Acute Ischemic Stroke & Chronic Carotid Artery Stenosis: Evolving Endovascular Approaches.

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JACC Annual Meeting, New York, NY, Dec 9th , 2016

Disclosures

1. *Consultant (Modest): Aldagen/Cytomedix , Covidien/Medtronic*
2. **Steering Committee member:**
   SWIFT Prime,
   RECOVER-Stroke ,
   MR RESCUE (Investigator Steering committee)
3. DSMB member: ESCAPE
4. Supported by grants from:
   Florida Biomedical State Grants
   CTSI, NIH
   Anderson Family Gift

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Acute Ischemic Stroke: Evolving Endovascular Approaches

1. Case Vignettes
2. Temporal Trends in the US
3. Results of 5 Landmark RCTs of Mechanical Thrombectomy
4. Clinical Insights from Sub-group analyses

Mechanical Thrombectomy (MT) at University of Miami, UHealth: >300 MTs since 2007

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Acknowledgements

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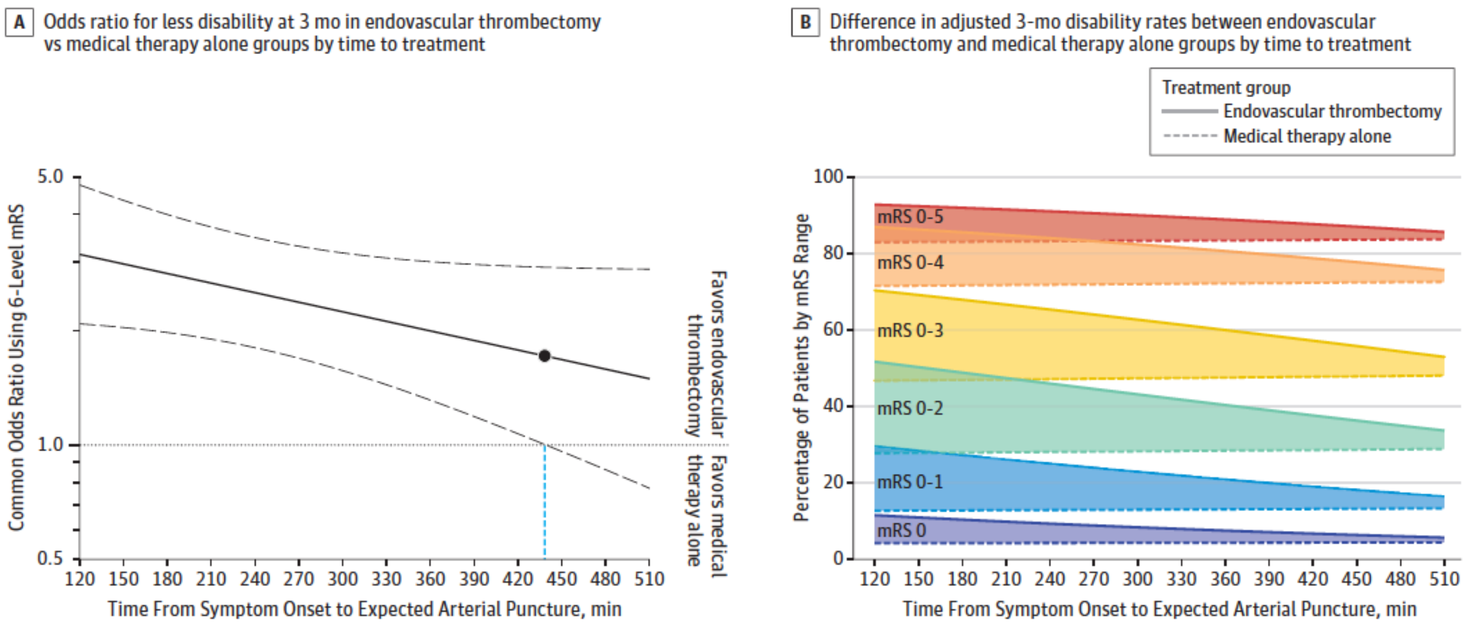
JAMA | Original Investigation

Time to Treatment With Endovascular Thrombectomy and Outcomes From Ischemic Stroke: A Meta-analysis

Jeffrey L. Saver, MD; Mayank Goyal, MD; Aad van der Lugt, MD; Bijoy K. Menon, MD; Charles B. L. M. Majoie, MD; Diederik W. Dippel, MD; Bruce C. Campbell, MD, PhD; Raul G. Nogueira, MD; Andrew M. Demchuk, MD; Alejandro Tomasello, MD; Pere Cardona, MD; Thomas G. Devlin, MD; Donald F. Frei, MD; Richard du Mesnil de Rochemont, MD; Olvert A. Berkhemer, MD; Tudor G. Jovin, MD; Adnan H. Siddiqui, MD, PhD; Wim H. van Zwam, MD; Stephen M. Davis, MD; Carlos Castaño, MD; Biggya L. Sapkota, MD; Puck S. Fransen, MD; Carlos Molina, MD; Robert J. van Oostenbrugge, MD; Ángel Chamorro, MD; Hester Lingsma, PhD; Frank L. Silver, MD; Geoffrey A. Donnan, MD; Ashfaq Shuaib, MD; Scott Brown, PhD; Bruce Stouch, PhD; Peter J. Mitchell, MD; Antoni Davalos, MD; Yvo B. W. E. M. Roos, MD; Michael D. Hill, MD, MS; for the HERMES Collaborators

Figure 1. Association of Time From Symptom Onset to Expected Time of Endovascular Thrombectomy Procedure Start (Arterial Puncture) With Disability Levels at 3 Months in Endovascular (n = 633) vs Medical Therapy (n = 645) Groups



EDITORIAL

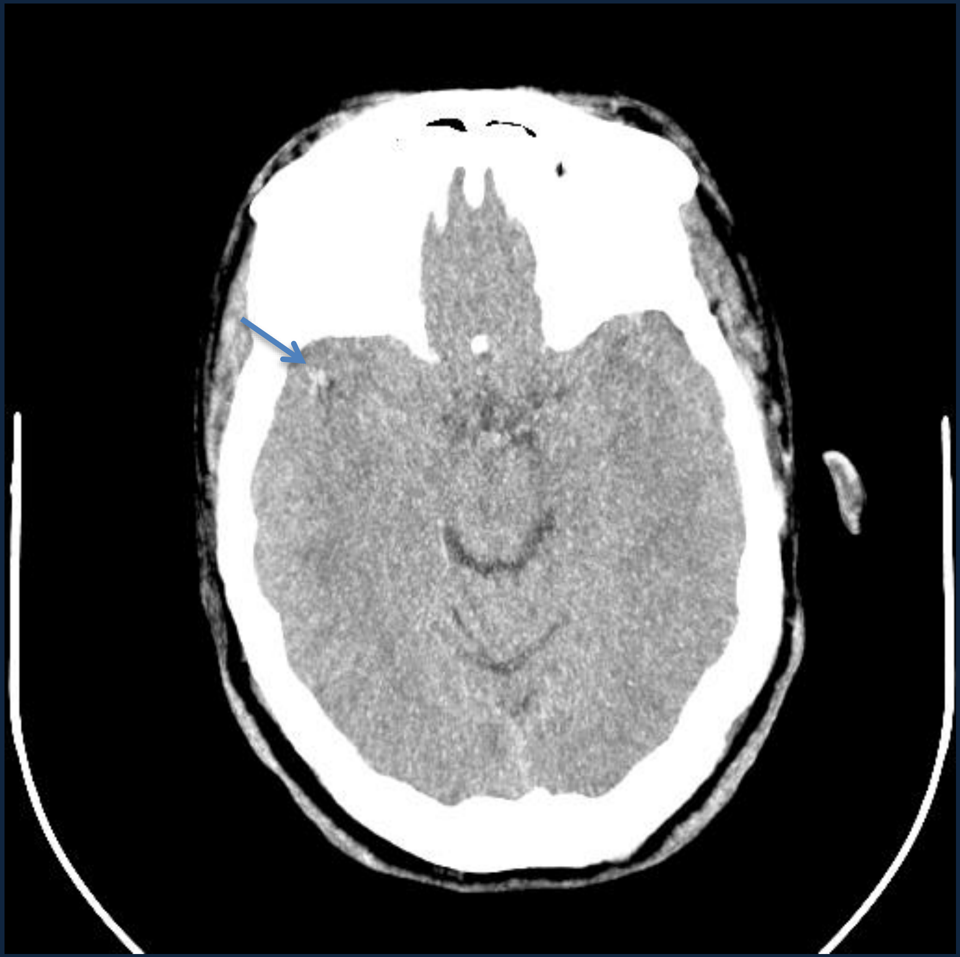
Endovascular Thrombectomy for Ischemic Stroke

The Second Quantum Leap in Stroke Systems of Care?

Steven Warach, MD, PhD; S. Claiborne Johnston, MD, PhD

63 year old woman w Afib, Coumadin discontinued due to GYN bleeding with 2 hours of RMCA syndrome: NIHSS 8

CT Reconstruction (MIP) shows clot in RMCA M1-M2 junction



IV tPA strarted and simultaneously wheeled to Angio Suite (No MRI, no CTA)

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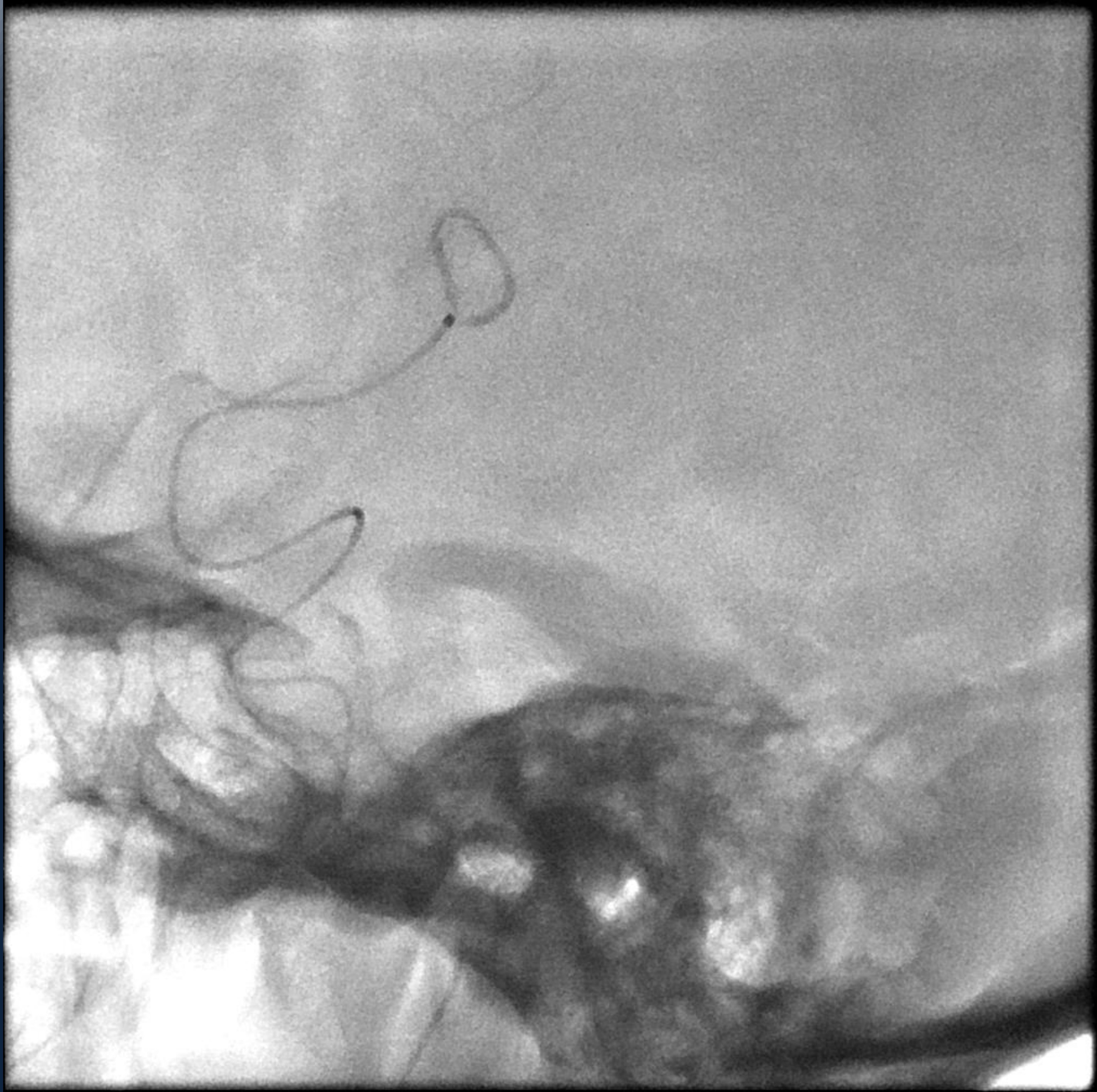
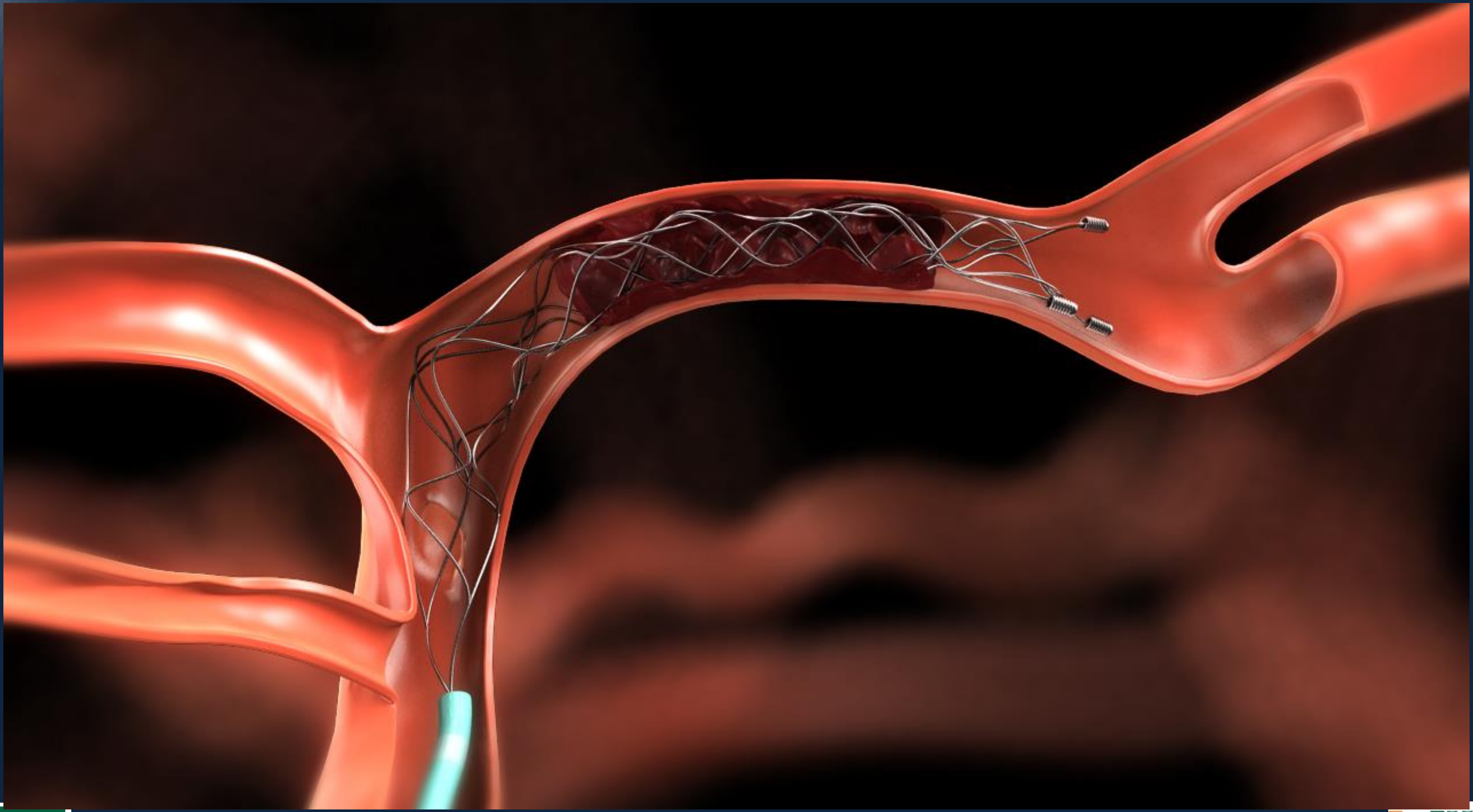
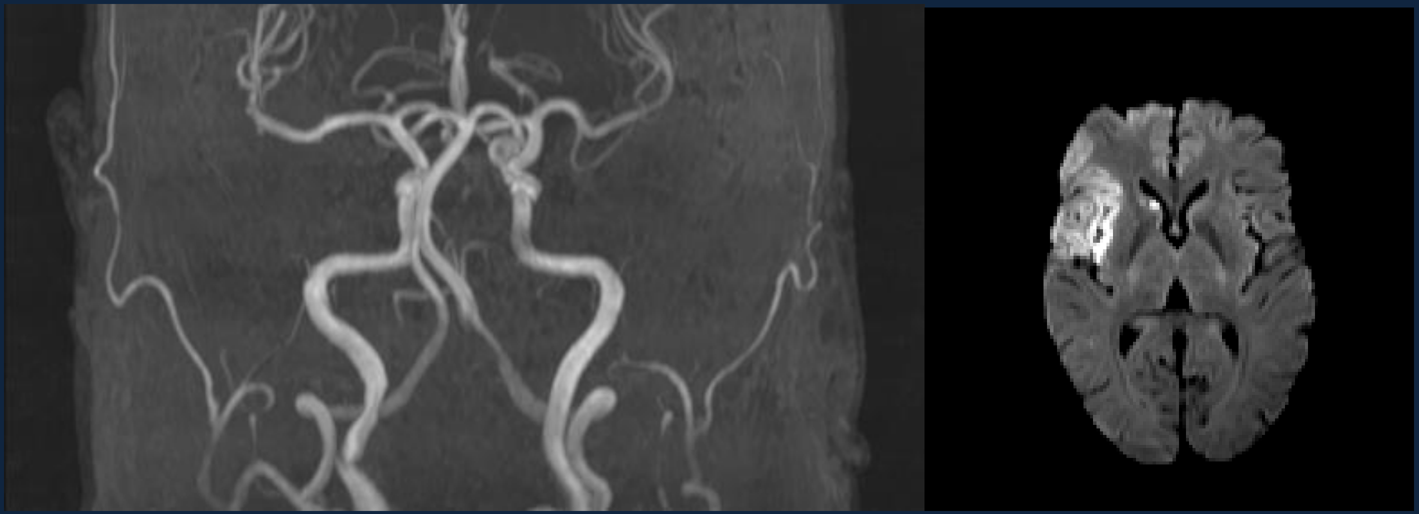


Stent like Thrombus Retrievers



- Groin Puncture: 18:16
- TICI 3 (Complete) recanalization: 19:08
- Puncture to Recanalization time: 52 minutes

MRI/A 48 hours post ET



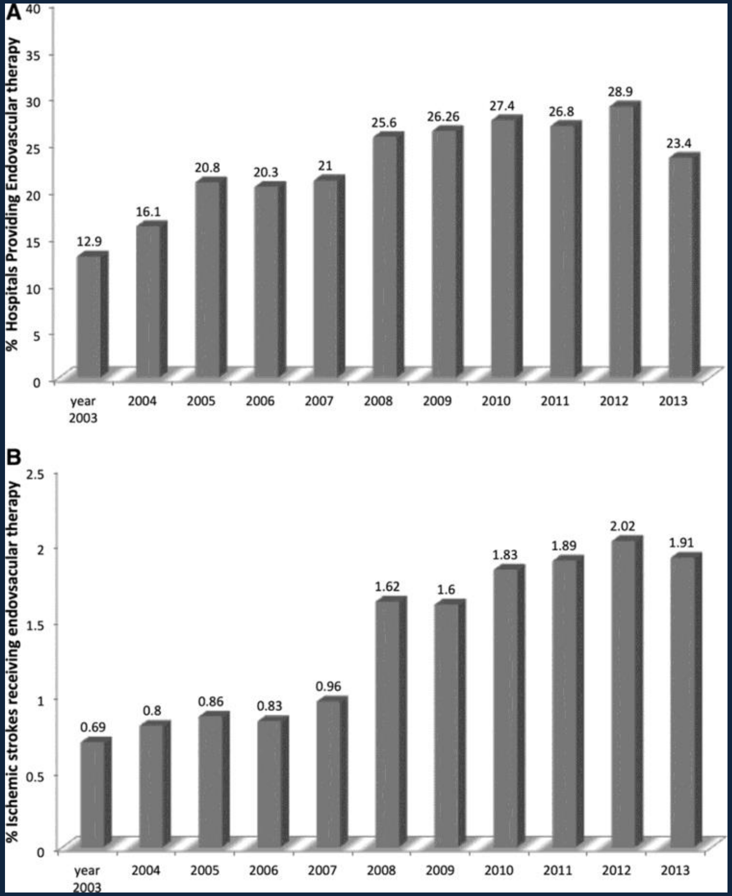
Functional Outcome: Status Post ET

- NIHSS: Decreased from 8 to 1 in 48 hour
- Discharged Home at 4 days

Mechanical Thrombectomy for Acute Stroke…….

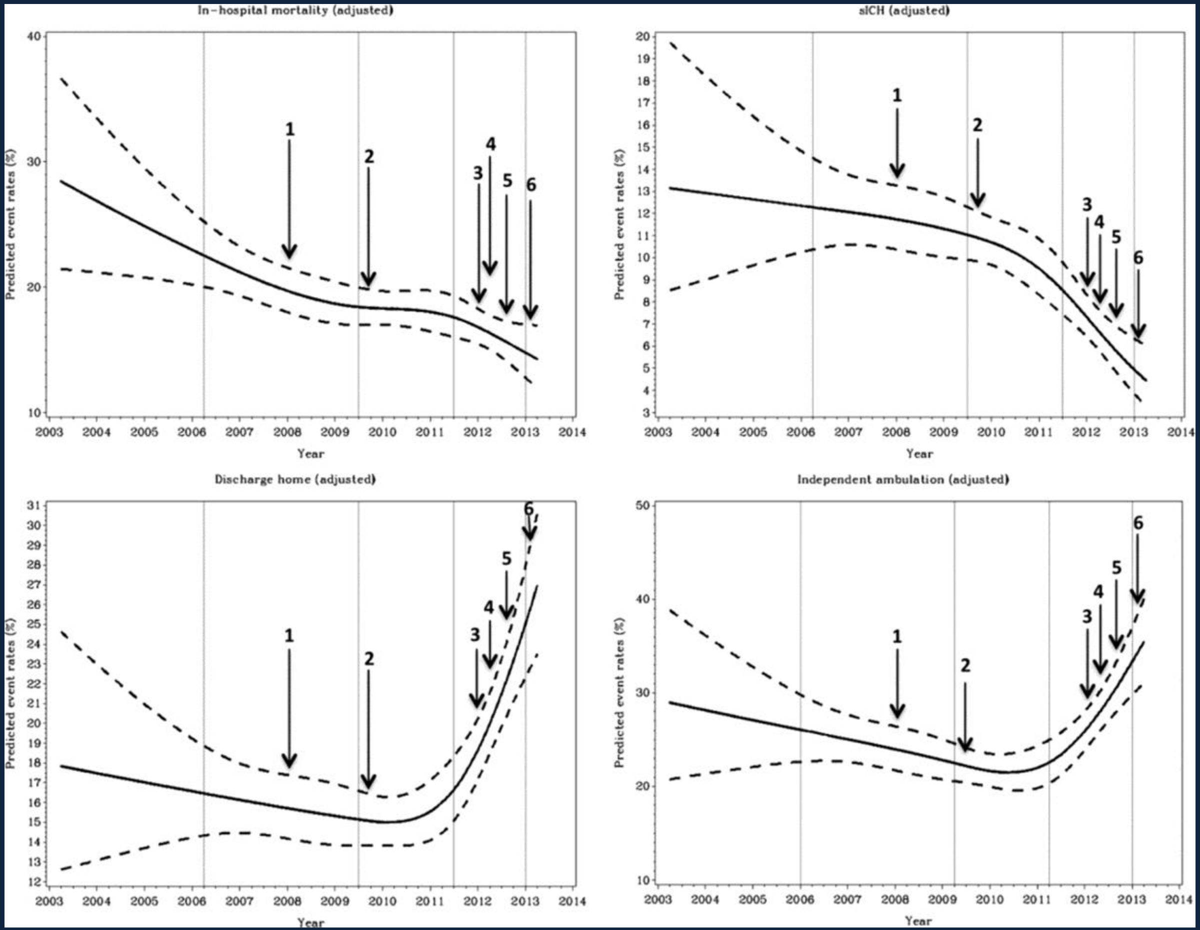
2015: It WORKS!!

Temporal trends in the use of endovascular therapy within hospitals participating in Get With The Guidelines-Stroke (GTWG-Stroke) during the past decade.



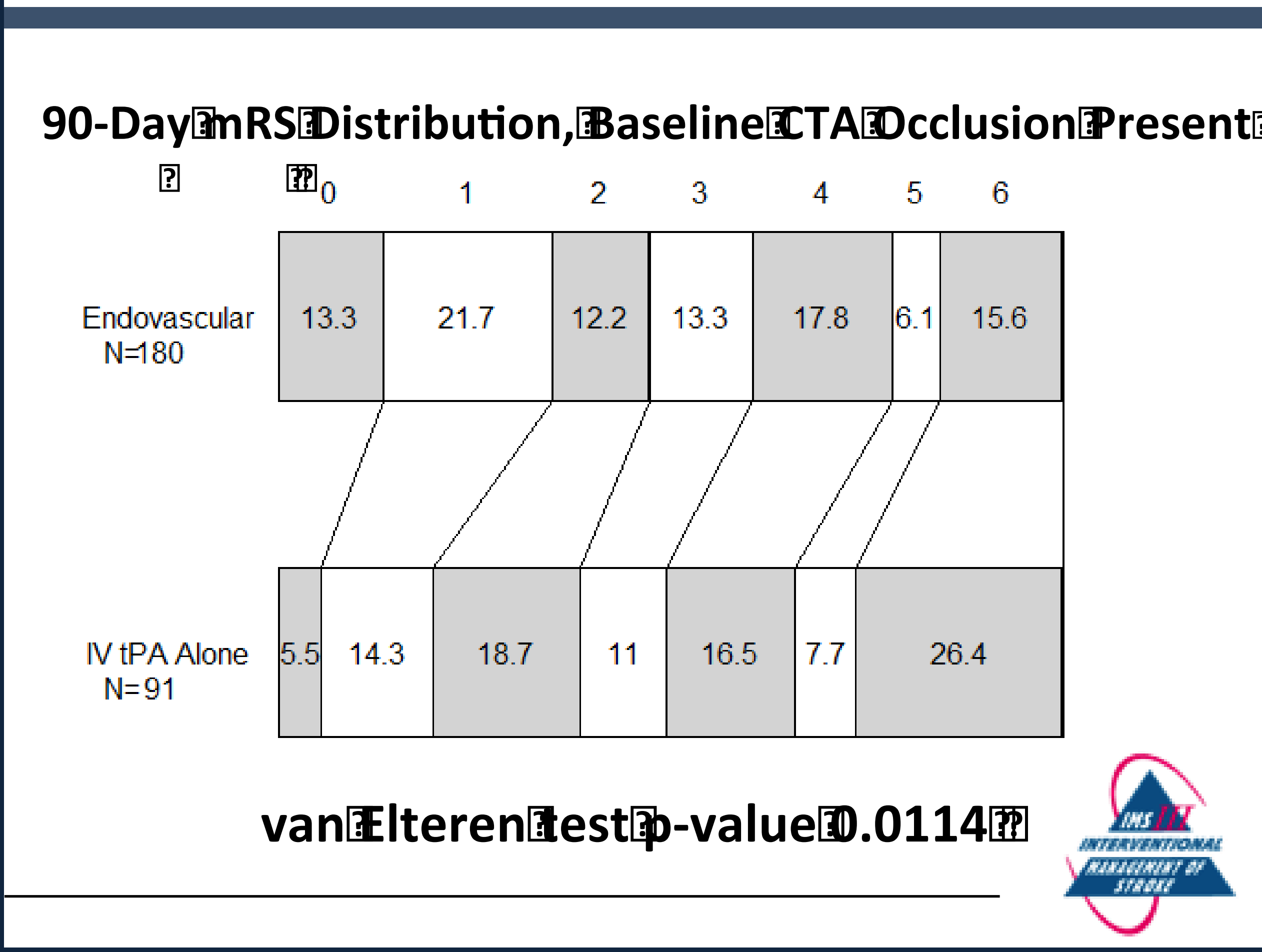
Bijoy K. Menon et al. Stroke. 2015;46:989-995

Clinical outcomes with endovascular therapy during the past decade.



Bijoy K. Menon et al. Stroke. 2015;46:989-995

IMS-3: Outcomes in CTA Confirmed occlusions



A. Demchuk, IMS III: Comparison of Outcomes between IV and IV/IA Treatment in Baseline CTA Confirmed ICA, M1, M2 and Basilar Occlusions, slide 20, Presented at ISC 2013, Honolulu Hawaii

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IMS-3 Documented Proximal Large Artery Occlusion (LAO)

Post-hoc analysis: Carotid T/L or Tandem ICA+M1

	Endovascular				IV tPA Only			
Baseline Primary Occlusion Vessel Category	Subjects with Baseline CTA	mRS 0-2	Subjects with 24 hour* CTA	Percent Recanalized** of Subjects with 24 hour* CTA	Subjects with Baseline CTA	mRS 0-2	Subjects with 24 hour* CTA	Percent Recanalized** of Subjects with 24 hour* CTA
All	189	44.44%	146	86.30%	91	38.46%	68	64.71%
ICA-T/L	39	23.08%	23	82.61%	19	5.26%	14	28.57%
Tandem M1 with ICAo	7	42.86%	7	85.71%	4	0.00%	4	25.00%
Combined	**46**	**26.09%***	**30**	**83.33%****	**23**	**4.35%***	**18**	**27.78%****

***Fisher p value 0.0471 (% mRS)**

****Chi-square p-value 0.0001 (% recanalized)**

Dr. Broderick, PI IMS-3; Personal communication

- “Ideally, if we were starting over, we would include only those subjects with major arterial occlusions prior to t-PA”

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Mechanical Thrombectomy Trials: How Comparable?

	MR CLEAN	ESCAPE	EXTEND-IA	SWIFT-P	REVASCAT
Patients	502	316	70	196	207
NIHSS					
Control	18	17	13	17	17
EVT	17	16	17	17	17

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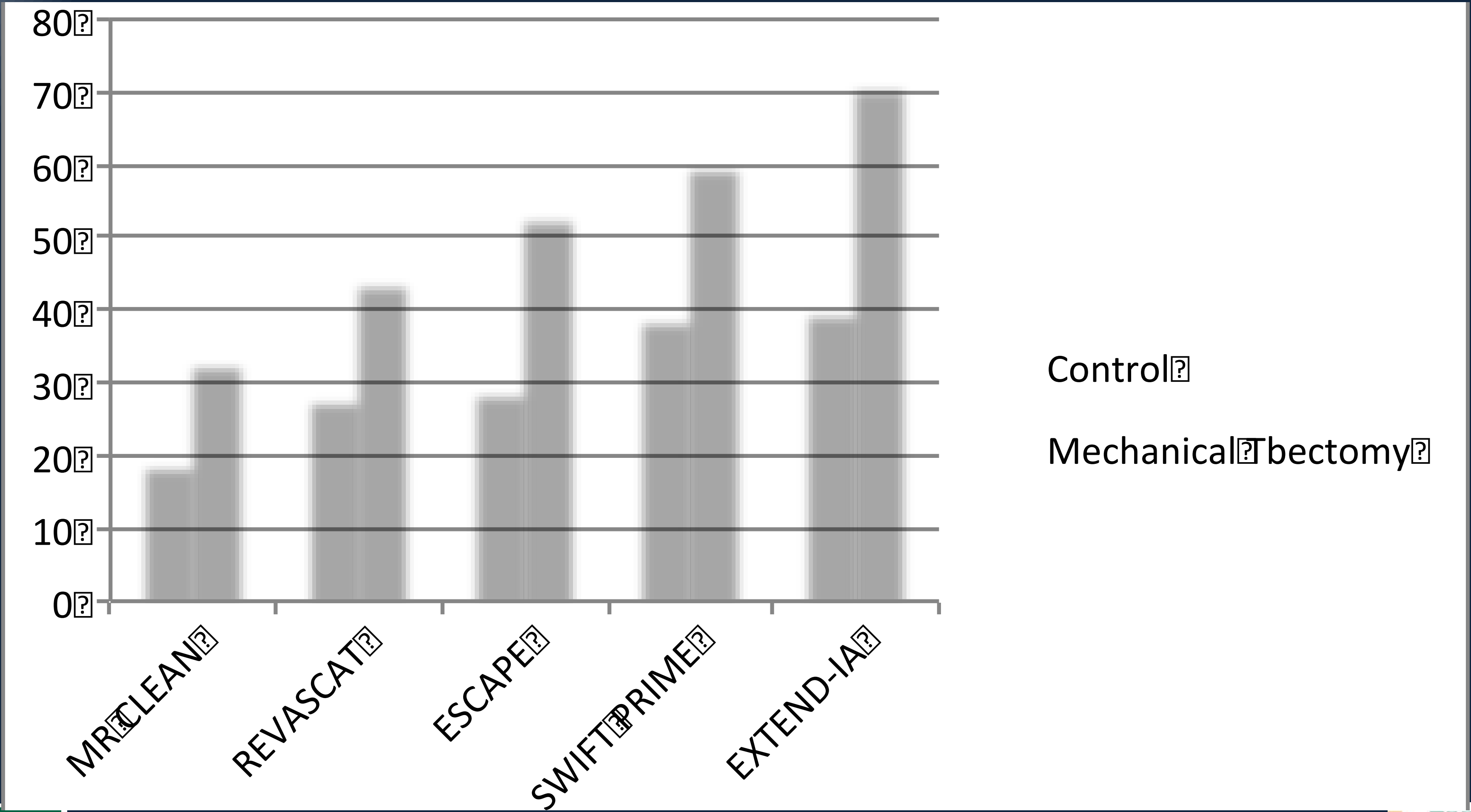
mRS 0-2 in 2nd generation Mechanical Thrombectomy trials



Summary Table: Trends ?

		mRS 0-2		Absolute Benefit	Mortality		Absoltue Mortality benefit (%)
		EndoRx (%)	Medical (%)		EndoRx (%)	Medical (%)	
MR CLEAN	502	31.5	19	12.5	18.9	18.4	-0.5
ESCAPE	316	53	29.3	23.7	19	10.4	8.6
REVASCAT	207	43.7	28.2	15.5	18.4	15.5	2.9
SWIFT-Prime	196	60.2	35.5	24.7	12.4	9.2	3.2
EXTEND IA	70	71	40	31	20	8.6	11.4

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MT: New Standard of Care 2015

Stroke
JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart Association | American Stroke Association

2015 AHA/ASA Focused Update of the 2013 Guidelines for the Early Management of Patients With Acute Ischemic Stroke Regarding Endovascular Treatment: A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

William J. Powers, Colin P. Derdeyn, José Biller, Christopher S. Coffey, Brian L. Hoh, Edward C. Jauch, Karen C. Johnston, S. Claiborne Johnston, Alexander A. Khalessi, Chelsea S. Kidwell, James F. Meschia, Bruce Ovbiagele and Dileep R. Yavagal
on behalf of the American Heart Association Stroke Council

Stroke. published online June 29, 2015;

Class I, Level A

Patients should receive endovascular therapy with a stent retriever if they meet all the following criteria (Class I; Level of Evidence A). (New recommendation):

(a) prestroke mRS score 0 to 1,

(b) acute ischemic stroke receiving intravenous r-tPA within 4.5 hours of onset according to guidelines from professional medical societies,

(c) causative occlusion of the internal carotid artery or proximal MCA (M1),

(d) age ≥18 years,

(e) NIHSS score of ≥6,

(f) ASPECTS of ≥6, and

(g) treatment can be initiated (groin puncture) within 6 hours of symptom onset

Why did Mechanical Thrombectomy finally work for AIS ?

– Patient Selection with CT imaging
– Times to intervention
– Achievement of highe rate of Substanial reperfusion (TICI 2b/3)

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Summary Table: Trends ?

		mRS 0-2		Absolute Benefit	NNT	sICH	
		EndoRx (%)	Medical (%)			EndoRx (%)	Medical (%)
MR CLEAN	502	31.5	19	12.5	8	6*	5.2*
ESCAPE	316	53	29.3	23.7	4	3.6	2.7
SWIFT-Prime	196	60.2	35.5	24.7	4	1	3
EXTEND IA	70	71	40	31	3.2	6	0

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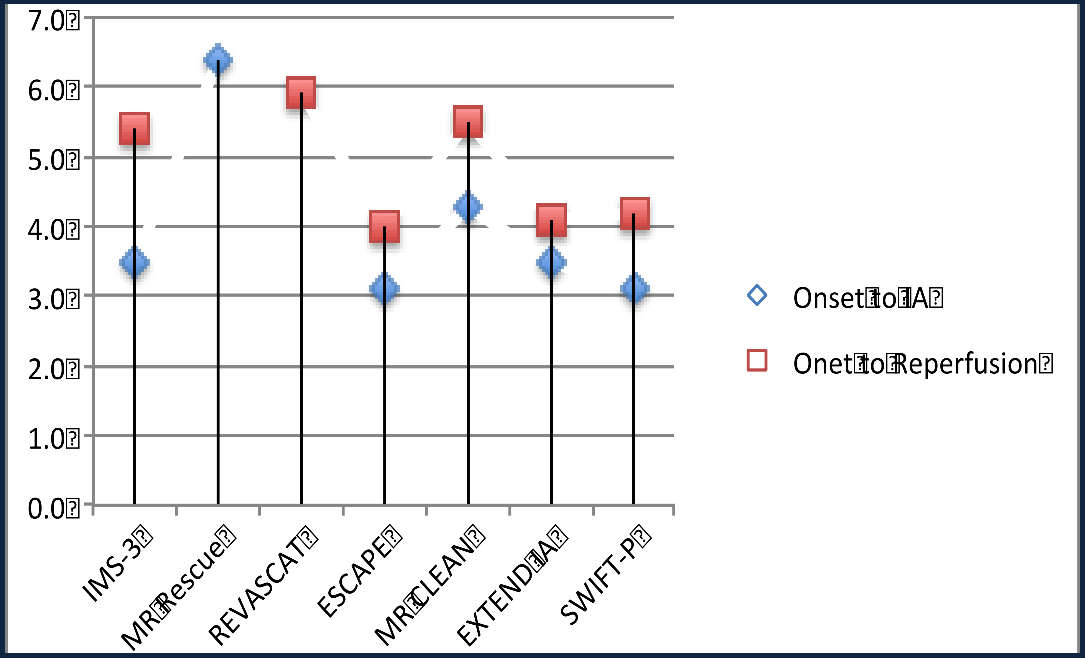
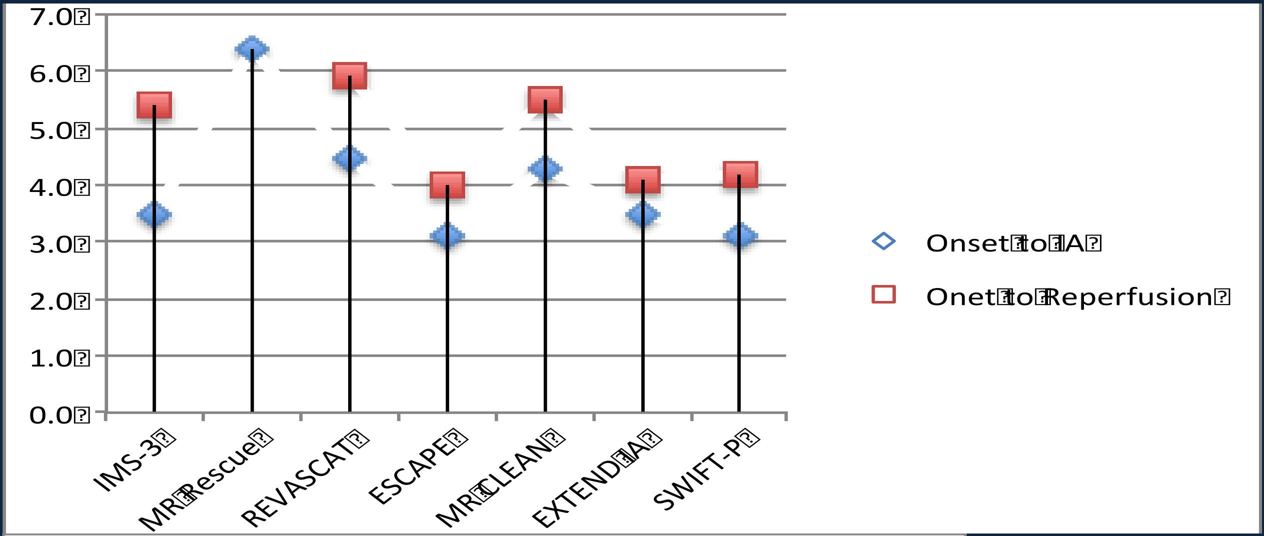
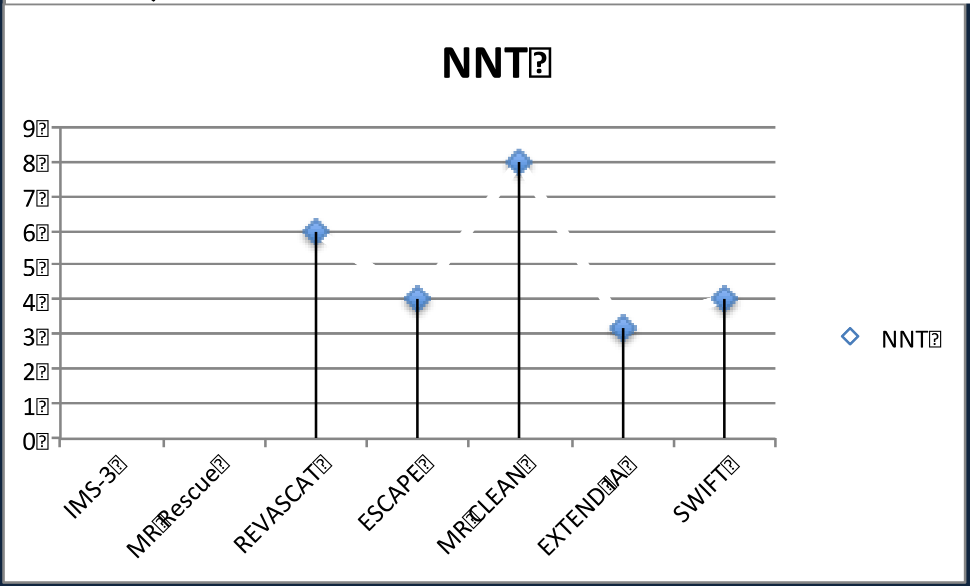
Key Factors for Success

1. Confirmed Proximal Occlusion: ICA, M1, M2
2. Faster Times to Reperfusion

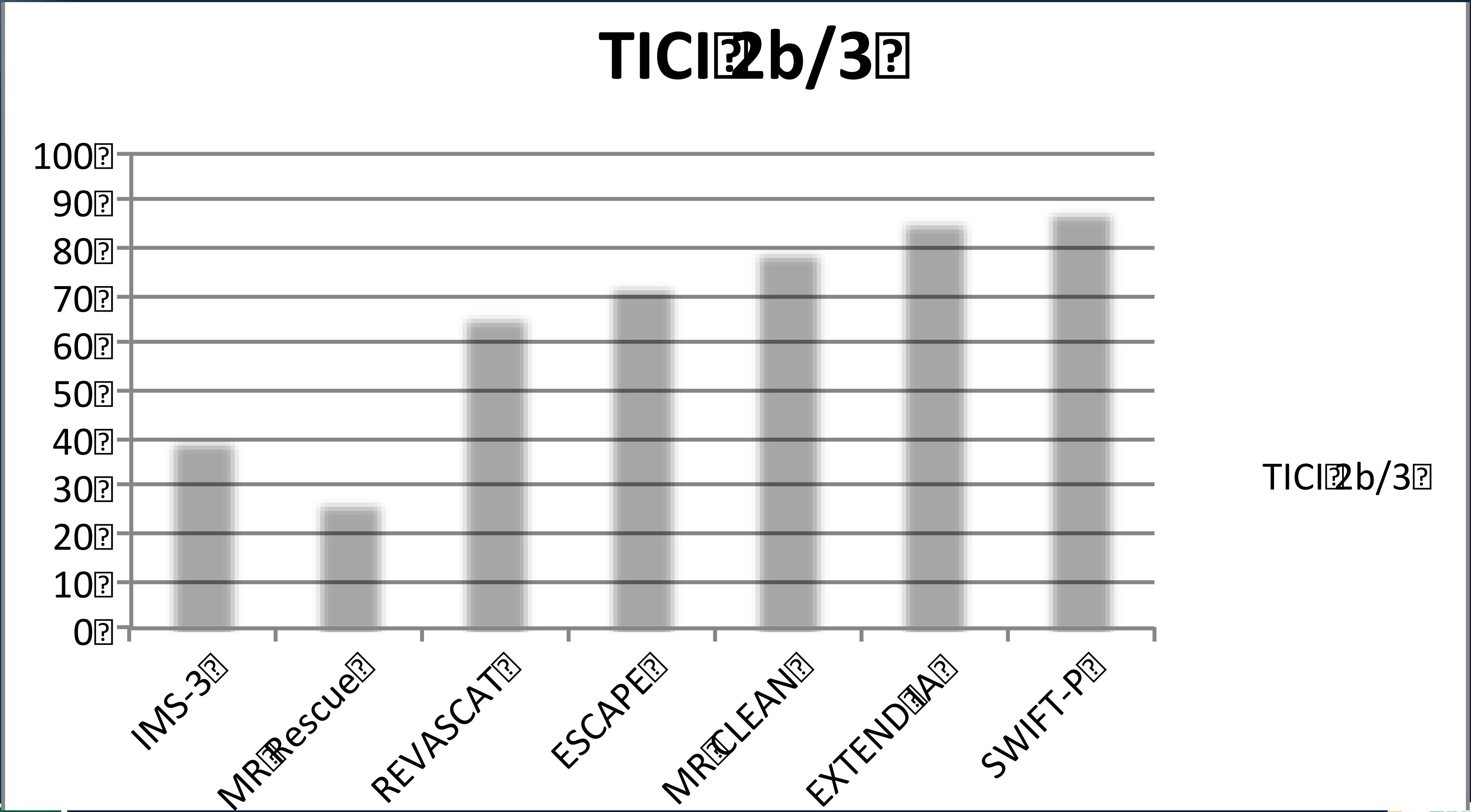


Workflow: Times to Intervention & NNT





3. Substantial Reperfusion: ≥TICI 2b/3



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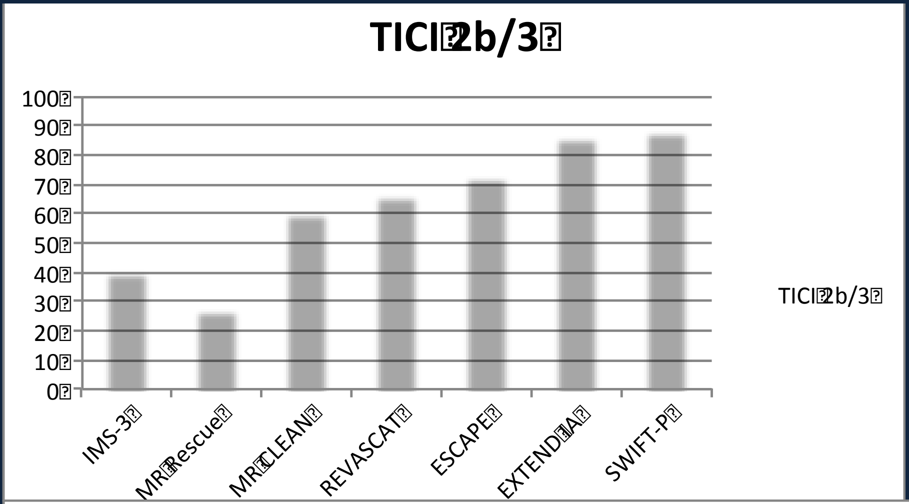
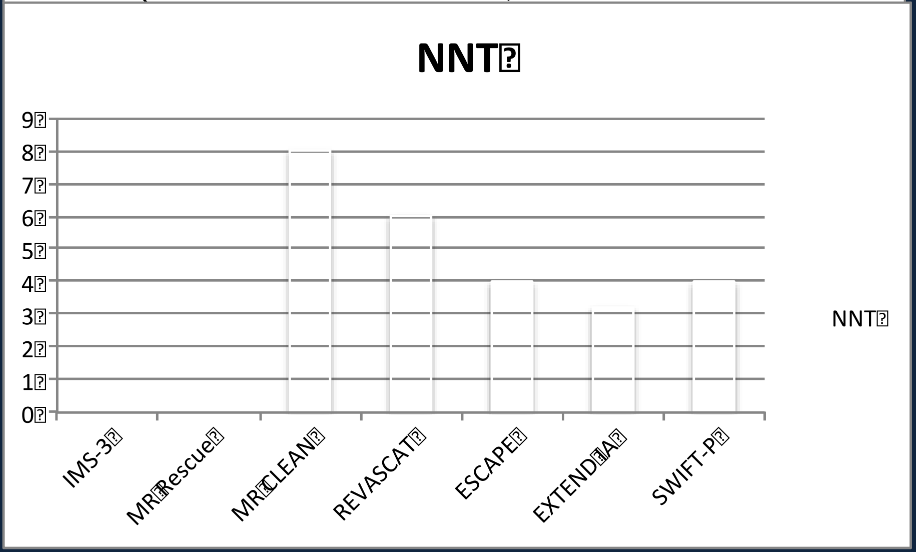
TICI 2b/3 rate & NNT





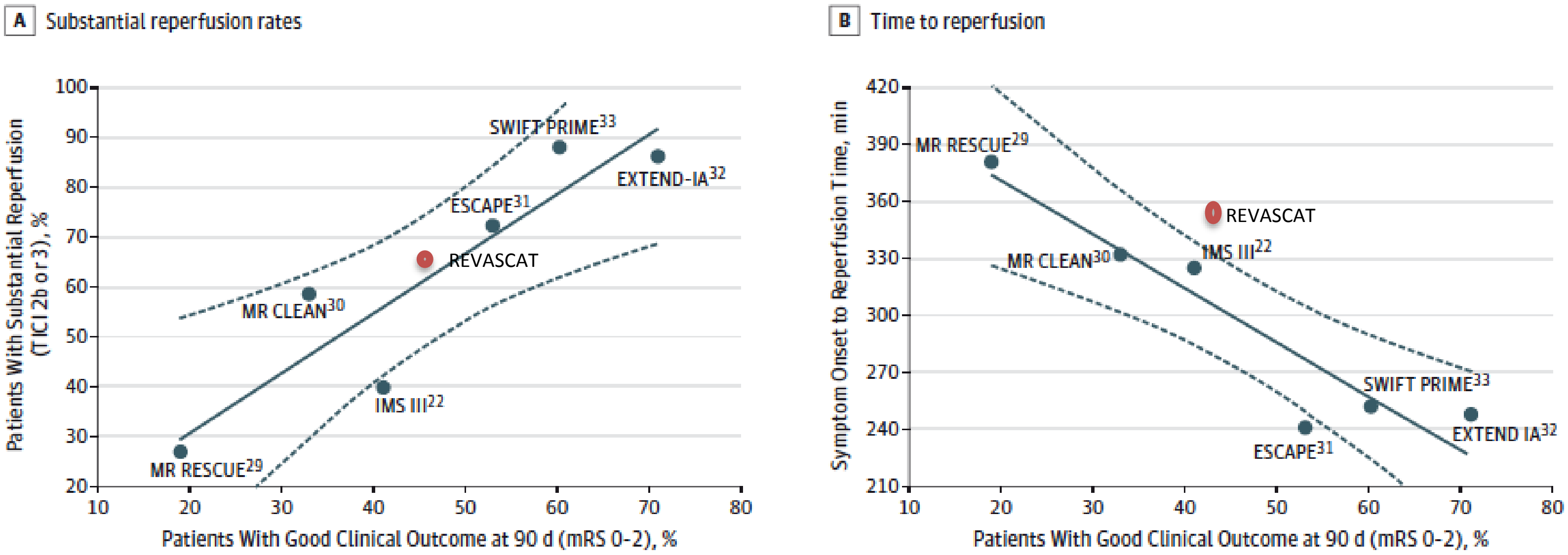
Review

Acute Stroke Interventi
A Systematic Review

JAMA. 2015;313(14):1451-1462. doi:10.1001/jama.2015.3058

Shyam Prabhakaran, MD, MS; Ilana Ruff, MD; Richard A. Bernstein, MD, PhD

Figure 3. Rate of Reperfusion and Time to Reperfusion Compared With Percentage of Good Outcomes in the 6 Trials Comparing Endovascular Treatment to Medical Treatment Alone



mRS indicates modified Rankin Scale; TICI, thrombolysis in cerebral infarction. The dotted lines indicate 95% CIs.

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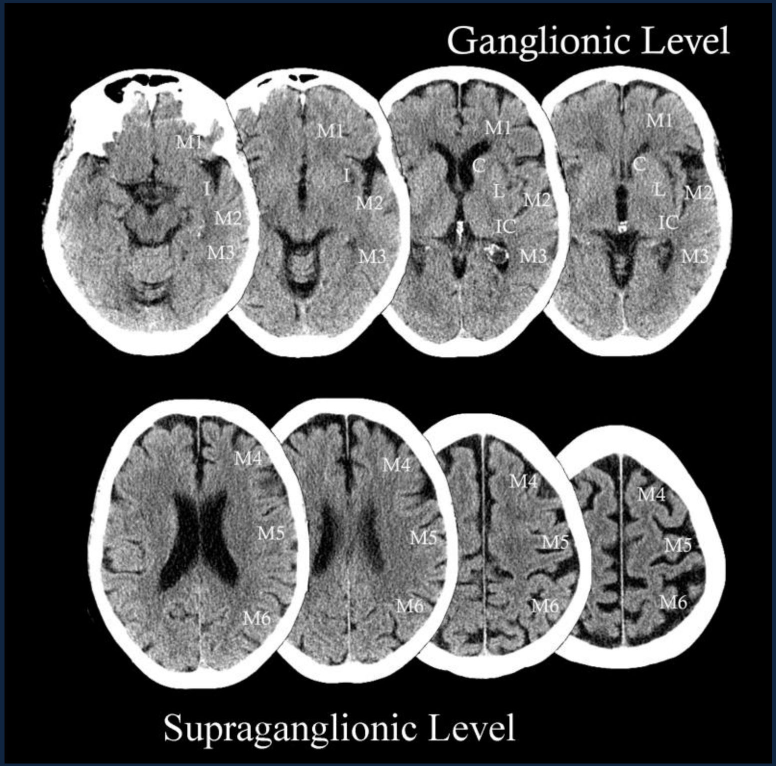
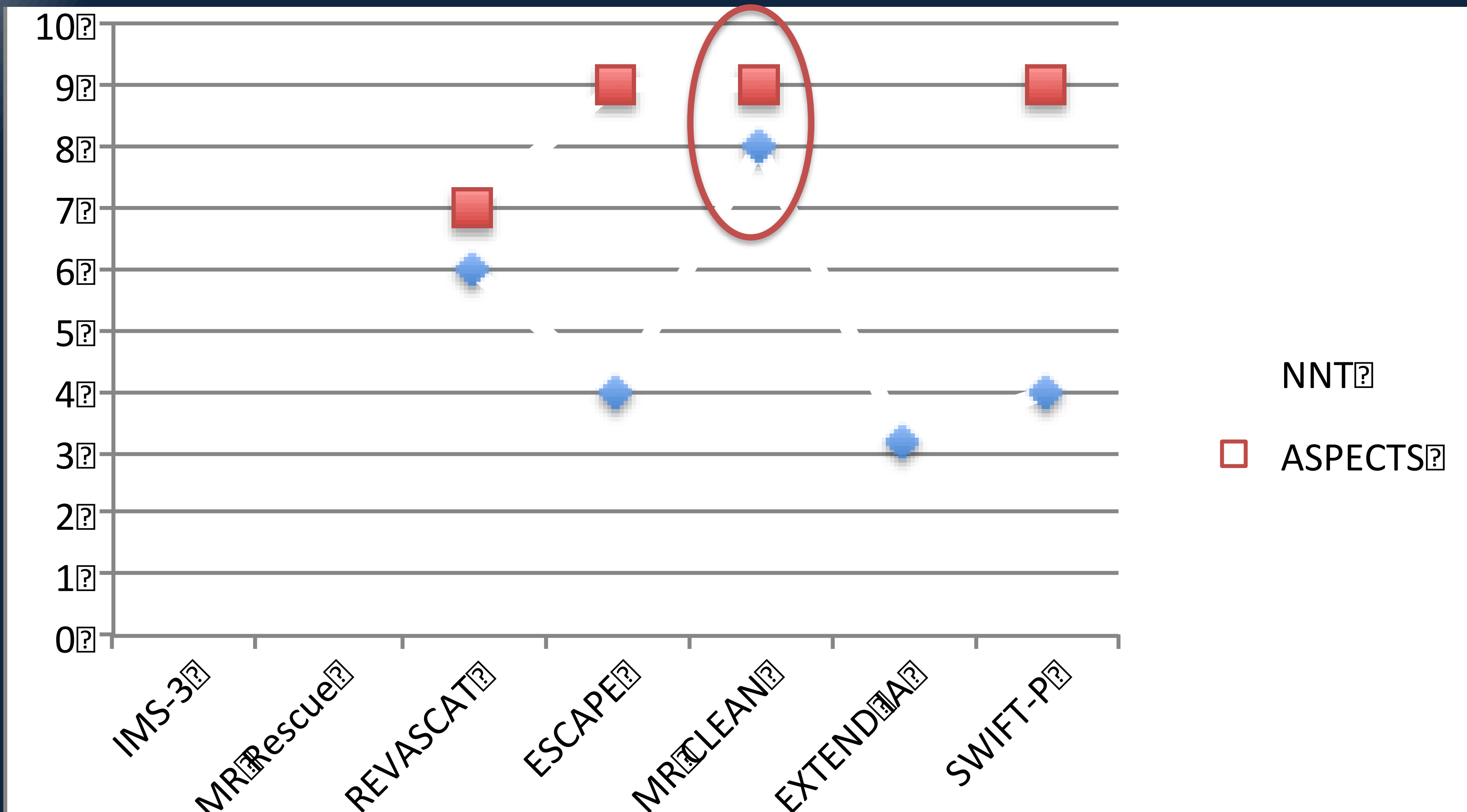
CT ASPECTS Score

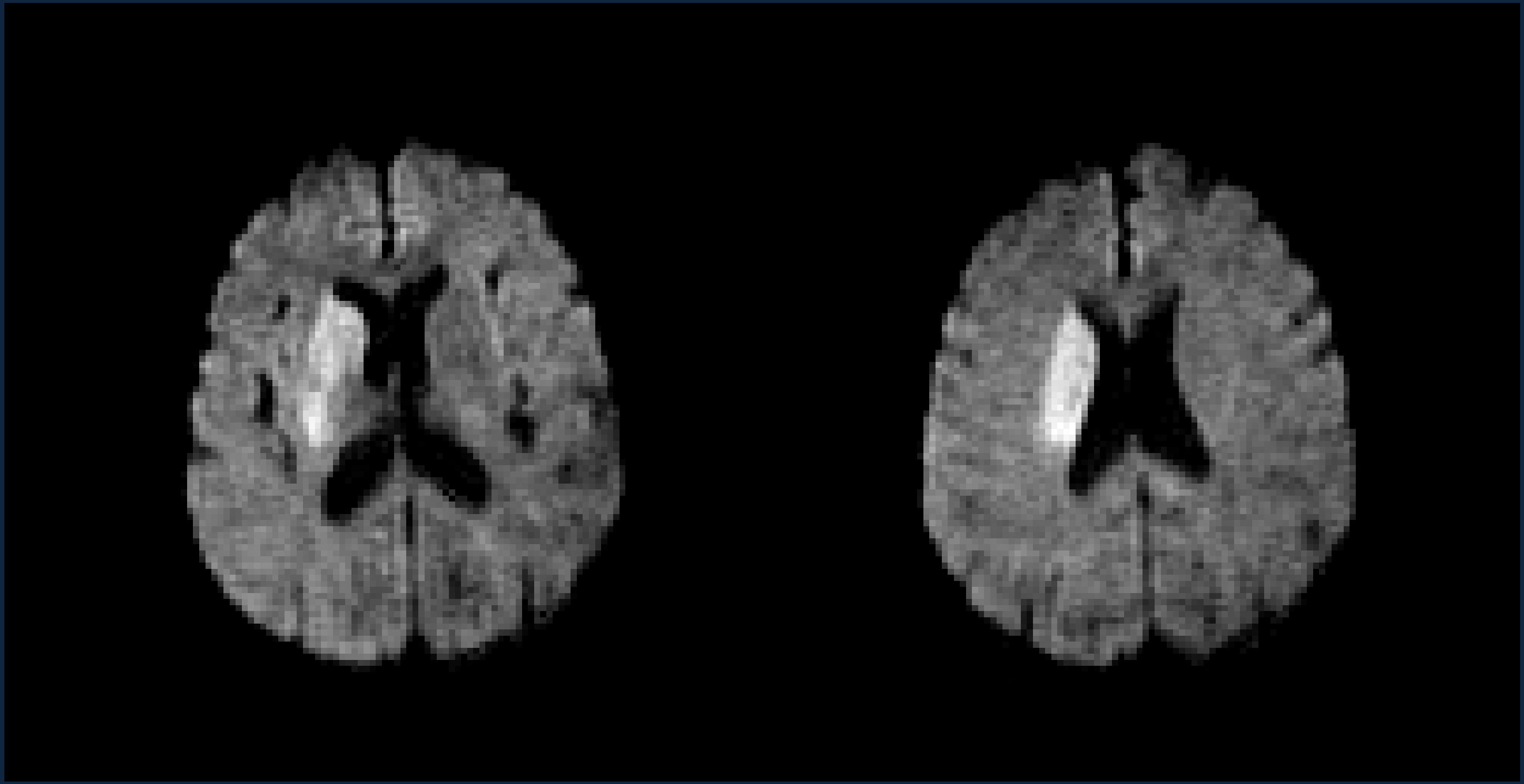
- Evaluation of two standardized regions of the MCA territory: the **basal ganglia level**, and the **supraganglionic level**
- All cuts at each level evaluated
- The abnormality should be visible on at least two consecutive cuts
- 1 point is subtracted from 10 for any evidence of early ischemic change for each of the defined regions.
- A normal CT scan: ASPECTS 10 points.
- Diffuse involvement throughout the MCA territory: ASPECTS score 0



Selection using ASPECTS



58 Y Hispanic M with acute RMCA syndrome at 5.5 h from symptom onset; NIHSS 13. DWI imaging



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S/p IV tPA at OSH. Left hemiplegia, gaze deviation.
RCCA angiogram at 6.5 h

issing flow in the
ight carotid artery

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“Stent-Retriever” Clot Retrieval Device

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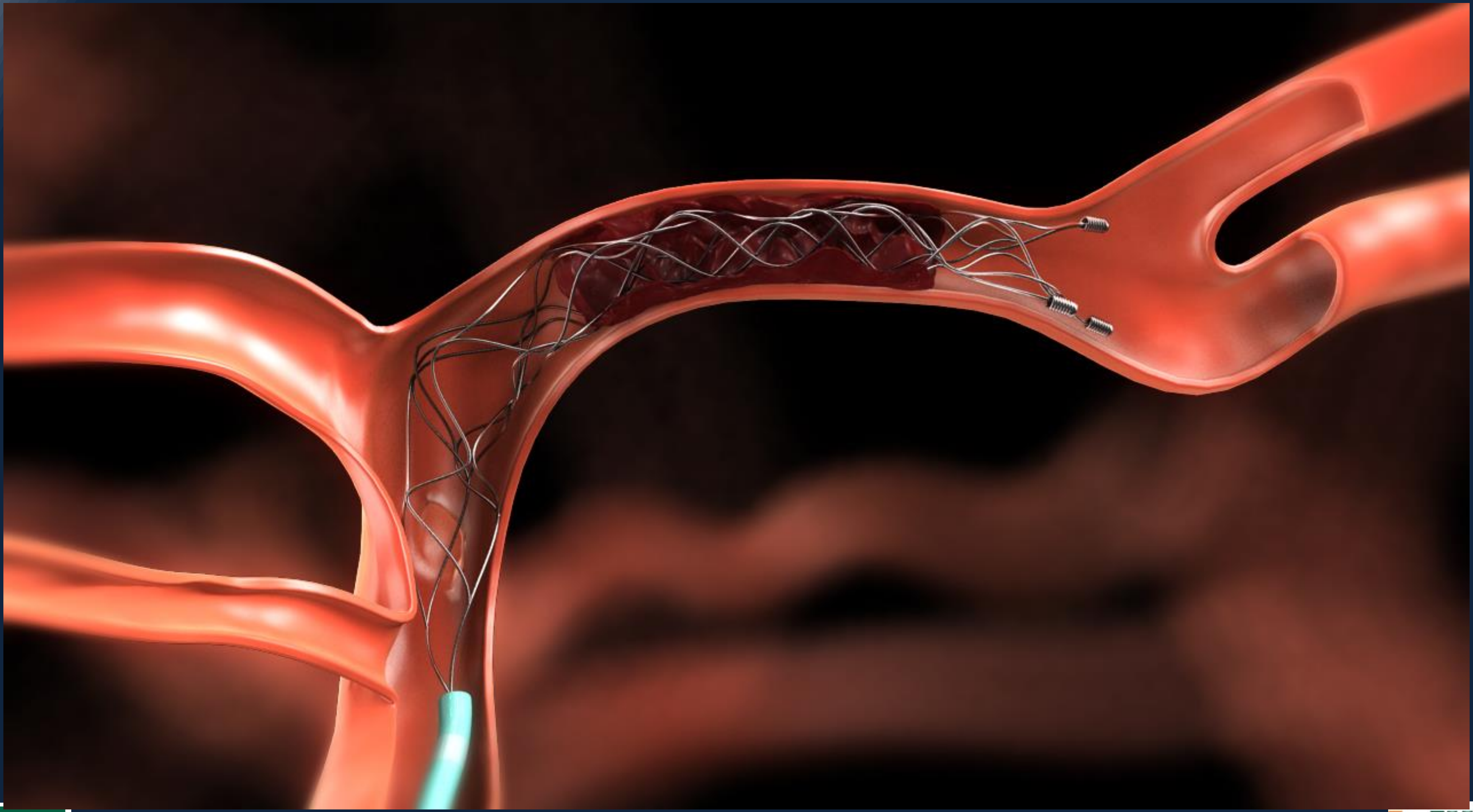
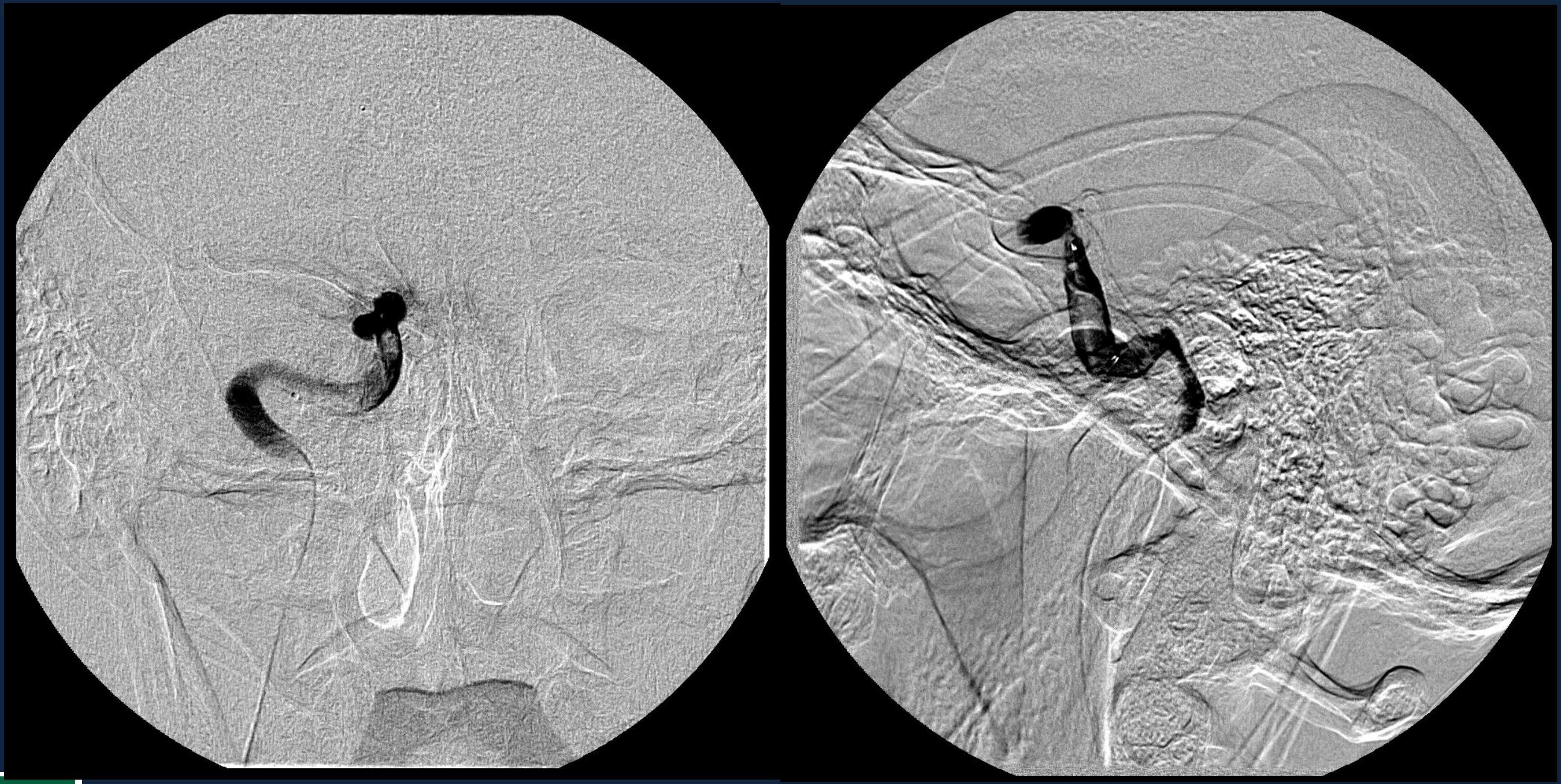
Stent like Thrombus Retrievers



Right Cavernous ICA Occlusion



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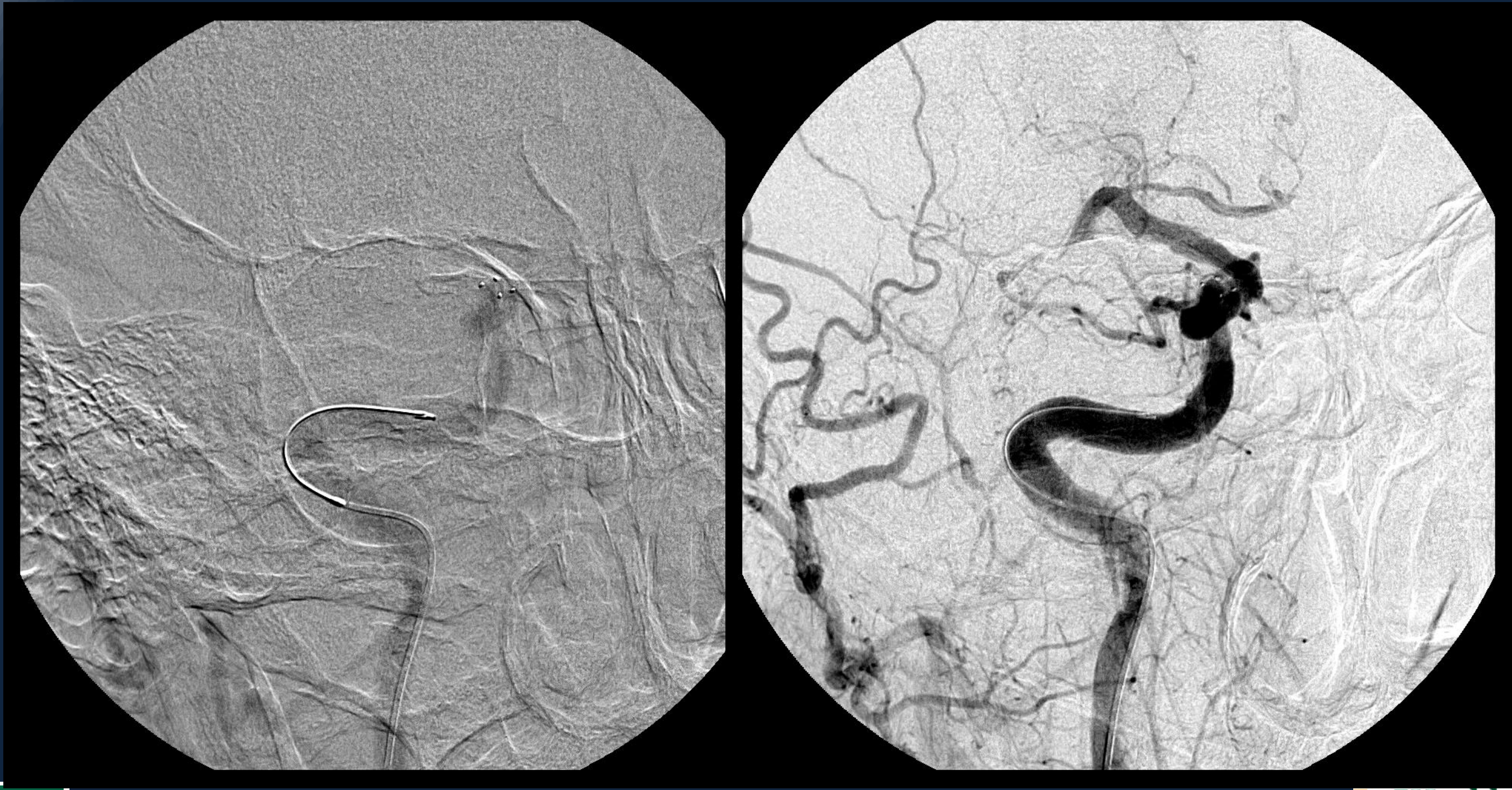
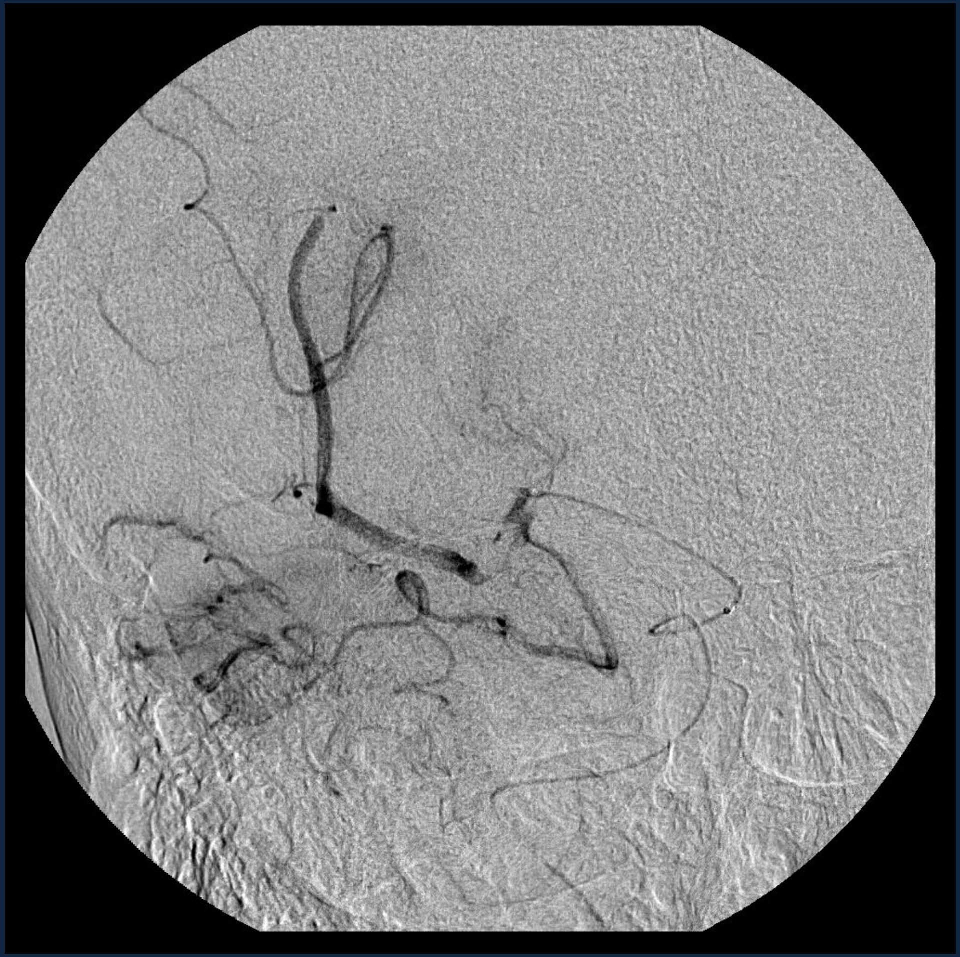
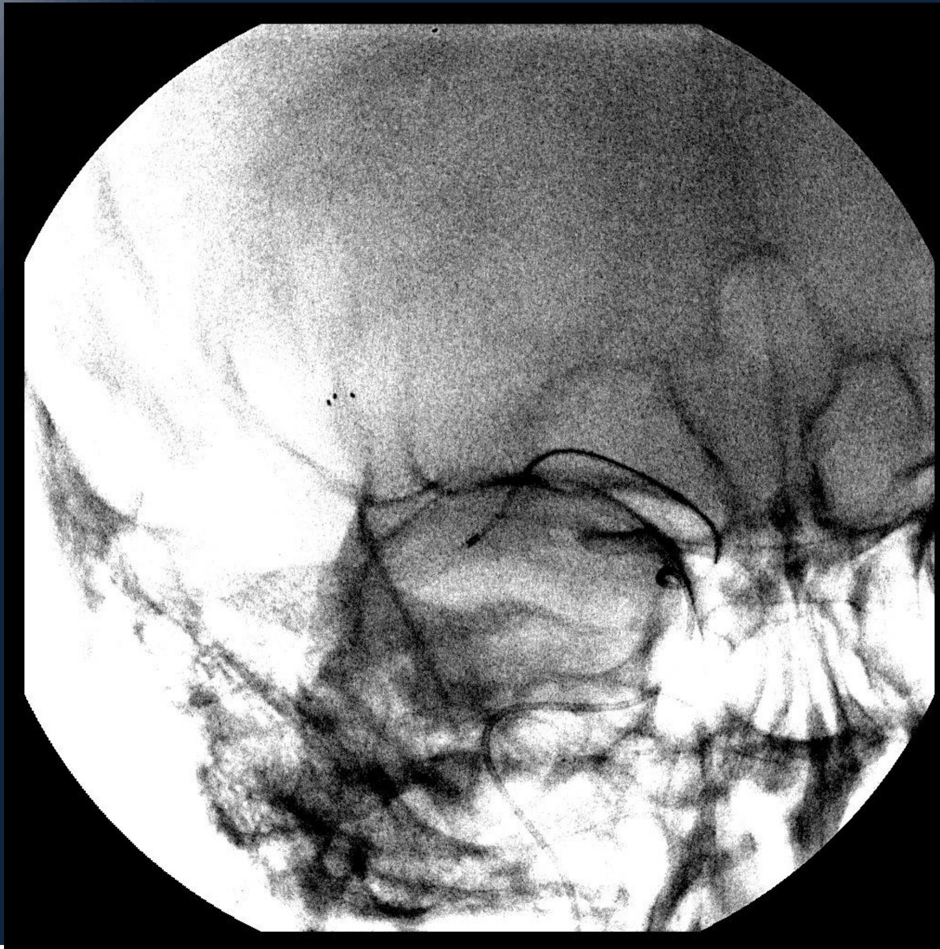
Thrombectomy with Stent-Retriever



Right MCA M1-M2 occlusion



Thrombectomy Device in R MCA



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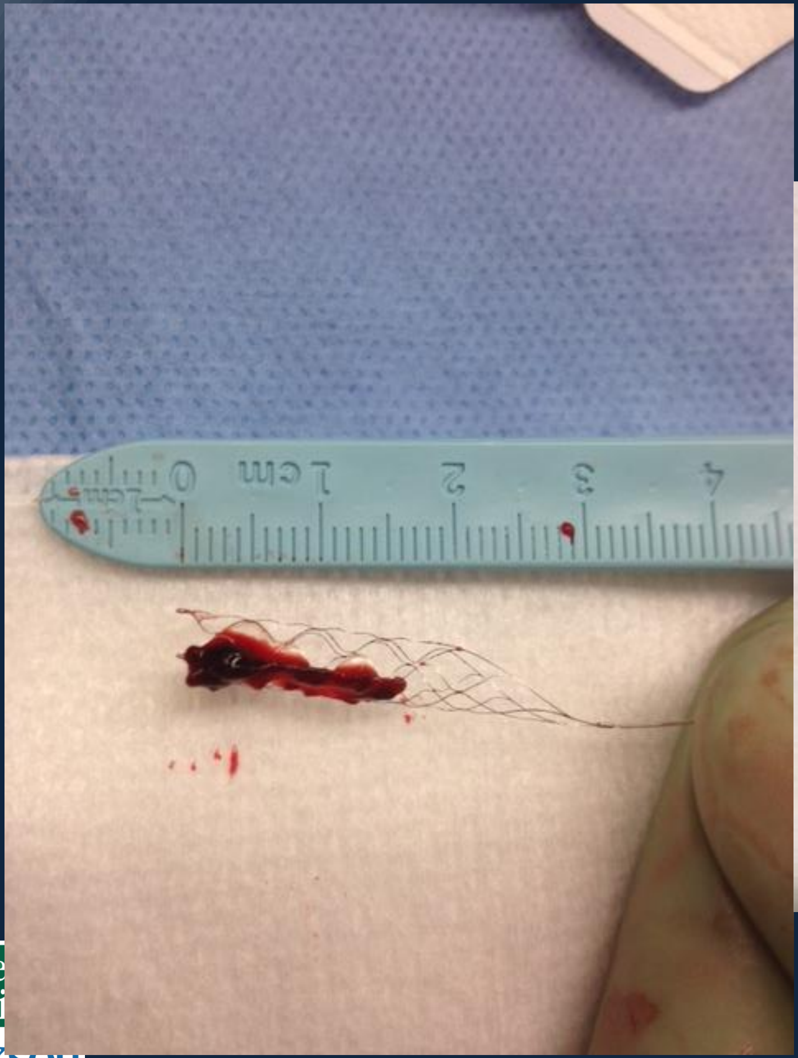
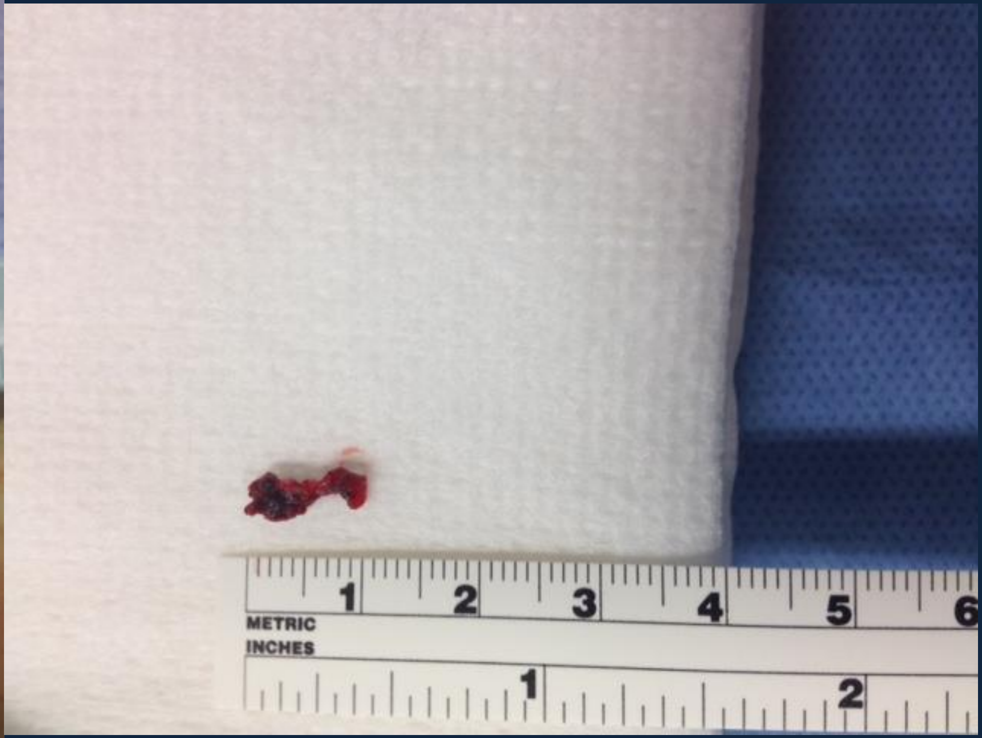
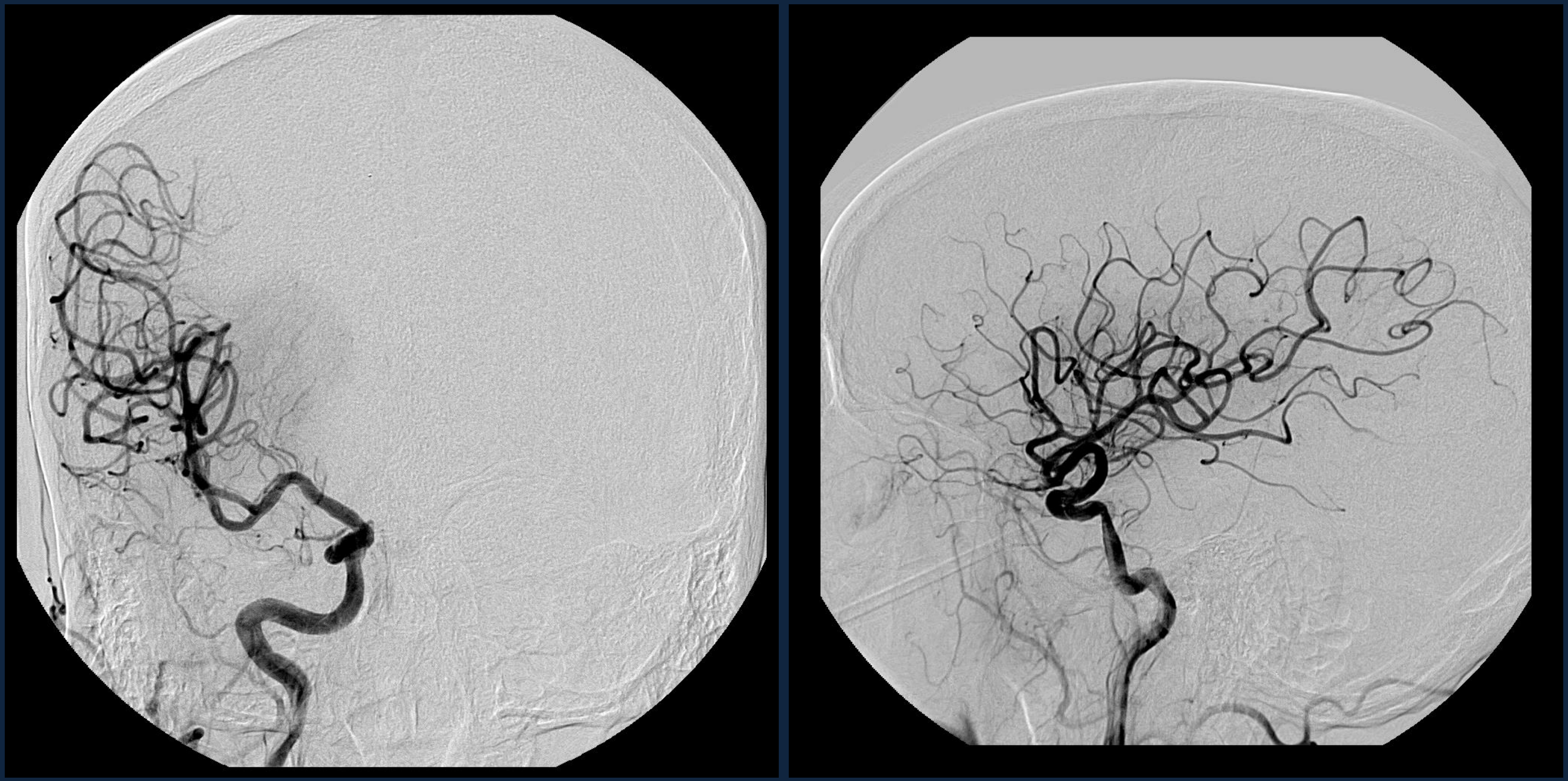
1 cm Thrombus on Thrombectomy Device





Complete Recanalization of RICA and MCA



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NIHSS recovered to 3 at 1 wk. NIHSS 2 at 6 wks.

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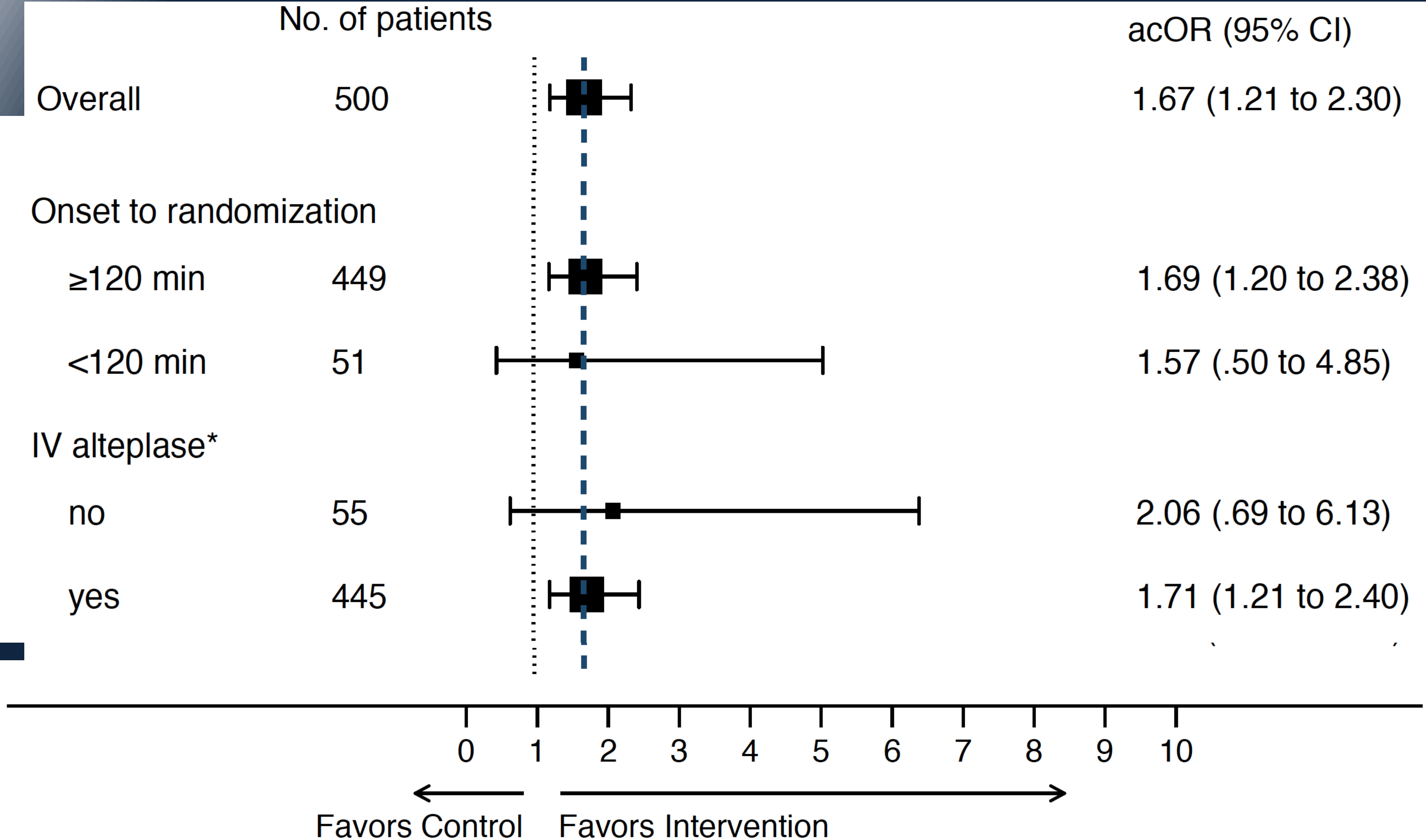
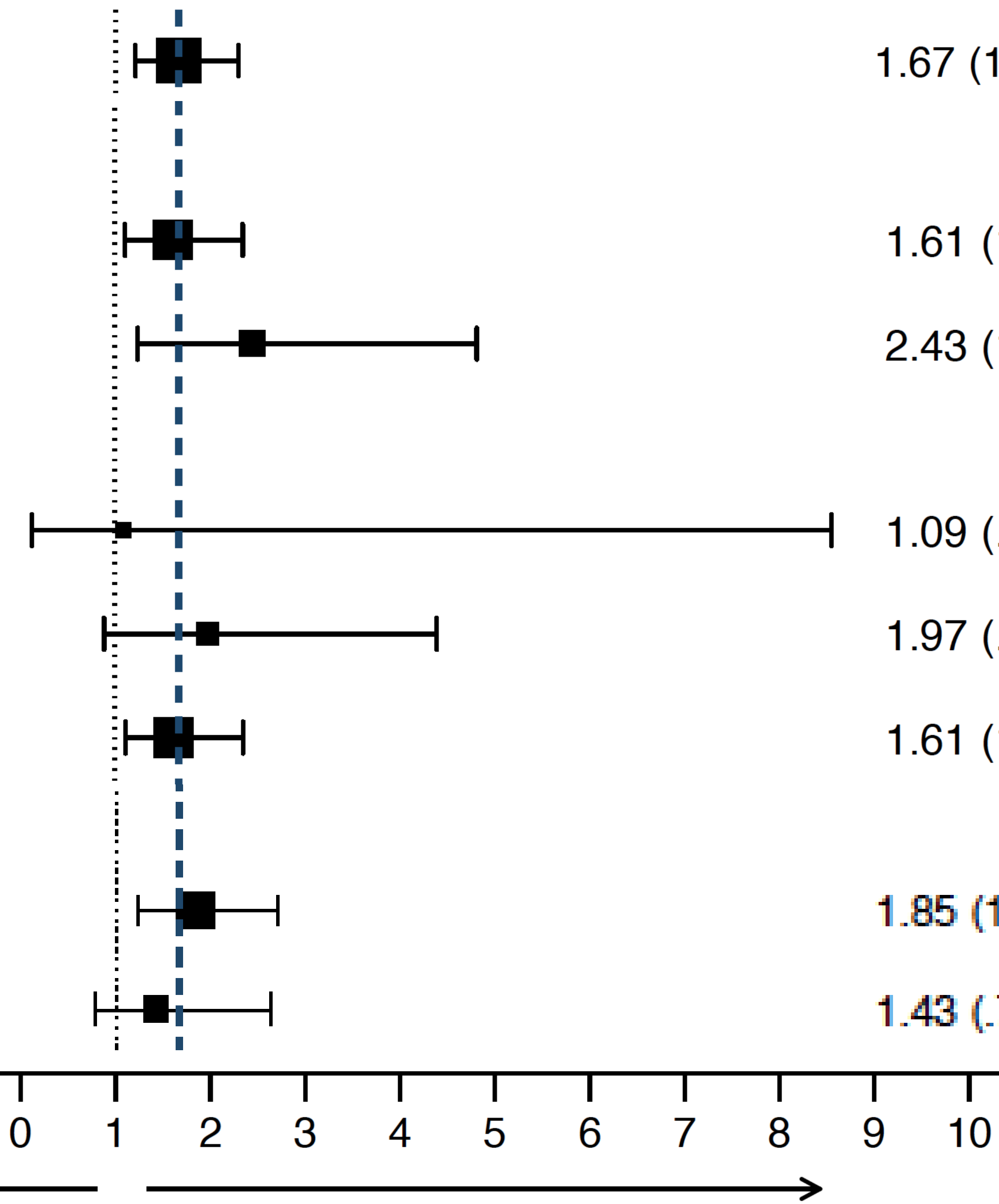
Subgroup analyses: time from onset and IV alteplase

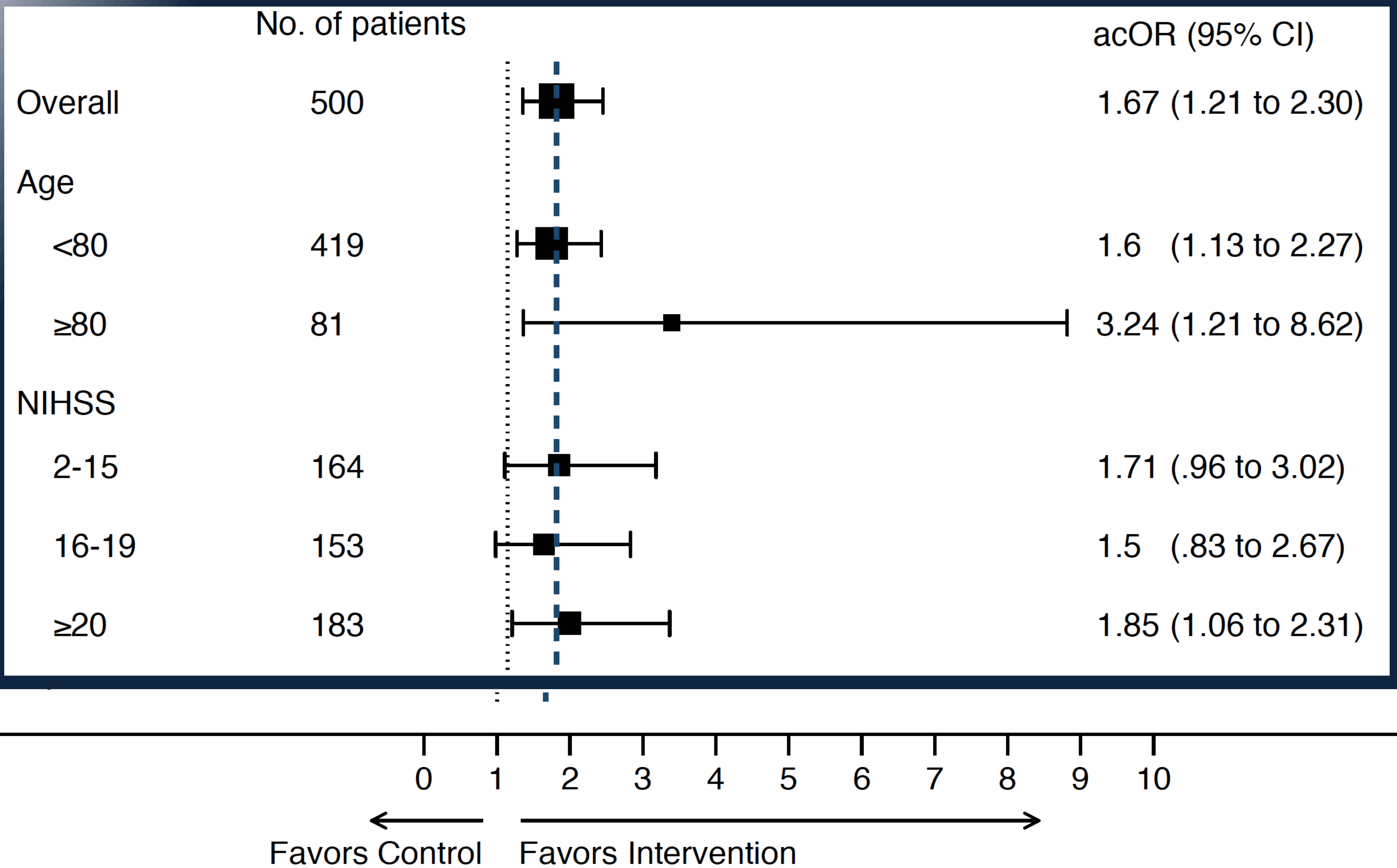


Subgroup analyses: neuro-imaging

	No. of patients	acOR (95% CI)
Overall	500	1.67 (1.21 to 2.30)
ICA terminus occlusion		
absent	366	1.61 (1.10 to 2.33)
present	134	2.43 (1.24 to 4.77)
ASPECTS		
0-4	28	1.09 (.14 to 8.46)
5-7	92	1.97 (.89 to 4.35)
8-10	376	1.61 (1.11 to 2.33)
Extracranial ICA occlusion^		
absent	354	1.85 (1.25 to 2.72)
present	146	1.43 (.77 to 2.64)

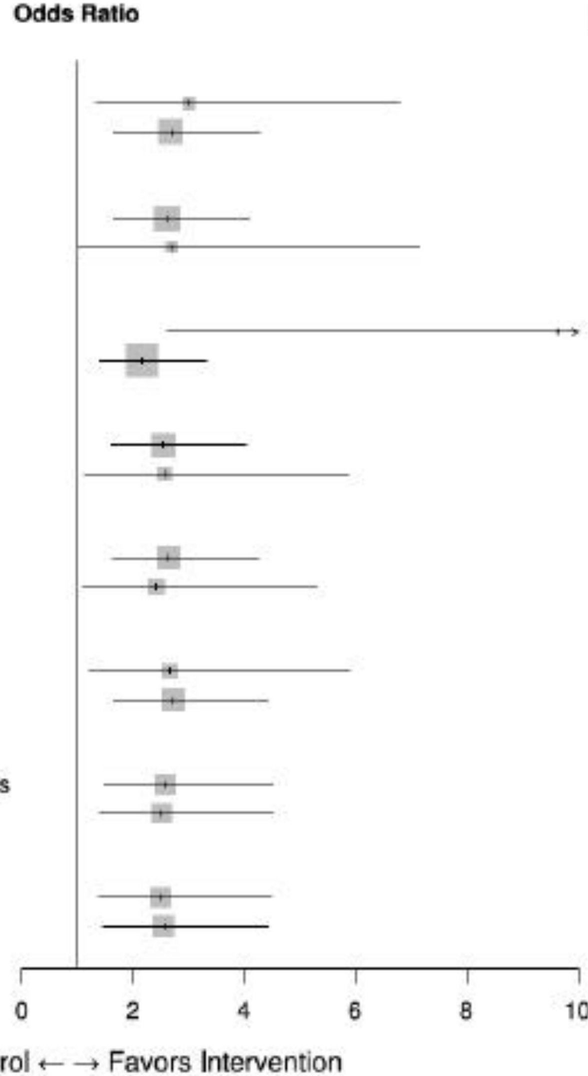


Subgroup analyses: Age and NIHSS



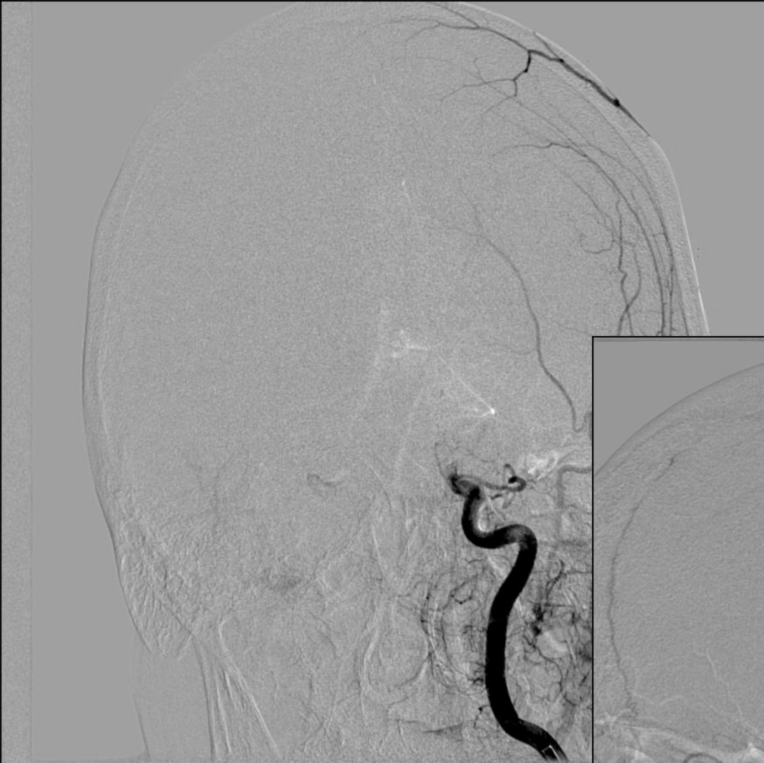
Sub-groups

Variable	Estimate	95% C.I.
Age		
Greater than 80 years	3.01	[1.34; 6.79]
Less than or equal to 80 years	2.67	[1.66; 4.30]
ASPECTS		
Score 8-10	2.61	[1.66; 4.09]
Score less than 8	2.69	[1.01; 7.16]
Cervical ICA Occlusion		
Yes	9.64	[2.62; 35.49]
No	2.15	[1.40; 3.30]
IV tPA		
Received	2.54	[1.60; 4.04]
Not Received	2.57	[1.12; 5.87]
NIHSS Baseline		
Score 6-19	2.64	[1.64; 4.25]
Score greater than 19	2.41	[1.10; 5.31]
Occlusion Location		
ICA T/L	2.65	[1.20; 5.88]
MCA (M1 or All M2s)	2.72	[1.67; 4.44]
Onset to Randomization Time		
Less than or equal to 180 minutes	2.59	[1.49; 4.53]
Greater than 180 minutes	2.51	[1.39; 4.53]
Sex		
Male	2.49	[1.38; 4.49]
Female	2.55	[1.46; 4.44]



89 Y F 5 h from symptom onset NIHSS 14, expressive aphasia, s/p I.V. tPA 0.6 mg/kg at 2.5h

Left terminal ICA occlusion, MERCI Thrombus Retrieval



Dileep R. Yavagal, MD

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cm firm thrombus retrieved
3 passes and 5 mg IA tPA

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Discharge NIHSS 1, mRS 1, no motor weakness, minimal speech difficulties.

Chronic Carotid Artery Stenosis: Evolving Endovascular Approaches

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Chronic Carotid Artery Stenosis : Evolving Endovascular Approaches

1. Endovascular Techniques for Carotid Stenosis Rx
2. CREST results
3. Guidelines for Treatment in Sympatomatic and Aysmptomatic Carotid Stenosis
4. Case Vignettes

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Carotid Stenosis: Advances in Techniques

59 year old gentleman with 2 episodes of transient left sided weakness : R Carotid Stenosis of 90%

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Carotid Stenting with Proximal Protection

Proximal protection Vs. Distal Protection: PROFI study

Bijuklic et al. Embolic Protection in Carotid Artery Stenting. JACC Vol. 59, No. x, 2012 Month 2012:000–000

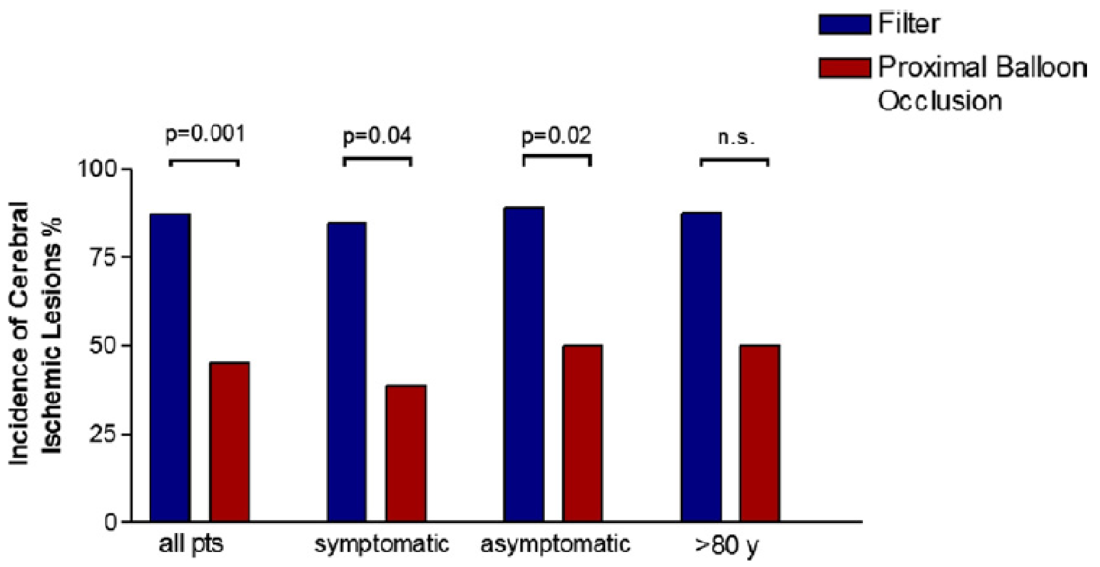

Figure 2 Incidence of New Ischemic Lesions in Patients With Filter Protection Versus Proximal Balloon Occlusion

In addition, symptomatic patients, asymptomatic patients, and patients >80 years of age are displayed.

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Carotid Revascularization Endartrectomy Vs Stenting Trial (CREST) Primary Results

Table 2. **Primary End Point, Components of the Primary End Point, and Other Events, According to Treatment Group.***

End Point	Periprocedural Period				
	CAS (N=1262)	CEA (N=1240)	Absolute Treatment Effect of CAS vs. CEA (95% CI)	Hazard Ratio for CAS vs. CEA (95% CI)	P Value
	no. of patients (% ±SE)		*percentage points*		
Death	9 (0.7±0.2)	4 (0.3±0.2)	0.4 (−0.2 to 1.0)	2.25 (0.69 to 7.30)†	0.18†
Stroke					
Any	52 (4.1±0.6)	29 (2.3±0.4)	1.8 (0.4 to 3.2)	1.79 (1.14 to 2.82)	0.01
Major ipsilateral	11 (0.9±0.3)	4 (0.3±0.2)	0.5 (−0.1 to 1.2)	2.67 (0.85 to 8.40)	0.09
Major nonipsilateral‡	0	4 (0.3±0.2)	NA	NA	NA
Minor ipsilateral	37 (2.9±0.5)	17 (1.4±0.3)	1.6 (0.4 to 2.7)	2.16 (1.22 to 3.83)	0.009
Minor nonipsilateral	4 (0.3±0.2)	4 (0.3±0.2)	0.0 (−0.4 to 0.4)	1.02 (0.25 to 4.07)	0.98†
Myocardial infarction	14 (1.1±0.3)	28 (2.3±0.4)	−1.1 (−2.2 to −0.1)	0.50 (0.26 to 0.94)	0.03
Any periprocedural stroke or postprocedural ipsilateral stroke	52 (4.1±0.6)	29 (2.3±0.4)	1.8 (0.4 to 3.2)	1.79 (1.14 to 2.82)	0.01
Major stroke	11 (0.9±0.3)	8 (0.6±0.2)	0.2 (−0.5 to 0.9)	1.35 (0.54 to 3.36)	0.52
Minor stroke	41 (3.2±0.5)	21 (1.7±0.4)	1.6 (0.3 to 2.8)	1.95 (1.15 to 3.30)	0.01
Any periprocedural stroke or death or post-procedural ipsilateral stroke	55 (4.4±0.6)	29 (2.3±0.4)	2.0 (0.6 to 3.4)	1.90 (1.21 to 2.98)	0.005
Primary end point (any periprocedural stroke, myocardial infarction, or death or postprocedural ipsilateral stroke)	66 (5.2±0.6)	56 (4.5±0.6)	0.7 (−1.0 to 2.4)	1.18 (0.82 to 1.68)	0.38

CREST: Periprocedural Stroke (30-days)

Table 3. **Primary End Point and Its Individual Components among the 1181 Asymptomatic and the 1321 Symptomatic Patients, According to Treatment Group.***

End Point	Periprocedural Period					4-Yr Study Period (Including Periprocedural Period)				
	CAS	CEA	Absolute Treatment Effect of CAS vs. CEA (95% CI)	Hazard Ratio for CAS vs. CEA (95% CI)	P Value	CAS	CEA	Absolute Treatment Effect of CAS vs. CEA (95% CI)	Hazard Ratio for CAS vs. CEA (95% CI)	P Value
	no. of patients (% ±SE)		*percentage points*			*no. of patients (% ±SE)*		*percentage points*		
Myocardial infarction										
Asymptomatic patients	7 (1.2±0.4)	13 (2.2±0.6)	−1.0 (−2.5 to 0.4)	0.55 (0.22 to 1.38)	0.20					
Symptomatic patients	7 (1.0±0.4)	15 (2.3±0.6)	−1.2 (−2.6 to 0.1)	0.45 (0.18 to 1.11)	0.08					
Any periprocedural stroke or postprocedural ipsilateral stroke										
Asymptomatic patients	15 (2.5±0.6)	8 (1.4±0.5)	1.2 (−0.4 to 2.7)	1.88 (0.79 to 4.42)	0.15	24 (4.5±0.9)	13 (2.7±0.8)	1.9 (−0.5 to 4.3)	1.86 (0.95 to 3.66)	0.07
Symptomatic patients	37 (5.5±0.9)	21 (3.2±0.7)	2.3 (0.1 to 4.5)	1.74 (1.02 to 2.98)	0.04	48 (7.6±1.1)	37 (6.4±1.1)	1.2 (−1.8 to 4.1)	1.29 (0.84 to 1.98)	0.25
Any periprocedural stroke or death or postprocedural ipsilateral stroke										
Asymptomatic patients	15 (2.5±0.6)	8 (1.4±0.5)	1.2 (−0.4 to 2.7)	1.88 (0.79 to 4.42)	0.15	24 (4.5±0.9)	13 (2.7±0.8)	1.9 (−0.5 to 4.3)	1.86 (0.95 to 3.66)	0.07
Symptomatic patients	40 (6.0±0.9)	21 (3.2±0.7)	2.8 (0.5 to 5.0)	1.89 (1.11 to 3.21)	0.02	51 (8.0±1.1)	37 (6.4±1.1)	1.6 (−1.4 to 4.6)	1.37 (0.90 to 2.09)	0.14
Primary end point (any periprocedural stroke, myocardial infarction, or death or postprocedural ipsilateral stroke)										
Asymptomatic patients	21 (3.5±0.8)	21 (3.6±0.8)	0.0 (−2.2 to 2.1)	1.02 (0.55 to 1.86)	0.96	30 (5.6±1.0)	26 (4.9±1.0)	0.7 (−2.1 to 3.4)	1.17 (0.69 to 1.98)	0.56
Symptomatic patients	45 (6.7±1.0)	35 (5.4±0.9)	1.4 (−1.2 to 3.9)	1.26 (0.81 to 1.96)	0.30	55 (8.6±1.1)	50 (8.4±1.2)	0.2 (−3.0 to 3.4)	1.08 (0.74 to 1.59)	0.69

CREST: Conclusions

In conclusion, carotid revascularization performed by highly qualified surgeons and interventionists is effective and safe. Stroke was more likely after carotid-artery stenting. Myocardial infarction was more likely after carotid endarterectomy, but the effect on the quality of life was less than the effect of stroke. Younger patients had slightly fewer events after carotid-artery stenting than after carotid endarterectomy; older patients had fewer events after carotid endarterectomy. The low absolute risk of recurrent stroke suggests that both carotid-artery stenting and carotid endarterectomy are clinically durable and may also reflect advances in medical therapy.

operators are **experienced**, having successfully performed the procedures in **20 cases** with proper technique and a **low complication rate** based on independent neurological evaluation before and after each procedure.

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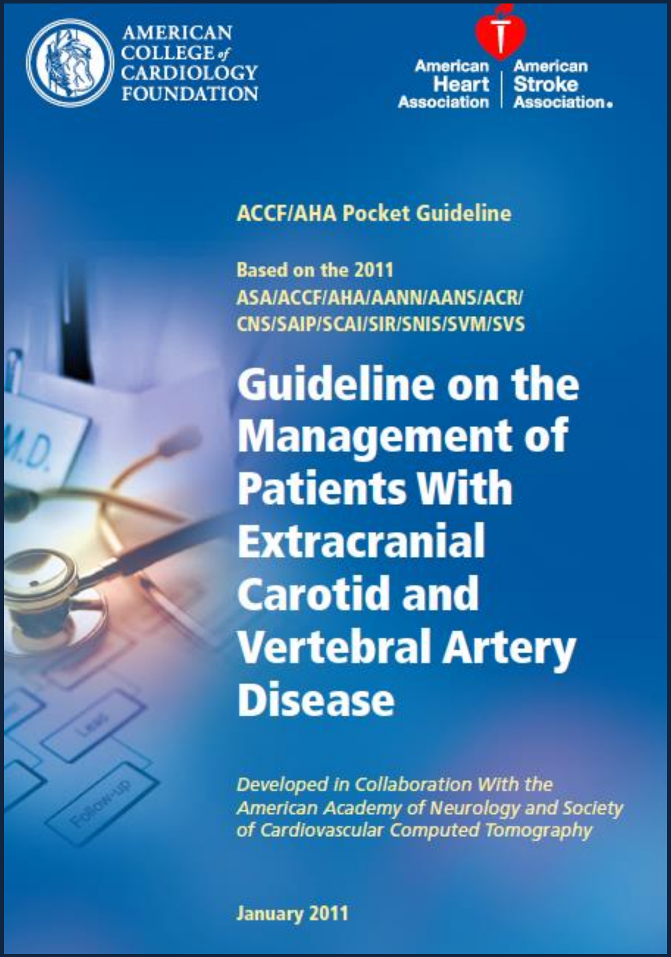
Specialty and Primary Endpoint

Specialty	HR (95% CI) Crude	HR (95% CI) adjust for age, sex , sx status
Cardiology	Reference	Reference
Neuroradiology/Neurointerventionist	1.37 (0.69-2.72)	1.27 (0.63-2.54)
Interventional Radiology	0.83 (0.37-1.86)	0.72 (0.32-1.63)
Vascular Surgery	1.02 (0.52-2.00)	1.18 (0.60-2.31)
Neurosurgery	1.72 (0.91-3.28)	1.49 (0.76-2.89)
p-value for difference	0.344	0.505


ACCF/AHA Pocket Guideline

Based on the 2011
ASA/ACCF/AHA/AANN/AANS/ACR/
CNS/SAIP/SCAI/SIR/SNIS/SVM/SVS

Guideline on the Management of Patients With Extracranial Carotid and Vertebral Artery Disease

Developed in Collaboration With the American Academy of Neurology and Society of Cardiovascular Computed Tomography

January 2011

Carotid Revascularization Level 1 Guidelines 2011

Class I

1. Patients at average or low surgical risk who experience nondisabling ischemic stroke[2] or transient cerebral ischemic symptoms, including hemispheric events or amaurosis fugax, within 6 months (symptomatic patients) should undergo carotid endarterectomy (CEA) if the diameter of the lumen of the ipsilateral internal carotid artery is reduced more than 70%[3] as documented by noninvasive imaging (Level of Evidence A) or more than 50% as documented by catheter angiography (Level of Evidence B) and the anticipated rate of perioperative stroke or mortality is less than 6%

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Carotid Revascularization Guidelines 2011

2. Carotid artery stenting (CAS) is indicated as an alternative to CEA for symptomatic patients at average or low risk of complications associated with endovascular intervention when the diameter of the lumen of the internal carotid artery is reduced by more than 70% as documented by noninvasive imaging or more than 50% as documented by catheter angiography and the anticipated rate of periprocedural stroke or mortality is less than 6%. (Level of Evidence: B)

3. Selection of asymptomatic patients for carotid revascularization should be guided by assessment of comorbid conditions, life expectancy, and other individual factors and should include a thorough discussion of the risks and benefits of the procedure with an understanding of patient preferences. (Level of Evidence: C)

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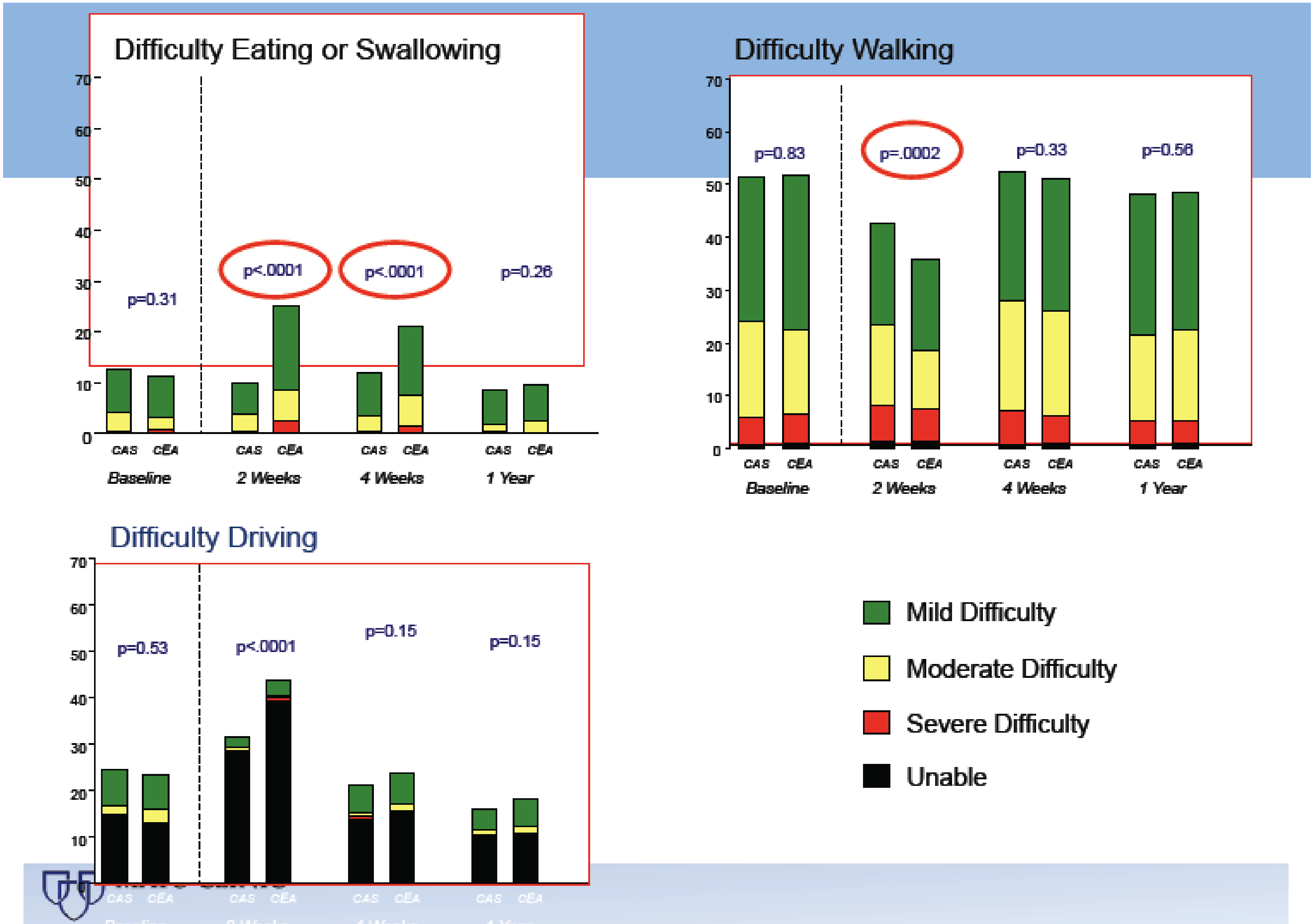
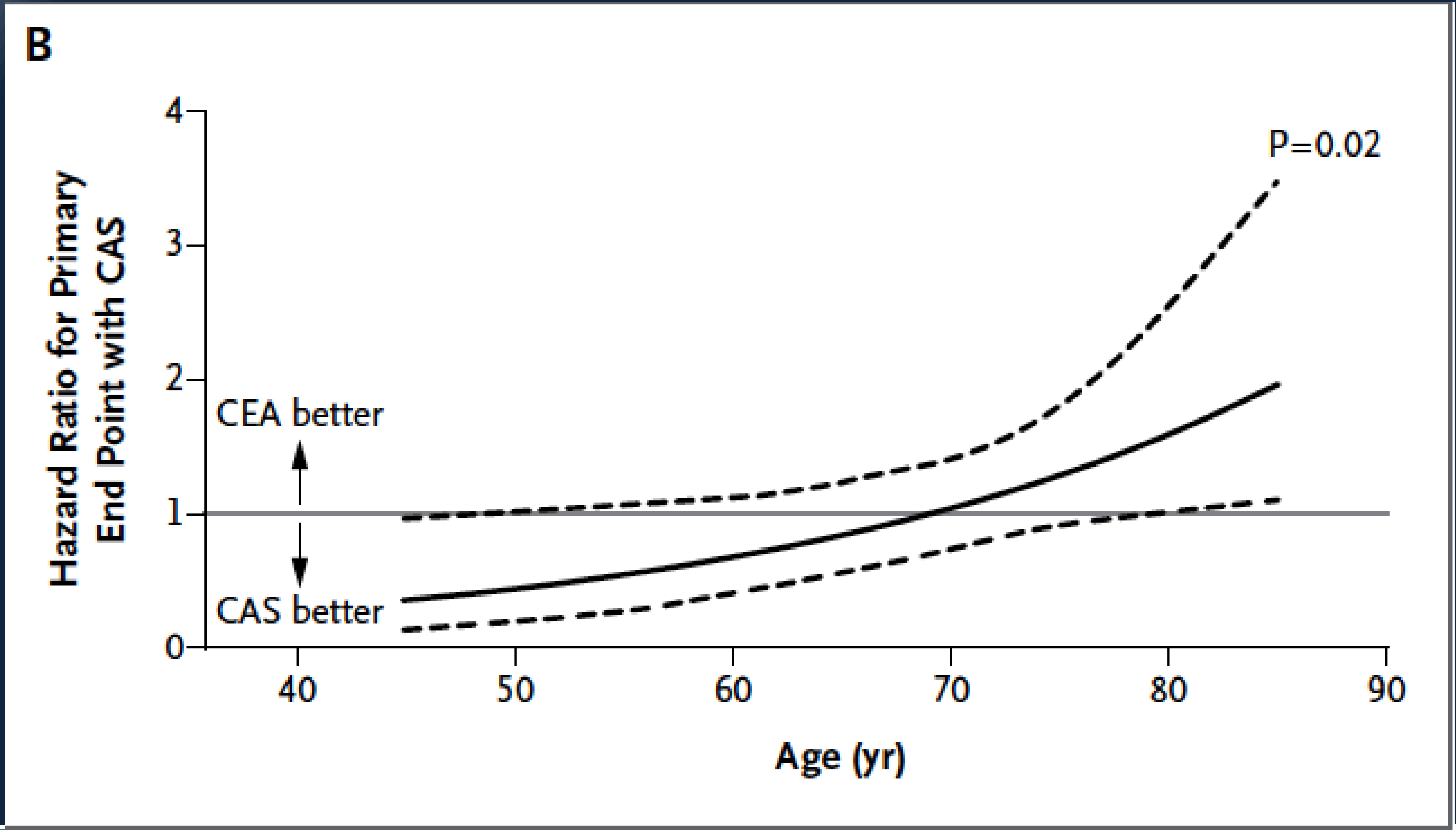
Impact of Periprocedural Stroke and Cranial Nerve Palsies

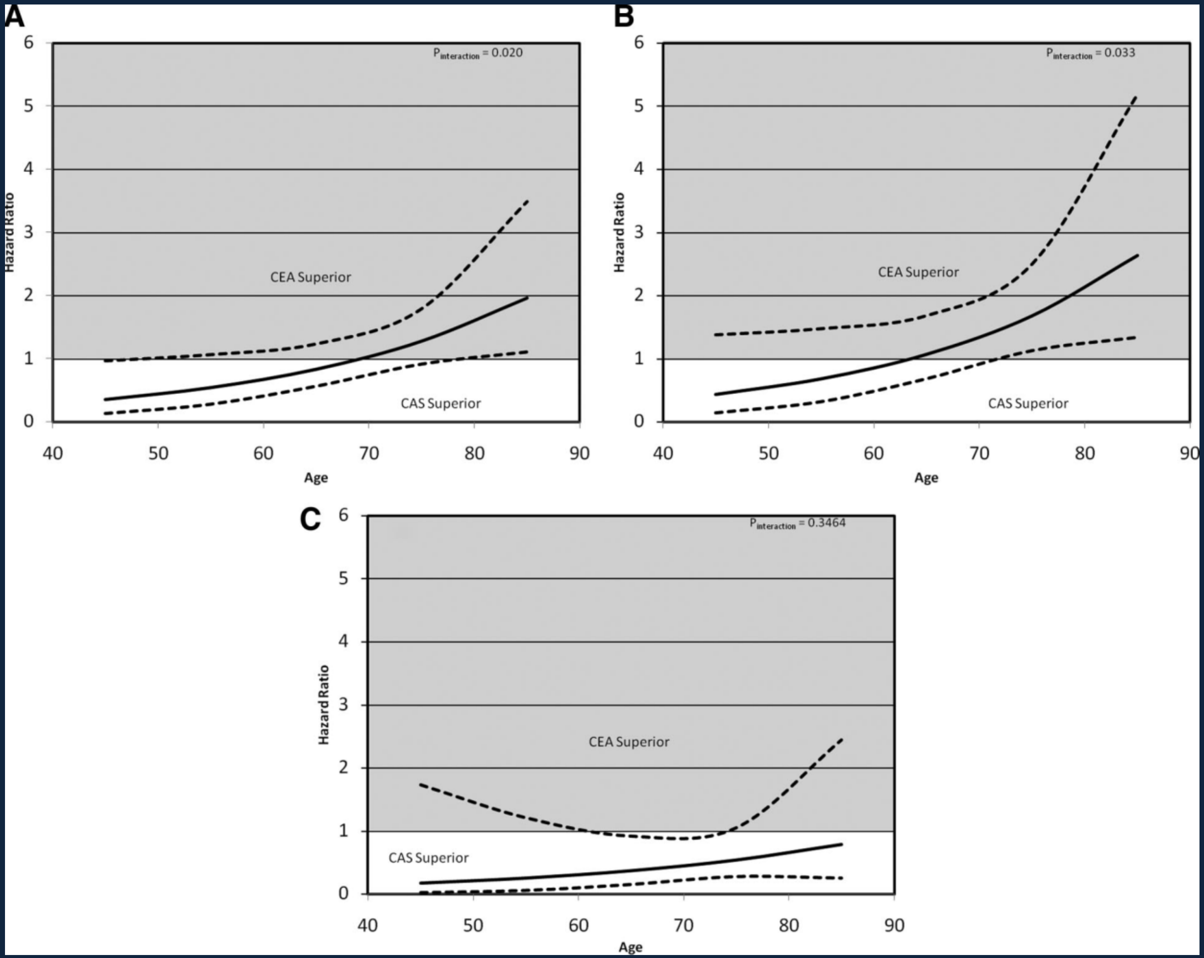


Slide Courtesy: Dr. Tom Brott, MD

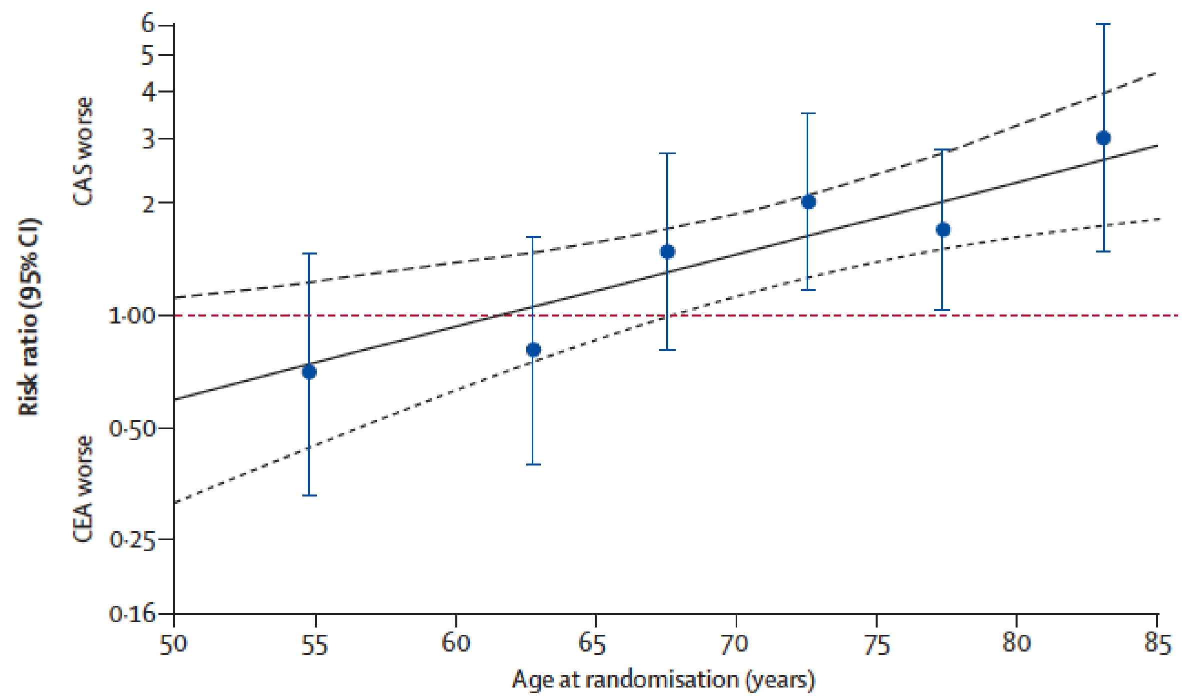
Patient Selection: Age > 70 years has significant impact



Age and Periprocedural Stroke and MI: Effect Driven By Stroke



Impact of Age: Meta-analysis (EVA-S3, SPACE, ICSS)



Age group (years)	<60	60–64	65–69	70–74	75–79	≥80
CAS events	11	14	25	41	35	27
CEA events	16	16	16	17	24	10

Figure 7: Treatment risk ratios of any stroke or death within 120 days of randomisation by age (both continuous and by age groups)

Patient Selection: Angio- Anatomic

Image courtesy Dr. Tom Brott, MD

Patient Selection: Angio-anatomy

	N Studies	N Patients	Pooled RR (95% IC) for Stroke or death	RR (95% CI)	I²	P (Het)	P (Sig)
Anatomical factors							
Type III aortic arch	2	488		1.82 (0.97-3.41)	0	0.81	0.06
Left vs right side	5	9384		1.29 (1.05-1.58)	26.55	0.24	0.02
Increased ICA-CCA angulation	2	406		3.41 (1.52-7.63)	45.13	0.18	<0.001
Aortic arch calcification	2	341		1.80 (0.74-4.37)	22.00	0.26	0.19
Contralateral ICA occlusion	8	4050		0.83 (0.48-1.44)	0	0.88	0.50
Target stenosis							
Lesion length > 10mm	3	634		2.36 (1.28-3.38)	14.36	0.31	0.01
Calcification	5	1334		1.62 (0.99-2.64)	0	0.67	0.05
Ostial location	2	781		1.75 (0.99-3.11)	0	0.54	0.06
Stenosis≥90% (NASCET)	5	4547		1.29 (0.64-2.58)	70.87	0.01	0.88
Ulceration	3	906		1.73 (0.64-4.69)	53.81	0.11	0.15
Technical factors							
Cerebral protection	23	15702		0.55 (0.41-0.73)	40.67	0.02	<0.001
Closed vs open cells stent	4	4830		0.80 (0.47-1.37)	55.66	0.08	0.15
Filter vs balloon	3	3987		0.88 (0.45-1.71)	0	0.84	0.71
Eccentric vs concentric filter	3	3253		1.64 (0.71-3.76)	0	0.45	0.25

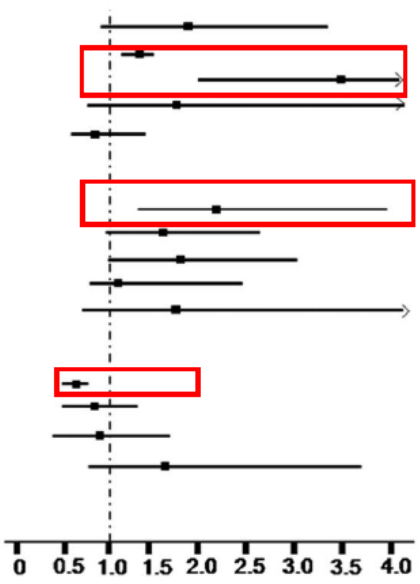


Figure 3. Pooled risks of 30-day stroke or death according to different subgroups.

High Risk for Carotid Stenting

1. ICA-CCA angulation > 60 degrees
2. Left Carotid
3. Lesion length > 10mm
4. Maybe Type III aortic arch
   – (contralateral radial/brachial access)

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80 year old Hispanic lady with an episode of sudden onset of gibberish speech. CUS showed 70-90% stenosis

Asymptomatic Carotid Stenosis (ACS)

Asymptomatic Carotid Stenosis

The NEW ENGLAND JOURNAL of MEDICINE

EDITORIAL

Endarterectomy, Stenting, or Neither for Asymptomatic Carotid-Artery Stenosis

J. David Spence, M.D., and A. Ross Naylor, M.D.

N ENGL J MED 374;11 NEJM.ORG MARCH 17, 2016

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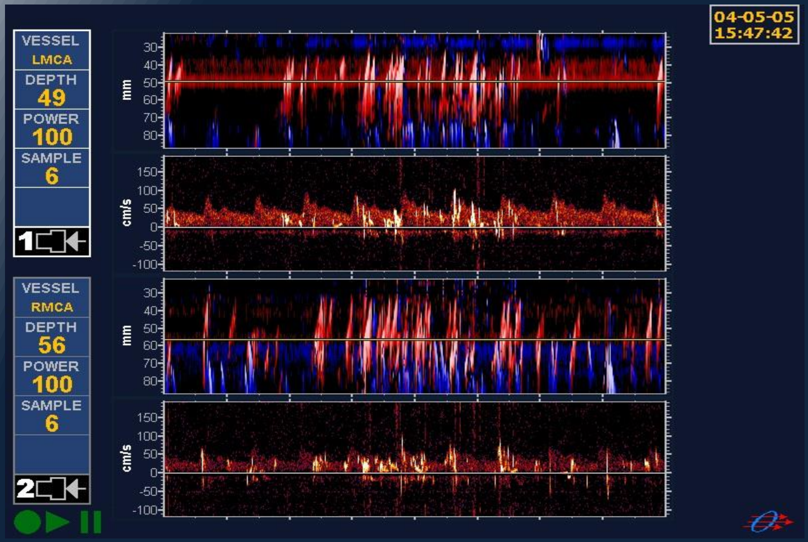
ACAS

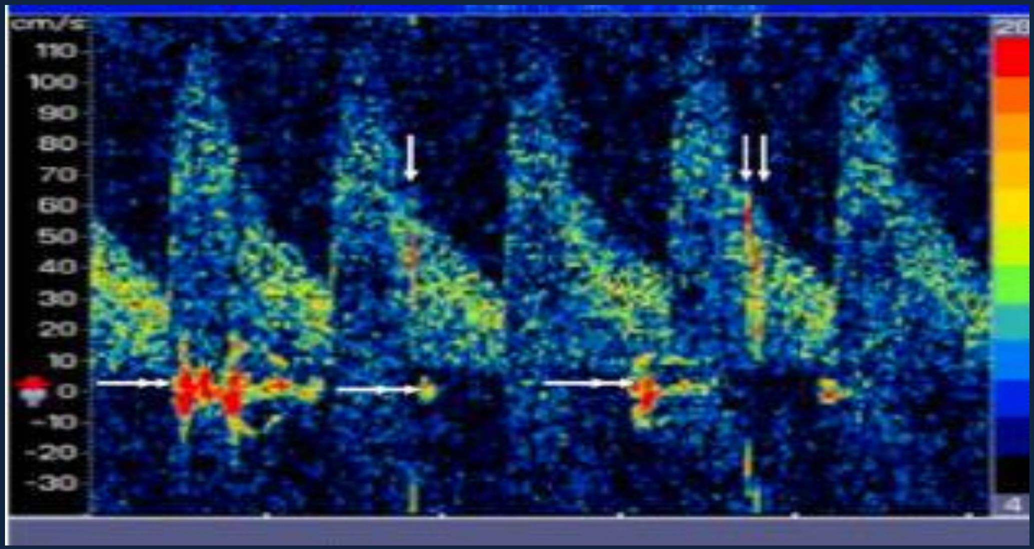
Benefit of Carotid Revascularization in asymptomatic is significantly smaller than in Symptomatic patients

Number needed to treat = 83

JAMA 1995;273:1421-8

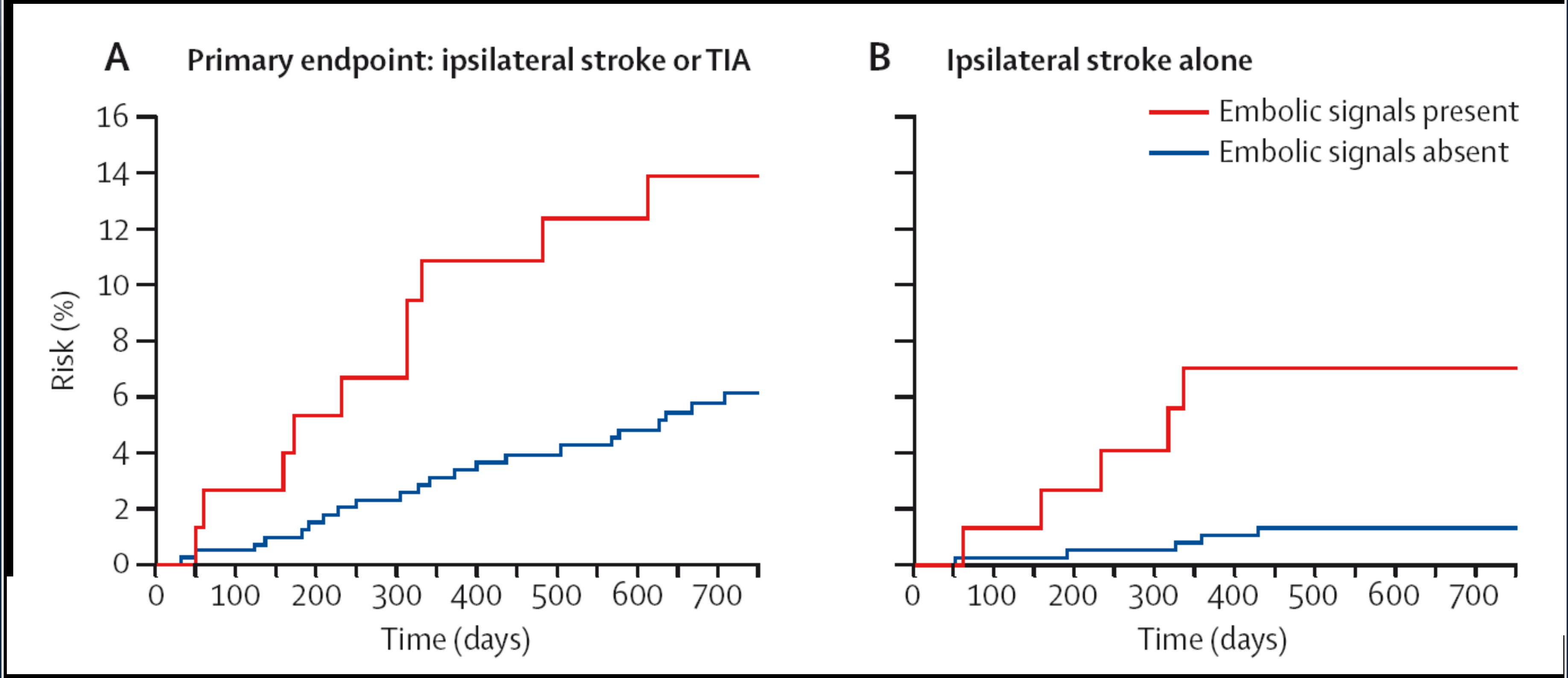
Cerebral Microemboli (MES/HITS) CLINICAL SIGNIFICANCE





Slide courtesy Dr. H. Marcus, MD, UK

ACES: Primary analysis - Results



HR 2.54 (1.20-5.36) p=0.015

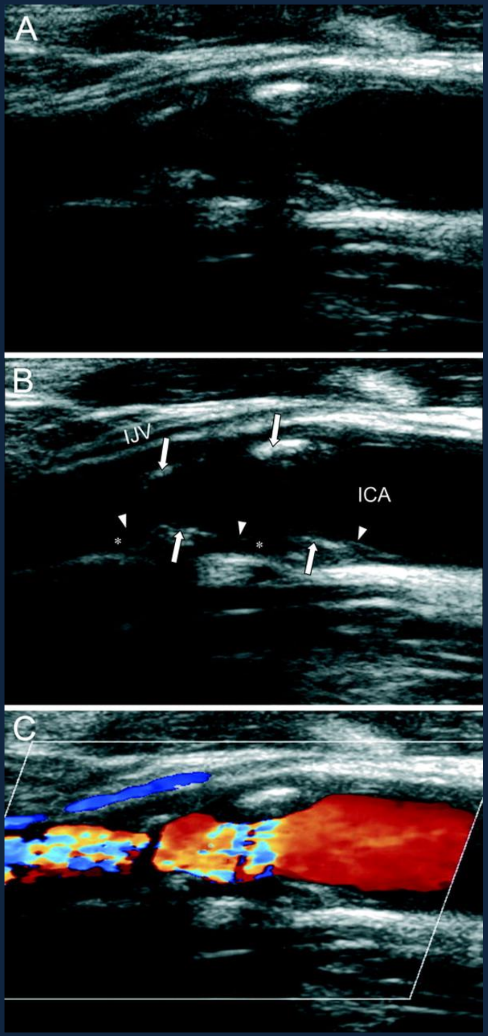
HR 5.57 (1.61-19.32) p=0.007

Asymptomatic Carotid Emboli Study (ACES) Markus et al. Lancet Neurol 2010;9:663–671.

Asymptomatic Carotid Emboli Study (ACES) Markus et al. Lancet Neurol 2010;9:663–671.

Endpoint	Absolute annual ipsilateral stroke risk
Primary	ES+ 3.62 ES- 0.70
Secondary	ES+ 5.50 ES- 0.89

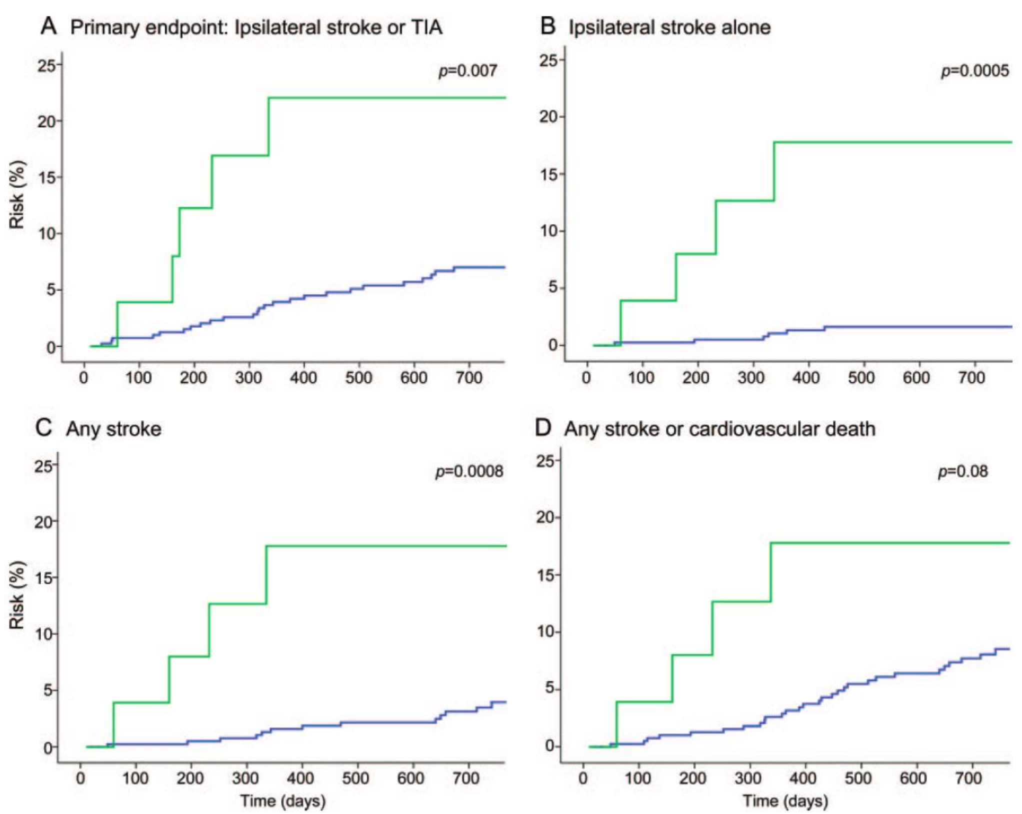
Figure 2 Conventional B-mode ultrasound vs. compound ultrasound Anterolateral view of the internal carotid artery (ICA) shows a heterogeneous plaque (A, B, and C).



Kwee R M et al. Neurology 2008;70:2401-2409

ACS: Risk Stratification with Carotid Ultrasound and Emboli detection

Figure Kaplan-Meier plots showing the difference in endpoints between the groups with (green) and without (blue) both echolucent plaque and embolic signals



(A) Ipsilateral stroke and TIA, (B) ipsilateral stroke, (C) any stroke, and (D) any stroke and cardiovascular death.

Risk of Ipsilateral Stroke in ACS: Risk Stratification by CUS and EDS

- Plaque echolucency alone
  - HR 6.43, 95% confidence interval [CI] 1.36–30.44, p = 0.019
- Plaque echolucency and ES positivity
  - HR 10.61, 95% CI 2.98–37.82, p = 0.0003

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Future

1. RCT in ACS testing best revascularization versus aggressive medical therapy
2. Studies confirming Patient selection strategies
3. CS Training
4. CS technique
5. Improving EPD and Stent design

CS Technology is rapidly evolving

The results of a simplified technique for safe carotid stenting in the elderly

Dimitrios Christopoulos, MD, PhD,[a,b] and Eugenios Philippov, MD,[b] *Thessaloniki, Greece*

J Vasc Surg 2011;54:1637-42.

The concept of an anatomy related individual arterial access: lowering technical and clinical complications with transradial access in bovine- and type-III aortic arch carotid artery stenting.
Dahm JB, van Buuren F, Hansen C, Becker J, Wolpers HG. Vasa. 2011 Nov;40(6):468-73.

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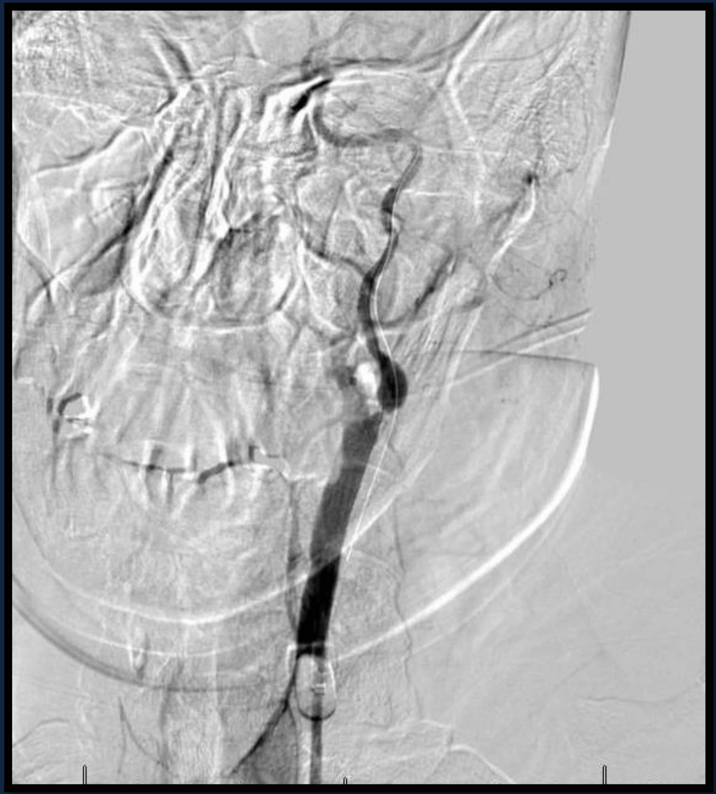
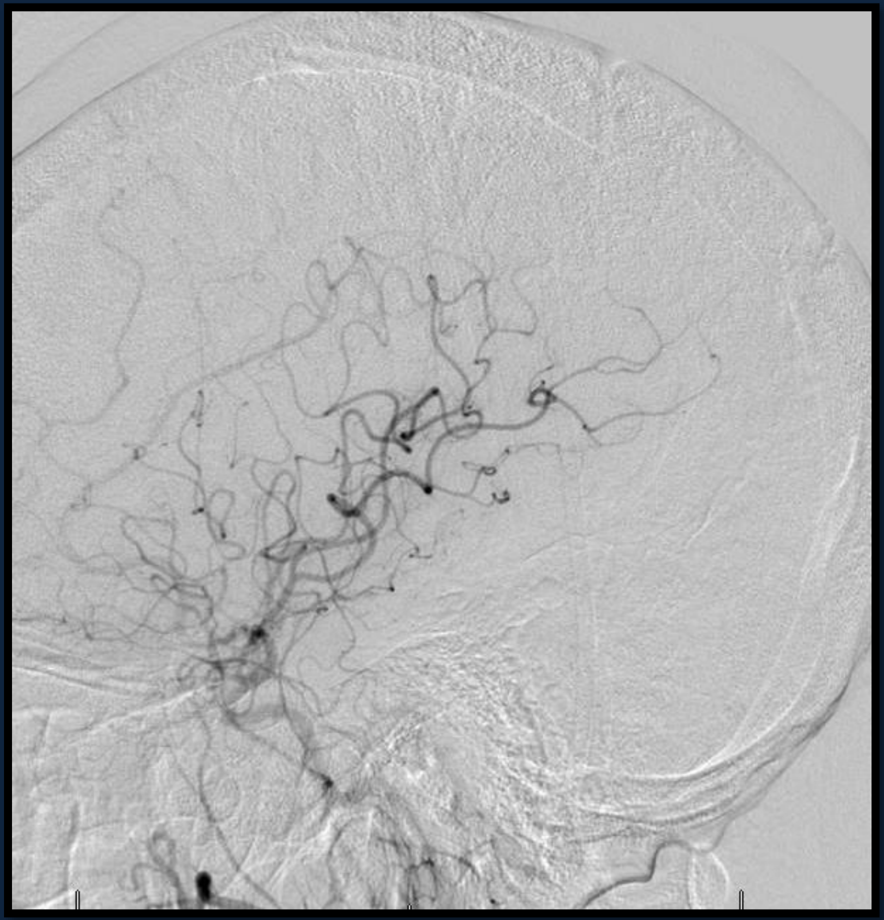
- 58 Y old lady with history of HTN, HLD, presented with right hemiparesis and slurred speech.
- Patient MRI showed acute stroke in the left MCA territory with high grade stenosis of the left Internal carotid artery.

High Grade Stenosis of the Left Internal Carotid Artery.

Distal Balloon Inflated; ECA occlusion

Proximal and Distal Balloon Inflation





Carotid Stenosis: Conclusions

1. CS is preferred for high risk CEA patients

   recurrent stenosis, high neck lesions, contralateral carotid occlusion, and severe cardiac or pulmonary diseases

2. Carotid Stenting is now standard of care (well-accepted) minimally invasive **alternative** to CEA in average risk patients with indication for CEA
3. Patient selection for CS is critical to ensure complication rates (periprocedural stroke and death) similar to CEA
4. Risk stratification of asymptomatic carotid Stenosis(ACS) with Ultrasound/Doppler is very promising
5. CS technology is rapidly evolving to further improve already good results with CS

Thank you!

dyavagal@gmail.com