

Endovascular Therapy of Acute Ischemic Stroke: Who to treat and who to leave alone

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Disclosures

1. *Consultant (Modest): Covidien/Medtronic, Neuralanalytics*
2. **Steering Committee member:**
SWIFT Prime,
RECOVER-Stroke ,
MR RESCUE (Investigator Steering committee)
3. DSMB member: ESCAPE
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Acknowledgements

UM/JMH

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MD, Seemant Chaturvedi, MD, Erika
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Roberto Heros, MD, Jacques Morcos, MD

Stroke Coordinator

Daniel D'Amour, RN

Mid-Level

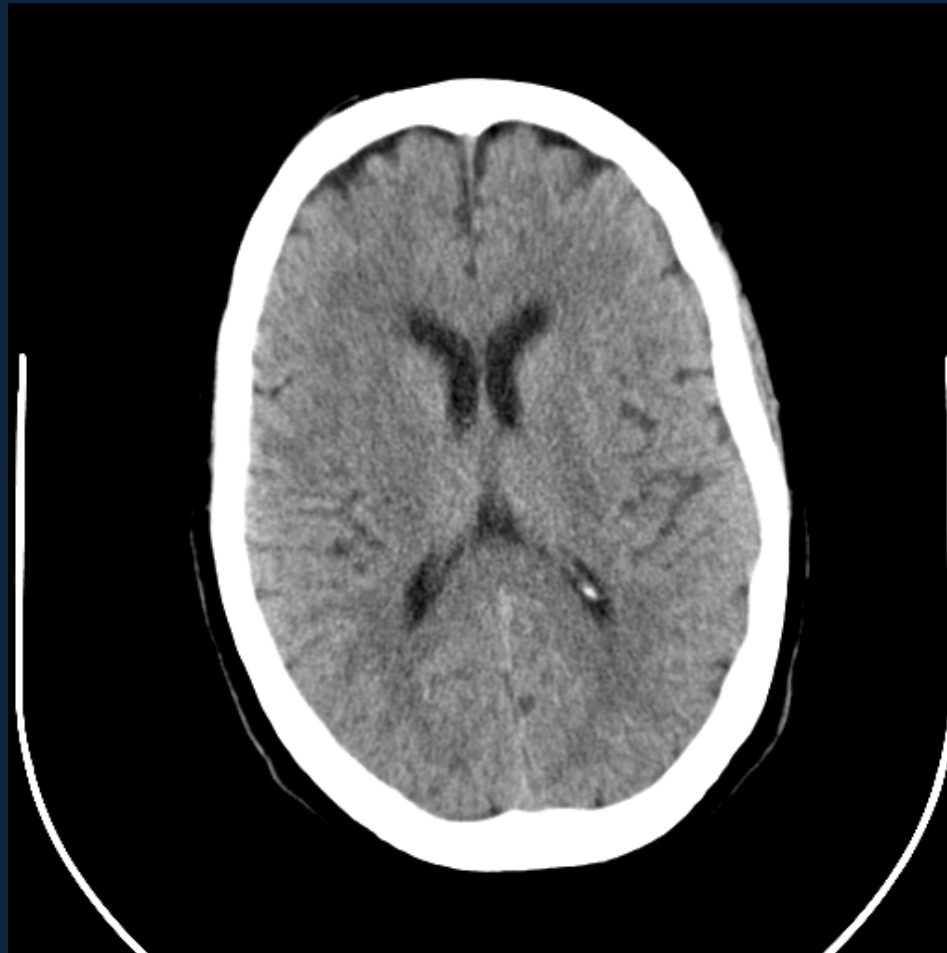
Kathy Hess, ARNP



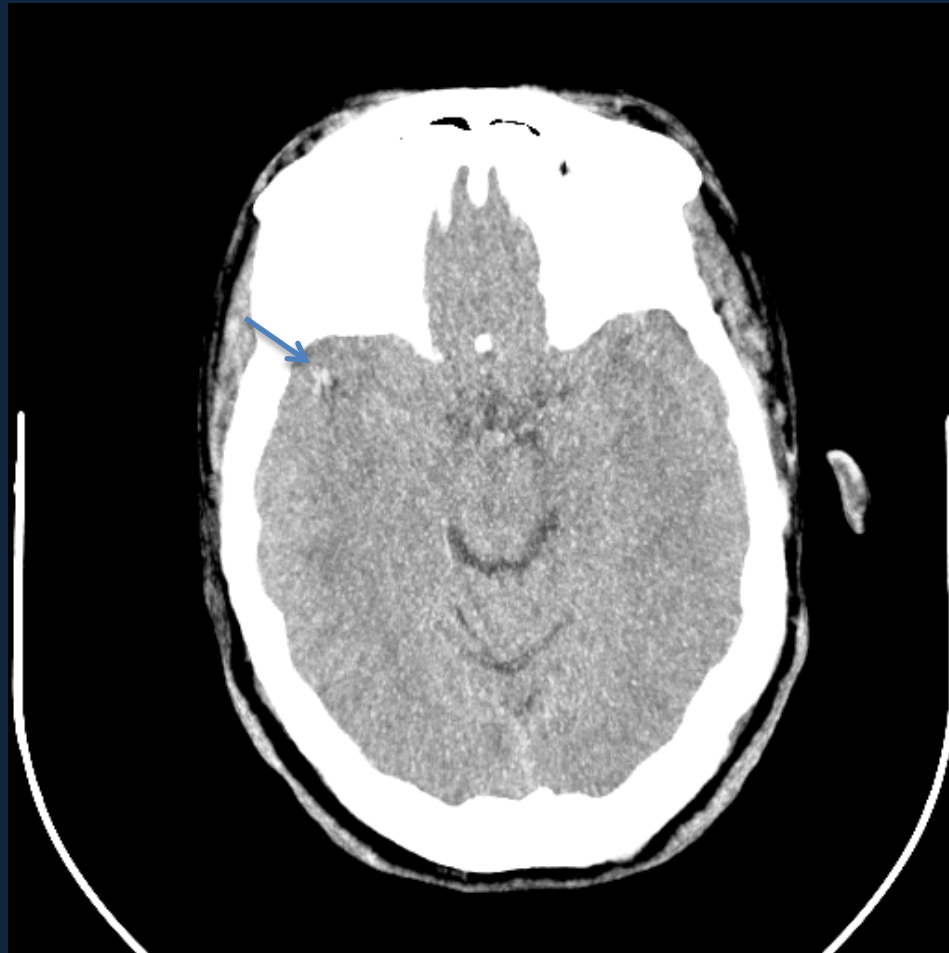
Outline

1. Case Vignettes
2. 5RCT Summary & Metanalysis
3. Time Sensitivity of MT
4. Stroke Protocols and Workflow
5. Advances on the Horizon

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



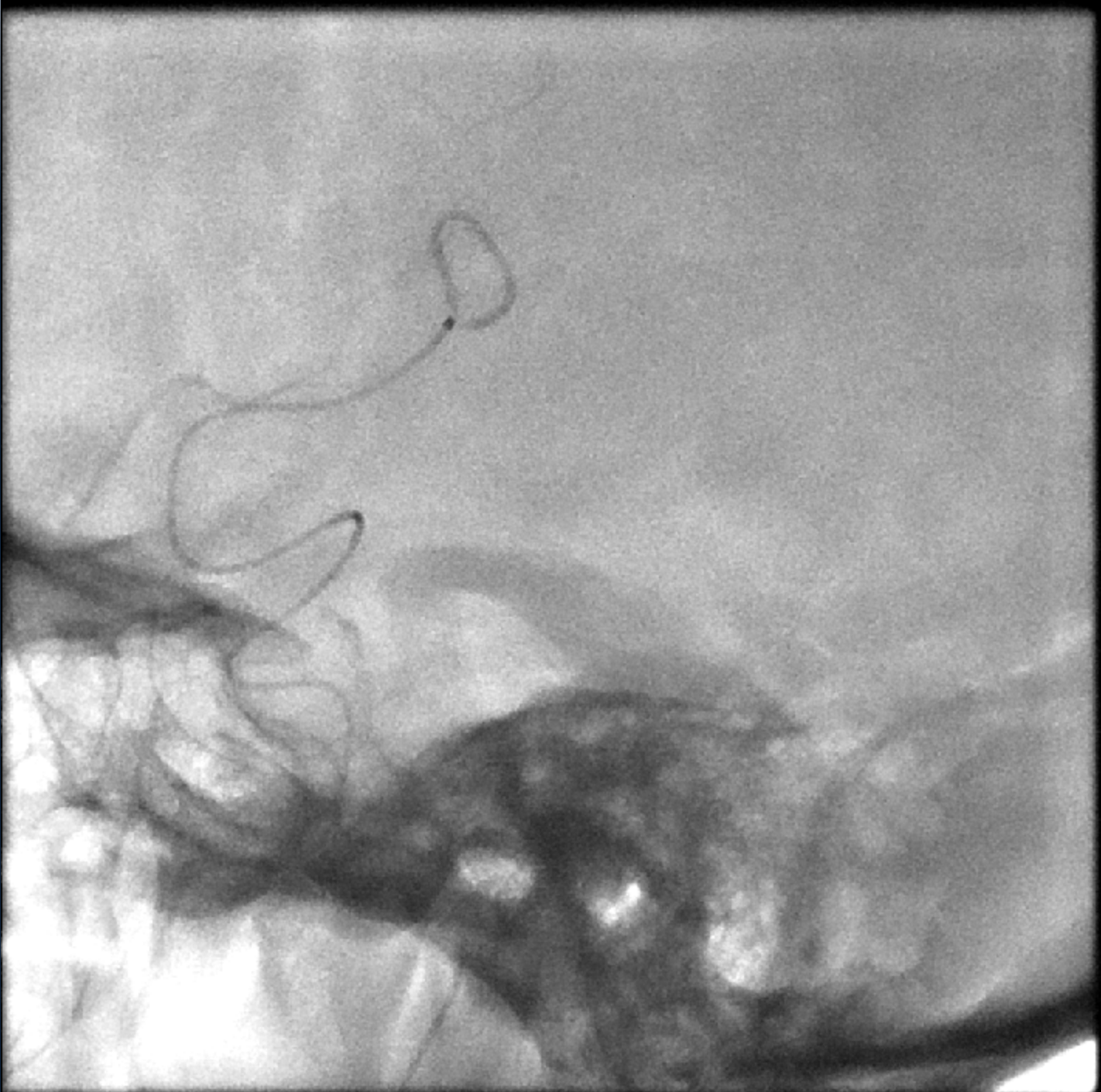
CT Reconstruction (MIP) shows clot in RMCA M1-M2 junction



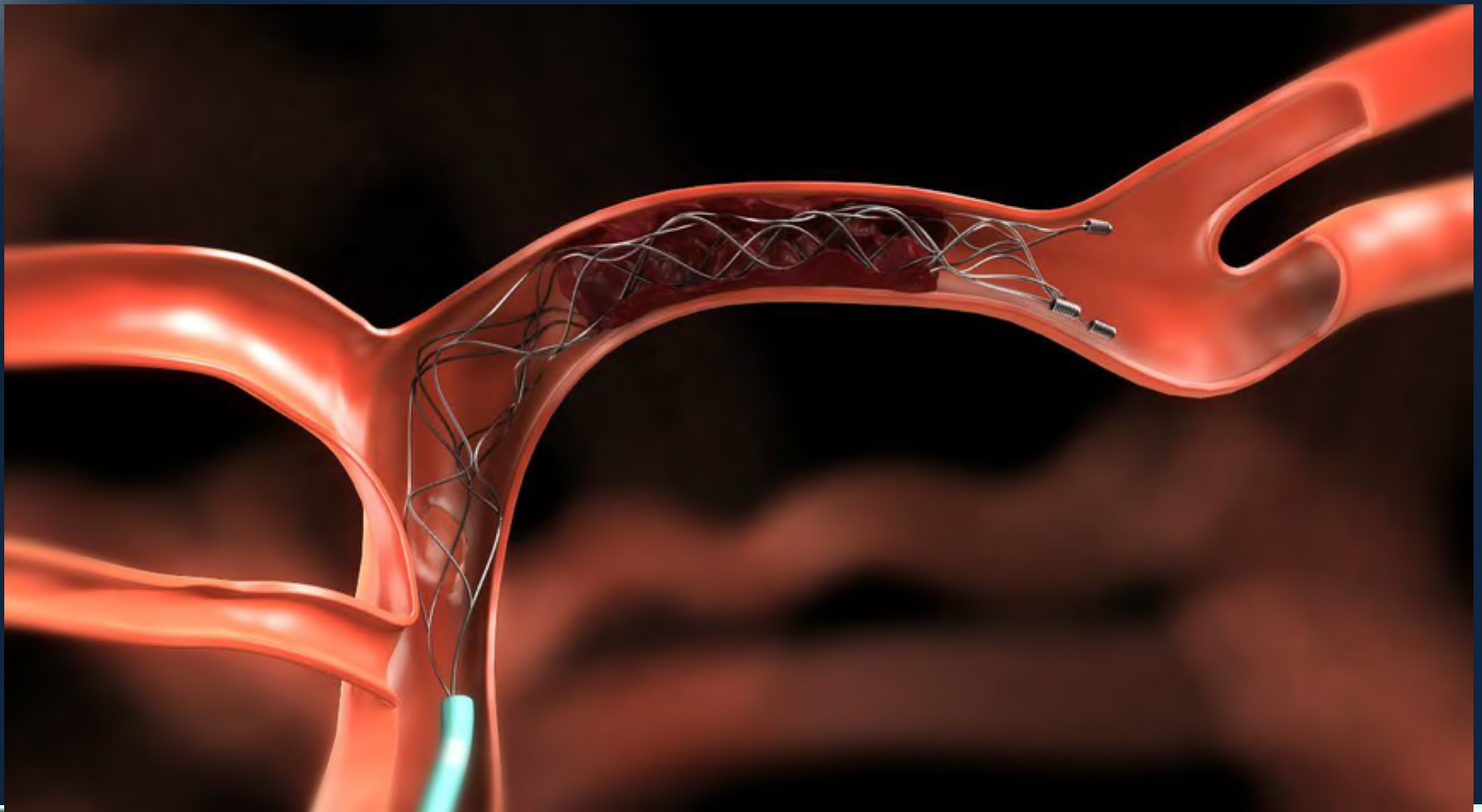
IV tPA started and simultaneously wheeled to
Angio Suite (No MRI, no CTA)



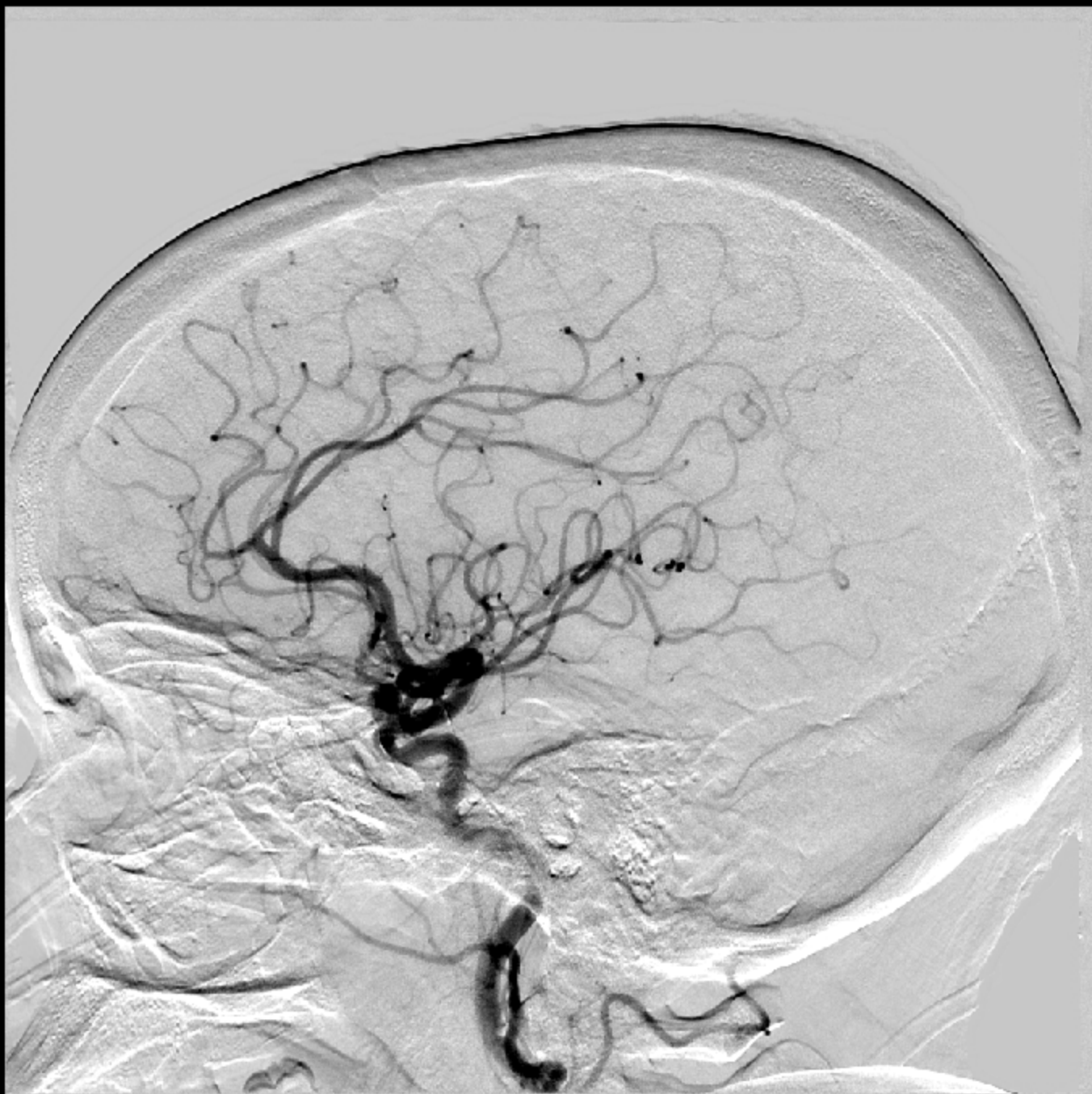




Stent like Thrombus Retrievers



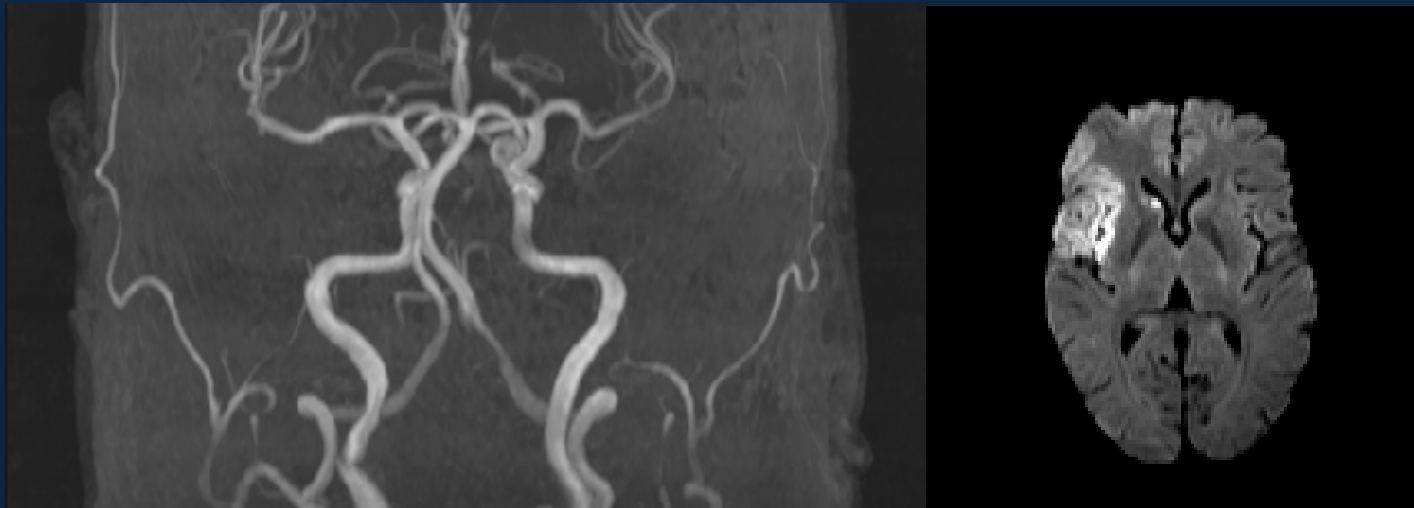




MT Workflow

- LKW: 1445
- Door: 1645
- Picture (CT): 1720
- Groin Puncture: 18:16
- TICI 3 (Complete) recanalization: 19:08
- Puncture to Recanalization time: **52 minutes**

MRI/A 48 hours post ET



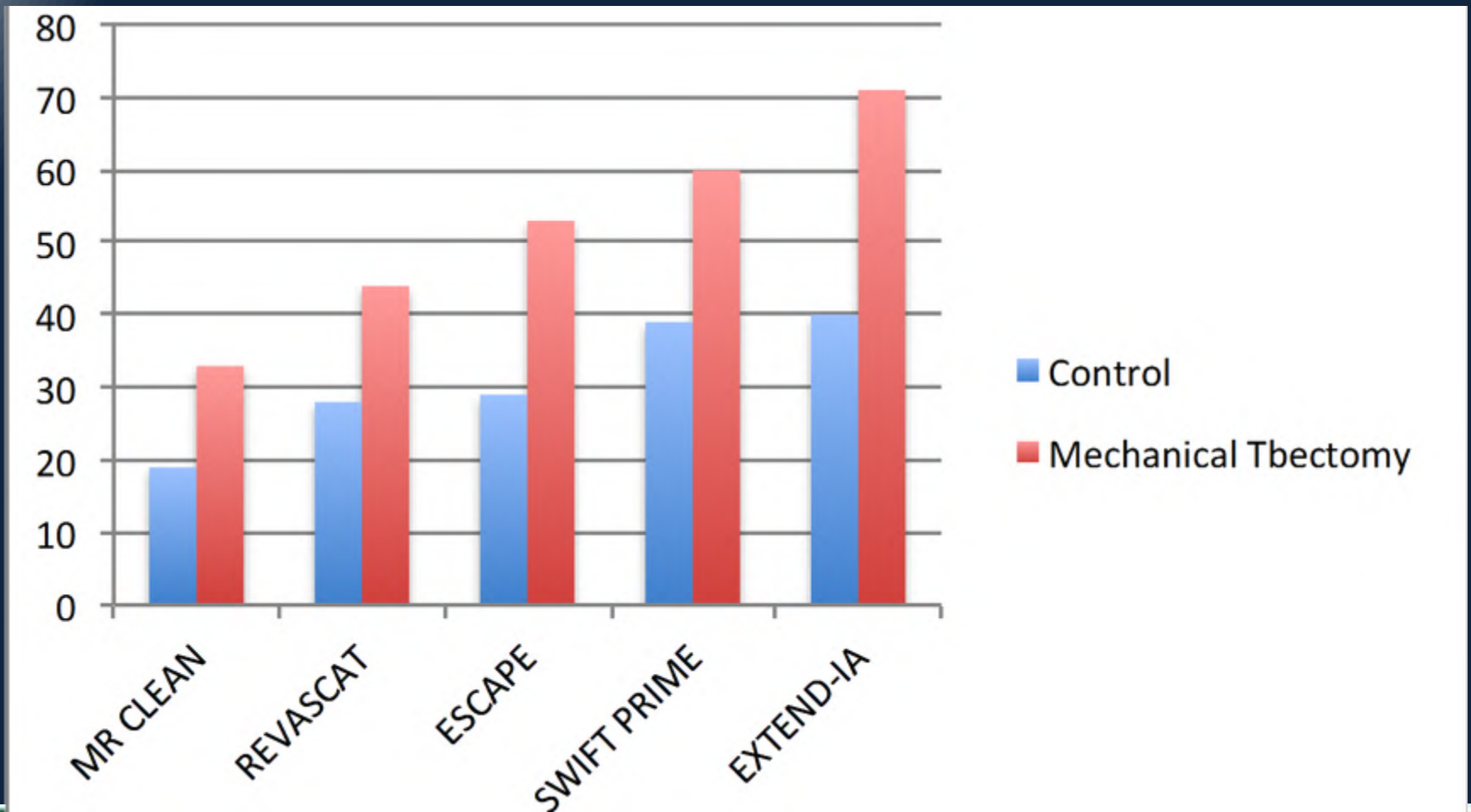
Functional Outcome: Status Post ET

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

Mechanical Thrombectomy for Acute Stroke.....

2015: It WORKS!!

mRS 0-2 in 2nd generation Mechanical Thrombectomy trials



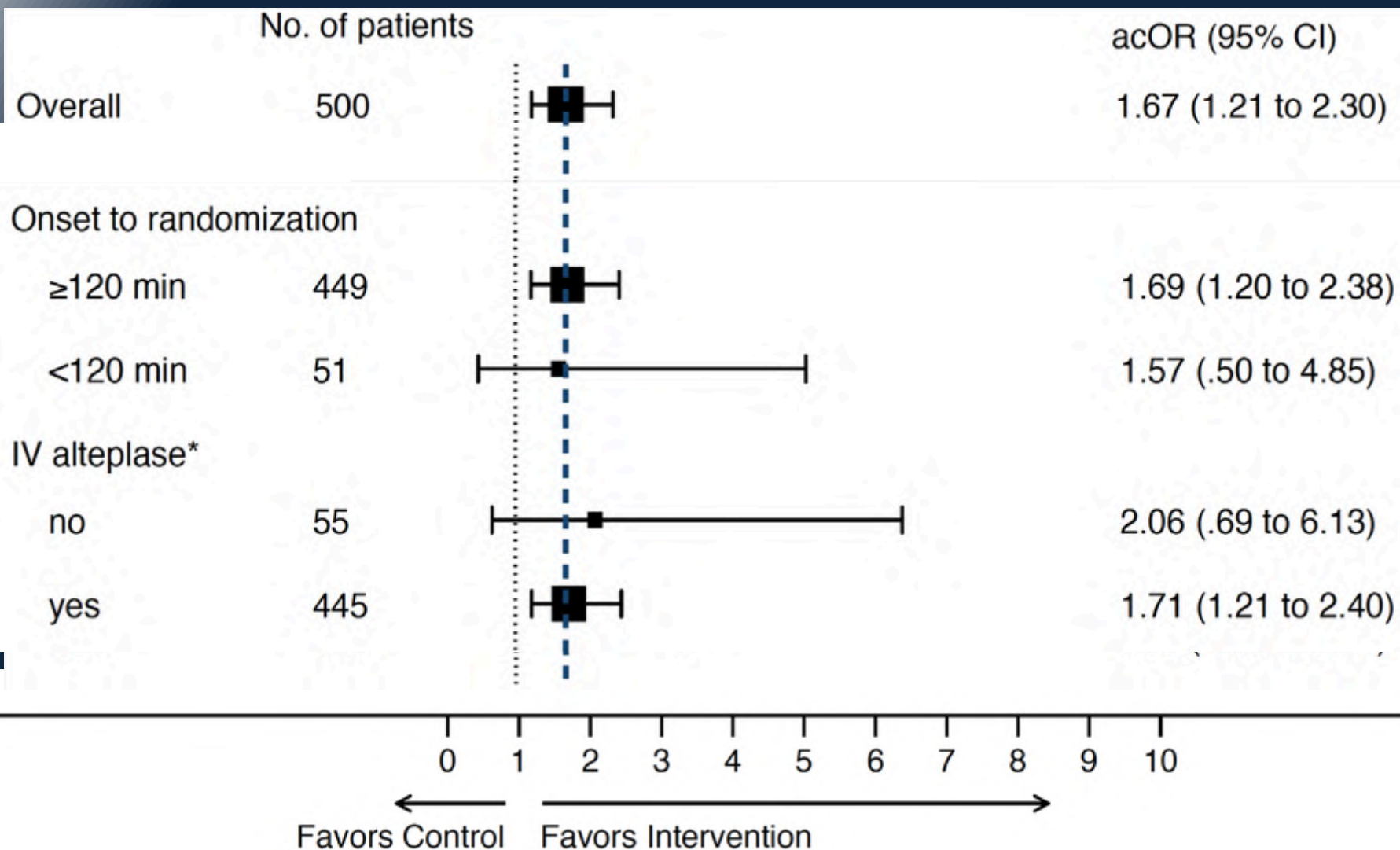
Summary Table: Trends ?

		mRS 0-2		Absolute Benefit	Mortality		Absolute 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

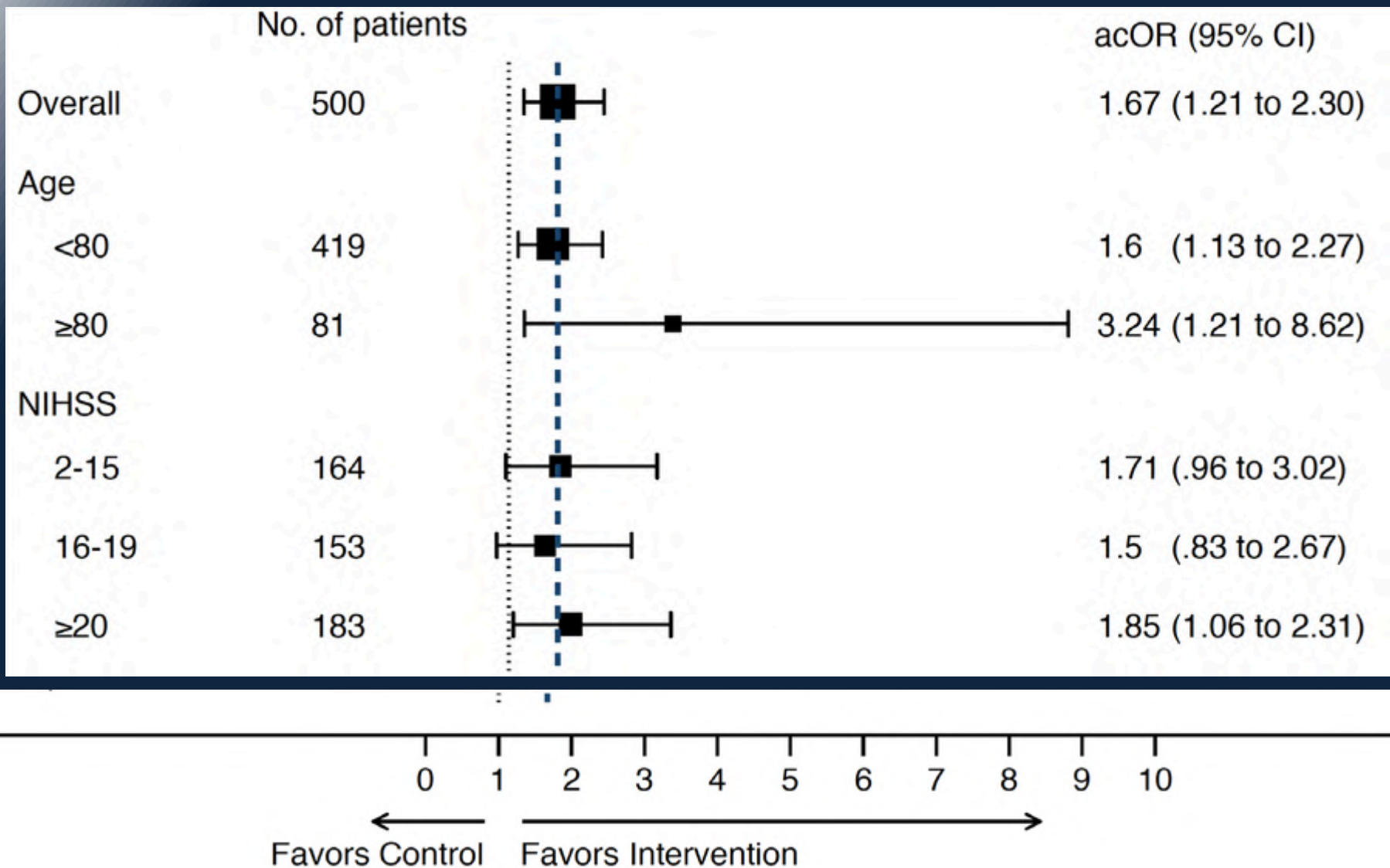
Mechanical Thrombectomy: Safety and Efficacy Summary Table

		mRS 0-2		sICH		NNT
		EndoRx (%)	Medical (%)	EndoRx (%)	Medical (%)	
MR CLEAN	502	31.5	19	6*	5.2*	7
ESCAPE	316	53	29.3	3.6	2.7	4
SWIFT-Prime	196	60.2	35.5	1	3	4
EXTEND IA	70	71	40	6	0	3.2

Subgroup analyses: time from onset and IV alteplase



Subgroup analyses: Age and NIHSS



Monumental Efficacy of MT + IV tPA

Table 2. Summary of the estimated effects of various interventions for heart attacks and stroke in terms of the NNT

<i>a</i> NNT to prevent 1 death or dependency at 1 year [32]	
Care of an AIS patient in a stroke unit	18
Aspirin for AIS	83
<i>b</i> NNT to prevent 1 stroke at 1 year [32]	
Endarterectomy for symptomatic severe carotid stenosis	26
Anticoagulation for nonvalvular atrial fibrillation	41
Endarterectomy for asymptomatic severe carotid stenosis	100
<i>c</i> NNT to benefit functional outcome	
Mechanical thrombectomy in AIS [1, 4]	3-7
IV tPA in 0- to 3-hour time window for AIS [33]	8
IV tPA in 3- to 4.5-hour time window for AIS	14
<i>d</i> NNT to prevent 1 death at 1 month [34]	
IV thrombolysis in 0- to 6-hour time window for STEMI	43
IV thrombolysis in 6- to 12-hour time window for STEMI	63

MT: New Standard of Care 2015

Stroke

JOURNAL OF THE AMERICAN HEART 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

Mechanical Thrombectomy (MT) at Jackson Memorial, UMH, UHealth: >450 MTs since 2007



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THE PRESENT AND FUTURE

STATE-OF-THE-ART REVIEW

Acute Ischemic Stroke Intervention



Priyank Khandelwal, MD,^a Dileep R. Yavagal, MD, MBBS,^{b,c} Ralph L. Sacco, MD, MS^b

HERMES Metanalysis

Endovascular thrombectomy after large-vessel ischaemic stroke: a meta-analysis of individual patient data from five randomised trials

Mayank Goyal, Bijoy K Menon, Wim H van Zwam, Diederik W J Dippel, Peter J Mitchell, Andrew M Demchuk, Antoni Dávalos, Charles B L M Majaie, Aad van der Lugt, Maria A de Miquel, Geoffrey A Donnan, Yvo BW E M Roos, Alain Bonafe, Reza Jahan, Hans-Christoph Diener, Lucie A van den Berg, Elad I Levy, Olvert A Berkhemer, Vitor M Pereira, Jeremy Rempel, Mónica Millán, Stephen M Davis, Daniel Roy, John Thornton, Luis San Román, Marc Ribó, Debbie Beumer, Bruce Stouch, Scott Brown, Bruce CV Campbell, Robert J van Oostenbrugge, Jeffrey L Saver, Michael D Hill, Tudor G Jovin, for the HERMES collaborators

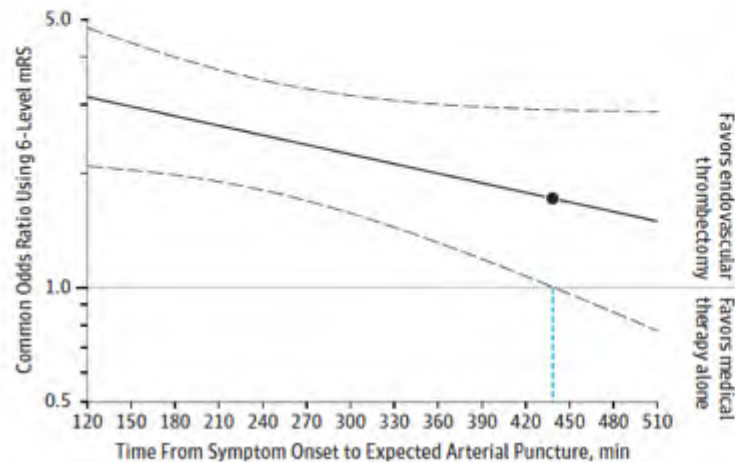
www.thelancet.com Published online February 18, 2016 [http://dx.doi.org/10.1016/S0140-6736\(16\)00163-X](http://dx.doi.org/10.1016/S0140-6736(16)00163-X)

- Individual Patient level metanalysis of 5 RCTs: 1287 patients
- Mechanical thrombectomy is of benefit to majority of patients with anterior circulation LVO worldwide;
- Major Determinants of Outcome: Age, Baseline NIHSS

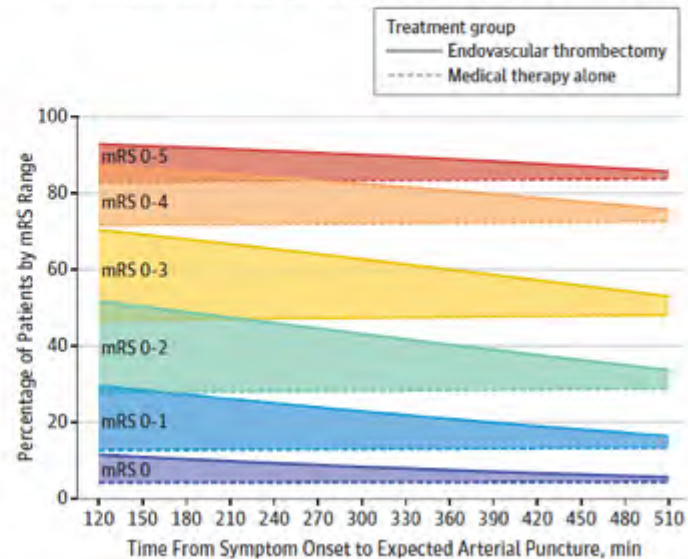
- **MT is Very Time Sensitive**
- **MT should be initiated as soon as possible within the first 7.3 hours after symptom onset**

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

A Odds ratio for less disability at 3 mo in endovascular thrombectomy vs medical therapy alone groups by time to treatment



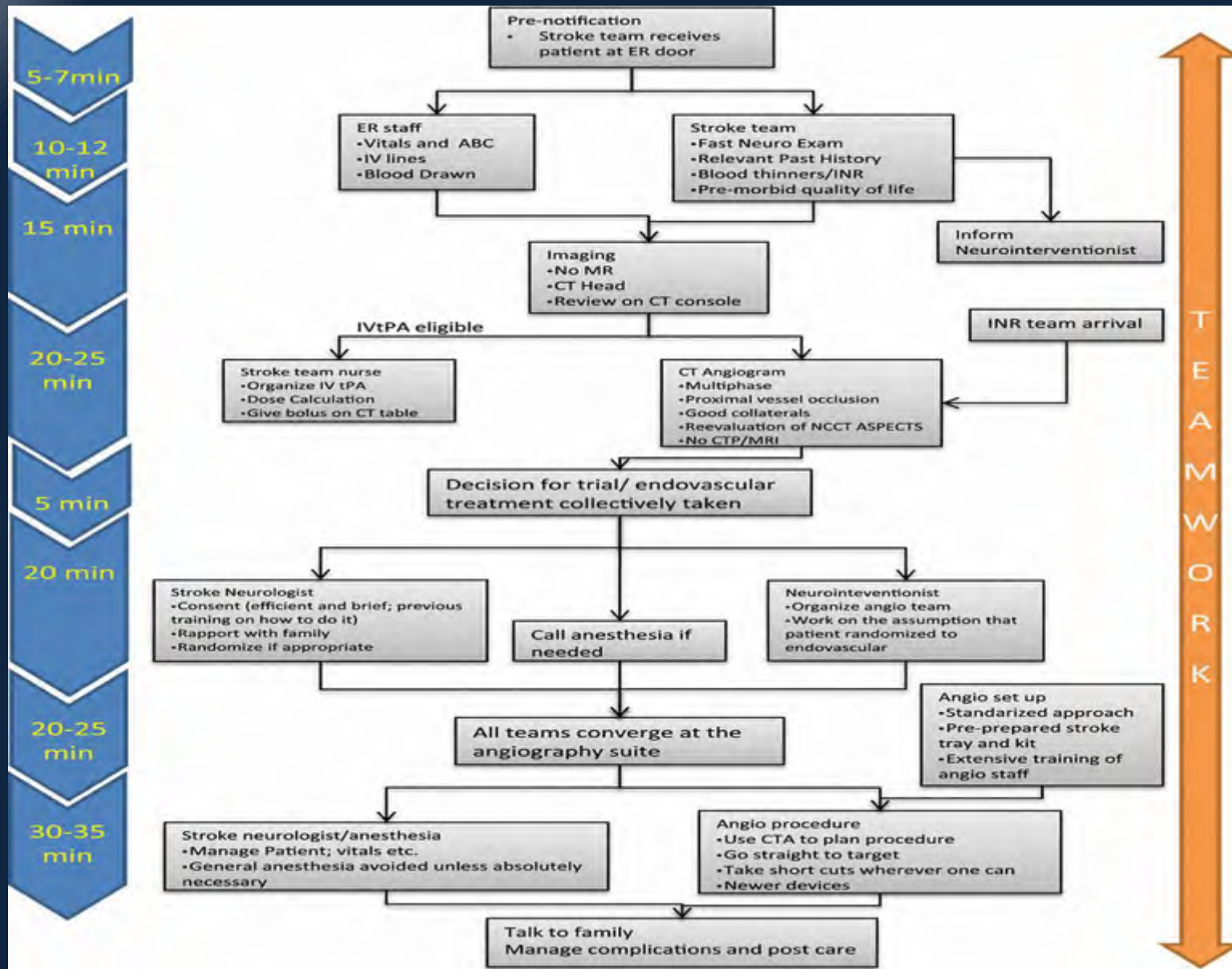
B Difference in adjusted 3-mo disability rates between endovascular thrombectomy and medical therapy alone groups by time to treatment



Functional Independence 64% with reperfusion at 3 hours vs 46% with reperfusion at 8h

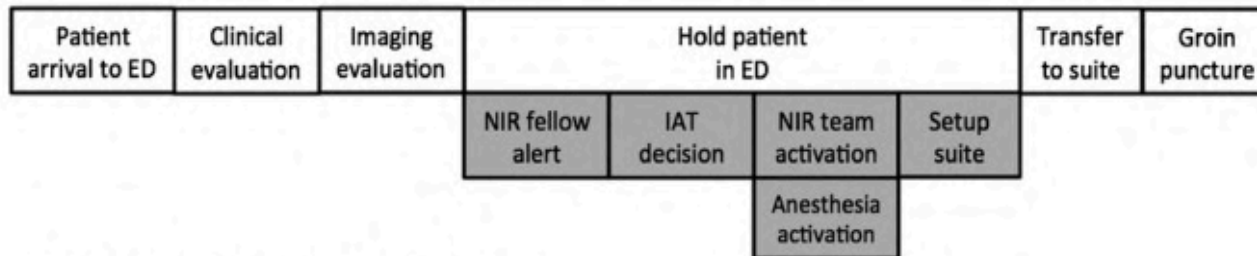
- Among every 1000 patients achieving substantial endovascular reperfusion (>TICI2B),
 - every 15-minute faster door-to-reperfusion time,
 - 39 patients would have a less-disabled outcome at 3 months,
 - 25 more who would achieve functional independence

Flow chart showing workflow and various steps at each stage./ Calgary Model.

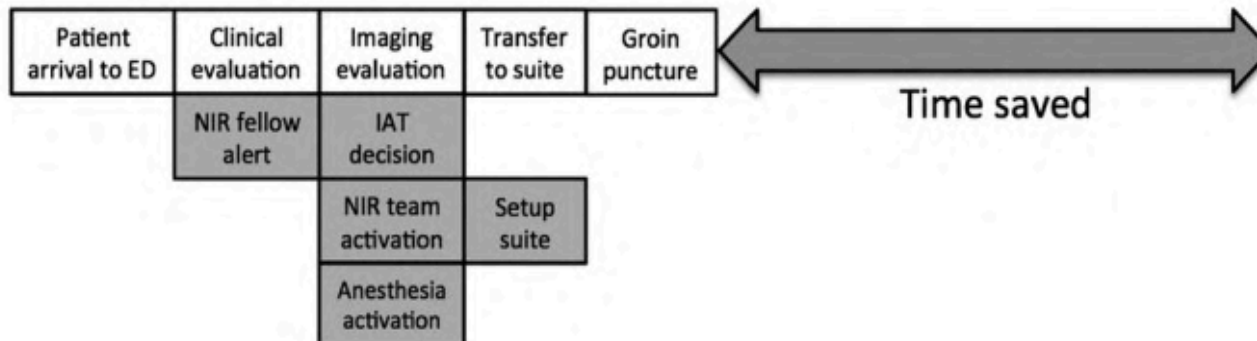


Comparative Workflow Analysis: MGH

A Pre-QI (Sequential) IAT process



B Post-QI (Parallel) IAT process



90 year old LMCA syndrome LKW

45 min



Rescue 14

PATIENT CARE TEAM

ED Physician: Dr. Chitty
Neurologist: Dr. Chaffin
Neuro-Interventionalist: Dr. Dileep Yavagal

PATIENT PRESENTATION

6/27/2016

- 90 year old female was witnessed to have had a sudden onset of aphasia and severe right sided weakness. BP upon arrival was considered high, 174/68. Patient had a history of arrhythmia and asthma.

PROCEDURAL DESCRIPTION

- City of Miami FR #14 recognized her symptoms and notified Jackson of a stroke alert. The patient was quickly evaluated, received a CT scan and was sent in for emergency endovascular treatment to remove the blood clot in the left MCA.

CASE CONCLUSION

- Dr. Yavagal removed the patient's blood clot with the Solitaire™ 2 Revascularization Device. Patient experienced rapid functional improvement.

NIHSS Starting 18 Final NIHSS 0

CASE IMAGES

Pre



Post



Stroke Case Metrics

Door to CT	Door to Groin	Door to Reperfusion
<u>12 minutes</u>	<u>64 minutes</u>	<u>150 minutes</u>

Time of Symptom Onset: 1:10 PM

ED Arrival: 1:55 PM

CT Complete: 2:07 PM

Groin Puncture: 2:59 PM

TICI 3 Revascularization: 4:25 PM

26 Y LMCA syndrome Last Known Well (LKW) 80 min



Jackson
MEMORIAL HOSPITAL

Acute Stroke Thrombectomy



Rescue 24

Last Seen Normal	ED Arrival (Door)	CT (complete)	tPA (needle)	Groin (puncture)	Reperfusion
9:10 AM	10:29 AM	10:44 AM	10:47 AM	11:10 AM	11:40 AM

PATIENT PRESENTATION

8/6/15: 26 yr old F, right side facial droop and aphasia. EMS transport patient to Jackson. Starting NIHSS 6. CT showed left MCA occlusion. Patient sent directly to neuro lab for intervention.

PATIENT OUTCOME

Immediate improvement. Single pass with Solitaire 4X40mm for full TICI 3 reperfusion. Final NIHSS score of 0, patient discharged home with zero deficits and returned to normal daily activity.



Before



After

PERFORMANCE METRICS

Door to CT	15 min
Door to tPA	18 min
Door to Groin	41 min
Door to Reperfusion	71 min!!

Clot removed with a Solitaire Stent



EMS: City of Miami FR
ED: Dr. Gutfreund
Neurology: Dr. Ziayee & Dr. Marulanda
Neuro Interventionalist: Dr. Yavagal

Stroke Coordinator: Daniel D'Amour
Nurse/TechTeam: Merle DuPlessis, Joane Jadotte, Success St Fleur & Barbara Peart-James

NOTES: Exemplary partnership between City of Miami FR and Dr. Yavagal's crew. Fast response on every level contributed to full patient recovery.

68 year old w LMCA syndrome, LKW 45 min



Rescue 202

Acute Ischemic Stroke Thrombectomy



Miracles made daily.

PATIENT PRESENTATION

10/21/2016 60 year old male had a sudden onset of right arm weakness and slurred speech. EMS was called.

PROCEDURAL DESCRIPTION

Miami Dade FR arrived at the scene, recognized the patient's stroke symptoms and transported him to Jackson as a stroke alert. A CT scan in the ED showed a left M2 clot. Patient was not a candidate for IV t-PA. With an NIHSS of 16, the patient was sent in for emergency endovascular treatment.

PATIENT OUTCOME

Immediate improvement! Dr. Starke removed the patient's blood clot with the 4X40mm Solitaire™ 2 Revascularization Device to open up the left MCA for immediate blood flow. **Final NIHSS 0!** Patient will be discharged without any deficits from his stroke.

PATIENT CARE TEAM

ED Team: Dr. Winifred Holsing Fili
Radiology: Dr. Pagan
Neurology: Dr. Malik
NeuroSurgeon: Dr. Robert Starke
Core Stroke Team: Dr. Romano, Kathy, Daniel, Nida

Before



After



Stroke Case Metrics

Door to CT	Door to Groin	Door to Reperfusion
10 minutes	64 minutes	101 minutes

Last Seen Normal
9:50 AM

ED Arrival (Door)
10:15 AM

CT Complete
10:25 AM

Groin Puncture
11:19 AM

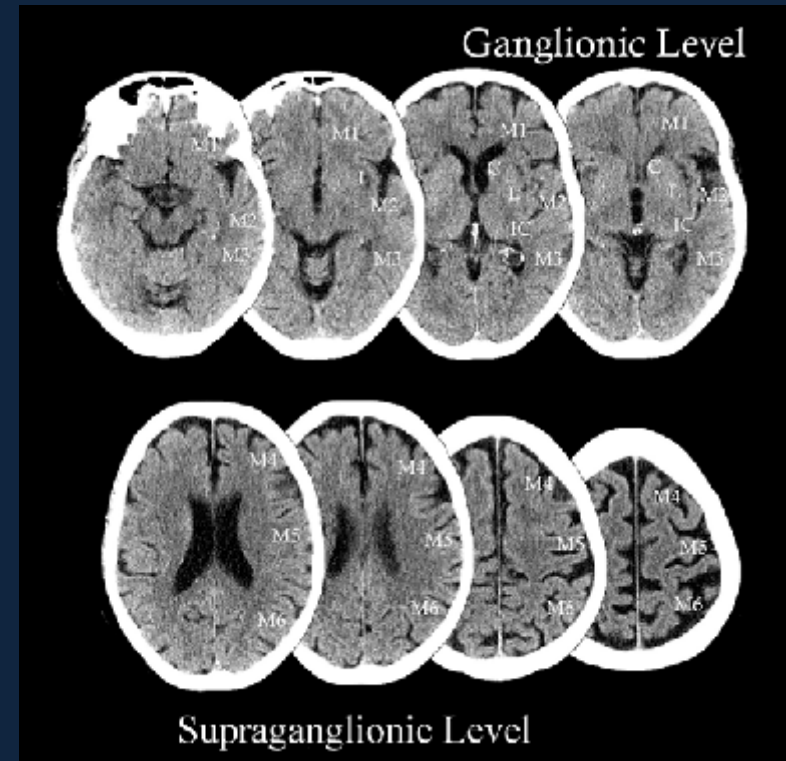
Reperfusion
11:56 AM

Imaging Selection

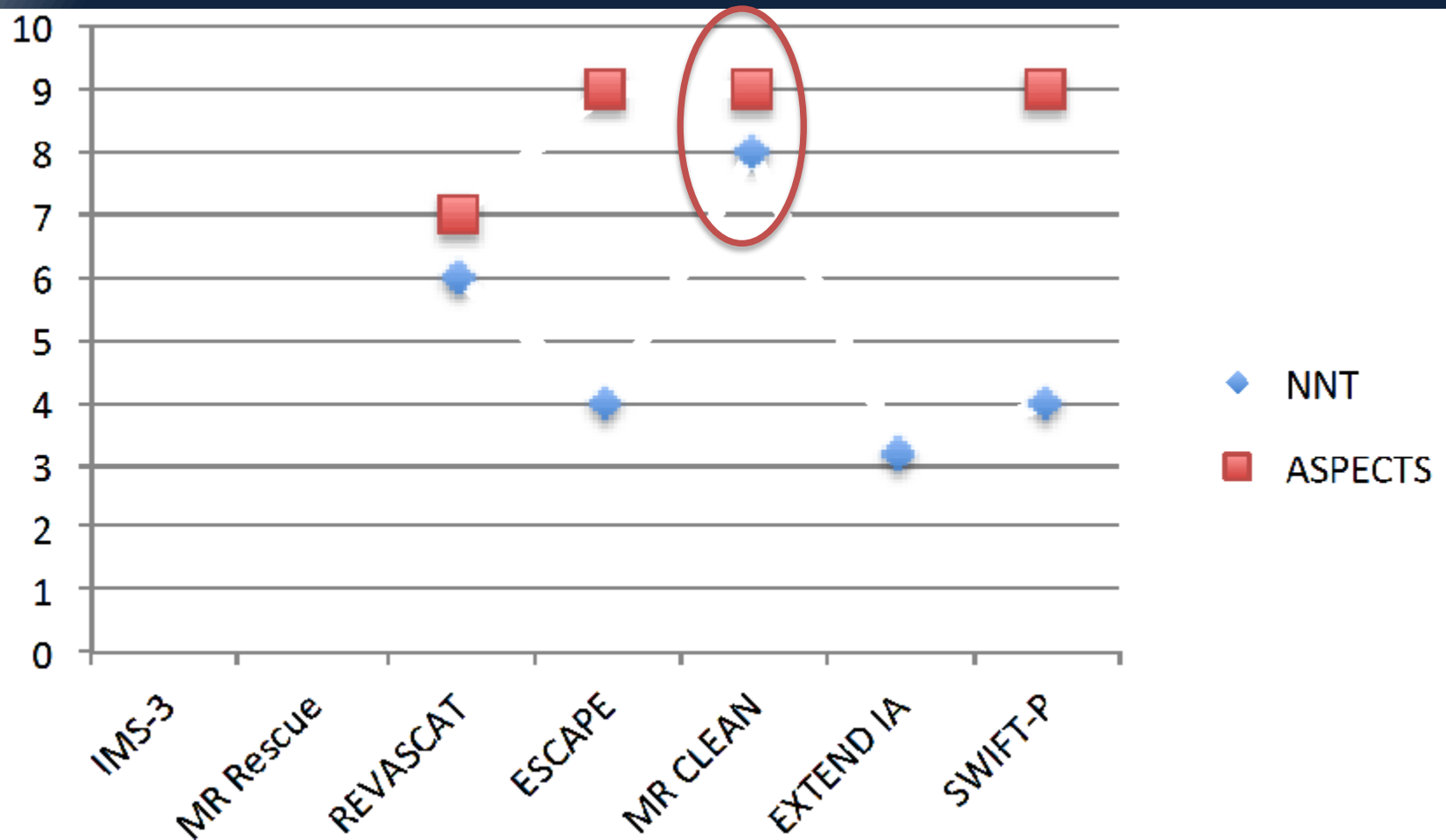
- Emergency imaging of the brain is recommended before initiating any specific treatment for acute stroke (Class I; Level of Evidence A). In most instances, nonenhanced CT will provide the necessary information to make decisions about emergency management. (Unchanged from the 2013 guideline)

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



Imaging: CTA/MRA

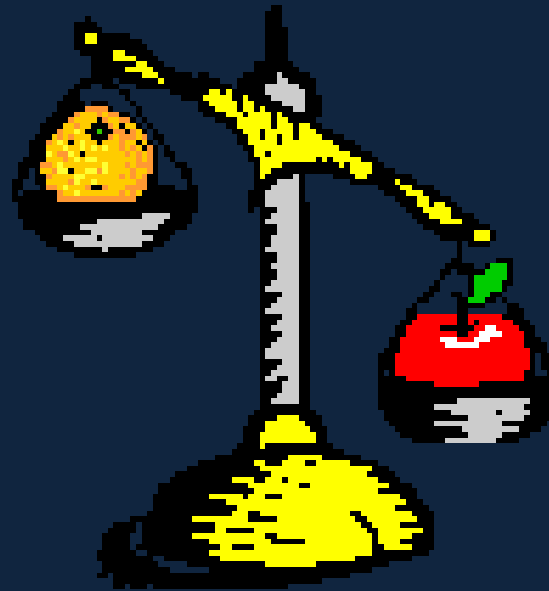
- If endovascular therapy is contemplated, **a noninvasive intracranial vascular study is strongly recommended** during the initial imaging evaluation of the acute stroke patient but should not delay intravenous r-tPA if indicated. For patients who qualify for intravenous r-tPA according to guidelines from professional medical societies, initiating intravenous r-tPA before noninvasive vascular imaging is recommended for patients who have not had noninvasive vascular imaging as part of their initial imaging assessment for stroke. Noninvasive intracranial vascular imaging should then be obtained as quickly as possible (**Class I; Level of Evidence A**). (**New recommendation**)

Perfusion imaging: Not yet

- The benefits of additional imaging beyond CT and CTA or MR and MRA, such as CT perfusion or diffusion- and perfusion-weighted imaging, for selecting patients for endovascular therapy are **unknown (Class IIb; Level of Evidence C)**.

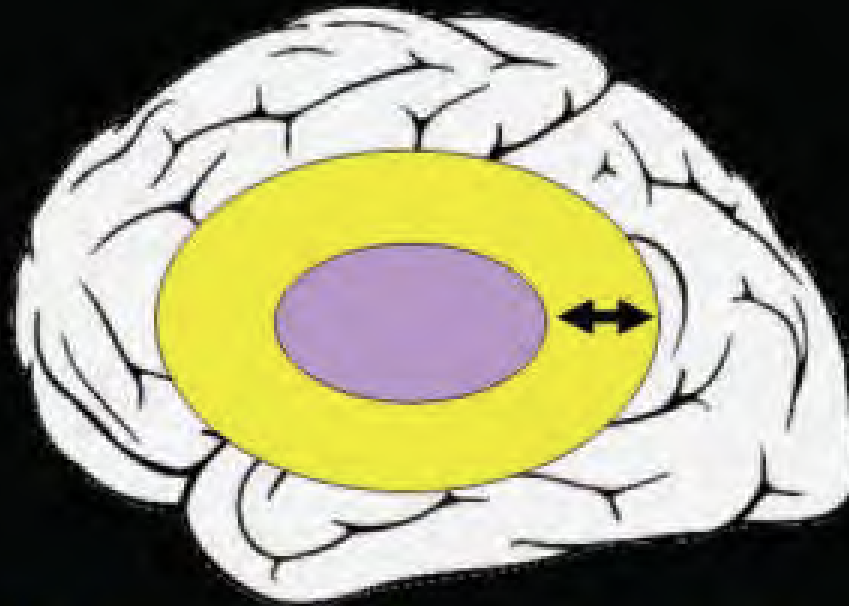
Time Delays Vs Better Neuroimaging Selection

Time Delays



Advanced
Neuroimaging

Perfusion diffusion mismatch



DWI Abnormality: Bioenergetic Compromise = Core



Perfusion Abnormality: Hemodynamic Compromise



Diffusion/Perfusion Mismatch = Penumbra

MR RESCUE

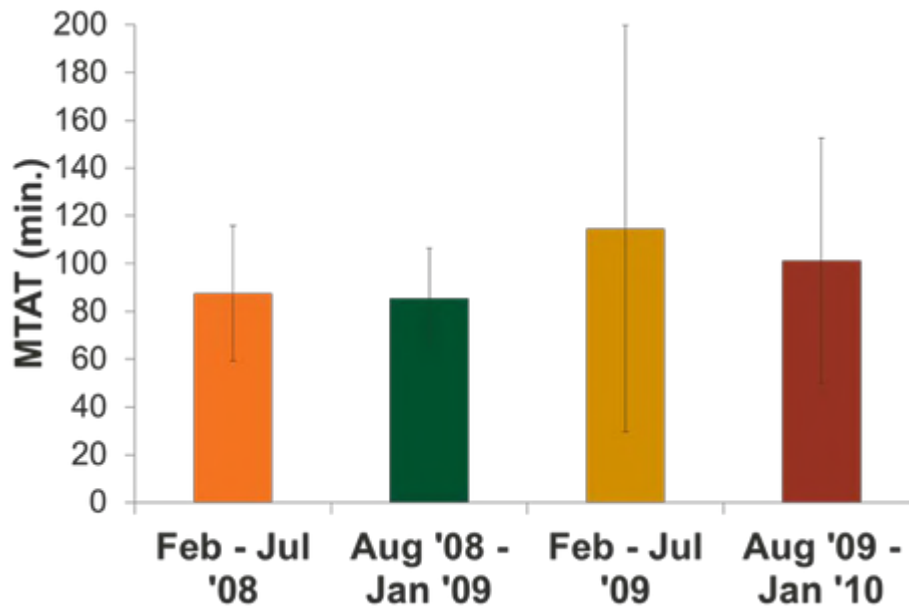
Design	Pragmatic IA (P +NP) vs med Rx (P +NP)
Time window	8h
Randomization	1:1
n	64(34+30) vs 54(34+20)
Age	65.5
mNIHSS	17
IA Recan rate % TICI >2a/>TICI 2B	67/ 27
mRS 90	14//9 vs 23//10
sICH	4% overall
Time to Rx	6.3h
Mortality (%)	21
Stentriever	0%

Is Advanced Imaging Futile?

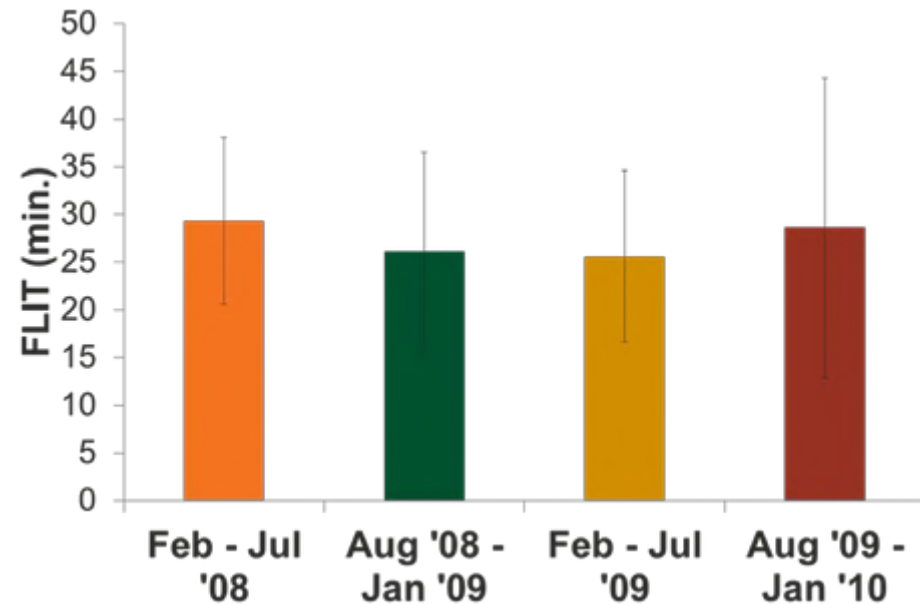
MR RESCUE Vs DEFUSE 2

	MR RESCUE	DEFUSE 2
Design/n	RCT/118	Prosp Cohort/138
mRS90 0-2/FCR		
Favourable Penumbra (%) / TMM	34	8.8 (OR)
Non-Penumbra (%) / NTMM	21	0.2 (OR)
Picture to Puncture (P2P)	120 min	42min
Picture to RePerfusion (P2RP)	NR	90min
Core volume (median)	36/37ml	13ml
Predicted core	60 (34-107)	
T Max threshold	>4sec	>6sec

MIAMIS: MRI Turnaround time over 2 years

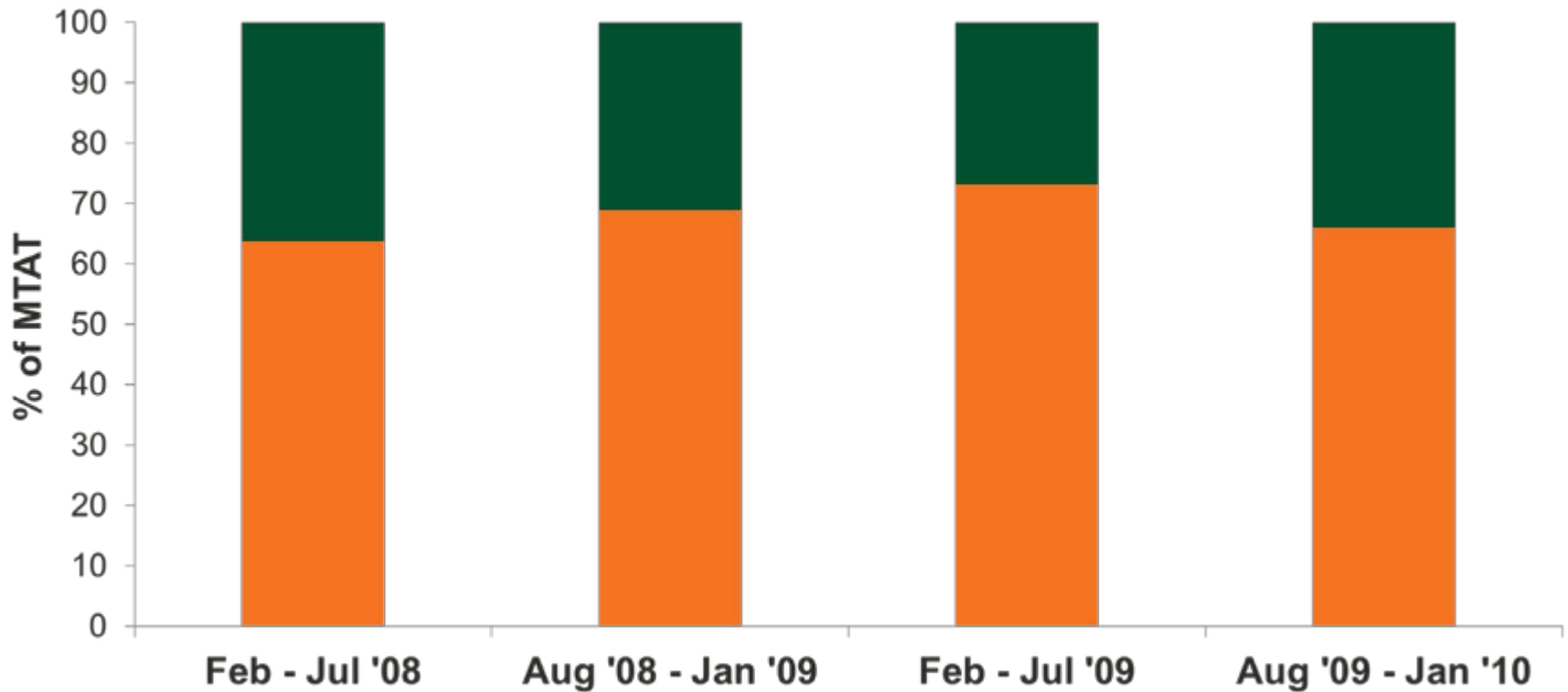


Average MRI turn around times (MTAT) $\pm$ 1 SD in the 4 six month time periods. The overall mean MTAT was 99.59 ± 54.78 min. There was no significant difference among the time periods ($F = .96$; $p = .42$).



Average first to last image times (FLIT) $\pm$ 1 SD in the 4 six month time periods. The overall mean FLIT was 27.72 ± 12.78 min. There was no significant difference among the time periods ($F = .36$; $p = .79$).

MIAMIS: Breakdown of the MRI Turn Around Time



Breakdown of the MRI turn around time (MTAT) into its components, order to first image time (OFIT) and first to last image time (FLIT). The overall mean OFIT was 73.80 ± 51.95 min. OFIT accounted for the majority of MTAT in all time periods (Feb.-Jul. '08 = $63.70 \pm 14.01\%$, Aug. '08-Jan '09 = $68.85 \pm 9.69\%$, Feb.-Jul. '09 = $73.21 \pm 18.32\%$, Aug. '09-Jan. '10 = $65.98 \pm 21.33\%$) and did not differ significantly among the time periods ($F = .68$; $p = .57$).

Automated Standardized Imaging Mismatch Processing: DEFUSE2-RAPID

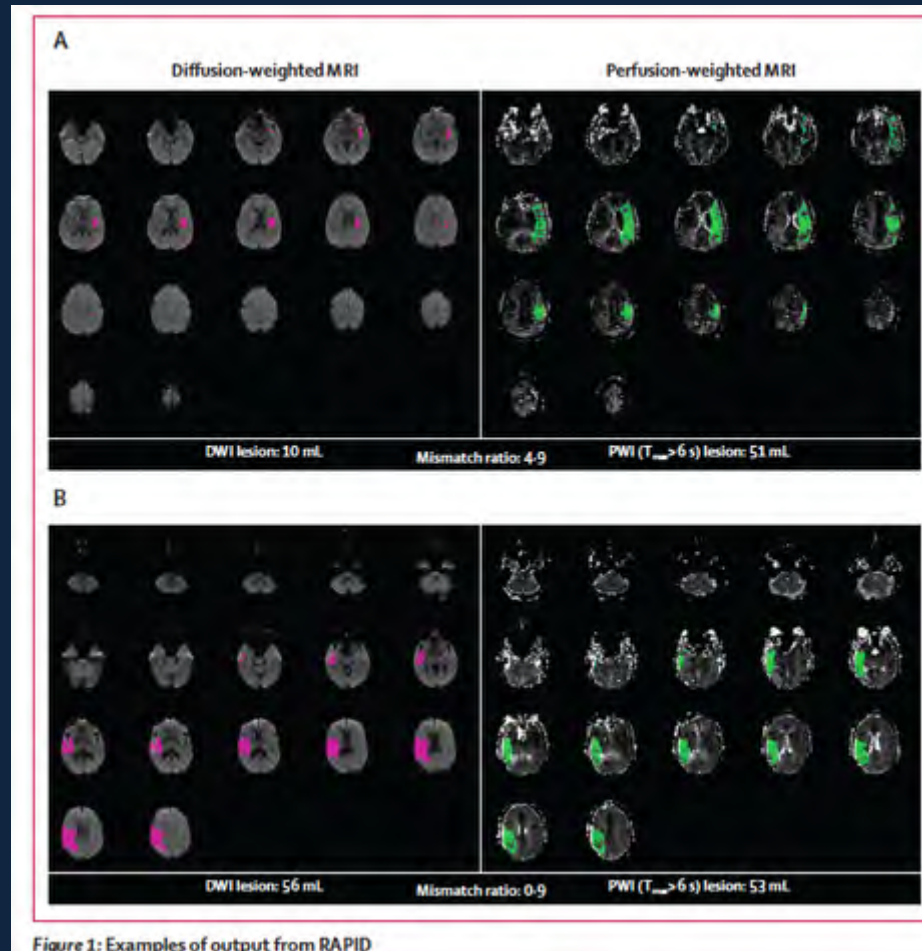
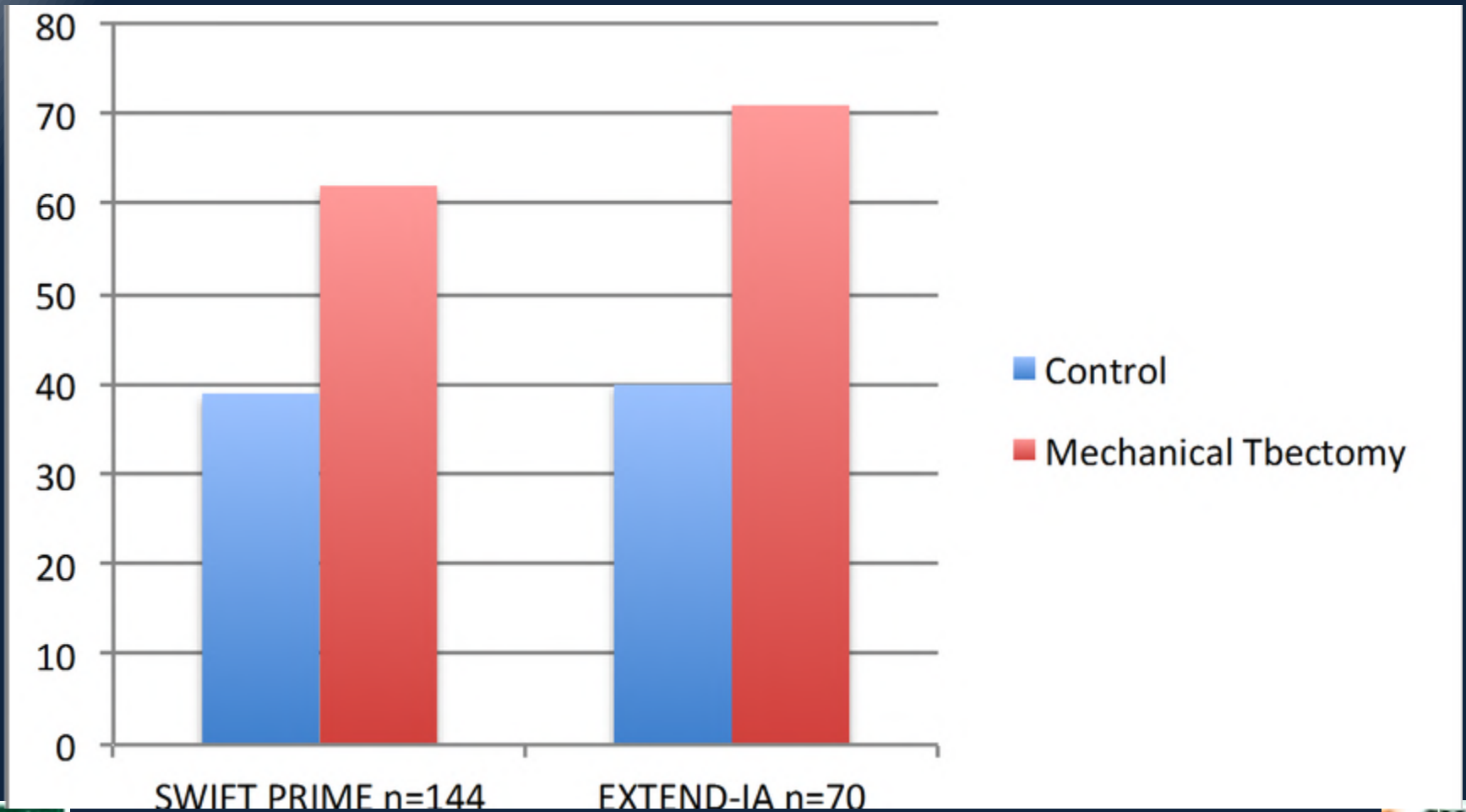


Figure 1: Examples of output from RAPID

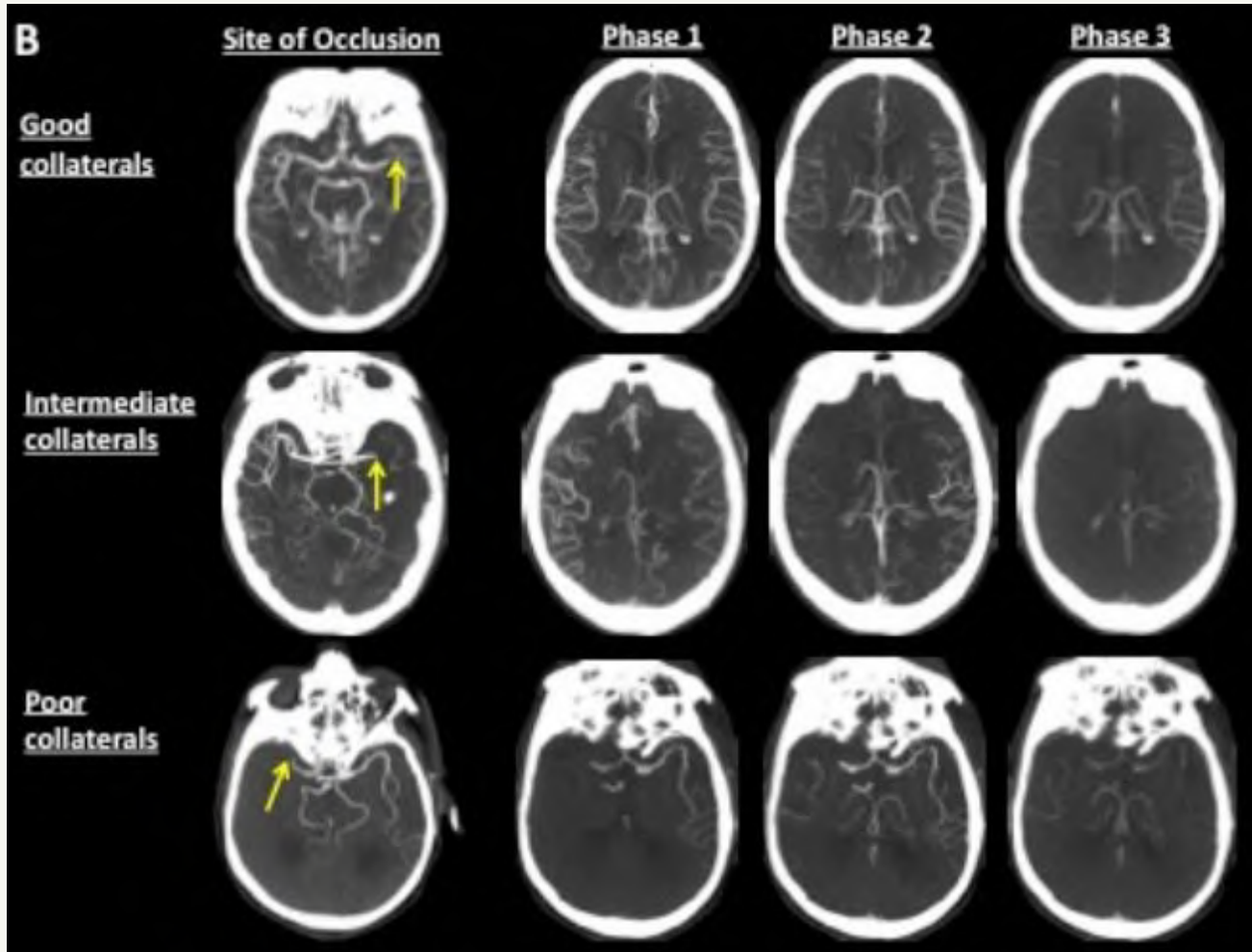
Outcomes in patients with Perfusion RAPID selection



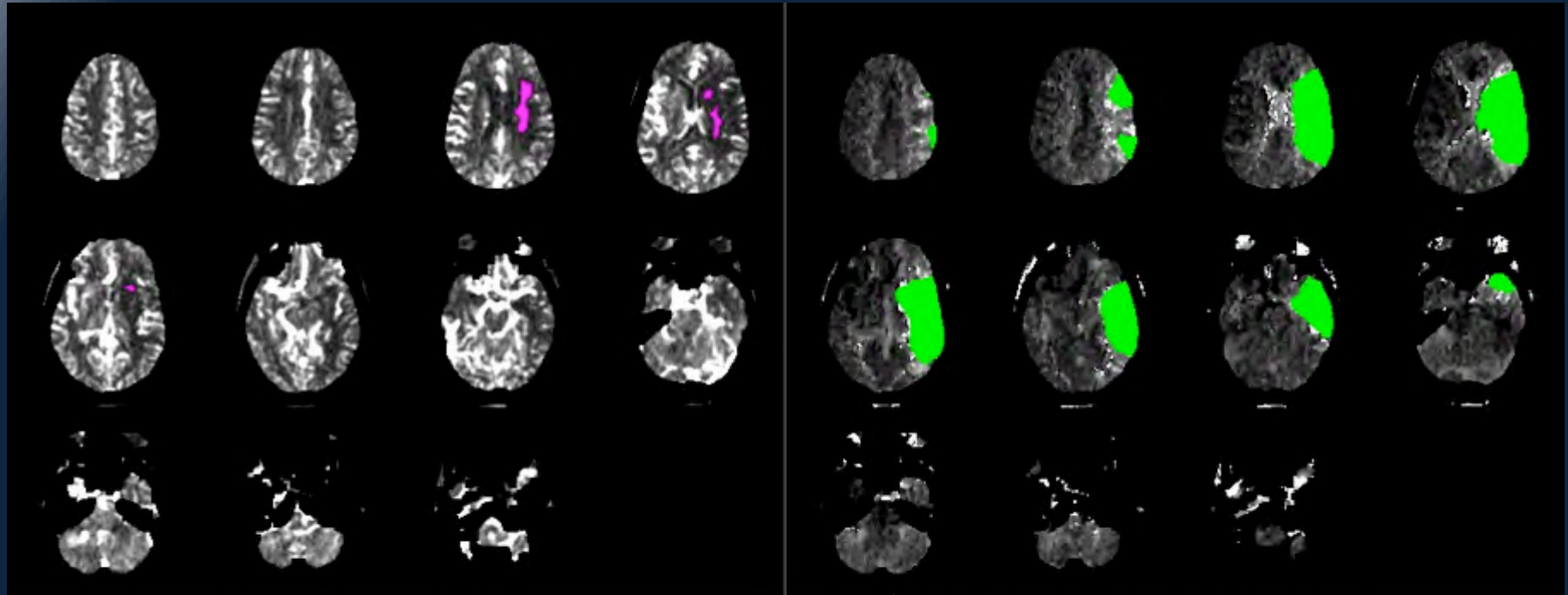
Perfusion RAPID selection: Core and Hypoperfusion volumes

	Baseline core volume, ml (median)	Hypoperfusion volume, ml (median)	24 hour 100% reperfusion (%)	median 27-hour infarct volume
EXTEND IA	12.3	106	100	18 (IQR 12-52)
SWIFT-PRIME	6	118	65.5	28 (IQR 12-78)

CT Angiography Collateral assessment



SWIFT PRIME: RAPID OUTPUT MAP



Estimated core 9 ml

Hypoperfusion ($T_{max} > 6s$) 172 ml

Mismatch volume: 163 ml

Mismatch ratio: 19.3

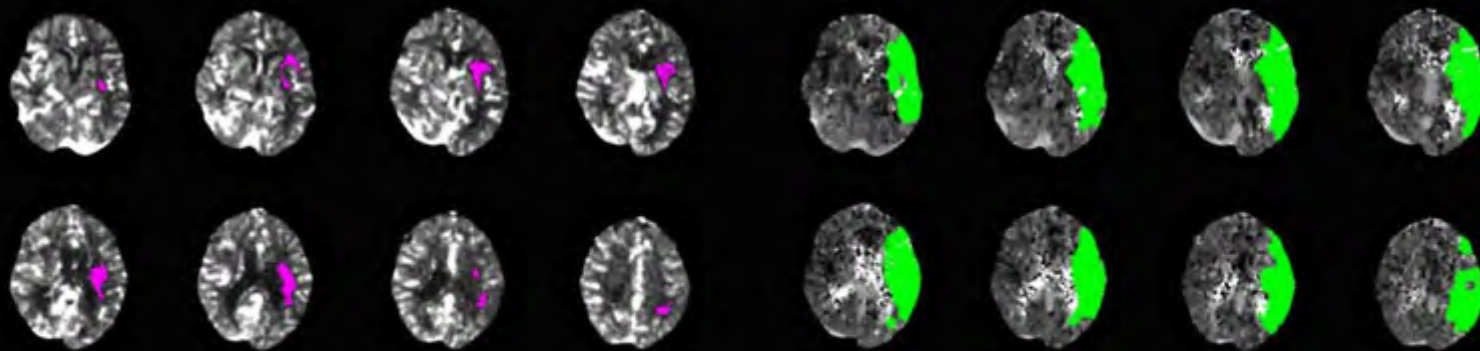
Estimated core $< 50ml$?: YES

Mismatch volume $\geq 15ml$ and ratio > 1.8 ?: YES

($T_{max} > 10s$) $\leq 100ml$?: YES

SWIFT PRIME CASE: SMALL CORE WITH COMEplete REPEFUSION

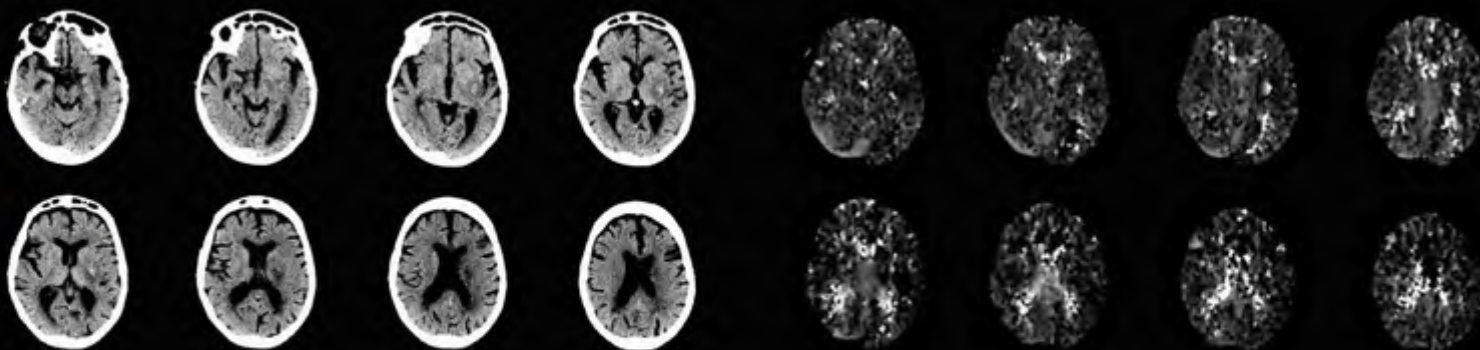
Baseline
CTP



CBF ($< 30\%$): 11 ml

Perfusion (Tmax $>6s$) volume: 151 ml

24 h Follow Up
CT/CTP

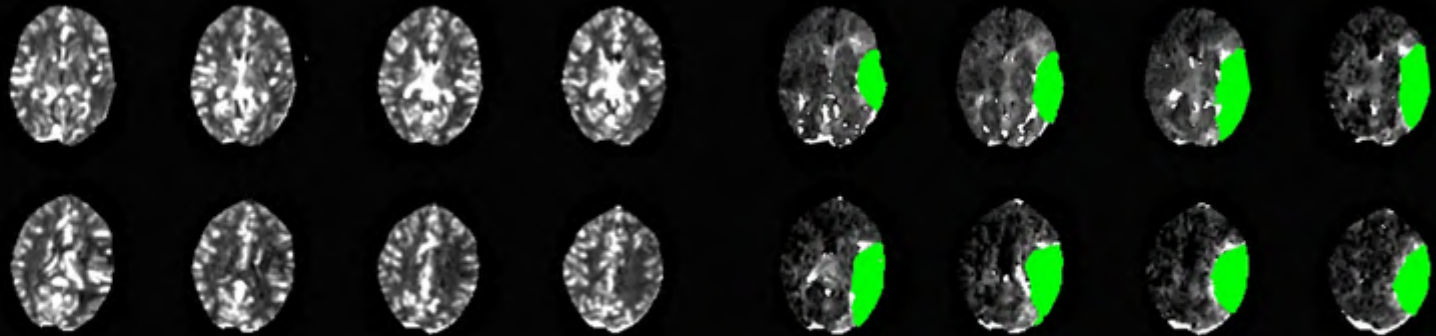


Infarct volume: 12 ml

100% Reperfusion

NO CORE WITH COMPLETE REPERFUSION

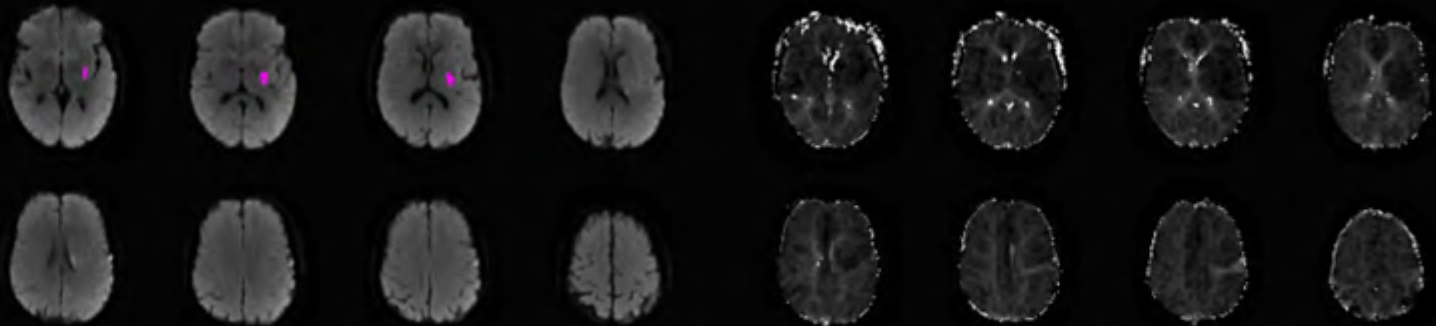
Baseline
CTP



CBF (0.3 threshold) 0 ml

Hypoperfusion (Tmax>6s) 135 ml

27 h Follow Up
MRI



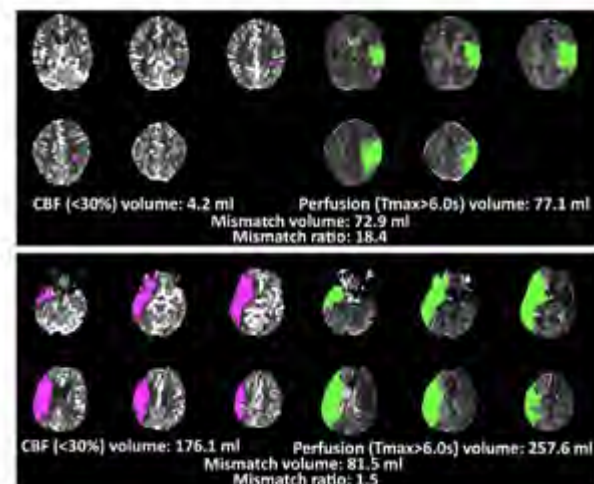
Infarct Volume ml

100% Reperfusion

Computed Tomographic Perfusion to Predict Response to Recanalization in Ischemic Stroke

Maarten G. Lansberg, MD, PhD,¹ Søren Christensen, PhD,¹ Stephanie Kemp,^{1*} Michael Mlynash, MD, MS,¹ Nishant Mishra, MD, PhD ¹ Christian Federau, MD,¹ Jenny P. Tsai, MD,¹ Sun Kim, MD,¹ Raul G. Nogueira, MD,² Tudor Jovin, MD,³ Thomas G. Devlin, MD,⁴ Naveed Akhtar, MD,⁵ Dileep R. Yavagal, MD,⁶ Diogo Haussen, MD,² Seena Dehkharghani, MD,² Roland Bammer, PhD,⁸ Matus Straka, PhD,⁷ Greg Zaharchuk, MD,⁸ Michael P. Marks, MD,⁸ and Gregory W. Albers, MD¹ for the CT Perfusion to Predict Response to Recanalization in Ischemic Stroke Project (CRISP) Investigators

RESULTS of revascularization



ANN NEUROL 2017;00:000–000

DAWN Clinical Trial: 6-24 hour window

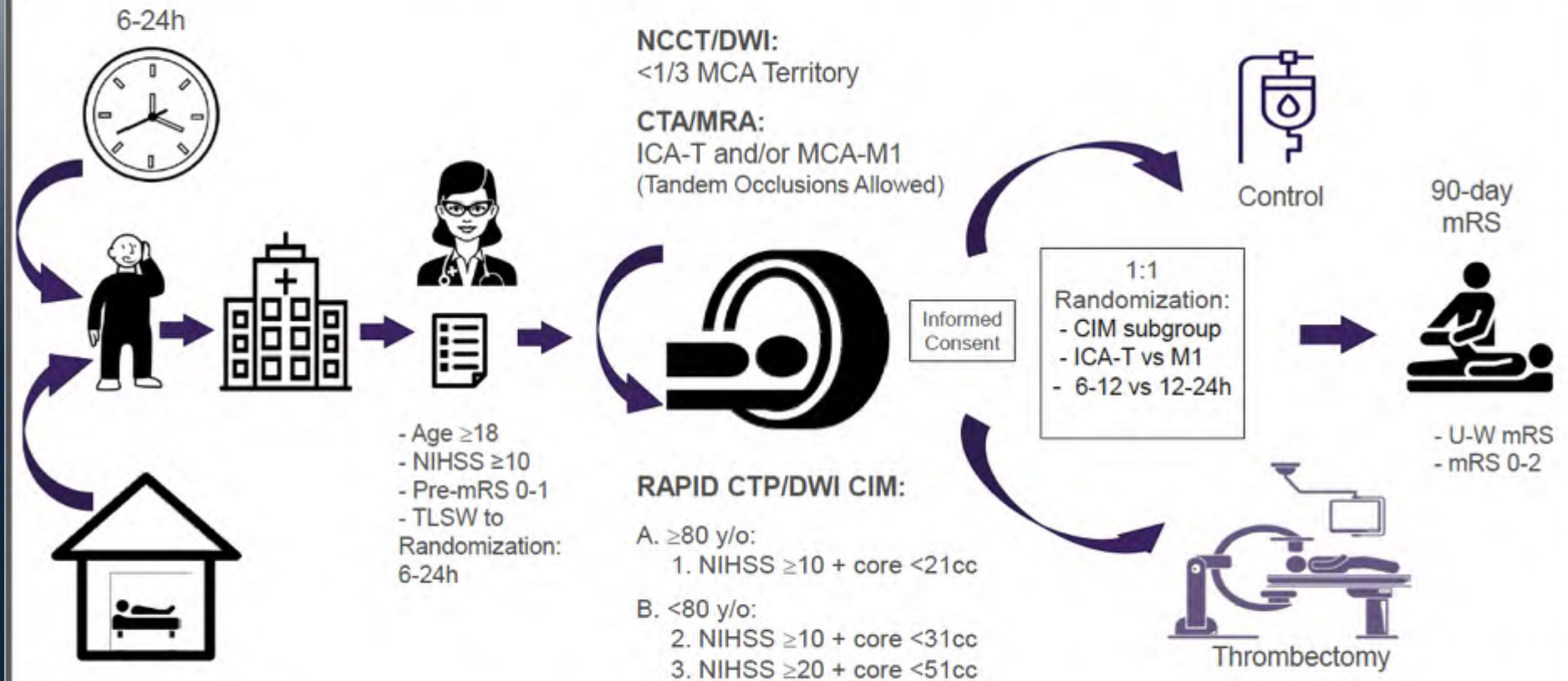
Study Objective

To demonstrate superior functional outcomes at 90 days with Trevo plus medical management compared to medical management alone in appropriately selected patients treated six to 24 hours after last seen well

Study Design

Study design	Global, multi-center, adaptive, population enrichment, prospective, randomized, open, blinded endpoint (PROBE), controlled FDA IDE trial
Patient population	• Acute ischemic stroke (AIS) with large vessel occlusion • Able to be randomized between six to 24 hours after time last known well • Clinical imaging mismatch (CIM) defined by age, core, and NIHSS
Target vessel	Intracranial ICA, M1 segment of the MCA
Randomization	1:1 Trevo + medical management vs. medical management alone
Sites	Up to 50 sites worldwide (30 US and 20 international)
Sample size	500 maximum subjects: 250 in the treatment arm and 250 in the control arm. Minimum sample size is 150 subjects.
Follow-up	24 hours (-6/+24), day 5-7/discharge, day 30 ($\pm$ 14), and day 90 ($\pm$ 14)

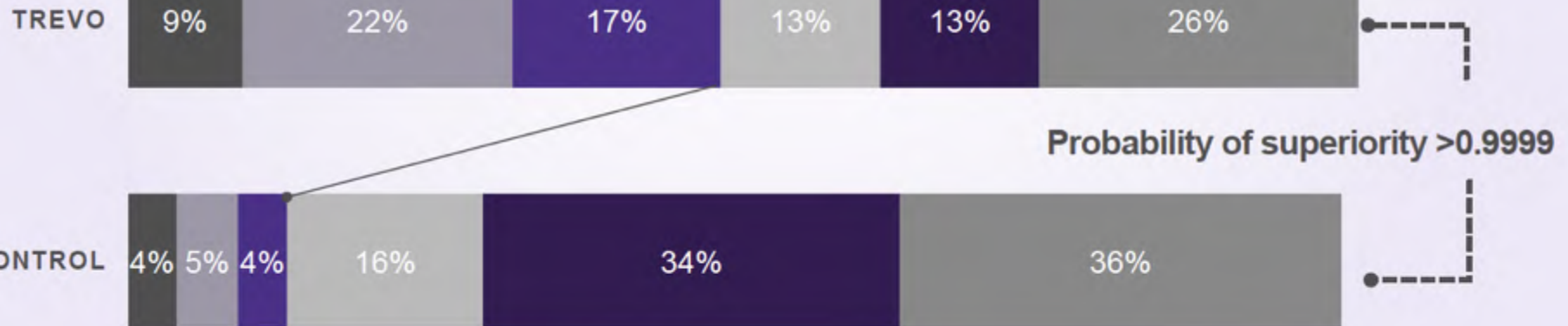
Study Methods: Workflow



DAWN: MT significantly beneficial in 6-24 hour window

Primary outcome

■ mRS 0/uW mRS 10 ■ mRS 1/uW mRS 9.1 ■ mRS 2/ uW mRS 7.6
■ mRS 3/ uW mRS 6.5 ■ mRS 4/ uW mRS 3.3 ■ mRS 5-6/ uW mRS 0



73% relative risk reduction of dependency in ADL's
NNT for any lower disability 2.0



DAWN: Results

Co-primary endpoints

	Trevo	MM	Treatment benefit (95% CI)	Bayesian probability of superiority
Day 90 weighted mRS	5.5 ± 3.8	3.4 ± 3.1	2.1 (1.20, 3.12)	>0.9999*
Day 90 mRS (0-2)	48.6%	13.1%	35.5% (23.9%, 47.0%)	>0.9999*

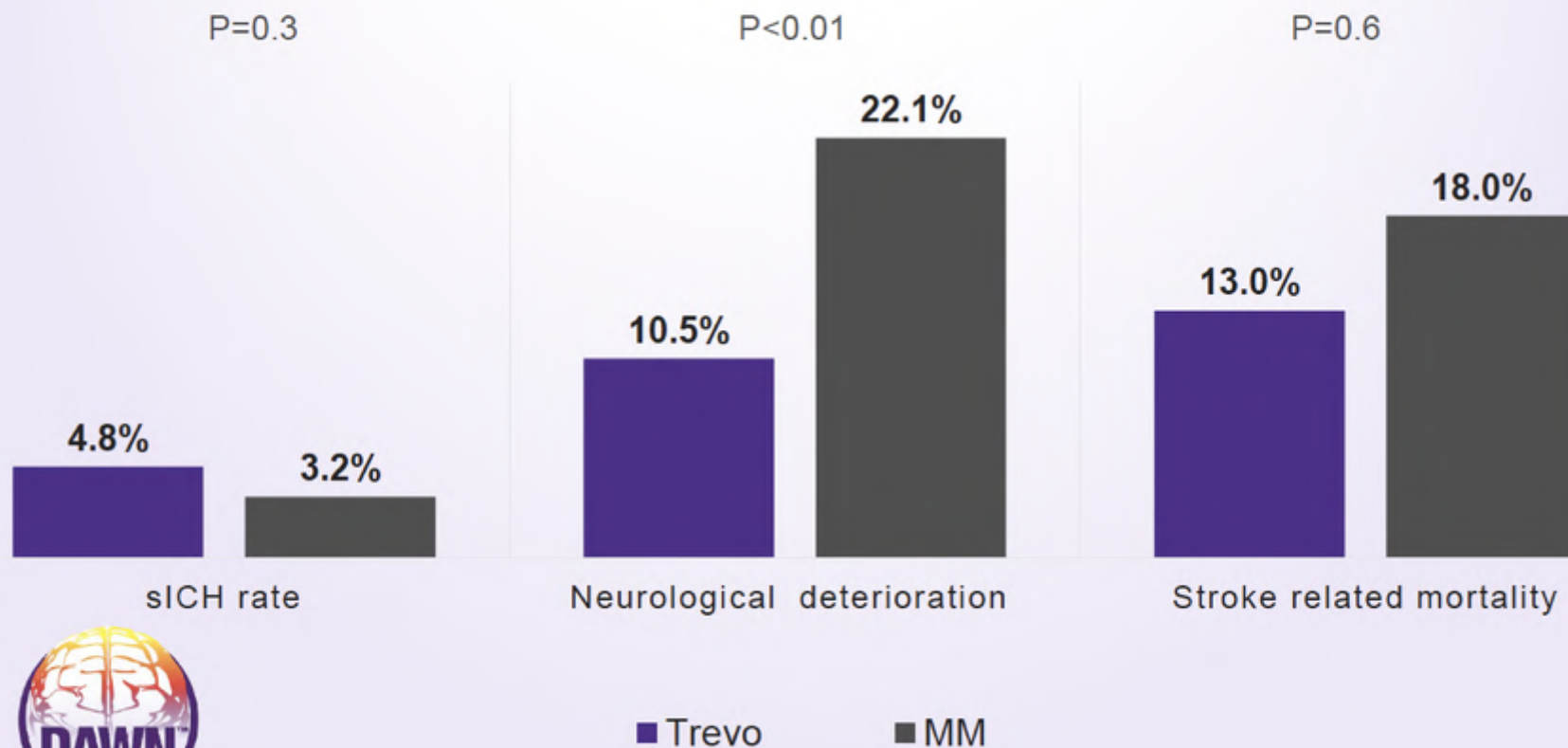
NNT for 90-day functional independence = 2.8



*Similar to $p < 0.0001$

DAWN: Safety Results

CEC adjudicated safety outcomes



DAWN: Conclusions

Conclusions

- Thrombectomy with Trevo in DAWN-eligible patients is associated with improvement in clinical outcomes across the entire range of utility weighted mRS and with higher rates of functional independence (mRS 0-2) compared to standard medical therapy (48.6% vs 13.1%, probability of superiority >0.999, NNT = 2.8)
- The treatment effect size in DAWN is the highest out of any stroke trials to date and suggests that the presence of Clinical-Core Mismatch is a critical predictor of treatment effect independent of time to presentation
- Treatment effect persisted throughout 24 hours from TLKW; however, earlier treated patients do better
- Thrombectomy with the Trevo device in patients presenting beyond 6 hours of TLSW had comparable safety profile to thrombectomy performed within 6 hours



Current UHealth Acute Stroke Imaging Selection Protocol

8/8 Rule

A. 0-6h, → Non-Contrast CT ASPECTS, → CTA H & N → Angio

A. → Non-Contrast CT ASPECTS, → HD-MCA on MIPS → Angio

B. >6h or Wake up Stroke → CTA/CTP or DWI/MRA → Angio

UM-JMH Acute Ischemic Stroke Rx Time Windows (1-888-UM-STROK)

- 0-4.5 h: IV tPA → **CT ASPECTS/CTA** → $\pm$ MT
- 4.5-6 h: **CT ASPECTS/CTA** → $\pm$ MT
 - → Non-Contrast CT ASPECTS, → HD-MCA on MIPS → Angio
- 6-24h/Wake-up : CTA+ CTP or **DWI/MRA** → $\pm$ MT

MT = Mechanical Thrombectomy

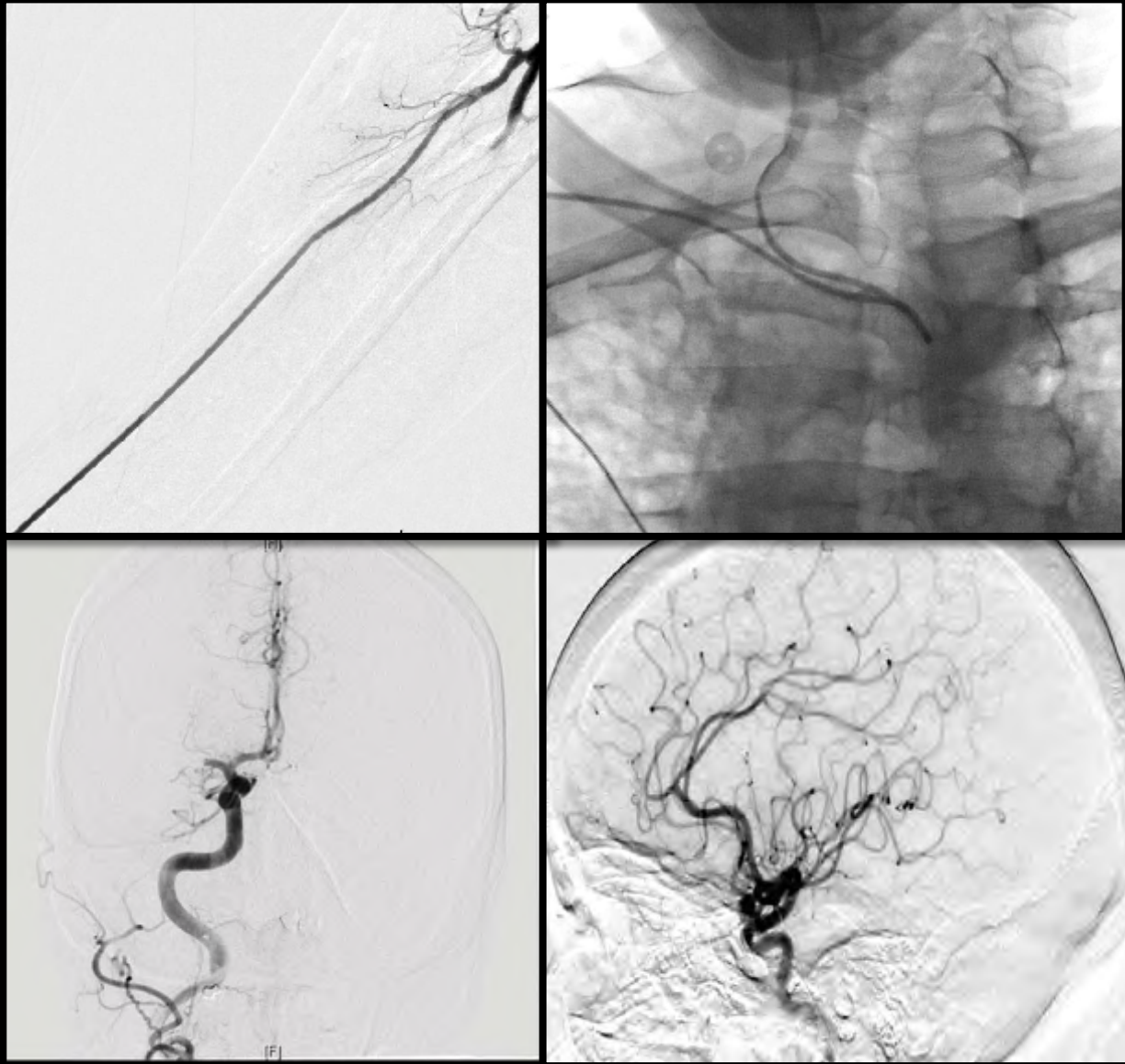
Advances in MT: On the Horizon

- Transradial & Direct Carotid Access
- Expansion of Time Window: 12h, 24h, Wake-up Stroke
 - DAWN study, DEFUSE 3, POSITIVE
- New Devices: Embotrap



Transradial Access to Mechanical Thrombectomy

A



Embotrap: ARISE2 completed enrollment Feb 2017



The image shows a medical device, the EmboTrap II, which is a catheter with a series of overlapping, mesh-like filters. The device is shown in a 3D perspective view, with the filters arranged in a line. The background is a solid blue color.

emboTrap[®] II
Revascularization Device

Click buttons for more info

- Rapid Flow Restoration **FLOW**
- Open Design to Trap Inside **TRAP**
- Distal and New Territory Protection **PROTECT**

Summary: Take Home Points

1. MT with IVtPA is immensely effective for large vessel occlusion (LVO) stroke and safe across age and stroke severity
2. Outcomes from MT are extremely time sensitive and the impact of delay is unlike any emergency we are used to
3. Strategies to cut minutes and seconds at every step can mean a difference between a patient walking vs wheelchair

4. Distal occlusions may be effectively treated with MT but likely need randomized trials
5. Posterior circulation occlusions very likely benefit from MT. A RCT may be unethical.

d

Mission Thrombectomy 2020
(MT 2020): 20,2000 Thrombectomies /Year
worldwide by 2020



Thank you!

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