

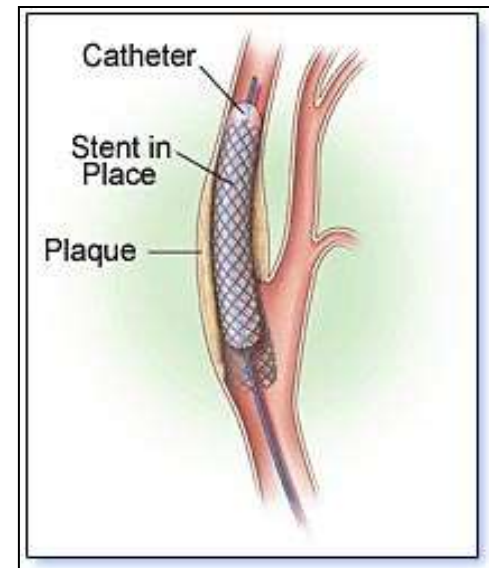
*Paul Hsien-Li Kao, MD Professor of Medicine
National Taiwan University College of Medicine*

ERCAO

Carotid Occlusion Recanalization Trial

Carotid stenosis

- * Causing embolism, responsible for 20-30% of ischemic stroke
- * Endarterectomy and stenting reduces future stroke rate, but contra-indicated only for total carotid occlusions (CAO)

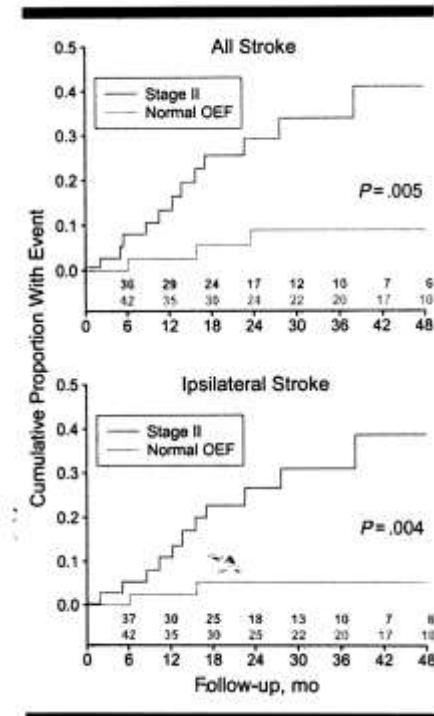


Why?

- * With cessation of antegrade flow, the risk of embolic stroke is low
- * Surgical bypass failed to show benefit
- * It is rare, and endovascular recanalization is difficult and dangerous

No embolism does not mean safety

- * Severe carotid stenosis or CAO leads to cerebral hypo-perfusion
- * Annual stroke risk in patients with objective cerebral ischemia is as high as 20%



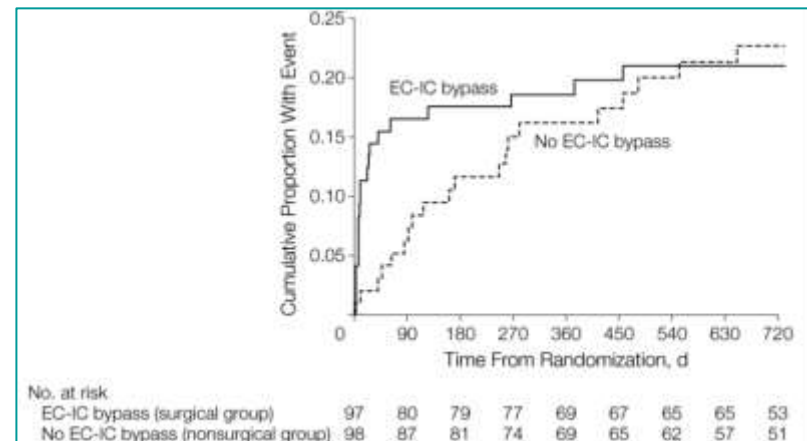
Klijn CJ, et al. Stroke 1997;28:2084

Grubb RL Jr, et al. JAMA 1998;280:1055

Derdeyn CP, et al. Neurology 1999;53:251

Surgery provides no benefit

- * Endarterectomy is not possible in CAO
- * EC/IC bypass failed to yield benefit in CAO
 - * High complication
 - * Poor pt selection



EC/IC Bypass Study Group. N Engl J Med 1985;313:1191

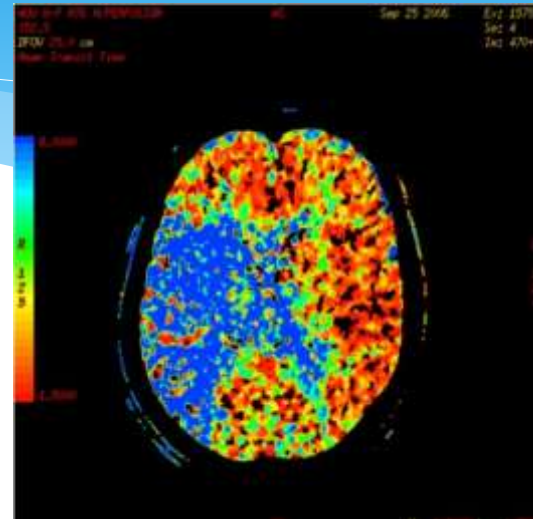
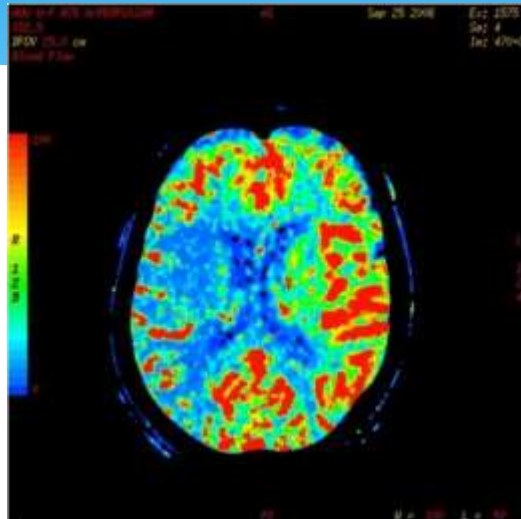
Powers WJ, et al. JAMA 2011;306(18):1983

An cardiologist's doubt

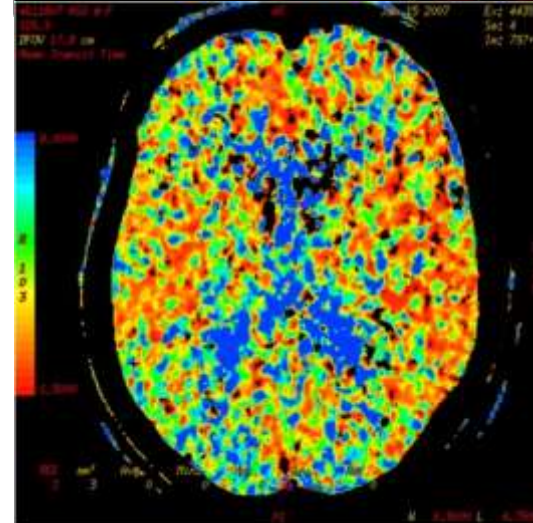
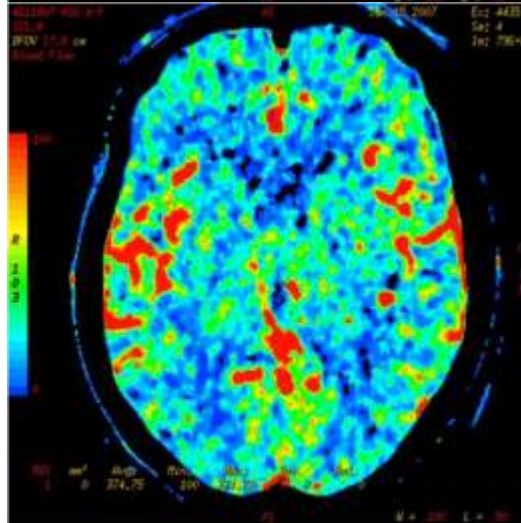
- * Carotid intervention should also improve hemodynamics
- * But can we demonstrate perfusion failure?
- * How can we prove the benefit of rectifying perfusion, if any?

Objective cerebral ischemia

baseline



post stenting



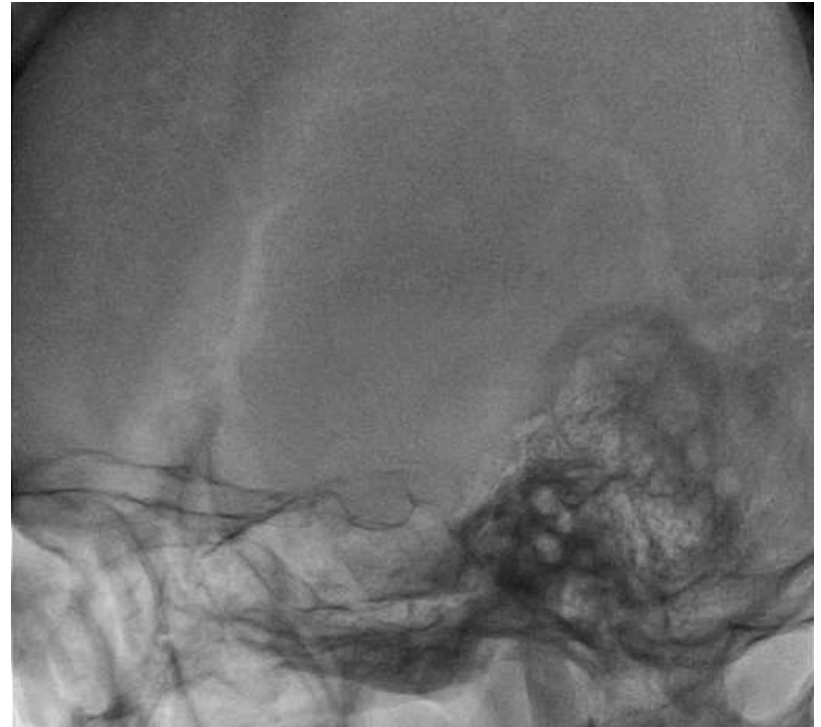
stress blood flow

stress mean transit time

Example case



Progressive “dementia”



Final angiograms



Our experience with CAO

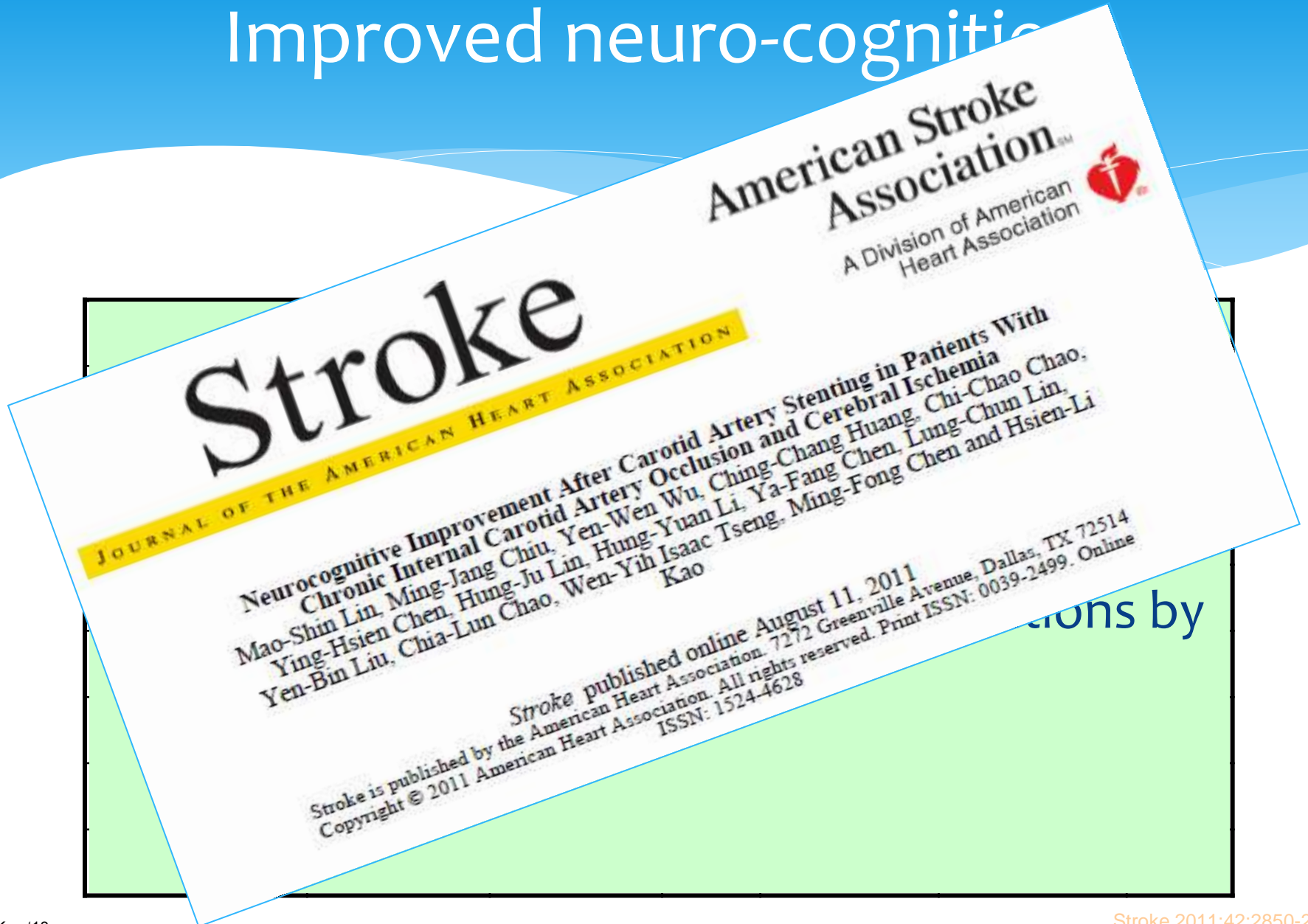
- * 235 CAO attempts in 1409 carotid procedure since 2002 (16%)
- * Feasibility and safety has been reported, with overall 73% success and 4.3% 30d stroke/death
 - * 83% success and 3.3% 30d stroke/death since 2016

JACC 2007;49:765-771

Circ Cardiovasc Intervent 2008;1:119-125

NTUH data on file

Improved neuro-cognitive



American Stroke
Association™
A Division of American
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Stroke

JOURNAL OF THE AMERICAN HEART ASSOCIATION

**Neurocognitive Improvement After Carotid Artery Stenting in Patients With
Chronic Internal Carotid Artery Occlusion and Cerebral Ischemia**
Mao-Shin Lin, Ming-Jang Chiu, Yen-Wen Wu, Ching-Chang Huang, Chi-Chao Chao,
Ying-Hsien Chen, Hung-Ju Lin, Hung-Yuan Li, Ya-Fang Chen, Lung-Chun Lin,
Yen-Bin Liu, Chia-Lun Chao, Wen-Yih Isaac Tseng, Ming-Fong Chen and Hsien-Li
Kao

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Correlation of NCF to perfusion

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Interventional Cardiology

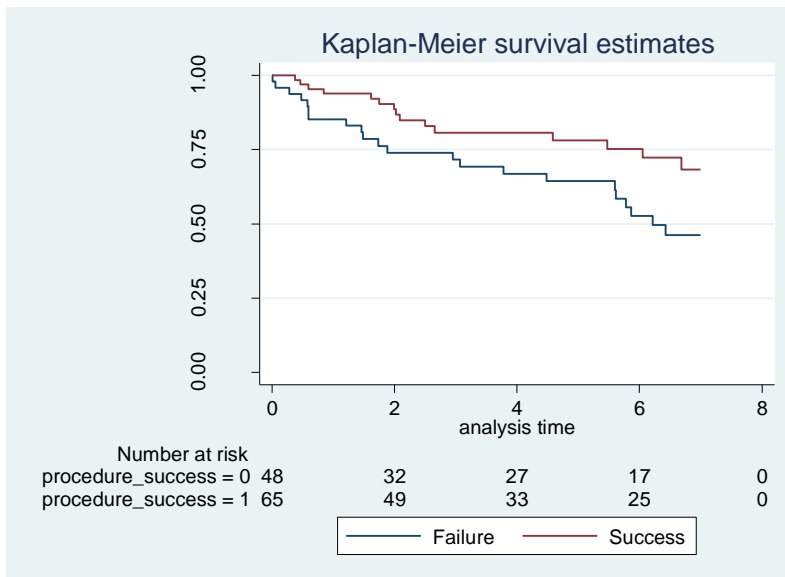
CLINICAL RESEARCH

Association of the Recovery of Objective Abnormal Cerebral Perfusion With Neurocognitive Improvement After Carotid Revascularization

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Hung-Yuan Li, MD, PHD,* Ming-Jang Chiu, MD, PHD,§|| Chi-Chao Chao, MD,§
Yen-Wen Wu, MD, PHD,*¶#** Ya-Fang Chen, MD,†† Jen-Kuang Lee, MD,††
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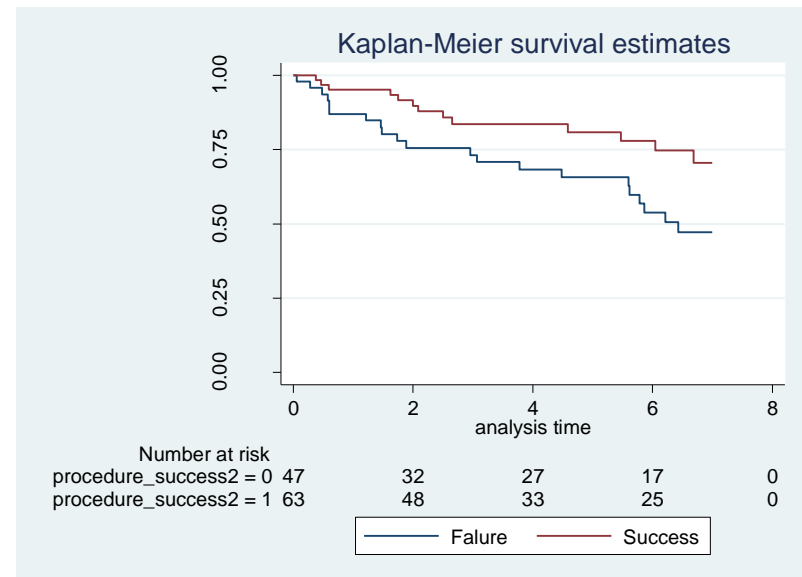
Overall clinical outcome

Composite endpoints: stroke/TIA + ICH + Death



Logrank test: $p=0.0326$
Hazard ratio: 0.48, $p=0.040$ after adjusting age, sex, DM, HTN, hyperlipidemia, smoking, CAD, CKD, prior ipsilateral ischemic event

Same endpoints, excluding peri-procedural complications

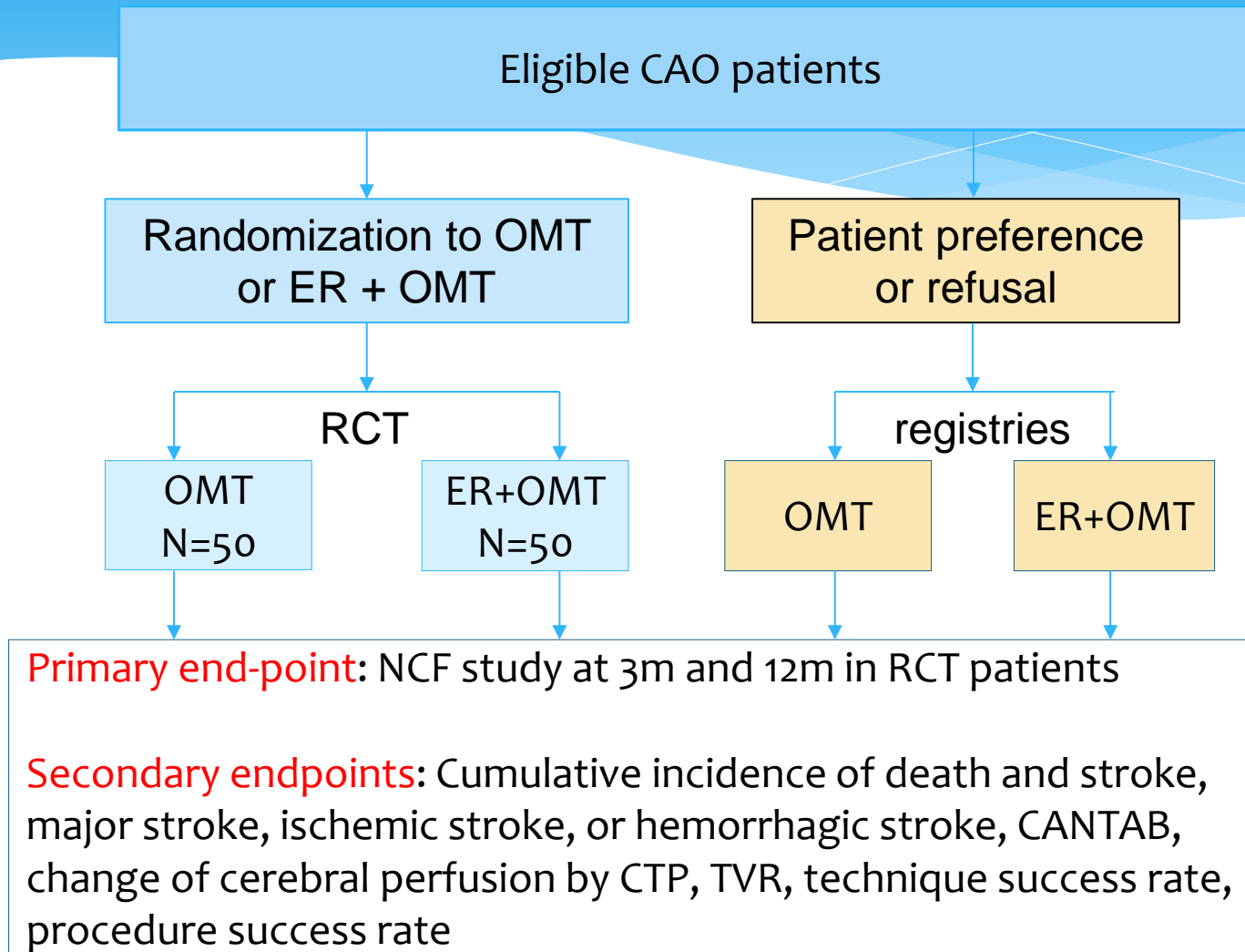


Logrank test: $p=0.0236$
Hazard ratio: 0.44, $p=0.024$ after adjusting age, sex, DM, HTN, hyperlipidemia, smoking, CAD, CKD, Prior ipsilateral ischemic event

ERCAO trial

- * Prospective randomized control trial to evaluate the benefit of **E**ndovascular **R**evascularization for **CAO** in addition to optimal medical therapy
- * To include as many patients as possible and to observe real-world outcomes, 2 parallel registry arms are also included
- * Funded by NTUH A1 Project grant 201702049RINA
- * ClinicalTrials.gov ID NCT03179774

Flow chart



Inclusion criteria

- * Classic NASCET carotid symptoms on optimal medical treatment after documentation of CAO, or
- * Objective ischemia by CTP
- * Collaborative research team including neurologist, neuro-psychiatrist, clinical psychiatrist, radiologist, and interventionist

CT perfusion

- * Performed off-line at a workstation using commercial software (CT Perfusion 3, Advantage 4.2; GE Healthcare)
- * Cerebral blood volume (CBV), cerebral blood flow (CBF), time to peak (TTP), and mean transit time (MTT) will be calculated
- * By independent radiologist

Neurocognitive function (NCF)

- * Questionnaire and tasking
 - * Mini-Mental State Examination (MMSE)
 - * Alzheimer Disease Assessment Scale–Cognitive subscale (ADAS-Cog),
 - * Verbal fluency (category naming: fruits, vegetables, and fishes)
 - * Color trailing test parts 1 and 2
- * Conducted by independent neuro-psychiatrist

Battery of CANTAB

Stage	Tests	Estimated Minutes
Practice and attention	Motor Screening Task (MOT)	2
	Reaction Time (RTI)	5
	Rapid Visual Information Processing (RVP)	7
Memory	Paired Associates Learning (PAL)	10
	Delayed Matching to Sample (DMS)	12
	Pattern Recognition Memory (PRM)	5
Decision making and executive function	Spatial Working Memory (SWM)	8
	Spatial Span (SSP)	8
	Intra-Extra Dimensional Set Shift (IED)	7
	One Touch Stockings of Cambridge (OTS)	10

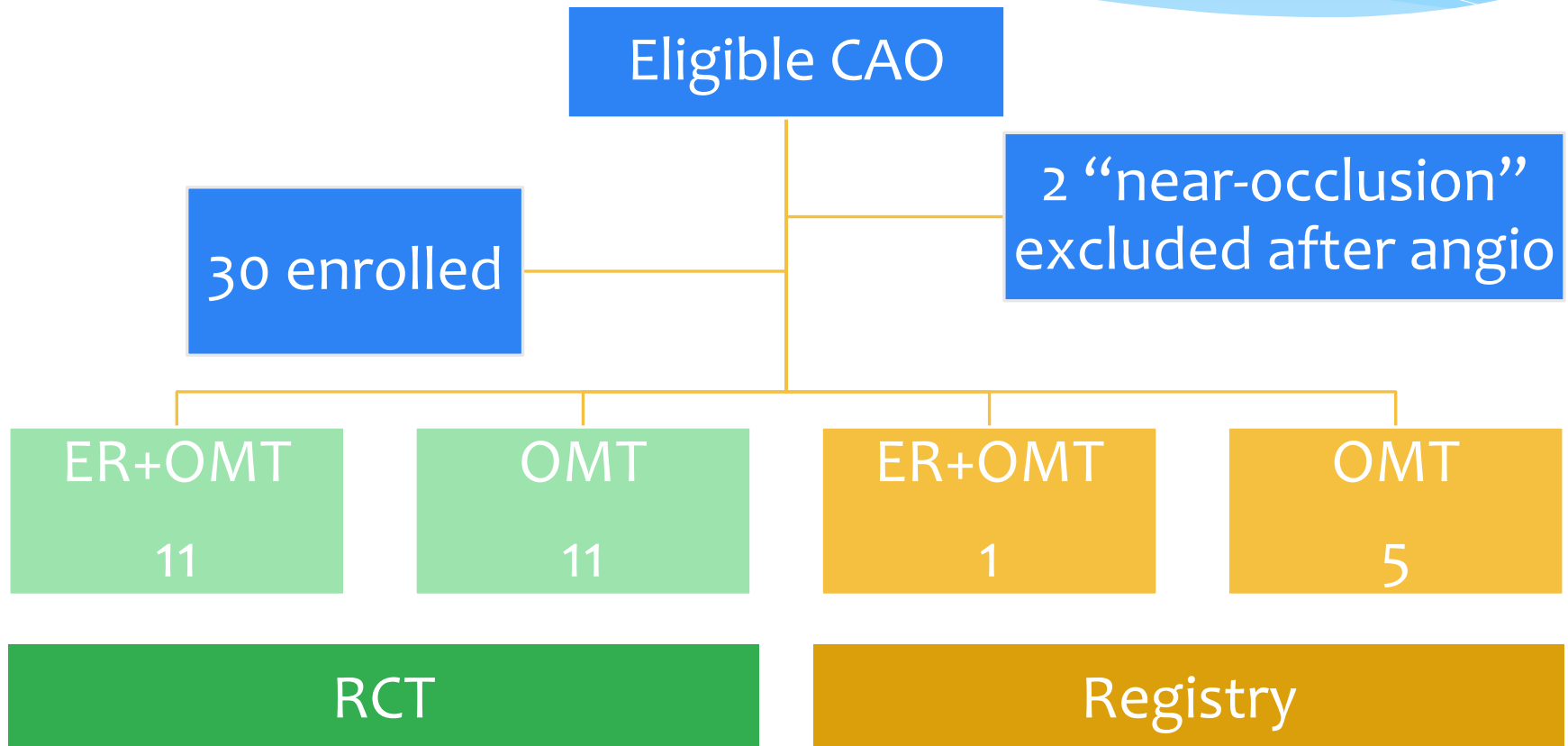
Optimal medical therapy

- * Dual antiplatelet therapy
- * Aggressive treatment of dyslipidemia
- * Treatment of hypertension and diabetes according to national guidelines
- * Smoking cessation
- * Lifestyle modification, including diet and exercise

Endovascular Intervention

- * A standard endovascular procedure will be performed
- * **Technical success:** if the occlusion segment was recanalized with final residual diameter stenosis of <20%, establishing grade 3 antegrade TIC1 flow
- * **Procedure success:** technical success without 30d stroke/death

Current enrollment status



Conclusions

- * Hemodynamic insufficiency may be as important as embolism in carotid artery disease
- * Benefit of carotid intervention may not be limited to stroke prevention, but also includes cerebral perfusion and neurocognitive improvement
- * ERCAO trial may prove the long-term neurological and survival benefit of carotid revascularization in CAO patients

Thanks for your
attention