrhage

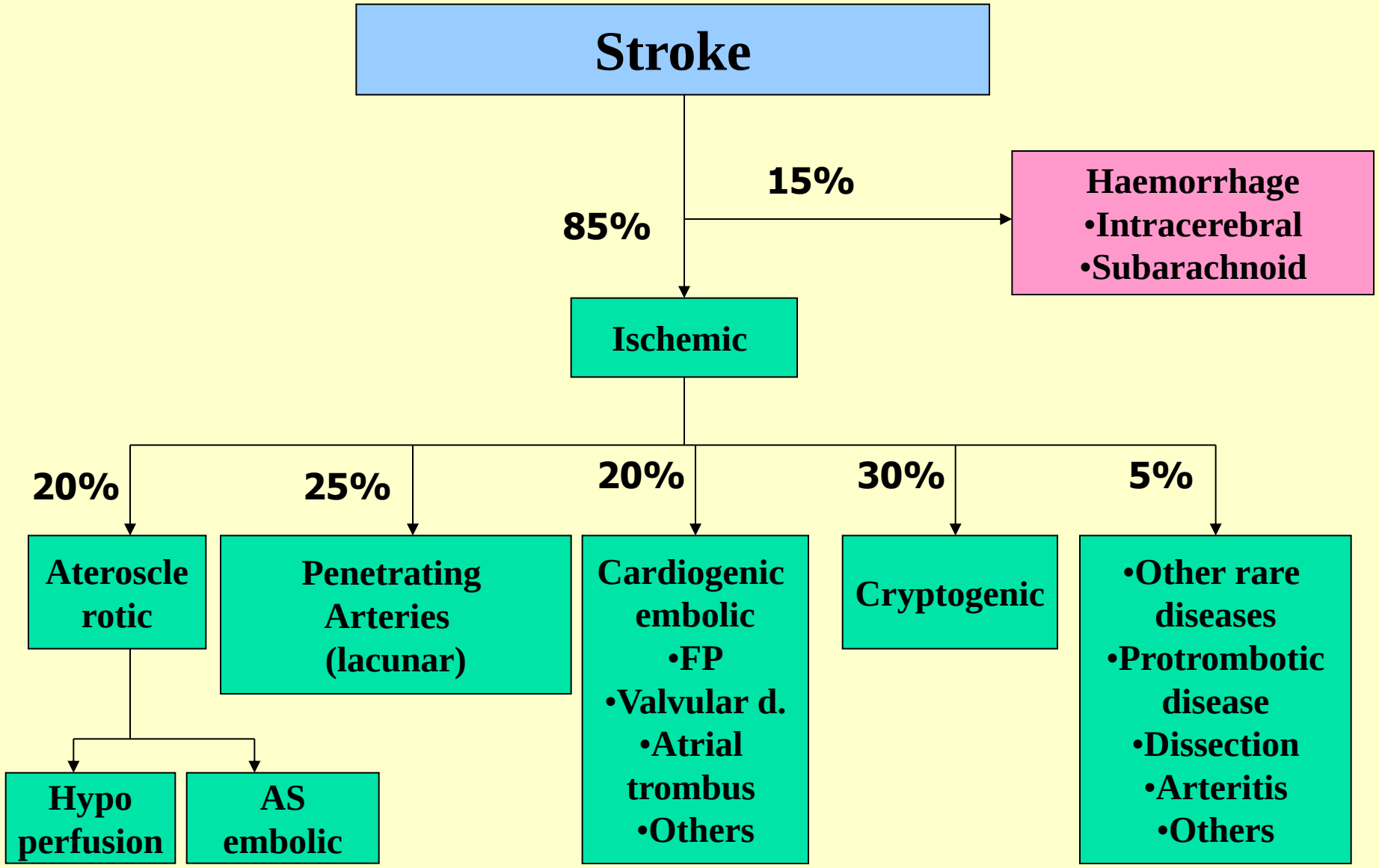
Epidemiology

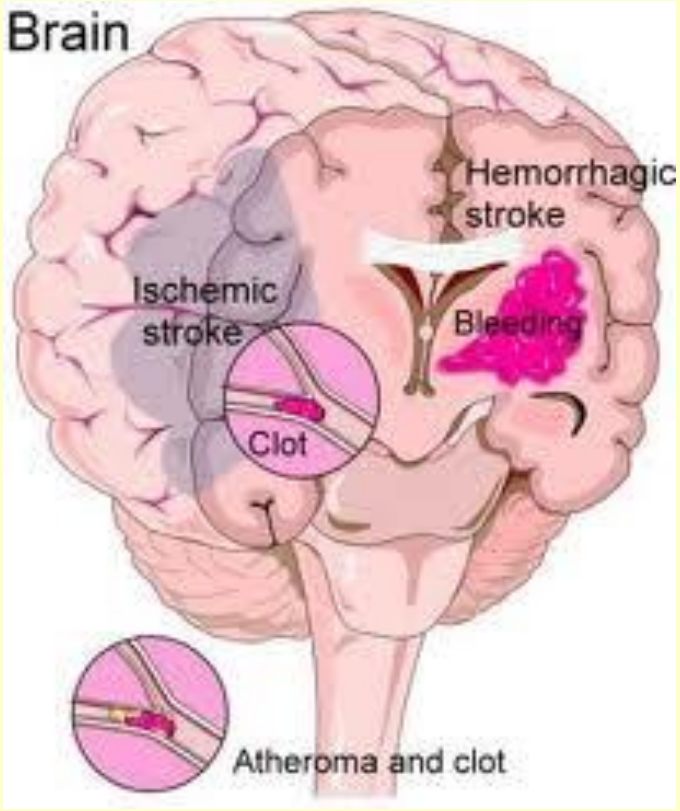
- Incidence – 125 – 446/100 000 inhabitants ***(Feigin V.L. et al., Lancet Neurol, 2009)***

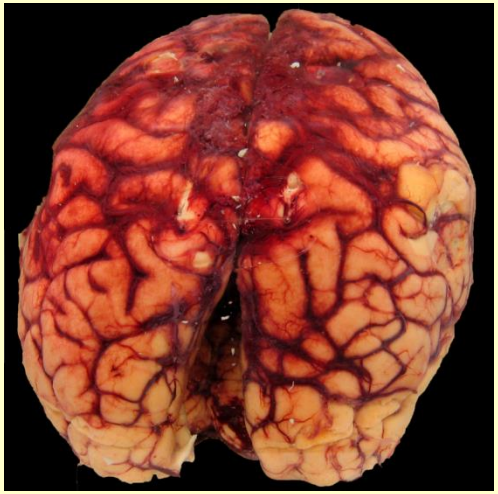
- **SLOVAKIA**
- **Mortality: 100-200/100 000**
- **Incidence: 300-500/100 000**

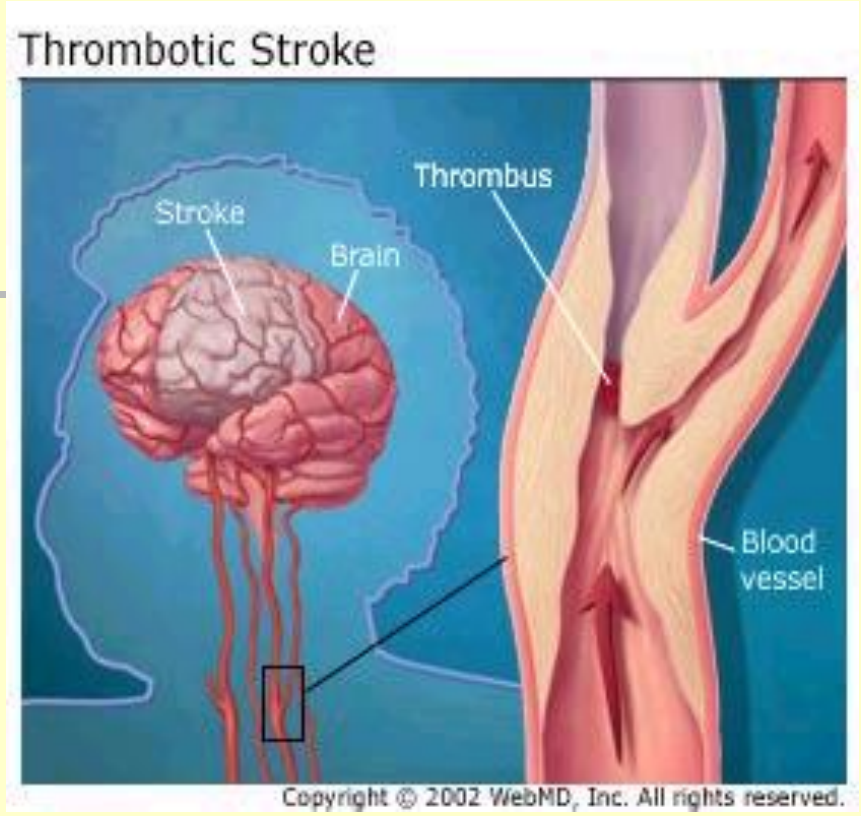
Patients with stroke at ND FNLP Košice SNP 1 in years 1986 - 2002




Stroke
85%
15%
Haemorrhage
•Intracerebral
•Subarachnoid
Ischemic
20%
25%
20%
30%
5%
Aterosclerotic
Penetrating Arteries (lacunar)
Cardiogenic embolic
•FP
•Valvular d.
•Atrial trombus
•Others
Cryptogenic
•Other rare diseases
•Protrombotic disease
•Dissection
•Arteritis
•Others
Hypo perfusion
AS embolic


Brain
Hemorrhagic stroke
Ischemic stroke
Bleeding
Clot
Atheroma and clot




Thrombotic Stroke
Stroke
Brain
Thrombus
Blood vessel
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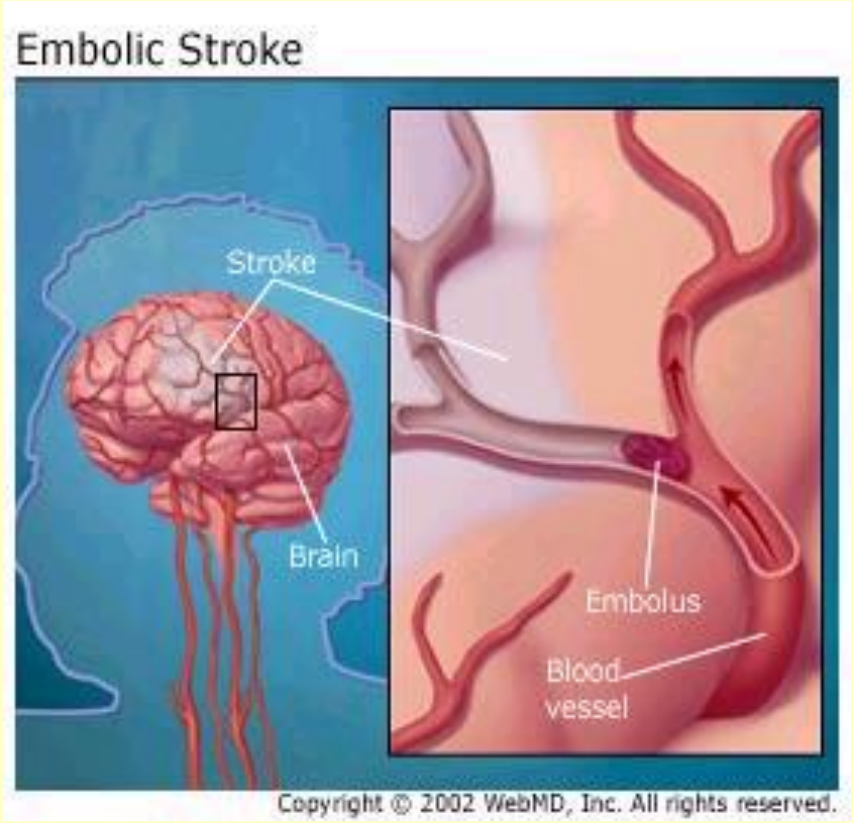
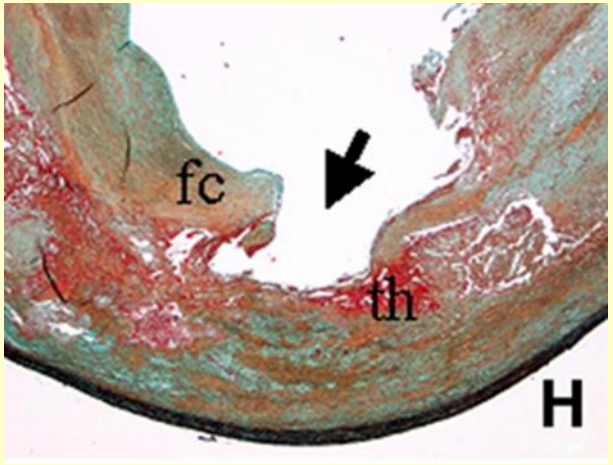

Embolic Stroke
Stroke
Brain
Embolus
Blood vessel
Copyright © 2002 WebMD, Inc. All rights reserved.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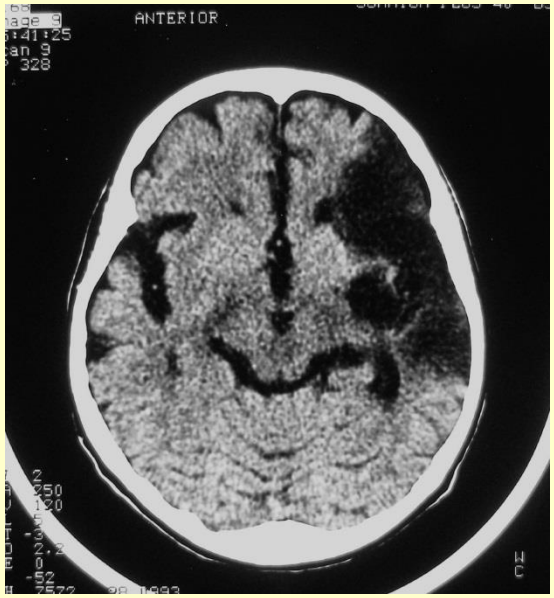
Cerebrovascular diseases



Brain ischemia

Brain haemorrhage

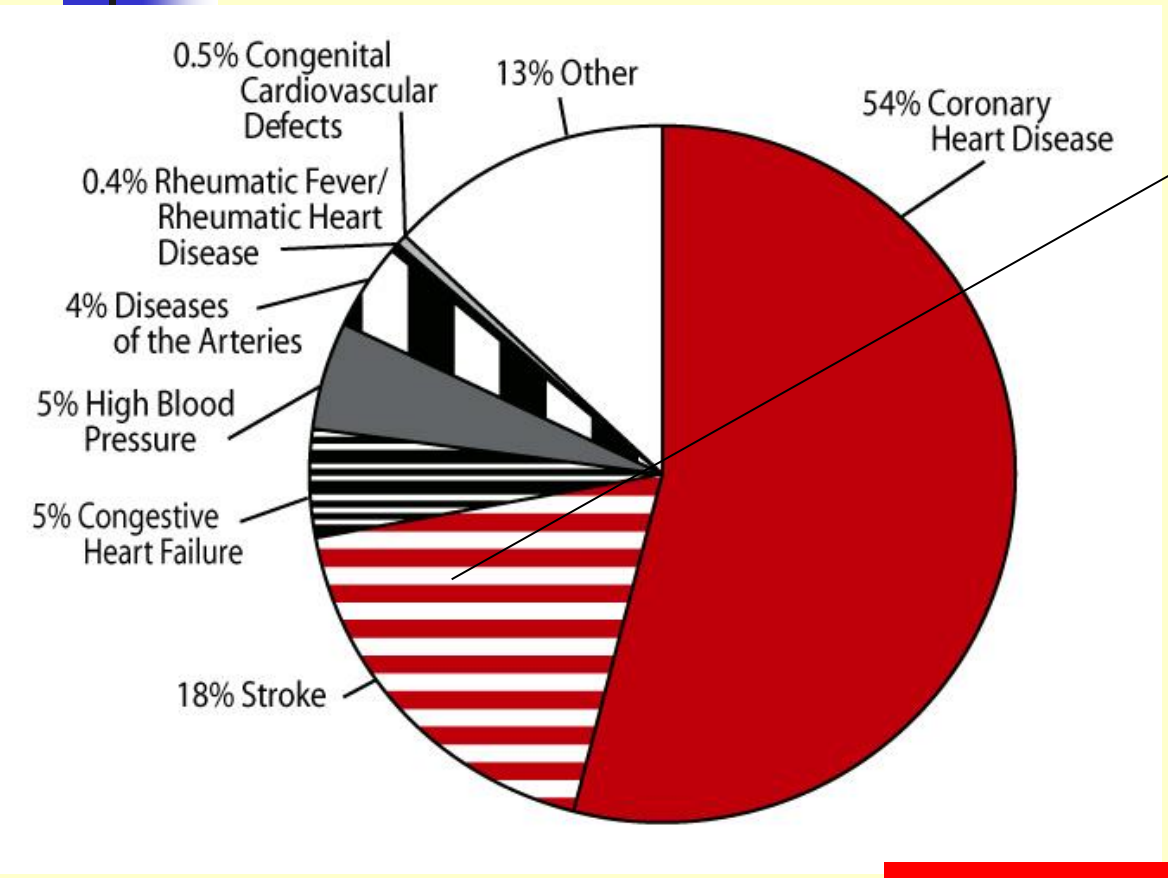
Subarachnoid haemorhage

Head injury, **NO** stroke

Subduralny hematoma

Epidural hematoma

Death/ vascular diseases (AHA)



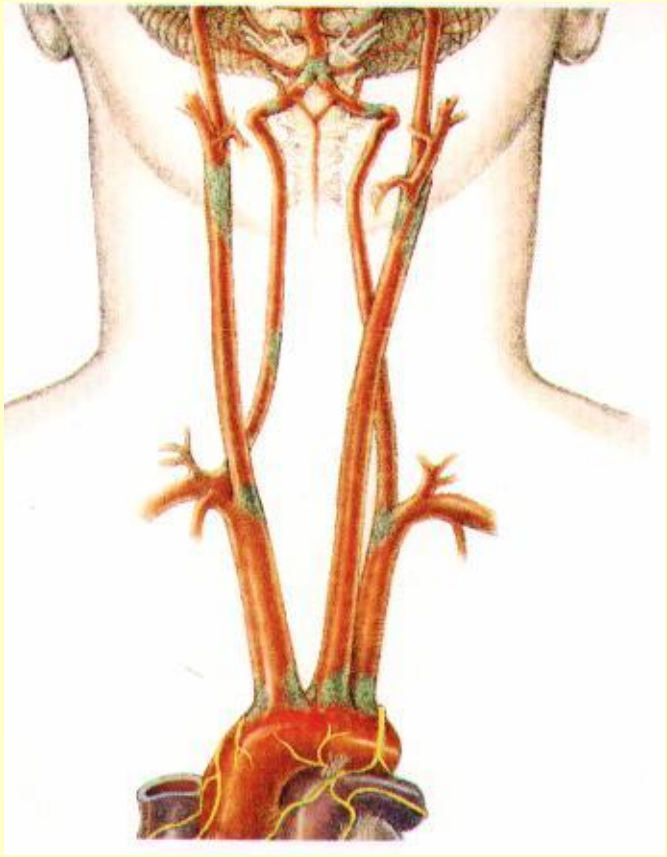
50 % pacients after stroke → disabled

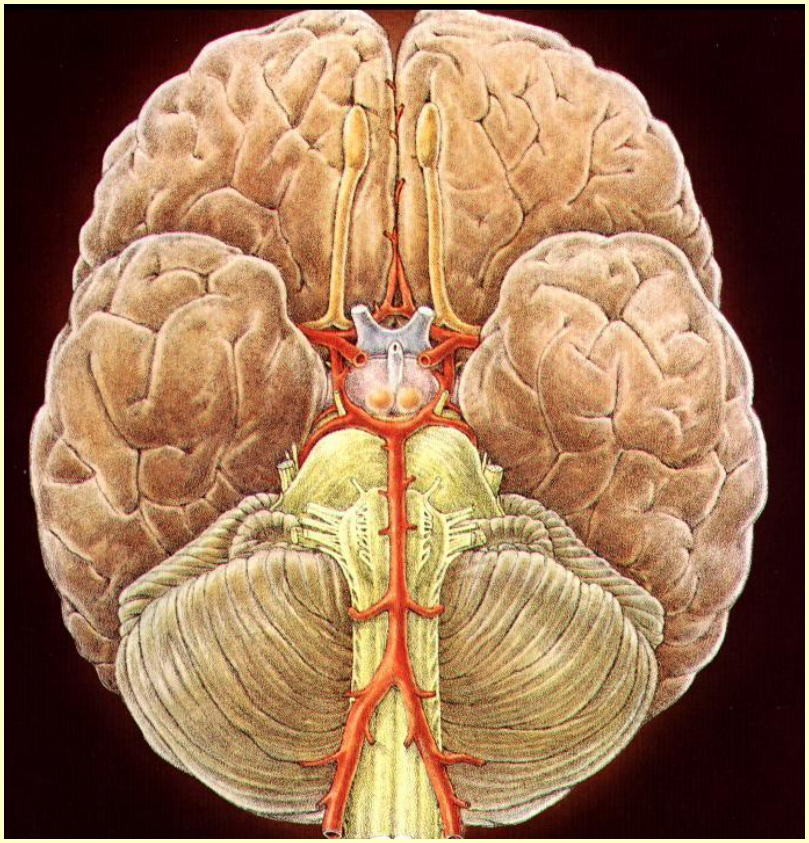
Budget for stroke

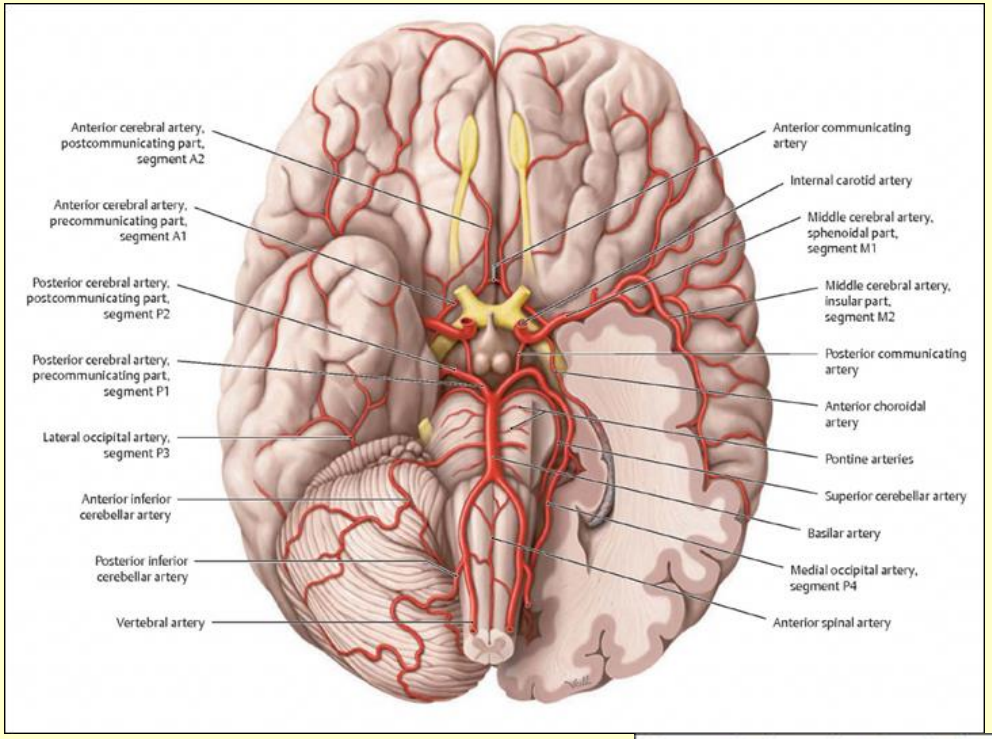
Stroke therapy – very expensive

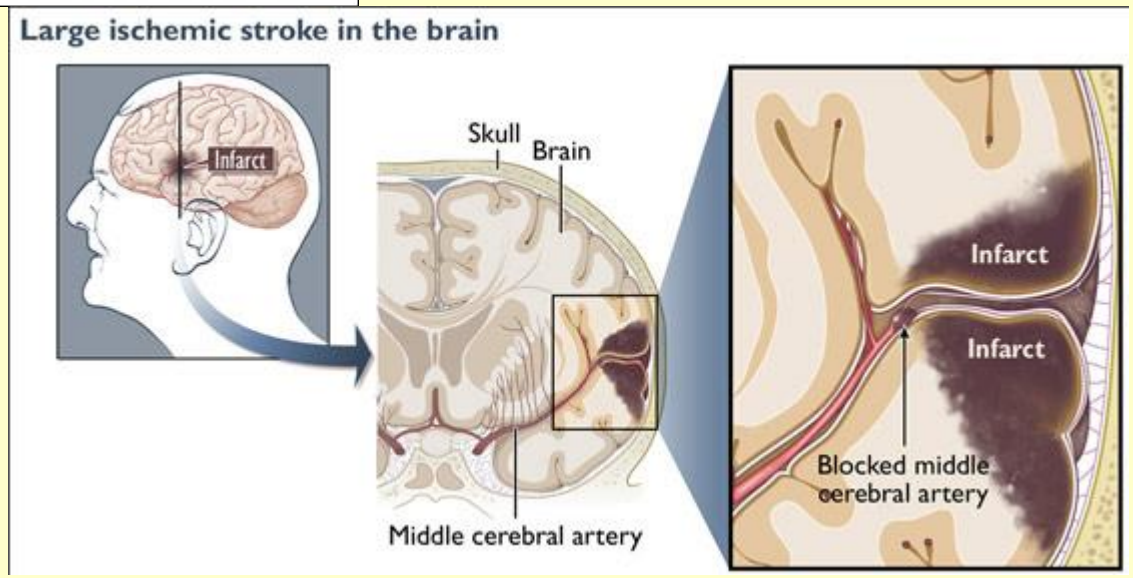
Bonita R. et al.: Stroke, 1997; AHA, 2000;
Truelsen T. et al.: Eur J Neurol, 2006

Anatomy of cerebral arteries

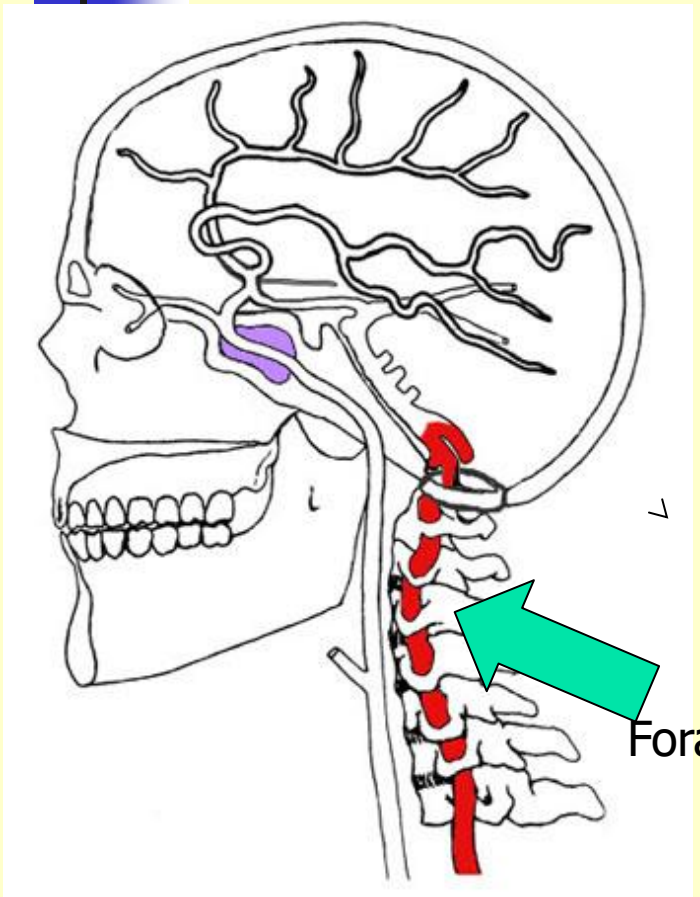




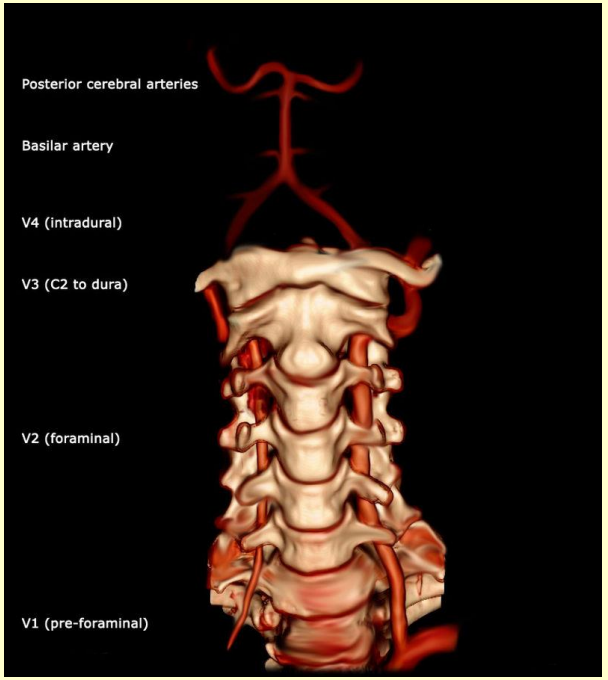

Anterior cerebral artery, postcommunicating part, segment A2
Anterior cerebral artery, precommunicating part, segment A1
Posterior cerebral artery, postcommunicating part, segment P2
Posterior cerebral artery, precommunicating part, segment P1
Lateral occipital artery, segment P3
Anterior inferior cerebellar artery
Posterior inferior cerebellar artery
Vertebral artery
Anterior communicating artery
Internal carotid artery
Middle cerebral artery, sphenoidal part, segment M1
Middle cerebral artery, insular part, segment M2
Posterior communicating artery
Anterior choroidal artery
Pontine arteries
Superior cerebellar artery
Basilar artery
Medial occipital artery, segment P4
Anterior spinal artery


Large ischemic stroke in the brain
Infarct
Skull
Brain
Middle cerebral artery
Infarct
Infarct
Blocked middle cerebral artery

Vertebral arteries



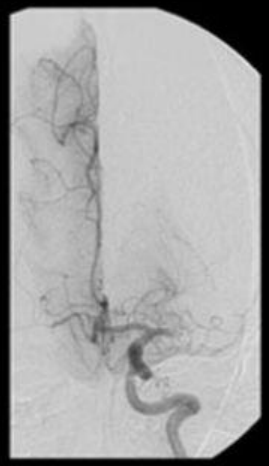
Foramina transversaria

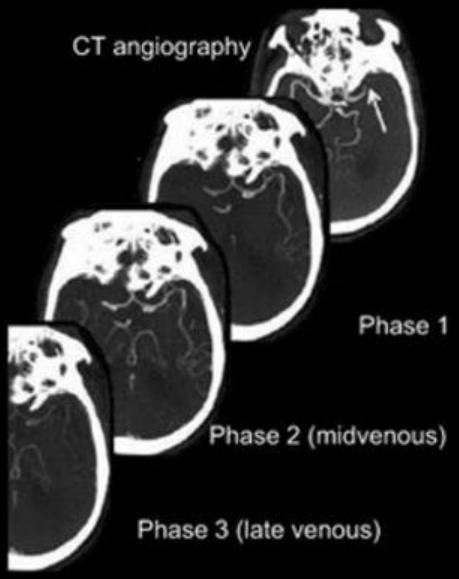


Regulation of cerebral circulation

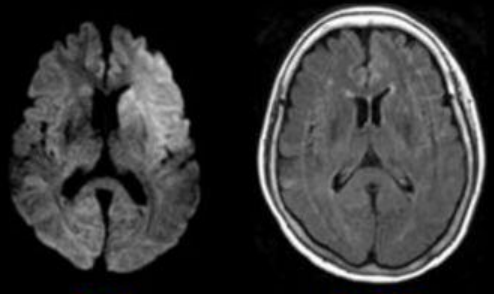
- Blod flow - 50 – 60 ml/100 g of brain tissue/min.
- Blod flow below 20 ml/100 g/min. – functional changes of neurons – reversible dysfunction (few hours)
- Blod flow below 12, or 10 ml/100 g/min structural changes irreversible changes – brain infarct,

Patient with poor collaterals

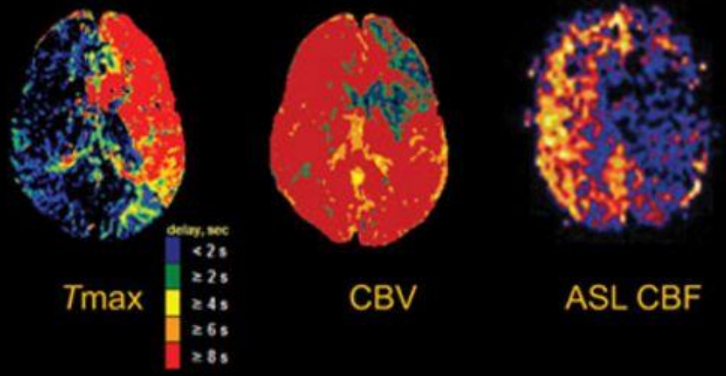




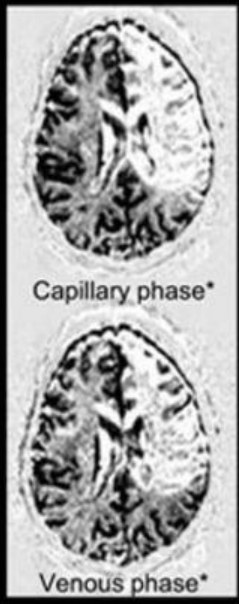
Multiphasic map (ESCAPE trial)



DWI FLAIR Day 7 DWI

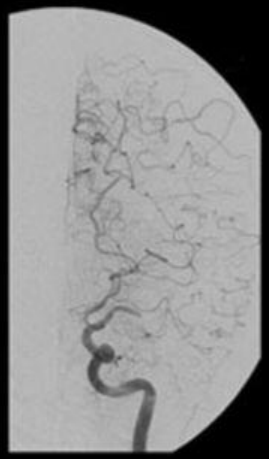


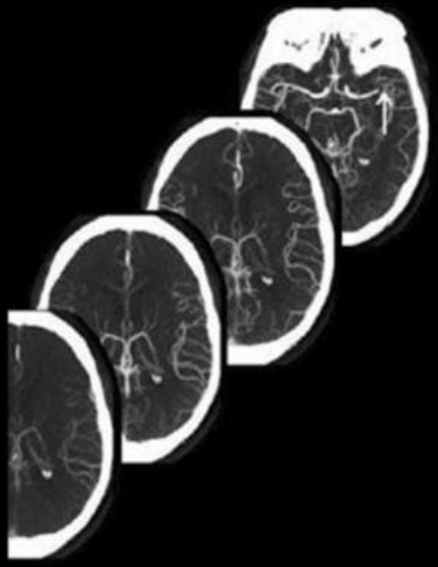
Tmax CBV ASL CBF

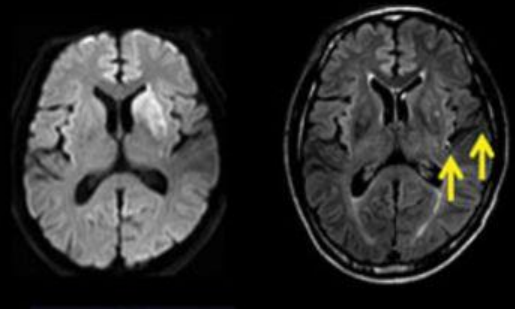


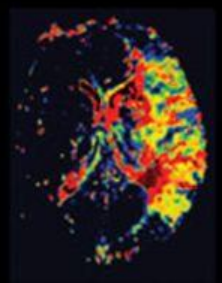
Collateral map (MRP-based)

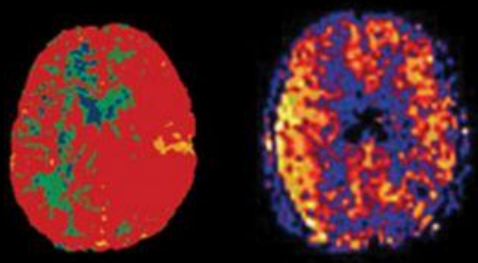
Patient with good collaterals

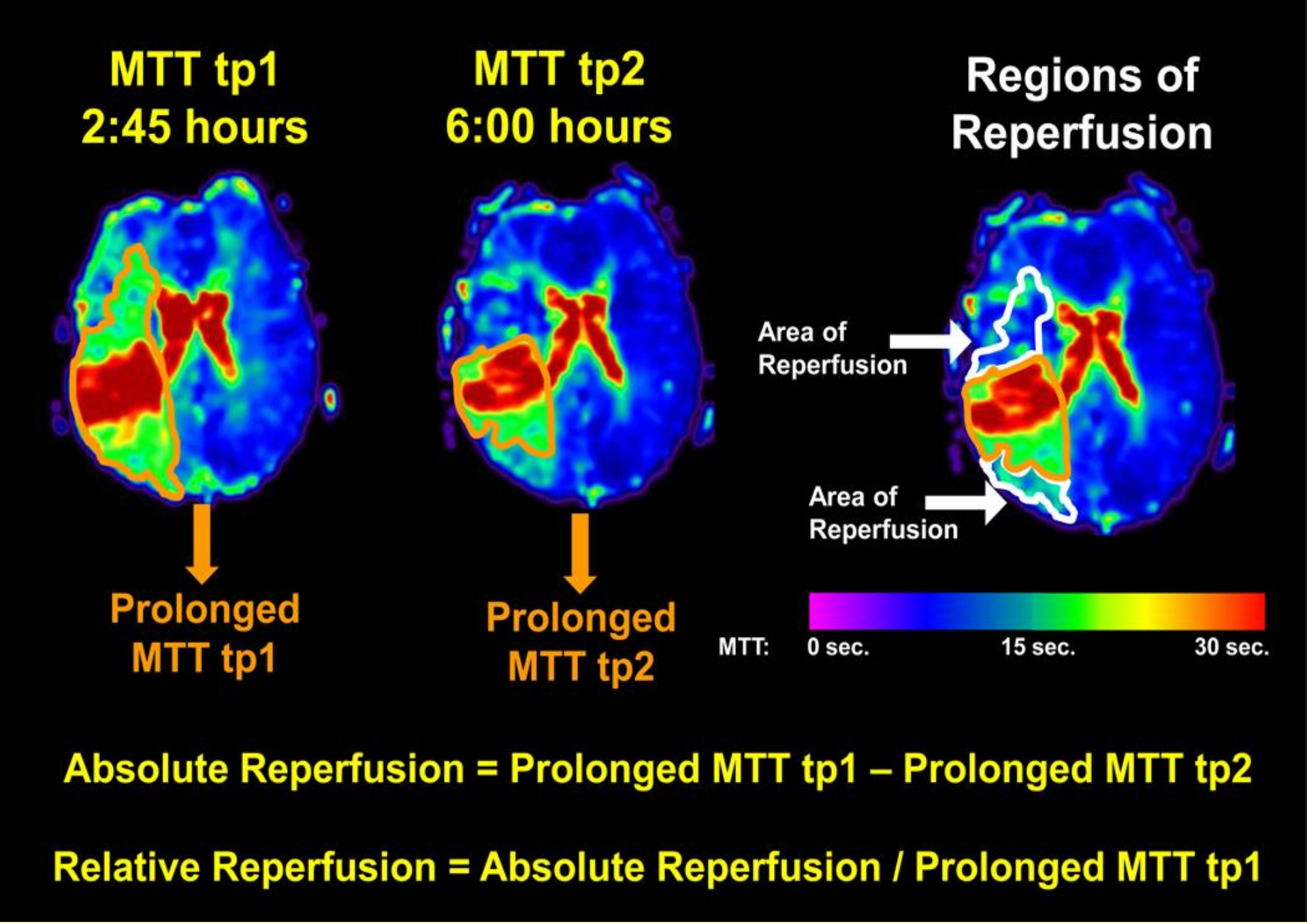






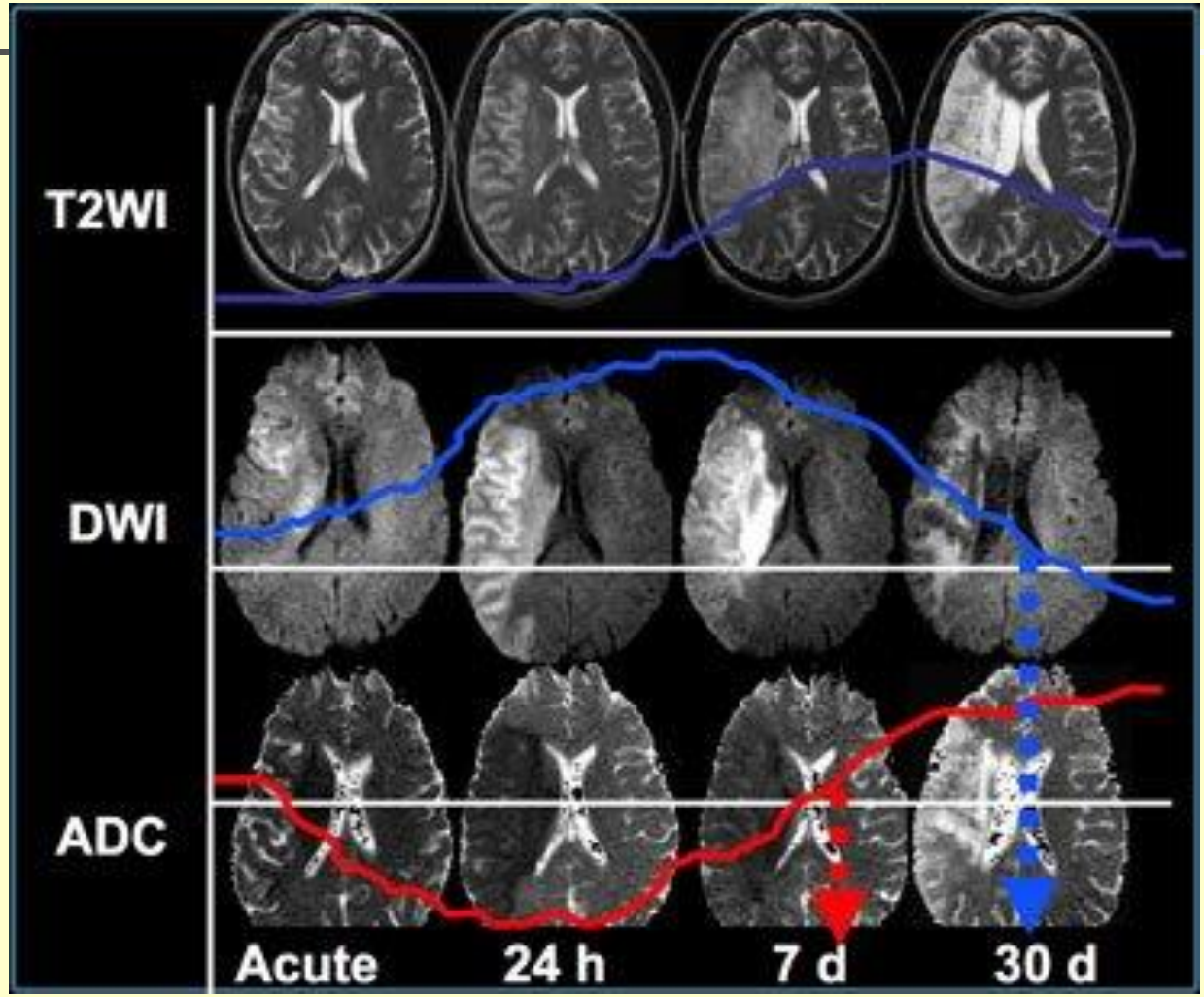






Ford AL et al. Stroke. 2011 May ; 42(5): 1307–1313.

MRI –DWI



Risk factors of stroke

➔Non modifiing RF

- Age
- Sex
- Genetics

➔Modifiing RF

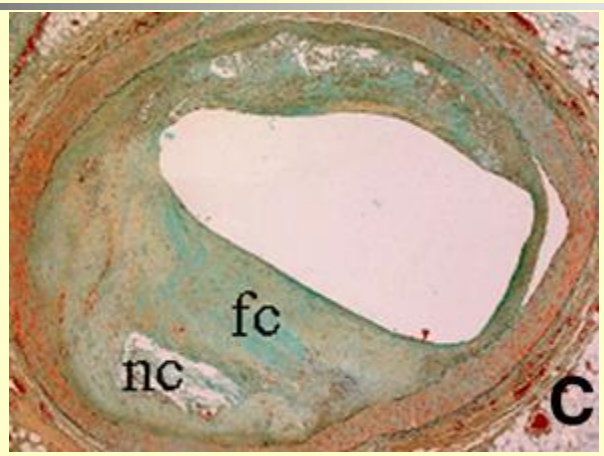
- Hyperetension
- Atrial fibrillation
- Smoking
- Hypercholesterolemia
- Alcohol
- Asympt. stenosis ACI
- Diabetes mellitus

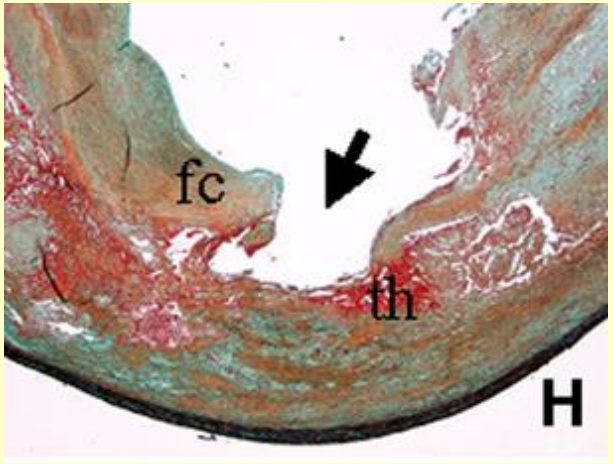
Sacco, Neurology 1998, 51 (Suppl 3), S27-S30

Arterial hypertension (AH)

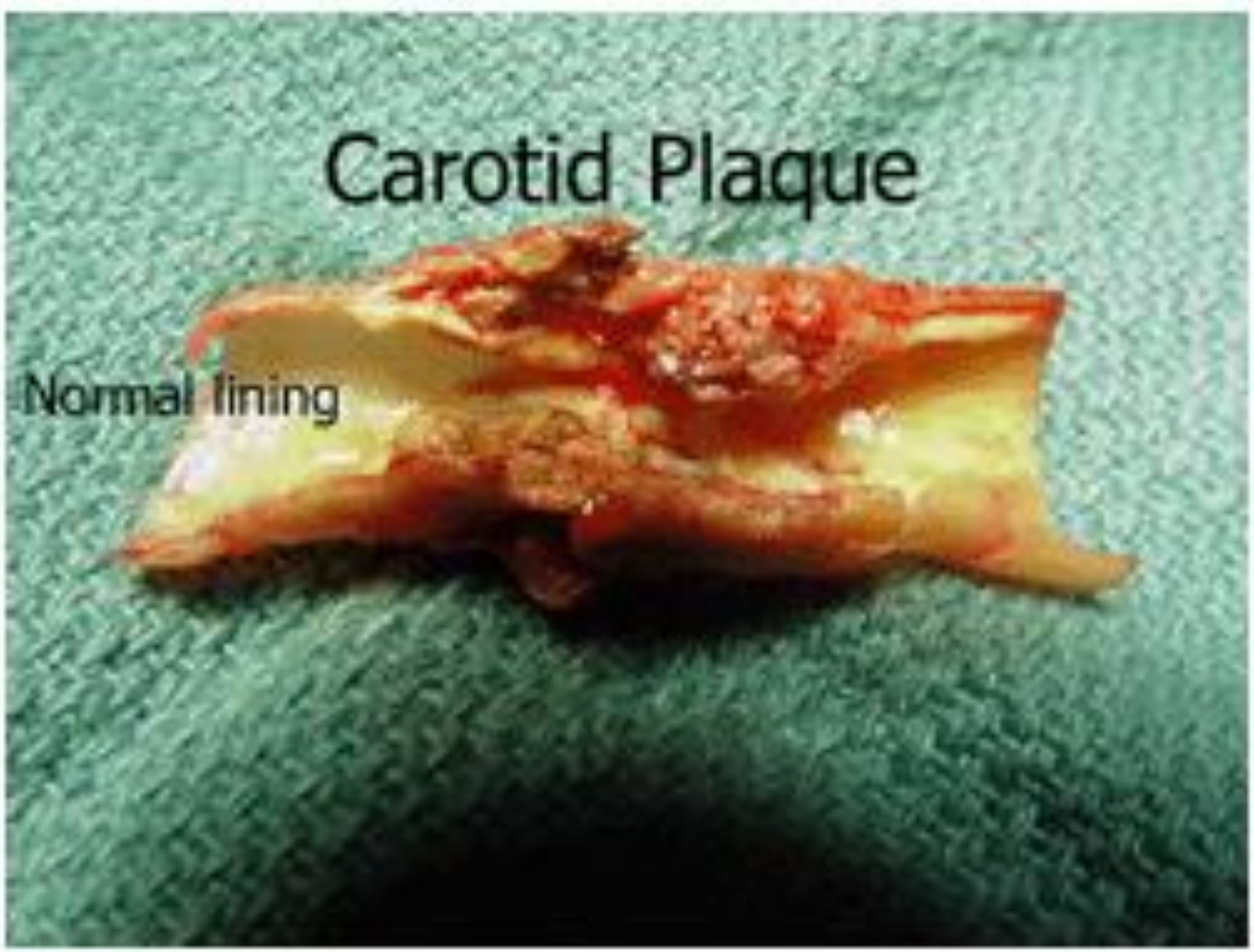
- – AS makroangiopathy, AS mikroangiopathy, vascular dementia, bleeding

Atherosclerosis





Spagnoli L.G. et al.: J Nucl Med, 2007


Carotid Plaque
Normal lining

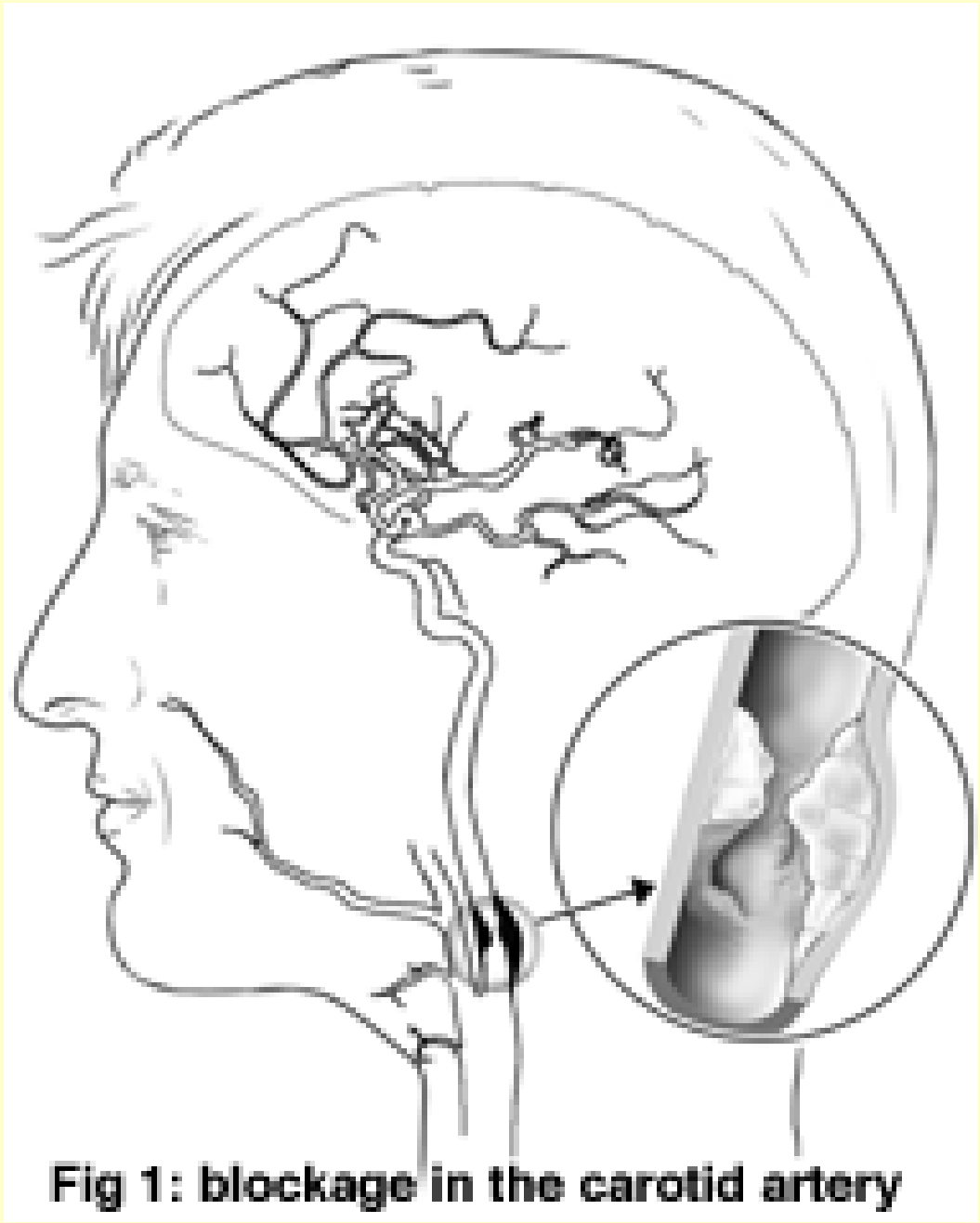
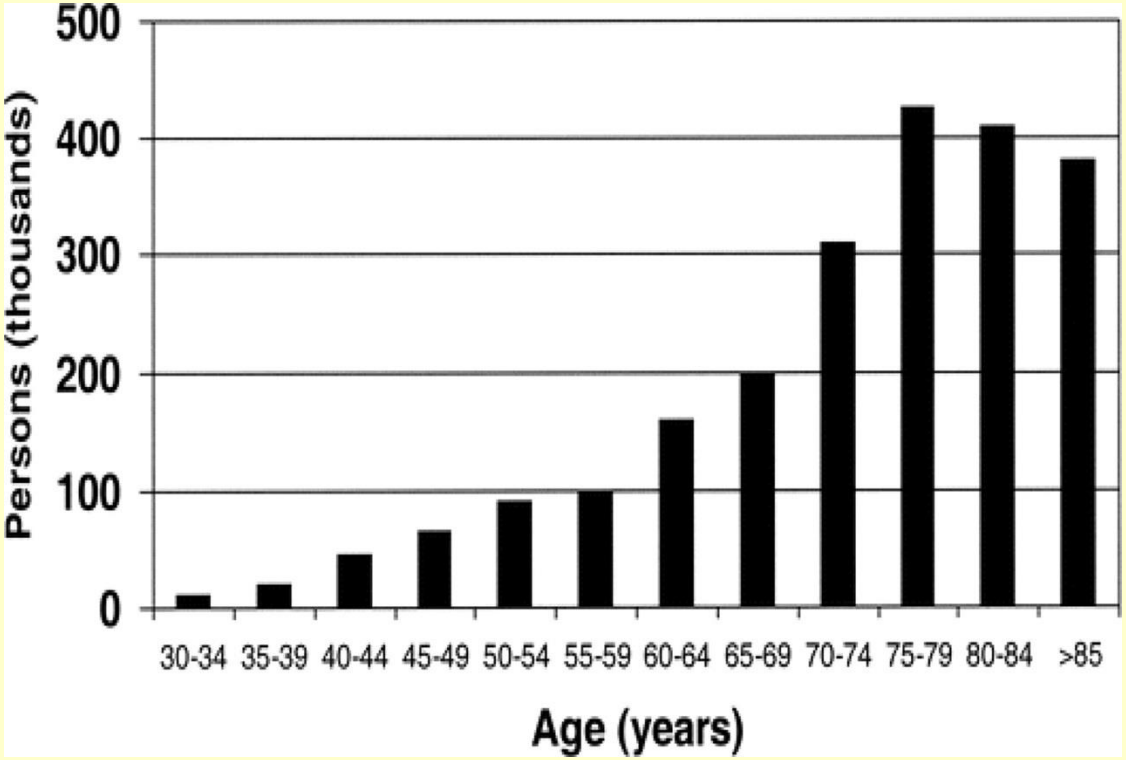


Fig 1: blockage in the carotid artery

Atrial fibrillation



Feinberg W.M., Arch Intern Med 1995

Atrial fibrillation

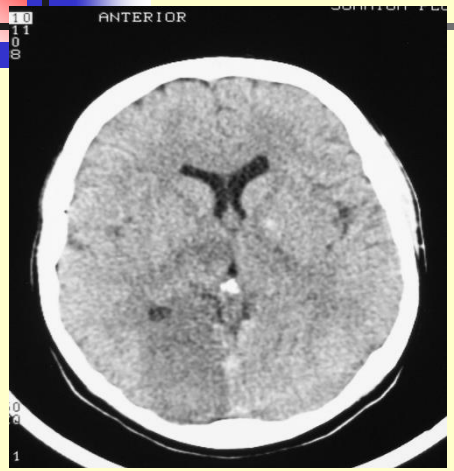
- AF ↑ risk of stroke 5-6-times
- $CHADS_2$ – (congestive heart failure, hypertension, age ≥ 75, diabetes, stroke)

  ≥ 2 – high risk
- CHA_2DS_2-VASc – max 9 points
- NOAC - trombin inhibitor - **Dabigatran,** factor Xa inhibitors– **Rivaroxaban, Apixaban, Edoxaban**

Diabetes mellitus (DM)

- Risk of atherotrombotic strokes, lacunes, dementia

Trombophilia
Z.K., female, 25 years



- **3 days after delivery**
- **Posit. familial history**
- **Deficit AT III**

3a 3b 3c 4

Szilasiová J., ...Gdovinová Z.: Cerebrovasc Dis, 2007

Trombophilia
L.T., man, 55 years

- Repeating strokes – leftside hemiparesis (2003, 2005), sekundary epilepsy
- Posit. familial history
- FV Leiden, MTHFR homozygot



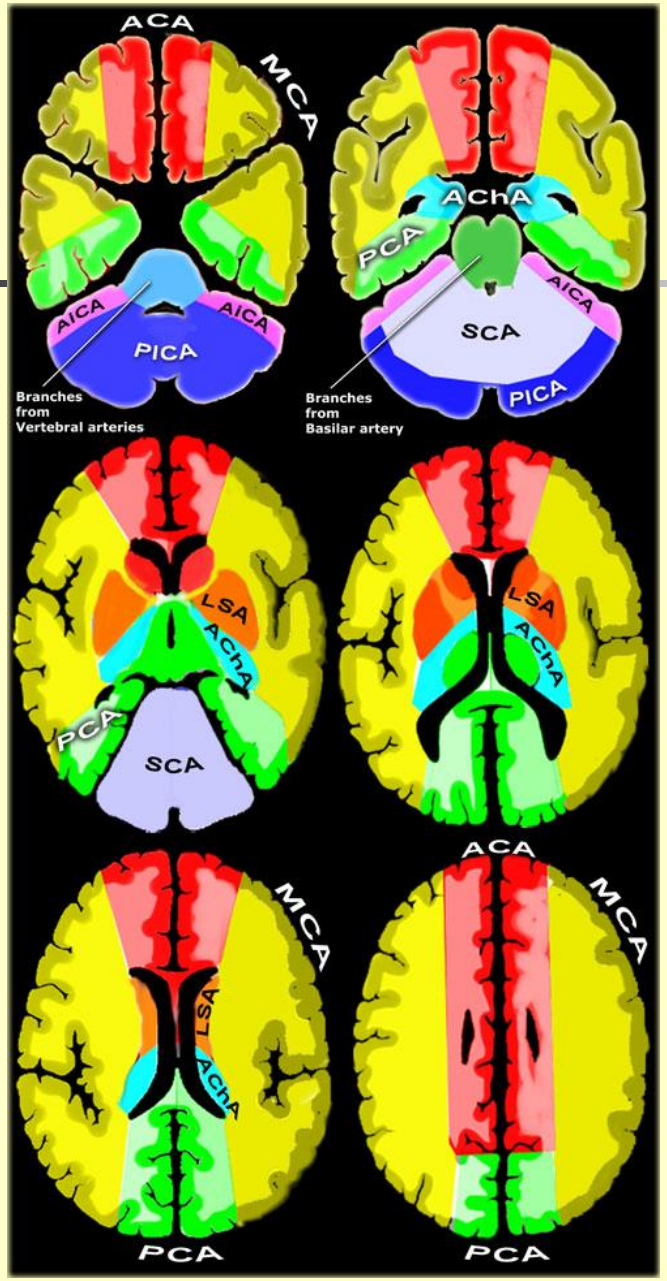

Szilasiová J., ...Gdovinová Z.: Cerebrovasc Dis, 2007

Classification of stroke I.

- Old defintion
- TIA – transitory ischemic atack - lasts 1 hour
- Brain infarct – completed stroke
- New „tissue-based“ definition of TIA
- A brief episode of neurological dysfunction caused by focal brain or retinal ischemia, with clinical symptoms typically lasting less than one hour, and without evidence of acute infarction
- Ischemic stroke (brain infarct) is defined as an infarction of central nervous system tissue.

Classification of stroke II.

- Territory of a. cerebri media
- Territory of a. cerebri anterior
- Territory of a. cerebri posterior
- Territory of a. bazilaris (vertebrobasilar)
- Territory of a. carotis interna
- Territory of a. carotis communis



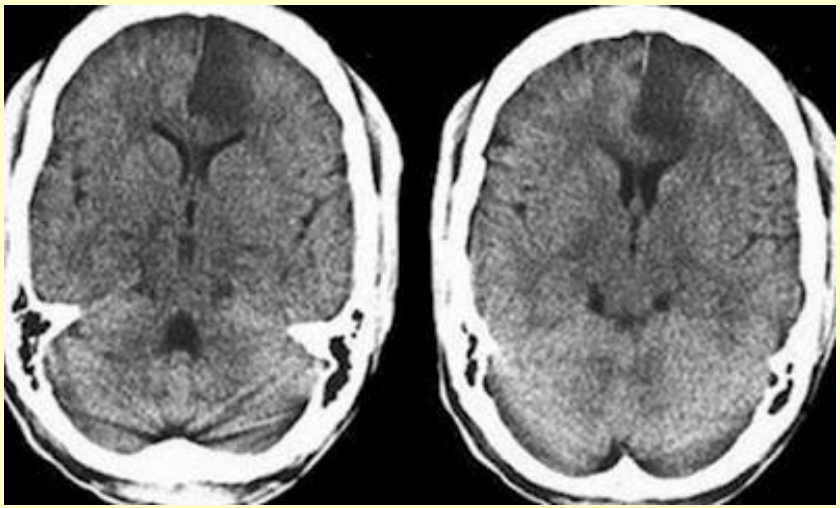
ACA – arteria cerebri anterior,
MCA – arteria cerebri media,
PCA –arteria cerebri posterior,
AChA – arteria chorioidea anterior,
SCA – arteria cerebelli superior,
AICA – arteria cerebelli anterior inferior,
PICA – arteria cerebelli inferior posterior,
LSA – lentikulostriatálne artérie.

MCA territory

- **The most often embolic etiology – very sudden onset**
- **Speech disorder, hemiparesis (dominantly on upper extremity, central lesion of n. VII.**
- **Wernicke – Mann position of the body**

ACA territory

- **Central paresis of lower extremity**
- **Disorders of behaviour – prefrontal sy**



PCA territory

- **Visual field disorders – homonymous hemianopsia**

BA territory

- **Dizziness, diplopia, nystagmus, hemiparesis or kvadruparesis, hemiplegia alternans, cranial nerves lesions, problems with deglutination and speech**

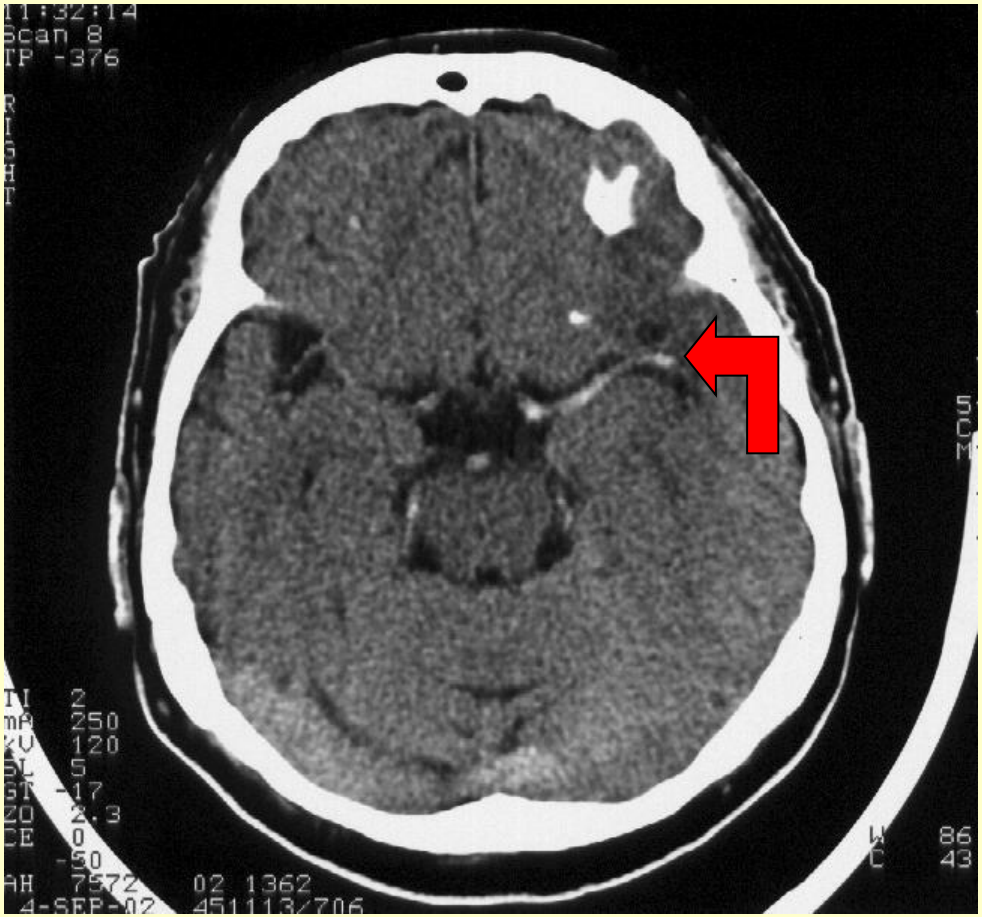
Classification of stroke III.

- **Brain infarct**
- **Lacunar infarct – diameter less than 1,5 cm**

Diagnostics of stroke

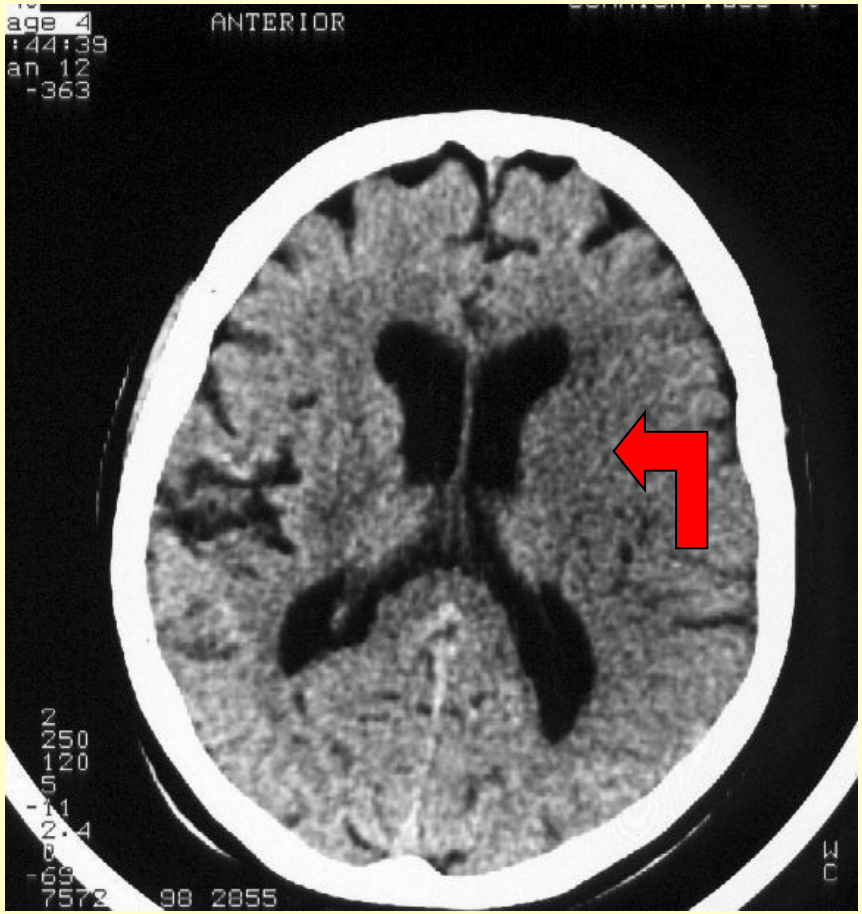
- Clinical feature
- Brain CT
- Laboratory – RBC, SR, coagulation, fibrinogen, Na, K, sugar, urea, kreatinin, cholesterol, triglycerids, CRP, TPIT
- Duplex of carotid arteries
- ECHOcardiography

Brain CT – early signs of ischemia

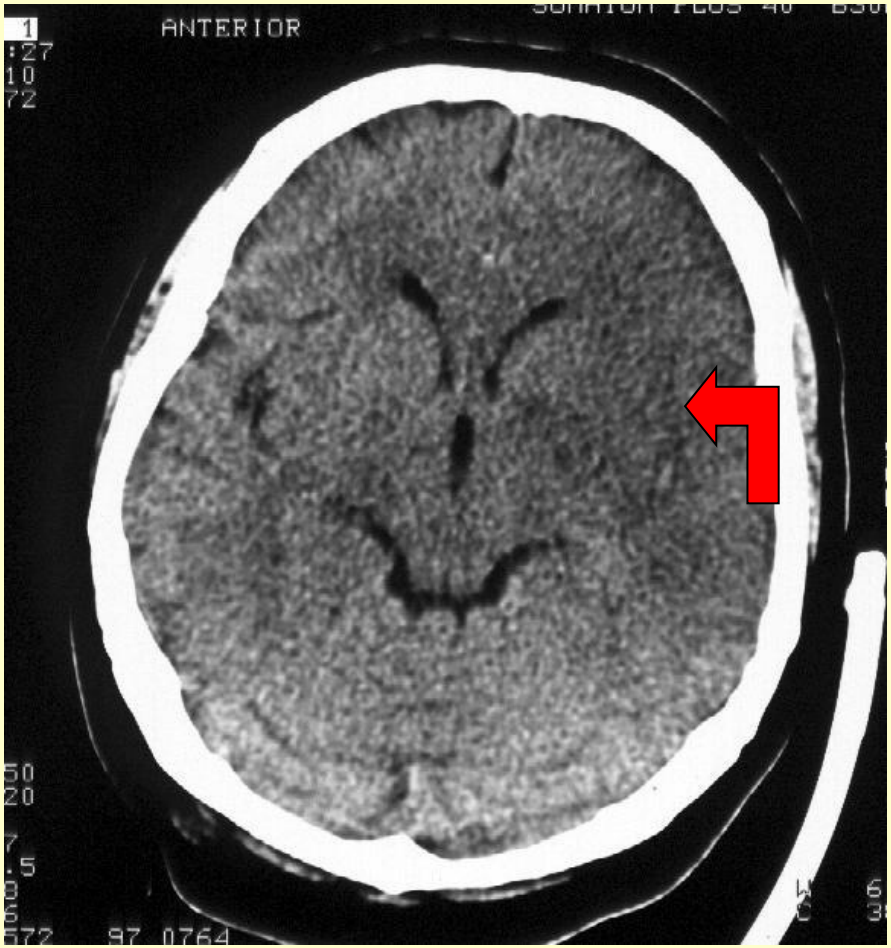


Brain CT – early signs of ischemia

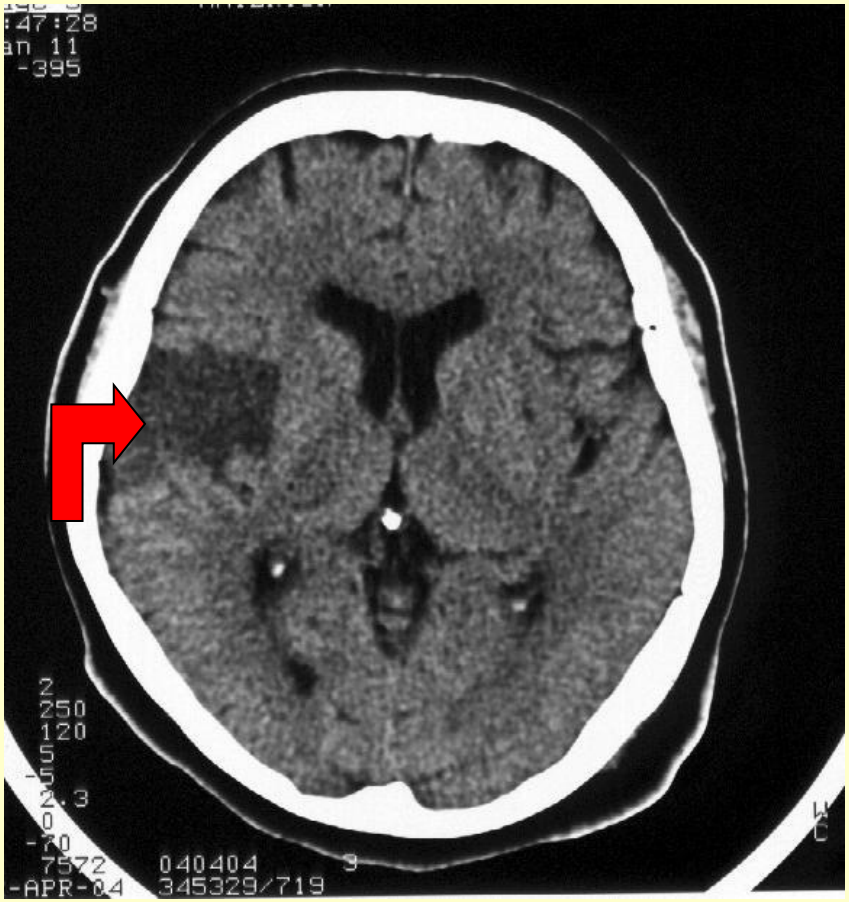
Brain CT – ischemia



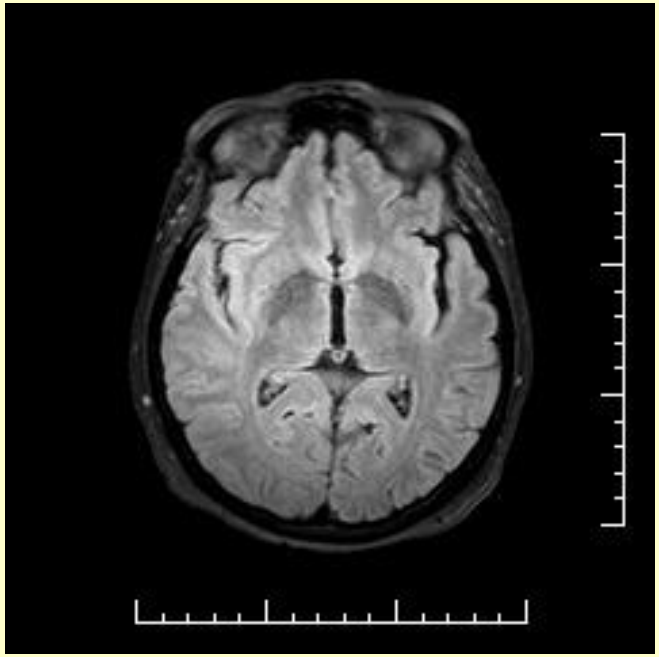
Brain CT – ischemia



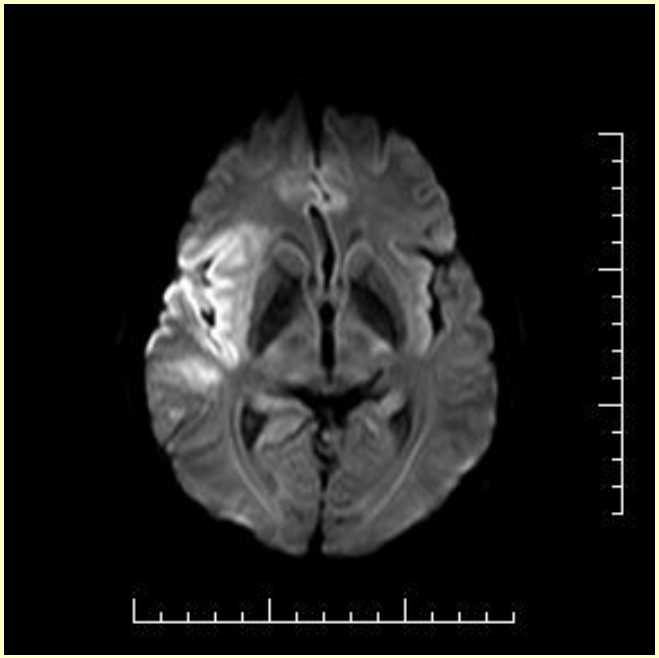
Brain CT – ischemia



„Wake-up stroke“

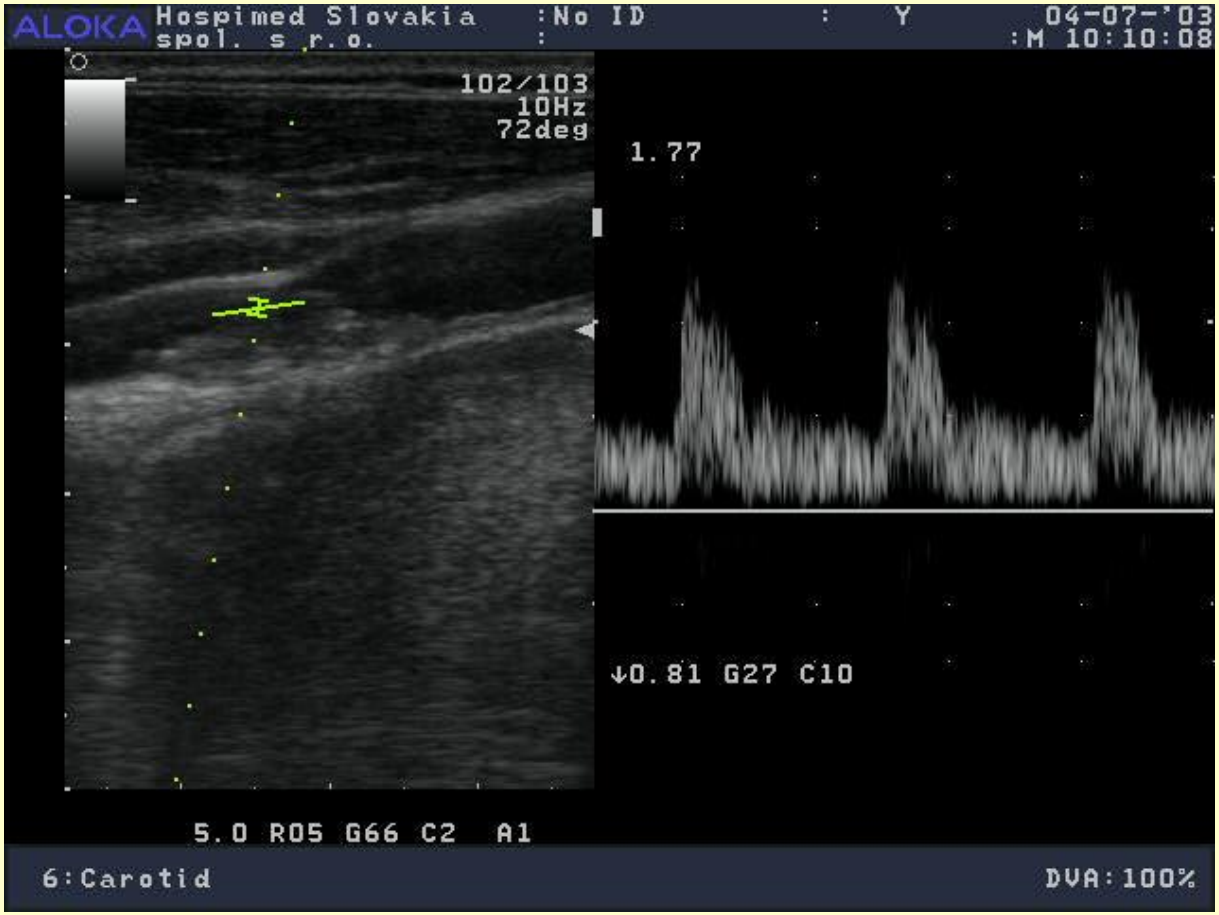


Brain MR – FLAIR

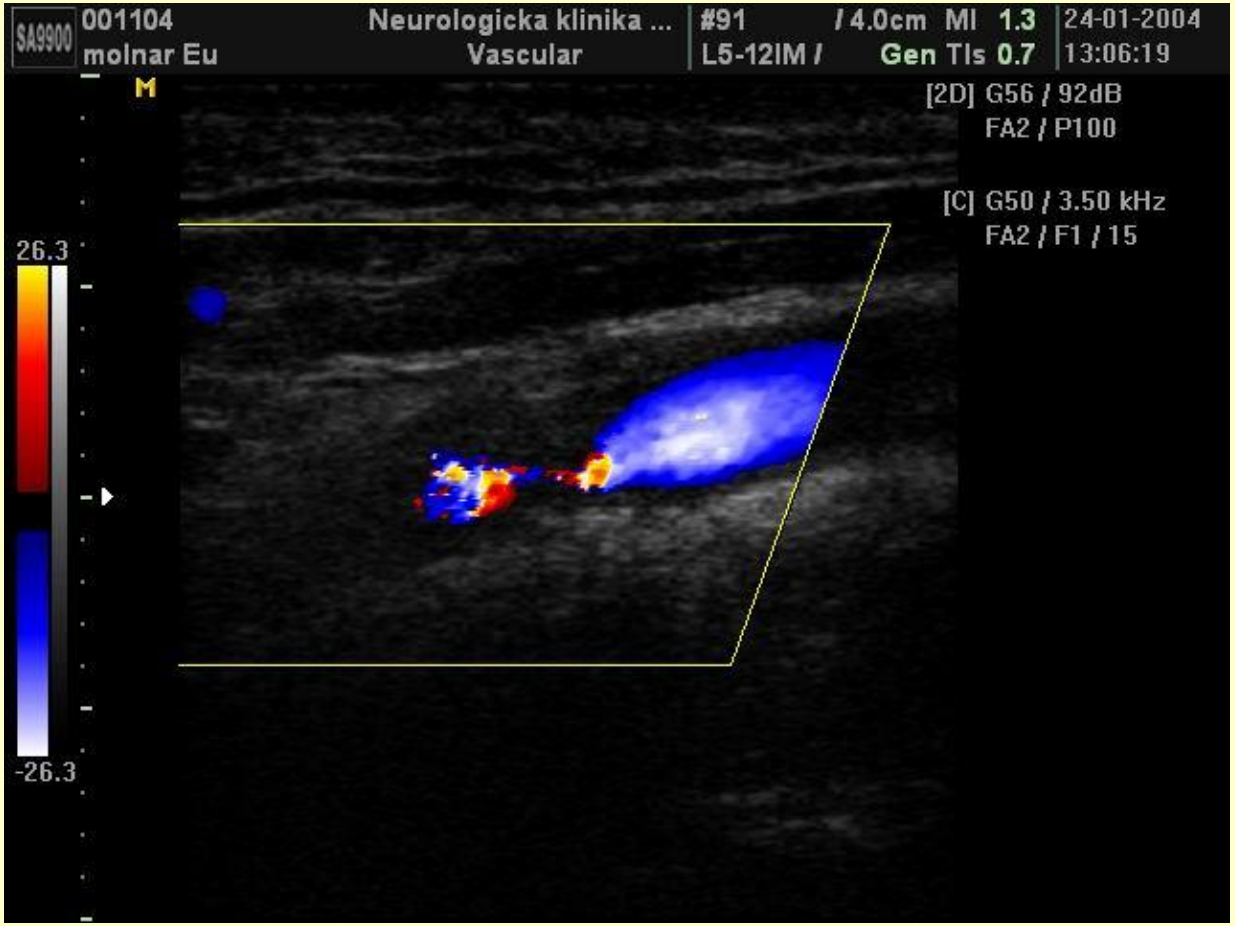


Brain MR – DWI

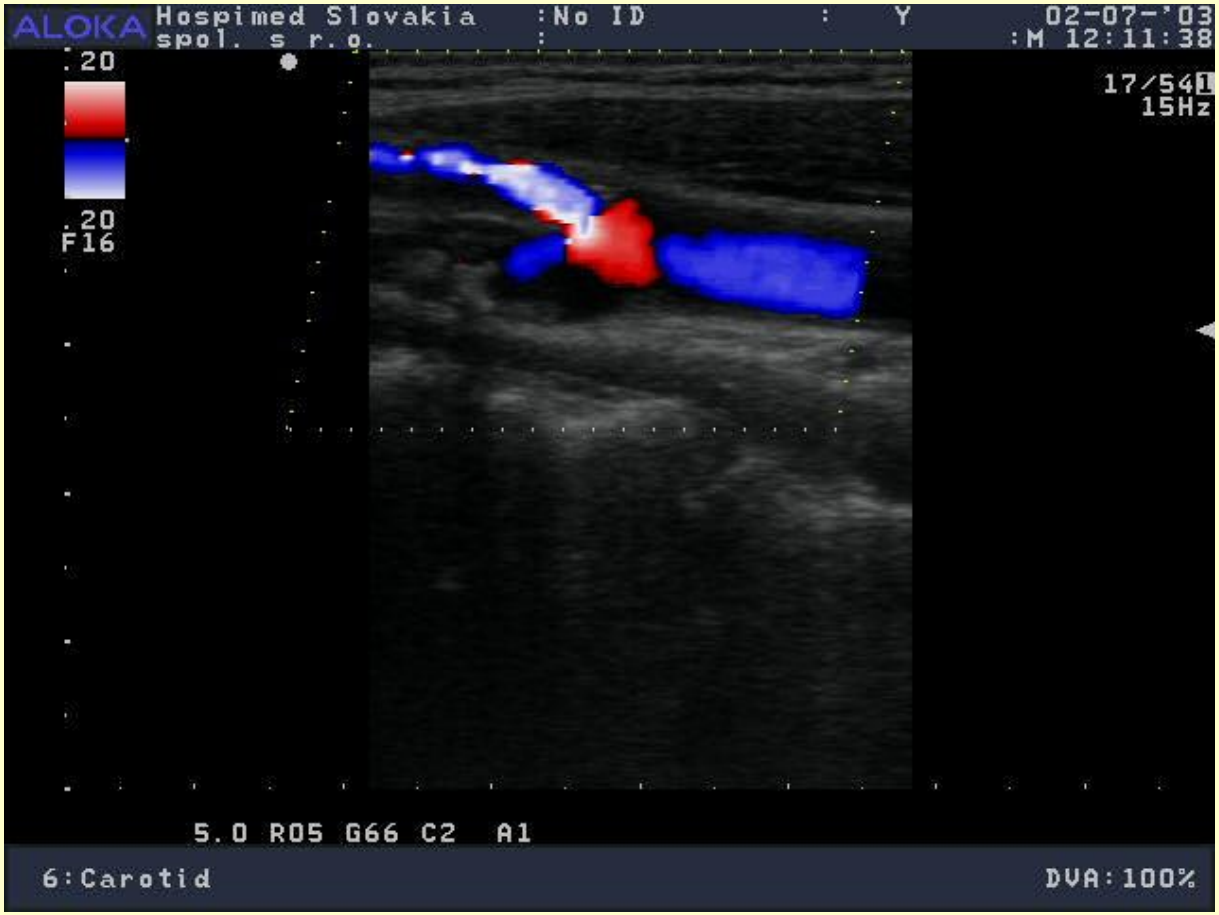
ICA stenosis



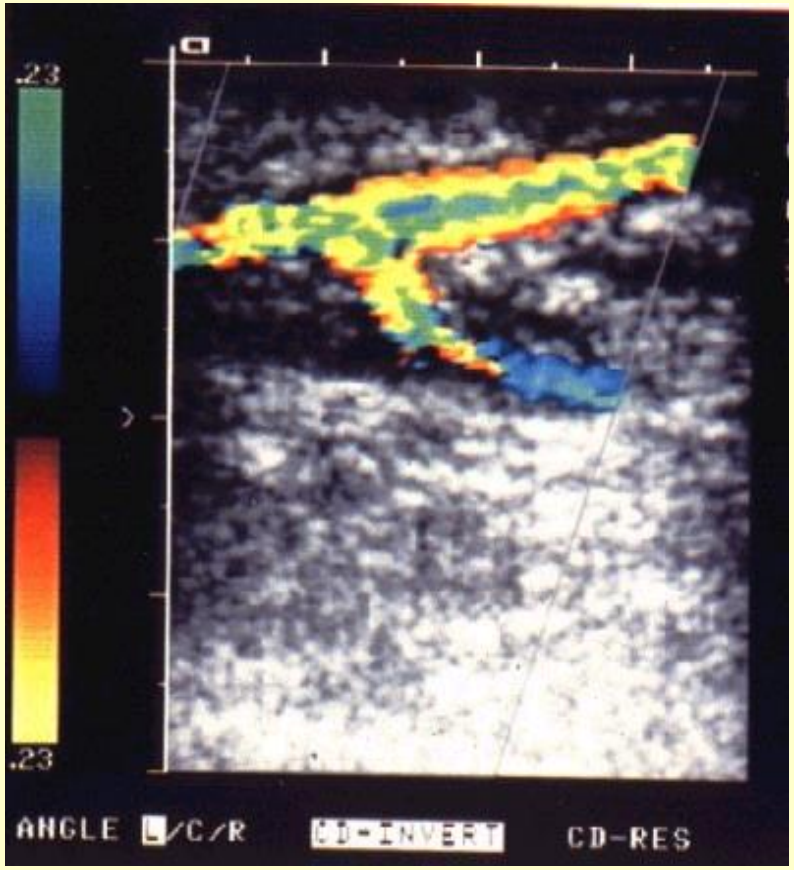
ICA stenosis

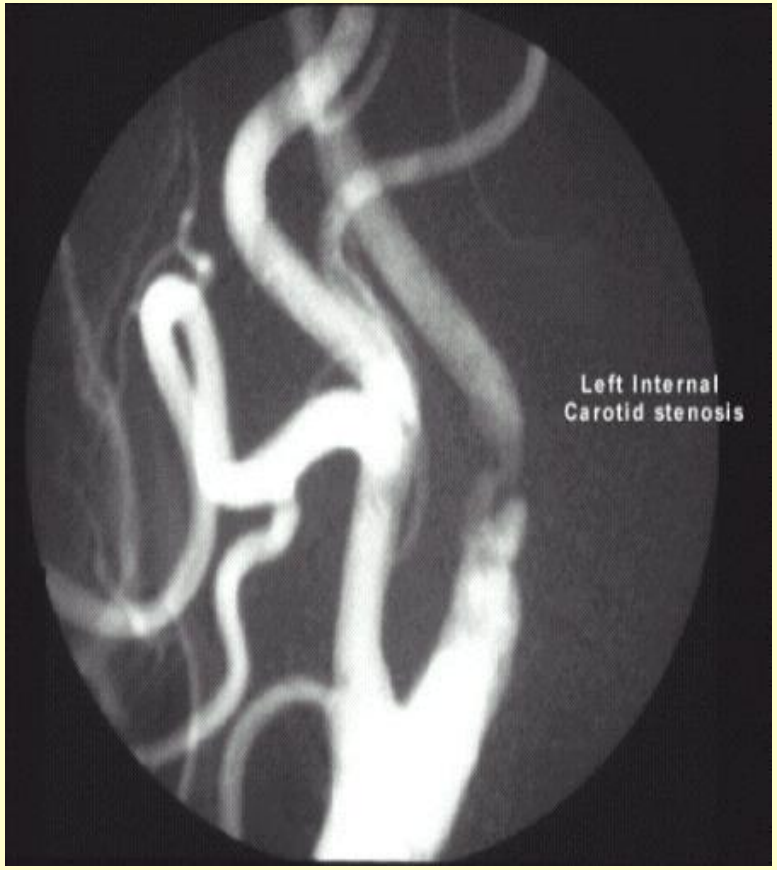


ICA stenosis



Duplex of carotid arteries and AG





Stroke therapy

- **Acute**

1/ Trombolysis - rt-PA (recombinant tissue plasminogen activator) -
≤ 4.5 hours after first symptoms!

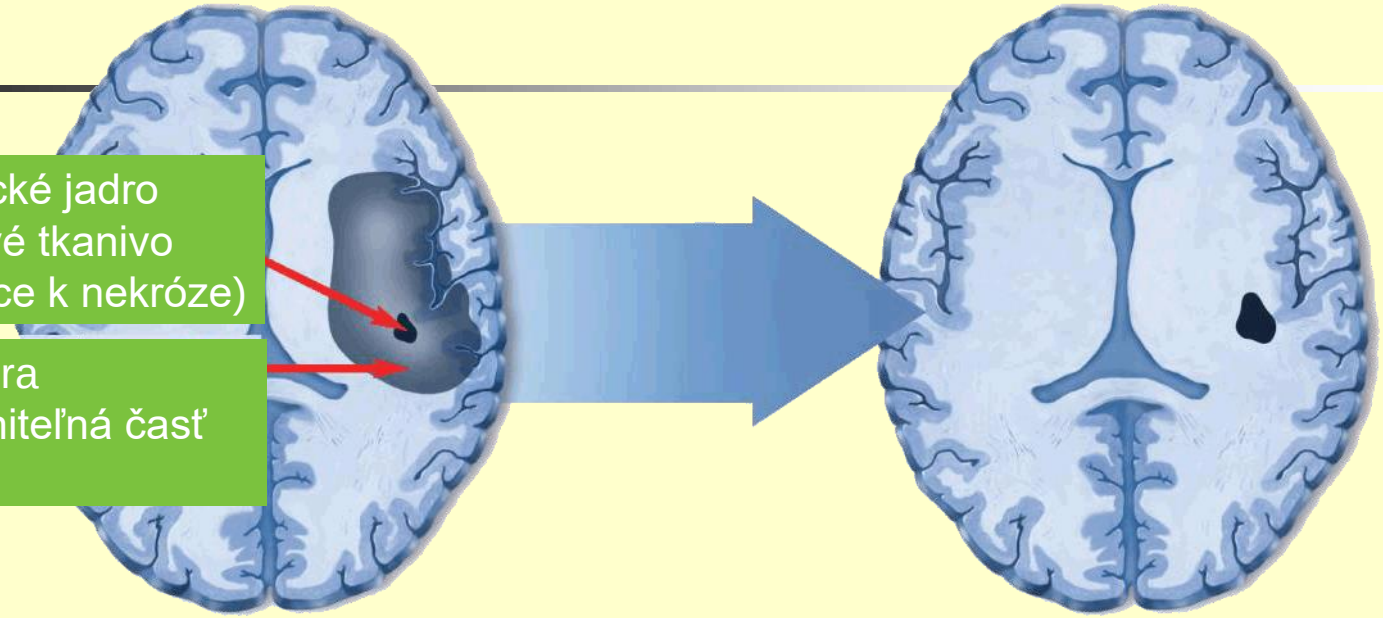
2/ Thrombectomy

≤ 6 hours after first symptoms!

3/ ASA – 325 mg – later that 6 hours

- **1/ - i.v. rt-PA 0,9 mg/kg**
- **Brain CT – negative, early signs of ischemia**

Možnosť úpravy neurologického poškodenia trombolytickou reperfúziou

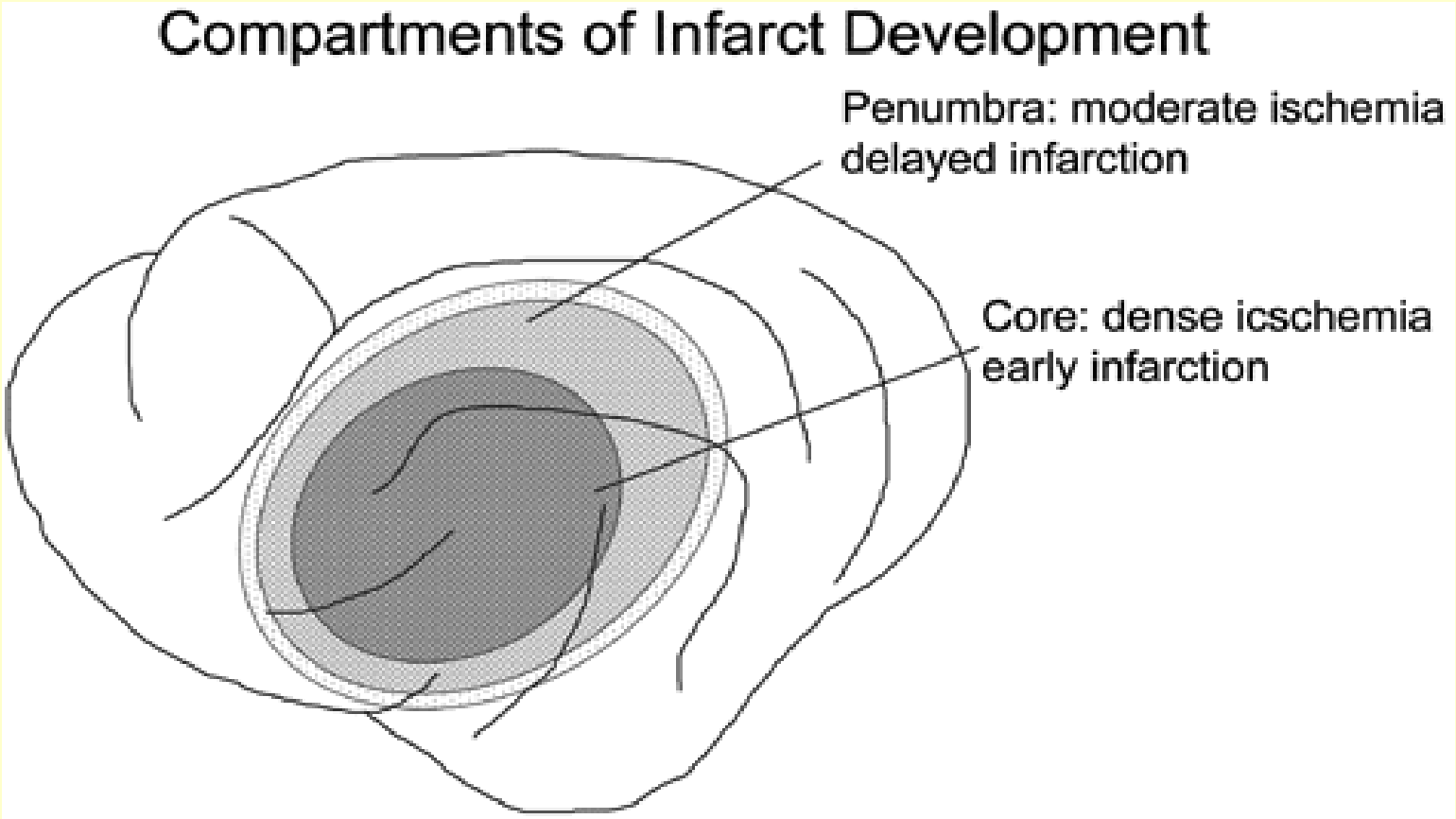


Neliečný pacient stráca v ischemickej oblasti približne 1,9 milióna neurónov každú minútu

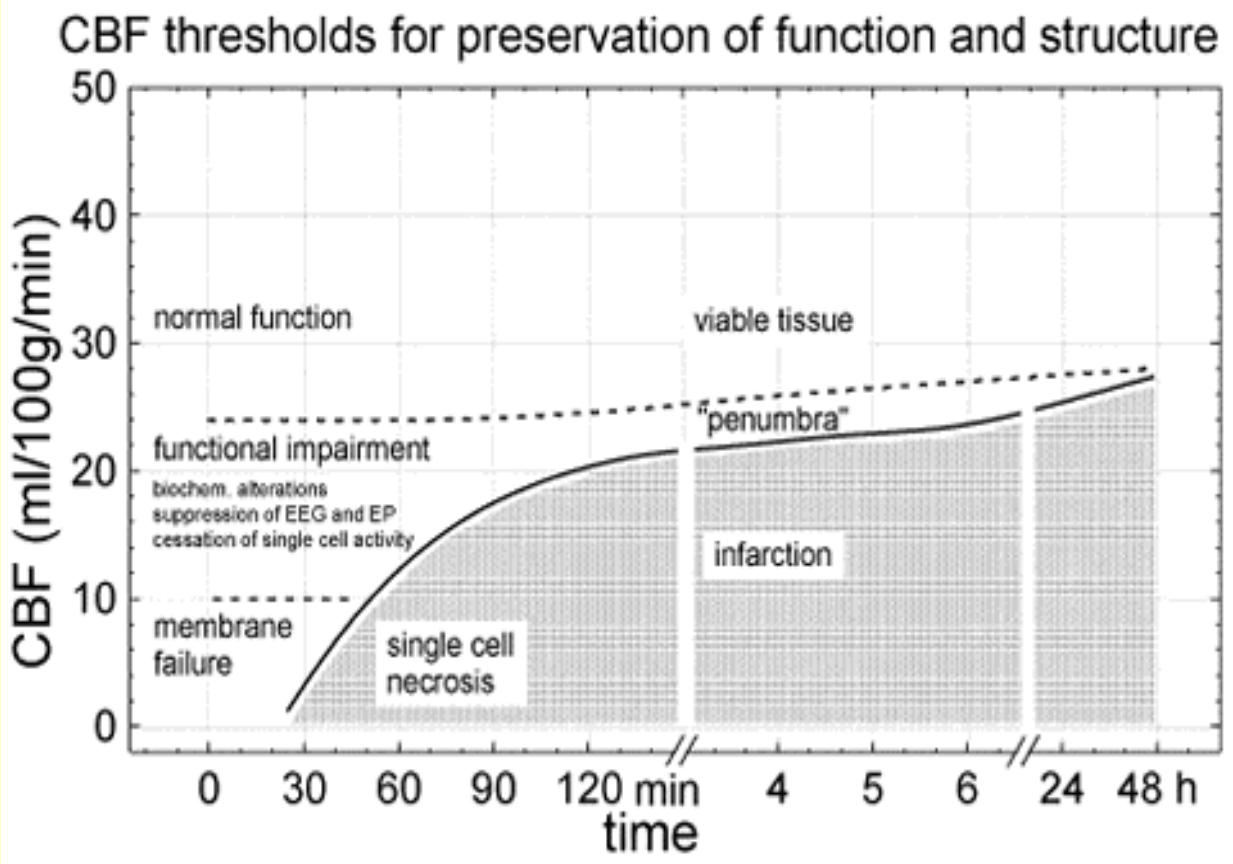
Reperfúzia ponúka možnosť redukcie rozsahu ischemického poškodenia

Saver. Stroke 2006;37:263-266.
González. Am J Neuroradiol 2006;27:728-735.
Donnan. Lancet Neurol 2002;1:417-425.

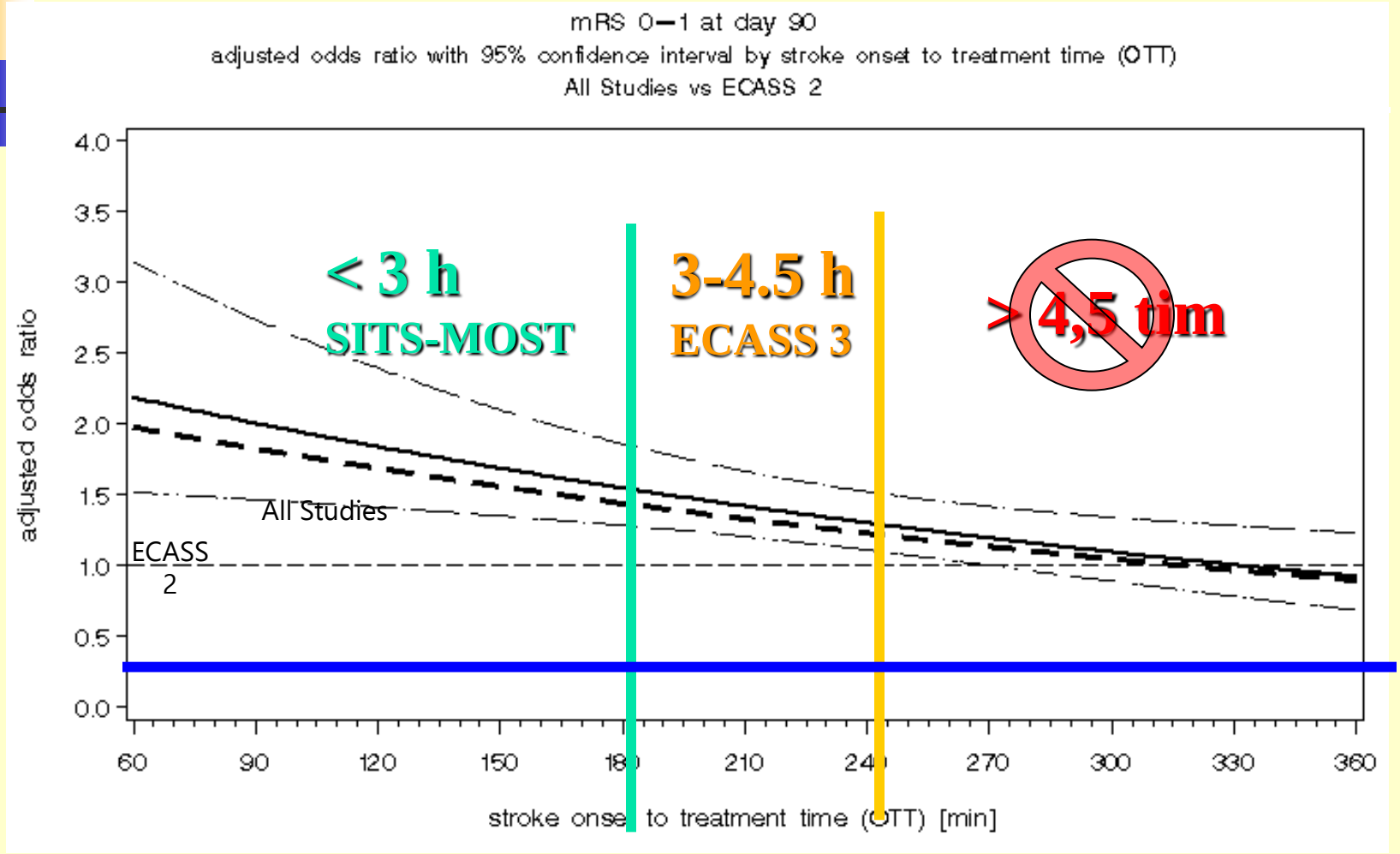
The goal of therapy



Development of ischemia

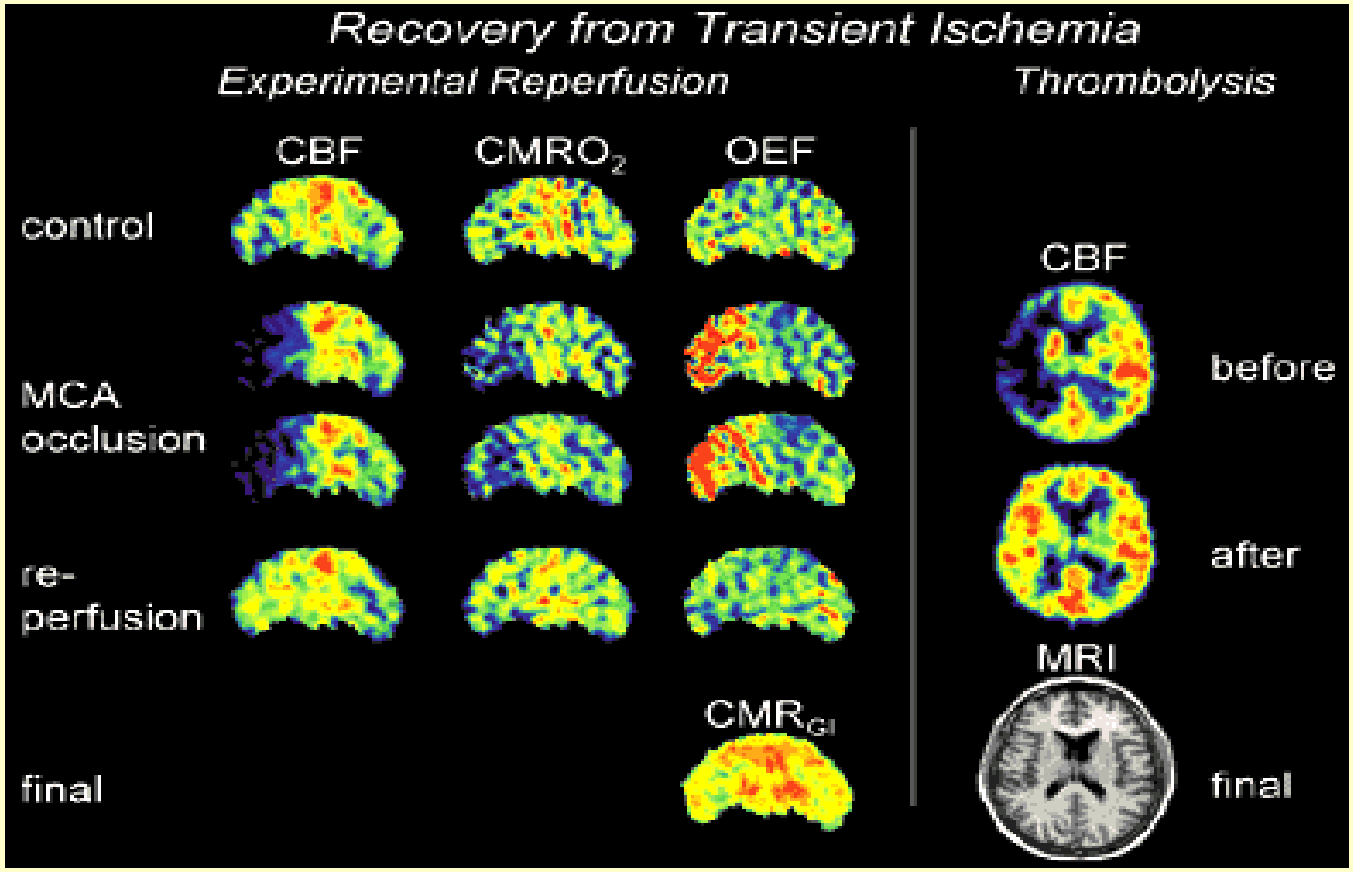


ECASS III



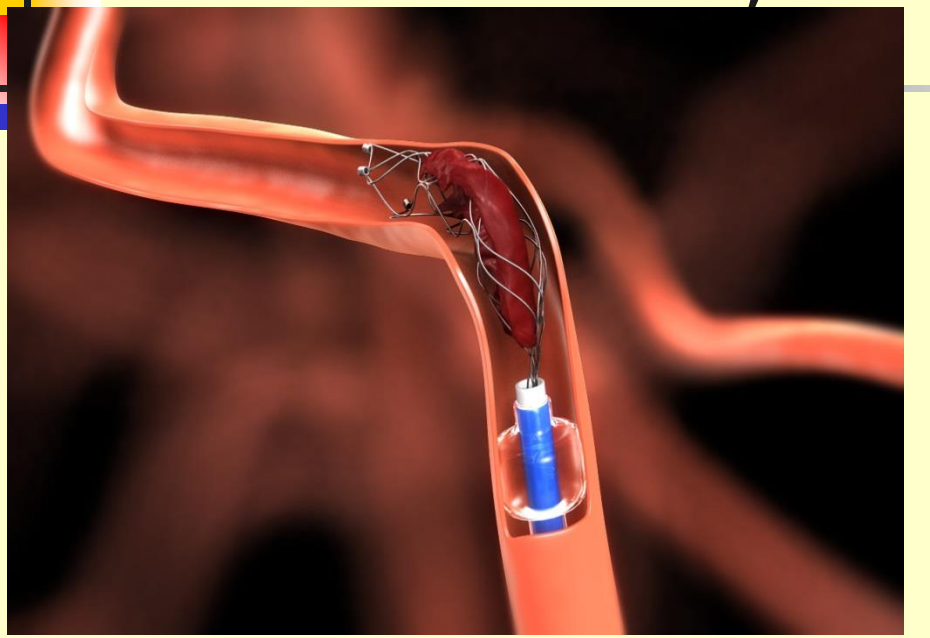
NNT – 2/90 min., 7/3h, 14/3-4.5h

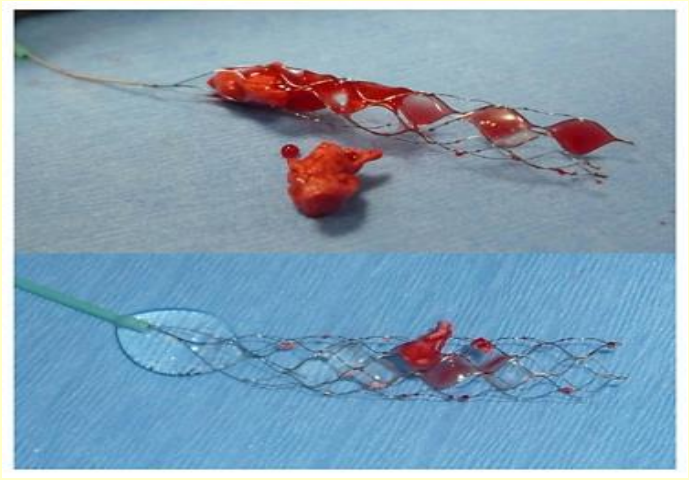
Trombolysis

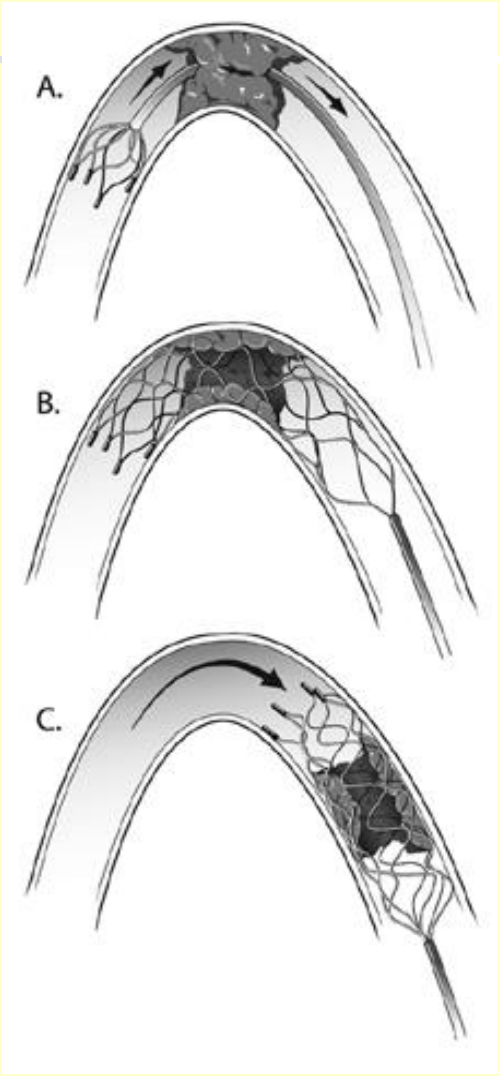


Endovascular therapy

Solitaire retriever, Trevo pro retriever







O.R. 52-years old woman

- Wake up - 5.45, she felt down, aphasia, right side hemiparesis
- Emergency
- 6.50 – hospital, NIHSS - 11
- 7.05 – brain CT
- 7.45 – rTPA
- 9.05 – DSA, trombektomy

O.R. 52-years old woman

DSA before TE

DSA after TE

O.R. 52-years old woman

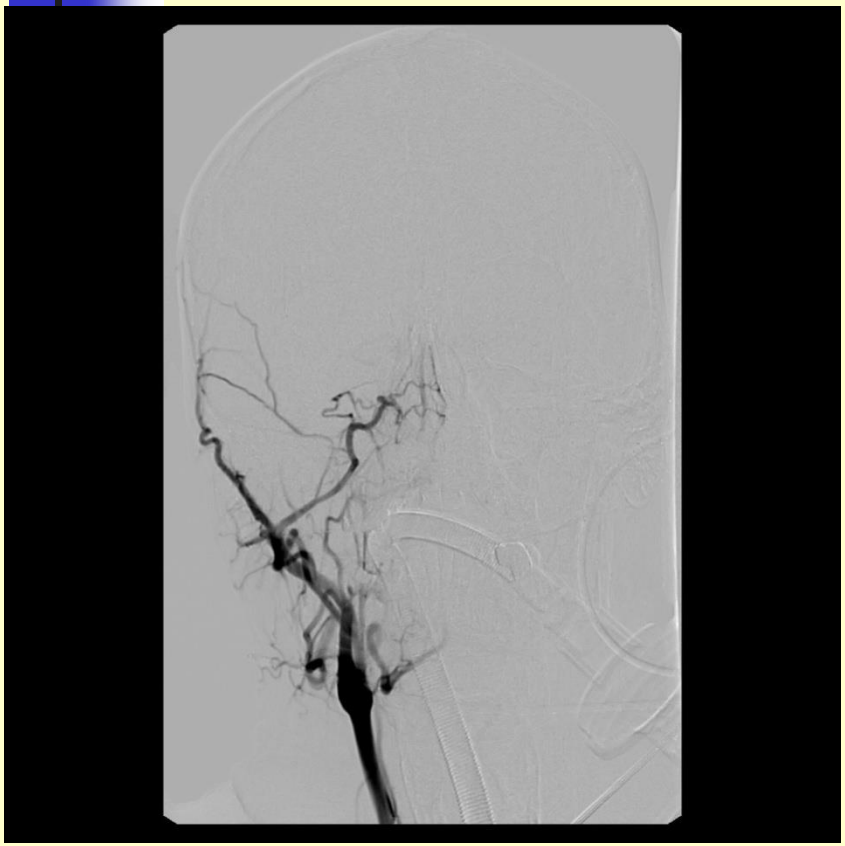
- Brain CT after 24 hours
- mRS – 0 at time of discharge

T.T. 37-years old man

- 30.7. 2013 –orchiektomy and CHT
- 30.8.2013 at 16.00 weakness of left extremities
- Admitted in hospital at 18.00, barin CT at 19.20
- Admitted in our hospital at 21.15, 30.8.2013

Angiography

Trombektomy 30.8.2013 at 22.45



CT after TE and decompressive craniotomy

After po 24 hours

After 72 hours

After 15 days

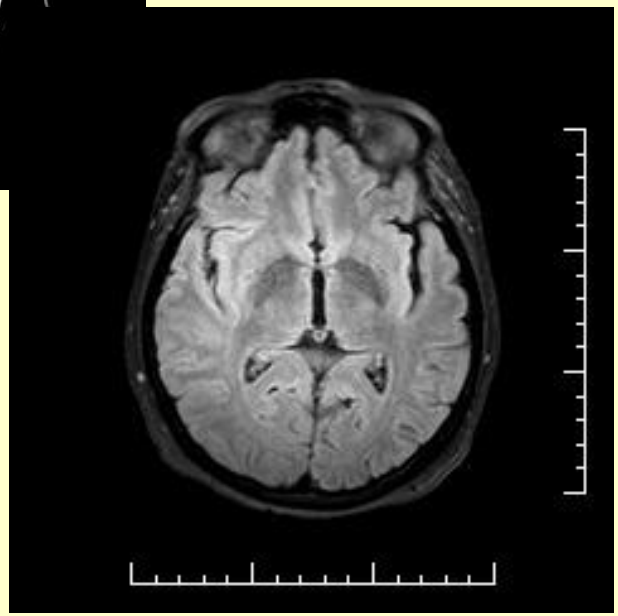
Eric Jordan sings Puccini


Adult
HR
150
50
73
SV Rhythm
SpO2
100
90
95
PVC
0
Pulse
Perf
CNN

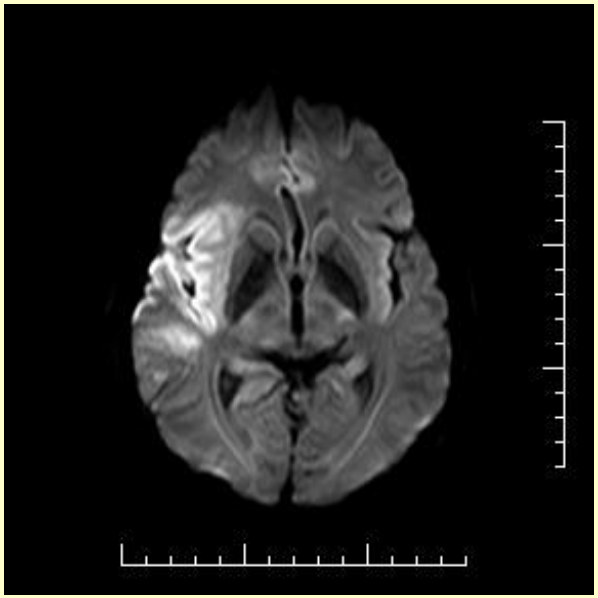
„Wake-up stroke“

Košice, May, 2015

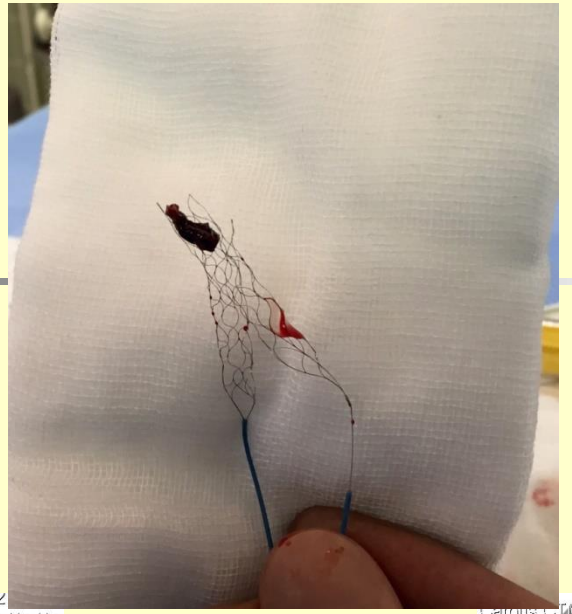
67- year old patient , waked up at 5.30 – left side hemiparesis, NIHSS – 10 points



Brain MR – FLAIR



Brain MR – DWI




Carotis C+M
IODINE
1949/12/10
65Y F
2015/4/24
0.1 RAO
0.1 CRA
93.0 kV
234.0 mA
Velkosť pixelu: 0.244 mm
W: 713 L: 2105


Carotis C+M
IODINE
1949/12/10
65Y F
2015/4/24
0.1 LAO
9.3 CRA
94.0 kV
230.0 mA
Velkosť pixelu: 0.244 mm
W: 607 L: 2096

Therapy after acute stroke

- **Therapy of risk factors – prevention**
- **Antiagregants**
- **Anticoaguants**
- **Endarterectomy (CAE) – also acute**
- **STENT**
- **Rehabilitation**

Guidelines for antiagregants

- **Antiagregants**
- **Non cardioembolic strokes**
- **ASA, 50 – 325 mg 1xD**
- **Combination ASA and dipyridamol 200 mg 2xD**
- **Clopidogrel 75 mg 1xD**

Albers GW a kol., *Chest* 2001;

Indications for anticoagulants in patients with stroke and AF

- **Stroke, AF and**
- $CHADS_2$ – (congestive heart failure, hypertension, age ≥ 75, diabetes, stroke)

  ≥ 2 – high risk
- Warfarin – INR 2,0-3,0
- Direct oral anticoagulants
- Direct inhibitor of thrombin – Dabigtran
- Inhibitors of Xa – Apixaban, Rivaroxaban, Edoxaban

RELY – ARISTOTLE – ROCKET AF

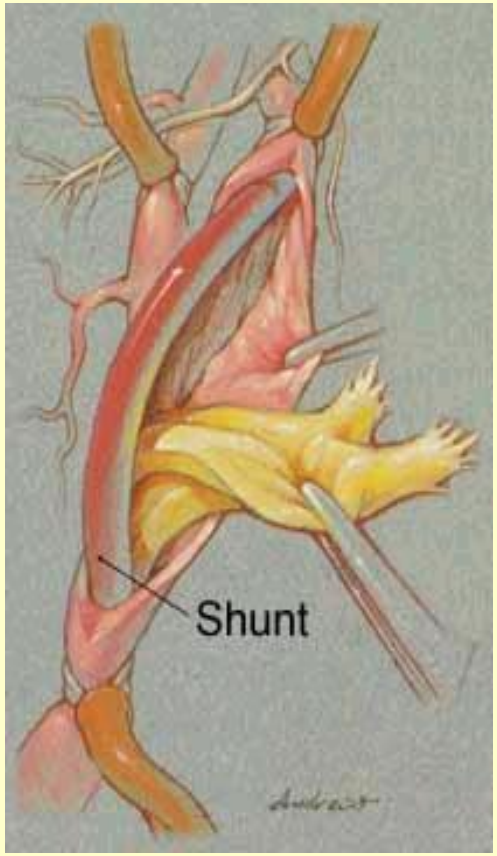
Charakteristika štúdií	RELY dabigatran	ROCKET AF rivaroxaban	ARISTOTLE apixaban
Mechanizmus účinku	IIa	Xa	Xa
Počet pacientov	18 113	14 264	18 201
Dávkovanie	150 mg 2x/ day 110 mg 2x/ day	20mg 1x/ day (15mg 1x/ day)	5mg 2x/ day 2,5 mg 2x/ day
Dizajn	PROBE	Double blind	Double blind
Priemer $CHADS_2$	2,1	3,5	2,1
Priemer TTR	64%	55%	62%
Medián TTR	67%	58%	66%
Prerušenie liečby (Warfarín)	21,2% (16,6)	23,9% (22,4)	25,3% (27,5)

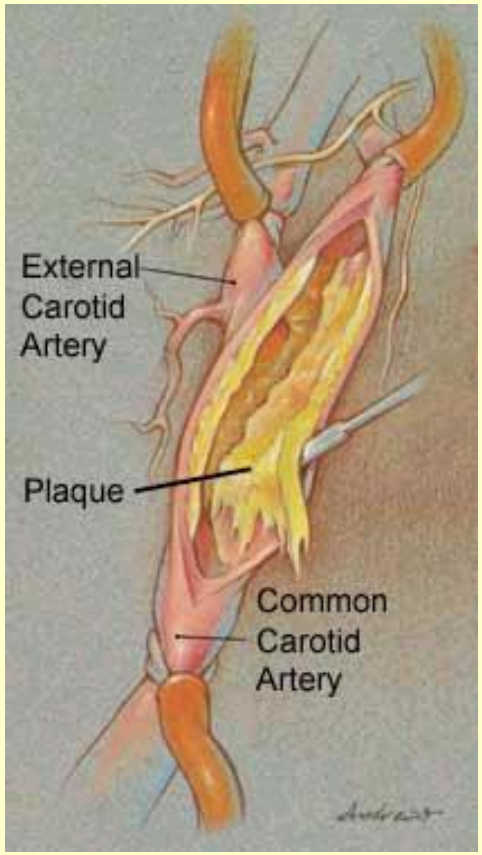
Connolly SJ *et al. N Engl J Med* 2009; **361**:1139–1151.Connolly SJ *et al*. *N Engl J Med* 2010; **363**:1875–1876 (letter to editor).
SPC Pradaxa tvrdé tobolky 110/150 mg, 8/2011;
Granger CB et al. NEJM 2011: 10..1056/NEJMoal 1107039. NEJM.org ; Patel MR et al. NEJM 2011;10.1056/NJMoal1009638.NEJM.org.
https://www.dcri.org/news-publications/slides-presentations/ROCKET-AF-LBCT FINAL.ppt/view?searchterm=rocket

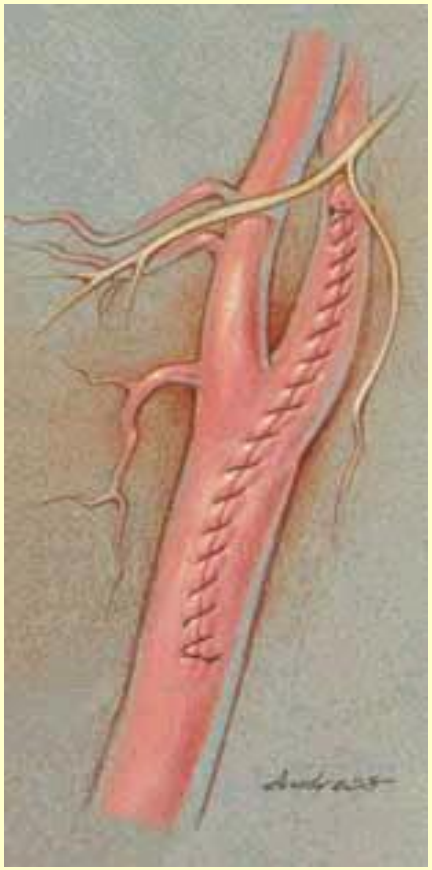
Endarterectomy ICA

- **Indications**
- **ACI stenosis > 70% (in ulcerating AS plaques – risk of embolisation – > 60%)**
- **Brain CT**
- **After TIA – 2 days, small infarct within 2 weeks, others – 6 weeks after stroke**

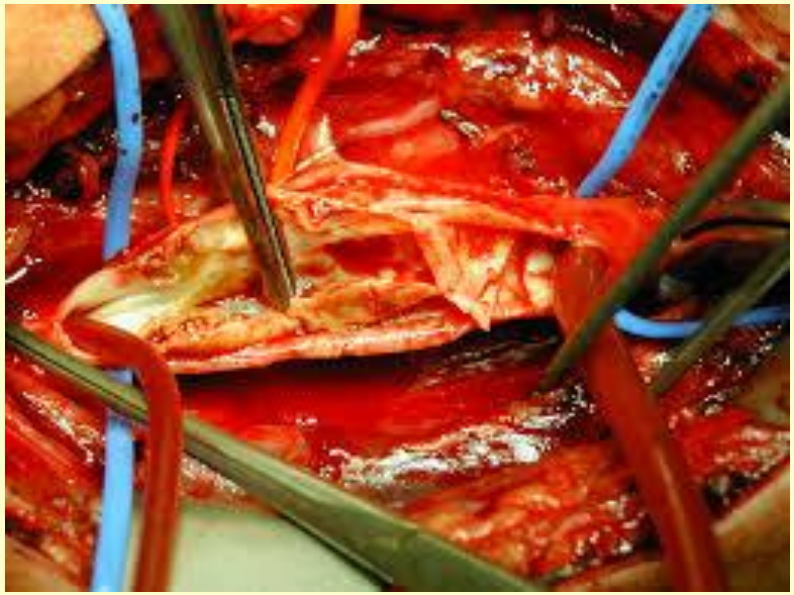
Endarterectomy

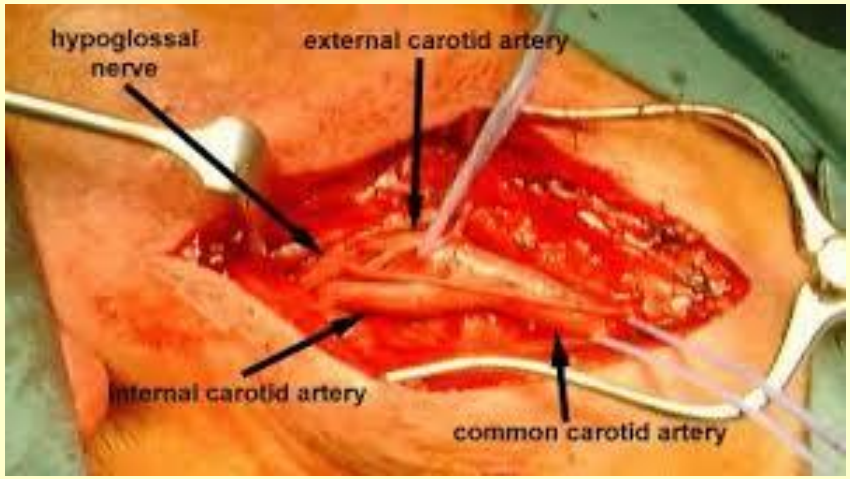


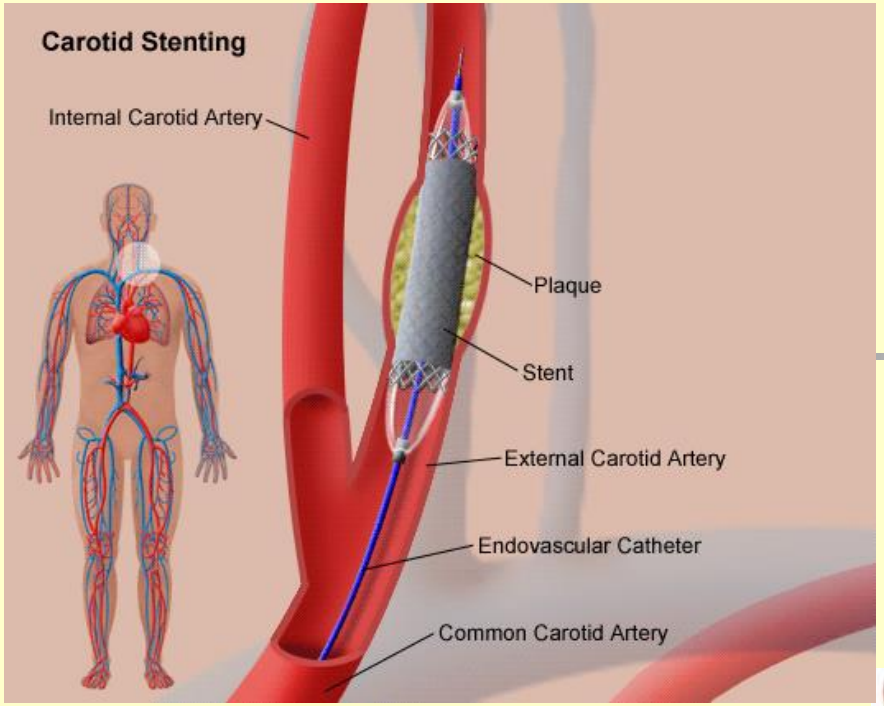


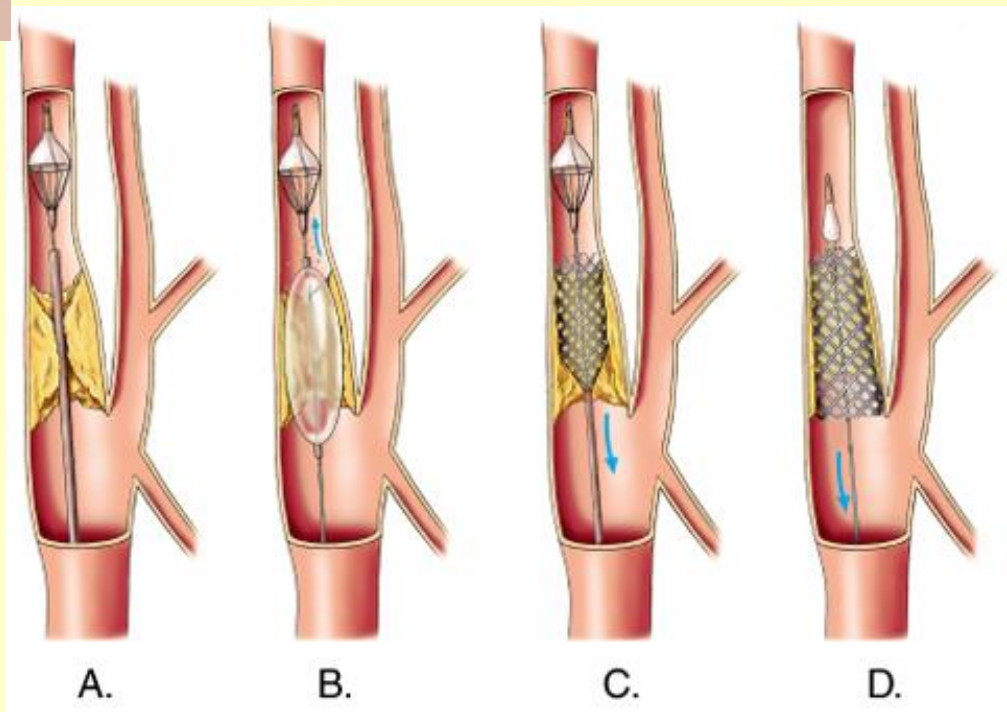


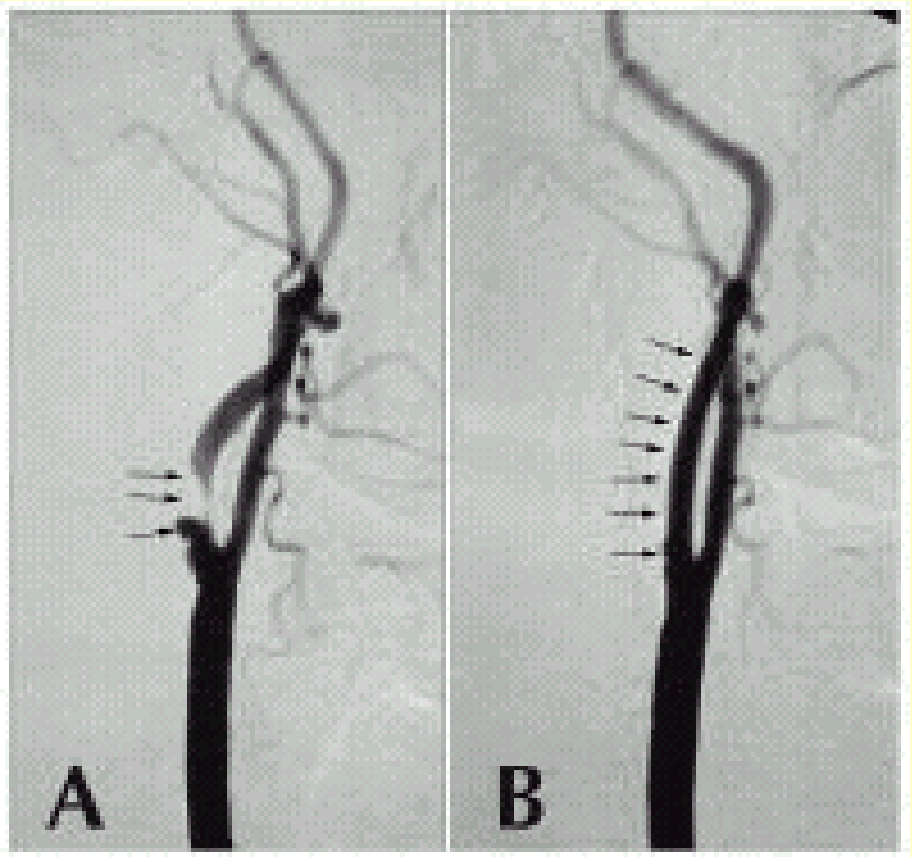
Endarterectomy



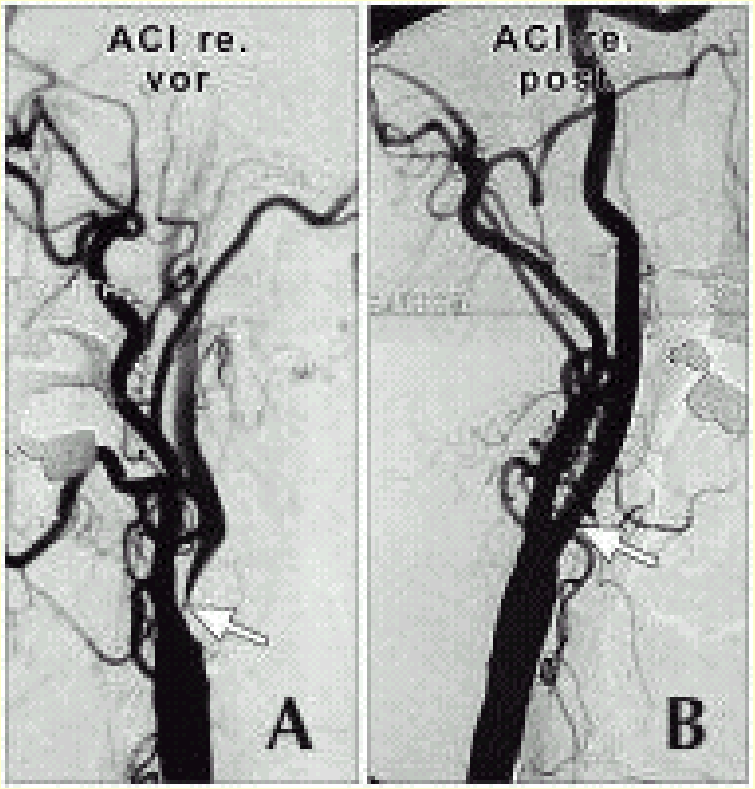



Carotid Stenting
Internal Carotid Artery
Plaque
Stent
External Carotid Artery
Endovascular Catheter
Common Carotid Artery

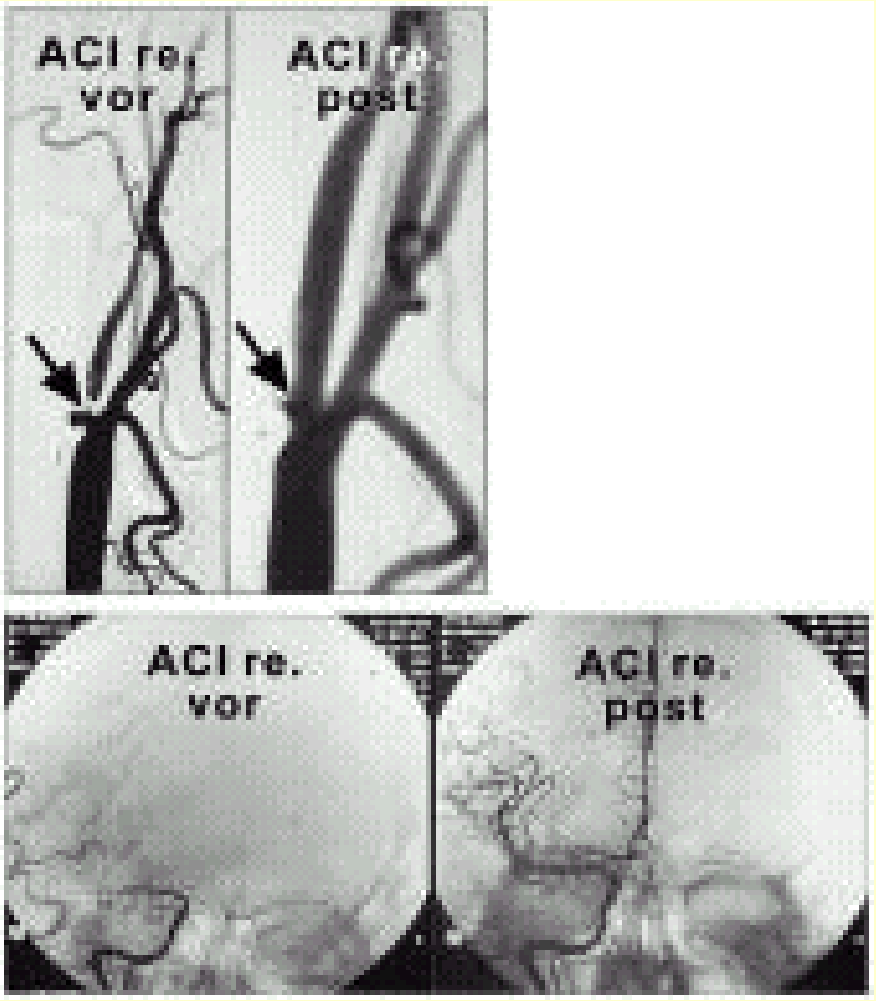

A.
B.
C.
D.



ICA
High grade stenosis - Stent



ICA
High grade stenosis - Stent



ICA
High grade stenosis - Stent

Indications of STENT

- **Patients with**
  - **operation risk**
  - **older patiens**
  - **risk of anaesthesia**
  - **changes on the neck**
- **Restenosis after CAE**

Advantages of STENT

- Less invasive method
- Less patients with restenosis
- Shorter hospitalization
- Smaller risk of wound complications