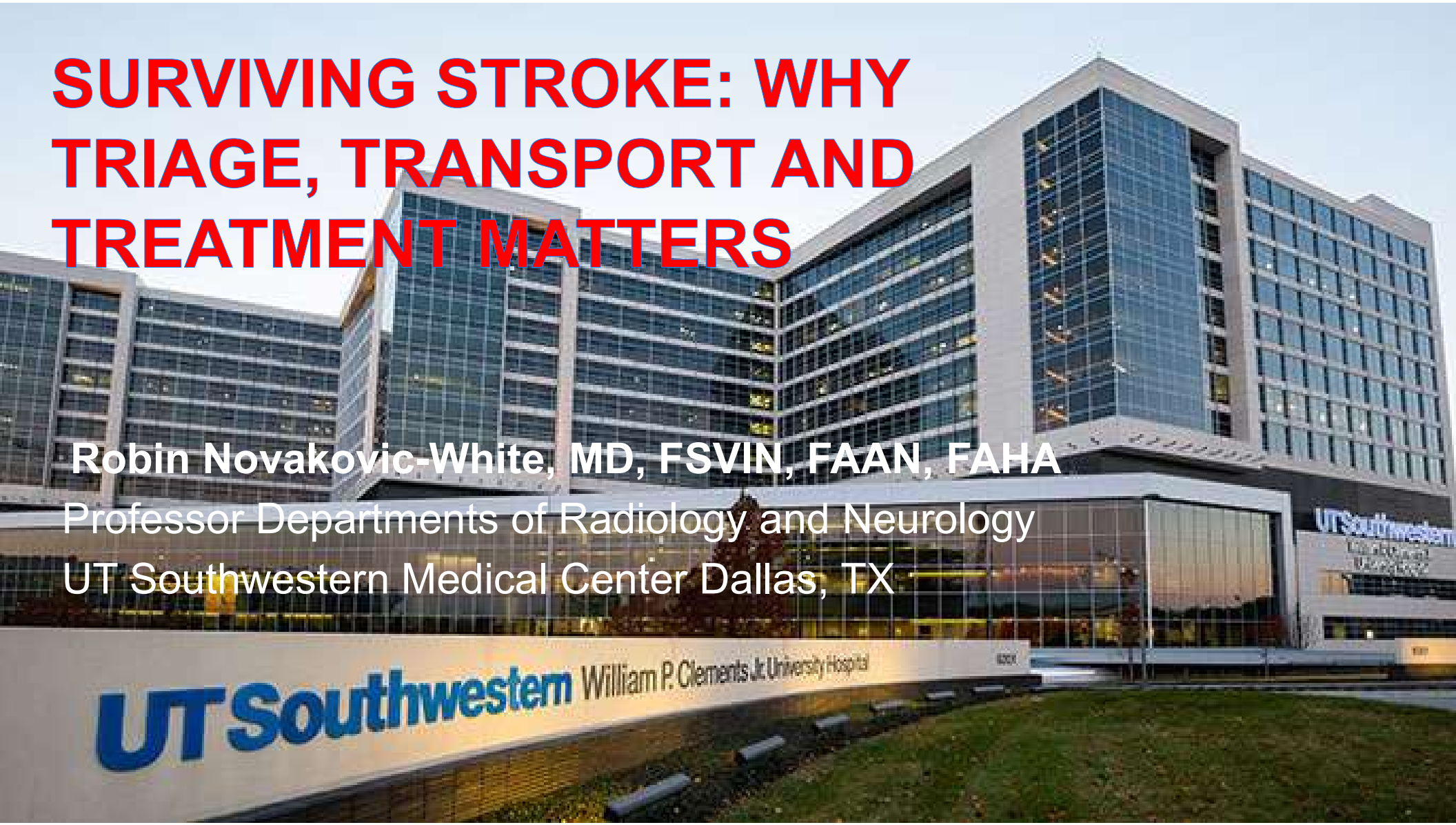
SURVIVING STROKE: WHY TRIAGE, TRANSPORT AND TREATMENT MATTERS



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Dr. Robin Novakovic-White Disclosures

	No, nothing to disclose
x	Yes, please specify:

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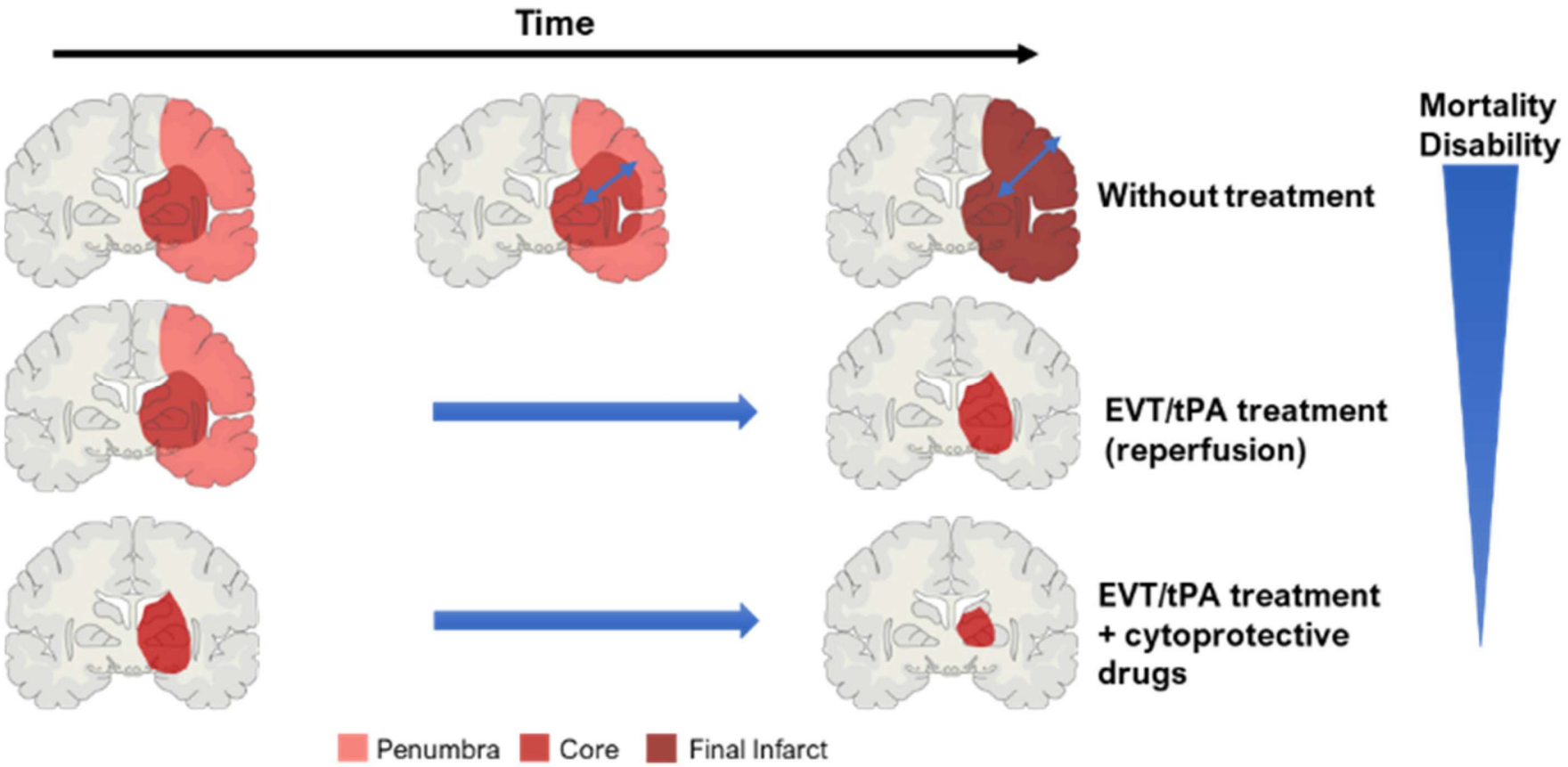
AHA - S:VIN Journal								Commission Editor
Aidoc		X			X			

Objectives

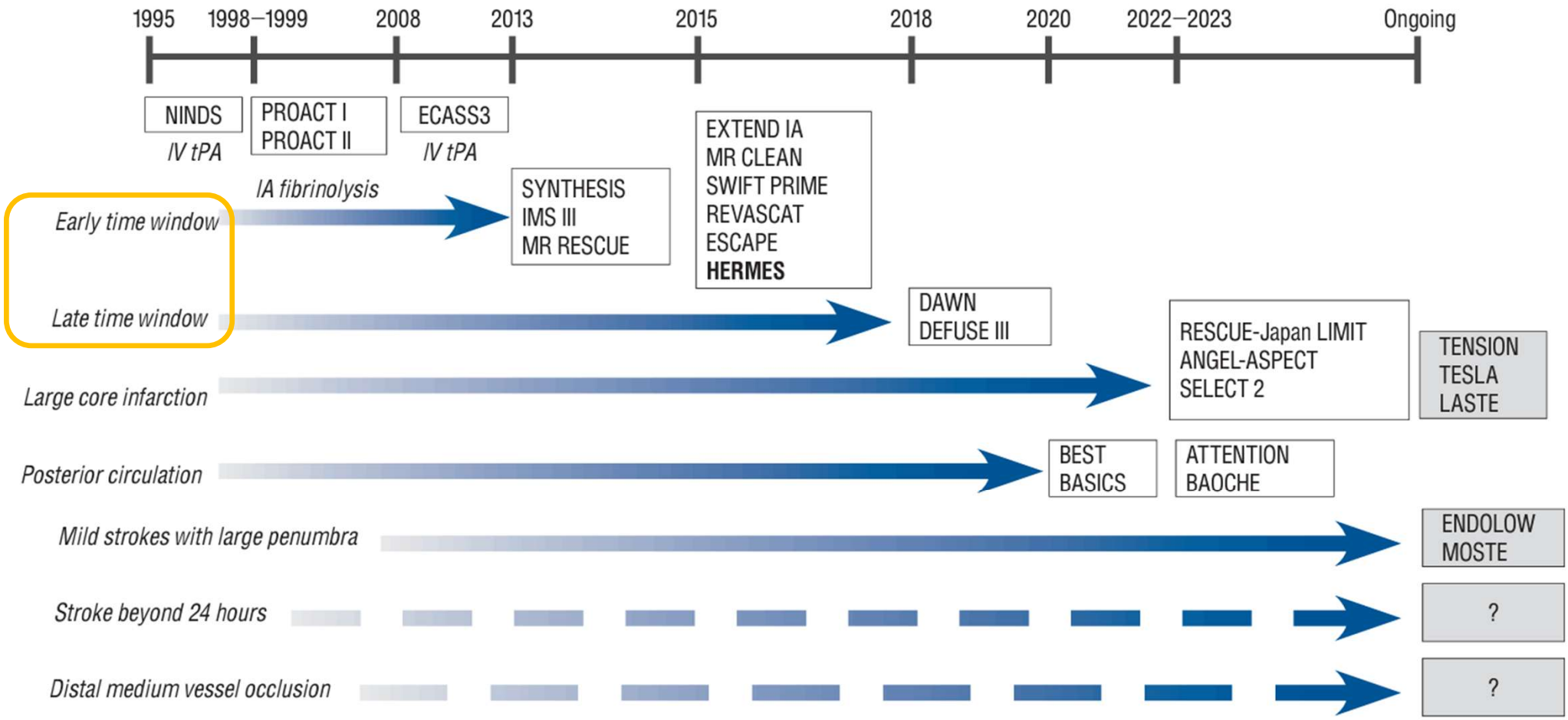
- Review current indications for endovascular thrombectomy
- Recognize the role for endovascular treatment in expanded settings of:
  - large core infarcts
  - basilar occlusion
  - low NIHSS, with large penumbra
  - distal vessel occlusion
- Discuss the role of AI and workflow optimization in acute ischemic stroke

Stroke Progression



Biomedicines. 2022;*10:*2561.

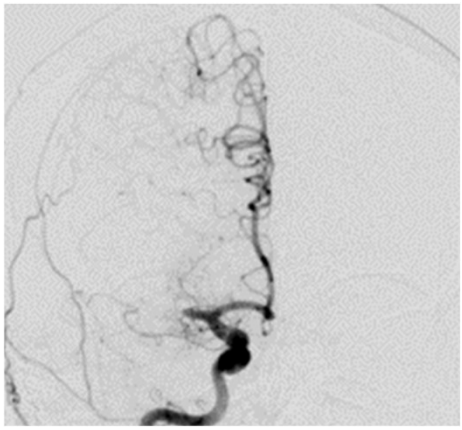
Thrombectomy basics

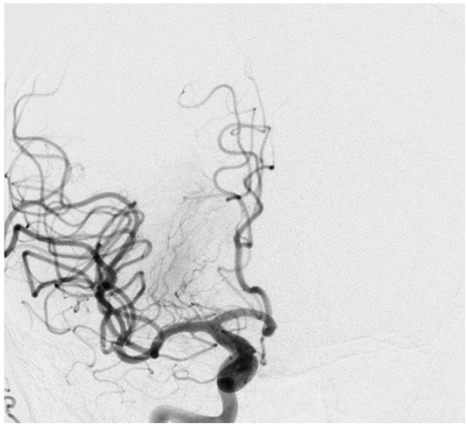

1995
1998–1999
2008
2013
2015
2018
2020
2022–2023
Ongoing
NINDS
IV tPA
PROACT I
PROACT II
ECASS3
IV tPA
IA fibrinolysis
SYNTHESIS
IMS III
MR RESCUE
EXTEND IA
MR CLEAN
SWIFT PRIME
REVASCAT
ESCAPE
HERMES
Early time window
Late time window
DAWN
DEFUSE III
RESCUE-Japan LIMIT
ANGEL-ASPECT
SELECT 2
TENSION
TESLA
LASTE
Large core infarction
Posterior circulation
BEST
BASICS
ATTENTION
BAOCHE
Mild strokes with large penumbra
ENDOLOW
MOSTE
Stroke beyond 24 hours
?
Distal medium vessel occlusion
?

Current AHA/ASA Guidelines

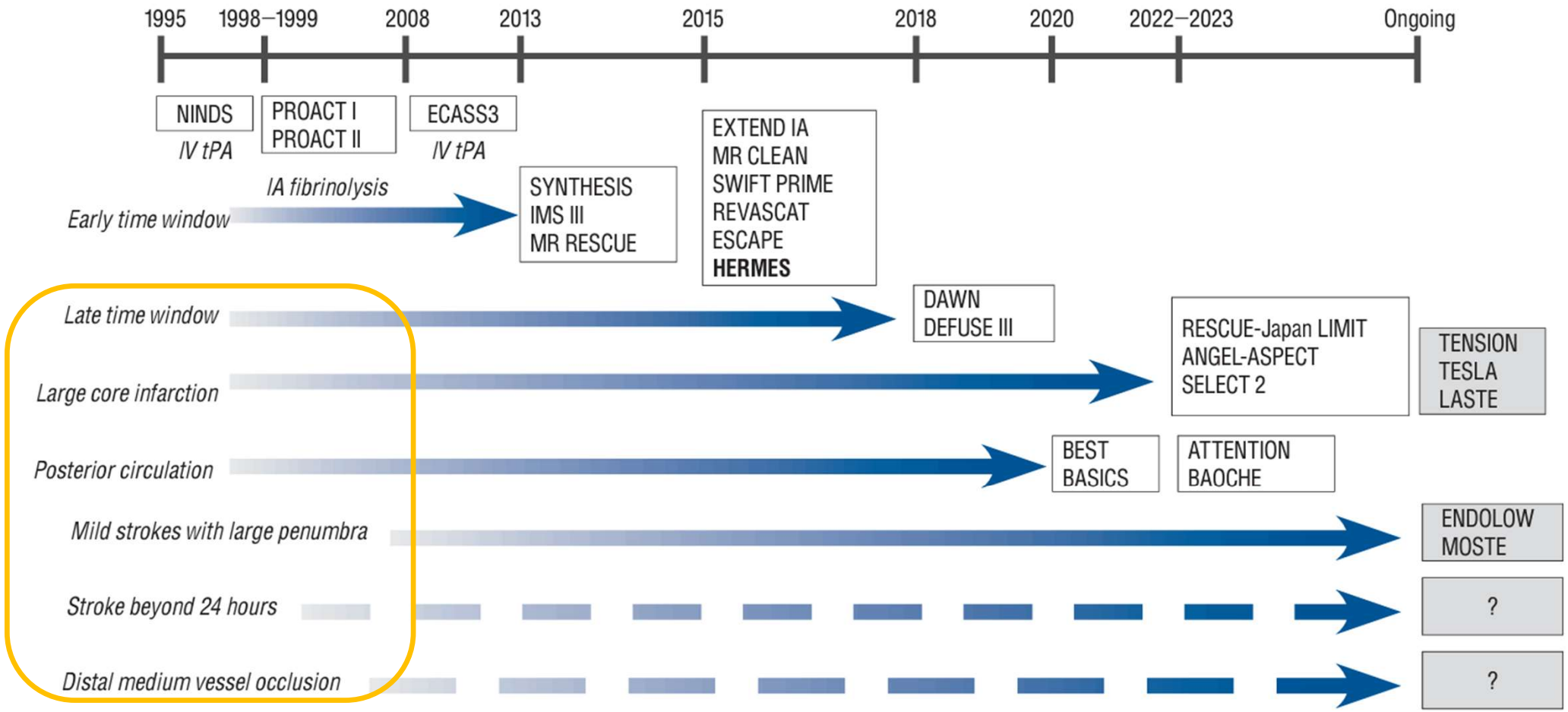
- 2015: ICA/M1, within 6 hrs, NIHSS ≥6, ASPECT ≥6
  - –Improved mRS 90days, no significant safety concerns
  - –Class *I Level A*
- 2018: within 24hrs if core-penumbra mismatch

3.7. Mechanical Thrombectomy (Continued)	COR	LOE
7. In selected patients with AIS within 6 to 16 hours of last known normal who have LVO in the anterior circulation and meet other DAWN or DEFUSE 3 eligibility criteria, mechanical thrombectomy is recommended.	I	A
8. In selected patients with AIS within 6 to 24 hours of last known normal who have LVO in the anterior circulation and meet other DAWN eligibility criteria, mechanical thrombectomy is reasonable.	IIa	B-R





Stroke. 2015; 46:3020-34.
Stroke. 2018; 49:e46-99.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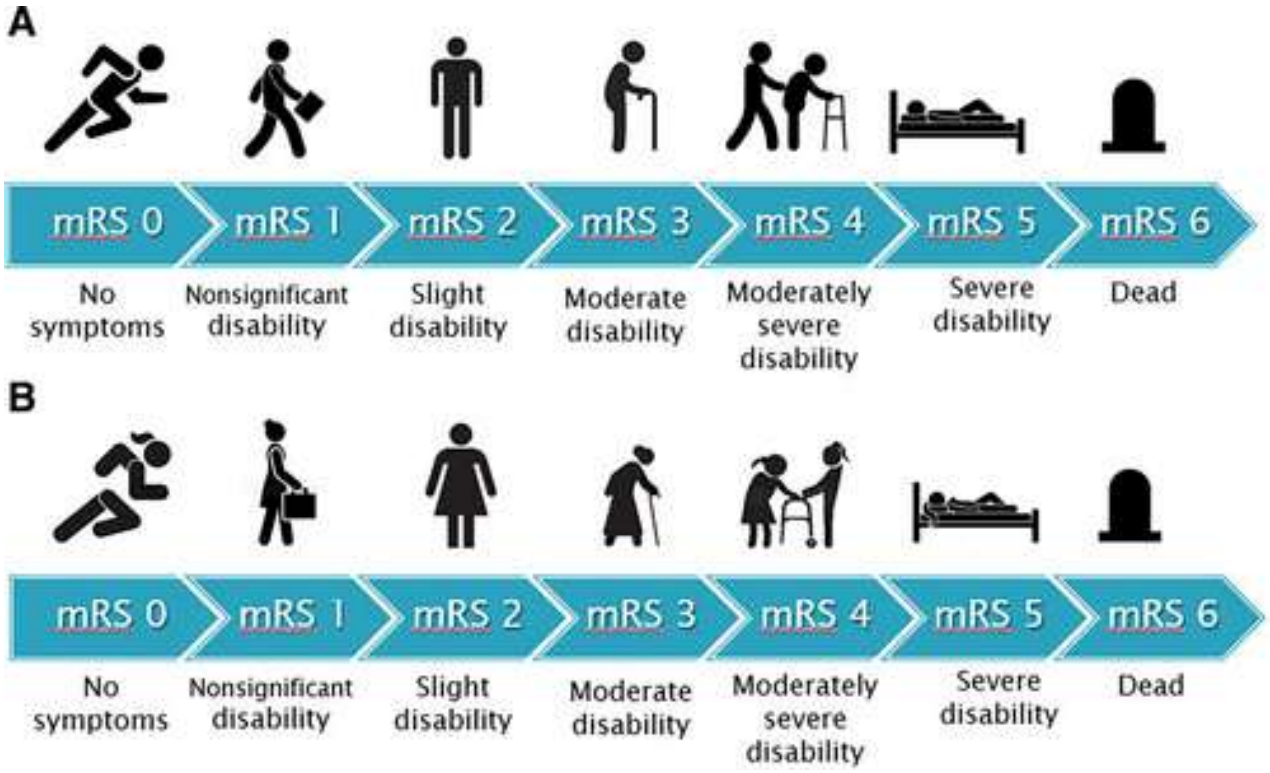
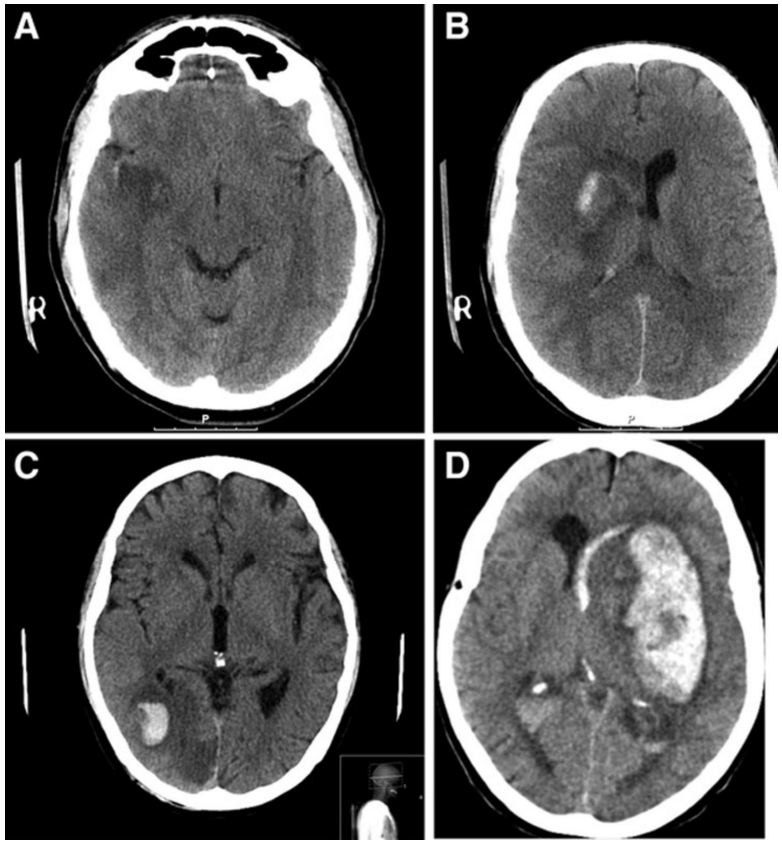
?
Distal medium vessel occlusion
?

Modified Rankin Scale (mRS)



Hemorrhage Classifications

- Heidelberg Classification
  - –A: HI1 scattered petechiae
  - –B: HI2 confluent petechiae
  - –C: PH1 <30% infarct, no mass effect
  - –D: PH2 ≥30% infarct + mass effect
- ECASSIII
  - –sICH: any hemorrhage associated with ≥4pt increase in NIHSS or death
- SITS-MOST
  - –sICH: PH2 at 22-36hrs associated with ≥4pt increase in NIHSS or death



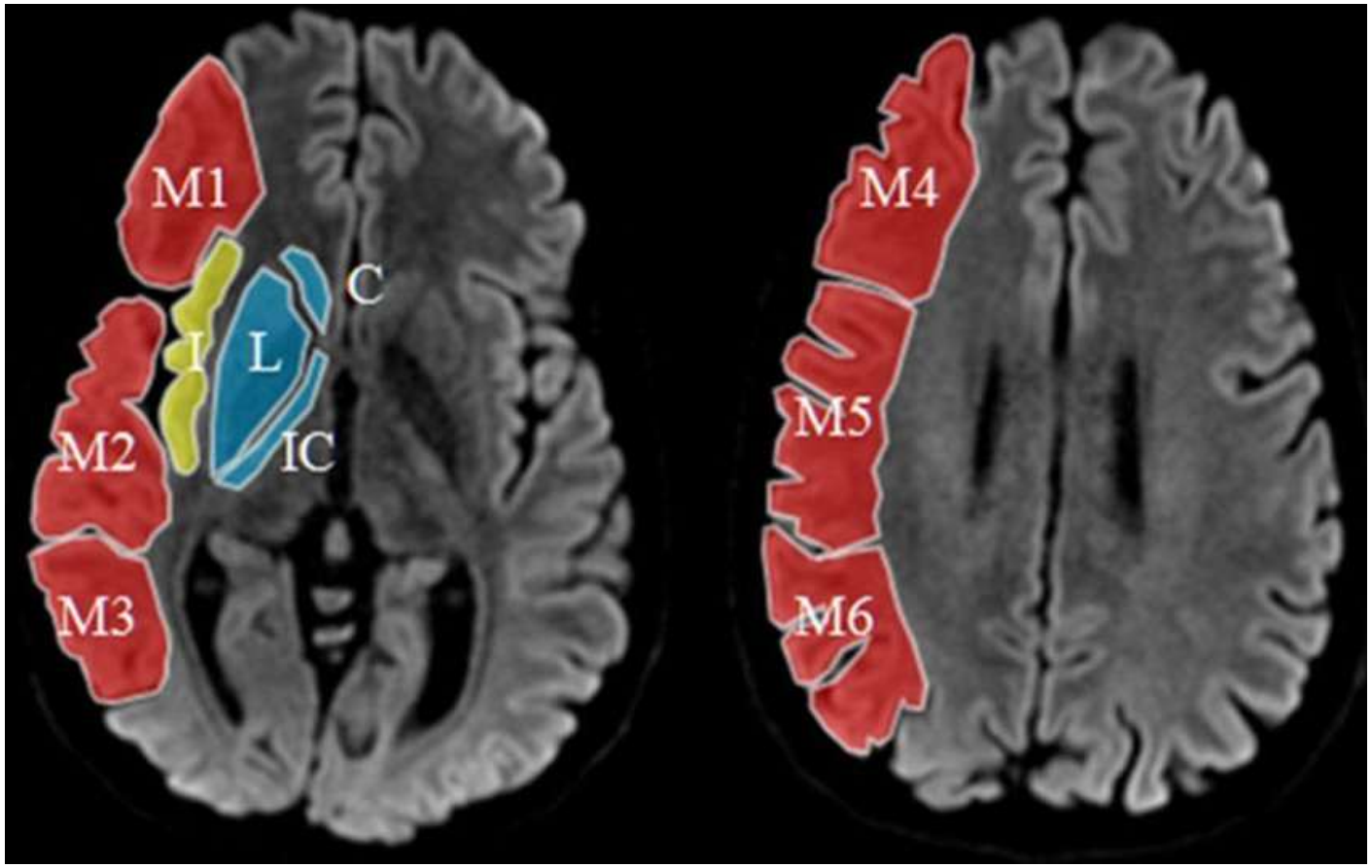
Stroke. 2015;46:2981–2986
N Engl J Med 2008; 359:1317-1329
Lancet 2007;369:275-282

Thrombectomy for Large Core

Thrombectomy for Large Core

- 6 RCTs enrolled large core infarcts
- ICA, M1 occlusions
- Within 24 hrs of LSW
- Core size by CT ASPECT, CT Perfusion, MRI
- Outcomes: mRS, sICH, mortality

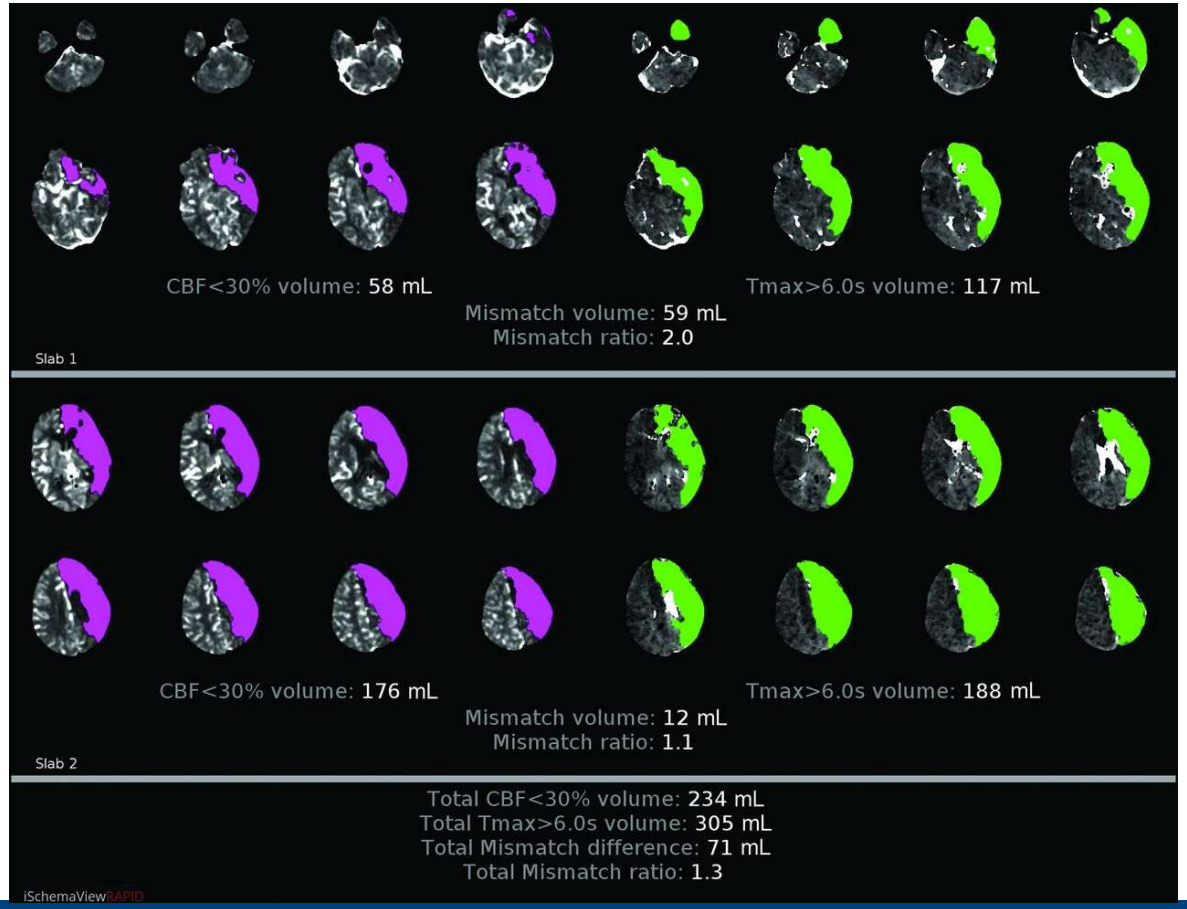
ASPECT scoring



- C – Caudate
- I – Insular ribbon
- IC – Internal Capsule
- L – Lentiform
- M1 – Anterior MCA Cortex
- M2 – MCA cortex lateral to the insular ribbon
- M3 – Posterior MCA cortex
- M4 – Anterior MCA superior territory
- M5 – Lateral MCA superior territory
- M6 – Posterior MCA superior territory

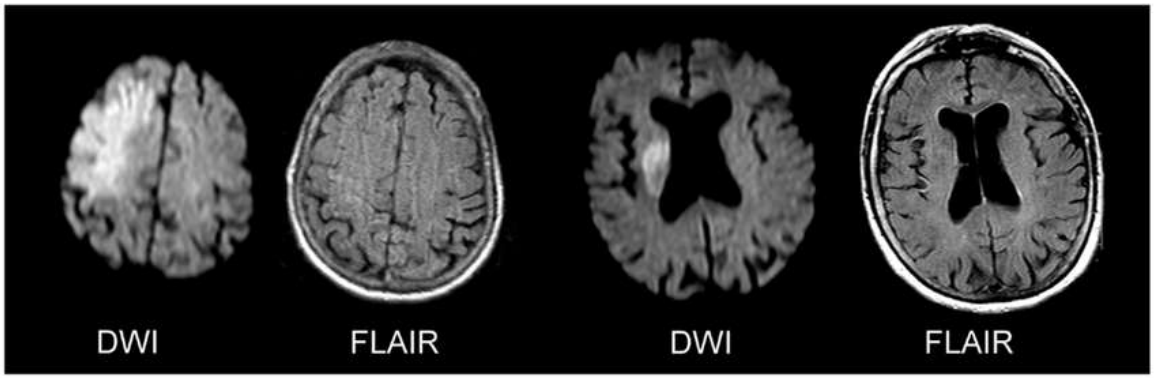
Stroke. 2016;47:1553-1558

CTP Core-Penumbra Imaging (RAPID)

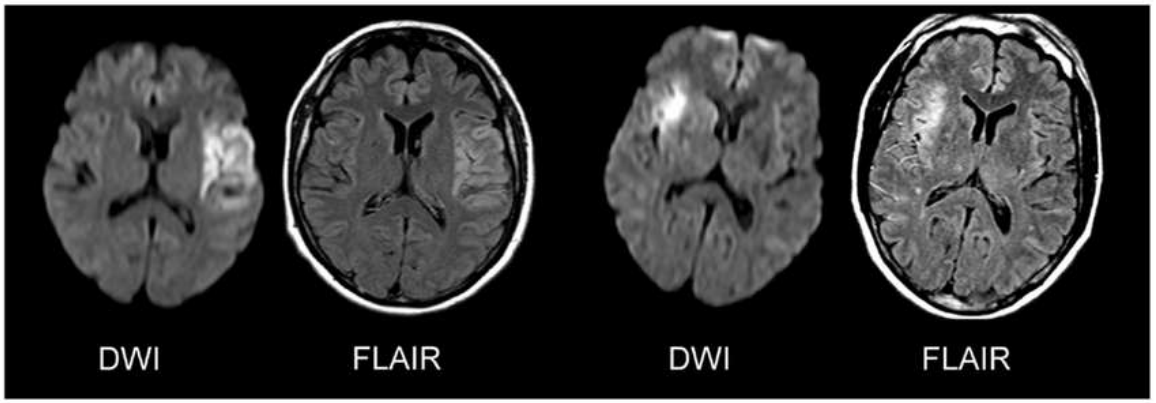


MRI Core Imaging

DWI-FLAIR-mismatch

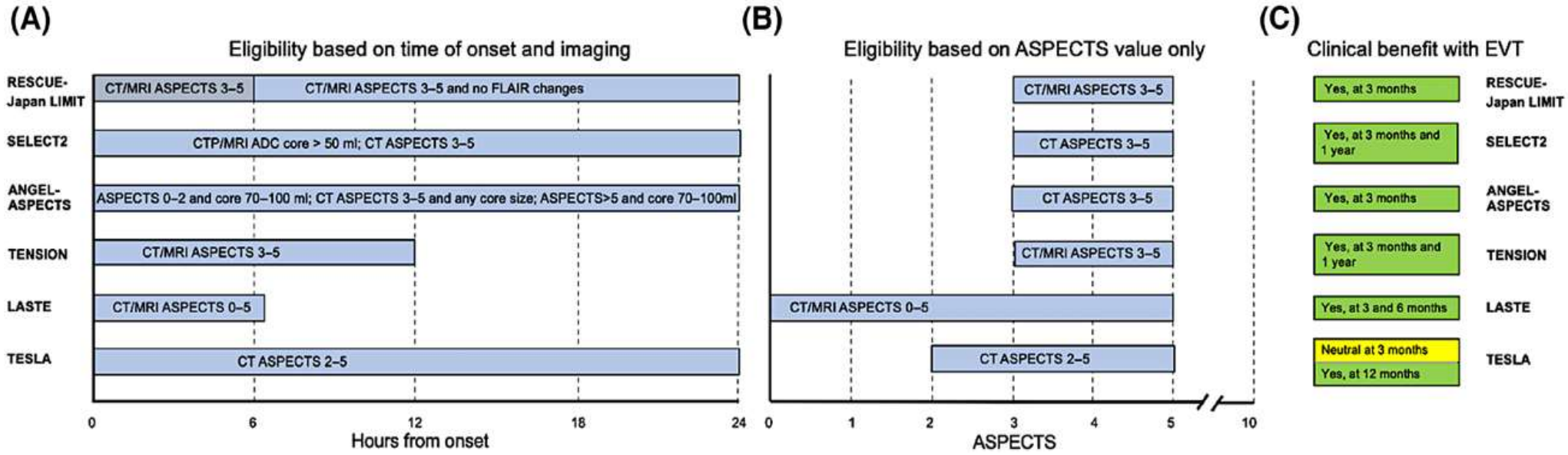


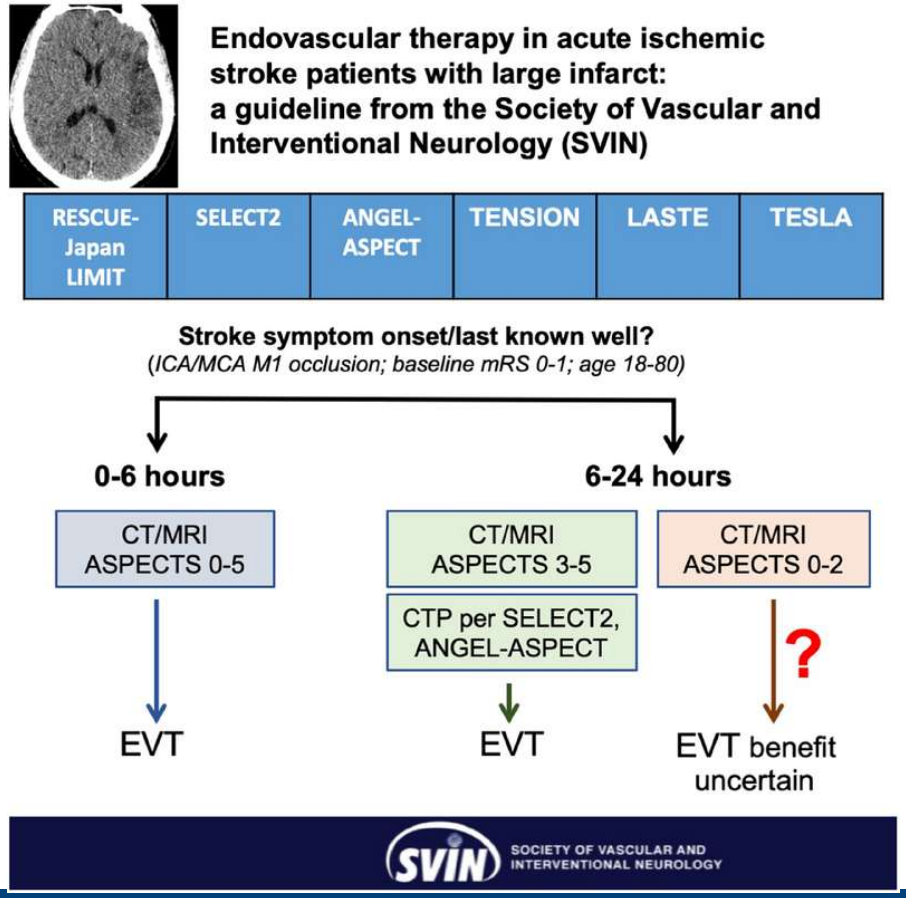
No DWI-FLAIR-mismatch



Frontiers Neurol. 2014; F185:117

Thrombectomy for Large Core

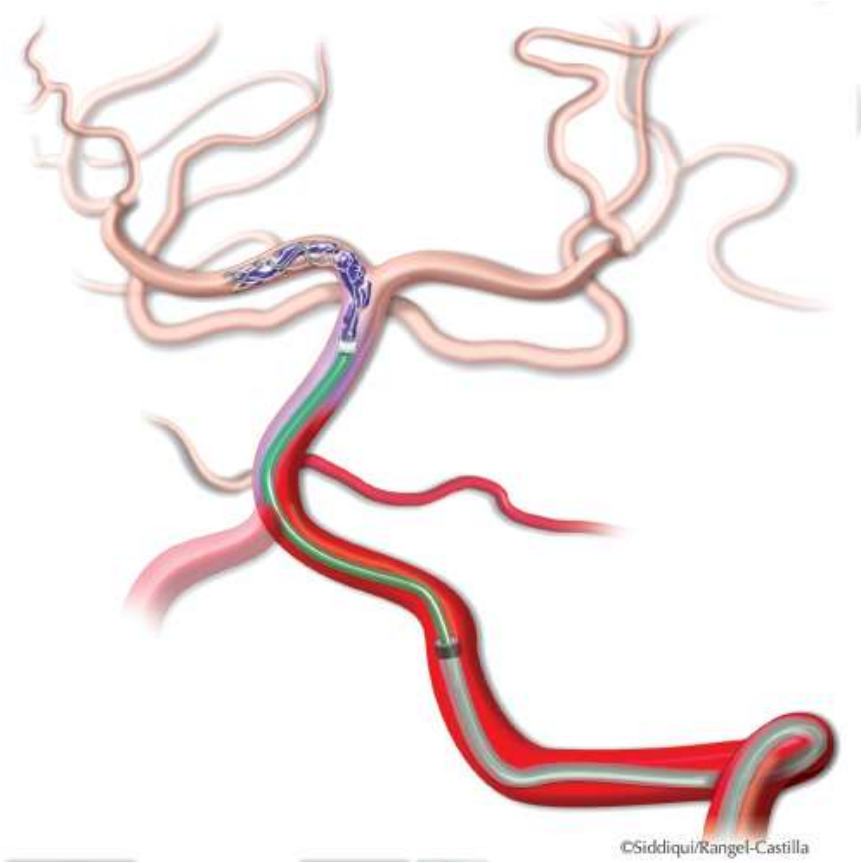


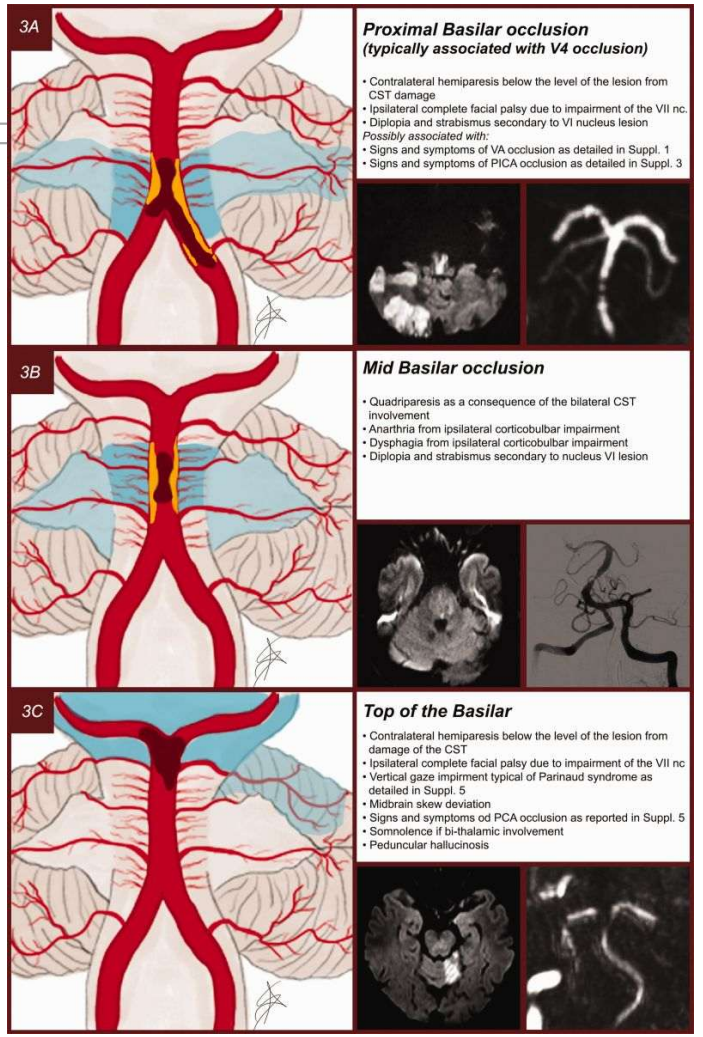


- Despite increased hemorrhage rates
- Benefit of thrombectomy for large core infarcts, up to 24hrs

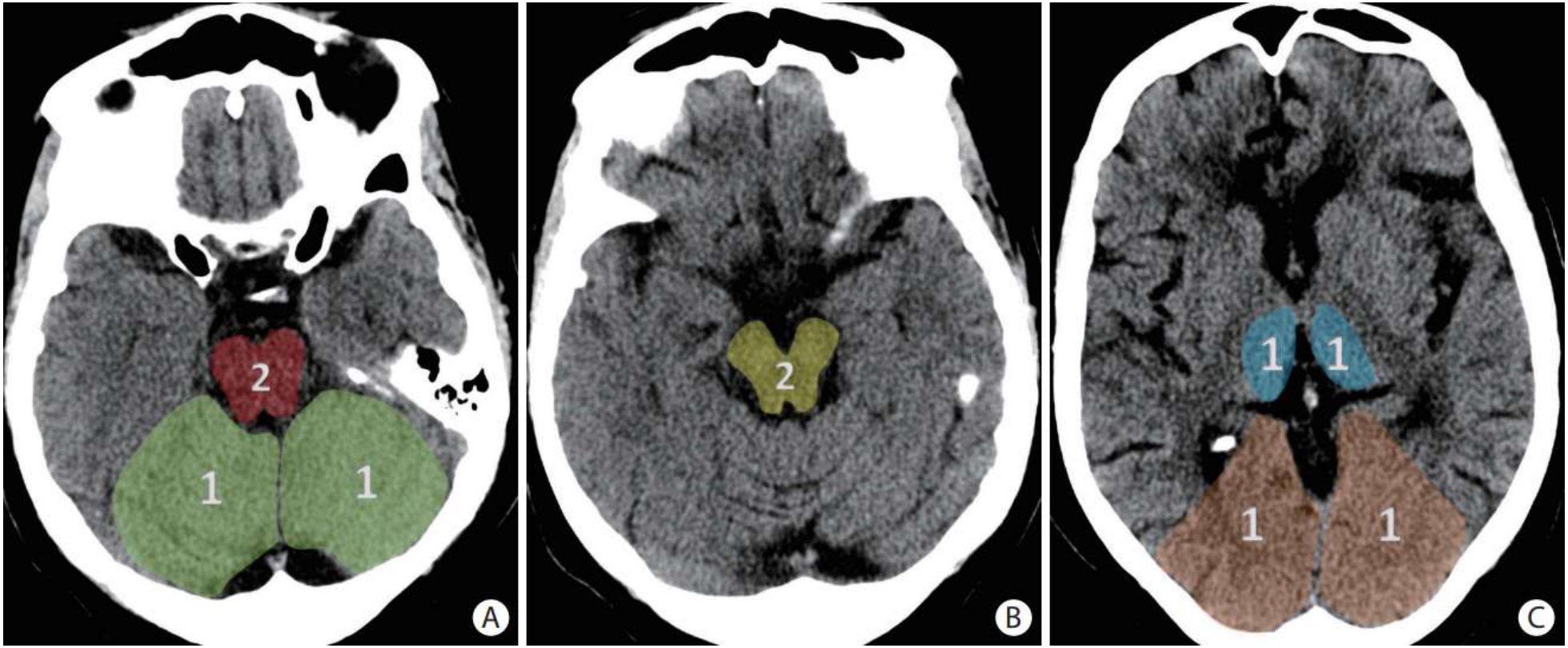
Basilar Artery Thrombectomy

Basilar thrombectomy





pcASPECT

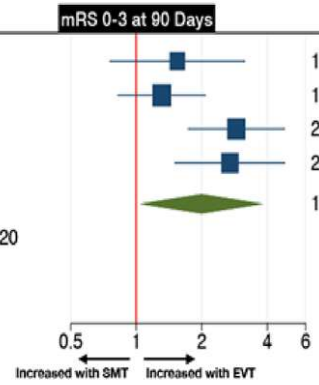


Basilar occlusion

(A)

Study	EVT Yes	EVT No	SMT Yes	SMT No	Odds ratio with 95% CI	Weight (%)
BEST	28	38	21	44	1.54 [0.76, 3.15]	19.42
BASICS	68	86	55	91	1.31 [0.82, 2.08]	29.28
ATTENTION	104	122	26	88	2.89 [1.73, 4.80]	27.11
BAOCHE	51	59	26	81	2.69 [1.51, 4.81]	24.19
Overall					1.99 [1.04, 3.80]	

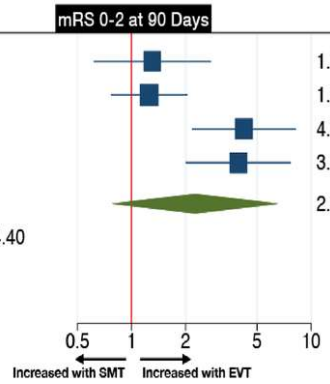
Heterogeneity: $\tau^2 = 0.10$, $I^2 = 54.65\%$, $H^2 = 2.20$
Test of $\theta_i = \theta_j$: Q(3) = 6.74, p = 0.08
Test of $\theta = 0$: t(3) = 3.28, p = 0.00
Random-effects REML model
Knapp-Hartung standard errors



(B)

Study	EVT Yes	EVT No	SMT Yes	SMT No	Odds ratio with 95% CI	Weight (%)
BEST	22	44	18	47	1.31 [0.62, 2.75]	23.06
BASICS	54	100	44	102	1.25 [0.77, 2.03]	27.78
ATTENTION	75	151	12	102	4.22 [2.18, 8.16]	24.65
BAOCHE	43	67	15	92	3.94 [2.02, 7.67]	24.51
Overall					2.26 [0.78, 6.57]	

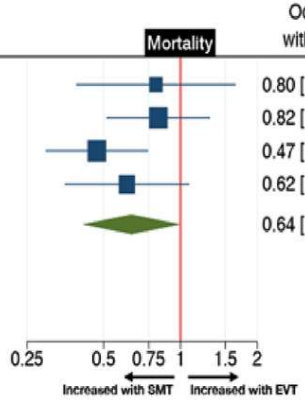
Heterogeneity: $\tau^2 = 0.35$, $I^2 = 77.26\%$, $H^2 = 4.40$
Test of $\theta_i = \theta_j$: Q(3) = 13.67, p = 0.00
Test of $\theta = 0$: t(3) = 2.42, p = 0.02
Random-effects REML model
Knapp-Hartung standard errors



(C)

Study	EVT Yes	EVT No	SMT Yes	SMT No	Odds ratio with 95% CI	Weight (%)
BEST	22	44	25	40	0.80 [0.39, 1.64]	14.89
BASICS	59	95	63	83	0.82 [0.52, 1.30]	30.93
ATTENTION	83	143	63	51	0.47 [0.30, 0.74]	31.31
BAOCHE	34	76	45	62	0.62 [0.35, 1.08]	22.86
Overall					0.64 [0.42, 0.99]	

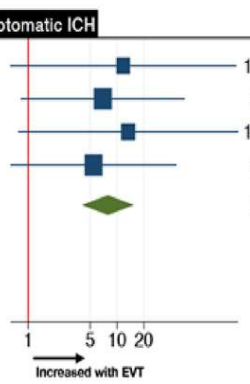
Heterogeneity: $\tau^2 = 0.02$, $I^2 = 18.61\%$, $H^2 = 1.23$
Test of $\theta_i = \theta_j$: Q(3) = 3.23, p = 0.36
Test of $\theta = 0$: t(3) = –2.96, p = 0.00
Random-effects REML model
Knapp-Hartung standard errors



(D)

Study	EVT Yes	EVT No	SMT Yes	SMT No	Odds ratio with 95% CI	Weight (%)
BEST	5	61	0	65	11.72 [0.63, 216.33]	17.14
BASICS	7	147	1	145	6.90 [0.84, 56.83]	32.81
ATTENTION	12	214	0	114	13.34 [0.78, 227.45]	18.13
BAOCHE	6	96	1	87	5.44 [0.64, 46.07]	31.92
Overall					7.89 [4.10, 15.19]	

Heterogeneity: $\tau^2 = 0.00$, $I^2 = 0.00\%$, $H^2 = 1.00$
Test of $\theta_i = \theta_j$: Q(3) = 0.33, p = 0.95
Test of $\theta = 0$: t(3) = 3.35, p = 0.00
Random-effects REML model
Knapp-Hartung standard errors



Basilar occlusion

- Despite increased hemorrhage rates

- Benefit of thrombectomy for basilar occlusion, up to 24 hrs

Recommendation	COR	LOE	Expert opinion consensus on COR
EVT is moderately recommended in patients presenting with BAO within 12 hours from onset and meeting the following criteria: age 18 to 80 years, prestroke mRS score of 0 to 2, NIHSS score ≥10, and pc-ASPECTS ≥8.	2a	B-R	EO-C

Recommendation	COR	LOE	Expert opinion consensus on COR
EVT is moderately recommended in patients presenting with BAO between 12 and 24 hours from onset and meeting the following criteria: age 18 to 80 years, prestroke mRS score 0 to 1, NIHSS score ≥10, and pc-ASPECTS ≥8.	2a	B-R	EO-C

Thrombectomy for low NIHSS

Low NIHSS

- Clinical equipoise NIHSS 0-5 with LVO
- Disability can be severe (HH, aphasia) or mild (face, arm, leg all mild)

- Spontaneous recanalization
- Some, but not all patients deteriorate
- MT risks include vessel injury and distal embolism to new territories

ENDOLOW

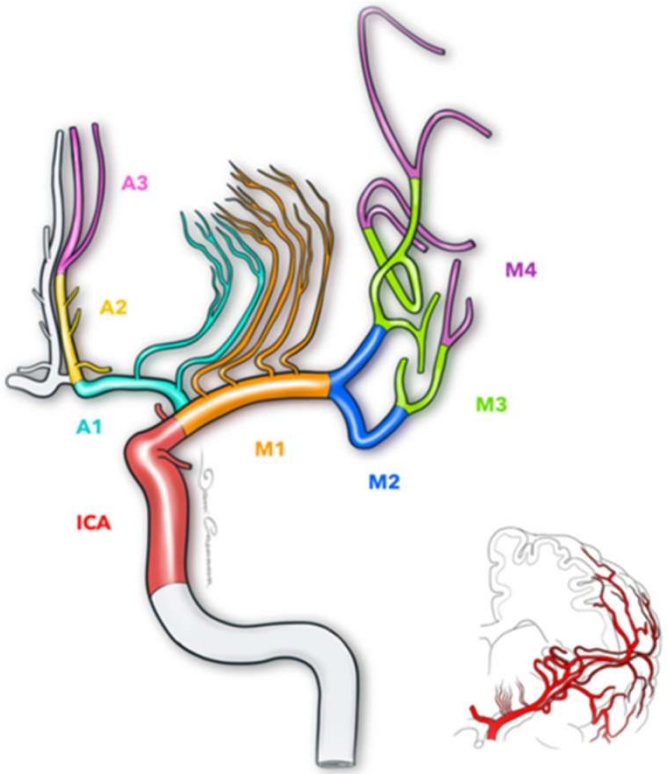
ENDOVASCULAR THERAPY FOR LOW NIHSS ISCHEMIC STROKES

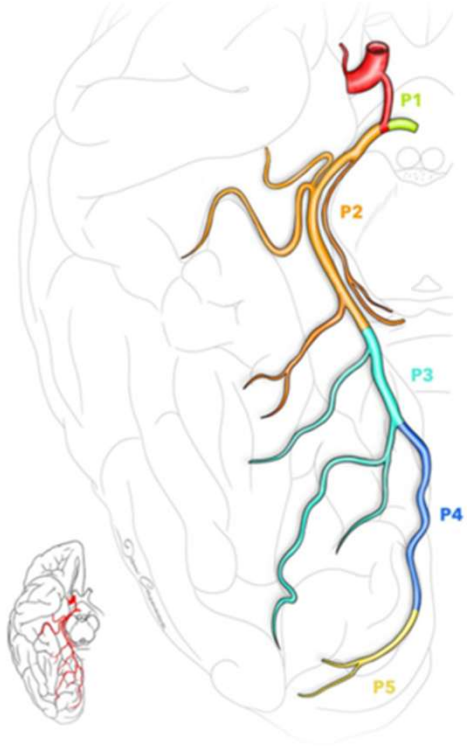
MOSTE

MinOr Stroke Therapy Evaluation

Distal Vessel Occlusion Thrombectomy

DMVO
Clinical Trials





	M2	M3	M4	A1	A2	A3
DISTAL	x	x	x	x	x	x
DISCOUNT	x*	x		x	x	x
ESCAPE-MeVO	x	x			x	x
DISTALS	x	x		x	x	x

	P1	P2	P3
DISTAL	x	x	x
DISCOUNT	x	x	x
ESCAPE-MeVO		x	x
DISTALS	x	x	x

Why not chase all DMVOs?

- Distal: longer course = less stable system/more tugging forces
- Medium: Thinner arterial walls = increased risk of dissection
- Tortuous: more twists/turns = higher risk of tearing perforator branches
- Together: increased risks of vasospasm, dissection, perforation
- +/- General anesthesia risks
- Smaller at-risk tissue volume = less potential benefit

Distal medium vessel occlusions (DMVO)

- DISTAL: within 6hrs or 24hrs if mismatch, NIHSS ≥4 or clearly disabling
  - –543 pts M2 (co or nondom)-M4, A1-3, P1-3 (2/3 were MCA)
  - –NS mRS 90d, NS mortality, but sICH 5.9% MT vs 2.6%
- ESCAPE-MeVO: within 12 hrs, NIHSS >5 or >3 if clearly disabling
  - –530pts M2-3, A2-4, P2-3 (85% were MCA)
  - –NS mRS 90d, but mortality 13.3% MT vs 8.4%, and sICH 5.4% MT vs 2.2%

	M2	M3	M4	A1	A2	A3
DISTAL	x	x	x	x	x	x
DISCOUNT	x*	x		x	x	x
ESCAPE-MeVO	x	x			x	x
DISTALS	x	x		x	x	x
DUSK	x	x		x	x	x

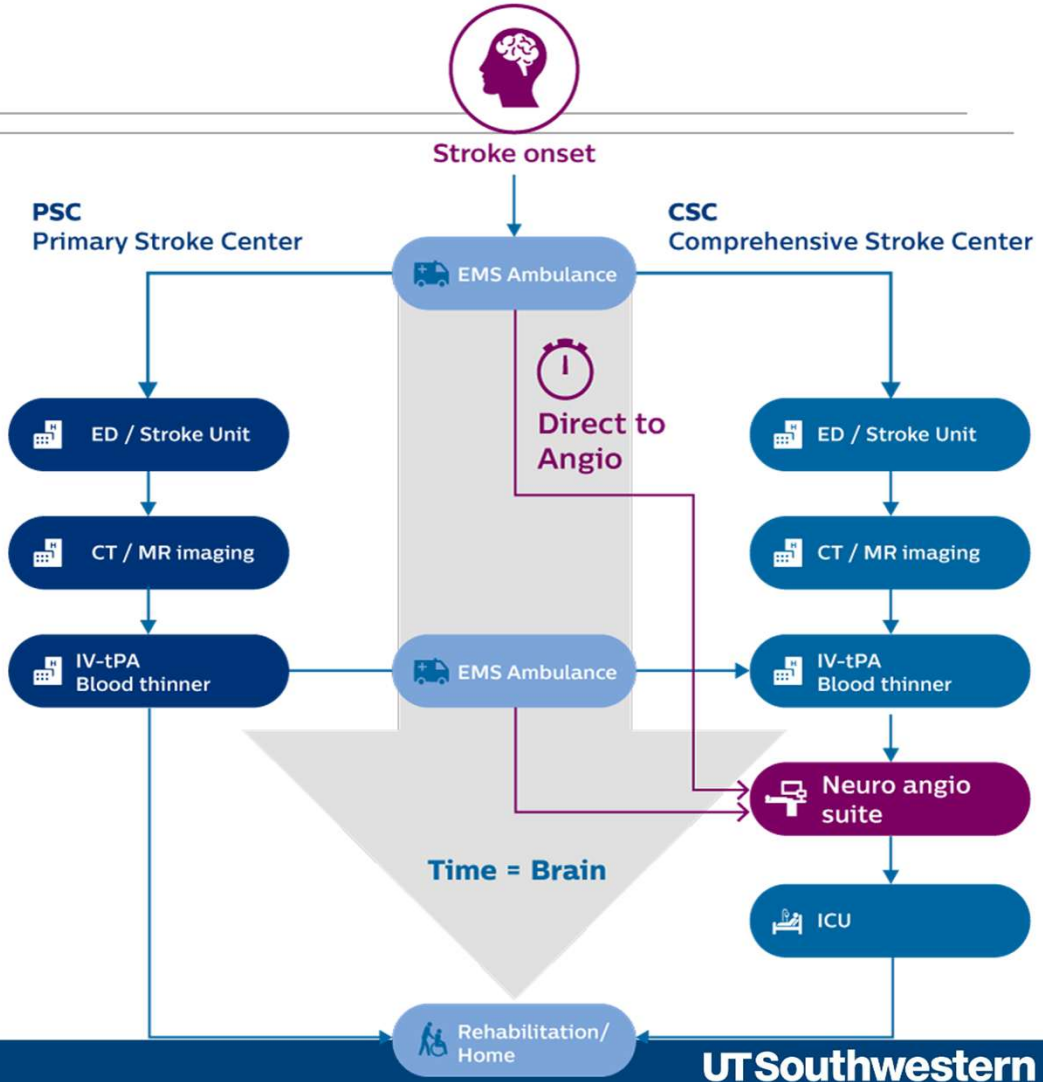
	P1	P2	P3
DISTAL	x	x	x
DISCOUNT	x	x	x
ESCAPE-MeVO		x	x
DISTALS	x	x	x
DUSK	x	x	x

NEJM. 2025; DOI: 10.1056/NEJMoa2408954.
NEJM. 2025; DOI: 10.1056/NEJMoa2411668.

Direct to Angio

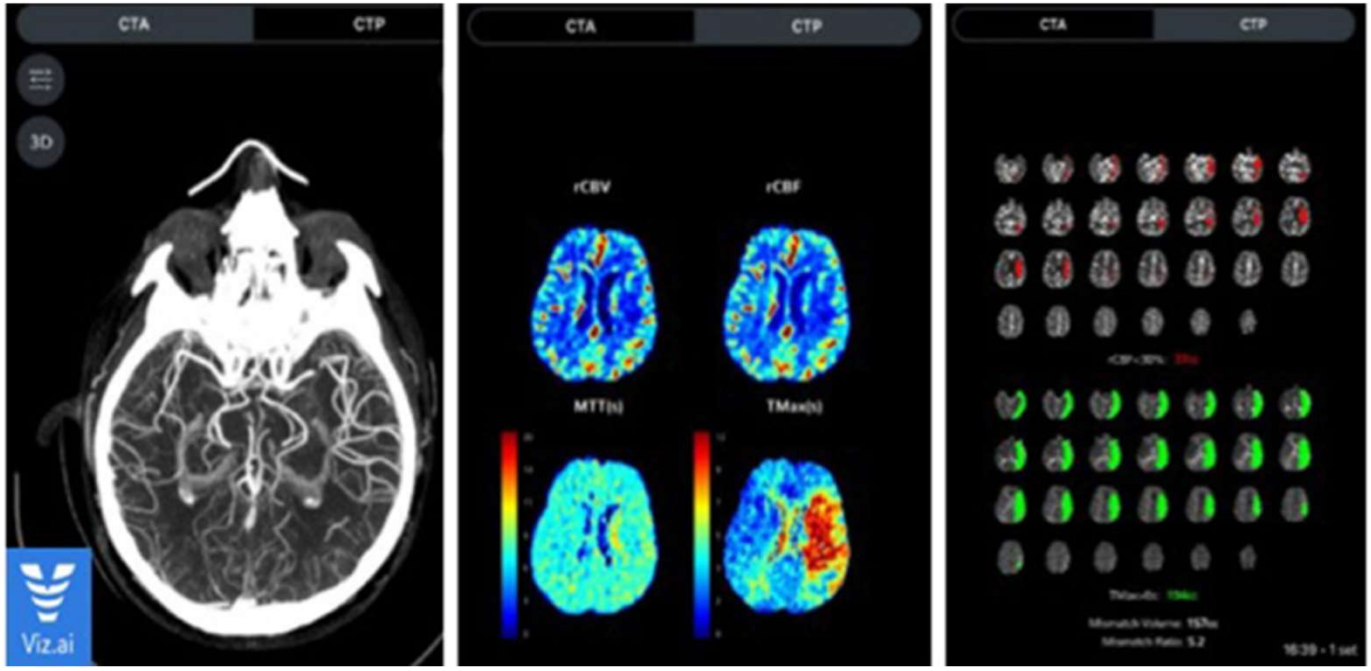
Direct to angio

- Transfer direct to angiosuite (rather than ER) reduces time to reperfusion by 30-40 minutes
- Delay AvoIding Primary Evaluation for ThRombectomy of Acute StrokE Patients with Large Vessel OCclusion in the Angiography SuiTe (DIRECT) Trial



Artificial Intelligence

AI Platforms



Brain Institute

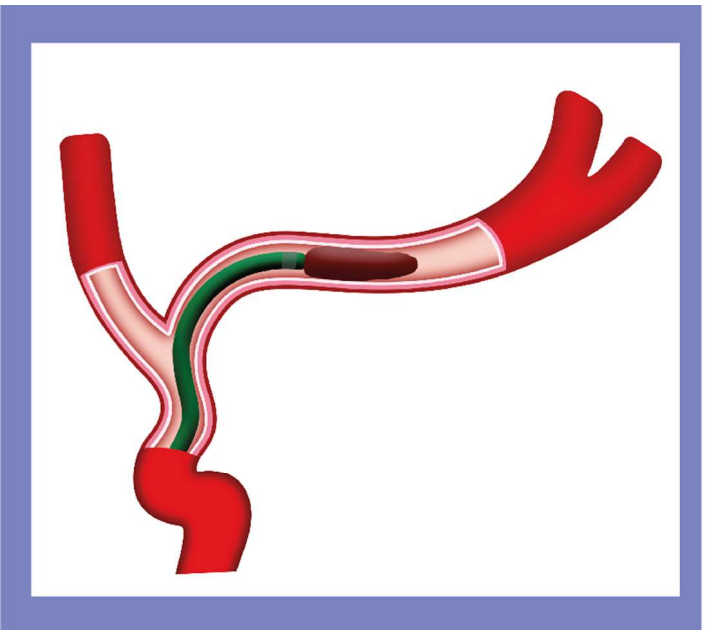
Summary: Expanding Thrombectomy

- Benefit for large core infarcts, despite increased hemorrhage
- Benefit for basilar artery occlusion, despite increased hemorrhage
- Ongoing investigation for low NIHSS
- No benefit yet for distal MVOs, with increased hemorrhage *2 of 5 trials

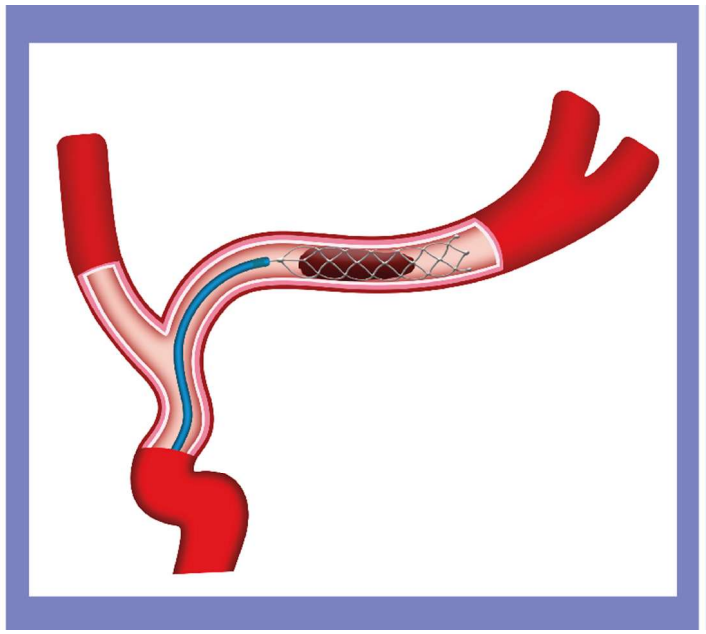
- Direct to Angio protocols save time, ongoing trials for safety/efficacy

Stroke Thrombectomy

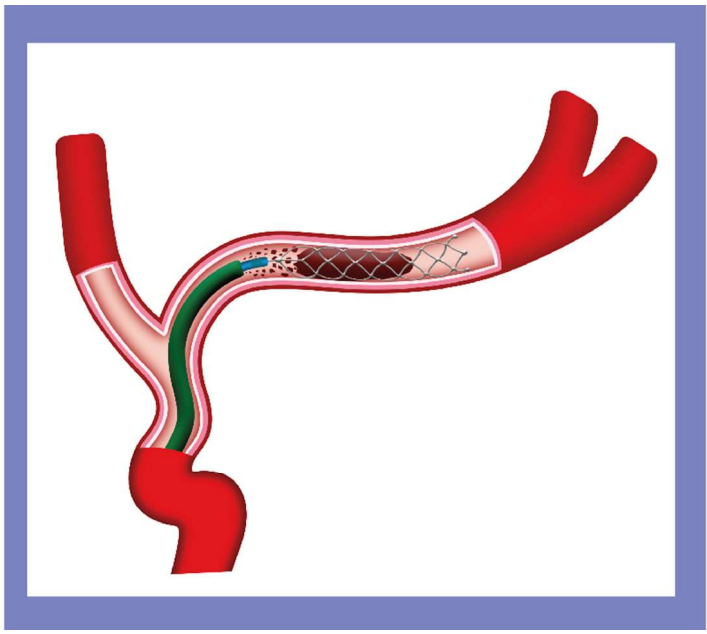
Aspiration (ADAPT)



Stent retriever



Combination (Solumbra)




ANY
QUESTIONS?