

cardioembolic stroke : how is it different?

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talk outline

- '뇌'는 '심장'과 다르다
- Cardioembolic stroke은 다른 stroke subtypes과 어떻게 다른가?
- Ischemic stroke mechanism 추정의 어려움

뇌졸중은?

- 腦卒中

- Lumper

- 中風

- Splitter

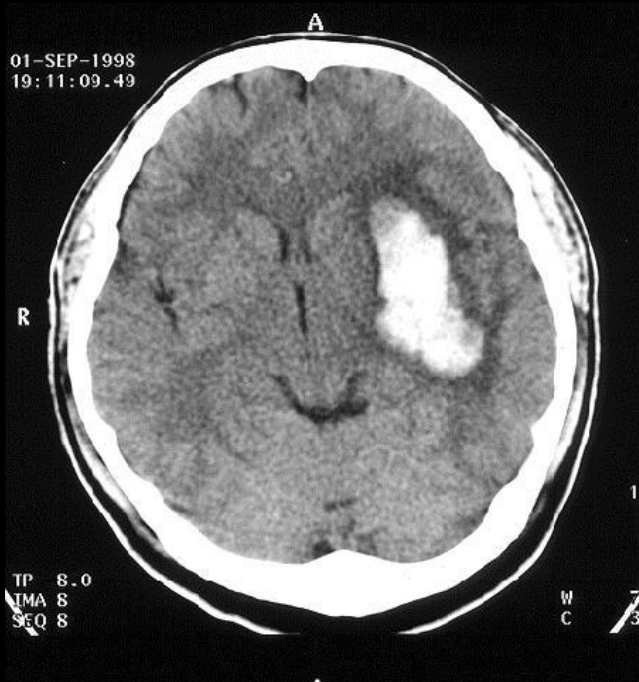
Ischemic vs. Hemorrhagic strokes

- cerebral vessel **occlusion** → infarct, ischemic stroke
- cerebral vessel **rupture** → hemorrhage

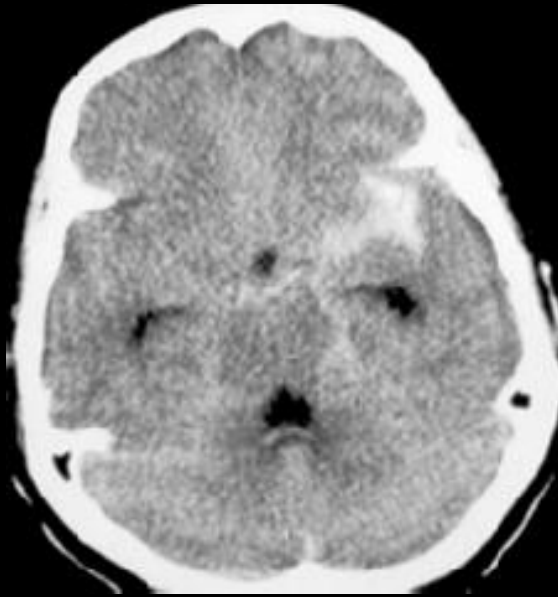
CT 이전 시대

- 임상적으로 뇌졸중 의심
- 뇌출혈과 뇌경색을 감별하기 위해
 - 뇌척수액 검사
 - 혈관조영술
 - 부검

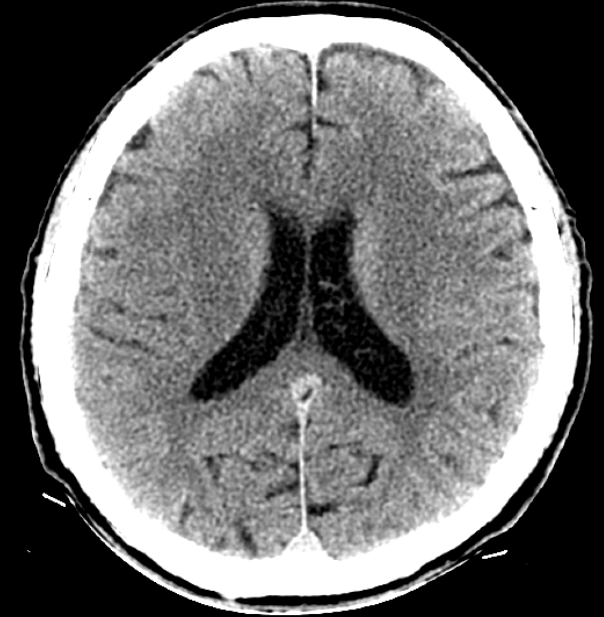
뇌출혈 진단 – CT (computed tomography)



intracerebral
hemorrhage



subarachnoid
hemorrhage

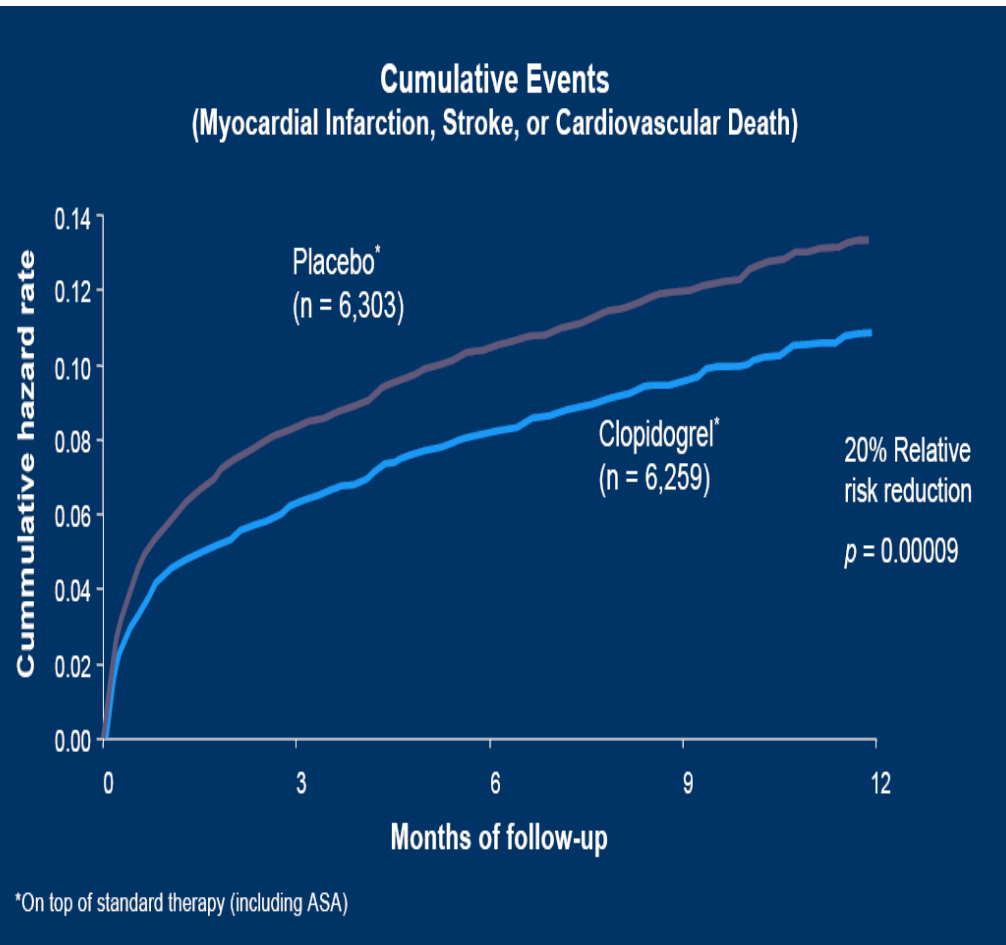


cerebral
infarction

뇌경색의 분류는 왜 중요한가?

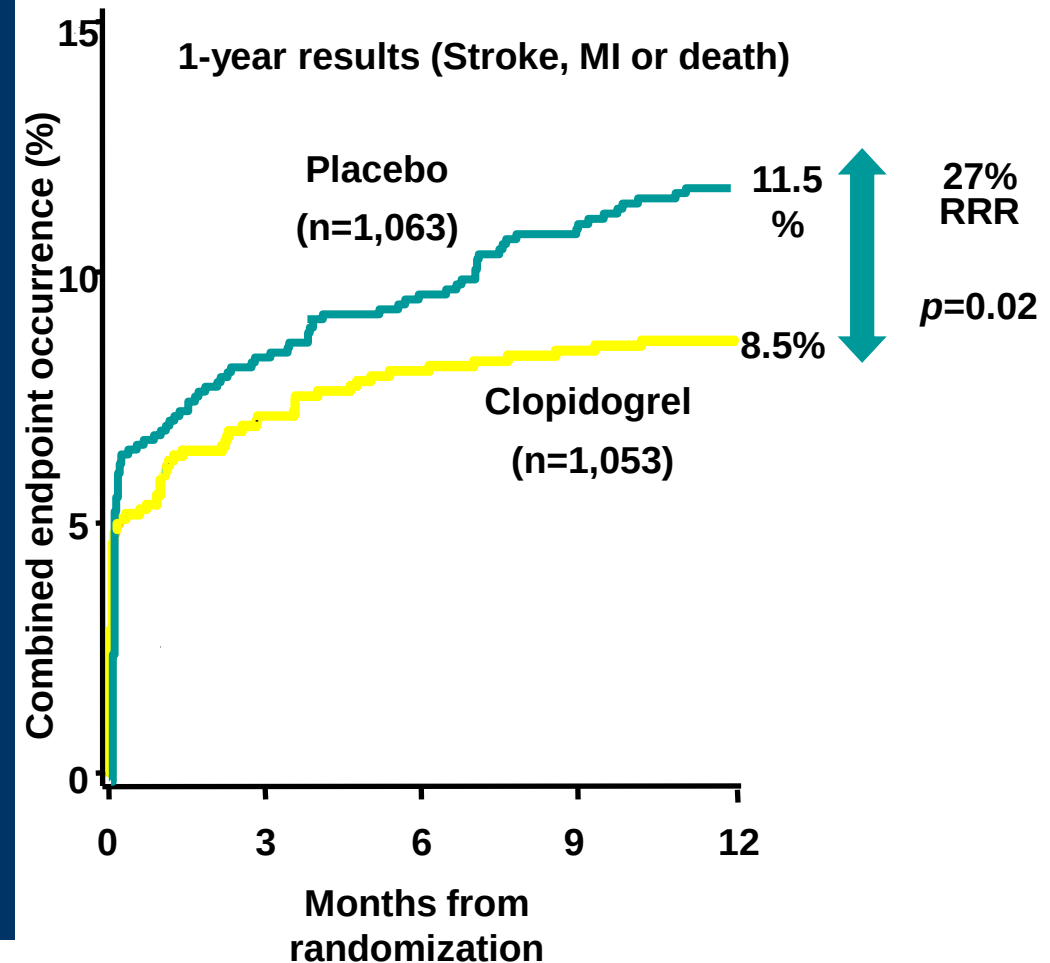
- stroke subtype influences outcome, recurrence, and choices for management

CURE



NEJM 2001

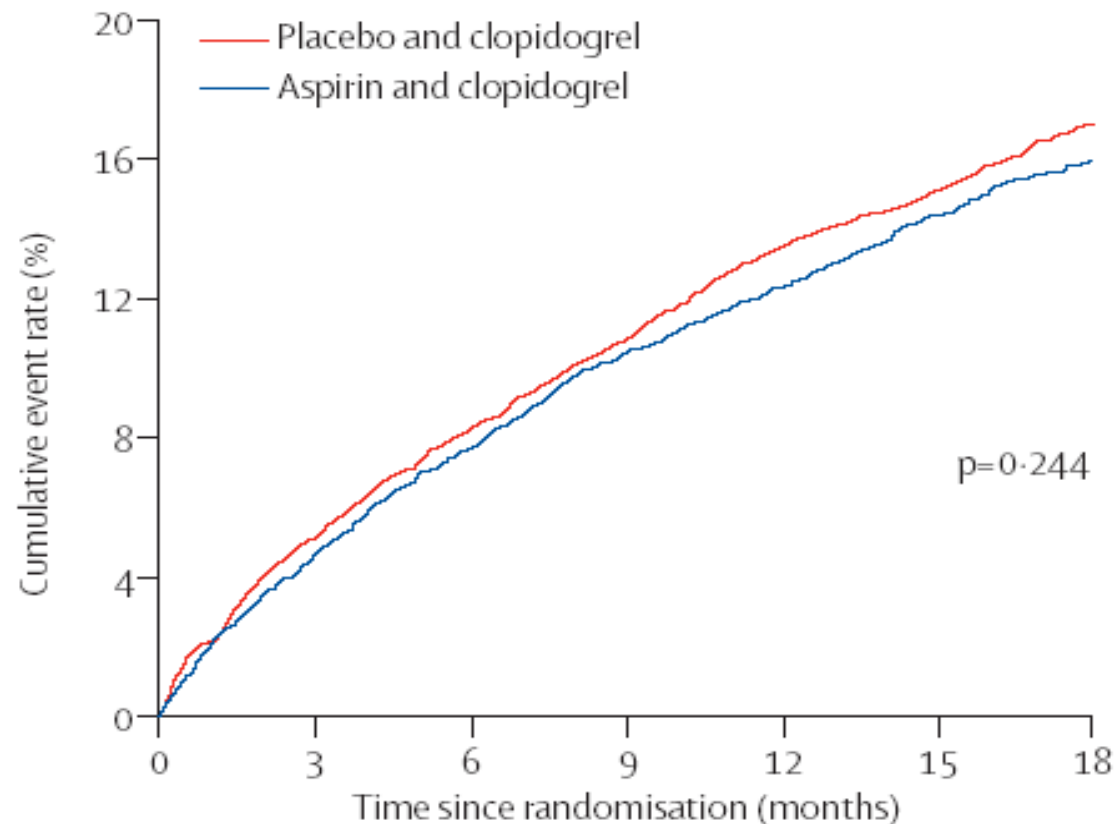
CREDO



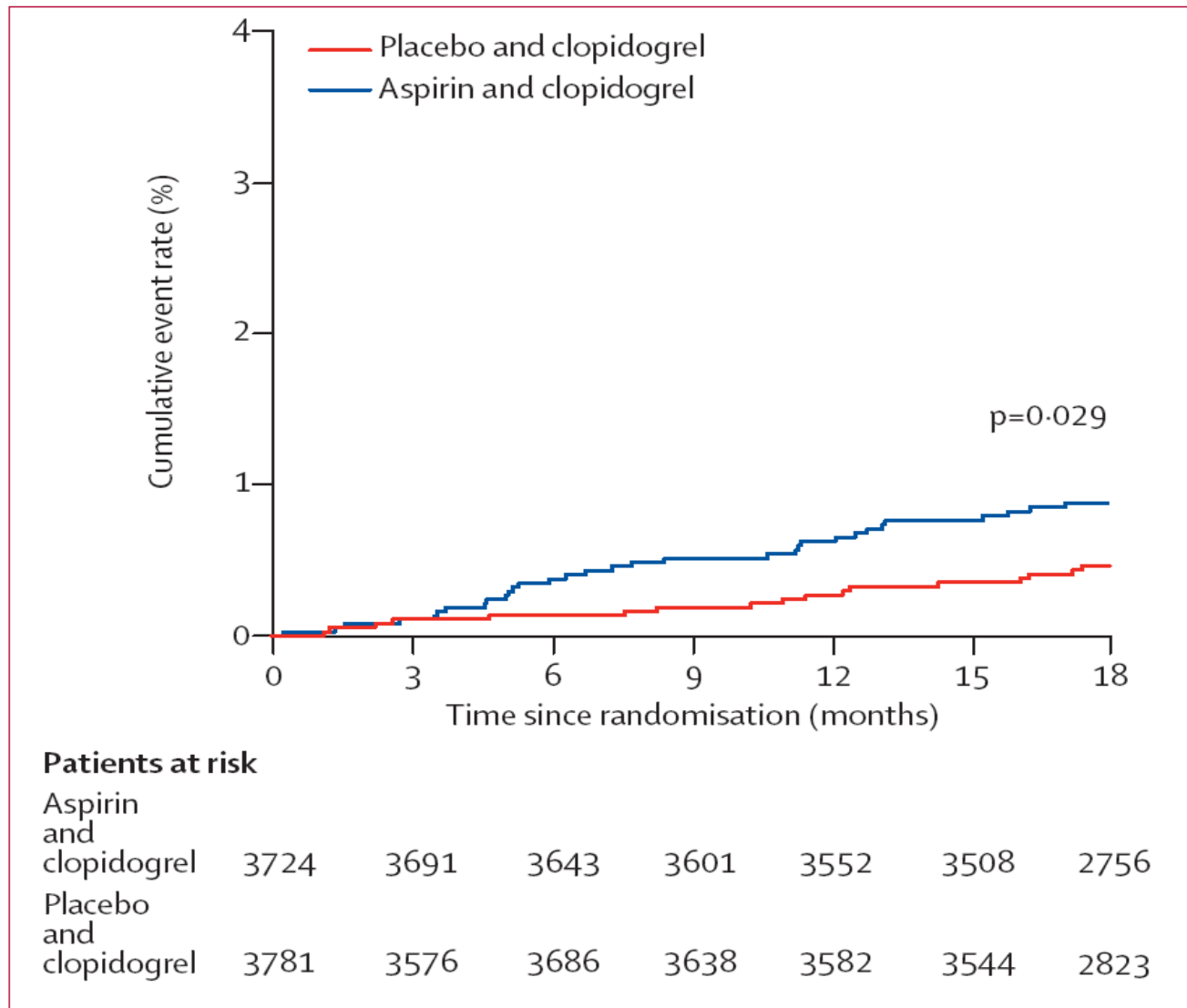
JAMA 2002

MATCH – ASA+CPG vs. CPG

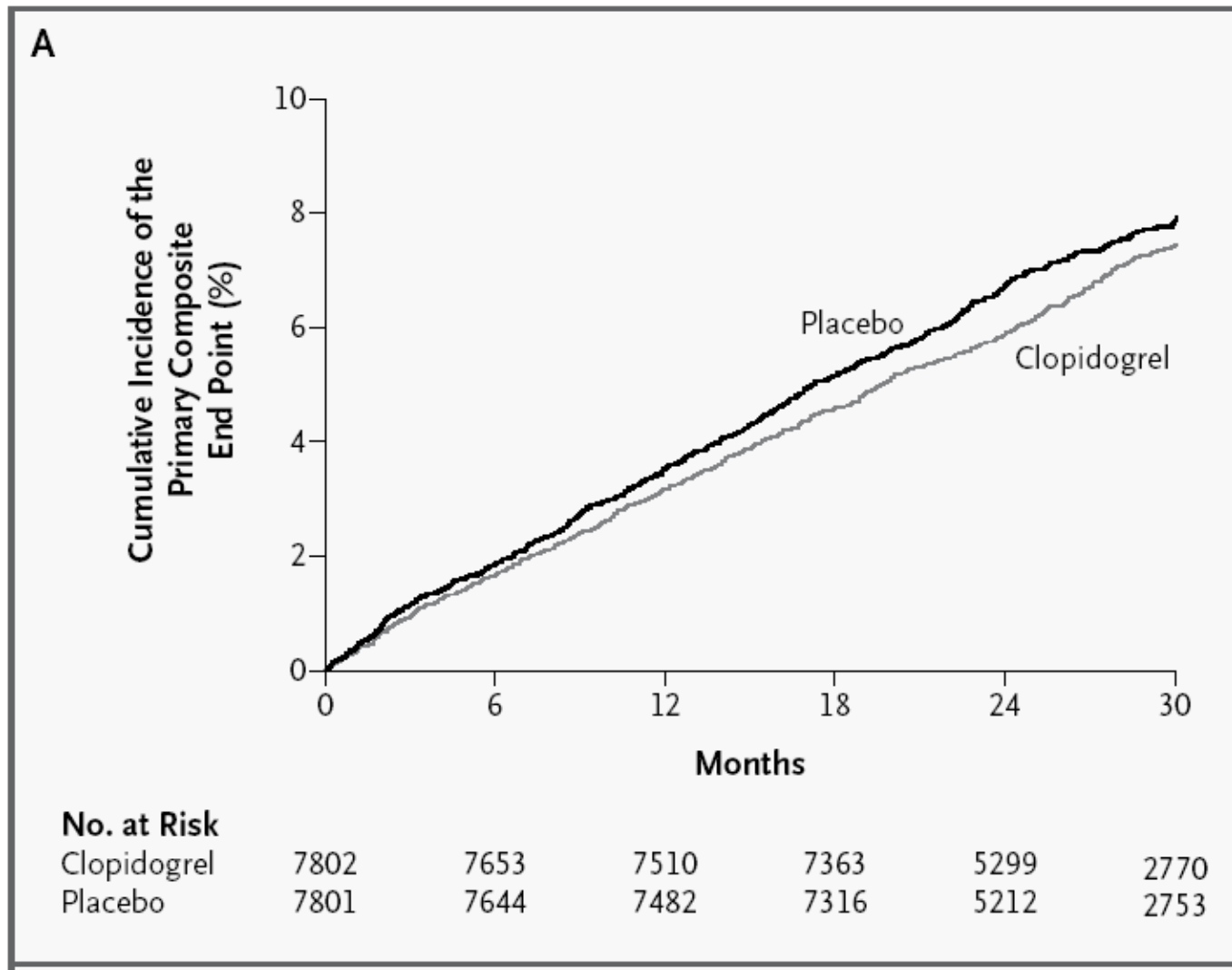
Management of Atherothrombosis with Clopidogrel in High-risk patients with recent ischemic stroke or TIA



Dual antiplatelets increases bleeding in stroke!



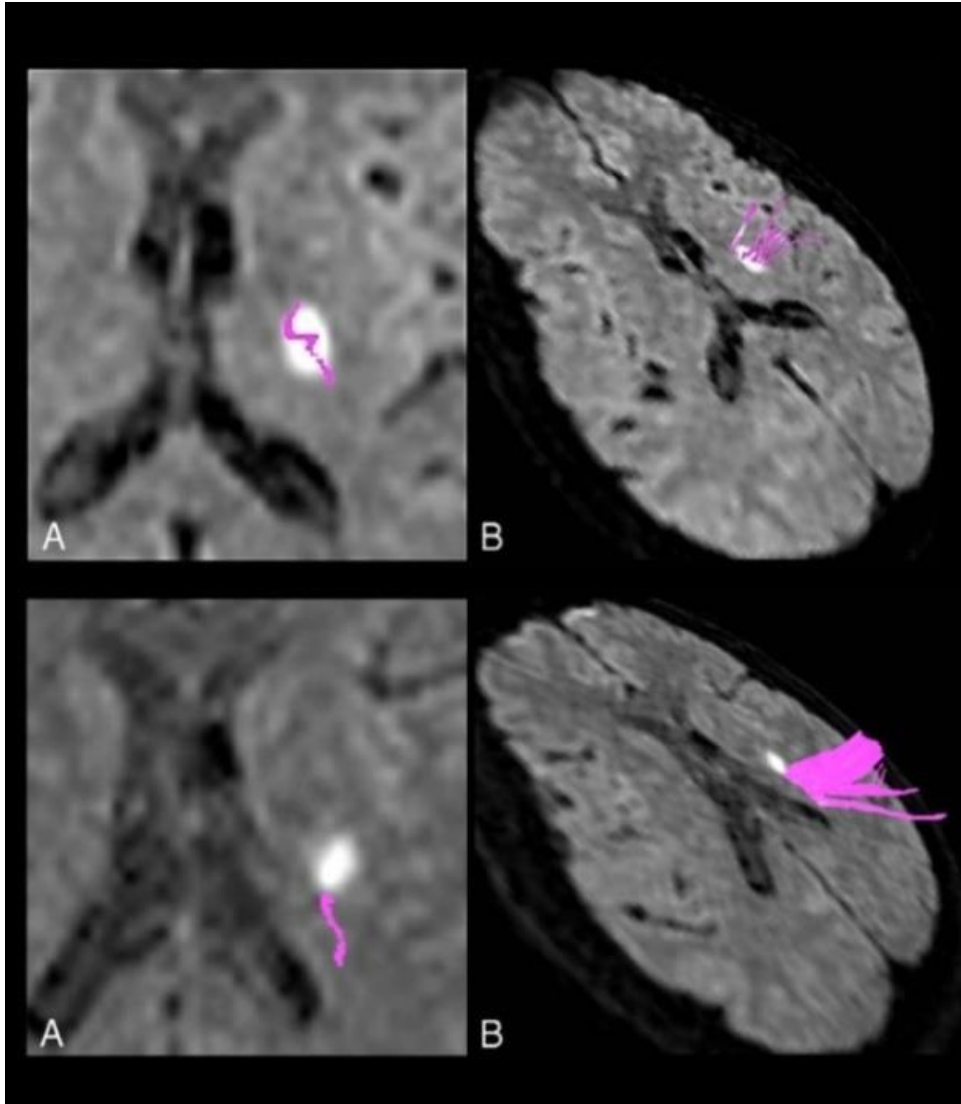
CHARISMA – ASA+CPG vs. ASA



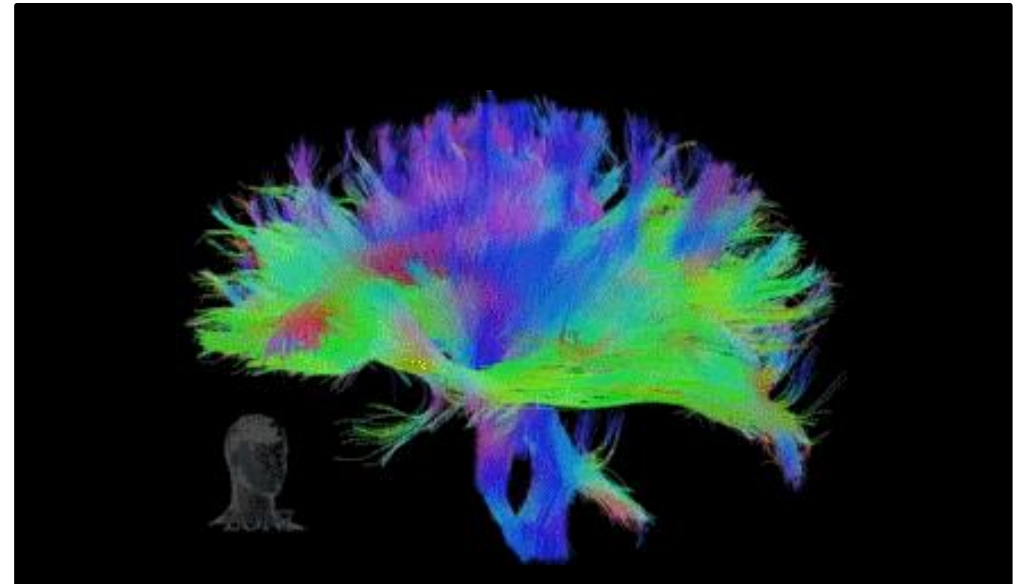
Stroke mechanism is heterogeneous!

- Cardioembolism (**CE**)
- Large-artery atherosclerosis (**LAA**)
 - Intracranial LAA
 - Extracranial LAA
- Small-vessel occlusion (**SVO**)
- **Other** determined etiology
- **Undetermined** etiology
 - two or more causes
 - cryptogenic
- Thrombotic
- Embolic
 - Cardioembolic
 - Artery-to-artery
- Hemodynamic
- Lacunar (small-vessel)
- Mixed

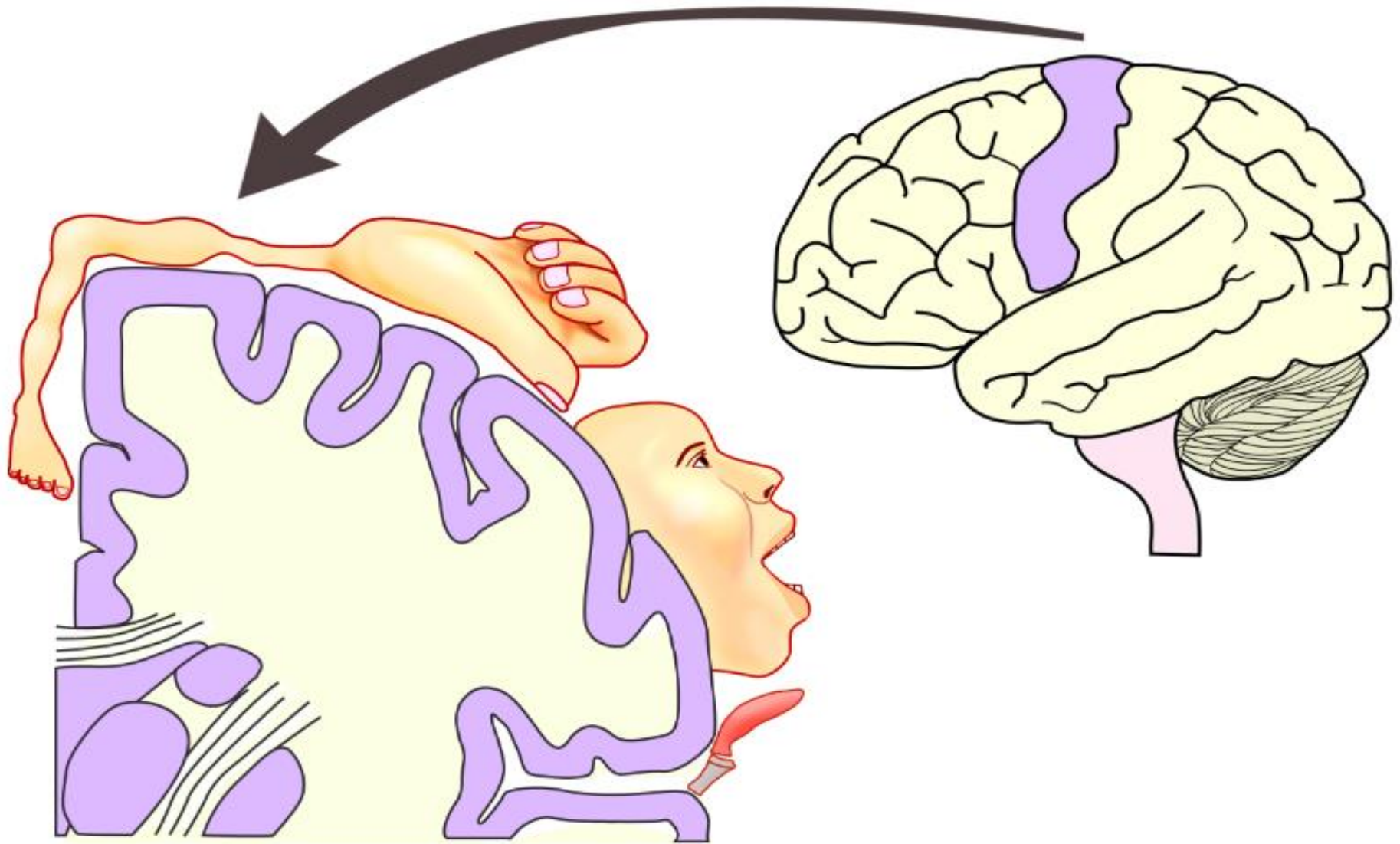
Stroke outcome is location dependent!



- 뇌신경 경로에 따라 예후도 개인마다 다르다



cortical homunculus

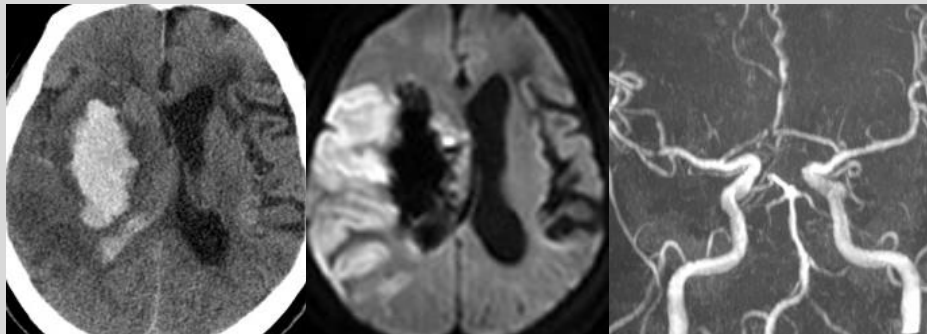
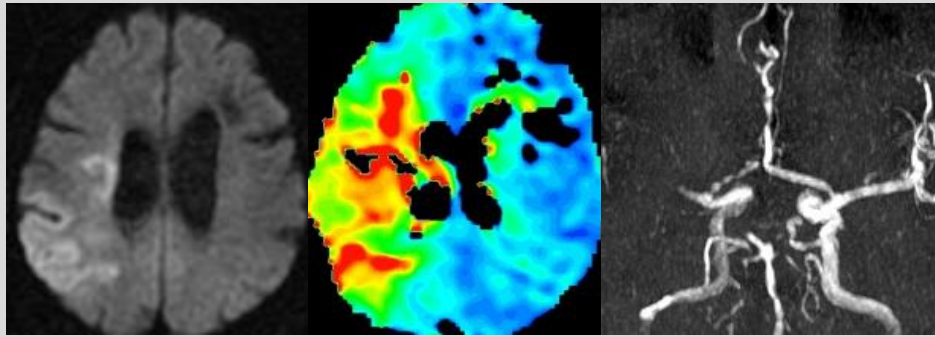


sometimes unpredictable!

혈전용해술

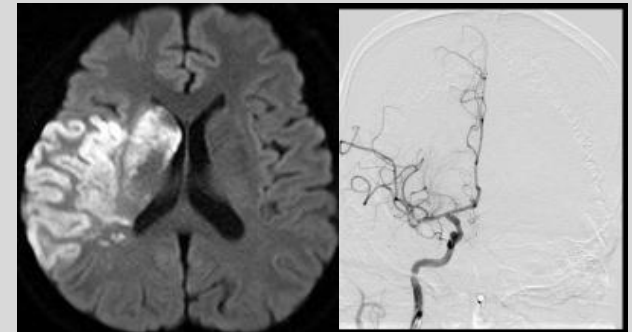
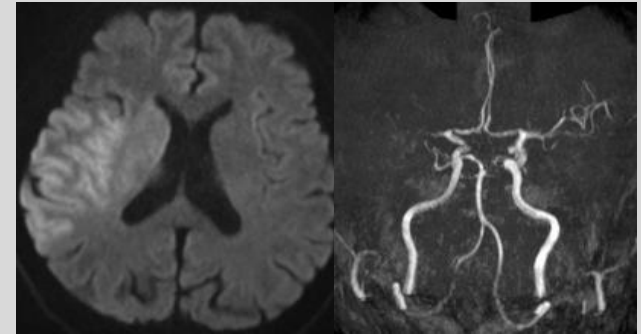
- 소수의 기준만으로는 예후 예측 어렵다

Case I

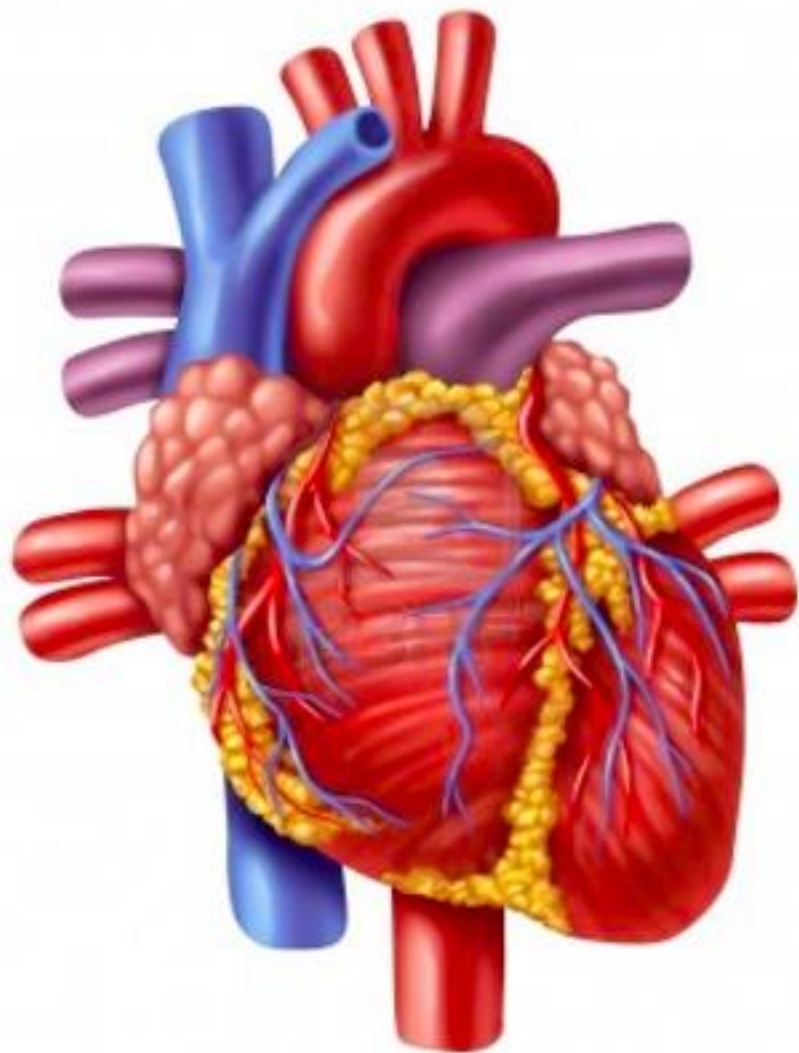


Poor outcome

Case II

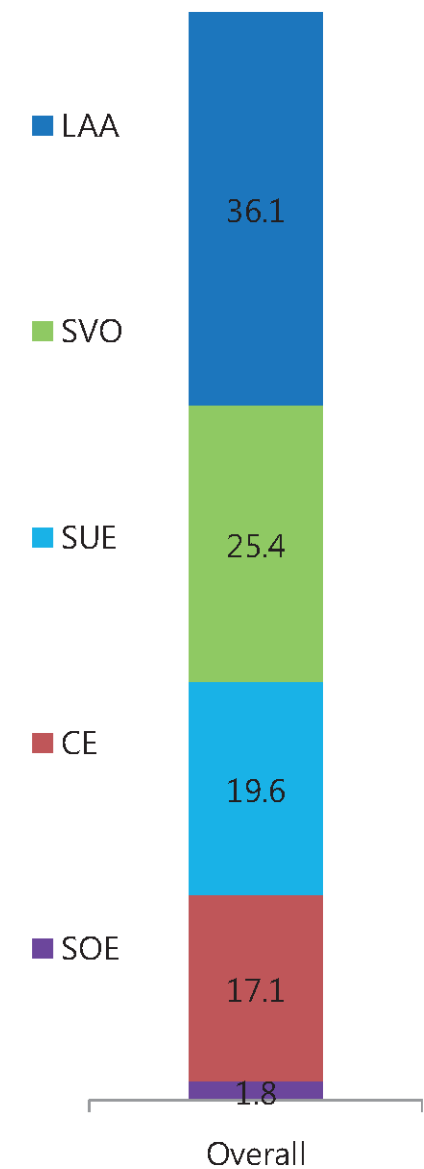
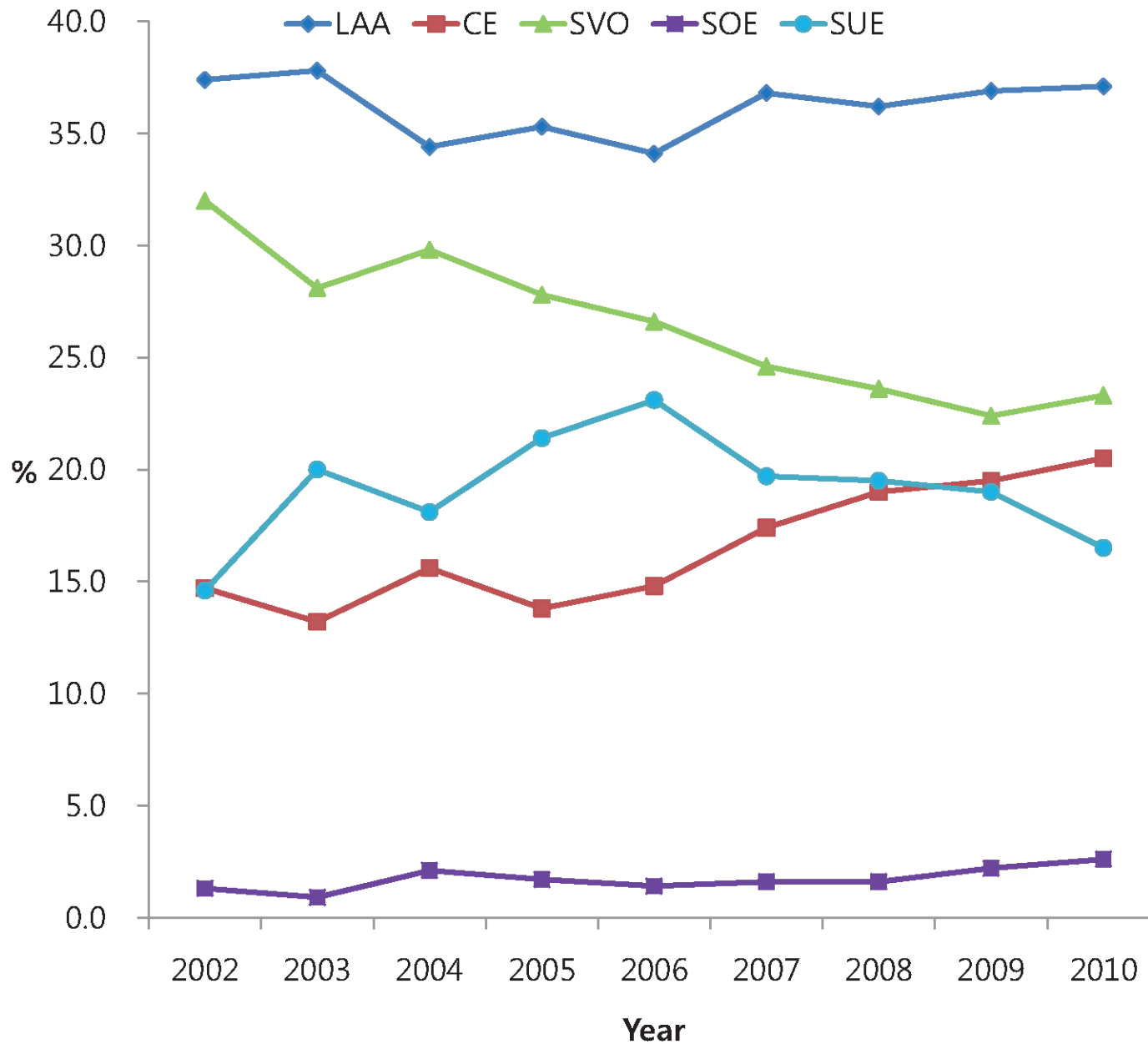


Favorable outcome



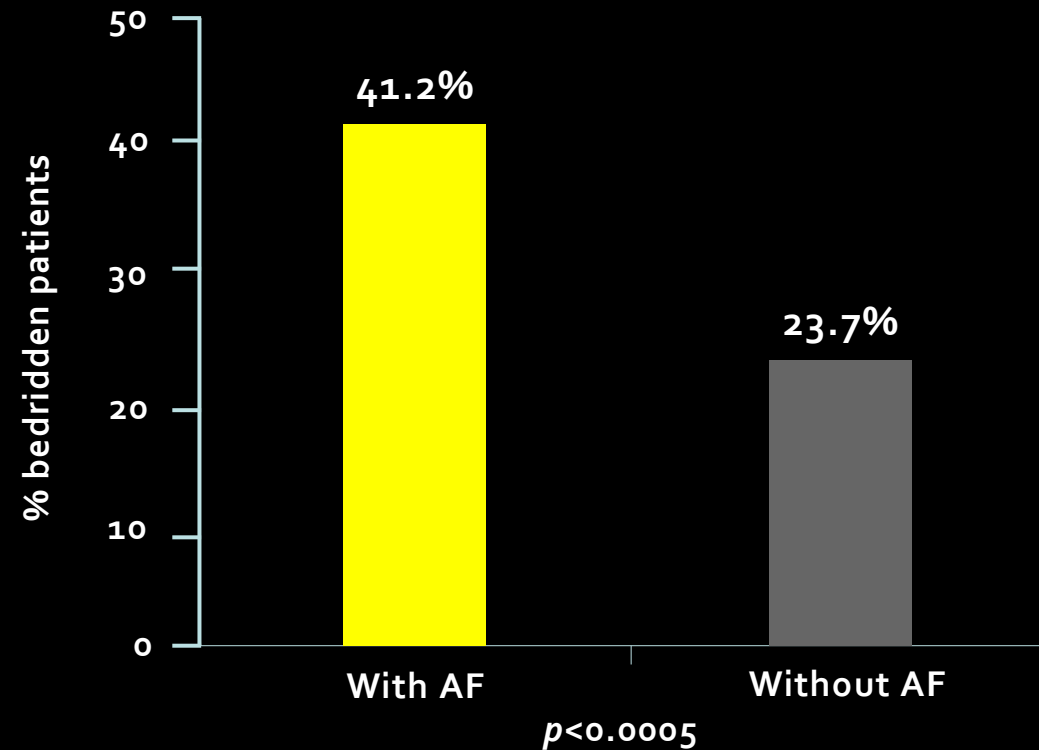
Characteristics of Cardioembolic Stroke

TOAST classification



Clinical features

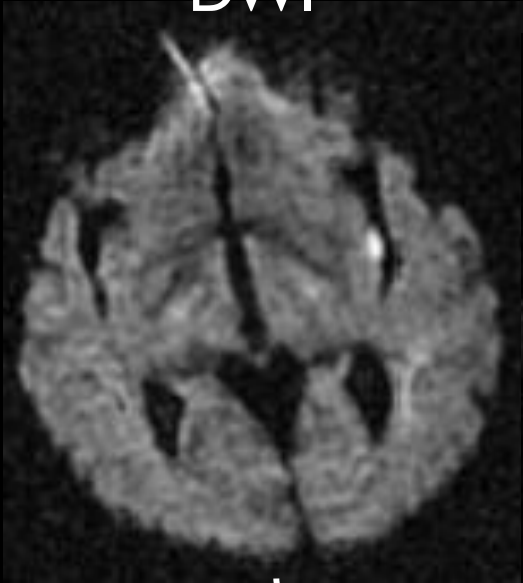
- Maximal deficits at onset
- More severe clinical presentation
- Poorer outcome



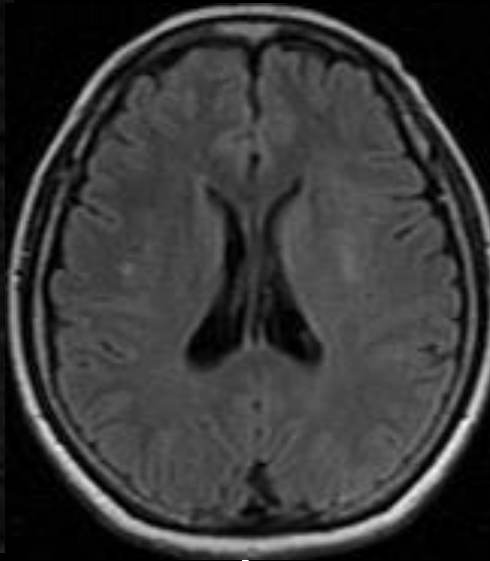
Neuroepidemiology 2003

뇌경색의 구성요소 - 4P

DWI



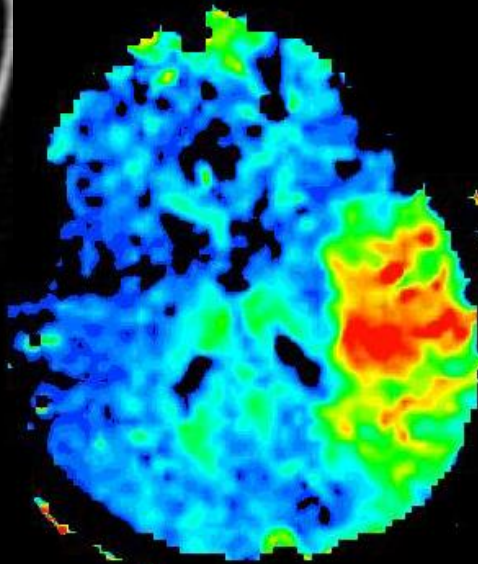
FLAIR



parenchyma

penumbra

PWI



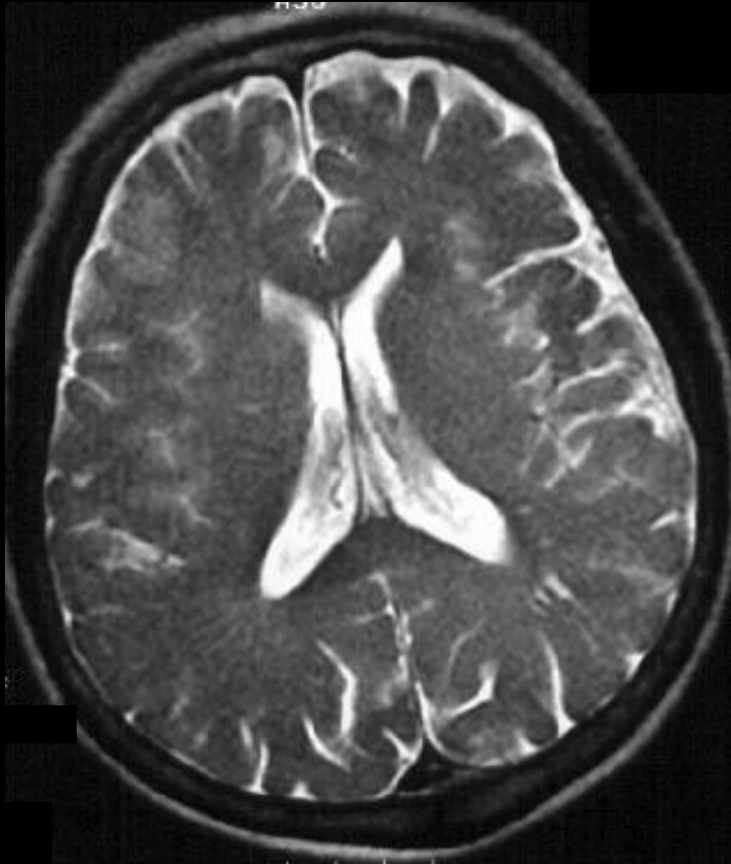
perfusion

MRA

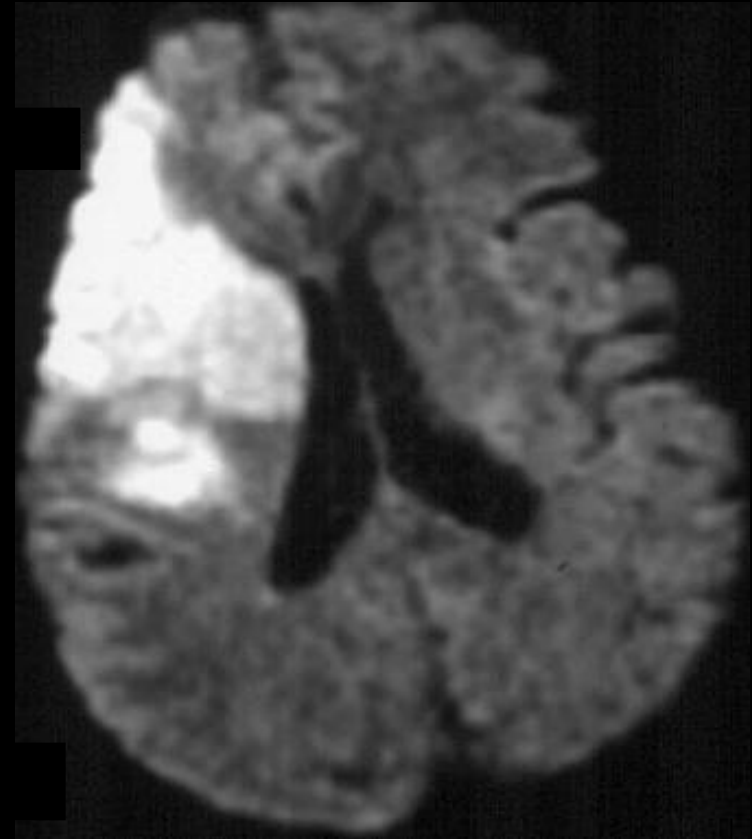


pipe

급성 뇌경색, 어디 있을까?

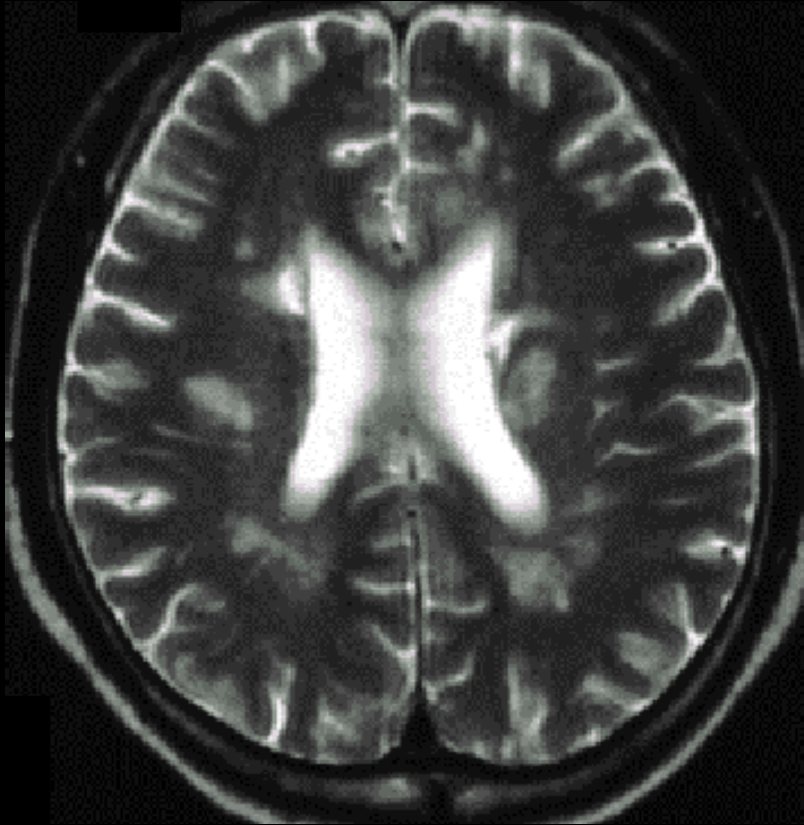


T2-weighted image

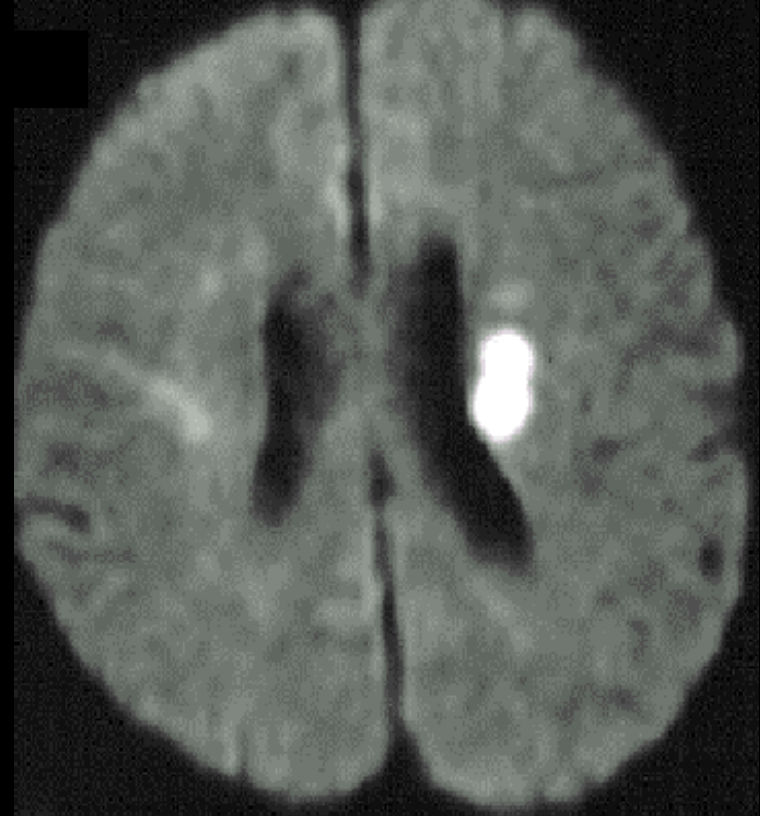


diffusion-weighted image (DWI)
확산강조 MR 영상

급성 뇌경색, 어느 것일까?

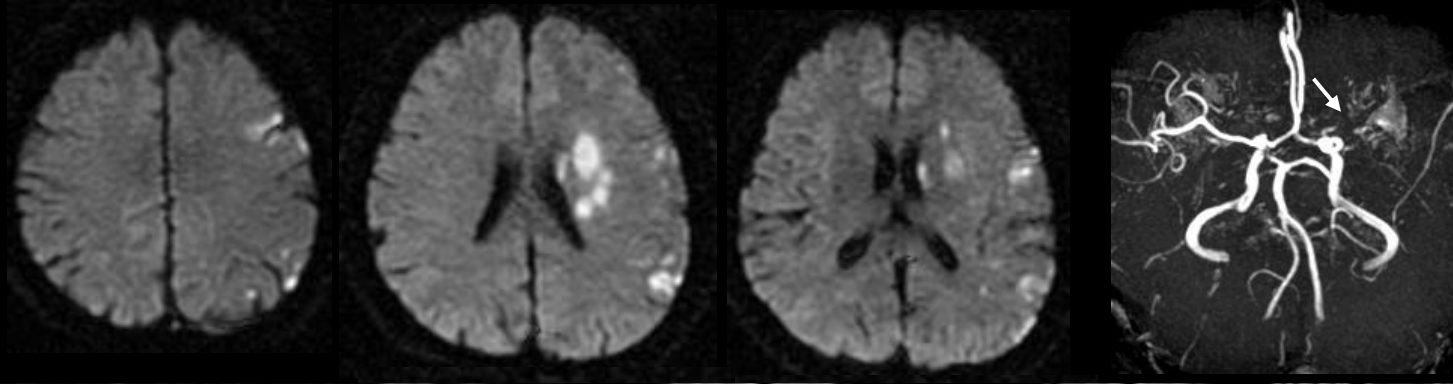


T2-weighted image

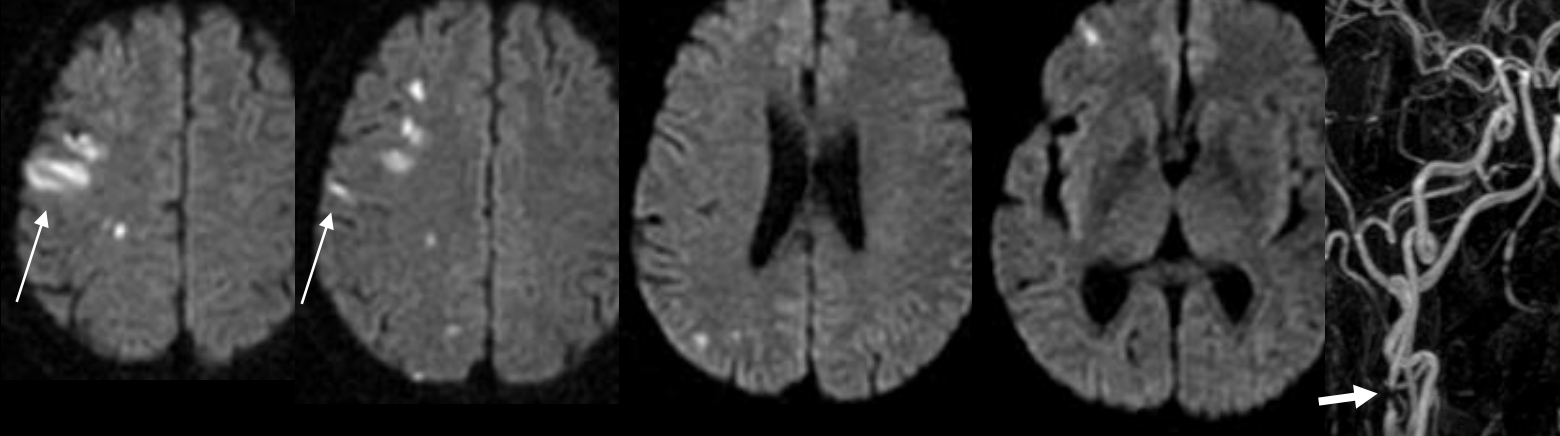


DWI

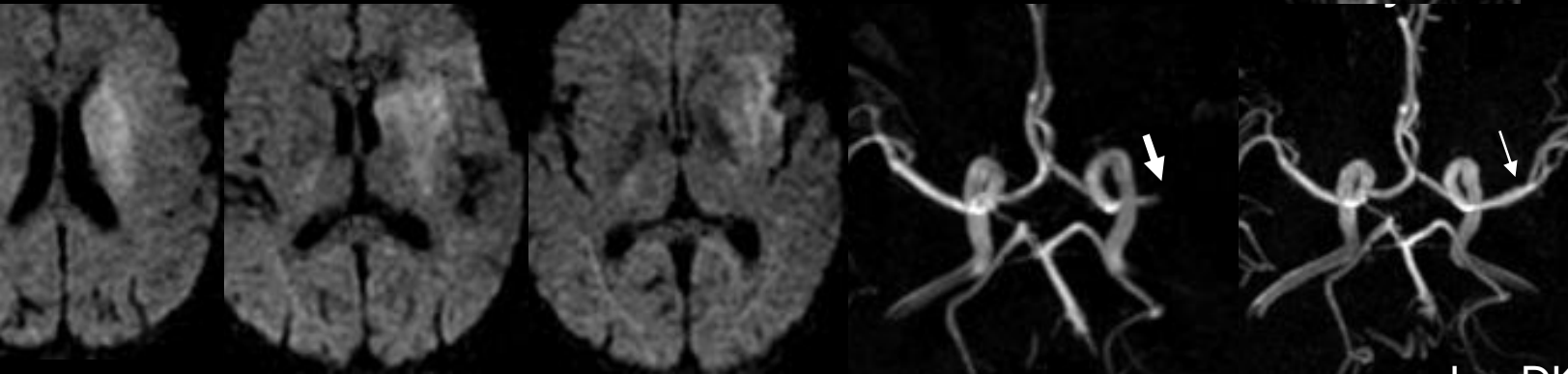
뇌경색 패턴을 보면 원인을 가늠할 수 있다



가까운 혈관
middle cerebral a

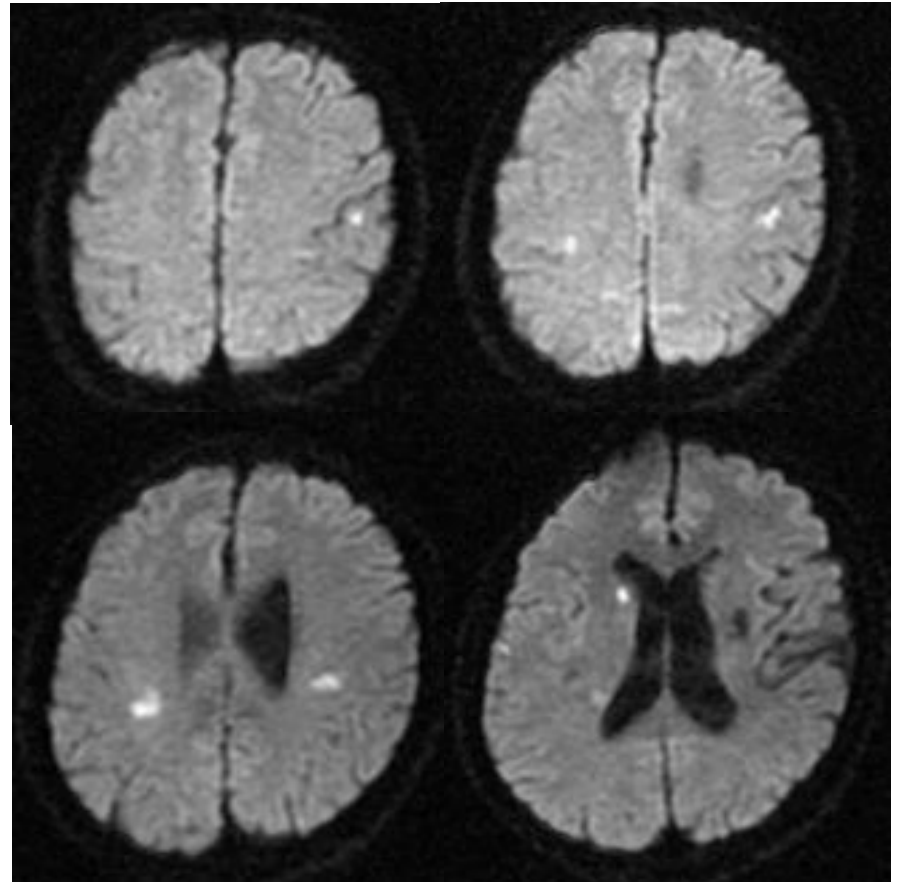
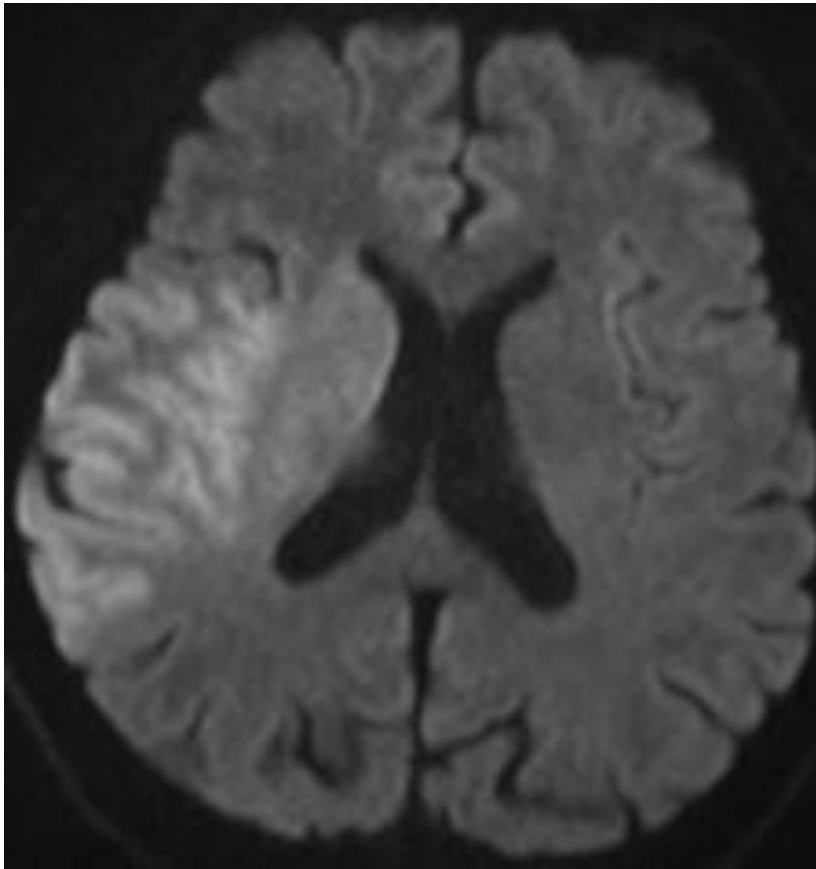


먼 혈관
internal carotid a

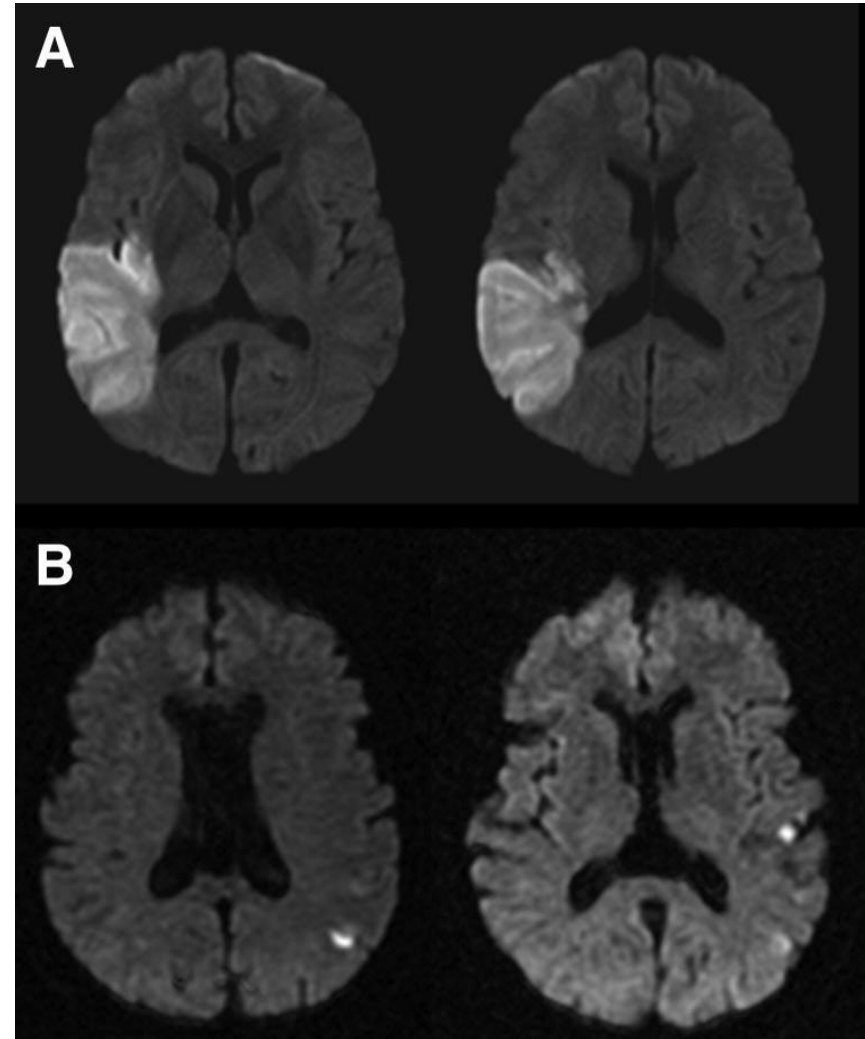
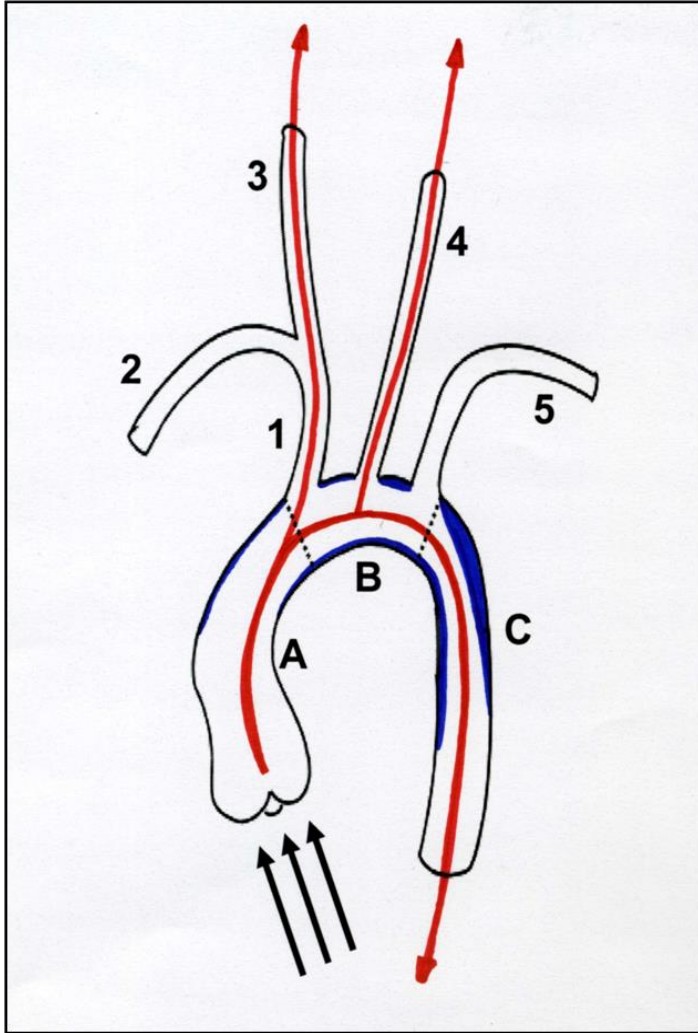


심장
cardioembolism

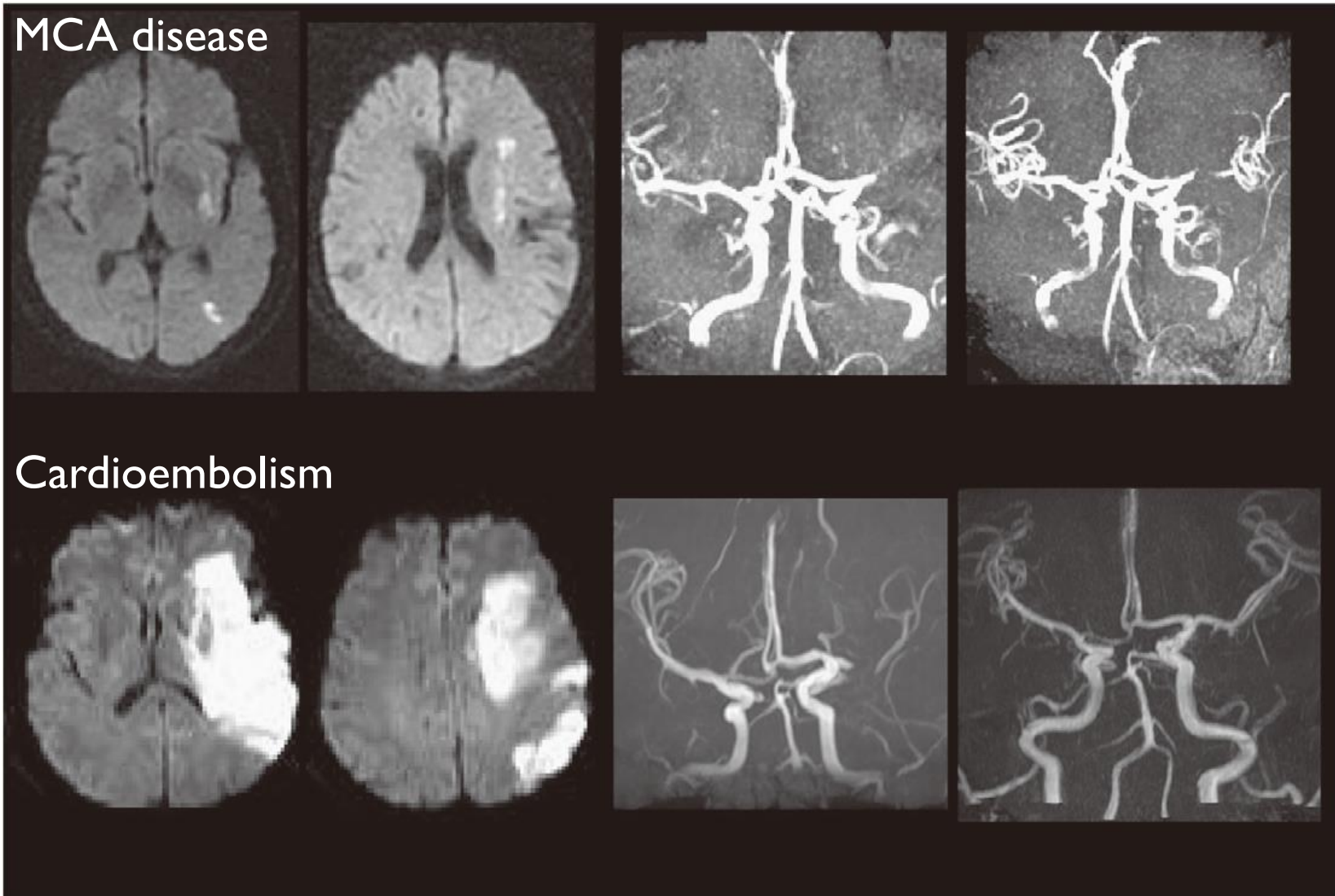
CE stroke – Large or Multiple



Right-brain propensity of cardioembolism



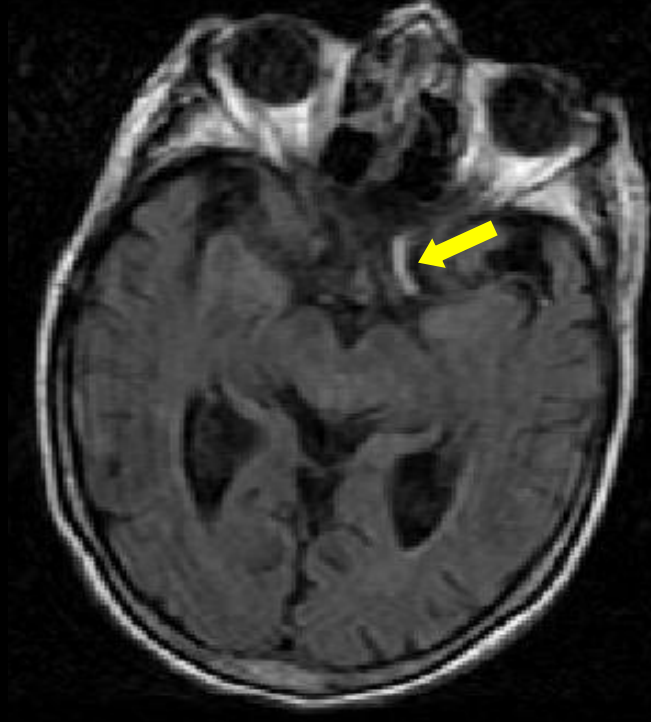
Pipe – Evaluation of early recanalization is useful



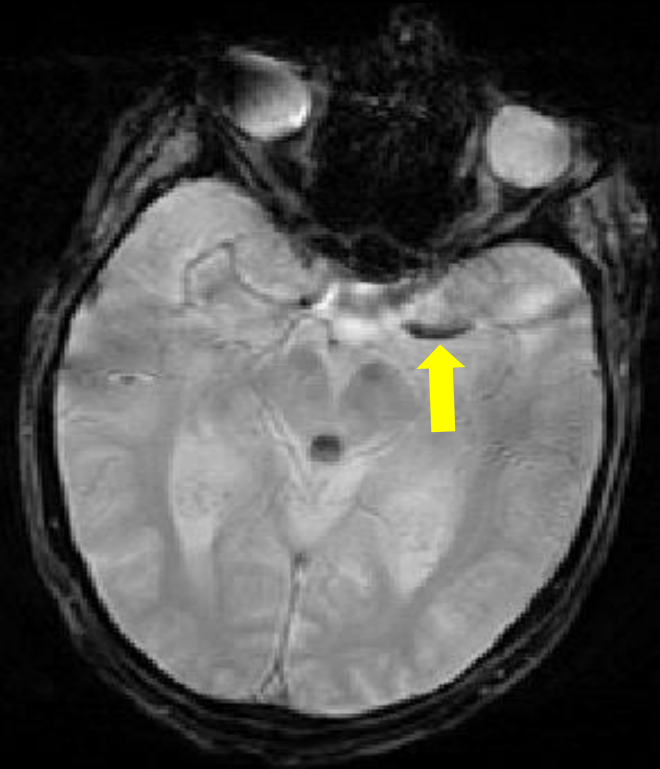
막힌 혈관은 CT, MRI에서도 보일 수 있다



CT

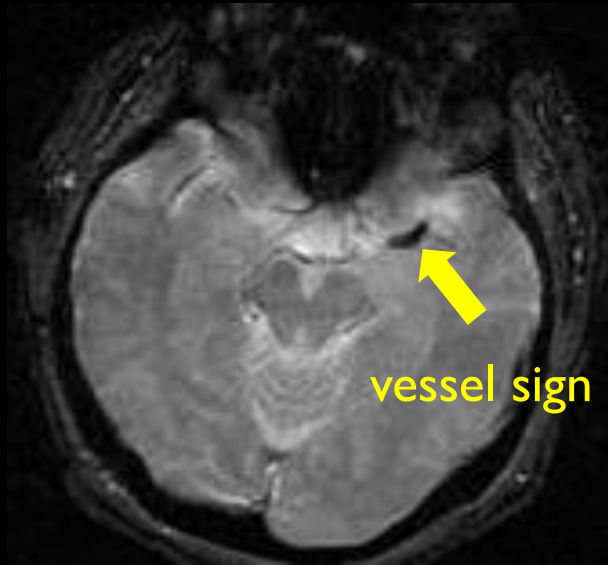
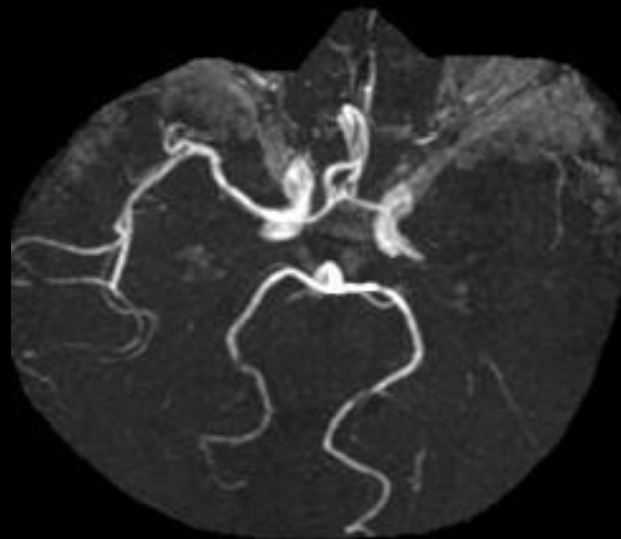


FLAIR

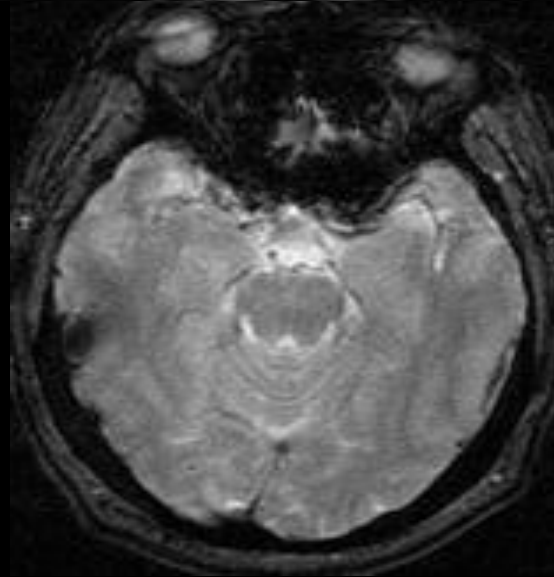
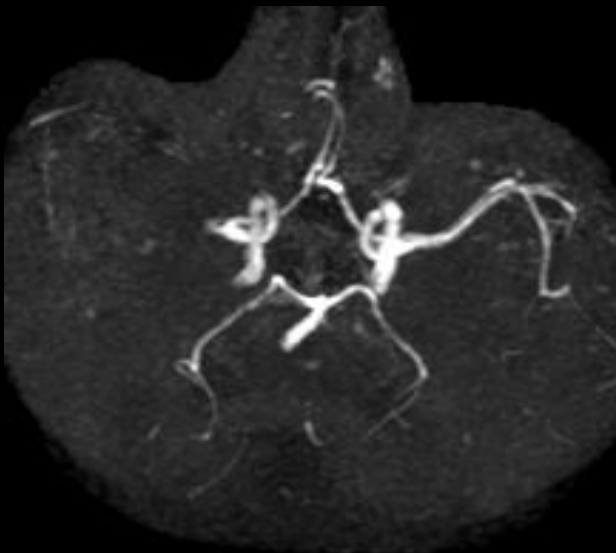
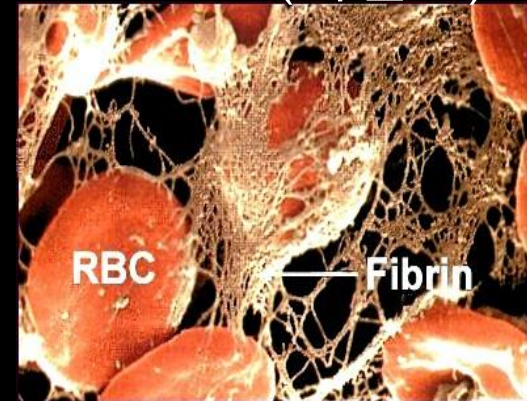


Gradient echo T2*

무엇이 막았을까? - 혈전 성분



red clot (적혈전)

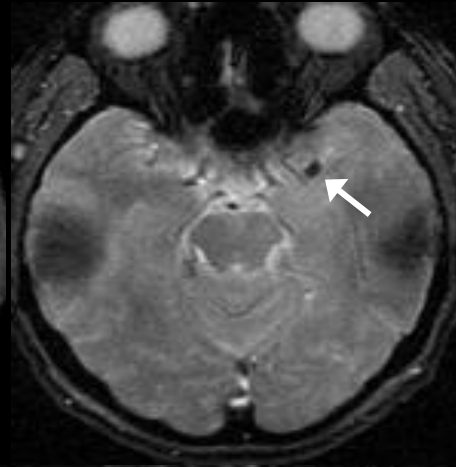
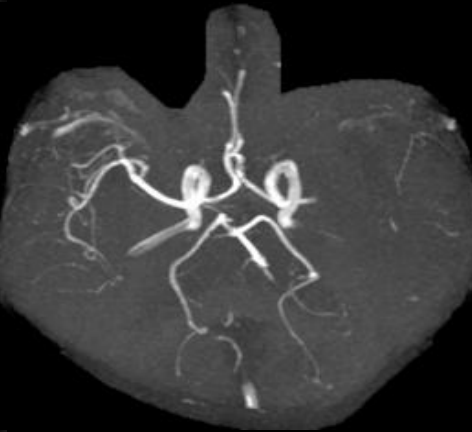
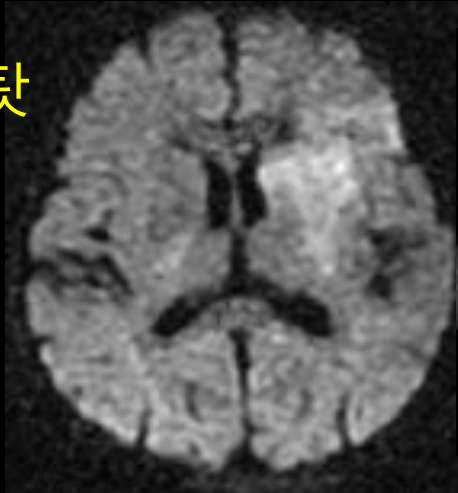


white clot (백혈전)

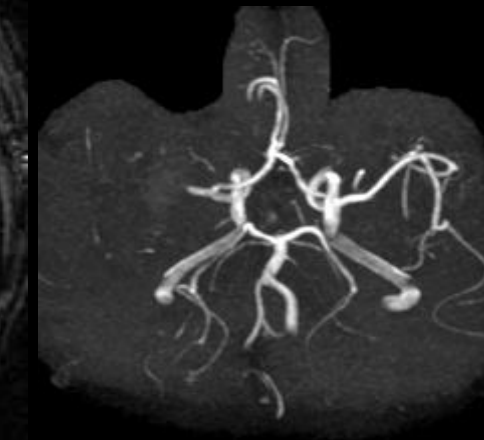
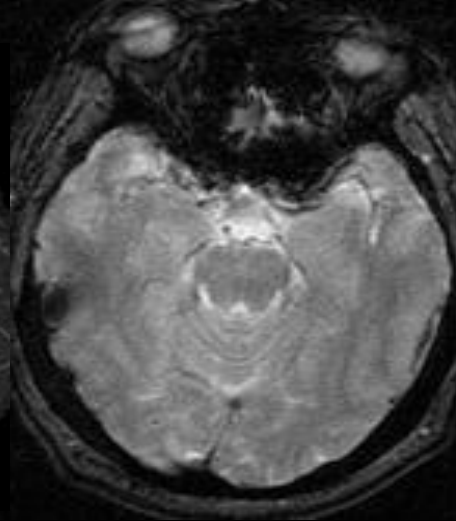
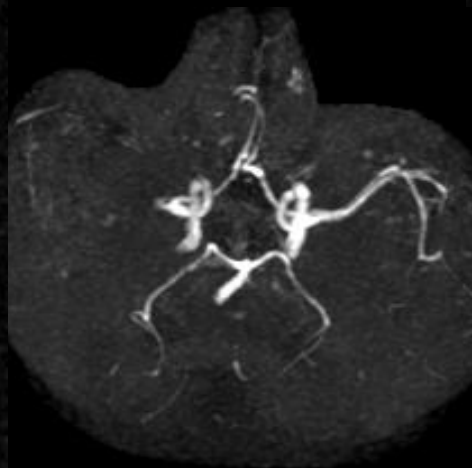
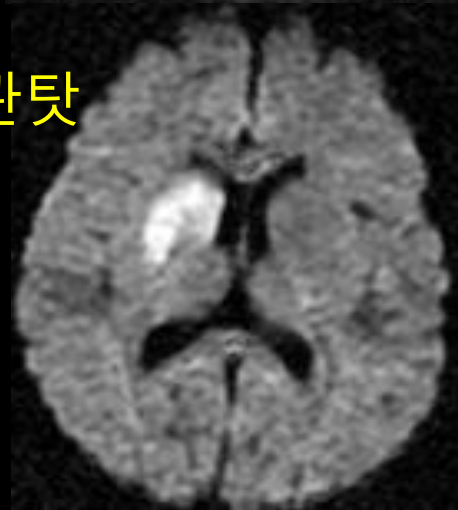


혈전 성분이 중요한 이유 - 혈관재개통 여부

심장타



뇌혈관타



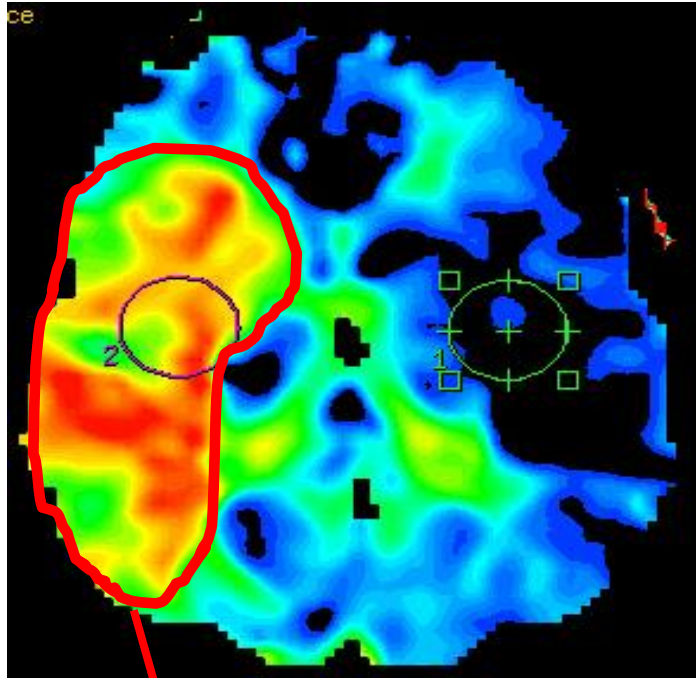
DWI

MRA

GRE

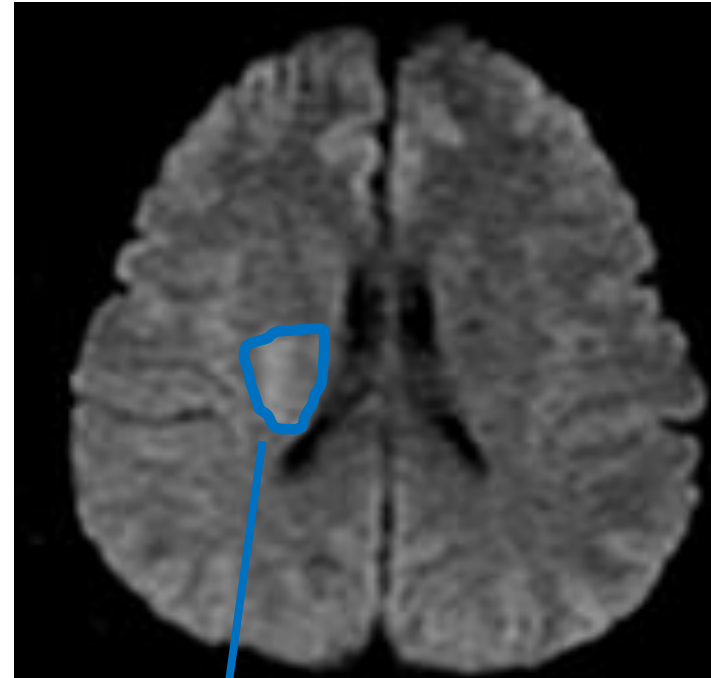
follow-up
MRA

Perfusion MRI



Perfusion defect

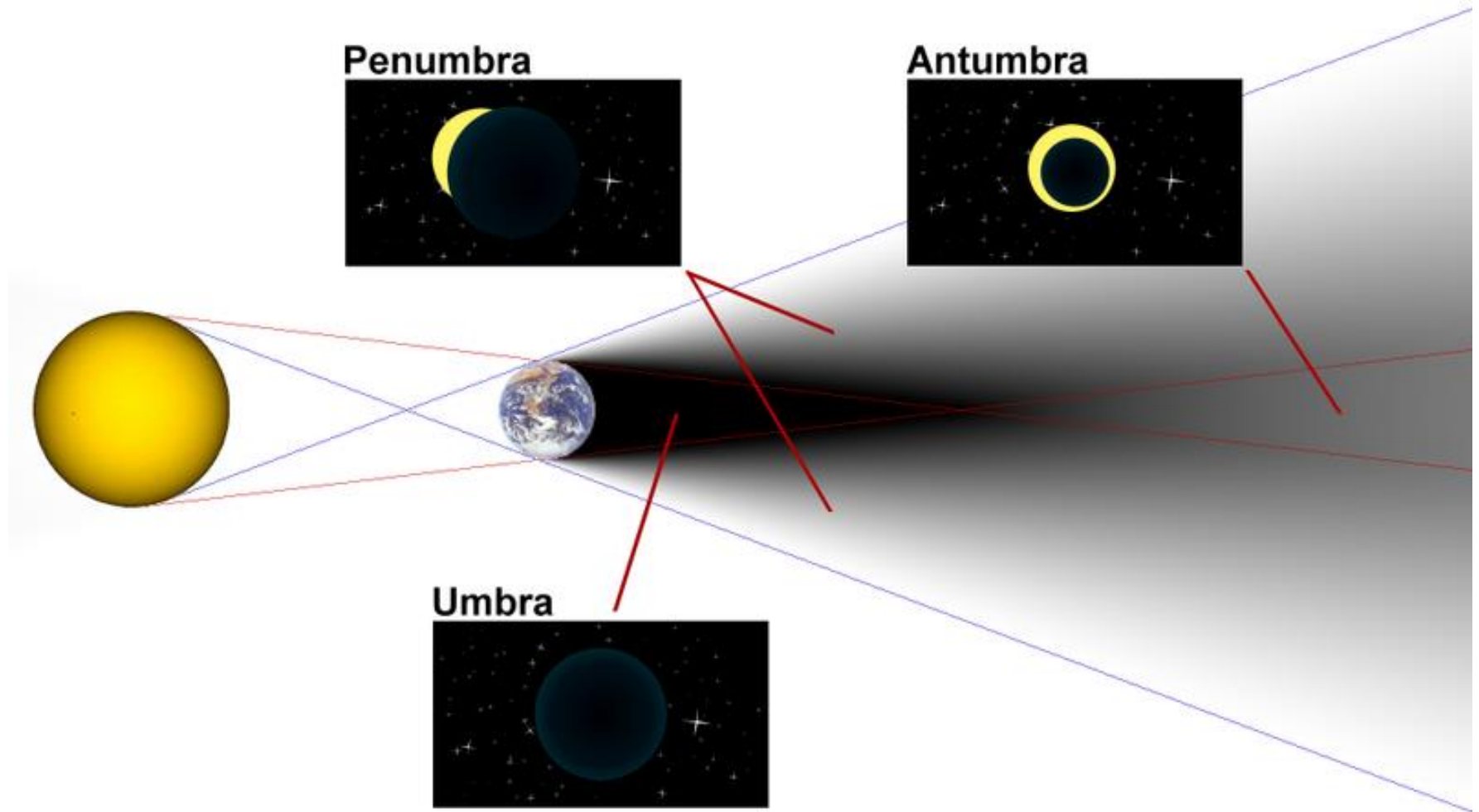
Diffusion MRI



Infarct core – game over!

Mismatch (penumbra) – salvageable!

penumbra (pen + umbra) 반음영

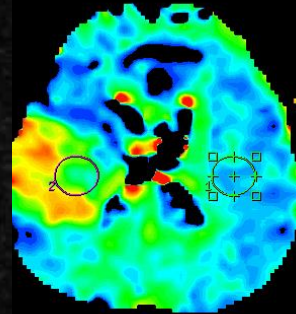
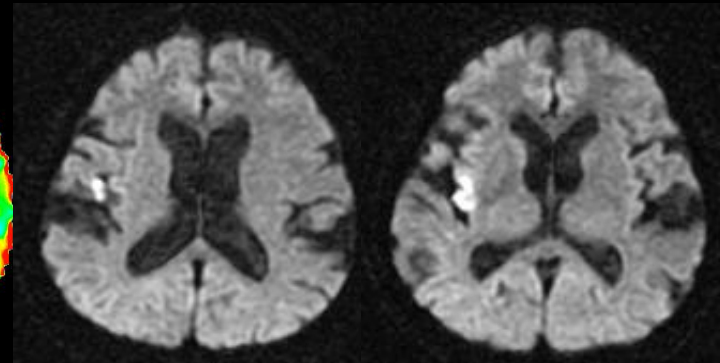
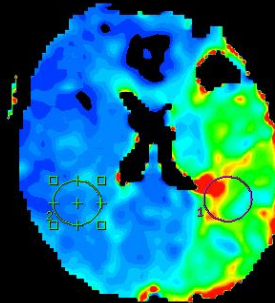
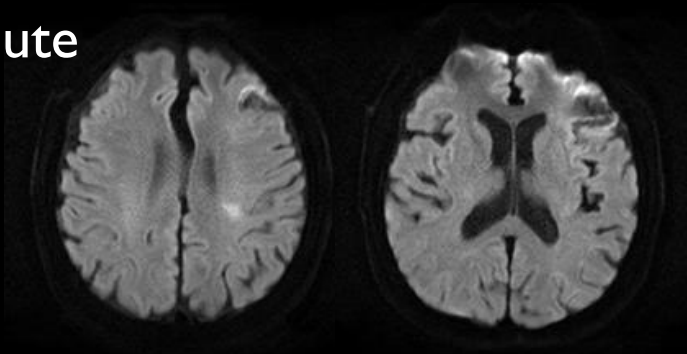


Stroke is dynamic! – infarct growth

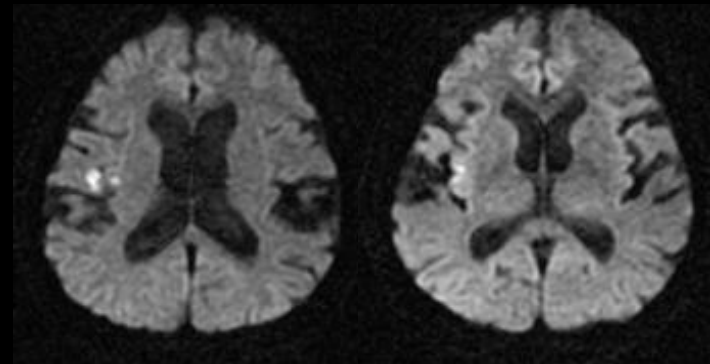
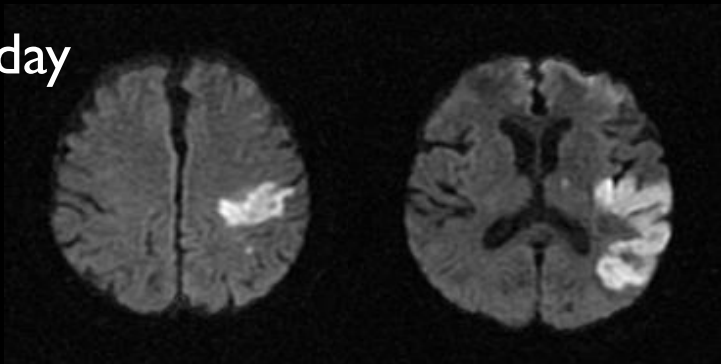
A

B

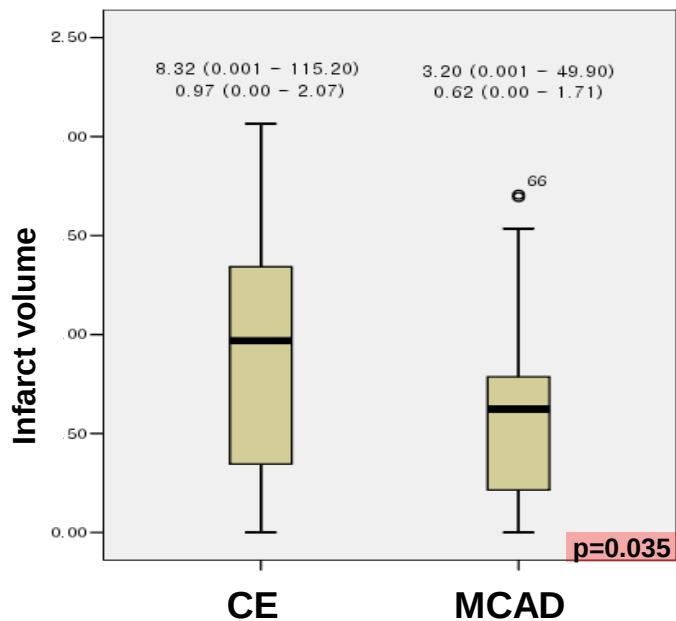
acute



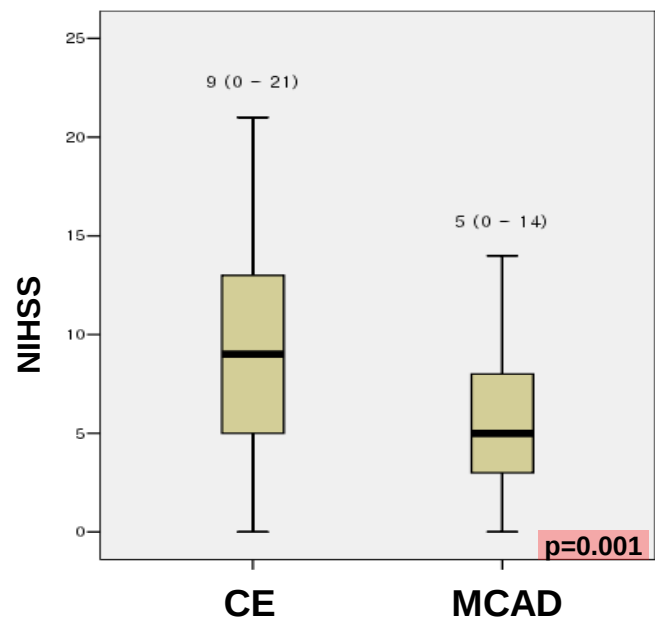
5-day



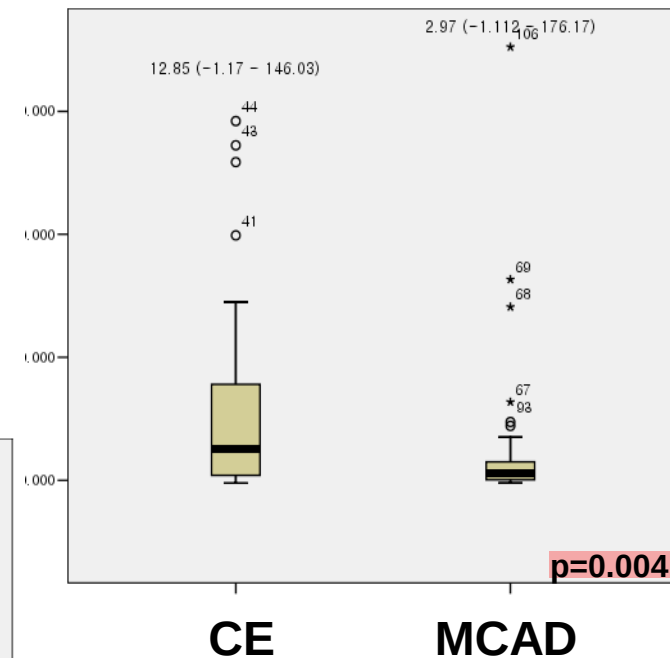
Baseline infarct volume



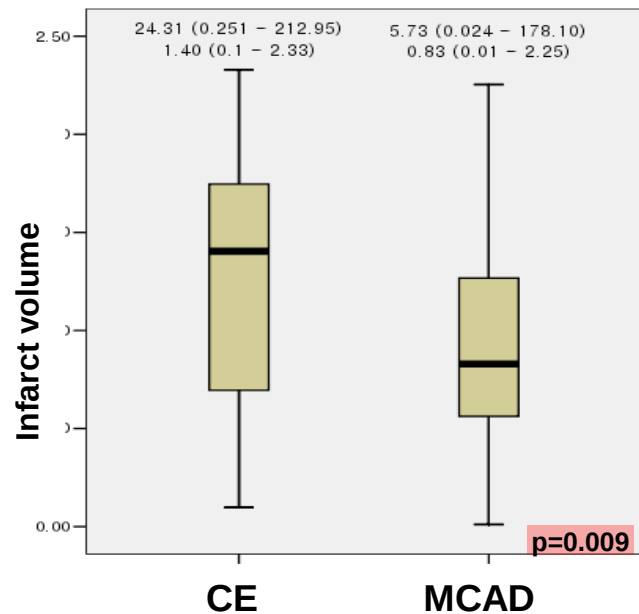
Baseline NIHSS



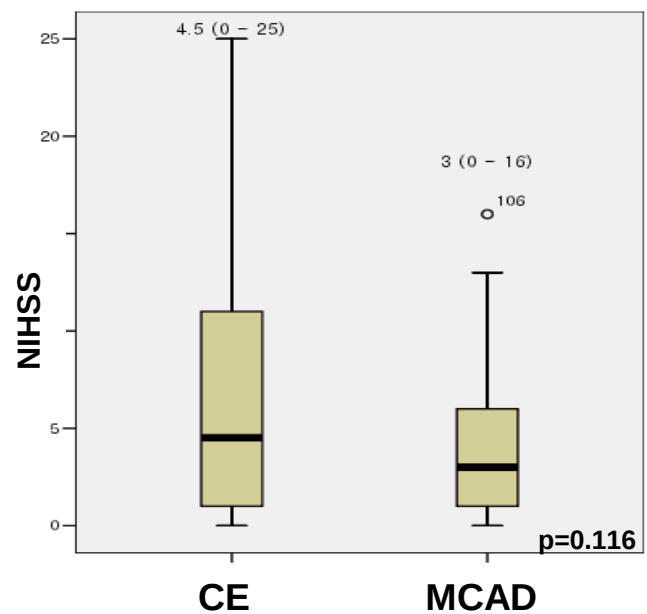
infarct growth



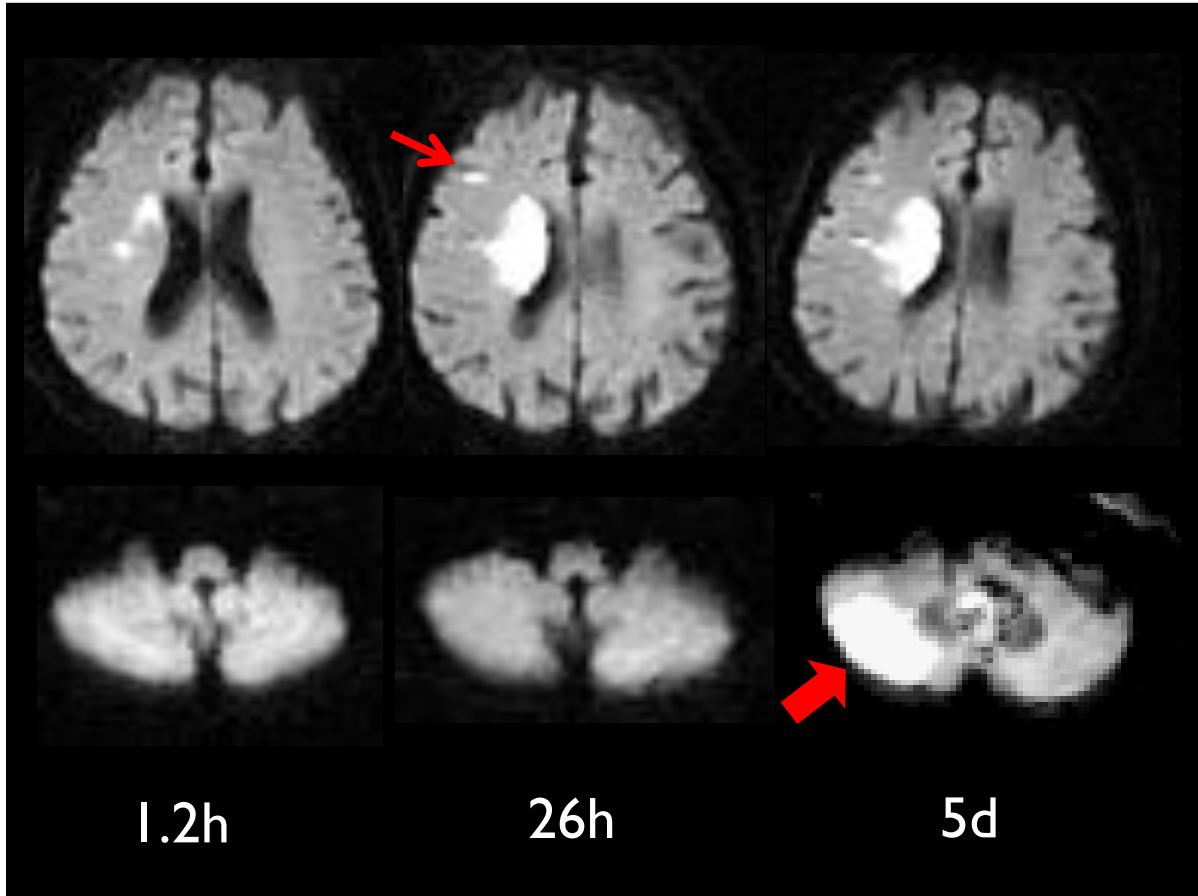
5 day infarct volume



5 day NIHSS



Stroke is dynamic! – new infarcts

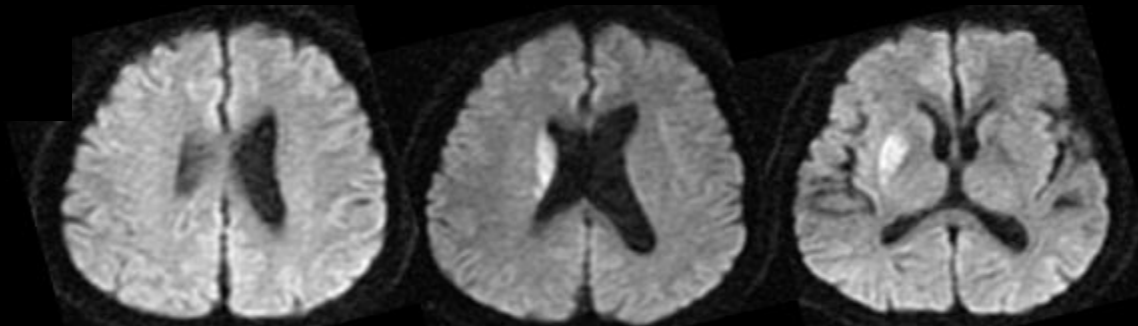


- lesion recurrence
34%
- clinical recurrence
2%

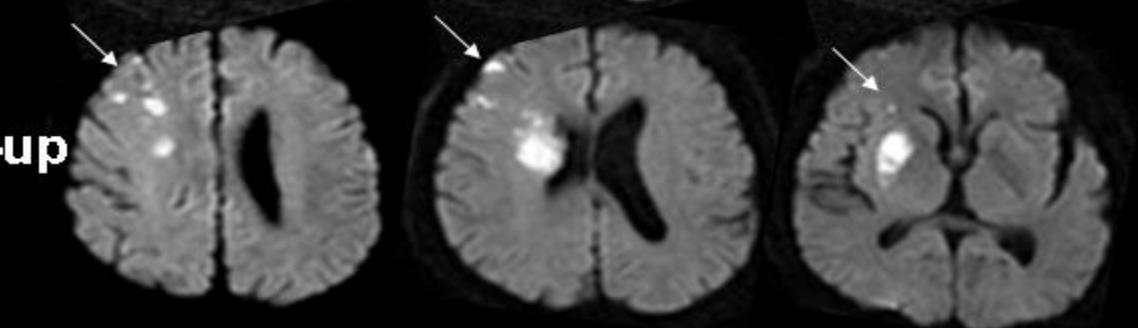
Kang DW et al. *Ann Neurol* 2003,
Neurology 2004, *Arch Neurol* 2006

MCA 탕

Acute

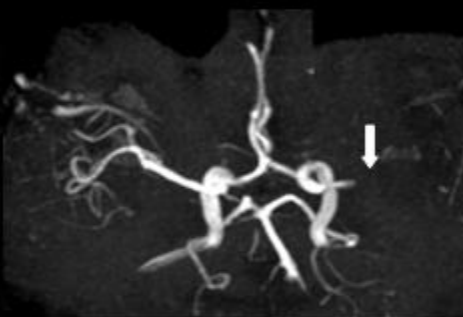
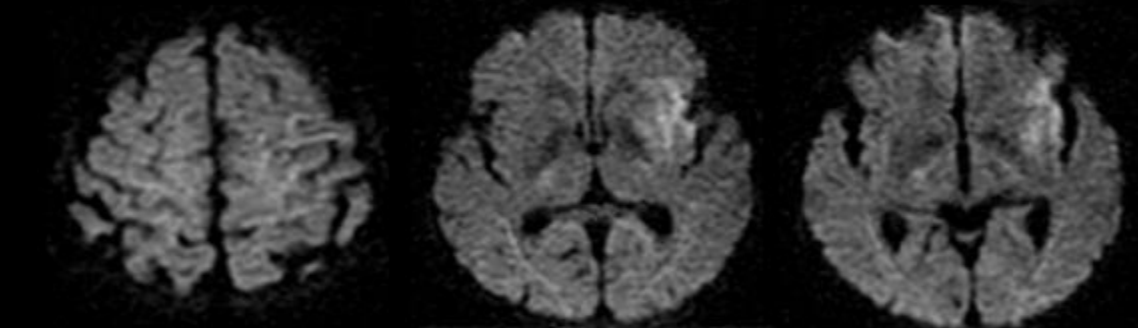


5-day
Follow-up

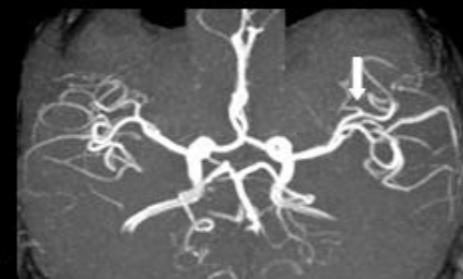
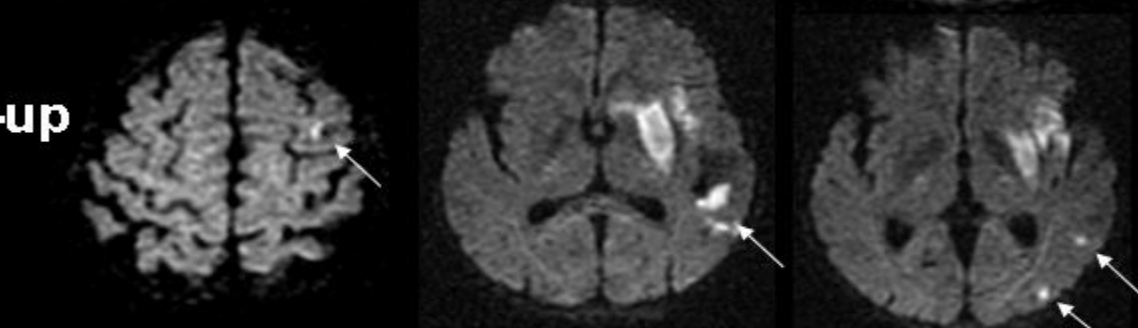


심장 탕

Acute



5-day
Follow-up



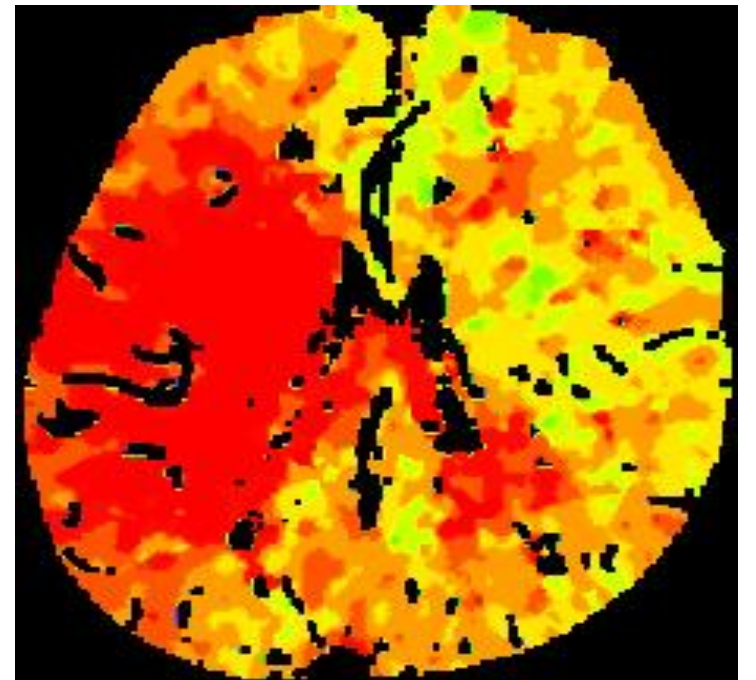
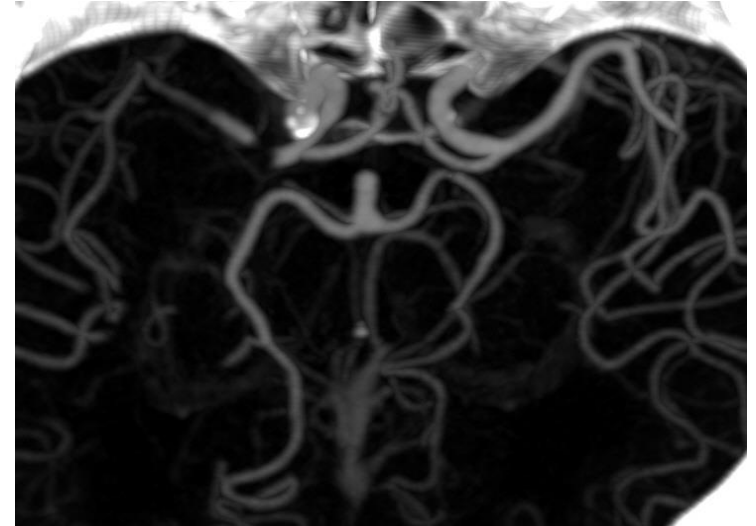
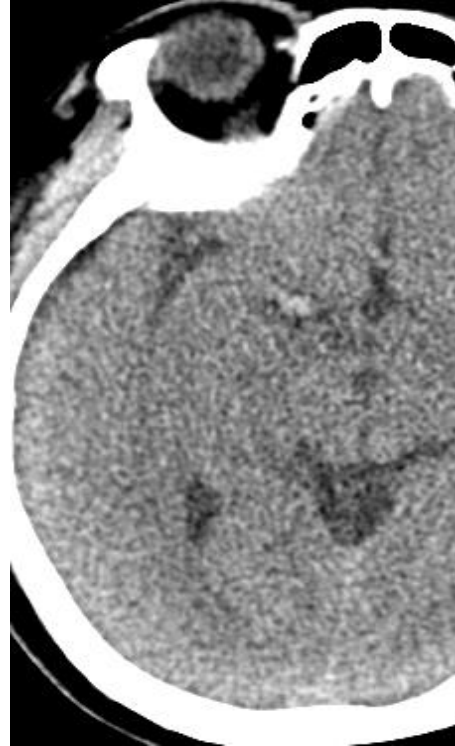
Summary – features of CE stroke

- Prevalence is increasing
- Maximal deficits at onset
- More severe, poorer outcome
- Larger or multiple infarcts at baseline
- More infarct growth
- Recanalize shortly
- Red (fibrin-rich) clot, responsive to fibrinolytic Rx

Stroke mechanism 추정의 어려움

- puzzle 인가? mystery 인가? -

F/71yr, pAfib, SSS, HT, HL
TIA (dysarthria, left mild weakness)



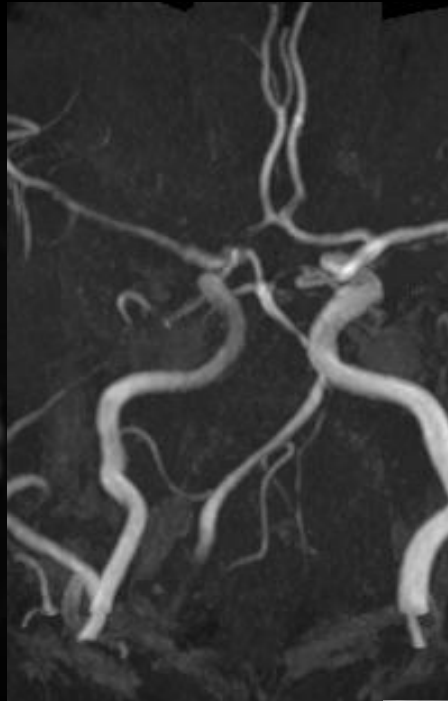
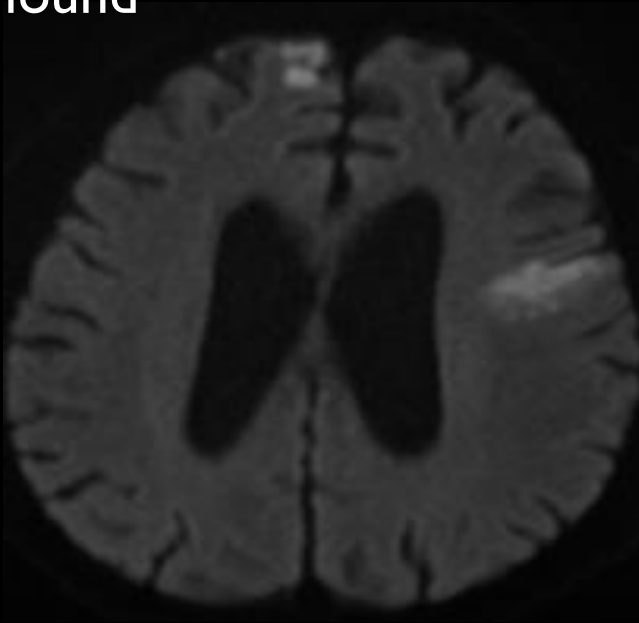


M/75

CC: aphasia

HT, DM, HL, smoker

Afib newly found



Right carotid



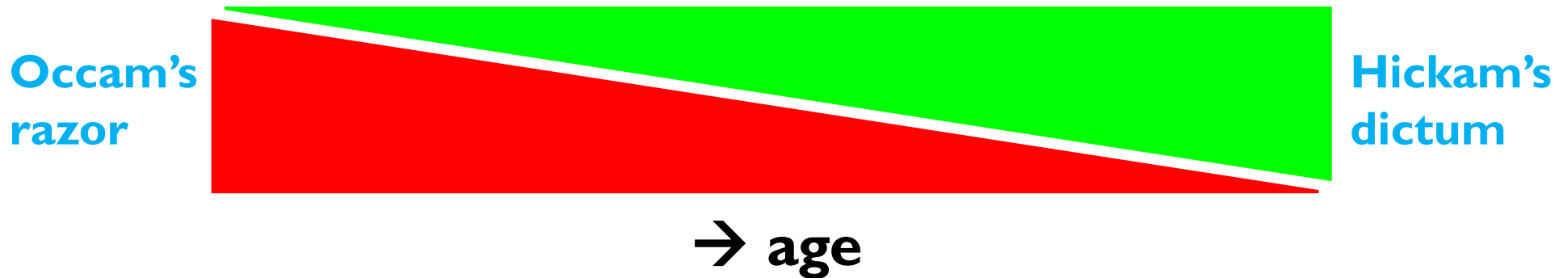
Left carotid

Occam's razor



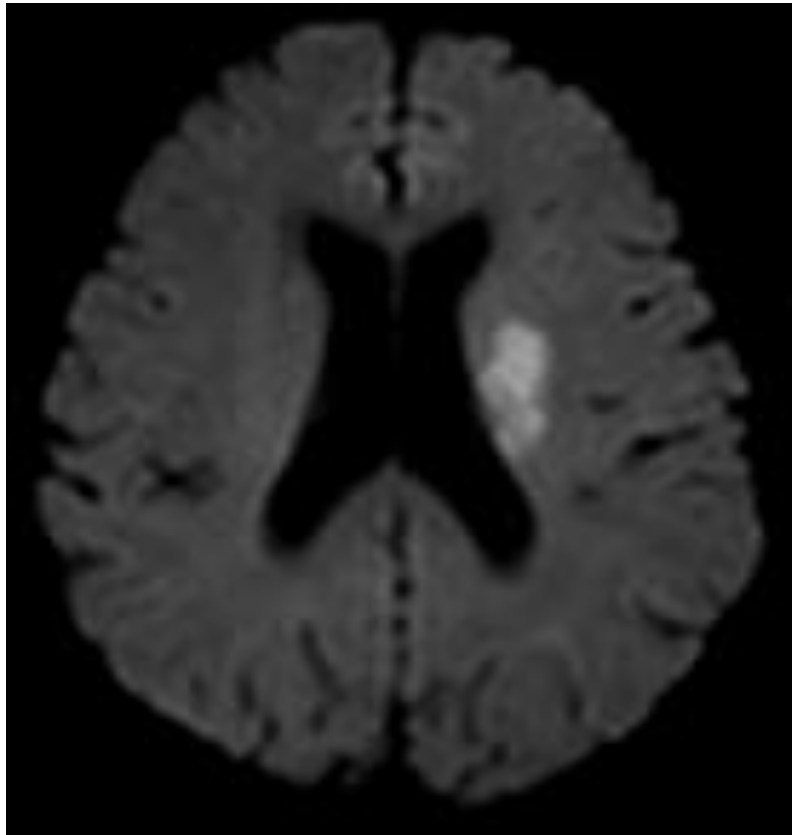
- William of Ockham (Occam)
 - 14th-century English logician, theologian
- The **simplest** explanation or strategy tends to be the **best** one
 - Among competing hypotheses, favor the simplest one

Occam's razor vs. Hickam's dictum

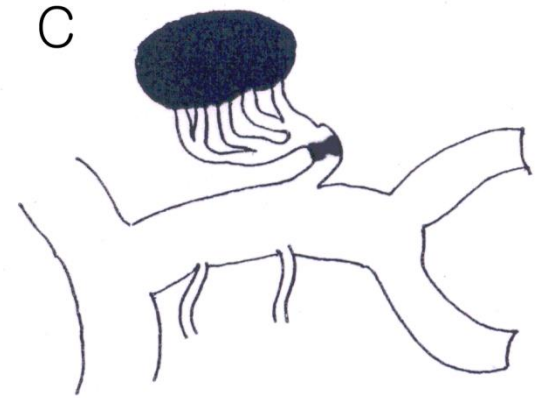
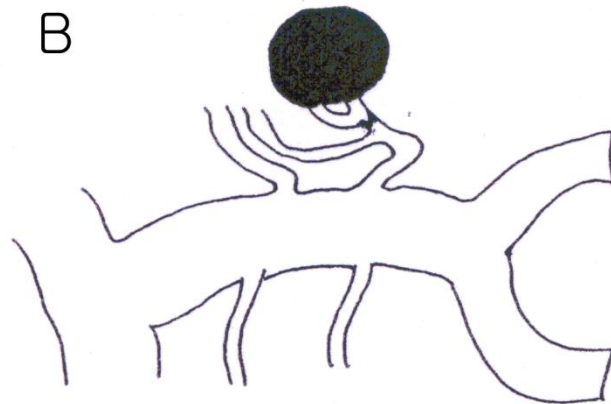
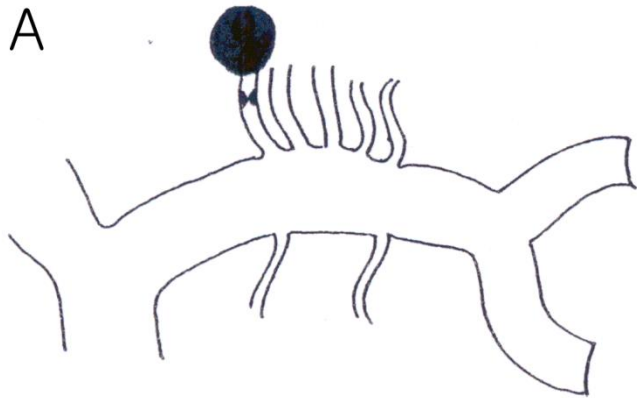


- fever, anemia, retinal embolus, cardiac murmur
- Infective endocarditis in **young** patients
- Aspirin-induced blood loss, cholesterol embolus, insignificant aortic sclerosis, viral illness in **older** pts

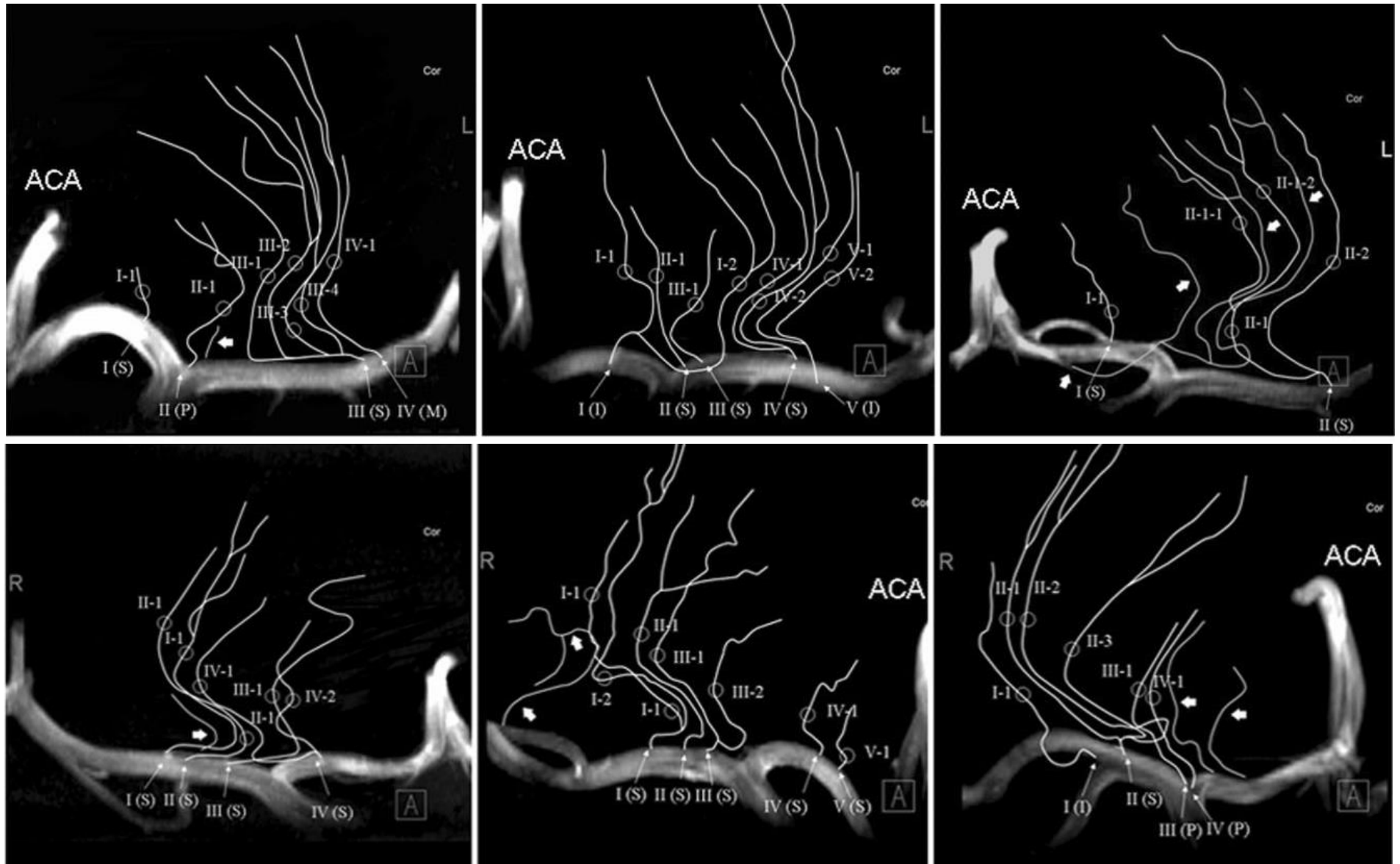
Small-vessel occlusion (lacunar infarct)

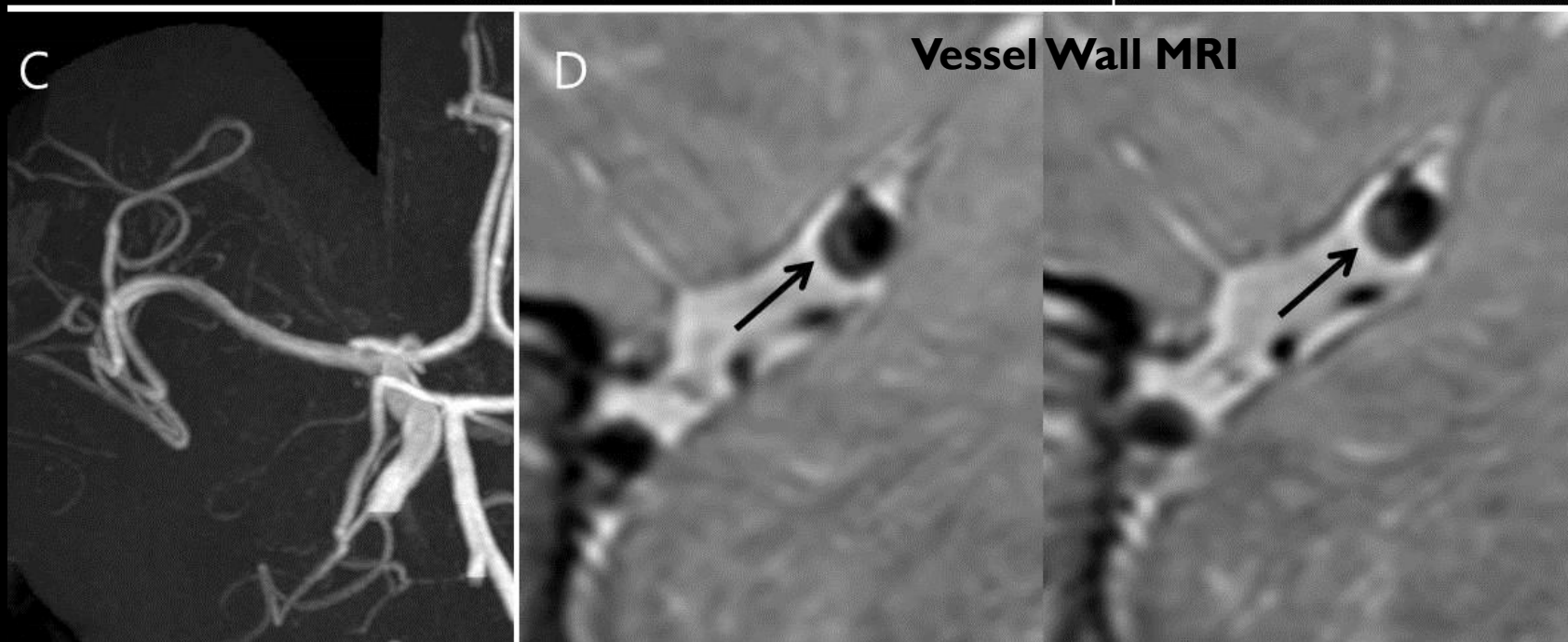
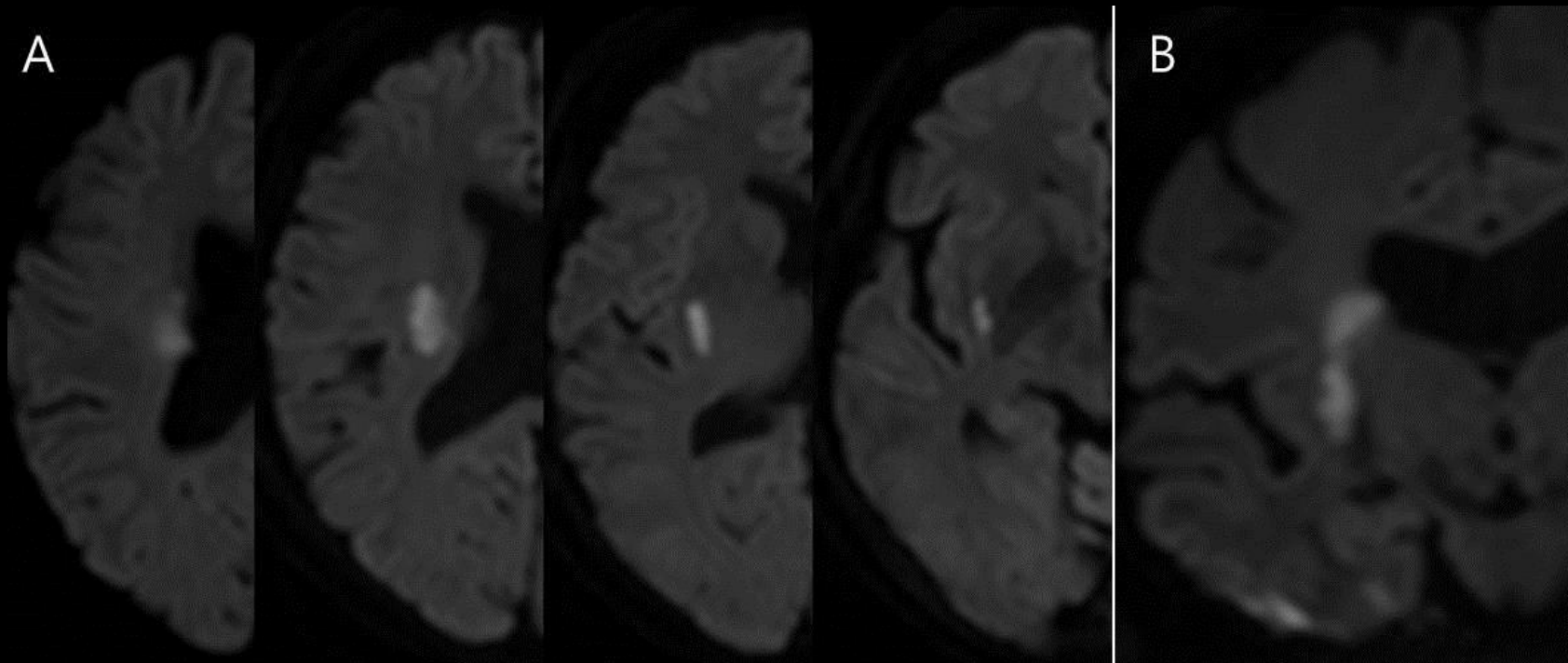


variable branch patterns, variable size

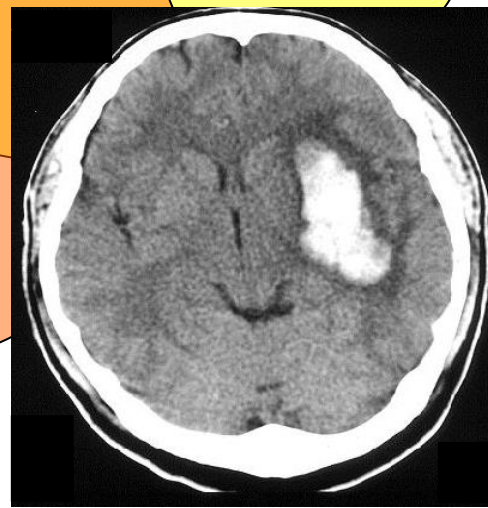
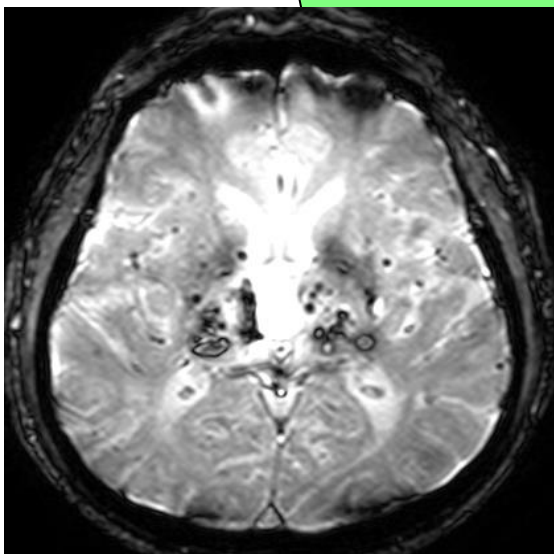
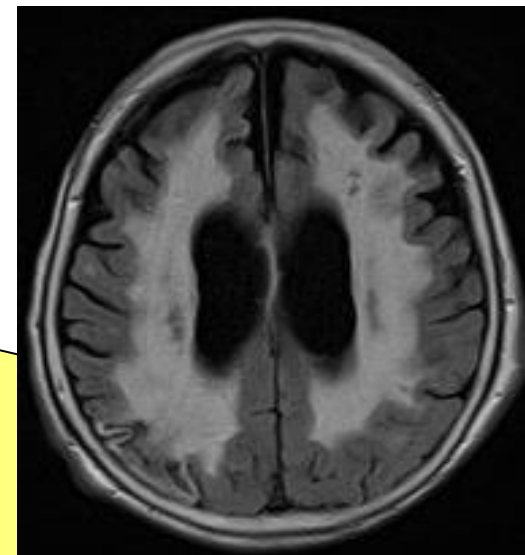
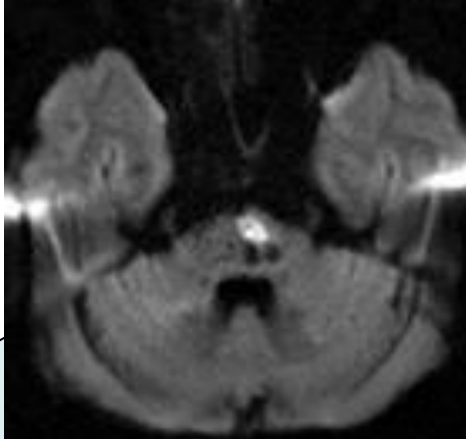
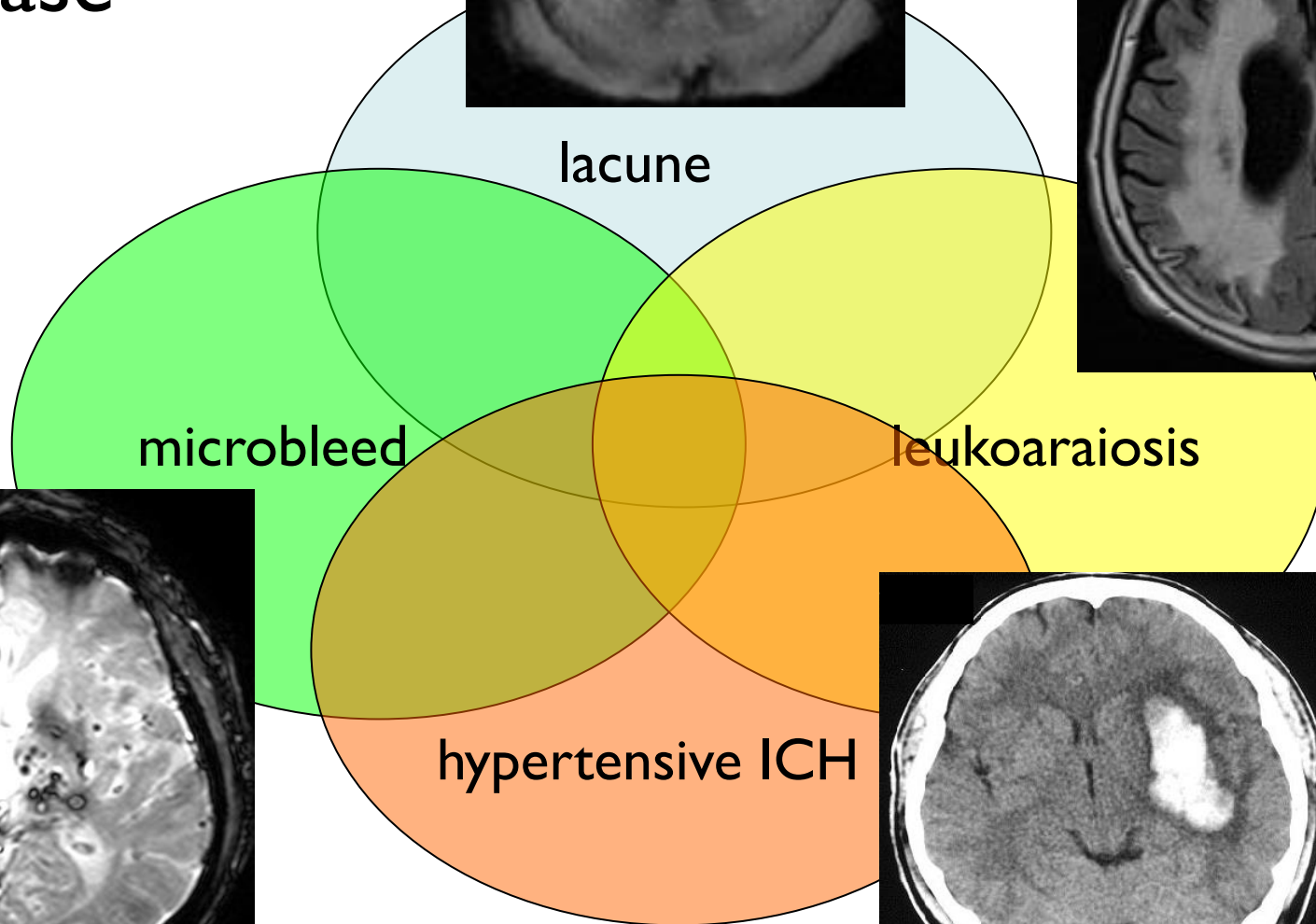


Variations in perforating arteries – 7T MRI



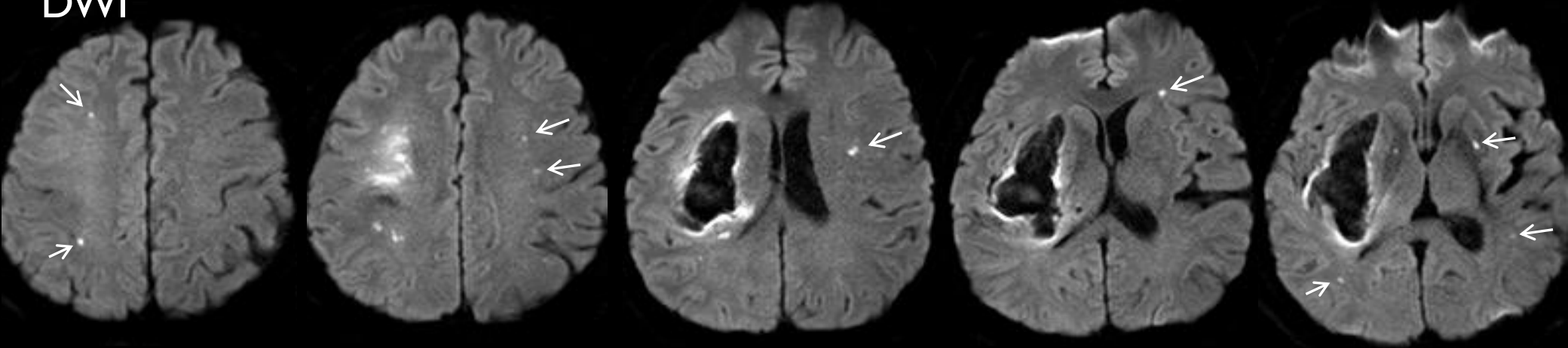


Small-Vessel Disease

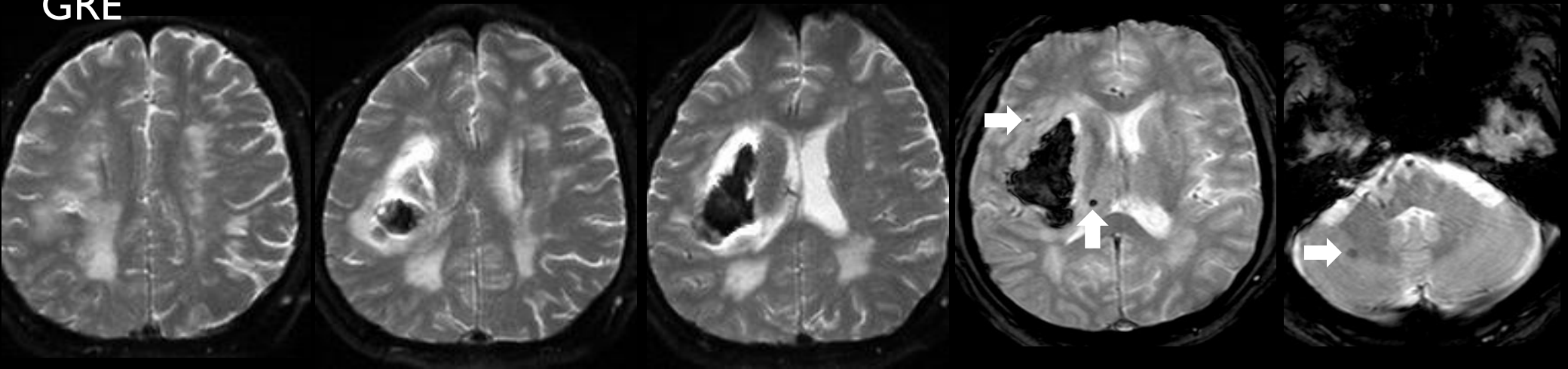


급성 뇌출혈과 급성 뇌경색의 공존

DWI



GRE



Puzzle?



Mystery?



thanks!